



2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



D.8.4 Impact Evaluation Report

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Responsible Author(s):	Helber López - Project Evaluation Manager
Responsible Co-Author(s):	Ángel Aparicio, Annika Kunasvirta, Carolin Zimmer, Jari Hietaranta, Joel Franklin, Lucia Ilieva, Neva Leposa, Maximilian Pfortner.
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List of Co-authors

MADRID		
Nuria Blanco	Luis Fernández Heredia	Pilar Martín de Castro
Carlos Corral	Carmen Hernanz	Laura Delgado
Sergio Fernández	Ana Rosa Llorente	Luis Tejero
Enrique García Cuervo	Marisol Santos	Alicia Velasco
Mariana Guerra	Isabela Velázquez	
MUNICH		
Carolín Zimmer	Maximilian Pfortner	Alexandra Bensler
Elisabeth Nagl		

RUSE		
Pepa Rizova	Margarita Tzekova	Zdravka Yakimova
Lora Sarkisyan		
STOCKHOLM		
Amanda Baumgartner	Helena Kalland	Thomas Sjöström
Robin Billsjö	Tony Karlsson	Eva Sunnerstedt
Helene Carlsson	Joram Langbroek	Maria-Angeliki Evliati
Jessica Danielsson	Anna Nordberg	Joel Franklin
Johanna Eriksson	Neva Leposa	
TURKU		
Stella Aaltonen	Matti Ojanpää	Anette Korkiakangas
Jari Hietaranta	Jari Paasikivi	Päivi Kynkäänniemi
Juha Jokela	Mari Sinn	Roope Virta

Abbreviations

ACM: Adaptive City Mobility

ANPR: Automatic Number Plate Recognition

BAU: Business as Usual

BHLS: Buses with high level of service

CBG: Compressed biogas

CEP: courier, express and parcel

CNG: Compressed Natural Gas

CRTM: Consorcio Regional de Transportes de Madrid

ECC: Elderly Community Centres

EMT: Empresa Municipal de Transportes de Madrid

ESS: Electric Scooter Sharing

EV: Electric Vehicles

FAPS: Fraunhofer Accident Prevention School

FML: FM Logistics

GA: Grant Agreement

GHG: Greenhouse gases

IA: Innovative Actions

ICE: Internal Combustion Engine

KPI: Key Performance Indicators

LBG: Liquefied biogas

LED: Light Emitting Diode

LEM: Local Evaluation Managers

LEV: light electric vehicles

LIDAR: Light Detection and Ranging

MaaS: Mobility as a Service

MER: Measure Evaluation Reports

ML: Measure Leaders

MSP: Mobility Service Providers

NOx: Nitrous oxides

PEM: Project Evaluation Manager

PER: Process Evaluation Report

PHEV: Plug-in Hybrid Vehicle

PM: Particulate Matter

PT: Public Transport

PTA: Prepaid Ticket Advice

P2P: Peer-to-peer

P&R: Park&Ride

RA: Research area

RCSWF: Regional Council of SW in Finland

SCBA: Social Cost Benefit Analysis

SAP: Systems, Applications and Products

SL: Stockholm Region Public Transport Authority

SUMP: Sustainable Urban Mobility Plan

VKT: Vehicle Kilometre Travelled

WP: Work Packages

WPL: Work Package Leaders

Abstract

This document introduces the impact evaluation of the CIVITAS ECCENTRIC project, with a short summary of the procedure, defined by the Project Evaluation Manager according to SATELLITE guidelines, followed by the compilation of abstracts and conclusions of the Measure Evaluation Reports (MER) written by the Local Evaluation Managers. The complete MERs are annexed to this document. The MERs include information about impact and process of every measure implemented and are the most complete documents for understanding the process of implementation and evaluation of CIVITAS ECCENTRIC measures.

Table of Contents

INTRODUCTION.....	12
IMPACT EVALUATION METHODOLOGY.....	13
ECCENTRIC KPIs AND GENERAL FRAMEWORK	13
CONNECTIONS TO OTHER COMPONENTS OF THE LOCAL EVALUATION	16
WORK PACKAGE 2: INCLUSIVE URBAN PLANNING, NEW PARKING POLICIES AND MOBILITY MANAGEMENT	21
TUR 2.1 CITIZEN AND STAKEHOLDER INVOLVEMENT IN MOBILITY PLANNING AND PRODUCTION OF NEW MOBILITY SERVICES.....	21
TUR 2.2 CITY DISTRICT / URBAN CORRIDOR CASES AS PILOTS FOR SUSTAINABLE URBAN MOBILITY	22
MAD 2.3 ADAPTIVE PARKING MANAGEMENT BASED ON ENERGY EFFICIENCY AND OCCUPANCY	24
RUS 2.6 PARK & RIDE IN THE PERIPHERAL DISTRICT	26
MUC 2.7 COMMUNITY INFORMATION AND PARTICIPATION PORTAL.....	27
MAD 2.8 MOBILITY MANAGEMENT STRATEGIES FOR VULNERABLE GROUPS	29
MUC 2.9A NEIGHBOURHOOD ORIENTED MARKETING OF SUSTAINABLE MULTIMODAL MOBILITY SERVICES: DIRECT AND DIALOGUE MARKETING	32
MUC 2.9B NEIGHBOURHOOD ORIENTED MARKETING OF SUSTAINABLE MULTIMODAL MOBILITY SERVICES: MOBILITY MANAGEMENT FOR LOCAL SCHOOLS	34
MUC 2.9C NEIGHBOURHOOD ORIENTED MARKETING OF SUSTAINABLE MULTIMODAL MOBILITY SERVICES: MOBILITY MANAGEMENT FOR COMPANIES	37
MUC 2.10 TRANSFER – EXCHANGING COMMUNICATION AND INFORMATION TECHNOLOGY FOR EVERYDAY MOBILITY BETWEEN GENERATIONS	39
RUS 2.11 INFORMATION, TRAINING AND AWARENESS RAISING.....	40
WORK PACKAGE 3: MOBILITY AS A SERVICE FOR AND BY ALL.....	42
TUR 3.1 & TUR 3.2 SMART MULTIMODAL MOBILITY SERVICES: APPLYING MOBILITY AS A SERVICE CONCEPT & INTEGRATED TICKETING AND INFORMATION SYSTEM FOR MOBILITY.....	42
MAD 3.3 OPEN PLATFORM FOR MULTIMODAL MOBILITY INFORMATION AND SERVICES	45
STO 3.5 DEVELOP SMART CHOICE OF MOBILITY SERVICES	46
MUC 3.7 THE APP FOR THE CITY LAB.....	47
WORK PACKAGE 4: ENABLING SAFE WALKING AND CYCLING	50
MAD 4.1 INNOVATIVE AND PARTICIPATIVE APPROACH TO TRAFFIC SAFETY ON A NEIGHBOURHOOD LEVEL .	50
MUC 4.2 SOFTWARE-CONTROLLED SAFETY MANAGEMENT IN THE ROAD NETWORK	51
RUS 4.3 PROVIDING SECURE PEDESTRIAN CROSSWALKS	53
RUS 4.4 SAFE SIDEWALKS WITH CYCLING FACILITIES IN THE PERIPHERICAL DISTRICT	54
STO 4.5 POLICY FOR REROUTING CYCLISTS DURING CONSTRUCTION WORK	55

MAD 4.6 PEDESTRIAN FRIENDLY PUBLIC SPACE OUTSIDE THE CITY CENTER	56
MAD 4.7 ENABLING CYCLING OUTSIDE THE CITY CENTER	58
TUR 4.8 EASY, SAFE AND COMFORTABLE CYCLING AND WALKING ROUND THE YEAR	60
STO 4.9 OFFERING TEST FLEETS OF E-BIKES AND E-FREIGHT BIKES	62
WORK PACKAGE 5: EFFICIENT AND CLEAN PUBLIC TRANSPORT SOLUTIONS	64
MAD 5.1 HIGH-LEVEL PT SERVICE CORRIDORS IN PERIPHERAL DISTRICTS	64
STO 5.2 SPEED UP CORE BUS ROUTES	66
RUS 5.4 INTRODUCTION OF A NIGHT LINE TO DRUZHBA (AFTER 21 H) WITH GNC BUSES	67
TUR 5.5 BIKE-SHARING AND CAR-SHARING SCHEMES	68
TUR 5.7 INTRODUCTION OF ELECTRICAL PUBLIC TRANSPORT	70
MAD 5.8 ELECTRIC AND HYBRID BUSES FOR PUBLIC TRANSPORT	72
MUC 5.9 INTERMODAL (E-) MOBILITY STATIONS	73
MUC 5.10 SUSTAINABLE MOBILITY VIA E-SCOOTER SHARING	75
WORK PACKAGE 6: PROMOTING THE UPTAKE OF CLEAN VEHICLES	77
STO 6.1 OFFERING EV-REST FLEETS TO SELECTED TARGET GROUPS	77
MAD 6.2 TEST FLEETS, POLICY INCENTIVES, AND CAMPAIGNS FOR THE UPTAKE OF ELECTRIC VEHICLES... ..	78
TUR 6.4 ELECTRIFICATION OF MUNICIPAL FLEET & PROMOTION OF ELECTRO-MOBILITY	80
STO 6.5 DEVELOPING THE CLEAN VEHICLE WEB PORTAL (MILJOFORDON)	82
STO 6.6 MASTER PLAN FOR DEVELOPING EV-CHARGING IN STO	83
STO 6.7 PROMOTE INSTALLATION OF EV-CHARGING FACILITIES IN MULTIFAMILY HOUSES	85
WORK PACKAGE 7: TOWARDS BETTER AND CLEANER URBAN FREIGHT LOGISTICS	87
MAD 7.1 CONSOLIDATION CENTER WITH EVs AND LOCAL REGULATIONS FOR CLEAN URBAN FREIGHT LOGISTICS	87
STO 7.2 CONSOLIDATING STO MUNICIPAL FREIGHTS	90
MUC 7.3 SUSTAINABLE CITY LOGISTICS BY COMBINING CARGO-BIKE-DELIVERY-SERVICES WITH A FLEXIBLE STORAGE SYSTEM	91
STO 7.4 NIGHT DELIVERY WITH CLEAN AND SILENT VEHICLES	93
MAD 7.6 PROTOTYPE FOR AN ULTRA-LOW EMISSIONS CARGO VEHICLE	94
TUR 7.7 INTRODUCING BIOGAS FOR URBAN FREIGHT LOGISTICS	95
MEASURES SHIFTED TO A PROCESS-BASED EVALUATION METHODOLOGY	97
STO 2.4 DYNAMIC OCCUPANCY-BASED PARKING FEES	97
STO 2.5 GREEN PARKING STANDARDS IN ÅSTRA CITY DEVELOPMENT	97
MUC 3.4 BEACON BASED INDOOR ROUTING AS A MOBILITY SERVICE APP	98
RUS 3.6 MOBILE APP AND INTERNET PORTAL FOR PT	98

RUS 5.3 ANALYSIS OF PT DEMAND AND REORGANIZATION OF PT NETWORK IN DRUZHBA (DATA COLLECTION)	99
MUC 5.6 CONCEPTION AND DEVELOPMENT OF AN INTEGRATED E-BIKE SHARING SCHEME.....	99
MUC 6.3 ELECTRIC LIGHT-WEIGHT VEHICLES – ONE FOR ALL	99
MUC 7.5 NEIGHBOURHOOD ORIENTED CONCIERGE SYSTEM AT THE DEVELOPMENT AREA DOMAGKPARK	100
ANNEX.....	101
COMPLETE MEASURE EVALUATION REPORTS	101

List of Figures

Figure 1: Summary of the CIVITAS ECCENTRIC evaluation activities.....	14

List of Tables

Table 1: ECCENTRIC impact categories and Key Performance Indicators (KPI).	16
Table 2:List of CIVITAS ECCENTRIC measures and their evaluation processes.	20

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INTRODUCTION

This is the fourth report for WP8, and the second delivering results of the evaluation process. The document contains Measure Evaluation Reports (MER) for each individual ECCENTRIC measure, in accordance with the Grant Agreement (GA), the guidelines provided by SATELLITE, and ECCENTRIC own Evaluation Plans (D.8.2). The reports present the results of impact evaluation for almost all measures.

This document introduces the impact evaluation of the CIVITAS ECCENTRIC project, with a short summary of the procedure, defined by the Project Evaluation Manager according to SATELLITE guidelines, followed by the compilation of abstracts and conclusions of the Measure Evaluation Reports (MER) written by the Local Evaluation Managers. The complete MERs are annexed to this document. The MERs include information about impact and process of every measure implemented and are the most complete documents for understanding the process of implementation and evaluation of CIVITAS ECCENTRIC measures.

The document is structured around Work Packages (WP) as basic evaluation units. As specified in the GA, MERs are included as produced originally by Local Evaluation Managers (LEM), with no further analysis or interpretations by any other member of CIVITAS ECCENTRIC. Synthesis and analysis will be provided in D.8.5 Final Evaluation Report

Each individual MER presents first basic information of the measure, to provide context for the reader to understand what has been evaluated during the covered period. Afterwards, Key Performance Indicators (KPI) are discussed, explaining the alignment between those selected and the objectives of the measure and corresponding WP.

Following the introductory sections, Baselines and Business-as-Usual scenarios are defined providing reference and context to interpret the final measurements and enabling the calculation of the actual impact of the measure. The actual impact is discussed together with the outcomes of the process evaluation to provide the final evaluation results at measure level.

There are some special cases of measures which did not generate a MER but followed an alternative methodology. For reasons external to the evaluation itself, some measures had to shift from the impact-centered evaluation framework, to an evaluation scheme more focused in the process. This would allow these measures to provide richer information than they would generate following the regular methodology.

These measures went under a Detailed Process Evaluation, digging deeper into the more difficult process these measures had to face during planning and implementation stages. The lessons extracted from this evaluation are included as Process Evaluation Reports in the following and final deliverable of WP8 (D.8.5 Final Evaluation Report).

The individual details of each one of these special cases are presented in the section afterwards.

IMPACT EVALUATION METHODOLOGY

Key Performance Indicators (KPI) are the backbone of impact evaluation. These indicators summarize the efforts to measure quantitatively the outputs of the implemented measures, enabling fair and objective evaluations and comparisons.

The selected indicators were the result of careful selection and harmonization across CIVITAS ECCENTRIC, in a process that involved Local Evaluation Managers, (LEM), Project Evaluation Manager (PEM), Measure Leaders (ML), and Work Package Leaders (WPL), ensuring that evaluation results were comparable to certain extent, and results could be disseminated under the same framework.

The indicators are framed within the CIVITAS Evaluation Framework developed by SATELLITE and applicable to all CIVITAS Innovative Actions (IA) projects initiated in 2016 and to be finalized in 2020. This framework evolved simultaneously with the IAs, and its content is as well the result of the contributions of these projects. The indicators are as well framed within the CIVITAS ECCENTRIC Evaluation on Measure and Project Level work package (WP8), particularly by the definitions in Task 8.4 – Impact Evaluation.

In Task 8.5 – Project Evaluation, KPIs are an important part of the comparative assessments, as they provide measurable inputs to the analysis of the effectiveness of the actions taken and its contribution to the expected goals, whilst enabling cost-benefit-analysis, site evaluation and cross-site evaluations.

KPIs contribute as well to qualitative understand the behaviour and effects of the actions and decisions taken within the system of variables and stakeholders in the urban realm.

ECCENTRIC KPIs and general framework

In CIVITAS ECCENTRIC about half of the evaluation activities and results are related to the KPIs. CIVITAS ECCENTRIC evaluation is in fact divided in two parts: Impact evaluation and process evaluation.

In the case of impact evaluation, evaluation collected data to determine the value of KPIs at two moments in time: Before implementation of the measure (baseline), and about month 36th (when measures would be in operation for a long enough period of time to consolidate its effects and non-immediate impacts would appear). In addition, a business-as-usual scenario (a scenario without the measures) was estimated to provide baseline values for the two evaluation horizons.

Close to the end of CIVITAS ECCENTRIC, impact evaluation (namely the registered values for the KPIs) has allowed to perform the comparative assessments by normalizing the outputs of individual measures. KPIs allow to compare similar measures but with different contexts (e.g. in different cities), or different measures with similar context (e.g. same laboratory area). One of the methodologies implemented for the comparison is the Social Cost Benefit Analysis, whose results make part of the comparative evaluation in the Final Evaluation Report (D.8.5)

KPIs are as well part of the System Analysis in project-level evaluation. KPIs relate to each other. How are these indicators connected has been an ongoing activity that the evaluation group took over during the last four years. The understanding of the system where stakeholders, planners, and individuals make decisions and affect each other, is key to draw meaningful and comprehensive conclusions for CIVITAS ECCENTRIC.

The following figure summarises the CIVITAS ECCENTRIC evaluation tasks as defined on the Grant Agreement, highlighting in orange frames the KPI connected tasks as described in the previous paragraph.

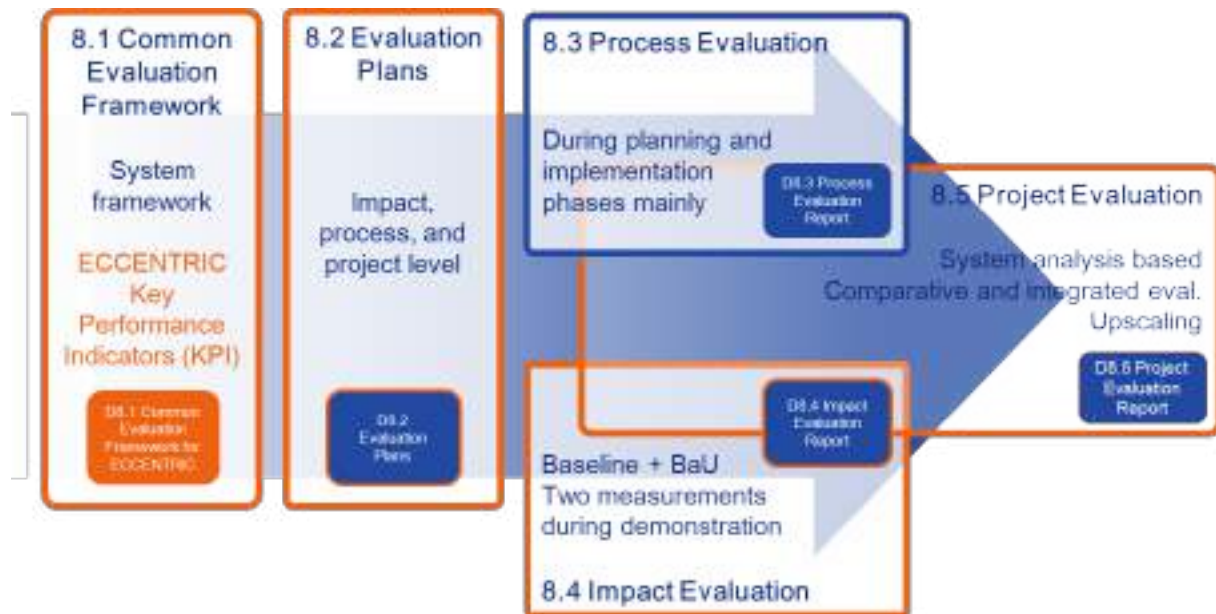


Figure 1: Summary of the CIVITAS ECCENTRIC evaluation activities.

The primary criteria to select and define KPIs were their relevance to each measure’s expected impacts, data availability, and data collection feasibility within the existing project resources, and their alignment with the ECCENTRIC objectives. The text below is extracted directly from the ECCENTRIC Grant Agreement:

“The well-balanced local consortia in the five partner cities of CIVITAS ECCENTRIC will demonstrate and evaluate the impact of a package of innovative integrated sustainable urban mobility measures on key indicators:

Reducing:

Energy use, CO2 emissions and fossil fuel dependency for the transport of people and goods.

Air pollution (NOx, PMx and noise generated by road traffic).

Road accidents (fatal and heavily injured).

Road congestion and time needed for trips.

Improving:

Accessibility for all, deeply rooted in a gender and generation/age balanced approach.

Social inclusion and equal opportunities for all, particularly vulnerable groups,

Liveability, reducing the area of public space dedicated to cars and giving priority to active modes.

Competitiveness and excellence of public transport and multimodal way of travel.

Efficiency and environmental performance of urban freight distribution.

Local economy: Reduction in mobility costs, more efficient use of resources, increase in jobs.”

CIVITAS ECCENTRIC KPIs are aligned throughout the project, from its general objectives, the objectives of each WP, and the objectives of each measure. The categories of impact follow the CIVITAS Evaluation Framework and each relevant aspect was tracked by at least by one indicator. In total, 29 indicators cover 7 impact categories. The following table presents the structure of impacts and indicators relevant for the project.

Impact Category	Impact sub-Category	Key Impact Aspects	ID	Indicator
SOCIETY PEOPLE	Acceptance	Awareness level	01	Awareness
		Acceptance level	02	Acceptance
		Fulfilment expectations of	03	Satisfaction
	Accessibility	Physical accessibility to transport services	04	Access to mobility services
			05	Physical barriers
			06	Car ownership
		Usage and operation capabilities	07	Operational barriers
		Economic accessibility	08	Relative travel cost
SOCIETY-GOVERNANCE	Planning	Planning process	09	Contributions to policy, plans and programs
TRANSPORT SYSTEM	General	Modal split	10	Mode shift
			11	Modal split
		Total travel	12	Vehicle-kilometre travelled
		Transport utilization system	13	System usage
	Car	Parking	14	Parking turnover
	Public transport	Quality of service	15	Commercial speed
		Congestion levels	16	Peak/off-peak travel time difference

	Safety	Service reliability	17	Accuracy of time keeping
		Transport safety	18	Number of fatalities and seriously injured
			19	Number of incidents
ECONOMY	Costs	Investment costs	20	Investment cost
		Operating cost	21	Operating cost
	Benefits	Economic development	22	Job/sales impact
ENVIROMENT	Pollution and nuisance	Emissions	23	CO ² emissions
			24	NO ^x emissions
			25	PM emissions
		Noise	26	Noise level
ENERGY	Energy consumption	Energy consumption	27	Vehicle energy efficiency
LAND USE	Urban space	Use of space	28	Use of space for parking
		Attractiveness of space	29	Quality of public space

Table 1: ECCENTRIC impact categories and Key Performance Indicators (KPI).

The classification of impacts and the indicators as well, are common across CIVITAS, although not all indicators in the current Evaluation Framework have been include in this selection. The principles outlined for CIVITAS ECCENTRIC determined the range of relevant KPIs. As other impacts are as well relevant for local evaluation purposes, additional indicators might be included in evaluation reports.

Connections to other components of the local evaluation

LEMs have conducted process evaluations at measure level in accordance with the evaluation plans (D.8.2). Results for this evaluation have been delivered in 2019 in the Process Evaluation Report (D.8.3), and outcomes of these results are summarized in the MERs to provide a complete overview of the measure impact.

After the delivery of D.8.3. some measures are undergoing a detailed process evaluation to gain further insight into the planning, implementation and operation of the measure. Initially, this evaluation strategy was implemented to avoid thin-spreading efforts and resources, allowing to focus in those measures with interesting processes. The results of this detailed process evaluation are included in D.8.5 as part of the cross-site evaluation.

Local conditions external to CIVITAS ECCENTRIC, detailed in the last chapter of this deliverable, made in some cases impossible to perform the impact evaluation in timely fashion.

Delays in approvals, political decisions and other reasons, shaped good study cases for process evaluations, and the consortium decided to fall back to detail process evaluations for these measures as well. This way, these measures will be able to deliver useful lessons for future implementations, albeit impact figures have to be subject of further research.

The table in the following pages summarizes the evaluation process underwent by each one of the ECCENTRIC measures.

Code	Measure	Impact Evaluation	Process Evaluation	SCBA
TUR 2.1	Citizen and stakeholder involvement in mobility planning and production of new mobility services	Yes	Standard	
TUR 2.2	City District / Urban Corridor Cases as Pilots for Sustainable Urban Mobility	Yes	Standard	
MAD 2.3	Adaptive parking management based on energy efficiency and occupancy	Yes	Standard	
STO 2.4	Dynamic occupancy-based parking fees		Detailed	
STO 2.5	Green parking standards in Åstra city development		Detailed	
RUS 2.6	Park & Ride in the peripheral district	Yes	Standard	Selected
MUC 2.7	Community information and participation portal	Yes	Standard	Selected
MAD 2.8	Mobility management strategies for vulnerable groups	Yes	Detailed	
MUC 2.9	Neighbourhood oriented marketing of sustainable multimodal mobility services	Yes	Standard	Selected
MUC 2.10	Transfer – Exchanging communication and information technology for everyday mobility between generations	Yes	Standard	
RUS 2.11	Information, training and awareness raising	Yes	Detailed	

Code	Measure	Impact Evaluation	Process Evaluation	SCBA
TUR 3.1	Smart Multimodal Mobility Services: applying Mobility as a Service concept	Yes	Detailed	
TUR 3.2	Integrated Ticketing and Information System for Mobility	Yes	Standard	
MAD 3.3	Open platform for multimodal mobility information and services	Yes	Standard	
MUC 3.4	Beacon based indoor routing as a mobility service app		Detailed	
STO 3.5	Develop smart choice of mobility services	Yes	Standard	
RUS 3.6	Mobile app and internet portal for PT		Detailed	
MUC 3.7	The App for the City lab	Yes	Standard	
MAD 4.1	Innovative and participative approach to traffic safety on a neighborhood level	Yes	Standard	
MUC 4.2	Software-controlled safety management in the road network	Yes	Standard	
RUS 4.3	Providing Secure Pedestrian Crosswalks	Yes	Detailed	
RUS 4.4	Safe Sidewalks with cycling facilities in the peripheral district	Yes	Detailed	
STO 4.5	Policy for rerouting cyclists during construction work	Yes	Standard	
MAD 4.6	Pedestrian friendly public space outside the city center	Yes	Standard	
MAD 4.7	Enabling cycling outside the city center	Yes	Standard	
TUR 4.8	Easy, Safe and Comfortable Cycling and Walking Round the Year	Yes	Detailed	
STO 4.9	Offering test fleets of e-bikes and e-freight bikes	Yes	Standard	

Code	Measure	Impact Evaluation	Process Evaluation	SCBA
MAD 5.1	High-level PT service corridors in peripheral districts	Yes	Standard	
STO 5.2	Speed up core bus routes	Yes	Standard	Selected
RUS 5.3	Analysis of PT demand and reorganization of PT network in Druzhba (data collection)		Detailed	
RUS 5.4	Introduction of a night line to Druzhba (after 21h) with GNC buses	Yes	Standard	
TUR 5.5	Bike-sharing and Car-sharing schemes	Yes	Detailed	
MUC 5.6	Conception and development of an integrated e-bike sharing scheme		Detailed	
TUR 5.7	Introduction of Electric Public Transport	Yes	Standard	Selected
MAD 5.8	Electric and hybrid buses for public transport	Yes	Standard	Selected
MUC 5.9	Intermodal (E-) Mobility stations	Yes	Detailed	Selected
MUC 5.10	Sustainable mobility via E-scooter sharing	Yes	Standard	Selected
STO 6.1	Offering EV-rest fleets to selected target groups	Yes	Standard	Selected
MAD 6.2	Test fleets, policy incentives, and campaigns for the uptake of electric vehicles	Yes	Detailed	Selected
MUC 6.3	“Electric light-weight vehicles – one for all”		Detailed	
TUR 6.4	Electrification of Municipal Fleet & Promotion of Electro-mobility	Yes	Standard	Selected
STO 6.5	Developing the Clean Vehicle Web Portal (Miljofordon)	Yes	Standard	

Code	Measure	Impact Evaluation	Process Evaluation	SCBA
STO 6.6	Master plan for developing EV-charging in STO	Yes	Standard	
STO 6.7	Promote installation of EV-charging facilities in multifamily houses	Yes	Detailed	
MAD 7.1	Consolidation center with EVs and local regulations for clean urban freight logistics	Yes	Detailed	Selected
STO 7.2	Consolidating STO municipal freights	Yes	Standard	
MUC 7.3	Sustainable city logistics by combining cargo-bike-delivery-services with a flexible storage system	Yes	Standard	
STO 7.4	Night delivery with clean and silent vehicles	Yes	Detailed	Selected
MUC 7.5	Neighborhood oriented concierge system at the development area Domagkpark		Detailed	
MAD 7.6	Prototype for an ultra-low emissions cargo vehicle	Yes	Standard	
TUR 7.7	Introducing biogas for urban freight logistics	Yes	Standard	Selected

Table 2: List of CIVITAS ECCENTRIC measures and their evaluation processes.

WORK PACKAGE 2: INCLUSIVE URBAN PLANNING, NEW PARKING POLICIES AND MOBILITY MANAGEMENT

TUR 2.1 Citizen and stakeholder involvement in mobility planning and production of new mobility services

Abstract

Measure TUR 2.1. aimed to evaluate and adopt participatory methods and good practices; and to test and utilize the possibilities brought by new technologies and social networks (mobile apps, social media) in the development of participatory mobility planning. A case study in developing a concept for interactive and participatory planning concerning inter-modal solutions in public transport (PT), particularly park and ride was then implemented based on the good practices gathered. Knowledge on mobility preferences was also gathered via producing a mMobility barometer. The measure had a regional approach and it reached a wider target group than Turku citizens alone, including the neighboring municipalities (Turku, Raisio, Naantali, Kaarina and Lieto).

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data is gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 2.1. was measured. Data was derived from surveys, policy documents and from the Measure Leader information.

Overall, the measure reached its objectives satisfactorily. Knowledge on mobility preferences in the region increased during the measure implementation and the citizens felt they had gained slightly improved possibilities to participate in mobility planning. Participatory methods were tested in conjunction with developing the park-and-ride plan, which successfully provided the first development plan for park-and-ride of both private cars and bicycles in the Turku core region. It became evident during measure implementation that participatory planning as such has not become firmly established in local and regional planning yet. Changing this culture of planning is a complex process that requires time and continued efforts. According to evaluation results, integrating participatory methods into project/policy-based transport planning provides an opportunity to change planning culture little by little.

Conclusions

Validated direct impact

The measure achieved its main objectives satisfactorily. The following key results were identified:

- Information was gained on the views and attitudes of the residents in Turku core region concerning the objectives and measures of the Turku regional traffic system plan.
- Participatory methods were tested in conjunction with developing the park-and-ride plan.

- The Park-and-Ride plan was submitted, successfully providing a development plan for park-and-ride of both private cars and bicycles in the Turku core region.

Main lessons learned

According to the ML, the main lessons learned were linked to the participatory planning approaches in particular.

- Participatory planning as such has not become firmly established in local and regional planning yet and to do so, planning culture needs to change. This is a complex process requiring time. Integrating participatory methods into project/policy-based transport planning, like in the example, can be a way to change planning culture little by little.
- When planning to use participatory methods in a development or planning process it is of great importance to identify target groups first and then select methods that respond to the needs and the envisaged level of discussion with each group. Using a mix of methods is crucial to be able to reach out to different groups. Online methods (web-based survey, mobile application) proved to be successful in this measure, in particular for involving young people and people who only have little time to participate.

Long term impact

- The mobility barometer will be developed further and it will be executed regularly in the future, most likely either every 2 or 4 years. Marketing of the survey will be planned more carefully and the aim is to increase the number of participants to at least double of the level reached in 2017 and 2019. This is a step towards getting more inhabitants involved in regional traffic system planning.
- Experiences from the procurement process and executing the Park-and-ride plan were useful. There is no known cause, except for financial issues, why this kind of process could not be possible to repeat. A plan made by a consultant using participative methods can naturally be more expensive.
- Overall, the measure has pinpointed the importance of participatory planning also on regional traffic planning level. Work for developing more participatory regional traffic planning will continue through other projects and through RCSWF's (Regional Council of SW in Finland) own day-to-day work.

TUR 2.2 City District / Urban Corridor Cases as Pilots for Sustainable Urban Mobility

Abstract

Measure TUR 2.2. aimed to develop intelligent mobility services and solutions by creating a mobility node for seamless transport and advising companies and housing companies located in the district of Kupittaa (the living laboratory area) on intelligent mobility solutions in the region. The integration of smart mobility branding and marketing into urban communications was also part of this measure. In the Kupittaa district, a mobility node was to be created that would combine cycling and bike sharing, car sharing, public transport and information boards and provide year-round seamless cycle and walking connections. Via the node, MaaS (Mobility

as a Service) services were also to be tested in the region. Target groups of this measure included students, companies and housing companies based in the laboratory area.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 2.2. is measured. Data was derived from local and national surveys, secondary city statistics, policy documents and the Measure Leader information.

Housing companies and private companies were surveyed, contacted and concrete information materials planned. As a result, awareness of sustainable mobility increased in the area. On average, 66% of the companies surveyed in the laboratory area were aware of CIVITAS ECCENTRIC measures. 20% of the companies and housing companies in the area had used the measures tested in the laboratory area. Actions to improve traffic safety in the laboratory area were taken in form of blocking access to a thoroughfare, still ongoing at the time of writing this report. The measure significantly contributed to policy level development in the city, making smart mobility more deeply ingrained into the city planning processes. The main output of the measure, the mobility node, was not realized, however. Plans for the mobility node were made but due to a complex array of issues related mostly to land-ownership and securing financing, it could not be implemented during the project lifetime. Due to this partial failure of the measure, ex-post data could not be obtained on many of the indicators. The failure to implement the mobility node however provided a valuable viewpoint into the complexity and time and resource consuming nature of implementing infrastructure-related projects in an already densely populated urban area.

Conclusions

Validated direct impact

- Housing companies and private companies were surveyed, contacted and concrete information materials planned. As a result, awareness of sustainable mobility increased in the area.
- 20% of the companies and housing companies in the area have used the measures tested in the laboratory area.
- Plans for the mobility node were made and are ready when the realisation of such becomes feasible.
- The measure significantly contributed to policy level development in the city, making smart mobility ingrained more deeply into the city planning processes.
- Actions to improve traffic safety in the laboratory area were taken.

Main lessons learned

- The measure has proven, first and foremost, that planning and implementing mobility measures that require take-over of urban space in an already densely-populated area can be a daunting endeavour. The issues related to land-ownership proved too challenging to overcome within project duration, which ultimately resulted in the failure to implement the mobility node. The risks for this were not foreseen. It has particularly been shown that these types of processes are very long if, as in this case, the necessary site for the mobility node does not belong to the city. Ideally, a mobility node should be planned in a location that is both suitable and owned by the city.
- When planning to implement resource-intensive, potentially expensive endeavours such as a mobility node, sufficient funding should be secured already prior to planning

to ensure the realisation of said plans. This will create momentum for relevant decision-making processes.

- Complex issues such as those included in this measure have shown the need to increase staffing levels. This is the case, for example, in the field of cooperation between companies and apartments. Also, a lot of time should be planned to do coordination and persuasion work.
- Company`- mobility management requires the active participation of the companies themselves. They are not obliged to cooperate, although mobility management for companies is especially beneficial for the employees. It is therefore important to find the right approach and to motivate companies to participate. First small successes could be registered in this measure with information screens about public transport and information channels of stakeholders.

Long term impact

- The impact of the measure cannot be underestimated, despite the failure to realise its main planned output, the mobility node. It could even be stated, with a positive attitude, that the learnings from the measure would have been significantly lower without its partial failure. The failure to implement the mobility node has provided a valuable viewpoint into the complexity and time-consuming nature of implementing infrastructure-related projects in an already densely populated urban area.
- As a result of the measure, traffic and mobility are now better embedded on policy level (within Smart&Wise Turku strategy) and mobility communication on city-level has improved greatly. These impacts are likely to benefit sustainable mobility promotion and development projects on city level in the future.
- For the first time, companies and housing companies were contacted systematically in order to map out their most relevant concerns and needs in terms of smart mobility planning. This provided a beneficial learning opportunity on how to proceed with company mobility management in the future.

MAD 2.3 Adaptive parking management based on energy efficiency and occupancy

Abstract

This measure has been implemented in the parking facilities of the EMT headquarters (the municipal transport company known as *Empresa Municipal de Transportes de Madrid*), located outside, but very close (just 600 m away) to the CIVITAS ECCENTRIC Living Lab (Vallecas). The possibilities for upscaling this innovative solution are quite high, as EMT is currently managing 23 car parks in Madrid (10,958 parking spaces, spread out over 7 resident car parks, 4 short-term car parks, 9 mixed-use car parks and 3 P+R car parks).

The EMT staff working at the central office amounts to 1,357 people. There are 149 parking places within the building, i.e., 9.1 persons per each parking place. Access to the parking is limited to authorised vehicles, and is controlled by an automatic license plate recognition system. During the implementation of the measure, authorisations have been awarded based on a set of criteria that included, inter alia, vehicle occupancy and vehicle technology.

With the implementation of the measure, access to the parking was controlled with a technology based on image processing, and making it possible to identify cars with more than one passenger.

The reliability of the access control system during the demonstration period has been fair: The results achieved during the demonstration do not provide yet the necessary reliability to establish a completely automated parking control access system. The percentage of vehicles correctly detected (i.e. identifying the plate number and the right number of occupants) reached 86% in February 2019. The number of days without disruption increased until March 2019 (90%). Since April 2019, the system was subject to more frequent disruptions due to a variety of technical failures (insufficient capacity of the hard disk saving images, failure of the laser detector...). Performance improved in the following three months (July to September 2019), with more than 94% of vehicles correctly detected, and slightly decreased in October 2019, to 85%.

The measure objectives have been partially achieved. It is worth recalling that the initial site of this measure was changed, from a peripheral office tertiary area to the EMT headquarters. As a result of this change in location, the objective 2 (reduction of parking offences) became irrelevant, as the EMT headquarters had not an influence on parking offences in the area; additionally, as the size of the parking facility is small, its impact on traffic in the surrounding area would be very low, if relevant at all.

The reduction in car travel, measured in the access to the EMT headquarters has been substantial, as measured by the occupancy of the parking facility: 13.2 percentage points: however, this has not resulted in noticeable changes in traffic conditions in the surrounding area, without congestion problems. An increase in car occupancy in the vehicles accessing the parking lot has been measured (from 1.12 in December 2018 to 1.15 in February 2019 and 1.18 in October 2018, although with some up and downs from month to month; this is confirmed by the increase in the modal share of car-pooling (from 4.2% to 8.3%).

Conclusions

Validated direct impact

Based on the observed impacts and the interpretation and comments provided in this report, the measure has achieved the following key results:

- This measure has been effective in achieving some modal change towards car-pooling and in increasing average car occupancy.
- This measure has also been effective in reducing the average occupancy of the EMT parking facility.
- The influence of this measure on vehicles' characteristics has not been demonstrated: plug-in hybrid and electric cars remain marginal within the staff's cars.
- The environmental impacts (emissions and energy consumption) of car-pooling are likely to be modest compared to the resources required to support car-pooling, as modal change is more likely to happen in shorter than in longer trips (probably due to the difficulties to find a trip partner and the more rigid conditions (e.g. timing) associated to long trips).
- The reliability of the automated system for car occupancy control has not been sufficiently demonstrated, and remains a technical challenge to be improved in next tests.

Main lessons learned

The main lessons learned are linked to the measure impacts:

- Parking management measures are effective in encouraging modal change; this includes changes in the criteria to grant access to parking facilities in a company's premises. In particular, car-pooling can be promoted through parking management measures.
- A priority parking access measure in itself does not provide an incentive strong enough to change users' car choice: the staff is not likely to change their car purchase decisions at the light of the new parking access policy.
- The environmental impacts (emissions and energy consumption) of car-pooling are likely to be modest compared to the resources required to support car-pooling, as modal change is more likely to happen in shorter than in longer trips (probably due to the difficulties to find a trip partner and the more rigid conditions (e.g. timing) associated to long trips).
- Automated control of car occupancy remains a technical challenge, that cannot provide fully-satisfactory control of parking access at this stage of the technical know-how.

Long term impact

Two long-term impacts can be anticipated for this measure, if maintained by the EMT management:

- EMT can make a more effective use of the available parking space. Establishing more rational parking access rules, EMT has reduced the parking occupancy rate, as some non-qualifying employers (probably with long daily stays and daily car-use) have found alternative solutions (public transport, paid parking outside the premises), liberating space for employees with more flexible travel behaviour (occasional car users, flexible working routines, including trips outside the EMT premises...). The additional space liberated opens an opportunity to further explore more environmentally efficient parking access in future (e.g. without attributing fixed parking places to particular employees), or to look for alternative use of the liberated space (e.g. storage, basic equipment, etc.). This possibility can be replicated in other companies with scarce parking space or sustainable mobility commitment
- Car-poolers could expand in the future, if the incentives to them are strengthen (e.g. full access to the parking facility, instead of the current bonus in the allocation of fixed spaces), considering the favourable results obtained. However, the environmental benefits of such trends remain uncertain, considering the results obtained in this project.

RUS 2.6 Park & Ride in the peripheral district

Abstract

This measure describes the implementation of the Park&Ride (P&R) concept that took place for the first time in Bulgaria in the City of Ruse. The P&R was implemented in the Ruse Living Lab – the peripheral Druzhba district, affected by high traffic volumes and having deteriorated public space due to the big number of cars parked everywhere around the buildings and on the streets. The P&R station is situated on the main road from Varna to Ruse, at the entrance

in the city, in order to allow visitors to leave their cars at the parking and to travel by PT to the city centre.

The ultimate goal was to promote the modal shift towards public transport by reducing the use of cars by commuters and visitors to reach the city centre. The P&R station relieves road congestions along the routes regularly taken from Druzhba to the centre. Many PT stops are situated nearby providing easy connections. The measure also helps to reduce the number of cars parked on the public spaces in Druzhba, as well as the cars parked in the central part of Ruse.

The key challenge of this measure was the identification and selection of a suitable location of the P&R facility. It was not easy to do, as there were not so many free municipal terrains close to the entrance of the city, with good connections with PT and big enough to serve as a P&R station. This issue has been overcome by carrying out an exhaustive analysis of the territory in the laboratory area. Additionally, this question was put for discussion during meetings and informational events with representatives of the local citizens and experts working in the field of parking policy.

The P&R station having 41 slots, was officially opened in May 2019 but the setup of the ticketing system and the deployment of the information and promotion campaign took time, so only during the last quarter of 2019, the facility was functioning with good capacity. Nowadays it is visible that the measure turned out to be a success and there are plans to upscale it by introducing it in other parts of the city (i.e. at the main entrances from Sofia and from Bucharest). It will be done in the frames of the Ruse SUMP (that is actually in stage of implementation) and after the introduction of the new transport scheme of Ruse, because it is important that the new P&R stations are situated closely to the PT stops.

Conclusions

Validated direct impact

The P&R station is small but already has some positive local impact.

Main lessons learned

This pilot station is only the first step to the construction of a set of P&R stations at the main entrances of the city.

Long term impact

- Reduction of the car flow to the city centre of Ruse

MUC 2.7 Community information and participation portal

Abstract

The measure MUC 2.7 aims to implement a community information and participation portal accessible for all Domagkpark residents and other interested visitors. The website provides information about current events and topics within Domagkpark neighbourhood. Website users can find information about any kind of (sustainable) mobility options in the Living Lab and general facts about the housing area.

As a central information hub, not only for local developments, but also for the CIVITAS ECCENTRIC project as a whole and the other measures being implemented within the Living Lab, it plays an important role for the information gathering behavior of all residents having access to internet. Data from several user online surveys and the evaluation of a web analytics tool show that there is a high awareness and satisfaction among Domagkpark residents which are using the website to browse events, mobility options and general Domagkpark information.

Evaluation results for MUC 2.7 were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019), two online surveys with the website users, interviews with the ML and a statistical data analysis via the website's backend.

Evaluation results show that about 80% of all Domagkpark residents actually know about the community portal www.domagkpark.de, while one third also actively used the website to get helpful information. About 75% stated to be “satisfied” or “very satisfied” with the website and the information which is provided. The system is used by about 2.500 visitors per month and the number slightly increased within 2 years of backend data observation.

It comes out that measure MUC 2.7 is a very good example for replication and upscaling due to its high impact and relatively low implementation and maintenance costs. Regarding the objectives to be achieved with the measure, it's hard to tell about their accomplishment because there are other measures influencing objectives like reduction of emissions or congestion. But the improvement of livability and accessibility of Living Lab information for all residents can clearly be traced back to the implementation of the website www.domagkpark.de.

Conclusions

Validated direct impact

- Due to its low investment and operational costs, the measure MUC 2.7 has a very high impact on the Domagkpark community because the website delivers up-to-date information about sustainable mobility option within the Living Lab, events and general information about Domagkpark.
- The access to this portal is very easy and can be used by everyone living in Domagkpark or visitors being interested in current topics.
- The factors of awareness and acceptance of the community portal is not constantly high but this is mainly due to the fact that the people are already well informed and do have a very strong community life apart from the digital world.
- Factors like reduction of emissions or mode shift within Domagkpark cannot conclusively be attributed to the website, but nevertheless the portal is a helpful tool to inform the residents about current trends in sustainable mobility.
- The website is used very regularly by its residents and fulfils the user's needs by giving the most relevant information, links and important contacts.

Main lessons learned

- A website for the Living Lab is a very helpful and important tool to keep residents informed about current developments regarding events and other news occurring.
- A website is easy to access by residents and used regularly to browse any kind of information.
- For the promotion of other ECCENTRIC measures, it's a very helpful platform because information can be spread easily.

- Regarding the relatively low investment and maintaining costs of MUC 2.7 the launch of a website like www.domagkpark.de is highly recommendable regarding the reach of the website.

Long term impact

- Domagkpark residents might use the website regularly to get actual information about what is going on within the Living Lab.
- If there are things to implement within Domagkpark, the website can be used as an efficient tool to promote those new topics.
- Regarding the shift to more sustainable mobility option in the long run, it is desirable to pursue the initial idea to provide real-time mobility information by the local mobility operator (partner 17- MVG, the Transport Company of the City of Munich).

MAD 2.8 Mobility management strategies for vulnerable groups

Abstract

This measure develops and implements a participative process targeted at vulnerable groups (elderly and children), in order to support the design and the decision making processes of sustainable mobility policies. Following a bottom-up collaborative approach, specific mobility management actions and methods have been developed and implemented for the targeted groups, including tailored peer-to-peer (P2P) analysis and communication strategies.

In the participating schools, the methodological approach follows the successful experience of the previous project IEE_STARS, based on an accreditation scheme where peer-to-peer communication is placed at the core. This genuine P2P bottom-up participation at schools has also inspired the methodology that the measure has successfully tested with the elderly.

A total number of 45 main events (workshops, cycling and walking activities, intergenerational activities and massive participation at the European Mobility Week in 2016, 2017, 2018 and 2019, among others) have been organised, engaging more than 700 persons. In particular, the project activities were successful in the co-creation of audiovisual and presential P2P campaigns by seniors and in the implementation of a pilot project to complete the renovation of Constitución Square, meeting the concerns and suggestions of the elderly participating in the co-design process. The measure also achieved the implementation of real-time bus information boards in some Elderly Community Centres (ECC), and, regarding the children and teens, encouraged and significantly expanded walking and cycling among pupils at the participating schools.

The measure achieved good results in terms of expanding the share of sustainable mobility modes among pupils and the elderly in the Living Lab. In the case of the elderly, private car trips accounted for only 6.2% of the trips, and this low share has been maintained. On top of that, the share of walking trips has increased by 8.5 percentage points, from 66.7% to 75.3%, replacing public transport trips. In the case of children, the increase in the use of sustainable transport modes has been 3.4 percentage points, mainly replacing car trips by public transport trips and walking. In terms of acceptance, all the persons interviewed expressed their full support to the actions undertaken. In terms of satisfaction, the scores were always high in both social groups. The subjective perception of mobility safety by the elderly has significantly increased during the period, from 3 in 2017 to 3.9 over 5 in 2019.

The emissions saved are significant in the case of the elderly, particularly when the Business as Usual (BAU) scenario is considered. The CO₂ emissions saved per year are estimated at 540 tons or a 36% reduction compared to BAU. A similar percentage of reduction is achieved in the case of NO_x (Nitrous oxides) and PM. In the case of children, emission savings are much lower, due to the much smaller size of the population targeted in this case (3,950 pupils in the 7 schools), but they are more significant in relative terms. The annual reduction in CO₂ emissions is estimated at 24 tons or 36%; similar relative reductions are estimated for NO_x (39%) and PM (36%).

Other relevant social effects achieved by this measure relate to active ageing, fighting loneliness and increased autonomy of seniors, as illustrated by the consolidated experience of one local Walker's Club established during the measure, with almost one hundred seniors who continue organising their bi-weekly walks into their neighbourhood and other active meetings after the measure was completed.

Overall, most of the objectives have been achieved in both vulnerable groups, children and elderly. The project has clearly outperformed in the objectives related to participation (objective #1) and to visibility (objective #4). The project campaigns in this measure have reached 684 people, and the measure has organised 45 events until the end of August 2019; activities have continued after the European financial support to this project measure was over, thanks to municipal support and voluntary commitment. The project has also exceeded its initial target in what refers to the perception of mobility safety by the elderly (objective #3), moving from 3 to 3.9 on a 1-5 scale (or a 30% increase) between 2017 and 2019.

Regarding modal shift, the project activities have had a positive effect in seniors' walking, which increased by 8.5 percentage points, mainly due to trips that were formerly made by public transport. In the case of children, the share of sustainable transport modes increased from an already high 72.7% to 74.3% or 1.6 percentage points, below the 5-point target.

Conclusions

Validated direct impact

- The ECCENTRIC activities aiming at raising awareness on urban mobility among children and at increasing the share of sustainable transport results have substantially achieved their expected targets. However, it is worth noticing that the share of car use remains substantial in all cases, and that there are schools in which, particular social and land use characteristics jeopardise modal change in spite of the educational efforts and children willingness to try alternative modes.
- Whereas the reduction in car use among pupils results in an increase in the modal share of public transport and walking, the share of cycling hardly changes, and remains very low. This suggests that encouraging cycling for school trips remains a medium to long-term goal, that has to be sustained beyond the school-year cycle of ECCENTRIC activities. Furthermore, it needs to be supported by adequate framework conditions in the city, such as bold pro-cycling policies, and adequate infrastructure for safe cycling.
- In the case of seniors, the aim of the measure moved from reducing car use (as baseline data showed that it was already very low) to the improvement of public transport conditions for them, and to the promotion of walking, based on healthy, autonomy and psycho-social considerations as well as sustainable mobility goals.
- Urban seniors make a very limited use of cars, at least in high-density residential neighbourhoods in the periphery such as Vallecas. However, their mobility can be

significantly supported through improvements in the quality of the public space and walking conditions.

Main lessons learned

The following lessons can be highlighted:

- Self-organising activities to promote sustainable mobility have a strong potential and capacity to mobilize the targeted social groups when they address the topic with an integrated approach close to the interests and points of view of these groups, e.g. including the dimensions of health, autonomy and empowerment in the use of public space of senior and children groups.
- Concerning the implementation process of measures targeting children and the elderly. The project showed the limited impact of “one-shot” activities and the need to engage with these groups in lengthy processes. For this reason, it seems reasonable to stablish long-term programmes with dedicated personnel and resources, that can be continued through time in schools and ECCs, and embed these activities within the schools’ and ECCs’ programmed activities.
- The difficulties faced to get actions included in the municipality’s investment pipeline suggest the need to establish internal bureaucratic procedures within the city services, that can be able to provide a more flexible and tailored response to the bottom-up proposals coming from these participatory activities so that, without compromising transparency and accountability, these proposals can be assessed and implemented within reasonable deadlines.
- Modal share for children is possible, but there seems to be a ceiling of a few percentage points in what can be achieved. It is also worth noticing that most of the modal change from car use is likely to move towards public transport rather than to walking.
- The promotion of cycling among children (and even more for the elderly) seems a long-term battle, with no visible achievements in the short-term. This is probably due to the still weak share of cycling in Madrid and the lack of extended and connected cycling infrastructure.
- Actions aiming at encouraging modal change among these social groups need a favourable environment and policy framework. In this sense, they need to be framed within bold policies supporting sustainable mobility at the city level, as happened during the implementation of this measure in Madrid.
- Urban planning has a strong influence in mobility conditions, particularly in the case of children. The school which presented lower results in terms of climate change (Loyola de Palacio) was located in a recently developed area with a strongly car-oriented design. Actions in such neighbourhoods are hardly effective without more comprehensive strategies to redesign the urban space.

Long term impact

The main expected long-term impacts of this measure are the following ones:

- The embedment of sustainable mobility practices within the activities of an increasing number of schools and ECCs in the city.
- An increase in the autonomy of children and the elderly, facilitated by more friendly environments and better mobility conditions; unsurprisingly, children seem likely to prefer using public transport, whereas the elderly have a strong tendency to increase the number of their walking trips.

MUC 2.9a Neighbourhood oriented marketing of sustainable multimodal mobility services: Direct and dialogue marketing

Abstract

The measure MUC 2.9 is divided into three sub-measures which aim to implement neighbourhood-oriented marketing of sustainable, multimodal mobility services in Domagkpark and Parkstadt Schwabing. Sub-measure MUC 2.9c focuses on a comprehensive mobility management for companies, actually carried out with the help of a ride sharing app called JobRide. The mobility management for local schools (MUC 2.9b) offers mobility education and training to children and their parents in order to strengthen active, independent and sustainable trips to school and leisure activities.

This measure MUC 2.9a focuses on a direct and dialogue marketing which is addressed to all residents of the CIVITAS ECCENTRIC Living Lab – Domagkpark and Parkstadt Schwabing. The targeted marketing campaign aims to support local residents to change their mobility behaviour into a less car-dependant lifestyle. The customized marketing actions consist of various materials which are designed in a very modern and appealing way and also have a direct connection to their own neighbourhood. There are information brochures, handy maps of the Living Lab and an order form where interested residents can order additional information about different mobility options and free trial offers and vouchers to actually incentivise to make use of those mobility choices.

Evaluation results for MUC 2.9a were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019), statistical data delivered by the measure's subcontractor about general campaign respondents, interviews with the ML and an online survey about general satisfaction and awareness of the mobility marketing campaign.

The direct dialogue marketing campaign was successfully launched in June 2019. The first of a total of three rounds was running for about six months. Evaluation data were obtained several times during this timeframe. The actual usage rate is lower than initially expected, although the interest of the residents can be classified as high, based on their feedback on the mobility mail. An important result is therefore the high inhibition threshold of users to actually use new offers, although their interest is very high.

The impact assessment of measure MUC 2.9a showed that about 15% of the residents which received the marketing material via post, responded to the campaign by ordering further mobility related information. About 52% to 55% ordered trial offers for the local public transport and e-scooter sharing. About 43% were interested in information about bike sharing and 37% to 40% were asking for more information about car sharing. Those who actually made use of the trial offers which were sent to them, mainly used bike sharing (51%), the e-scooter sharing (44%) or public transport (PT) offers like the local IsarCard (44%). The car sharing trial offer which was used the most, was the stationary car sharing (26%). Free-floating mobility service providers have lower usage numbers (about 16%).

Nevertheless, 87% of the residents who are actually ordering information material and redeeming their vouchers are highly satisfied with the entire process and the individual consultation via telephone by the subcontracted marketing and sales firm.

Conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Managers, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

These conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

Validated direct impact

- Information about sustainable and efficient mobility options was sent to all 2.950 households in the Living Lab. This provided information leads to a high number of test trials orders which are carried out online or via telephone.
- The response rate of residents ordering mobility information material or vouchers is at 15,4% (10/2019).
- The trial offers which have been ordered the most are IsarCard for using PT, E-scooter-sharing and the MVG bike sharing. Carsharing test trials are the least ordered.
- Actually received (and not just ordered) vouchers for different sharing options or IsarCard are especially the MVG bike sharing offer, E-Scooter-sharing (emmy) and the IsarCard for Munich's PT. Carsharing test trials are redeemed less. due to a more complicated registration procedure (cf. interviews with local residents).
- Actually used (and not just received) vouchers for different sharing options or IsarCard are comparably low to the amount of trial offers which have been ordered and actually received.

Relevance of supporting activities

- There were no supporting activities but the positive political landscape in the City of Munich to implement such measure to increase the awareness of people towards more sustainable mobility options as well as the willingness of mobility service providers to support the campaign directly.

Interaction with other measures

- There was no direct interaction with other measures but the marketing campaign also provided information about the measure MUC 5.9 Intermodal (E-) Mobility stations. The mobility stations are a core part of the dialogue marketing because they provide several mobility modes at different places within the Living Lab.

Main lessons learned

- Data acquisition and protection of sensitive data as well as the completely new development of information material has been time-consuming.
- The perfect timing of the marketing campaign for new residents is very important. It should not start during summer holiday season or parallel to other festivities like Munich's Oktoberfest or other surveys being conducted for other CIVITAS ECCENTRIC measures in the Living Lab.
- Public dissemination and advertisement of the dialogue marketing actions on social media platforms like Facebook and YouTube is important to have a greater outreach than just sending the Mobility-mail via post.
- Personal mobility consultation and individual advice given by the subcontractor is to be mentioned as a very good way to organize such campaign. Residents feel well treated and individually consulted.
- However, since the vouchers for the test tickets were sent out only after a personal mobility consultation, the redemption rate was sometimes very low, as not all residents gave their telephone numbers. In the next round, the vouchers will therefore be sent to all interested

residents, even if they do not want a personal mobility consultation via phone. Thus the redemption rate will increase significantly.

- It is very important to involve all key stakeholders right from the beginning, as there are ML, subcontractor marketing and sales, various MSP (mobility service providers), mobility managers of Munich, local neighbourhood organisations and politicians.
- Feedback of residents using the trial offers stated that the balance between the amount information material and individual communication was well organized.

Long term impact

- Residents of the Living Lab have plenty of material to inform themselves about different sustainable mobility options in their surrounding and can change their mobility behaviour at any time.
- The incentive system is intended to lower the hurdle to take up new mobility services. After a one-time trial period, it is expected that the long-term use of these mobility services would continue.

Potentials for up-scaling in the city

- The holistic and attractive concept developed by the ML and the subcontractor doing marketing and sales can easily be up scaled in the city of Munich
- Regarding the costs, it should be mentioned that the campaign is relatively cost-intensive due to the complexity of the offers and newly developed products. However, the continuation is largely simple and cheap. A campaign in reduced form would be possible.
- In the case of an up-scaling in Munich, the potential is to be evaluated as very large, since the products and processes are easily transferable.
- In this respect, a transfer of the measure is already planned in another new development area in Munich, called “München Freiham”.
- A further replication is planned for the city-wide New Citizen project in Munich, with regard to the entirety of the multimodal sharing providers.

MUC 2.9b Neighbourhood oriented marketing of sustainable multimodal mobility services: Mobility management for local schools

Abstract

This measure MUC 2.9b mobility management for local schools offers mobility education and training to children and their parents in order to strengthen active, independent and sustainable trips to school and leisure activities. Several actions and projects are integrated in measure MUC 2.9b to reduce the number of parents picking up their children by car in the long-term as well as improve their feeling of security outside and their awareness of traffic and their own mobility behaviour. Due to the different mobility behaviour, motoric capabilities and possibilities of all age groups, different actions were implemented, focussing on a specific age group.

Four actions are part of the sub-measure:

- The action “Bus mit Füßen” is designed to enable school children to get to know their way to school safely in company with parents and other children and, in the long-term, to walk to school independently, without adults.
- Secondly, the school theatre play “Let’s Go!” is integrated into the measure, too, to deal with the topic of mobility in a playful way: different modes of traffic are presented and discussed regarding sustainability and safety.

- As a third action, the scavenger hunt “Kreuz und quer” is integrated. This motivates the children to spend more time outside in public space and to get to know their neighbourhood on foot, by bicycle or scooter and thereby improve their movement and general safety on the road.
- The last actions, “Bambini” and “Bambini box” is also designed to introduce children to the topic of mobility in a playful way as early as kindergarten and to intensify it during school. Here, too, the children should learn about transport options and be encouraged to walk or cycle on their own, by promoting the joy of movement and environmentally friendly travel.

All actions were successfully implemented within the last months of 2019, except “Bambini” due to some strategic problems. All actions are still on-going.

Evaluation results for MUC 2.9b were retrieved from different evaluation activities: Particular online questionnaires addressing the four actions being part of the sub-measure as well as analyses of registration numbers of the programs. In addition, there were some observing counting of pupils, qualitative observations and surveys taking place as well as interviews with relevant stakeholders.

The impact assessment of measure MUC 2.9b showed that there were for example about 900 participants joining scavenger hunt action and about 47 schools supporting the “Bus mit Füßen” action and among this particular program there are double the number of parents (666) being involved in the safe walking to school than in 2016 (316). Regarding the theatre play “Let’s go”, 52% of the visitor state that they want to hear more about the topic mobility.

Overall, the measure can be seen as positive, as even the youngest inhabitants are introduced to the topic of sustainable mobility and thus become aware of their mobility behavior and its effects in the long-term. In many activities, a gamification approach is used to motivate the children and introduce them to the topic in a playful way. It is important, however, to involve parents and childcare institutions at an early stage with this very sensitive target group, in order to make the measures transparent and achieve great acceptance. The actions carried out are easy to implement and do not require any elaborate preparations.

Conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

Validated direct impact

- During the implementation phase all actions show a great influence and impact on the mobility behaviour of the children
- The awareness and acceptance (cf. “Let’s Go!”: 78,8% liked the play, 52% evaluate it as an interesting topic, high understanding in the external effects of traffic; “Bus mit Füßen”: registrations 22 in 2019/20 and 37,5% satisfied parents 01/2020) of sustainable mobility for children and adolescents is very high due to the implemented actions
- Parents also accept these actions and show a high level of satisfaction with the actions and their objectives (cf. “Bus mit Füßen”: relief of parents, less concern, independence of children, knowledge about safety of children etc., 01/2020)

- Through the actions, the children move more actively outside in public space and thus develop a greater sense of security on the streets (cf. “kreuz & quer”: 894 registered players, increased walked distances: 16.773,6 km)

Relevance of supporting activities

- There were no supporting activities but the positive political landscape in the City of Munich to implement such measure to increase the awareness towards more sustainable mobility options
- There is less relevance of supporting activities, but high relevance of supporting stakeholders within the Living Lab.

Interaction with other measures

- There was no direct interaction with other measures but the measure MUC 2.7 of the “Community information and participation portal” supported the action through the local network and communication platforms.

Main lessons learned

- Due to the very sensitive target group of children, it is necessary to set very high standards for data protection and a safe implementation of the actions in general (cf. “kreuz & quer”).
- Furthermore, with regard to the sensitive user group, the background and the course of the actions must be transparently communicated to parents and institutions. For this purpose, personnel is necessary who can take over this task continuously.
- The implementation of such measures benefits from a large network and cooperation with local organisations. Therefore, it is necessary to involve the stakeholders at an early stage
- Within the action “kreuz & quer”, technical expertise is necessary. Here, a continuous learning process is evident: learning by doing! A test of the game in advance is absolutely necessary.
- A continuous information and communication strategy with local child care facilities and parents is crucial: many actions have lost participation because after some time there was less information about them (cf. “Bus mit Füßen”).
- It is necessary to develop the actions over time. Especially with topics such as mobility, which is currently undergoing major changes, continues review and adaption is important. For example, the content of the theatre play must be further adapted.
- In summary, these actions are easy to implement and carry out, as children and young people are motivated to participate in the measures. This requires little infrastructure and costs, but much time for planning and communication with the child-care facilities.

Long term impact

- The long-term effect of the actions cannot be determined yet. However, there are already experiences of the actions in other urban areas. There, no direct dependency can be statistically determined. However, it is assumed that the awareness raising by these measures is nevertheless given.
- Due to the satisfaction and successful implementation of the measures, a continuation of these measures in the Living Lab and also outside of it is desirable and is being sought by the City of Munich.

Potentials for up-scaling in the city

- The holistic and attractive concept developed by the ML and the City of Munich can easily be up scaled in the City of Munich. The potential for up-scaling is given for all of the mentioned actions. In the case of up-scaling in Munich, the potential is to be evaluated as

very large, since the lessons learned are already made and the actions are now easily transferable.

- In this respect, a transfer of the measure “kreuz & quer” is already planned in two other districts of Munich “Giesing” and “Trudering” in 2020
- As mentioned before, the time factor in particular is an essential factor for upscaling and less financial or infrastructural prerequisites.
- The “kreuz & quer” action in particular has great potential, as the measure is very well received by children and is easy to implement. Even though, this measure is, compared to other, the most expensive one.

MUC 2.9c Neighbourhood oriented marketing of sustainable multimodal mobility services: Mobility management for companies

Abstract

This Measure Evaluation Report shows the developments of MUC 2.9c which focuses on a comprehensive mobility management for companies, actually carried out within the campaign JobRide and the help of an existing ride sharing app called “TwoGo” (www.twogo.com). The new programme is implemented and tested within four participating companies in the business area of the Living Lab, Parkstadt Schwabing using the app TwoGo cooperatively. The app aims to bring together employees which could possibly share their rides to and from work/home, in order to reduce congestion, emissions and alleviate the general parking pressure in Parkstadt Schwabing.

Evaluation results for MUC 2.9c were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019) and statistical data provided by the subcontractor SAP (Systems, Applications and Products) who controls and maintains the used app TwoGo.

The JobRide campaign successfully found four interested testing companies. The biggest difficulty is the activation of potential users, though. If there is no investment in major marketing actions the app is not very intensively used. Due to a quiet low usage rate, there cannot be any reductions to be attributed to the implementation of the cooperation JobRide. The number of ride intents is very high (about 170 ride requests) compared to the number of rides actually carried out (about 2,5 rides) during the project lifetime. Nevertheless, by taking the lessons learned into account for the planned relaunch in 2020, it is expected that the number of trips will increase and the reduction of emissions will decrease significantly.

Conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

Validated direct impact

- Four companies located in Parkstadt Schwabing joined the JobRide cooperation and used the given app in their companies.

- The number of activated users varies from month to month and is at all times relatively low, due to the low advertising capacities in the companies.
- There is a quiet high number of ride requests per month but a very low number of rides is actually carried out in the end.

Relevance of supporting activities

- In the case of the planned parking management scheme, a round table has already been set up in the “Parkstadt Schwabing”, where residents and companies as well as the City of Munich are discussing about solutions, to reduce traffic in the neighbourhood.
- There is no information if the planned parking management scheme within the Living Lab is positively influencing the implementation of the JobRide cooperation yet. However, it can be assumed that the planned restrictions on parking space for employees in 2020 will lead to an increased visibility for JobRide.
- The activities, such as the “Corporate Mobility Management”, the “Climate Pact Munich” or the “Inzell Initiative” continue to be regarded as a very important support for the JobRide cooperation, by raising its visibility and acquiring new members for the cooperation.

Interaction with other measures

- Due to its focus on companies in Parkstadt Schwabing and their employees, there is less interaction with other CIVITAS ECCENTRIC measures. The website www.domagkpark.de was used to promote the JobRide app and attract companies to participate in the app testing phase.
- Promotion material was handed out during events of other measures.

Main lessons learned

- Without an intense marketing campaign promoted by the companies, it is rather difficult to attract potential app users.
- If there is a contact person in the company who gives direct support for the app users and helps to inform potential users about the usage, the awareness and acceptance of the app will possibly improve.
- Above all, the contact to the app provider and companies must be maintained more intensively in order to be informed about possible changes at an earlier stage.

Long term impact

- If the app is used more intense than it is used now, there is presumably a long-term impact measurable regarding the reduction of emissions or congestion.
- But currently there is no big long-term impact to be foreseen due to a very low usage rate and a very low number of actual rides carried out as ride shares, caused by the change of the software provider.

Potentials for up-scaling in the city

- The JobRide cooperation has great potential to be up scaled in the city due to its already practiced approach and the simple app programming which is no innovative aspect in itself.
- As a result of the conducted evaluations, it is recommended to put more effort into marketing actions which promote the app and the measure as such.
- Based on the good cooperation and exchange with other initiatives (Corporate Mobility Management, Climate Pact Munich, Inzell Initiative etc.) an innovative parking management scheme will also be established within the pilot project area “Neumarkter Straße” in Munich, for which the JobRide theme shall also be incorporated.
- Due to the high registered interest of other companies and institutions in Munich, the general potential is seen as high. In particular, the relaunch appointment on 18th of

February 2020 is considered as a milestone for the replicability and expansion of the measure.

MUC 2.10 Transfer – Exchanging communication and information technology for everyday mobility between generations

Abstract

The measure MUC 2.10 Transfer - Exchanging communication and information technology for everyday mobility between generations was implemented with the aim to give senior citizens a better understanding of the possibilities of modern communication devices in terms of sustainable mobility in everyday life. The setup for exchanging mobility knowledge between generations are workshops which take place in secondary schools, led by the Measure Leader and accompanied by the student's teacher.

Evaluation results for MUC 2.10 were retrieved from paper-based evaluations with the students and seniors conducted at different times: before the workshop started, right after the workshop and six months after the workshop took place. The participation rate was throughout very high, except for the ex-post evaluation which was sent via post to the seniors and therefore had less answers.

The intergenerational exchange plays a big role within the measure and in the end exceeds the expectations of both measure target groups, secondary students from 13 to 17 years old and seniors living in Munich. More than 82% of the seniors and students stated that their expectations of the workshops were fully and predominantly met. Almost 95% of both groups found the cooperation between generations good and very good. Of originally planned 16 workshops, 15 already could be executed during the evaluation period and 11 of them are assessed for the ex-post evaluation. In total 400 participants from 7 different schools actively took part in the workshops.

In addition to an increasing awareness of the students and the seniors for a more sustainable way of transport, there is an increase to be recognized in the usage of "smart" devices, like smartphones, tablets and the internet (in total about +17%) used for getting ticket information in general, especially among the seniors.

Conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

Validated direct impact

- Raised awareness for sharing options like bike- and carsharing for students and seniors.
- Great willingness for a mobility behaviour change by both groups.
- The workshop format meets the expectations of the seniors and students. Also, the cooperation between both generations can be described as successful.
- Seniors more likely search for transport information via mobile phone or the internet than they did before taking part at the measure.

- Mode shift is developing towards more sustainable modes: walking, cycling, PT. Especially the number of seniors using a car is decreasing.
- Both target groups tend to use more sustainable transport modes: shown with the higher number of bicycles, e-bikes and IsarCard ownerships (IsarCard is used for Munich's PT).

Relevance of supporting activities

- The ML good contacts to secondary schools facilitates the cooperation and recruiting of schools.
- The cooperation with motivated teachers helped to execute the workshops during class.

Main lessons learned

- The cooperation between students and seniors is very successful as both sides can learn from each other.
- Students are the right group to teach seniors about using modern technology due to their affinity to digital media.
- Secondary schools give a suiting surrounding to foster the intergenerational exchange.
- The workshops executed by the ML are the right format to deliver content and work together in an interactive way.
- There is a huge demand from seniors to take part in the workshop format and learn about digital devices connected to the mobility and transport topic.
There is a very good understanding and way of getting along between the generations, students and seniors.
- A reliance on press for advertisement for participants should be minimized or kept in mind as sometimes wrong statements were published or no article was released.

Long term impact

- Hopefully all workshop participants are more sensitive towards more sustainable transport modes.
- Private contact between student-senior pairs was kept upright after the workshops in a few cases. Those contact between seniors was also fostered, for example meetings for a coming city trip with the local public transport.

Potentials for up-scaling in the city

- The measure MUC 2.10 is easy to up-scale in the city due to low costs and high impact possibilities among the target group.
- More schools within the city could be attracted by the positive evaluation outcome.

RUS 2.11 Information, training and awareness raising

Abstract

The main objective of this measure was to create awareness of the benefits of sustainable mobility in Ruse and its importance for increasing the quality of life. One seminar was organised for public transport personnel, six workshops - for citizens and NGOs, three mobility conferences and a large media campaign for stakeholders and the school community. The aim was to encourage the different actors to embrace sustainable mobility habits, to increase the use of public transport, and to make walking and cycling safer and transforming them into a desirable way of moving in the city. A special focus on traffic safety was made, with the aim of sensitizing the population in order to reduce the risk of road accidents.

The most important challenges in the implementation were related to the interest of the participants. After so many events since 2000. in the frames of various EU projects that have ended almost without visible results, the Bulgarian stakeholders were tired and disinterested. It was difficult to involve them in further project events.

The final evaluation of the measure shows very encouraging results. The objectives of RUS 2.11 were successfully achieved at higher level than expected. All important target groups were involved: local authorities, transport professionals, local citizens and their organizations, NGOs, disadvantaged groups, youth, academia and school children. Therefore, the new mobility measures foreseen in the CIVITAS ECCENTRIC project were widely discussed and promoted in order to change the mindset of all stakeholders.

The most important success factors of this measure were the good cooperation with the municipality, and the participative approach to the events proposing tailor-made seminars for each target group, together with perfect planning and conducting – well-organized distribution of the invitations, attractive agendas and catering and a lot of possibilities for the participants to express themselves and to share their opinion. A long-term co-operation of CSDCS with the local and regional media was also very helpful.

Conclusions

Validated direct impact

According to the impact evaluation after 3.5 years of work this measure has fully achieved its objectives, even for most of them the results exceeded the expectations. The measure RUS 2.11 has increased the knowledge, the understanding and the support for the sustainable mobility among local population, has obtained their support for the implementation of SUMP and has changed radically their perceptions by introducing the MaaR concept. The measure has informed as much citizens as possible about the ECCENTRIC project and the efforts of CSDCS team were highly appreciated by all the stakeholders, including the City Council and the Ruse Regional Administration.

Main lessons learned

Technical planning of such measures should be carried out meticulously and with strong stakeholders' involvement. Each event met the needs and requirements of the specific target group.

Long term impact

In general, the education and promotion campaign contributed to the recognizing the importance of the sustainable mobility and SUMP for climate change mitigation of the cities.

WORK PACKAGE 3: MOBILITY AS A SERVICE FOR AND BY ALL

TUR 3.1 & TUR 3.2 Smart Multimodal Mobility Services: Applying Mobility as a Service concept & Integrated Ticketing and Information System for Mobility

Abstract

Measures TUR 3.1. and TUR 3.2. aimed to have a functioning Maas ecosystem in place with at least three Maas operators running in the city of Turku by the end of the project. Prior to the project, the user could either buy means (a car or a bike) or tickets for transport (bus ticket, train ticket etc.) separately for each mode. In these measures, the development of a MaaS system and its services in the city of Turku was to be piloted. This included the creation of business models that enabled cooperation with different existing service providers and attracting new MaaS operators to come to the city by creating different service packages and marketing them through a variety of communication channels. A new open data interface and platform into which the ticketing system of the public transport system was incorporated was also to be developed. This enabled the integration of other local service providers into the MaaS ecosystem, such as taxis, parking houses etc.

The ticketing system for the bike sharing system was also integrated into the data interface as a demonstration of how the new information system and open integration enabled new business opportunities and models. All this was to result in easy and accessible multimodal services to citizens and tourists.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of measures TUR 3.1. & 3.2. was measured. Data was derived from local surveys, secondary city statistics, policy documents, the PT operator Föli and the Measure Leader.

As a result of the two measures, several MaaS operators have provided or are providing their services in the city. Combined tickets are being sold through the integrated ticketing system and the ticketing system of PTA (Prepaid Ticket Advice) functions also as a ticketing system to the bike sharing system (TUR 5.5.).

There are open interfaces available to the MaaS operators and to the mobility service providers wanting to bring their service visible together with public transportation. Cooperation models have been created and tested between different parties. In essence, MaaS services are available to the citizens, although awareness of these services still needs concerted promotional activities. Measure evaluation showed that awareness of MaaS is still rather low in the city and due to this, not many conclusions can be drawn on their acceptance or satisfaction. It was also clearly demonstrated that the complexity of MaaS calls for the continuous involvement of external and internal stakeholders, vital for the understanding of differing motivations, drivers and barriers that surround the issue and the various actors involved. Moreover, the success of MaaS endeavors at this point seems to culminate in the

public actor vs. private actor role/responsibility conundrum - an issue in most need of further research in addition to the business-case aspect from the consumer's point of view.

Conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Managers, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

Validated direct impact

- Several MaaS operators have provided or are providing their services in the city.
- Combined tickets are being sold through the integrated ticketing system.
- The ticketing system of PTA functions also as a ticketing system to the bike sharing system (TUR 5.5.).
- There are open interfaces available to the MaaS operators and also to the mobility service providers that want to bring their service visible together with public transportation.
- Cooperation models were created and tested between different parties.
- MaaS services are available to the citizens, although awareness of these services still needs concerted promotional activities.

Relevance of supporting activities

No supporting activities were identified for these measures.

Interaction with other measures

- TUR 5.5. "Bike-sharing and Car-Sharing Schemes": the bike share system was integrated into the PT platform Föli (www.foli.fi).
- TUR 2.2.: The mobility survey realized within the scope of the measure provided data for measures TUR 3.1. and TUR 3.2.

Main lessons learned

The main lessons learned from the measure are summarized below:

- Awareness of MaaS is still rather low in the city. Therefore, not many conclusions can be drawn on their acceptance or satisfaction. Generating public awareness is vital to a novel development such as MaaS. Further pilots and launches of new services therefore need to be combined with efficient communicative measures.
- The availability of MaaS services has had no effect on levels of car ownership in the city. As its rise is an increasing trend country-wide, it will take many years of established MaaS services to be able to attribute any decrease in car ownership to improved levels of service.
- As there are no established models for MaaS ecosystems due to the novelty of the concept, continued emphasis needs to be placed on development and testing of cooperation models, in addition to mere technical development.

- The complexity of MaaS calls for the continuous involvement of external and internal stakeholders. This is vital for the understanding of differing motivations, drivers and barriers that surround the issue and the various actors involved. Without stakeholder involvement, it is unlikely that the technical, financial and governance-related issues surrounding MaaS can be solved satisfactorily to all parties relevant.
- The success of MaaS endeavours at this point seems to culminate in the public actor vs. private actor role/responsibility conundrum. This is an issue in most need of further research in addition to the business-case aspect from the consumer's point of view. It is critical that these two seemingly opposing sides do not see each other as having opposing interests. Therefore, emphasis needs to be placed on creating an environment of open communication and interaction where knowledge and ideas are shared for mutual benefit between all relevant parties.

Long term impact

Previously, the consumer has needed to use various service providers' websites or applications to find information and purchase tickets or services. Combining services and information into joint platforms is said to promote multimodality and, ultimately, change the model of ownership in transport as the eased access to different modes leads to decreased need for private cars, for example. By providing the first open PT-integrated ticketing system in Turku and by developing cooperation models between different actors, a process to reach these goals has been initiated. However, the long-term impact of these measures is to the most part up to the establishment of functioning business models. Without these, it is unlikely that MaaS will develop into a serious rival for private car ownership.

Potentials for up-scaling in the city

As the open interface has now been established within the PT operator's platform, there are plenty of opportunities to offer various services to be integrated into it. It is thereby up to the ability to demonstrate the business case of combined ticketing and better access of information to the citizens to fully unveil the potential of MaaS services in the city. All in all, the following questions should be solved at least to some extent before MaaS can flourish in the city – or in any city, for that matter.

- What is the presumed role of the public transport providers in MaaS? Do they have the responsibility to support and facilitate MaaS development, financially or otherwise?
- How much risk-taking do private actors need to tolerate when trialling with MaaS? Should this risk be alleviated with public funding?

What is the added benefit of MaaS services to consumers if not for the price? Does the ease of use of e.g. combined ticketing surpass the higher cost of the ticket? In essence, can the way we move really be altered via improved services?

MAD 3.3 Open platform for multimodal mobility information and services

Abstract

This measure has developed an integrated Open Data mobility platform, gathering and providing information from all transport modes, prioritizing the more sustainable ones. Some information was already publicly available before the project, but only partially and without including real-time information for most services.

The information, analysed with a business intelligence approach, includes multimodal travel options and a consolidated database of public transport services in real time.

Initially, an open data portal with multimodal information from different sources was also planned (information on public bicycles, parking, car sharing, congestion, pollution, alternative modes and the main road network); however, this information was finally not provided by the relevant public and private actors.

The platform, with information of the whole region, will increase the attractiveness of PT services, as well as, enable the designing of mobility services for different kinds of user types and to promote new business models. The main innovative aspect of the measure is to make available to potential app developers real-time information on public transport and other services.

The main changes in the measure contents during this period are due to the unsuccessful attempts to engage some mobility serviced providers to make their real-time data publicly available in the platform. This has resulted in a more flexible concept, with different levels of integration. In those cases, in which information is available in open data format, platform users are allowed to access and download the information for their own use (this is the case mainly for public transport data); in other cases, the platform provides access points to the operators' websites. At this stage, no particular plans have been established to contact again reticent stakeholders. This could also expand to the future to new "emerging" providers of mobility solutions (on-street shared bikes and motorbikes, electric scooters...).

The project could not achieve its objective to increase the number of data providers, as a way to expand the mobility information available in the platform. The mobility providers that were approached by the measure team argued that real-time data information was commercially sensitive for them, as competitors could identify their commercial strategies (e.g. deployment of vehicles in certain places in the city). These concerns can be due to the fact that new mobility providers are still trying to consolidate their position in the mobility market, with limited resources, and are keen to preserve their own identity, rather than getting integrated in the general mobility system.

The increase in the number of queries to the new open data portal (with substantial improvement in terms of real-time information) compared to the old one has increased by 11% in a little more than 2 years. CIVITAS ECCENTRIC has been successful in mobilising the developers' community and in supporting the development or improvement of more than 18 mobile apps and 9 websites providing information on the mobility system in Madrid.

The quality of the information has been positively assessed by public transport users, with an average score of 3.8. Websites and apps are being used to estimate of waiting times ("always" by 46.9% "and sometimes" by 18.3% of respondents, respectively), for trip planning ("always"

by 32.9% “and sometimes” by 29.7% of respondents, respectively), and for on-route verification (“always” by 15.4% “and sometimes” by 19.1% of respondents, respectively).

The platform is already covering the whole metropolitan region, and is expected to remain operational after the termination of the project. The Consorcio Regional de Transportes de Madrid (CRTM) intends to keep working with reluctant mobility providers in order to integrate them in the platform.

Conclusions

Validated direct impact

- The measure has successfully empowered app developers to provide enhanced information services through their applications. More than 18 app are currently available in Madrid providing real-time information on mobility services.
- Public transport users are very satisfied with the real-time information available in Madrid.
- The deployment of alternative apps has resulted in a slight decrease in the users of the CRTM app “Mi Transporte”.
- The measure has not achieved its initial ambition of including additional real time information from additional mobility services not integrated in the public transport system, such as taxis, car sharing or micromobility services.

Main lessons learned

- Open data platforms can be an excellent tool for app developers to get interested in urban mobility and develop innovative applications providing real-time information for users.
- Users appreciate the availability of a variety of mobility apps, as they can look for those better tailored to their particular expectations.
- Users are primarily interested in getting information on waiting times, trip planning and to a lesser extent, on-route confirmation of the itinerary.
- New mobility operators, providing services outside the traditional transport system such as car or bike sharing and micromobility are reluctant to share their information in such platforms. Efforts to do so are likely to require early involvement of these stakeholders and an adequate framework to gain their trust.

Long term impact

It can be expected that the platform will serve to consolidate the central role of CRTM, as the regional public transport authority, in integrating mobility services in Madrid, with a focus on public transport.

STO 3.5 Develop smart choice of mobility services

Abstract

The City of Stockholm aims to improve mobility options for citizens, particularly to enable the use of more sustainable travel modes as an alternative to energy- and emissions-intensive private automobile use. In particular, this measure consists of the establishment and operation of a (beta) MaaS-Service, Ubigo, with the participation SnappCar, GoMore and the City of

Stockholm in order to provide sustainable transport options as alternative to private car and to facilitate the development of services offering alternatives to the private car for the citizens in Stockholm. Outputs of measure STO 3.5 included establishment of the UbiGo integrated mobility subscription platform, allowing access to public transport, taxi, rental cars, shared cars, and other mobility services.

This measure STO 3.5 implemented a set of Mobility-as-a-Service (MaaS) initiatives in the City of Stockholm: firstly, an integrated mobility service comprising public transport use, car rental and taxi bookings; and secondly, two separate peer-to-peer mobility services that pair automobile owners with travelers who wish to borrow a car for local trips. Awareness of MaaS-type services was gauged using a general web-based survey, satisfaction for the UbiGo service was measured by a targeted app-based survey, and usage was monitored using each MaaS provider's internal operations records.

The results showed that all three MaaS providers experienced very strong growth during the project: UbiGo, which started from zero, jumped to over 1800 bookings per month by December 2019. Customer satisfaction with UbiGo was high, with an average score of 3.8 out of 5. GoMore and SnappCar, reporting in percentage growth, increased by 261% and 623% respectively, between 2018 and 2019. Overall awareness of peer-to-peer mobility services such as GoMore and SnappCar increased during the project period from 49% to 67%.

The findings indicate that MaaS is experiencing a strong period of growth in the Stockholm market, both in terms of an integrated mobility platform in the form of UbiGo, and in terms of new business models for mobility service in the form of SnappCar and GoMore. Among the general population, an improved awareness and comprehension of these services was detected, indicating that even non-users have been aware of the growth in this sector.

Conclusions

Validated direct impact

- Use of all three services increased substantially during the project
- Awareness of MaaS increased during the project
- Satisfaction with the UbiGo integrated mobility platform was high

Main lessons learned

Some of the lessons learned are as follows:

- Few users can lead to uncertain results; for UbiGo, for example, the survey responses were small, and moreover, even fewer participated in multiple waves of the survey so the responses in each wave are largely from different users.
- Curiosity is a key driver for early-adopters of the services.
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Long term impact

The long-term impact is still highly uncertain, where there are potential implications on long-term behaviours such as household auto ownership and household locations to areas with lower public transport access.

MUC 3.7 The App for the City lab

Abstract

The measure MUC 3.7 The App for the city lab aims to develop an app for the Living Lab which offers optimal routes with low degrees of air pollution for people walking or cycling. The app is called “Luftlotse - Der saubere Weg durch die Stadt” (- the clean way through the city) and integrates (among others) a routing function, information about the degree of air pollution in the direct surrounding and individual CO2 savings depending from the distance travelled by walking or cycling.

This Measure Evaluation Report shows the development of MUC 3.7 which was not always without problems due to several technical and content-wise adjustments which had to be done. A first version of the app was available on 30th September 2019. A first field test/evaluation took place in February 2020. About 11 people registered for the app but not many of them were willing to give feedback through the two online surveys which were conducted before and after the test launch.

Evaluation results for MUC 3.7 were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019), statistical data from the app’s backend and a short online user survey which was conducted with the app users.

As there is an insufficient number of app users actually rating the system that there could not be a significant number of valid and representative results shown for the Baseline and After scenario. The backend data has been read out in 02/20 and showed a problem with delivering data for VKT (Vehicle Kilometre Travelled) and emissions.

Conclusions

Validated direct impact

- First of all, the measure managed to provide a downloadable and usable app.
- No validated impact on most of the KPIs like satisfaction, mode shift or car ownership as number of users and duration of field test was too low/short.
- Due to several marketing activities awareness for sustainable mobility and air pollution was risen.

Main lessons learned

- The major lesson learned was, that the intended citizen participation did not work well. For example, the process to host an air quality monitor was too complex. Many potential private hosts dropped out, when a contract had to be signed. However, this was unavoidable. It is one example among others, that a quite elaborate process like the setup of a measure grid across a whole district should not be tackled depending on private households. An institution from the municipal side should be partner from the beginning to provide infrastructure and suitable spots in public space to install measuring devices. Only a quite low engagement amongst the inhabitants of the Living Lab in general was perceived. E.g. only five persons took part in the workshop about the app’s functions. In future projects one should be aware, that an easy process of participation cannot be taken for granted. Sufficient resources in time and money should be provided for that.
- Agile project management (concerning development of new software) can be quite challenging. In particular, if it is done via subcontracting. The controlling must be really strict. And the specifications for each new sprint/step must be as detailed as possible. If this is not the case, misunderstandings are very likely to happen. If it is already clear on beforehand, that the software development will be quite complex and demanding, a well-known company might be the better choice than small start-up with resources difficult to judge.

Long term impact

- Awareness about air pollution raises in the Living Lab.
- Changes in mode shift are possible (because digital incentives about CO2-savings work).
- Profound feedback from more users after a longer runtime can lead to further development of the app and higher degree of acceptance and satisfaction.
- Continuous improvement of the product might also attract new stakeholders.

WORK PACKAGE 4: ENABLING SAFE WALKING AND CYCLING

MAD 4.1 Innovative and participative approach to traffic safety on a neighbourhood level

Abstract

This measure has conducted a comprehensive road safety study in the demonstration area, the districts of Puente de Vallecas and Villa de Vallecas, complemented by the development of a GIS-based application to map road safety incidents, categorized by type (e.g. with cyclist involved, pedestrians, etc.), as well as high risk locations (either real or perceived). The GIS-based tool has been used in more than 70 studies and 300 proposals developed by the technical services of the municipality.

The measure also intended to involve citizens and key stakeholders to deliver a proper policy and planning approach, gain population support and trigger new mobility behaviour. This involvement was finally implemented through a social media analysis tool, screening messages in social networks (Twitter) related to traffic accidents.

Overall, the measure substantially achieved its initial objectives. Although the number of accidents increased by 12.4% in 2018, the number of persons seriously injured decreased by 16.9%. In accordance with the messages analysed in social media, the perception of safety levels in the city has increased, from 2.0 in December 2018 to 2.3 in September 2019. However, there are two considerations to make related to these values: for the former, it is worth to highlight that the measure was implemented only at the end of 2018, and its impact in the 2018 accident figures is therefore very low, if significant at all; for the latter, the number of social media messages identified within the category “accidents” was too low (just 7 in December 2018, 11 in September 2019 and a peak of 25 in February 2019) to provide a reliable picture of the public’s perception.

Conclusions

Validated direct impact

- The number of fatalities and seriously injured decreased in the two districts between 2017 and 2018, by 16.9%, whereas at the city level it decreased by 6.5%. However, it is uncertain that this decrease can be attributed to CIVITAS ECCENTRIC, as the implementation of the measure was not completed until November 2018; it will be necessary to wait until 2019 data becomes available to assess this impact.
- The analysis of social media messages has not been able to provide reliable conclusions, due to low number of messages related to accidents that could be identified, and the inability to identify the parts of the city or the transport mode they referred to. The number of messages identified between December 2018 and September 2019 within the category “accidents” was very low: just 7 in December 2018, 11 in September 2019 and a peak of 25 in February 2019. This is a tiny fraction of the more than 1000 accidents per month at the city level, and suggests that social media does not seem to provide a fair image of traffic safety in the city.

- The GIS tool has effectively been mainstreamed within the technical practice of municipal services: The municipality has reported to have undertaken 70 studies and 300 proposals during the demonstration period, in which the new tool has been used.
- The measure did not complement its technological approach with physical interventions, as initially envisaged in the project proposal: it did not implement particular actions in the living lab, such as to provide ‘shared speed’ environments leading to safer conditions to all users.

Main lessons learned

- Although relatively resource-intensive to integrate accident data reports, the development of a GIS-based tool has proved effective in facilitating the analysis of accident statistics in the city and to support the technical practice of the municipal services: The municipality has reported to have undertaken 70 studies and 300 proposals during the demonstration period, in which the new tool has been used.
- Monitoring the impact of accident-related measures is difficult, as the number of casualties and accidents can be influenced by many other variables and policy actions.
- The potential contribution of social media message analysis to accident monitoring and assessment is limited, due to the low number of messages related to accidents that can be identified, and the inability to identify the parts of the city or the transport mode they referred to. Direct engagement with the public and improved participatory channels remain necessary to effectively integrate the views and knowledge of the public in road safety policies in cities.

Long term impact

The long-term impact of this measure is associated to the progressive adoption of a more sophisticated approach to accident analysis and to the design of accident-reduction measures by the municipality of Madrid and other cities. The figures provided by the municipality are encouraging, as they suggest that the GIS-based tool is being widely used and the measure contents and conclusions are being widely shared with other Spanish cities.

Long-term impacts in terms of improving the public’s involvement in road safety policies are more uncertain; CIVITAS ECCENTRIC has shown the need to look for direct involvement, rather than to indirect procedures, to gain understanding in the public’s perceptions for safe urban mobility, but effective alternatives will still have to be identified and tested.

MUC 4.2 Software-controlled safety management in the road network

Abstract

The measure MUC 4.2 ‘ aims to reduce the amount and consequences of accidents, especially for walking and cycling. Three different approaches are being tested to increase road safety in the road network of the Living Lab and beyond. This contributes strongly to the general road safety concept of the City of Munich, which is developed in parallel and based on the experiences of MUC 4.2. While one sub measure provides the basic foundation for further investigations with a comprehensive in-depth analysis of the road safety status quo, another sub measures is testing a new, preventive and innovative software-controlled safety management for cyclists, called PING. The third sub measure is targeting a preventive

approach for school children and offering a workshop concept to increase the individual perception of potential dangers on the way to school.

Those three measures are tested to find out if they would be suitable to upscale them within the entire city and see if the outcome is satisfactory enough in terms of data quantity and quality. The ML's institution, the Department of Public Order, is highly interested to search and test measures which could possibly help to pursue the goal of the "Vision Zero" of 2018 – to prevent traffic death and fatal and severe crashes.

Evaluation results for MUC 4.2 were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019), data on road safety assessed by a subcontracted firm specialized in transport consulting, several workshops for the particular sub-measures were carried out and a paper-based survey was conducted at two different times with secondary school students regarding the FAPS program.

It comes out that the in-depth analysis done by local traffic experts gives very helpful and detailed information about the current accident hotspots within the Living Lab (about 5.000 accidents happened from 2010-2014). The tested innovative software-controlled safety management with the so called PING-button and an accompanying app is very well accepted by the users and the ML is satisfied with the data output this system generates. The developed workshop concept to teach pupils of 7th to 9th grade about road safety, shows that there is an increase about the awareness and perception of this important topic among the school children. 85% of the students stated to be satisfied and very satisfied with the FAPS (Fraunhofer Accident Prevention School) workshop concept and content. And 90% stated to accept the topic of road safety in their school schedule. Due to the teachers statement some adjustments could be done regarding the difficulty level of the workshop leaflet but in general this method seems to be successfully implemented.

Conclusions

Validated direct impact

- There is no quantifiable validated direct impact within the Living Lab because the measures did not change the mobility behaviour of the local residents regarding a higher road safety.
- But it can be said that sub measures MUC 4.2b and c have been successfully tested among the two different target groups.

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Main lessons learned

- The comprehensive in-depth analysis of the road safety within the Living Lab can be regarded as a good foundation for further actions in the field of road safety. The commission of this research was a good choice as experts delivered reliable results.
- Sub measures MUC 4.2b and c were well accepted by the respective target group.
- Feedback of PING-button users was very positive regarding the handling and procedure of the PING-ing.
- Students which took part in the FAPS workshop about road safety enjoyed the interactive and content-related concept. Most of the pupils stated to have gained knowledge about the road safety topic.
- The school's principal also gave positive feedback about the FAPS workshop concept. here were some recommendations named as well but all in all the satisfaction rate is still high.

Long term impact

- Long term impacts are given by the implementation of the new traffic flow concept in the southern part of the Living Lab, including comprehensive safety aspects based on the extensive accident inventory work done in sub-measure MUC 4.2.a). This measure has substantially changed traffic flows, risk hotspots, traffic speeds and most probable also the accident development in this part.

RUS 4.3 Providing Secure Pedestrian Crosswalks

Abstract

This measure deals with the infrastructure for pedestrians in the Ruse peripheral district Druzhba. It analysed the existing crosswalks and constructed new ones secured with LEDs (Light Emitting Diode), raised paths, etc. Additionally, cameras for video surveillance will be installed at junctions in the district.

The existing pedestrian crossings in Druzhba are not secure enough and present a high risk for accidents, leading to injuries and fatalities. Most people with disabilities and elderly people do not walk on the streets or travel by PT around the city due to the lack of convenient infrastructure.

So far, the key challenge for the implementation of this measure was to identify the most suitable locations for the new pedestrian crossings and to obtain the acceptance of the community for this. This has been achieved by carrying out an exhaustive analysis of the pedestrian infrastructure in Druzhba district and of the citizens' behaviour – their walking habits, preferred paths of movement around the district, points of interest, etc. Additionally, there were discussions with citizens in different formats – information events, round tables, interviews, questionnaires, social media, etc.

The measure contributed to the achievement of the ambitious goals of the project – to reduce the number of road accidents involving pedestrians and to make walking a safer and more desirable way of moving in the district and in Ruse. The safe infrastructure for pedestrians, including people with disabilities will further increase the share of walking in the modal split in Druzhba, reduce the number of accidents with pedestrians and strengthen the use of public transport by disadvantaged groups living in the district.

The crosswalks' measure turns out to be a success and could be easily up-scaled because the municipality already owns its design and the necessary technical specifications. The Ruse decision-makers have plans to introduce it into the set of SUMP measures thus constructing such crosswalks in other parts of Druzhba and Ruse.

Conclusions

Validated direct impact

This measure contributed to the achievement of the planned results despite of the late implementation due to political and technical reasons in the municipality. Walking increased by 5% from the original value measured before the implementation. The number of road accidents decreased with 23%.

The measure achieved 95% of satisfaction, 95% of acceptance and 100% of the citizens are aware about it and are using it actually.

Main lessons learned

The pilot crosswalks are only the first step to the transformation of the existing depreciated crosswalks into safe facilities allowing the enlargement of the share of walking and cycling in the modal split of Druzhba / Ruse. This measure is included in the Ruse SUMP and should be replicated all over the city.

Long term impact

- better safety for pedestrians and cyclists
- reducing the number of car users

RUS 4.4 Safe Sidewalks with cycling facilities in the peripheral district

Abstract

In this measure, a construction of safe sidewalks with cycling facilities towards the city centre was planned because the poor state of the existing pavements and cycling lanes in Druzhba district generated a high risk of road accidents involving pedestrians and cyclists. The footpaths on both sides of the main roads, connecting Druzhba with the central areas of the city, were either incomplete or in a very bad state of disrepair, and were unsafe for walking or cycling.

After a research of good practice and innovative solutions on design of safe pavements (shared with cyclists), the project team decided to implement the measure in the central part of Druzhba. Pavements were constructed along parts of the main roads only, as this was a pilot case. The design of the safe sidewalks envisaged the introduction of tactile paving between the walking paths and the cycling lanes of the sidewalks so that conflicts between pedestrians (including blind people) and cyclists were prevented.

The total length of the sidewalks that were designed under ECCENTRIC and were planned to be constructed in Druzhba was of 1500 m. The first segment of 300 m was constructed in the frames of the CIVITAS ECCENTRIC project. The three remaining segments will be constructed in the frames of the Ruse SUMP.

The measure contributed to the achievement of the ambitious goals of the project – to reduce the number of road accidents involving pedestrians and cyclists and to make walking and cycling a safer and more desirable way of moving in Druzhba. The sidewalks turn out to be a success and could be easily up-scaled because the municipality already owns its design and the necessary technical specifications. The Ruse decision-makers have plans to introduce it into the set of SUMP measures thus constructing such sidewalks in other parts of Ruse.

Conclusions

Validated direct impact

This measure contributed to the achievement of the planned results despite of the late implementation due to political and technical reasons in the municipality. Walking increased by 5% from the original value measured before the implementation. The number of road accidents decreased with 23%.

The measure achieved 95% of satisfaction, 95% of acceptance and 100% of the citizens are aware about it and are using it actually.

Main lessons learned

The pilot segment of the designed safe sidewalks in Druzhba is only the first step to the transformation of the existing depreciated pedestrian infrastructure into safe facilities allowing the enlargement of the share of walking and cycling in the modal split of Druzhba / Ruse. This measure is included in the Ruse SUMP and should be replicated all over the city.

Long term impact

- Better safety for pedestrians and cyclists
- Increase the share of walking/cycling in the modal split

STO 4.5 Policy for rerouting cyclists during construction work

Abstract

Stockholm has a goal that it should have functional infrastructure for traveling that makes it easy and natural to live environmentally friendly. In particular, it aims to encourage a safer road environment for cyclists, making cycling a more attractive option for all types of trips. This measure focuses on the design and implementation of temporary traffic management measures at construction sites to facilitate the safe and efficient flow of bicycle traffic. In particular, new types of barriers and traffic control devices for construction work that have cyclists in focus were tested. These materials were assumed to create an enhanced degree of safety and a more continuous travel path for cyclists.

This measure STO 4.5 develops and tests new potential standards for channeling bicyclists along construction sites in the City of Stockholm, through the use of alternate barrier materials that create a more rigid barrier between cyclists and motorized traffic, as well as between the construction site and the cycling path. The measure also contributed to a revision of the city standards for construction site traffic management that paid additional attention to the situation of vulnerable road users.

In the measurement of the impact, we compared the new standards for channeling bicyclists with the traditional channelization using the roadside survey method. The measure saw a reduction in bicycling traffic volumes, but far less than normal for a construction site, and a survey indicated that the approach was very favorable among cyclists. 85% of cyclists preferred the redesigned bicycle channelization and satisfaction rate improved.

In addition, as part of the measure, new guidelines were developed for both the overall design and for the choice of barriers for bicycle diversions around the construction site, and the recommendations in these guidelines were tested in a pilot study.

Conclusions

Validated direct impact

The pilot had the following validated impacts:

- Acceptance was high. Though it was not as high as acceptance for a test of traditional channelization, the question formulations were dissimilar enough that the difference could easily be explained by this.
- Average satisfaction was high, well above the earlier trial with traditional channelization.
- System usage, while diminished during the trial, maintained a much higher relative level than comparable worksites and bicycle diversion measures.
- No conclusions could be drawn on awareness due to lack of appropriate data collection, nor on incidents, with an absence of observed incidents during the baseline and trial periods.
- Costs were higher for the pilot than for traditional measures, and could be significantly higher if the diversion were in place for a lengthy time period.

Main lessons learned

Two main lessons have been recognized:

- The early pilots tested the bike lane channelization materials on a street with no active construction site. This caused a high level of frustration among surveyed cyclists, as the diversion was seen as unnecessary, and this had obvious impacts on the level of acceptance and satisfaction. Hence it is worthwhile to conduct pilots in conjunction with real worksites.
- Even with an improved channelization, many cyclists will still prefer to divert to the general-purpose traffic lanes, rather than using the diverted bicycle lanes.

Long term impact

The results of these pilots will inform the City's regulations and guidance for future construction sites, particularly once the traffic standards are formally amended to take them into account. These impacts will be city-wide and felt as often as construction sites are installed.

MAD 4.6 Pedestrian friendly public space outside the city center

Abstract

This measure has provided a vision for a future district-wide pedestrian network, and has implemented different pedestrian-friendly actions in the living lab, including the tactical action to improve the access to the University Campus with a temporary solution that will be consolidated in the future. Besides, this measure has delivered the detailed design of some ambitious actions that could not reach implementation during the project lifetime (pedestrian access to a hospital and an e-mobility station in a main nodal mode in *Sierra de Guadalupe*).

The final actions actually implemented within this measure included some sections within a future high-quality north-south pedestrian corridor (*Miradores Itinerary*), some improvements in the surroundings of the future e-mobility station and some improvements in the pedestrian core of Puente de Vallecas District (*Peña Gorbea Boulevard*). A pilot communication and awareness campaign on pedestrian mobility enhancement, highlighting the pedestrians' rights introduced by the new Municipal Ordinance in Madrid, was tested in the two CIVITAS ECCENTRIC areas of the living lab. The first urban signalisation pilot, focused on pedestrians and cyclists has been implemented in the area of the future e-mobility station.

Overall, the measure has been successful: the number of walking trips in the vicinity of the streets included in the measure has increased substantially (more than 9,000), far beyond the 1,000 target. The pedestrians' perception of the street conditions (which include safety as a key trait) has notably improved for 30% of them, which can be taken as a reasonable proxy to the consideration that safety perception among pedestrians has also improved. Finally, the reduction of CO₂ and other emissions can be considered as substantial, as it is equivalent to removing 100 cars from traffic in the area. It is however worth noticing that almost 8 of every 10 trips gained by walking are coming from public transport and only 2 from private cars.

The measure design and implementation stages showed the difficulties to introduce consistent participatory approaches when implementing innovative measures, particularly in the context of research and demonstration projects with tight schedules. To honour public participation commitments, demonstration projects may need to establish formalised participation plans at the beginning of the measure design identifying the local stakeholders to mobilize and the participation and decision-making procedures to be applied. In this case, the channelling of participation through an individual on-line consultation platform opened to all (www.participamadrid.org) has proved not to be appropriate for a quick and fair appraisal of the measure actions. Another lesson learned is that local bureaucracies can put demonstrations at risk, even in the most committed cities. Cities undertaking demonstrations would benefit of establishing special approval and budgeting procedures for these actions.

The measure results suggest that pedestrian-friendly actions are likely to significantly increase the number of walking trips, but only a small fraction of them is likely to come from former car users. When cities are trying to curb car use, they should probably introduce additional measures, such as specific car restrictions, besides promoting sustainable modes. This should be also considered by policy-makers when establishing climate change mitigation policies, as pedestrian-friendly measures, in the absence of car restrictions, are unlikely to provide significant emission savings.

Conclusions

Validated direct impact

- The measure was successful in increasing the number of walking trips beyond the initial project expectations, as an effect of the improvement of walking conditions in certain streets.
- Modal change to walking was mainly due to former public transport users: 83% of the new walking trips were formerly travelled by public transport.
- For sure, CO₂ and emission savings should be taken into consideration, but they cannot provide the main justification for action: Although relevant (equivalent to taking 100 cars off the streets), CO₂ savings in this measure were limited to less than 400 tons per year (or less than €10,000 at current CO₂ market prices), a figure largely insufficient to justify on its own the investments needed for physical changes in the streets on their own. Pedestrian-friendly policies can primarily be justified on the grounds of their wide public support, and the health and social benefits it provides, as confirmed by the users that participated in the survey.

Main lessons learned

- It is difficult to introduce consistent participatory approaches when implementing innovative measures, particularly in the context of research and demonstration projects with tight schedules. To honour public participation commitments, demonstration

projects may need to establish formalised participation plans at the beginning of the measure design identifying the local stakeholders to mobilize and the participation and decision-making procedures to be applied.

- Local bureaucracies can put demonstrations at risk, even in the most committed cities. Cities undertaking demonstrations would benefit of establishing special approval and budgeting procedures for these actions.
- Pedestrian-friendly actions are likely to significantly increase the number of walking trips, but only a small fraction of them is likely to come from former car users. When cities are trying to curb car use, they should probably introduce additional measures, such as specific car restrictions, besides promoting sustainable modes.
- This should be also considered by policy-makers when establishing climate change mitigation policies, as pedestrian-friendly measures, in the absence of car restrictions, are unlikely to provide significant emission savings.

Long term impact

Considering the good results achieved in terms of modal change, it can be expected that the pedestrian use of the streets included in the measure will continue growing, with potential spill-over effects to other areas in the city lab.

MAD 4.7 Enabling cycling outside the city center

Abstract

This measure has implemented different cycling-friendly actions in the living lab. Besides providing a vision for a future district-wide cycling network, it designed and implemented shared lanes for bikes and general traffic (*ciclocarriles*) along key north-south and east-west sections within the living lab. The design of mass-storage bike parking facility within the future e-mobility station in *Sierra de Guadalupe*, in cooperation with measure MAD 4.6 was not implemented.

Overall, the measure was successful in meeting or getting close to its initial targets: the number of new cycling trips in the living lab is estimated to have grown by 849 additional trips per day, not far from the 1,000 trip target. It can be stated that the bikers' perception of the street conditions (which include safety as a key trait for bikers) has notably improved for 15.8% of them, which can be taken as a reasonable proxy to the consideration that safety perception among cyclists has improved. Finally, the reduction of CO₂ (and other) emissions has been close to the target: 35.2 tons/year instead of 50 tons/year; this modest attainment in terms of emissions is consistent with the fact that only 8.5% of the trips changing mode to cycling are coming from private cars, and 47.1% from much less polluting public transport.

The measure design and implementation stages showed the difficulties to introduce consistent participatory approaches when implementing innovative measures, particularly in the context of research and demonstration projects with tight schedules. In the case of this cycling measure the participatory approach was particularly difficult due to the low share of cycling in the living lab and in the whole of Madrid. To honour public participation commitments, demonstration projects may need to establish formalised participation plans at the beginning of the measure design identifying the local stakeholders to mobilize and the participation and

decision-making procedures to be applied. Another lesson from this demonstration is that cycling actions need to be identified and implemented within duly formalised network concepts at the city and district levels. Without such formalisation, municipal technical services can risk to implement suboptimal actions without real impact in terms of attracting new bikers.

It is worth highlighting that only a small fraction of the cycling trips replaces car trips. When cities are trying to curb car use, they should introduce restriction measures, besides promoting sustainable modes: cycling-friendly measures provide modest CO2 emission savings, and, to be effective, mitigation actions require the introduction of bold car restrictions.

Conclusions

Validated direct impact

- The measure was reasonably successful in increasing the number of cycling trips almost reaching the initial project expectations, as an effect of the provision of shared lanes for cycling and general traffic (*ciclocarriles*) on certain streets.
- Modal change to cycling was mainly due to trips formerly done by pedestrians (54.8% of trips changing mode) and public transport users (36.6% of trips changing mode); only 8.5% of the cycling trips changing mode correspond to former car users.
- For sure, CO2 and emission savings should be taken into consideration, but they cannot provide the main justification for cycling action. Although the measure almost achieved the expected CO2 emission reduction target, its impact can hardly be considered as relevant: CO2 savings in this measure were limited to 35 tons per year (or less than €900 at current CO2 market prices), a figure largely insufficient to justify on its own the investments needed for physical changes in the streets on their own. Cycling-friendly policies can primarily be justified on the grounds of the health and social benefits it provides, and their potential for a more substantial modal change in the long-term, as confirmed by the users that participated in the survey, but not as a way to obtain short-term emission reductions, for which car restriction policies seem unavoidable.

Main lessons learned

- It is difficult to introduce consistent participatory approaches when implementing innovative measures, particularly in the context of research and demonstration projects with tight schedules. In the case of this cycling measure the participatory approach was particularly difficult due to the low share of cycling in the living lab and in the whole of Madrid. To honour public participation commitments, demonstration projects may need to establish formalised participation plans at the beginning of the measure design identifying the local stakeholders to mobilize and the participation and decision-making procedures to be applied.
- Cycling actions need to be identified and implemented within duly formalised network concepts at the city and district levels. Without such formalisation, municipal technical services can risk to implement suboptimal actions without real impact in terms of attracting new bikers.
- Only a small fraction of the cycling trips replaces car trips. When cities are trying to curb car use, they should introduce restriction measures, besides promoting sustainable modes.
- Cycling-friendly measures provide modest CO2 emission savings, which require the introduction of car restrictions.

Long term impact

The modest results achieved in terms of modal change are consistent with the initial project expectations and confirm that the promotion of cycling is a long-term objective requiring perseverance from the municipality and a consistent planning framework. This has been the approach in Madrid since the approval of the 2008 Cycling Master Plan, and it can be expected that the number of cyclists on the streets will continue growing, as the cyclist network continues being expanded.

TUR 4.8 Easy, Safe and Comfortable Cycling and Walking Round the Year

Abstract

During the winter months, cycling in Turku drops significantly. It only reaches about 20-25% of the cycling levels of the summer months. Increasing winter cycling rates through better maintenance of cycling routes and paths, combined with information campaigns, offered a good potential for improving the modal split. The objective of measure TUR 4.8. was thereby to increase the year-round traffic flows of cycling and walking by making the current infrastructure easier, safer and more comfortable to use. Especially the winter provided great potential for increasing cycling. Therefore, a study on available winter maintenance methods was to be performed. After the study, the winter method that showed the greatest potential, sweep salting, was to be piloted with a contract of 2+2 years. Feedback on the route was to be gathered meticulously and a cycling barometer performed to Turku residents twice during the project.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 4.8. was measured. Data was derived from the cycling barometer survey, the regional mobility barometer, secondary city statistics on insurance claims, secondary statistics from Statistics Finland, traffic calculators, city feedback channels, policy documents and the Measure Leader.

Overall, the measure achieved its objectives. A thorough review was made potential winter maintenance methods and a cycling barometer was performed twice to review the attitudes of the residents of Turku regarding the promotion of cycling the quality of cycling in Turku, providing valuable information for measure realization. The winter cycling maintenance pilot was implemented successfully and was in its third year of operation at the time of writing. A 39% increase in winter cyclist numbers was observed at the measurement point in central Turku. Although without further calculations strong conclusions on a permanent rise in winter cyclist numbers cannot be verified, the maintenance pilot was clearly well received and preliminary results on its potential impacts on wintertime modal shift are promising. The increased numbers of cyclists and walkers on the route also suggest that at least the perceived safety of the route is high, although due to lack of conclusive data no direct impact could be observed on incident or accident rates along the pilot route during the first two winters. The measure has also had a significant impact on cycling policy development in the city.

Conclusions

Validated direct impact

- A thorough review was made potential winter maintenance methods.
- A cycling barometer was performed twice to review the attitudes of the residents of Turku regarding the promotion of cycling the quality of cycling in Turku, providing valuable information for measure realization.
- The winter cycling maintenance pilot was implemented successfully and is now in its third year of operation.
- The pilot was well received by system users.
- System usage grew 39% on the route.
- The measure has had a significant impact on cycling policy development in the city.

Main lessons learned

- As the project defined a tight schedule for pilot realization, proper planning was essential for keeping with schedule. It was also vital that all the relevant parties within the city departments were involved already in the planning stage of the measure.
- Reviewing the citizens' attitudes regarding the promotion of cycling and views on the quality of cycling in Turku served as a highly useful starting point for development actions in the measure.
- Combining an external process with the established processes of a city organisation could sometimes be challenging. In similar endeavours, added attention needs to be placed on a clear division of roles and responsibilities and, most importantly, on proper communication between different parties, e.g. the maintenance contractor and project staff.
- The maintenance method chosen was demanding in terms of e.g. drying, other traffic on the route and surface materials. The fact that the route ran its course in the city centre (and not in a quieter area, an approach chosen by many cities piloting alternative maintenance methods) where there are plenty of external interfering factors for the maintenance made the process even more challenging. Placing the pilot route on streets where cycling and walking levels are high thus created an added need for supervision of the demonstration, allowing for quick reactions to any challenges encountered.
- Tendering for the pilot was made in a manner differing from traditional street maintenance tenders in Turku. As a maintenance method, sweep salting is rather varied and demanding, making it necessary to consider various aspects differing from usual maintenance methods in the tender. Preparation of the tendering thereby needs to be done thoroughly to allow for enough detail but at the same time leave room for improvement during the pilot period.
- Running a pilot applying a novel method such as sweep salting needs to be accompanied by both effective communicative measures and active gathering of feedback. Information on the prioritized cycling route was communicated to the public widely (both online information, media coverage and concrete signs on the route) along with the importance of giving feedback on user experiences via the city's official online feedback channel. The potential effect of the salt on the bicycle chains was one example of the issues that needed to be communicated to the public effectively. Active feedback also allowed for adjustments to be made on the method during the pilot.

Long term impact

Prioritized winter maintenance will continue in Turku at least for the optional two winters (2019/2020 and 2020/2021). Whether there will be continuance after this, with sweep salting or some other method, remains to be seen. The measure has, in any case, provided a valuable learning opportunity for improved winter maintenance in the varying Turku winters. As proved by the fact that winter cyclist numbers have increased along the route, based on data from the measuring points, it can safely be stated that the route has at least had an effect on winter cyclists' choice of route. Whether improved winter maintenance translates into actual changes in transport modes remains to be seen and needs more data collection to be verified. Also the impact on safety along the route and subsequent influence on decreased number of incidents/accidents is difficult to prove with the data available. The increased numbers of cyclists and walkers on the route suggest, however, that at least the perceived safety of the route is high. This was also reported by both the expert feedback group of avid cyclists and the general public.

In the end, in order to really have an impact on city-wide cycling numbers in the longer term, the maintenance route needs to be expanded.

STO 4.9 Offering test fleets of e-bikes and e-freight bikes

Abstract

The City of Stockholm aims to decrease transport emissions and free up road space by increasing the acceptance of e-bikes and e-cargo bikes as an alternative to private motor vehicles. These are despite the increasing sales, still infrequent in Stockholm.

This measure STO 4.9 offered companies and residents in the two neighbourhoods of the Living Lab in Stockholm the opportunity to test one of 25 pedelec e-bikes and e-freight bikes during a three-week period in order to find out whether, and to what extent, these vehicles provide a viable mobility option. This was with the obligation to complete a series of surveys and allow the bike's odometer to be used for evaluation. Evaluation was measuring acceptance, satisfaction, usage of the system, as well as the investment and operational costs.

The bikes were heavily used by participants, although this is more likely due to self-selection than due to the bicycles' electric assist. Comparing the statistics from the national household travel survey with the computed the average kilometres travelled, there was 126 km increase in the sum of all kilometres travelled by the e-bikes over a period of three weeks. Based on the results of the survey, conducted with the users we found that the acceptance was very high (11%, 10 point growth), and while only a minority chose to purchase an e-bike at the end, this minority was significantly greater than the population-level interest in purchasing e-bikes.

Conclusions

Validated direct impact

- The main impact is that the personal use of e-bikes in daily activity leads to a very positive impression of e-bikes.
- There are some indications that this leads to increased interest in purchasing one's own e-bike, but the findings here are not conclusive.

Main lessons learned

Some of the key lessons were:

- It was much more laborious than expected, with extensive consumer contact and sometimes difficult customers, despite the fact that they were benefiting from the free use of an electric bicycle for several weeks.
- This was particularly difficult for the lead partner, Cykelkonsulterna, who is not really a reseller, to manage selling directly to customers. The administrative tasks took much more time than expected.

Long term impact

The long-term impact will result from the overall growth in e-bicycling in Stockholm, and not specifically from this demonstration, being at such a small scale as it was.

WORK PACKAGE 5: EFFICIENT AND CLEAN PUBLIC TRANSPORT SOLUTIONS

MAD 5.1 High-level PT service corridors in peripheral districts

Abstract

This measure was expected to provide a first step towards the implementation of corridors served by Buses with High Level of Service (BHLS) in Madrid. It should implement and operate a pilot construction project covering a 3.6-km section connecting the living lab with the districts of Moratalaz, San Blas-Canillejas and Ciudad Lineal, in the northeast periphery of Madrid. It was also expected to explore different options for segregation (physical/flexible/virtual), priority (using IT tools) and enforcement (IT tools/video cameras). The construction project was finished and delivered by the consultants in September 2018. It provided a complete redesign of the cross section of the corridor, including reserved bus lanes and bike lanes, and re-arranging on-street parking. However, the pilot section did not receive the financial resources from the city council to be built. Accordingly, the scope of the final demonstration stage of this measure changed. The ECCENTRIC measure team decided to dedicate the resources initially budgeted for the implementation stage to a detailed analysis of the corridor, including the users' and residents' practices and priorities; this detailed analysis provided a better understanding of the lack of priority given by the local decision makers to the implementation of the priority corridor, and served to identify some lessons for better considering these issues at the initial stages of project design of such corridors. The study was completed in December 2019 and is being reformulated in the post-COVID framework in spring 2020.

Three main deviations from the original plan occurred during the design and implementation stages. The first and more relevant one was the decision of the municipality to not undertake the construction works for the pilot section. The second one was the decision to move the pilot section from the original location within the living lab to its current one, located mostly in the neighbouring district of Moratalaz. The third one referred to the lack of inclusion of some innovative components (for segregation and control of the bus lanes with ICT-related technologies) in the measure.

As the infrastructure has not been constructed and operated, the measure's objectives have not been achieved. However, it is still possible to take into consideration the new evidence provided by the survey completed in September 2019 and the technical study delivered by CRTM in December 2019; this information allowed to reasonably assess the measure's potential. The potential for modal shift from car use is estimated to be below the 4% measure objective. This is due to the low time savings achieved by the buses, and the lack of restrictive measures to car use (such as reduction in the number of general traffic lanes or in the number of parking places in the corridor). Bus commercial speed could increase substantially during the peak hours, reaching a maximum value of 14.0 to 14.5 km/h depending of the trip direction; the relatively high number of bus stops in the 3.6 km section prevents to attain higher values. Public transport users' satisfaction would be likely to increase in a moderate way in case the project was built. The potential for emission reduction is low, compared to the investment mobilised, due to the modest number of trips changing from private car to buses.

Conclusions

Validated direct impact

- The measure could not reach the demonstration stage and the expected direct impacts could not be verified. However, the information collected allowed to reasonably assess the measure's potential.
- The potential for modal shift from car use is estimated to be low, below 4%. This is due to the low time savings achieved by the buses, and the lack of restrictive measures to car use (such as reduction in the number of general traffic lanes or in the number of parking places in the corridor). The low time savings achieved are due to the relatively short distances driven on the corridor by the different bus lines (2 km at most of the 3.6-km long infrastructure) and the virtual lack of demand for trips that would make use of the whole north-south connection that could be provided by a new bus line.
- Commercial speed is estimated to increase substantially during the peak hours, reaching a maximum value of 14.0 to 14.5 km/h depending of the trip direction. The relatively high number of bus stops in the 3.6 km section prevents to attain higher commercial speeds.
- Public transport users' satisfaction would be likely to increase in a moderate way in case the project was built.
- The potential for emission reduction is low, compared to the investment mobilised, due to the modest number of trips changing from private car to buses.
- The estimated investment cost for the construction of the corridor is €4.25 million. Operational costs were not expected to change significantly, as the speed increase is not too significant and the additional demand does not require to introduce additional buses.

Main lessons learned

The following lessons can be highlighted:

- The actual implementation of innovative measures requiring physical interventions in the public space with significant public investment require to build up in advance strong support among decision makers and potential beneficiaries.
- Such support seems more difficult to build up in the case of tangential corridors, like this one, in which in contrast with traditional radial corridors, there is a lack of a clear image and most users only travel on a short section of it.
- Tangential corridors also seem to offer less potential for modal change from private cars. Accordingly, the emissions saved by the implementation of such corridors are not significant, and cannot justify on their own the substantial resources required.
- Car restrictions on the corridor are likely to significantly improve the performance of such measures: on the one hand, encouraging more car users to look for sustainable mobility alternatives; on the other hand, by reducing the road space required in the corridor, and the investment resources to be mobilised.

Long term impact

There are no concrete plans to implement this corridor or to revise the construction project developed by ECCENTRIC. However, it can be expected that the results of this measure will influence the approach of CRTM and EMT towards the design and implementation of bus corridors following the completion of the local advance of SUMP revision in 2020.

STO 5.2 Speed up core bus routes

Abstract

Stockholm is a growing city and in spite of a high public transport modal split of almost 80 % during the extreme peak, more people need to change to public transport to prevent rising congestion. To increase the speed and attractiveness of public transport, this measure tests the effectiveness of physical modifications to the roadway geometry, with a focus on corridors where fully segregated bus lanes are not feasible. The measure worked with two of the core buses in the outer urban area, focusing on increasing the speed and attractiveness of public transport, in terms of improved regularity, prioritisation of buses, reduced travel and dwell time etc.

In particular, geometric improvements were made along two trunk bus lines through the northern suburban districts of the City of Stockholm. Improvements included, for example, adding lengths of bus-only lanes, relocating and lengthening bus stop areas, and improving curbs for boarding and alighting. In the evaluation, we measured the following indicators: speed, regularity, dwell time, accuracy, and the investment costs for both bus lines. Monitoring made use of data collection systems already in place, namely the driving time data that is continuously collected for all bus routes, and the boarding count data collected on a rotating sample of buses; both data sources are reported to databases maintained by the Stockholm Region Public Transport Authority (SL).

Some of the results indicated a positive result, while others were ambiguous. Regularity in bus travel times improved on both study lines, by 5.7 and 4.1 percentage-points, respectively. Accuracy of timekeeping, measured on the one bus line where a comparison could be drawn, also improved, by 3.5 percentage-points. However, dwell times only decreased on one of the lines, by 0.4 seconds per passenger, while the other line saw no appreciable change. Moreover, overall commercial speed did not show any significant improvement, which we attribute to high variation in speeds by causes external to this experiment.

The main improvement was therefore the reliability of bus operations on these lines and the efficiency of boarding and alighting, but that when seen in the context of overall commercial speeds, these improvements are not noticeable. Having said that, travel time reliability has been shown to have outsized roles in passenger travel satisfaction, and shorter dwell time is a critical contributor to reliability, so these are encouraging results for improving passenger experiences.

Conclusions

Validated direct impact

The street modifications had several confirmed effects on bus route performance:

- Bus route regularity improved on both routes and accuracy of time-keeping improved on the one route for which a comparison could be drawn. These results indicate there were fewer disturbances to bus circulation along the routes.
- Dwell times improved on both routes, suggesting more efficient boarding and alighting.

Main lessons learned

- The project benefited from the use of a joint action plan, a joint working group of stakeholder representatives, and a joint steering group comprising stakeholder decision-makers, who could resolve questions where the joint action group could not agree.
- The bus lines in question operate partially outside the City of Stockholm in neighbouring municipalities, as well as on roads where the National Transport Authority is responsible. We learned that in order to succeed, all parties with some responsibility for either physical or regulatory aspects need to be represented in the working group, as well as contribute staff resources to participating.
- Police should also be involved and allocate resources to enforce new restrictions, to ensure the measures have their desired effects.
- In this case the neighbouring municipalities participated in problem scoping but not in implementation. This meant that measures were only deployed on partial routes, and we suspect that gains along the improved measures may have been undermined by the lack of similar measures elsewhere.
- Some of the potential gains for buses might have been undermined by increases in congestion for general traffic, which could have had detrimental effects for buses upstream and downstream of the measures. Also, a significant portion of drivers ignored the bus-only restrictions, undermining effectiveness.
- Some of the measures implemented were rather minor, and our data collection was not able to detect improvements in circulation attributable to these. However, these could still be motivated by other concerns such as improved comfort for passengers (and drivers) or simplifying boarding and alighting. Improvements' symbolic value should also be recognised.

Long term impact

The corridor improvements will continue to have some effect, but these are likely to be rather overshadowed by other, larger-scale changes in the road network.

RUS 5.4 Introduction of a night line to Druzhba (after 21 h) with GNC buses

Abstract

This measure was planned for the first time in Ruse in order to provide demand-oriented, fast, regular and reliable public transport service during the night for the Druzhba citizens. For this purpose, a new PT line named 'Good night' was established in the frames of the CIVITAS ECCENTRIC project connecting the peripheral district with the city centre.

The main challenges faced while developing and implementing this measure so far have been to find the best solution for the vehicles to be used for operating the new line, and to identify an appropriate solution to award the operation of the service. As the municipality didn't have enough resources for purchasing e-vehicles during the project lifetime, it was decided to use

the existing trolleybuses. This decision has solved the problem with the operator – the service was assigned to the municipal trolleybus company.

Before launching the new service, a huge research took place aiming at establishing the most convenient itinerary of the new line served by a trolleybus. The route is from Druzhba district to Central Railway Station with 14 stops and passes through the main streets and boulevards connecting the peripheral area with the central part of Ruse.

A large promotional campaign was launched for informing citizens about this initiative and inviting them to use it with the aim to decrease the use of cars and taxis for moving during the night. On 10th of May 2019 the ‘Good Night’ line was launched and started operating.

The measure strongly contributed to the social inclusion and livability in Druzhba. 90% of the citizens accept it and estimate that it will improve their living conditions. 90% are satisfied with the “Good night” line because it gives them possibilities to move in the night and to have access to the Ruse evening attractions thus decreasing the social inequality and improving the quality of life in the peripheral district.

Conclusions

Validated direct impact

The night line runs only for 9 months which is a very small period of operation, but already has some positive local impact.

Main lessons learned

Although the number of passengers increased 5 times since the beginning of the service, their total number is small and is not sufficient to support the service after the end of the project.

Long term impact

- Reduction of cars flow in the night
- Social inclusion of disadvantaged groups

TUR 5.5 Bike-sharing and Car-sharing schemes

Abstract

Bike share schemes offering affordable short-term rentals on a predefined geographical area have sprung up in many cities during the recent years. In Finland, Helsinki was the first city to implement a bike share system in 2016 and Turku followed with the system implemented in measure TUR 5.5. The system was to complement Turku’s public transport services and to be integrated to the public transport Föli’s IT-platform, providing a quick and easy way of getting around the city centre.

The bikes are available all year round and in the wintertime they are equipped with winter tyres. The bike share system consists of bikes for public use and bike stations that serve as pick-up and drop-off points. The user could pick up and drop off a bike at any station. The station network expands from the Kupittaa laboratory area along the city centre up to the port of Turku. In addition to bike share system implementation, the measure aims to encourage and enable car sharing systems to be offered in Turku.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data is gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 5.5. was measured. Data for the evaluation was derived from surveys, system usage logs, GPS logs, secondary sources from the city of Turku, policy documents and from the Measure Leader.

On the face of it, the measure achieved half of its main goals. The bike share system of 300 bikes and 37 stations is now in place. Car sharing companies are now offering their services in Turku, to be attributed to CIVITAS ECCENTRIC effect to a great extent. However, the city bikes have not become as attractive as was hoped and it remains inconclusive whether the system implementation has led to a growth in public transport.

Mitigating factors and negative interference, both internal and external, have been recognized that could explain the lower system usage at least to some extent. Problems prevailing with the technical realization of the user interface, for example, are likely to have caused loss of users. Despite lower system usage than expected, the measure has however reached its main goals somewhat satisfactorily and, importantly, served as a valuable learning process for implementing a novel system with some unique characteristics.

Conclusions

Validated direct impact

- The bike sharing system is in place and running.
- Car sharing companies have tested their services in Turku: there are several operators offering these services e.g. at an apartment complex and at organisations in the laboratory area.
- Despite lower usage rates than expected, system satisfaction is rather high.

Main lessons learned

The main lessons learned from the measure are summarized below:

- Setting up a bike sharing system is a huge undertaking that needs to be properly resourced both in terms of personnel, time and money. At least a minimum of 1.5 years should be reserved to a similar effort.
- Proper testing of the system is crucial in order to avoid (technical) problems in the first months of system launch.
- It was unfortunate but necessary due to the massive amount of resources needed for implementation of the bike share that car sharing received less attention in this measure. In retrospect, it could be concluded that it would have been wiser to focus just on the bike share in this measure.
- It should be properly acknowledged that there are risks entailed in launching a system with some unique characteristics and that dealing with this risk needs some financial leeway and trust in the project manager. In the Turku case, the bike share is a year-round system – the first of its kind – which even increases the risk as it creates an extra layer of issues to consider. Also, integration of the system to the PT ticketing system was something that has not been done everywhere and was not without its problems – however it was necessary to enable concurrent MaaS development.

- It is a must to have the bike share system as an all-year system as this gives a strong impulse for users on the potentiality of biking.
- It is advisable to carry out studies in regards to the measures. The bike share system has resulted in two Master studies: one on the tendering process and a second one on the enlargement potentiality.

Long term impact

The long-term impact of the measure remains to be seen. In order to be able to properly affect the choice of travel mode, the station network needs to be widened and some system elements altered. According to the ML, there are undergoing discussions on the future of the system and there is a preliminary decision not to continue with the current bike share system provider but to put out the tender again, with a set maximum budget per year. The measure has, in any case, served as a valuable model for other cities in their efforts to set up a bike sharing system (e.g. Tartu in Estonia, Joensuu, Kuopio and Tampere in Finland).

TUR 5.7 Introduction of Electrical Public Transport

Abstract

In measure TUR 5.7, new electric buses were introduced in the PT fleet of the city of Turku. The goal of the measure was to have six electric buses operating on bus line no. 1 between the Turku airport and the ferry terminal, becoming the first Finnish city to use electric vehicles on an entire line of public transport. The main actions to be taken were to be piloting the first electric bus line, planning for extension of electric bus lines, development of charging solutions, analyses of the use as well as marketing and communication, including campaigns. As a result of the measure, the noise level of bus traffic was expected to decline on the route operated with e-buses. Customer satisfaction was expected to increase on line 1 due to more comfortable rides and better service quality. Driver satisfaction was to increase due to a more comfortable driving environment (less vibration, lower noise level). The cost efficiency of bus traffic was to increase due to lower operation costs (energy + maintenance).

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation if the bus line were driven with regular diesel-fueled buses, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 5.7. was measured. Data for evaluation was derived from the concurrent research project eFöli and from surveys carried out by the regional PT office.

As a result of the measure, six electric buses were on traffic, partly funded by ECCENTRIC. Bus line no. 1 was almost fully electrified, with the e-buses covering 88.9% of the service needs on that route. Customer satisfaction was rather high for the line, slightly higher than average PT satisfaction in Turku. During the first operative years, the reliability of the system, however, failed to reach a satisfactory level. Due to various interruptions in the service, the e-buses were constantly supplemented by diesel buses. Overall reliability still needs to improve greatly. Also, in terms of realized driving output, the vehicles were yet to reach their planned yearly goals.

Turku winter conditions also presented some challenges for the operation, which was to be expected. The expected long-term impacts of the measure relate to improved knowledge on PT electrification gained throughout the project and the integration of these learnings on policy level. The measure particularly contributed to proving that PT electrification can be a viable option of organizing public transport towards carbon neutrality.

Conclusions

Validated direct impact

- 6 electric buses are on traffic, partly funded by ECCENTRIC.
- Bus line no. 1 is almost fully electrified, with the e-buses covering 88.9% of the service needs on that route.
- Customer satisfaction is rather high for the line, slightly higher than average PT satisfaction in Turku.

Main lessons learned

The main lessons learned are summarized by Aho in the eFöli publication “Procurement and commissioning of electric buses in Turku” (2019).

- In measures that involve new technology, delays and setbacks are naturally to be expected. During the first operative years, the reliability of the system has, however, failed to reach a satisfactory level. Due to various interruptions in the service, the e-buses have been constantly supplemented by diesel buses. Overall reliability still needs to improve greatly.
- In terms of realized driving output, the vehicles are yet to reach their planned yearly goals. In general, however, the output increased per each vehicle during the first years of operation. There are still recurring reasons why the traffic is periodically halted, e.g. bus auxiliary malfunction, charging infrastructure malfunction, planned maintenance and service or operative reasons. There is a general upward trend for improved mileage but it remains inconclusive whether the target level of operation has been reached permanently.
- Winter has presented some challenges for operation, which was to be expected. There was a distinct decline in the number of successful days particularly in winter 2017-2018, mainly due to problems with the integrated auxiliary heater. It remains to be seen whether these problems have been resolved and whether the good general performance level achieved can be sustained also during the cold period in the future.
- There is an image risk associated with poor reliability of service – both in the eyes of the public and public transport professionals. This may affect future development within the field. It is thus of great importance that in the future tendering processes for e-buses, attention is paid on all the details of achieving a fully functioning bus system.

Long term impact

The expected long-term impacts of the measure relate to improved knowledge on PT electrification gained throughout the project. Continuing PT electrification is a long-term goal in the city as expressed in the Turku Climate Plan. The measure has contributed to proving that PT electrification can be a very viable option for organizing public transport towards carbon neutrality.

MAD 5.8 Electric and hybrid buses for public transport

Abstract

This measure aims at increasing the efficiency and environmental performance of the public transport fleet of EMT, the municipal company in charge of bus services in the city of Madrid. Within this measure, 9 new hybrid buses were added to the EMT fleet and monitored for one year while operating on EMT route 140, a tangential bus line close to the ECCENTRIC living lab in Madrid.

The measure is in line with the Air Quality Plan and the Sustainable Urban Mobility Plan actions of Madrid City and also with the recently launched Madrid 360° Sustainability Strategy (presented in September 2019). It is also in line with EMT strategic plans regarding clean fleet uptake, started in 2016.

The new hybrid buses were presented to the press in December 2016 and received by EMT between that date and January 2017. They were included within a package of 200 new buses, of which 30 are hybrids (models MAN LION'S CITY HYBRID and IVECO URBANWAY HYBRID) and the rest CNG buses.

Overall, the achievement of the objectives has been satisfactory. Only the 30% reduction in energy consumption and CO₂ emissions has not been achieved in full considering the complete bus fleet (actual reduction has been 20.7%), due to the assignment of some conventional buses to L140 at peak-hour times and in particular circumstances, covering in total 23% of the annual km travelled; if these services had been covered with hybrid buses, the reduction would have achieved 27%, closer to the target.

It is worth noting that noise reduction was the improvement most noticed by L140 passengers (one third of them), so that this objective can be considered as fully achieved.

The replacement of the old Euro IV buses by the new hybrid buses had a stronger impact on NO_x and PM emissions than on CO₂ emissions, as the new hybrid buses combine the effect of fuel savings and a cleaner Euro VI engine replacing Euro IV buses. The impact on air quality is therefore higher than the effect on climate change mitigation, and is very well aligned with the objectives stated by the municipality in its last Air Quality Plan.

Two lessons can be highlighted for this measure: First, hybrid buses provide an effective alternative for the replacement of diesel buses, as they provide CO₂ emission and fuel savings of more than 20%, reduction in NO_x and PM emissions, and significant customers' satisfaction; noise reduction is the most valued improvement by users; second, hybrid buses are also economically efficient, as the additional costs can be recovered in less than 5 years, due to fuel and maintenance savings.

It can be expected that this measure will influence EMT's future bus procurement decisions.

Conclusions

Validated direct impact

- The measure has been successful in achieving significant reductions in the emissions of CO₂ and key pollutants (NO_x and PM), as well as in energy savings.

- Operating costs have decreased by 51.7%, due to the combined effect of reduced fuel consumption (-20.7%) and lower maintenance costs. No technical incidents have been reported during the demonstration period.
- Users' satisfaction has considerably increased, from a score of 3 to 4.2 after the introduction of the 9 hybrid buses.
- One third of users also valued the reduction in noise provided by these buses.
- The additional cost of a hybrid bus compared with the updated cost of the Euro IV diesel buses it replaces is recovered in less than 5 years, considering an average annual mileage of 50,000 km, due to fuel and maintenance savings.

Main lessons learned

The following lessons can be highlighted for this measure:

- Hybrid buses provide an effective alternative for the replacement of diesel buses, as they provide CO₂ emission and fuel savings of more than 20%, reduction in NO_x and PM emissions, and significant customers' satisfaction; noise reduction is the most valued improvement by users.
- Hybrid buses are also economically efficient, as the additional costs can be recovered in less than 5 years, due to fuel and maintenance savings.

Long term impact

It can be expected that this measure will influence EMT's future bus procurement decisions.

MUC 5.9 Intermodal (E-) Mobility stations

Abstract

The measure MUC 5.9 aims to implement a new multimodal mobility service for all citizens: mobility stations. These mobility stations are located within the Living Lab and combine and provide different sharing offers with charging infrastructure and general information about the different mobility options. They are easily accessible in close location to public transport offers and serve as an alternative to individual car ownership.

There are four mobility stations allocated in Domagkpark and Parkstadt Schwabing which address the individual mobility needs of residents and employees or customers who visit the Living Lab. As a transport related measure which promotes a mode shift and provides a sustainable alternative for motorized individual transport, MUC 5.9 is a central measure within Munich's ECCENTRIC landscape. Other CIVITAS ECCENTRIC measures are planned to be part of the mobility stations, e.g. the E-Trike (MUC 5.6 Conception and development of an integrated e-bike sharing scheme) or the electric light weight vehicle ACM (MUC 6.3 "Electric light-weight vehicles – one for all").

Evaluation results for MUC 5.9 were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019) and a workshop to investigate on the user experience and find out about the reasons for non-usage.

The evaluation of MUC 5.9 shows that about 76% of the residents which are making use of the mobility offers are satisfied with the mobility stations and the selection of vehicles as well

as the services which are being provided. In general, the usage rate of mobility stations is quite low (depending on the station, between 3%-15%) and cannot promote a positive mode shift towards more sustainable transport options within the short project lifetime. Residents obviously need more time to change their mobility behavior. To raise the awareness of the mobility stations and make them more visible, residents wish to have a more striking color marking of the station and to integrate the service into Munich's mobility apps.

Conclusions

Validated direct impact

- There are three mobility stations being installed in the Living Lab during the evaluation period and financed by ECCENTRIC: Gertrud-Grunow-Straße, Marianne-Brandt-Straße and Max-Bill-Straße.
- All mobility stations offer bikesharing, carsharing, e-scooter sharing, charging stations and an information pillar.
- 89% of the Living Lab are covered by mobility stations which are reachable within five minutes walking.
- The mobility stations which are implemented a longer time already are better known than the newer ones.
- Most of the residents got aware of the mobility stations because they ran by it, only 16% saw the advertisement.
- 76% of all users state that they are “satisfied” or “very satisfied” with the mobility stations.
- The system usage increased significantly after the first wave of the mobility marketing campaign took place in 06/2019 (see measure MUC 2.9a).
- Statistics by the MSP show that most users of the mobility station use classic carsharing, bikesharing and e-scooter-sharing options. The household survey shows that there is still a high percentage of people who know the vehicles and services a mobility station offers but do not use them. Conventional carsharing is still the most frequently used mobility option, pursued by e-carsharing, bikesharing or the e-cargo-bike sharing (this is only offered at the MS at FWS on private ground, not financed by CIVITAS ECCENTRIC).

Main lessons learned

- Most of the residents got aware of the mobility stations because they ran by it, less because of advertisement.
- The type of advertisement which is most successful are posters or billboards and word-of-mouth recommendations.
- But in general, 45% report that the mobility stations need to be made more recognisable by colour marking or digital positioning of the mobility stations in apps.
- Initial assumptions that the mobility stations are not used because of an unreliable availability of vehicles or lack of parking space did not turn out to be true. Most of the residents who do not use the mobility stations, state that they just do not need them.
- An evaluation period of 1-2 years is too short to see any shift towards a more sustainable mobility behaviour.
- Mobility stations are not used for regular trips, most of the questioned residents say that they never use the offers or less often than monthly. Only conventional carsharing is used more often.
- Ongoing construction works in new development areas hinder the implementation and completion of mobility stations.
- Early involvement of local stakeholders and planning community of the city is crucial for the planning process of mobility stations.

- Cooperation with MSP has to be practiced actively with marketing campaigns for their offers.

Long term impact

- There could be a long term impact regarding lowering emissions and promote a mode shift with the various sustainable mobility option which are being offered.
- Residents might become more familiar with the sharing concept and use the shared vehicles more often.

MUC 5.10 Sustainable mobility via E-scooter sharing

Abstract

The measure MUC 5.10 “Sustainable mobility via E-scooter sharing” is being implemented to broaden and optimize clean and space efficient mobility offers in ECCENTRIC areas. In 07/2018, a local electric scooter sharing¹ (ESS) business area was expanded to include the research area (RA), thus granting residents and employees in the research area access to ECC services. The ESS service provides free-floating^{Error! Bookmark not defined.} motor scooter sharing that can be booked via app. An ESS scooter can carry one to two people.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measures’ implementation and the ex-post data, which focuses on the impact of MUC 5.10.

Evaluation results for MUC 5.10 were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019) and the ESS usage dataset.

The measure evaluation shows how the introduction of ESS has reached its intended effects: Ever since ESS was introduced in Domagkpark/ Parkstadt Schwabing, the number of households using the services there has increased by 5,19%. Most emission-free ESS mode shifts have taken place from public transportation, followed by trips formerly taken by foot or by bicycle. This requires further research beyond the project as to whether ESS has contributed to making space for new public transportation users and furthering sustainable modes of transportation in the long run. In 2018 and 2019, trips related to the research area amounted to 24.029 km. The mere mode shifts from car to ESS trips leading to an emission reduction of 0,899 t of CO₂ in 2018/2019 as well as to reductions of 0,0022 t of NO_x and 0,3 kg of particle matters.

Once the in-depth study of ESS usage and motivations is finalized, the final step of the measure will be implemented.² It will aim at developing approaches to counterbalance ESS

¹ NB: In this context, E-scooters refer to moped-like L1e vehicles, not to the smaller E-scooters shared by companies such as Lime and Tier.

² Due to the lengthy amendment process, the MUC 5.10 project schedule was delayed compared to the other CIVITAS ECCENTRIC measures. Therefore, the measure will be finalized in the months to come.

sustainability challenges such as unwanted ESS substitution effects. These approaches will be disseminated to ensure a successful scaling and replication of ESS implementations throughout suburban spaces in the European Union.

Conclusions

Validated direct impact

- Key result 1 – The measure has enabled the ESS vehicle km travelled starting/ending in the research area to strongly increase seeing that its baseline of trips starting/ending in the research area was nil beforehand: 24.029 km were travelled to/from the research area in 2018/2019 after the introduction of the measure.
- Key result 2 – Most mode shifts ($\geq$ once a month) towards ESS come from public transportation followed by trips formerly taken by foot, by bicycle and by car.
- Key result 3 – The measure has enabled the ESS system usage starting/ending in the research area to increase seeing that its baseline of trips starting/ending in the research area was nil beforehand. The strongest annual usage per month to/from the research area in 2018/2019 was in July.
- Key result 4 – The introduction of ESS has directly reduced CO₂ (-2,95 t in 2018/2019), NO_x (-0,0085t NO_x in 2018/2019) and PM emissions (-100g). Knowing the total reductions within the entire Munich mobility system requires modelling the effects of the ESS modal shifts from public transport.³

Main lessons learned

- Key result 1 – Close cooperation and dialogue with both the responsible mobility company and the city in which the measure is implemented are key to a successful ESS introduction and study.
- Key result 2 – The measure has already contributed to decreasing the load factor in public transportation in an emission-free way. It can contribute to (further) sustainable mobility developments by enabling public transportation to transport new passengers that shifted from car usage.
- Further key results are expected as the measure, which started relatively late in the CIVITAS ECCENTRIC schedule, is finalized.

Long term impact

- Key expectation 1 - Effects such as a partial mode shift within the research area and a relevant number of driven kilometres can be expected to increase with the ESS service continuously establishing itself in the Munich mobility market throughout time.
- Key expectation 2 – Equally, the reduction of emissions is expected to increase depending on mode shift developments. The reduction of emissions can be strengthened by the counterbalancing approaches that were developed during the measure.
- Key expectation 3 – Whether the mode shift from public transportation to ESS leads to strengthening the former requires further research beyond the project. The suggested hypothesis is that by using ESS, the E-scooter drivers alleviate public transport running at maximum capacity, thus creating space for new passengers. If the 'new' public transport users shifted from trips formerly taken by cars, ESS can indirectly strengthen the mode share taken by space efficient means of transportation.

³ For instance, public transportation being less occupied due to ESS modal shifts can lead to new passengers being able to use it. Understanding the total emission reductions requires considering which modes of transportation the new public transportation passengers shifted from.

WORK PACKAGE 6: PROMOTING THE UPTAKE OF CLEAN VEHICLES

STO 6.1 Offering EV-rest fleets to selected target groups

Abstract

The City of Stockholm aims to become fossil-free. Service and delivery sector is particularly relevant to explore as most often service and delivery cannot be replaced by public transport and is experiencing a heavy increase due to growing population and e-commerce.

Light commercial vehicles account for 20% of the traffic in the inner city, which is the next biggest category after personal cars. Documenting / Testing user satisfaction with the EV vans and examining their energy efficiency can support the City's objective to become one of the world's leading clean vehicle cities by 2030.

This measure STO 6.1 incentivized companies operating light-duty commercial vehicles in Stockholm to purchase or lease an electric-powered van at a reduced price, making it comparable in price to an equivalent diesel-powered van. Participants driving the 15 vans agreed to provide data about their use of the EV and to respond to surveys about their experiences. In the analysis of the impact of this measure, we measured user satisfaction, energy efficiency, travel time, emissions, and operational and investment costs based on a survey, logbook, secondary sources.

Compared to diesel-powered alternative, the EV had zero tailpipe emissions and were significantly more energy efficient. The results showed that participants were, on average, very satisfied (about 74% acceptance rate) and would recommend EVs to others in their respective sectors.

Conclusions

Validated direct impact

The measure produced the following validated impact:

- Acceptance of, and satisfaction with, electric vehicles were clearly positive for participants overall, although some individual participants were less accepting or less satisfied.

Main lessons learned

Several lessons learned were:

- It is essential to get people to personally test new vehicles and infrastructure themselves; a majority were satisfied and can recommend EVs to others, which gives a positive dissemination of this potential solution that the City would like to promote.
- It is important to identify and test with the target group that will lead to the greatest impact. Consider which group(s) contribute most to city traffic, are identifiable, and have circumstances that lend themselves to green vehicle technology (that is, if it is not possible to change to other modes of transport entirely).

Long term impact

We expect the long-term impact to be a faster dissemination of the benefits of electric vehicles, and faster counteracting of the negative preconceptions many hold against EVs, which both can lead to a faster transformation of the light-duty goods vehicle fleets in Stockholm.

MAD 6.2 Test fleets, policy incentives, and campaigns for the uptake of electric vehicles

Abstract

This measure aimed at promoting the use of electric vehicles (EV) by the municipality of Madrid, private companies and individuals. It included activities for the integration of EVs in public and private fleets and to expand the public charging network in the city.

The initial measure expectations included to liaise with at least 5 key agents and companies (e.g. supermarket chains, shopping malls) in order to develop pilot projects concerning the use of electric vehicles, namely the launch of a “test fleet scheme”, including the potential implementation of electric charging facilities associated to their premises. In addition, strategies to promote the wide uptake of clean vehicles for freight delivery companies and private citizens will be designed and put in place.

Aiming to showcase EV benefits, as well as to play an exemplary role, the measure expected to introduce at least 20 electric vehicles in the municipal fleet.

The development of this measure was done in cooperation with EMT. EMT was expected to help the City Council in reaching out to different companies and stakeholders to involve them for a wider uptake of e-mobility, and to ease the access to its charging infrastructure, located at its public parking facilities, targeting specially car sharing services, taxi fleet and freight operators.

This measure has exceeded two of its three initial objectives, in both cases due to the commitment of the municipality: the number of electric cars added to the municipal fleet reached 130 units in January 2020, well above the initial objective of 20. The commitment of the municipal company EMT resulted in 5 fast-charging stations opened in different EMT-managed public parking facilities during 2018, to which it should be added 9 on-street fast-charging stations managed by the municipality as part of its own public charging network.

However, in spite of frequent contacts with different companies (and particularly with COOLTRA and Pascual), none of them engaged in the procurement of electric vehicles as a result of this measure.

Conclusions

Validated direct impact

The key results concerning the observed impacts of the measure can be summarised as follows:

- **Quick expansion of e-cars within the municipal fleet.** The number of e-cars in the municipal fleet expanded substantially, well above the projects target of 20 units. This achievement can be explained by the project’s adaptive management approach to make the most of some favourable drivers (Air Quality Plan, renewed political interest

on e-mobility...), involvement of final users and effective implementation of administrative instruments to facilitate the access of e-cars to the municipal fleet.

- **Quick expansion of the fast-charging network in the city, with low but increasing use.** The number of public fast-charging stations in the city increased substantially, first through the involvement of EMT (charging stations in some of its public parking lots) and later through the involvement of the municipality (on-street fast-charging stations) and the private sector (municipal incentives to those providing public fast-charging stations in their private premises). Monitoring of the use of EMT stations shows a low use, which can be explained by the preference of e-car owners for much cheaper home charging and by the still low number of e-cars in Madrid: sales of cars in Madrid with a “CERO” emissions label (which includes e-cars and plug-in hybrid cars) accounted for just 1.3% of total 2018 car sales.
- **Significant reduction of emissions and energy consumption.** For the 19 cars monitored by the project, the reductions in CO₂ emissions and energy use were substantial (83%), as well as in NO_x and PM (100%). These savings came, however, at a cost: the estimated abatement cost was high, some EUR 250.72 per tCO₂.

Main lessons learned

The main conclusions on the measure integrating impact and process evaluation findings can be summarised as follows:

- E-cars provide substantial reductions in CO₂ and pollutant emissions as well as in energy use (83% to 100%), without any drawbacks in terms of reliability and performance of the fleet. In spite of energy cost savings, abatement costs remain high (EUR 250,71 per tCO₂ saved), but are expected to decrease as new e-car models enter the market.
- To achieve the expected emissions abatement results, a bottom-up approach is recommended, actively involving the vehicle users and those responsible for the municipal services to which the e-cars will be allocated. This will greatly facilitate the selection of the adequate e-car model for the envisaged service, as well as the active involvement of drivers and other personnel in making the most of the performance potential of e-cars.
- For municipal and other governmental fleets, leasing schemes are a good alternative to circumvent bureaucratic barriers for procurement, and to relieve the reliability anxiety decision-makers and users may initially experience towards a new technology. Leasing schemes currently penalise e-cars versus ICE (Internal Combustion Engine) cars (additional cost of 45%), but this gap should decrease as lessors become more familiar with e-mobility and the availability and affordability of e-cars increase.
- The public fast-charging network can be substantially expanded in the short term, but it needs an adaptive management strategy to make the most of a rapidly evolving regulatory and demand framework. The combination of direct public action (by the municipality or through a public company like EMT in the case of Madrid) and cooperation with interested private companies is an effective way to achieve a strong deployment in a relatively short time (less than 2 years in Madrid).
- In the absence of such active policies, it is unlikely that the public fast-charging network will expand, due to a pervasive low demand explained not only by the low number of e-cars on the streets, but also but the convenience and lower costs of home charging.

- The ability of local governments to stimulate and support the electrification of private fleets is limited. This is due to the low priority that most corporate boards pay to fleet-related questions, to the fact that fleet-renewal decisions are taken only when the lifetime of the existing vehicles is close to termination, and to the still widely-perceived uncertainty regarding EV technology. Public action can be designed with a long-term strategy to raise awareness among corporate decision makers in the wider context of Corporate Social and Environmental Responsibility, rather than to spend public resources in incentives that are unlikely to change this conservative culture towards what is perceived as a marginal issue within many corporations.

Long term impact

Based on the evaluation of this measure, the following long-term impacts can be expected:

- Considering a car lifetime of 10 years, savings from the BAU scenario will reach 437 tons CO₂, 0.224 tones NO_x, 0.070 tons PM and 6.0 TJ, at an additional cost of €109,547.
- A decrease in CO₂ emissions and energy consumption, as well as NO_x and PM emissions from public car fleets in Madrid. The relevance of this impact relies on the rate of electrification of public and private fleets. Whereas the municipality is actively increasing the number of e-cars (as well as plug-in hybrid cars and electric cars with extended range), in the framework of its Air Quality Plan, this effort is still jeopardised by the higher costs of e-cars and the relatively low annual mileage of most of the fleet (some 12,000 km in the case of the ECCENTRIC-monitored fleet).
- A decrease in CO₂ emissions and energy consumption, as well as NO_x and PM emissions from private car fleets in Madrid. Although these impacts have not been achieved during the project life, it is expected that the activities undertaken by the project will result in at least 2 companies including a fleet of 50 e-cars after project completion. Assuming an average annual mileage of 12,000 km, this would result in additional savings of 1,150 tons CO₂, 0.590 tones NO_x, 0.184 tons PM and 15.8 TJ

TUR 6.4 Electrification of Municipal Fleet & Promotion of Electro-mobility

Abstract

According to the results of the Mobility Survey for Turku city employees from 2013, 15% of all commuting was under 5km, and 42% of work-related trips (during working hours) were under 5km, and were done by a passenger car (as a driver or passenger). 31% of these work trips (during working hours) are driven by employees using their own cars. Many, if not all, of these trips could be taken with some other mobility device/form than a car. In measure TUR 6.4., the City of Turku was to test nine light electric vehicles (LEVs), including e-bikes and e-scooters, as an alternative mode of travel to and from work and during the workday. For the purpose of exploring the usability of LEVs in replacing private car use and the attitudes and experiences of employees, a survey was to be conducted to each pilot participant.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline

to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 6.4. was measured. Data was derived from surveys, LEV usage records, secondary data from the city of Turku and reference data on emissions from the national LIPASTO database.

Overall, the measure reached its objectives satisfactorily. An e-vehicle pilot was carried out with nine different LEVs. 105 Turku city employees tested the vehicles and experiences gathered among them provided a valuable viewpoint on LEV usability and the main barriers and drivers related to their potential further deployment in the city fleet. It can be stated that the potential of LEVs as an energy efficient, low-emission, low-cost and feasible alternative for replacing the use of one's own car for work-related trips has been proven based on high acceptance and satisfaction levels among the users. Whether there has been any permanent impact on the modal share of the participants remains to be seen and would need further surveys to observe. An e-mobility plan is being devised during spring 2020 based on measure experiences and experiences from other cities, hopefully resulting in further uptake of LEVs in the city fleet.

Conclusions

Validated direct impact

- An e-vehicle pilot has been carried out with 9 different LEVs + one e-car (in Spring 2020).
- The views of the e-vehicle users have been reviewed and analysed.
- An e-mobility plan is being devised during spring 2020 based on measure experiences and experiences from other cities..
- The potential of LEVs as a feasible alternative for replacing the use of one's own car for work-related trips has been proven based on high acceptance and satisfaction levels.

Main lessons learned

The main lessons from the measure concerned the practical issues on how to organise and manage a test fleet, especially as a city authority, including test users and other involved actors.

- **The test period** of one year proved to be too long from the point of view of managing the pilot. Booking e.g. "for May next year" is too far in advance to manage. Changes in the schedule occurred constantly and it was challenging to ensure that eight people from each unit for two consecutive months take part. A good plan also has to be in place for physically moving the vehicles from one department to the other, as this might require additional resources (e.g. personnel or a bigger vehicle).
- When it comes to contractual agreements, **processes and responsibilities** must be very clear from the beginning to the end. In cases of vandalism, it was unclear who was responsible.
- Another lesson learned concerned **managing the e-vehicle users**. Educating testers on how to use the vehicle and communicating with them takes time. Although recruiting test users through the Head of Departments worked quite well, the next step could have been done slightly differently. Allocation of testers and coordination of the testing periods was handled manually in excel sheets. A manual system allows the human

factor to play in and it becomes difficult to accommodate everyone's changing schedules. A more automatic registration tool, e.g. an e-calendar, would have enabled for a more efficient process.

- **Weather conditions** can have a significant effect on the success of an e-vehicle pilot. A winter with lots of snow and/or ice on the roads combined with sometimes poor or untimely winter maintenance may lead to low participation rates for a pilot. Particularly among people who normally mainly use a car for commuting or for work-related travel during the day, wintry road conditions may present an insurmountable obstacle to even testing a LEV. Subsequently it is also important that e-vehicles are first presented to their users under favourable weather conditions. The fact that not all LEVs are by no means "winter-proof" should also not be overlooked – whether the LEVs are suitable for winter use or not should be carefully reviewed when selecting vehicles for testing.
- Potential issues with **storing the vehicles** should be resolved prior to the pilot. In a pilot aimed at a large number of employees, a suitable, safe and easily accessible temporary storing facility should be secured already prior to starting the pilot. During the Turku pilot it proved virtually impossible to transfer the LEVs directly from one department to another. Hence a temporary storage facility is likely to be needed.
- If possible, the vehicles should be acquired from **a local provider**, as when breakages occurred the waiting time for a spare part or a maintenance became remarkably long. In addition, a professional operator, either external or provided by the city, should be hired to take care of the transport and maintenance.
- Last but not least, the measure raised discussion on how to arrange such a pilot as a local authority and what happens when the aspect of sharing becomes more prevalent, which is not clearly defined in this measure.

Long term impact

The measure has provided a valuable insight into the barriers and drivers of replacing city fleets with electric vehicles. As such, it will act as a useful starting point for potential future procurements of e-vehicles to the city fleet.

STO 6.5 Developing the Clean Vehicle Web Portal (Miljofordon)

Abstract

Miljofordon.se is a web portal hosted by the City of Stockholm, providing an integrated information site about environmental vehicles relevant to all of Sweden. The central feature is a searchable database of environmental vehicles and their features, along with Swedish and European regulations associated with those vehicles. The site also features a fuel calculator and a map of charging locations across Sweden. There is also an opportunity to sign up for news articles relevant to the web site and environmental vehicles.

During Eccentric, the web site has been updated both in its content and its functionality, where these improvements were supported by stakeholder dialogs and user testing. The impact was measured by examining the number of visitors to the website, number of pages seen as well as the subscriptions to the newsletters. The key performance indicators are examined by using Google Analytics as well as tallying the subscriptions according to the newsletter subscription logs.

The results show an accelerating growth in visits to the web site from 43 000 sessions in 1st Quarter 2016 to over 108 000 sessions in 4th Quarter 2019. At the same time, interest in receiving news from miljofordon.se waned in the same period, with subscriptions reduced from 931 in early 2016 to 725 in late 2019. The results suggest a growing role of the web site as the main source of information, as its scope and content have expanded, as well as a growing general interest in the topics covered. At the same time, the results indicate a decreasing role of the newsletter as the promotion of membership has waned and as its content has shifted to online articles at the web site.

Conclusions

Validated direct impact

- Visits to the miljofordon.se web site increased not only steadily during the time period the improvements were made, but accelerated, suggesting a significantly broadening awareness of information about environmental vehicles.
- The news that was sent out had an overall declining role in increasing local knowledge about environmental vehicles, as efforts shifted to improving the web site.

Main lessons learned

One needs to be flexible in the project plan since conditions can change from the start to the end of the project. For example, in this case miljofordon.se was moved to a new platform at the start of the project, which we did not foresee when setting the project plan at the beginning.

Long term impact

The web site has taken a central role in Sweden as a repository for green vehicle information, at a time when interest in green vehicles is surging, hence it now has a key position in Swedish information networks over the long-term. More concretely, the information distributed on the web site will hopefully have an effect on the Swedish vehicle fleet, which as a long-term durable good will have an intrinsic impact that is long-lasting.

STO 6.6 Master plan for developing EV-charging in STO

Abstract

The City of Stockholm has a goal to increase the number of EV on-street charging stations. This long-term goal responds to, and encourages, the increasing use of EVs. This provides more charging opportunities for the EV users, attracts new EV users, and thereby supports decreasing fossil fuel emissions, improving air quality and decreasing noise pollution in the city. In particular, The City of Stockholm had originally set up a goal to install 500 on-street EV charging possibilities by 2020. In 2019 this goal was revised by the City Council to 4 000 public charging units by 2022 (out of which 2 000 should be put up in public garages by Stockholm Parking Company and 2 000 on-street through the Traffic Administration within the City of Stockholm).

This measure supported the installation of the EV on-street charging. The most important outcome of this measure was the production of an interactive map published on a website, which identifies where the installations are possible and allowing the energy suppliers to reserve and install the chargers. Impact evaluation was based on several indicators. First,

awareness rate counted the number of visitors to the website. Second, acceptance rate calculated the rate based on the tallied number that managed to successfully install chargers from the number of companies interested in setting up public charging. Satisfaction rate was comparing operations by using the map with the regular operations and was measured via an interview with the companies which installed charging, using a 1-5 scale (5- very satisfied). In addition, based on secondary sources, CO2 emission savings were calculated and costs for establishing the master plan and its updates were traced.

Results show that at least 200 on-street chargers have been put in operation. From the 6 companies which reserved streets for installing EV charging, 4 had installations process in place or completed the installations by the end of 2018. The companies are generally satisfied with the website and the map, satisfaction is 3.7 (1-5 scale, 5 – very satisfied). The website supported the installations of the EV on-street chargers, which indirectly also supported the reduction of CO2 emissions in the city. The City is supporting the continuous improvement of the process of installations and the process is ongoing.

Conclusions

Validated direct impact

- The City of Stockholm has not yet reached the set goal, 200 out of 500 EV on-street chargers were installed by 2020. A new goal – 4 000 chargers by 2022 was already set. The process of installations became less ad hoc and more systematized with the map which was produced in this measure.
- The website “Laddgator i Stockholm” has been visited 1055 times until the end of 2018.
- The website allows energy suppliers to reserve streets where they plan to install EV charging. Out of 6 reservations, 4 completed the installation process before the end of 2018. During 2019, 12 access right agreements for new charging streets were signed and 10 new charging streets were then completed and in operation before the winter.
- Satisfaction of the users with the process of installations without using a map is 2.7 while the satisfaction with the process by using the map is 3.7 (0-5 scale, 5 is very satisfied).
- The website and the new, ‘orange streets’, are also providing an opportunity to smaller companies to sell electricity to the EV car owners.
- The website supported the installations of the EV on-street chargers, which indirectly, and together with the available off-street chargers supported the reduction of CO₂ emissions in the city.

Main lessons learned

- The process can be more effective if the main actor is on board from the beginning of the project (in this project a good collaboration with the grid owner was found to be crucial).
- On the other hand, one does not have to adjust to, and try to motivate one actor, it is likely that they will get inspired along the way in any case.
- Transparent communication about the process is important so that every actor get the same information at the same time and are treated equally.
- Learn the jurisdiction in the field and get help to understand the different legal possibilities and drawbacks. Projects like this are more likely to get hindered by legal aspects rather than technical aspects.

Long term impact

The most important contribution of this measure is the fact that the installations of EV on-street charging are not done in an ad-hoc principle (from the City's perspective), but the process is systematized and the criteria for where the suitable places in the city are is carefully thought through. This can have an important long-term impact for the city in terms of planning the city and the liveability of the city. In addition, by providing more charging possibilities, citizens can be motivated to use EV cars, which can in turn contribute to cleaner air in the city.

STO 6.7 Promote installation of EV-charging facilities in multifamily houses

Abstract

The City of Stockholm aims to reduce fossil fuel emissions. To address this goal, this measure aims to provide all the necessary information about 'how' and 'why' to install EV charging in multi-family housing in the wider area of Stockholm, i.e. the municipality of Stockholm and its neighbouring municipalities.

In particular, this communication focused measure aims to provide information to the board members of housing associations on how to install EV charging possibilities in the multifamily housing, where 50% of the Stockholm citizens live. The communication focused outputs in this measure include, instructional films, a step-by-step guide for installations of chargers, seminars, exhibitions, and document templates, among other things. The target was to attract 500 participants to the seminars and to have 600 installed chargers during 2016-2018. The goal has been reached. Only in 2018, 455 people attended the seminars and more than 600 chargers were installed. In the impact evaluation, we measured awareness, acceptance, satisfaction, CO₂ emissions and costs.

Based on the conducted surveys, we identified that the satisfaction with the seminars among the associations' representatives was 4.25 (1-5 scale, 5 - very satisfied). We moreover found that at least 262 associations have started or planned to install EV charging in their multifamily houses in 2017 and 2018. Indeed, after the provision of a series of seminars, we are estimating that 910-1400 charging units have been installed in 2017 and 1300 were planned to be installed in 2018 or later. In sum we find the provision of information to be a good strategy for supporting the EV infrastructure installation process in the multifamily housing setting.

Conclusions

Validated direct impact

- At least 262 of the housing associations who have attended the seminars on how to arrange the EV charging installations have installed, or were planning to install, chargers in their housing (during 2017-2018).
- Satisfaction with the seminars given in 2018 is among the housing associations 4.25 (on a 0-5 scale, where 5 is very satisfied).
- Satisfaction with the seminars among the participating energy supplying companies is 4 (on a 0-5 scale, where 5 is very satisfied).
- Due to the installations we are estimating that 2300 ton of CO₂ is saved locally, per year, during 2017-2018.

Main lessons learned

- Giving seminars as a seminar series is more economical.
- Seminar content has to be continuously updated in cases of technological innovations.
- Very good to have a large number of charging companies present in a mini-exhibition to show the different charging equipment.
- More people attended the meetings than had actually signed up to come.

Long term impact

Accessibility to EV charging at home can motivate EV car ownerships and thus contribute to a reduction of CO2 emissions.

WORK PACKAGE 7: TOWARDS BETTER AND CLEANER URBAN FREIGHT LOGISTICS

MAD 7.1 Consolidation center with EVs and local regulations for clean urban freight logistics

Abstract

In this measure, the Municipality of Madrid in co-operation with a logistic operator (FM Logistics) is combining the implementation of an urban consolidation centre for last mile distribution, operated with clean vehicles, with regulatory measures, such as access regulations in traffic-restricted areas (by applying time windows for goods delivery) or vehicle restrictions based on weight, size and technology (zero and ultra-low emissions vehicles).

The measure is in line with Madrid's Sustainable Urban Mobility Plan (SUMP), and with the city's Air Quality Plan and Energy and Climate Change Plan. All these plans aim at improving urban freight distribution through a combination of a regulatory approach and the use of cleaner vehicles.

The design phase took place between September 2016 and February 2017. During this stage, a study on freight distribution in Madrid (also relevant for measure MAD 7.6) was completed, including some interaction with local operators, and feasible locations for the consolidation centre were identified. However, the operator was unable to produce a management plan for the consolidation centre, including distribution areas, potential clients, goods to be delivered, or services. Unfortunately, the envisaged "Local Freight Partnership", including the participation of other logistics service providers, did not materialise.

The implementation phase took place between March 2017 and February 2018. During this stage, the final location of the consolidation centre was selected (in Villaverde, in the southern periphery of the municipality), and the logistics operations were analysed in detail. For the operations, it was decided to make use of 7.5t hybrid trucks instead of electric vans as initially considered in the project proposal; however, the installation of electric charging points at the consolidation centre remained necessary, in order to support the operation of the electric prototype developed within measure MAD 7.6. During the implementation stage, a number of activities to liaise with stakeholders and potential clients were undertaken, with an aim at establishing the Local Freight Partnership envisioned in the initial project description; however, the only client interested in making use of the new clean services was SEPHORA, as the company had approved a corporate commitment to meet certain clean standards in their distribution activities. No particular activities were conducted for designing regulatory tools on urban freight delivery, as these tools were already under development in the context of the preparation of the revised Air Quality Plan and the new low emissions zone "Madrid Central"; the new norms have established differentiated time windows for urban delivery depending on the vehicle's characteristics.

The operational phase took place between February 2018 and June 2019, serving a total number of 15 SEPHORA shops in the central districts. To provide the delivery services, FM Logistic established a contract with Ontime, another operator in Madrid with a 70,000-m2

logistic centre in Villaverde (Avenida Zafiro 4), a district in the south of the municipality and relatively close to the city centre. Ontime also provides the fleet (8 hybrid 7.5-t trucks) needed for distribution. The goods to be distributed through the centre in Villaverde are collected by Ontime at the FML centre in Torrejón and transported with a 40-t articulated truck.

Most of the measure objectives have been successfully achieved. The measure has been effective in substantially reducing CO₂ emissions and energy consumption (by 54%) and NO_x and PM emissions (by 94% and 63%) for the logistics operations serving Sephora. However, the volume of these operations has been low compared with the hub capacity during the demonstration stage (only 5% to 10%, depending on the month considered), as only 429 shipments/year have been transferred to the new delivery system. This limitation explains the measure's failure to achieve the expected reduction of 90t CO₂eq per year initially foreseen.

The modest number of shipments served with sustainable logistics seems contradictory with the high scores obtained in the customers' awareness and acceptance of these services. It suggests that additional marketing efforts should be undertaken to gain new customers to make use of the new "Citylogin" services.

Conclusions

Validated direct impact

CO₂ emissions. In relative terms, the measure has achieved a significant reduction in CO₂ emissions (-54% compared with the "before" scenario). However, the limited size of the operations undertaken (just 429 shipments in one year) has resulted in absolute CO₂ emission savings significantly below the initial target (7.5 tons achieved compared with a target of 90 tons per year). A significant part of the emissions savings (4.5 tons) could have been achieved solely with the replacement of the Euro V delivery trucks by hybrid trucks (BAU scenario), whereas the rest (3.0 tons) are associated to the introduction of the last-mile delivery concept based on the consolidation centre.

NO_x and PM emissions have been reduced substantially, combining the effect of the hybrid delivery trucks and the consolidation centre: (-94% in NO_x emissions and -48% in PM emissions). Energy savings and total distance travelled have also been significantly reduced in the project operations: -54% and -45% respectively. The project has achieved its expected impacts on these particular indicators.

Use optimisation of delivery vehicles. The optimisation of the use of the 7.5-t hybrid trucks provide one of the most relevant operational savings for the logistics operator. In the case of Sephora, the distances travelled by these vehicles are cut almost by half for each shipment, and this should also be the case in other deliveries with destination in the central districts of Madrid. Shorter distances allow to dedicate these vehicles to provide additional services or to reduce the fleet size.

Investment and operational costs. The business model followed by the logistics operator in charge of this measure avoided the need for investments: the consolidation hub was installed in premises rented to another logistics company (Ontime), and the vehicles involved in the operations were operated by this company. The operating costs attributed to the project activities (shipments to Sephora) resulted in significant savings compared to the "before scenario", due primarily to the decreased use of 7.5 trucks (equivalent to €10,041 per year) already discussed above and, to a lower extent, to fuel savings (equivalent to €2,072 per year). However, these savings cannot compensate the significant cost increase for shipments

delivered from the consolidation centre to other destinations, due to the fact that these destinations are not optimal (their average distance is too high: 78 km); these results in an average cost increase of some €35.56 per shipment, with total operational costs for these shipments of €143,882. Therefore, unless the logistics operator succeeds in attracting more customers to these services, operations will not be feasible in the medium-term.

Increased awareness and acceptance. The measure has significantly increase awareness and acceptance of sustainable logistic solutions (score of 3.9 and 3.6 over 5 respectively) among current customers of the operator (FML). However, this has not resulted in any of these customers actually hiring these services yet.

In accordance with the results summarised above, it can be concluded that the measure has reached most of its targets, in spite of the modest number of deliveries provided. The operations have confirmed the high potential of the measure to provide emission and energy savings, to reduce operating costs and to increase the satisfaction of its customers. However, the fact that the measure has been unable to increase its size in order to manage a higher number of shipments shows that the barriers identified were strong and could not been effectively removed: on the one hand, the activities to attract potential customers have probably been insufficient: more efforts, including the materialisation of the initially envisaged Local Freight Partnership, would have been necessary; on the other hand, even if the survey stated that the levels of awareness and acceptance among potential customers were high after the measure was operational, the actual barriers for these customers to adopt clean logistics were difficult to identify or were not adequately addressed.

Main lessons learned

Four main lessons can be highlighted:

- The measure has confirmed the high potential of this sustainable logistics concept (a consolidation centre served with small low-emission trucks): The emissions and energy consumption associated to these deliveries have decreased significantly, and the operational costs are lower.
- The adoption of cleaner trucks (hybrid 7.5-t trucks in this case) has been effective in providing substantial emission and fuel savings.
- It seems extremely difficult to find customers willing to make use of these new services. The consequence is that only an average of 6% of the capacity of the consolidation centre has been dedicated to these services. The remaining capacity has been used to serve shipments with distances much longer than those for which the consolidation centre can provide environmental and economic benefits. Considering the customers' answers to the survey, and their high awareness and acceptance of the concept, it is not clear why such services are not being used.
- This demonstration measure was not adequate to identify and test regulatory tools. Regulatory tools follow a specific decision-making path within local governments, which is difficult to make compatible with the particular conditions of research and demonstration projects.

Long term impact

The long term impact of this measure is uncertain: on the one hand, the measure has proved the technical viability of the concept, as well as its consistency with sustainability objectives and the reduction in operational costs. On the other hand, the benefits of the measure (and

particularly the economic ones) can be achieved only if the operator can attract sufficient customer to make use of a substantial part of the capacity of the consolidation centre. The demonstration showed that, in spite of wide awareness and acceptance, attracting new customers is extremely difficult.

STO 7.2 Consolidating STO municipal freights

Abstract

The City of Stockholm aims to reduce fossil-fuel emissions, inter alia, by improving the efficiency of freight transport. This measure examines a possibility for using waterways transportation as an alternative to land-based transport in the construction projects.

The outputs of this measure include meetings between the City of Stockholm and the Region of Stockholm discussing the possibilities for the waterway transport in the planned construction project (building an extension of a metro line) and the pilot study that examines the economic, socio-environmental impacts of waterways transport as compared to the land based transport of the construction material, such as the noise and CO₂ emissions. Pilot test was conducted in the 'real' environment and included noise measurements when loading the barges in the inner part of the city, since the data for this context was missing. Moreover, CO₂ emission savings and costs were calculated based on the secondary sources, interviews with the port workers were used for the missing data.

The results of the pilot study show that a switch to waterways transport addresses the environmental sustainability goals most significantly. The CO₂ emissions would be reduced from 3.7 kg per transported ton on land by using trucks, given loading capacity of 11 ton and 30 km trip, to 1.1 kg per transported ton when using waterways, provided that loading capacity is 2000 ton and the receiving port is about 50 km away. This relates to the fact that more material can be transported on water when using barges, i.e. 2 ton per km instead of 0.18 when using trucks on land. The exterior noise levels would not necessarily be significantly higher than in the normal procedures, given that protective material is used to reduce noise. The costs are not significantly different. Waterways transport in construction projects can be considered as an alternative transportation especially in the cities with construction sites near the water.

Conclusions

Validated direct impact

Waterways freight transport when compared to the land-based transport using trucks can produce the following direct impacts:

- Barges can load up to 2000 ton of material whereas a truck can load 11 ton, thus the efficiency is according to this project calculated to be 2 ton/km in the first case and 0.18 ton/km in the second case, which depends on how far the place of disposal is.
- Using waterways transport can lead to a significant reduction in CO₂ emissions, from 3.7 kg/ton to 1.1 kg/ton (2.6 kg/ton reduction), provided a loading capacity of 11 ton and 30 km trip in the first case and 2000 ton and a 50 km trip in the second case.

- Loading the material on the barges can lead to a slight increase in the interior noise, while the exterior noise appears to blend into the background noise more.
- Operation costs for the waterways are comparable with the truck-based transportation.

Main lessons learned

- It is feasible to use the waterways in the city.
- It is important to evaluate this possibility early (e.g. before the type of transportation in a construction project is already selected).
- Use of protective material (e.g. a soundproof wall or protective material on the barge such as sand) can decrease noise levels, which makes waterway transport of construction material a suitable option even for the inner city areas.

Long term impact

The results of this measure show that the emissions could be significantly reduced, if (parts of) freight transport shifted from being land-based to waterways.

MUC 7.3 Sustainable city logistics by combining cargo-bike-delivery-services with a flexible storage system

Abstract

The measure MUC 7.3 aims to test a sustainable and efficient logistic system by providing boxes for temporary storage of parcels. The measure addresses any kind of delivery companies in Munich's urban area. The idea of an emission-free last mile delivery by cargo-bikes is pursued. Another objective is to avoid high traffic by delivery trucks in dense housing areas.

There are eight boxes being installed in Munich. These storage boxes are self-opening by an app and powered by integrated solar panels. This type of storage system is very innovative and new for the cargo-delivery landscape in Munich. The micro depot locations are defined in cooperation with the micro depot manufacturer and the courier company which uses the boxes.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measure's implementation and the ex-post data, which focuses on the impact of MUC 7.3.

Evaluation results for MUC 7.3 were mainly retrieved from interviews conducted with the measure's subcontractor. Due to the fact that no comprehensive assessment of regular statistics was done by the subcontractor, there is only data about the number of box opening during the project lifespan.

It turns out that measure MUC 7.3 is easy to implement but the usage by courier, express and parcel (CEP) companies is not yet very high. The courier company does not very frequently use the boxes (35 box openings during the project lifetime) and bigger CEP companies are not interested in the usage due to different requirements and specifications they need regarding the micro depot design. The measure will not outlive ECCENTRIC but there is a

chance of developing a new concept for a storage box system that meets the requirements of the delivery and courier firms.

Conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

Validated direct impact

- There are eight properly working storage boxes implemented in Munich.
- One courier service company is using the boxes, 25 couriers are registered in the accompanying app, theoretically all 50 couriers could use the micro depots.
- Projecting the number of 35 box openings, they are opened about once a week.
- There is no validated impact to be measured for MUC 7.3 because the micro depots were not sufficiently used by the key stakeholders as expected.
- In addition to that, no assessment of regular statistics was done by the micro depot manufacturer and the courier service due to unavailability of data or insufficient monitoring.

Relevance of supporting activities

- Planned supporting activities like workshops for courier drivers to make them aware of the storage system and explain the procedure did not take place during the implementation of the measure due to limited interest by the courier service.
- The guidelines on how to use the boxes were provided by the micro depot manufacturer. But it remains unclear how much added value they have.

Main lessons learned

- The concept was very new to the courier companies and therefore, the usage was not as high as expected.
- All stakeholders have to be stronger involved during the planning and concept development right from the beginning to include the needs and pain points of the key-stakeholders.
- The size of the boxes is not big enough for most CEP companies. They need depots with the size of containers and partially/fully equipped with restrooms, electricity and other amenities.
- Main reason for not or relatively rarely using the micro depots: the courier drivers are self-employed and costs will increase if they use the micro depots due to their pricing scheme. It is difficult to interfere in their individual business model.
- Another reason for the low usage can be found in the orders processed via the micro depot. There is no differentiation between the inserting and collecting courier. Otherwise no courier would use the box because additional costs occur. The additional costs are currently absorbed by RAPID. But RAPID can only contribute to a very limited extent on their own expenses. This could probably have been prevented by looking deeper into the processual details.

Long term impact

- Regarding the current status, execution and design of the micro depots, there probably will not occur long term impacts as it is unclear if a delivery truck is substituted with a (cargo) bike: With the current concept emissions will probably not decrease and no mode-shift will occur.

Potentials for up-scaling in the city

- In principle, the storage box system is very simple and easy to use but the interest among CEP companies and other courier services is very low.
- Because of that, it is not foreseeable that delivery trucks are being substituted by cargo-bikes and with that, a lowering of emissions within the City of Munich.
- But there are some smaller companies interested in the usage of the boxes (e.g. a laboratory). This is reported by the courier firm who is in close contact with their customers.

STO 7.4 Night delivery with clean and silent vehicles

Abstract

The City of Stockholm strives to promote a sustainable, clean and efficient urban transport. In order to address this long-term goal of the city, innovative technological solutions are often required. This measure tests and evaluates a possibility for transferring some freight transports, which are typically conducted during the day, to the night time using modern sustainable vehicles.

In this measure 1 Plug-in hybrid electric vehicle was conducting night time deliveries to 6 locations, taking three delivery routes from the beginning of 2019. Noise and air emissions are minimised by automatically switching from diesel mode to battery mode when entering urban areas. Two sets of data were collected, i.e. acoustic data, that measured noise levels and transport data, comparing the night time driving time, time accuracy of time keeping, and emission levels to the synthesised routes data based on the day-time deliveries.

The results of this measure show that night time deliveries are more time- and energy efficient, can lead to reduced emissions, while the delivery noise slightly adds to the background levels. In particular, time necessary for a delivery during night time is in average 30% shorter than a comparable day time delivery, while the accuracy of time keeping can be slightly improved (from 91-95% in this case). Using a hybrid truck for goods deliveries can lead to a 40% decrease in carbon dioxide emissions (about 80kg decrease per operation) while the noise of the actual delivery levels has been observed to add a substantial 2 dBA to the existing background noise level, measured at a façade some 5 meters from the source, during noisy segments of the night, and for a noisy location in the city. Unless the equipment in the final stage of the delivery is improved (to be more silent), night time deliveries are found to be still more suitable for the areas of the city where background noise levels are already elevated, such as main streets.

Conclusions

Validated direct impact

- Nighttime deliveries can be up to 30% shorter than comparable day time deliveries.
- Using a hybrid truck, which operates on diesel in the outskirts and uses a battery in the inner part of the city, can
 - o reduce driving noise by 7.4 dBA,
 - o decrease carbon dioxide emissions by 40% per operation.
- Accuracy of time keeping can be improved.

Main lessons learned

- Involvement: High level of involvement in the project is necessary (regular meetings)
- Reality check: It is necessary to examine (the suitability) of the places, by conducting site visits
- Plan: it is useful to plan in detail and to communicate the plan through regular meetings.

Long term impact

This measure used only one PHEV (Plug-in Hybrid vehicle). However, night deliveries using hybrid vehicles have a potential for:

- improved energy efficiency (due to shorted time needed)
- improved delivery accuracy (due to less traffic at night)
- decreased emissions (due to use of a hybrid vehicle)
- noise regulation (using diesel mode outside of the city vs. battery mode in the inner city)

MAD 7.6 Prototype for an ultra-low emissions cargo vehicle

This measure was not able to complete the testing phase as planned. COVID-19 disturbances impeded the testing planned for April. Preliminary results are presented in this report, while a complete evaluation will be attempted at a later date.

Preliminary Conclusions

Validated direct impact

This evaluation has not been able to assess the direct impact of this measure. This evaluation was intended to be based on the consideration of the greenhouse gases (GHG) and pollutant emissions saved, energy consumption, vehicle performance (km travelled) and satisfaction of key stakeholders.

Main lessons learned

The experience gained from this measure provide the following lessons:

- The relevance of the regulatory framework. As the measure intended to develop an electric prototype suitable to the characteristics of urban delivery in Madrid, the existing regulations on freight delivery, and their expected changes in the future became a decisive for the definition of the prototype. During the design stage, many uncertainties were raised by the stakeholders mobilised in the process, and most of them could not be solved until the future scenario was at least partially clarified by the municipality through the approval of the new Air Quality Plan and local legislation. It can be concluded that it is necessary for those cities aiming at promoting the deployment of electric trucks to establish clear medium and long-term roadmaps clarifying the urban delivery policies they intend to deploy and their long-term objectives.
- Flexible management. The development of an industrial prototype is resource-intensive, mobilises many providers and is subject to a significant risk of cumulative delays. It is advisable to achieve a reasonable level of definition already during the project proposal drafting stage and to develop a flexible management approach with the ability to mobilise additional resources and to identify activities that could be run in parallel to compensate delays. Flexible management should include the revision of the demonstration stage, in order to establish sound alternatives in case the initial validation plans become unfeasible.

- Early consideration of the commercialisation potential. The commercialisation potential is a powerful driver, which is likely to put pressure on the measure team and to request for changes in the initial measure design. This was obvious at different stages in this measure: the initial objective of developing and compressed natural gas (CNG) truck was abandoned, in favour of an electric prototype; the size of the truck was changed, to cover what was considered to be the most popular vehicle in urban delivery in Madrid; the selection of providers of key components was influenced by the prospects of subsequent cooperation with these providers during the commercialisation stage. A comprehensive assessment of the commercialisation potential since the early stages of the project (and even during the proposal preparation stage) is likely to result in an effective networking with providers and other stakeholders, and a bolder business case for the prototype, simplifying the measure implementation and demonstration stages.

Long term impact

In accordance with the information provided by the measure team, and particularly from *Avia*, the technological partner, the long-term impact of this measure is likely to be substantial. In spite of the delays in the implementation of the measure, the demonstration is expected to be completed before the closure of the project, and the prospects are bright in what refers to the full commercialisation of the vehicle in the next years.

TUR 7.7 Introducing biogas for urban freight logistics

Abstract

Within measure TUR 7.7., the City of Turku was to cooperate with relevant stakeholders in order to promote the use of biogas for heavy duty freight vehicles. Gasum Biovakka Ltd. was to invest in two biogas trucks and use them in the company's own waste and organic fertilizer logistics as an example of short-distance transport. One LBG (Liquefied biogas) truck was planned to be running a route between the Turku Waste Water Treatment Plant and Gasum's biogas production plant transporting sludge that is processed to biogas. The other truck was to be delivering nutrition waste from biogas plant to local farmers. In addition, the city of Turku was to promote the use of biogas by 2 – 3 delivery vans or similar which operate e.g. food transport in the city area.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 7.7. was measured. Data for evaluation was derived from Gasum Ltd. company statistics, driver interviews, vehicle usage logs, the Technical Research Centre of Finland Ltd. and the measure leader.

As a result of the measure, two biogas trucks were operating in Turku and experiences had been gathered on their suitability for the specific purposes of freight. The city of Turku had succeeded in promoting biogas vehicles among its fleet, proven by the addition of 15 new gas vehicles to the fleet in 2019. All in all, biogas vehicles had proven a feasible and

environmentally friendly alternative to diesel/petrol vehicles in heavy traffic and among city fleets. The use of biogas as transportation fuel increased during the project and the number of registered gas vehicles rose significantly in Turku. Although these developments cannot be entirely be attributed to project impact due to the strong contributing influence of the measure's supporting activities, the measure provided a fine opportunity for showcasing biogas use in heavy traffic and served effectively in promoting biogas as a viable option for passenger cars. LBG/CBG (Compressed biogas) trucks have proven a viable and cost-efficient alternative in heavy traffic, a development to be attributed to project impact to a large extent.

Conclusions

Validated direct impact

- Two biogas trucks are operating in Turku.
- The city of Turku has succeeded in promoting biogas vehicles among their own fleet.
- The use of biogas as transportation fuel has increased during the project.
- The number of registered gas vehicles has risen significantly in Turku.
- LBG/CBG trucks have proven a viable and cost-efficient alternative in heavy traffic.

Main lessons learned

- Biogas vehicles have proven a feasible and environmentally friendly alternative to diesel/petrol vehicles in heavy traffic and among city fleets.
- A potential barrier is that currently the motors in LBG trucks have less horsepower than their diesel counterparts, which may in some cases reduce their suitability for certain functions. However, this barrier is valid only for the Finnish market, since the trucks in Finland require more horsepower than other European markets due to the forest and paper industry requirements.
- Another potential barrier is the LBG filling infrastructure – if it's not expansive enough, the operating radius especially with heavy traffic may prove too limited. Gasum is currently building 50 new LBG filling stations in Finland, Sweden and Norway which will cover the requirements of the logistics market.
- It was originally planned that the city of Turku would promote the use of biogas by 2 or 3 delivery vans or similar which operate e.g. food transport in the city area. This did not take place as there was no incentive budget that could be used for this, and information provision alone was not appealing enough for the companies. It would have helped to take this into account when planning the project.
- It is important to include the biogas communication material systematically to the different communication channels.

Long term impact

The measure has provided a fine opportunity for showcasing biogas use in heavy traffic and served effectively in promoting biogas as a viable option for passenger cars. During the project, the number of biogas vehicles (passenger cars) has risen significantly. It has been estimated that the only real limiting factor for increasing the share of biogas among transportation fuels in the long term is its production capacity.

MEASURES SHIFTED TO A PROCESS-BASED EVALUATION METHODOLOGY

The measures in this section are not delivering a MER in this deliverable, but instead follow a Detail Process Evaluation and deliver their reports together with the final evaluation deliverable D.8.5. The reasons behind this decision for each measure are detailed below.

STO 2.4 Dynamic occupancy-based parking fees

Measure 2.4 was testing two new technological solutions for measuring occupancy and enforcement of compliance with regulations. In particular, parking occupancy and parking enforcement is tested by using a Light Detection and Ranging (LIDAR) and Automatic Number Plate Recognition (ANPR) method. The technology tested, and the knowledge assembled, could support a potential implementation of dynamic fees in the future or/and could support manual enforcement in parking. Due to several issues, including delays in planning, legal issues, and a high fluctuation of personnel working with the measure as described below, it was difficult to produce a reliable quantitative measurements of the KPIs, thus the impact evaluation report (MER) was not delivered.

First, the planned measure was not feasible in the time frame of the Eccentric due to legal restrictions. A new focus had to be found which caused a delay in the implementation of the measure due to the extended planning phase. Second, this measure was initially merged with measure 2.5. This merging complicated the identification of the KPIs and increased the dependency on the developments within measure 2.5, which also experienced needs for re-defining the focus and problems with implementation. Third, the measure was dealing with a highly innovative technological solutions, for which the former measure leader was unsure what will be possible to measure. And lastly, there was a high fluctuation of the personnel, among both the measure leaders and the evaluation team at KTH.

The implementation of the measure produced valuable, qualitative, knowledge nevertheless. The issues that occurred in each of the phases of the project, as well as the barriers and drivers, are detailed in the process evaluation report (PER). This qualitative knowledge can be useful for learnings in the aspects of upscaling or replications within the City of Stockholm and in other cities.

STO 2.5 Green parking standards in Åstra city development

Measure STO 2.5 was exploring whether attaching a freight transport by using sustainable vehicles (an e-cargo bike and an electric car) to the reuse and recycle pop ups stations can contribute to car-independent lifestyles in the cities. The focus of the measures differed from what was planned for initially. Due to the below describe issues, including delays, legal issues, methodological difficulties and a high fluctuation of personnel working with the measures, it was concluded that the impact evaluation report (MER) is less valuable and is not delivered. Instead a detailed process evaluation report (PER) is delivered.

The implementation of STO 2.5 experienced first, several delays in the planning the measure. Since there were no existing buildings built under the new legislation (green standards related) which the measure initially intended to investigate, the initial plan was not feasible. Second, this measure was merged with measure STO 2.4 in the beginning. This complicated identification of the KPIs for each of the measures and increased the dependency on the

(problematic) development of measure STO 2.4. Third, the measure was conducted using qualitative methods, which made it difficult to convert the qualitative findings into the required quantitative KPIs. Fourth, a common measure leader was designated to both STO 2.4 and STO 2.5, which experienced a change in the last year of the project. This, in addition to the changes in the evaluation team at KTH, led to delays due to the need for synchronizing understandings around Eccentrics objectives and its requirements around the KPIs.

The implementation of the measure however produced very valuable, qualitative knowledge. This knowledge is summarized in the process evaluation report, which is more suitable for presenting the assembled qualitative data.

MUC 3.4 Beacon based indoor routing as a mobility service app

Measure MUC 3.4 consists of developing a routing application for blind and visually impaired persons based on existing services of the local public transport corporation. This was done by installing Bluetooth beacons at the mezzanine floor of the PT station Münchner Freiheit. These beacons interact with users' handheld devices, providing needed information to facilitate the mobility of this target group within public transport stations.

During a comprehensive field test it was found out, that the App did not work as expected and assured by the producer (main problem: Inaccuracy of localization like time delay, late recognition of the direction). After an intensive and detailed product evaluation, MLs institution decided to stop further investigation on this technical approach due to severe security concerns. The used technique was seen as not appropriate for an indoor navigation, especially for a highly vulnerable group like blind people. That is why the App is currently not in use until further notice. Therefore, a quantitative database for a MER is not available.

At the same time MVG now works intensively on optimising the service for blind and visually impaired people regarding orientation at a public transport station and discuss how the previous findings of MUC 3.4 help us to offer a better digital service for blind and visually impaired people. MVG and the Munich LEM therefore consider the value of a description of drivers and barriers within a Detailed Process Evaluation Report (PER) to be more helpful in terms of replication or upscaling a solid service for blind and visually impaired people in the near future.

RUS 3.6 Mobile app and internet portal for PT

Ruse had to develop Process Evaluation Report for Measure RUS 3.6 instead of a Measure Evaluation Report as the implementation of the measure was delayed compared to the initial plan mainly due to long administrative procedures for coordinating the elaborated by the municipal administration terms of reference for the mobile app with the State e-Government Agency. As result, Ruse Municipality decided to sign a contract for external consultancy services in order to meet the requirements of the State Agency and to find the best solution to introduce the new mobile app.

This delay in the implementation of the measure did not allow the elaboration of a detailed measure evaluation report as the effect of the implementation of the measure could not be examined during the duration of the project.

RUS 5.3 Analysis of PT demand and reorganization of PT network in Druzhba (data collection)

Ruse had to develop Process Evaluation Report for Measure RUS 5.3 instead of a Measure Evaluation Report as the actual implementation of the reorganization of the public transport lines in the peripheral district and in the municipality as a whole, could not be done during the duration of the project.

As a result of the Research and measure planning phase, the analysis made by the Ruse implementation team led to the decision of upscaling the measure to encompass the whole territory of the municipality. Only this way the Druzhba district could be better connected by public transport to the rest of the city. Thus, reorganisation of the public transport lines in Druzhba was financed by the CIVITAS ECCENTRIC project, while the Municipality decided to finance with its own budget the work being carried out for the rest of the territory.

As result of the work during the project, the Municipal Council of Ruse adopted in Sept. 2019 a completely New Transport Scheme for the territory of the municipality. However, for the actual implementation and evaluation of the impact, Ruse needs to purchase new rolling stock for public transport in order service the new PT lines. Ruse Municipality is currently implementing another EU financed project for the purchase of new electric buses and trolleybuses and is preparing the public procurements for choosing the operators for the lines of the new transport scheme, which will not be completed until the end of the project.

MUC 5.6 Conception and development of an integrated e-bike sharing scheme

Within measure MUC 5.6 the particular focus was on the development of a MVG eTrike and a subsequent integration in the existing bike sharing scheme (MVG Rad) as part of a multimodal public transport system and solution for medium distances in a city as well as its surrounding area. Target groups are mobility-impaired people and people who want to carry heavy loads.

Unfortunately, many, predominantly technical, problems occurred during the development of the prototype, mainly due to different partners and systems who/which have to fit together. Major problems are related to the connectivity of the different components, e.g. the motor controller which is not properly communicating with the board computer. Despite intensive investigation work that was done to fix existing product limitations, the prototype could not be tested in the living lab yet. For this reason, there is no quantitative database available for a MER production, but already some findings due to an ex ante survey.

MVG hopes to carry the test in the living lab in spring/summer 2020. MVG and the Munich LEM therefore consider the value of a description of drivers and barriers within a Detailed Process Evaluation Report (PER) to be more helpful for ongoing and future developments on eTrikes for mobility-impaired people.

MUC 6.3 Electric light-weight vehicles – one for all

Due to technical developments concerning the Adaptive City Mobility (ACM) vehicle and infrastructure, which were part of a different research project (ACM2 funded by the German Federal Ministry for Economic Affairs), the research design for the ECCENTRIC measure MUC 6.3 (ACM) was adapted.

Mainly, the long-term ACM fleet tests were replaced by fleet tests events, in which potential customers were driven around in the ACM vehicles as passengers. While it has enabled GCX to successfully generate insights and results to promote the use of electric lightweight vehicles for car sharing and logistics, the results are qualitative rather than quantitative. Among others, a deep understanding on use cases, relevant ACM marketing strategies and sustainability potentials were obtained. The results being qualitative can be put down to the fact that the short-term field tests allowed an approximate ACM usage experience for the customers, which was then examined.

However, no long-term customer perceptions and routines or ecological effects could be measured, since these did not actually take place. Therefore, the quantitative KPI approach no longer is adequate to evaluate ACM, which is why it was decided in a common meeting between the ML and the LEM to hand in an extensive PER instead of a MER for the measure MUC 6.3.

MUC 7.5 Neighbourhood oriented concierge system at the development area Domagkpark

The main goal of the measure was to reduce vehicle kilometres travelled by delivery trucks in the demonstration area. As a result, energy use and emissions (CO₂, NO_x, PM) are decreasing, congestion is reduced, contributing to better social inclusion, liveability, and efficiency of urban freight.

As quantifiable impacts were scheduled: Awareness and acceptance of the concierge system, satisfaction with the service, mode shift towards sustainable modes, avoided VKT by delivery trucks, reduced emissions, CO₂, NO_x and PM (Particulate Matter).

The service with the name “DomagkWerk” has launched in October 2017 and in spring 2019 the operator has decided to leave the project as it was not possible to maintain the service. Main reason was a lack of profits and a financial loss with every parcel handled. ML has found a new operator (called “Shubidoo”) who restartet the concept in a modified way in April 2019.

The main reason for the abandonment of the first operator was the low interest and motivation the CEP companies brought into the process. They basically should deliver the parcels to the concierge (DomagkWerk) and the DomagkWerk should do the last-mile delivery with emission free cargo bikes on costs of the delivery firms. At least that’s what the CEP companies prospected within the first conversations with the ML. In the end the CEP companies denied to finance this concept. So only a pure Parcelshop could be established and the initial idea of MUC 7.5 could not be pursued. Several approaches later on towards the CEP companies weren’t successful either as the CEP companies state that they wouldn’t offer a special service tailored to the individual needs of a small area, like the Living Lab.

Only very few ecofriendly delivery trips could be carried out in trial operation and a collection of meaningful figures for the “quantifiable impacts” was not possible in terms of avoided VKT by delivery trucks, reduced emissions CO and reduced emissions NO_x, PM.

The MI and LEM therefore consider the value of a description of drivers and barriers within a Detailed Process Evaluation Report to be more helpful in terms of replication or up scaling than an incomplete and insufficiently meaningful set of figures of a Measure Evaluation Report

ANNEX

Complete Measure Evaluation Reports

WORK PACKAGE 2: INCLUSIVE URBAN PLANNING, NEW PARKING POLICIES AND MOBILITY MANAGEMENT

TUR 2.1 CITIZEN AND STAKEHOLDER INVOLVEMENT IN MOBILITY PLANNING AND PRODUCTION OF NEW MOBILITY SERVICES.....	103
TUR 2.2 CITY DISTRICT / URBAN CORRIDOR CASES AS PILOTS FOR SUSTAINABLE URBAN MOBILITY.....	127
MAD 2.3 ADAPTIVE PARKING MANAGEMENT BASED ON ENERGY EFFICIENCY AND OCCUPANCY.....	167
RUS 2.6 PARK & RIDE IN THE PERIPHERAL DISTRICT.....	197
MUC 2.7 COMMUNITY INFORMATION AND PARTICIPATION PORTAL.....	228
MAD 2.8 MOBILITY MANAGEMENT STRATEGIES FOR VULNERABLE GROUPS.....	269
MUC 2.9A NEIGHBOURHOOD ORIENTED MARKETING OF SUSTAINABLE MULTIMODAL MOBILITY SERVICES: DIRECT AND DIALOGUE MARKETING.....	307
MUC 2.9B NEIGHBOURHOOD ORIENTED MARKETING OF SUSTAINABLE MULTIMODAL MOBILITY SERVICES: MOBILITY MANAGEMENT FOR LOCAL SCHOOLS.....	354
MUC 2.9C NEIGHBOURHOOD ORIENTED MARKETING OF SUSTAINABLE MULTIMODAL MOBILITY SERVICES: MOBILITY MANAGEMENT FOR COMPANIES.....	404
MUC 2.10 TRANSFER – EXCHANGING COMMUNICATION AND INFORMATION TECHNOLOGY FOR EVERYDAY MOBILITY BETWEEN GENERATIONS.....	440
RUS 2.11 INFORMATION, TRAINING AND AWARENESS RAISING.....	477

WORK PACKAGE 3: MOBILITY AS A SERVICE FOR AND BY ALL

TUR 3.1 & TUR 3.2 SMART MULTIMODAL MOBILITY SERVICES: APPLYING MOBILITY AS A SERVICE CONCEPT & INTEGRATED TICKETING AND INFORMATION SYSTEM FOR MOBILITY.....	509
MAD 3.3 OPEN PLATFORM FOR MULTIMODAL MOBILITY INFORMATION AND SERVICES.....	548
STO 3.5 DEVELOP SMART CHOICE OF MOBILITY SERVICES.....	574
MUC 3.7 THE APP FOR THE CITY LAB.....	601

WORK PACKAGE 4: ENABLING SAFE WALKING AND CYCLING

MAD 4.1 INNOVATIVE AND PARTICIPATIVE APPROACH TO TRAFFIC SAFETY ON A NEIGHBOURHOOD LEVEL.....	636
MUC 4.2 SOFTWARE-CONTROLLED SAFETY MANAGEMENT IN THE ROAD NETWORK.....	662
RUS 4.3 PROVIDING SECURE PEDESTRIAN CROSSWALKS.....	713
RUS 4.4 SAFE SIDEWALKS WITH CYCLING FACILITIES IN THE PERIPHERAL DISTRICT.....	743
STO 4.5 POLICY FOR REROUTING CYCLISTS DURING CONSTRUCTION WORK.....	772
MAD 4.6 PEDESTRIAN FRIENDLY PUBLIC SPACE OUTSIDE THE CITY CENTER.....	793
MAD 4.7 ENABLING CYCLING OUTSIDE THE CITY CENTER.....	827
TUR 4.8 EASY, SAFE AND COMFORTABLE CYCLING AND WALKING ROUND THE YEAR.....	858
STO 4.9 OFFERING TEST FLEETS OF E-BIKES AND E-FREIGHT BIKES.....	899

WORK PACKAGE 5: EFFICIENT AND CLEAN PUBLIC TRANSPORT SOLUTIONS

MAD 5.1 HIGH-LEVEL PT SERVICE CORRIDORS IN PERIPHERAL DISTRICTS.....	922
STO 5.2 SPEED UP CORE BUS ROUTES.....	959
RUS 5.4 INTRODUCTION OF A NIGHT LINE TO DRUZHBA (AFTER 21 H) WITH GNC BUSES.....	986
TUR 5.5 BIKE-SHARING AND CAR-SHARING SCHEMES.....	1017
TUR 5.7 INTRODUCTION OF ELECTRICAL PUBLIC TRANSPORT.....	1057
MAD 5.8 ELECTRIC AND HYBRID BUSES FOR PUBLIC TRANSPORT.....	1089
MUC 5.9 INTERMODAL (E-) MOBILITY STATIONS.....	1116
MUC 5.10 SUSTAINABLE MOBILITY VIA E-SCOOTER SHARING.....	1174

WORK PACKAGE 6: PROMOTING THE UPTAKE OF CLEAN VEHICLES

STO 6.1 OFFERING EV-REST FLEETS TO SELECTED TARGET GROUPS.....	1220
MAD 6.2 TEST FLEETS, POLICY INCENTIVES, AND CAMPAIGNS FOR THE UPTAKE OF ELECTRIC VEHICLES.....	1244
TUR 6.4 ELECTRIFICATION OF MUNICIPAL FLEET & PROMOTION OF ELECTRO-MOBILITY.....	1275
STO 6.5 DEVELOPING THE CLEAN VEHICLE WEB PORTAL (MILJOFORDON).....	1311
STO 6.6 MASTER PLAN FOR DEVELOPING EV-CHARGING IN STO.....	1330
STO 6.7 PROMOTE INSTALLATION OF EV-CHARGING FACILITIES IN MULTIFAMILY HOUSES.....	1360
MAD 7.1 CONSOLIDATION CENTER WITH EVS AND LOCAL REGULATIONS FOR CLEAN URBAN FREIGHT LOGISTICS.....	1383

WORK PACKAGE 7: TOWARDS BETTER AND CLEANER URBAN FREIGHT LOGISTICS

STO 7.2 CONSOLIDATING STO MUNICIPAL FREIGHTS.....	1417
MUC 7.3 SUSTAINABLE CITY LOGISTICS BY COMBINING CARGO-BIKE-DELIVERY-SERVICES WITH A FLEXIBLE STORAGE SYSTEM.....	1440
STO 7.4 NIGHT DELIVERY WITH CLEAN AND SILENT VEHICLES.....	1468
TUR 7.7 INTRODUCING BIOGAS FOR URBAN FREIGHT LOGISTICS.....	1496



2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



TUR 2.1

Citizen and stakeholder involvement in mobility planning and new mobility services

Measure Evaluation Report

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3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
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12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
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17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
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20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
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List of Co-authors

Mari Sinn	
Stella Aaltonen	
Marja Tommola	

Table of Contents

ABSTRACT.....	109
A. INTRODUCTION.....	110
A.1 EXPECTED RESULTS OF THE MEASURE.....	110
A.1.1 Quantifiable impacts.....	110
A.2 MEASURE DESCRIPTION.....	111
A.2.1 Measure outputs.....	111
A.2.2 Supporting activities	111
A.2.3 Interactions with other ECCENTRIC measures.....	111
A.2.4 Interactions outside ECCENTRIC	111
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION.....	111
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	111
A.5 IDENTIFIED RISKS.....	112
B. MEASURE IMPLEMENTATION	113
B.1 SITUATION BEFORE CIVITAS.....	113
B.2 INNOVATIVE ASPECTS.....	113
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	113
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE.....	113
C. IMPACT EVALUATION FINDINGS	116
C.1 EVALUATION APPROACH.....	116
C.1.1 Expected impacts and indicators.....	116
C.1.2 Baseline.....	117
C.1.3 The business-as-usual scenario.....	118
C.2 MEASURE RESULTS.....	119
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES.....	121
D. PROCESS EVALUATION FINDINGS	122
HERE THE MAIN FINDINGS OF THE PROCESS EVALUATION ARE SUMMARISED. MORE DETAILS ARE AVAILABLE IN THE PROCESS EVALUATION REPORT OF THIS MEASURE.....	122
D.1 DEVIATIONS FROM THE ORIGINAL PLAN.....	122
D.2 BARRIERS.....	122
D.2.1 Involvement/communication.....	122
D.2.2 Political/strategic.....	122
D.2.3 Problem-related	122
D.2.4 Planning.....	122

D.3 DRIVERS.....	122
<i>D.3.1 Involvement/communication</i>	123
<i>D.3.2 Positional</i>	123
D.4 SUPPORTING ACTIVITIES.....	123
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS.....	123
<i>D.5.1 Emphasize communication</i>	123
<i>D.5.2 Recognize that change takes time</i>	123
E. EVALUATION CONCLUSIONS	124
E.1 VALIDATED DIRECT IMPACT.....	124
E.2 RELEVANCE OF SUPPORTING ACTIVITIES.....	124
E.3 INTERACTION WITH OTHER MEASURES.....	124
E.4 MAIN LESSONS LEARNED.....	124
E.5 LONG TERM IMPACT.....	125
E.6 POTENTIALS FOR UP-SCALING IN THE CITY.....	125
F. ADDITIONAL INFORMATION.....	126
F.1 APPRAISAL OF EVALUATION APPROACH.....	126
F.2 FUTURE ACTIVITIES RELATING TO THE MEASURE.....	126

List of Tables

Table 1: Quantifiable impacts.....	110
Table 2: Target groups or affected parties.....	111
Table 3: Measure stakeholders.....	112
Table 4: Risk assessment.....	112
Table 5: Description of indicators.....	116
Table 6: Measurements.....	116

Project	City		
ECCENTRIC	Turku		
Measure code	Measure name		
TUR 2.1.	Citizen and stakeholder involvement in mobility planning and new mobility services		
Last update	Responsible	e-mail	telephone
6/5/2020	Marja Tommola	marja.tommola@valonia.fi	+358 40 832 8515

Abstract

Measure TUR 2.1. aimed to evaluate and adopt participatory methods and good practices and to test and utilize the possibilities brought by new technologies and social networks (mobile apps, social media) in the development of participatory mobility planning. A case study in developing a concept for interactive and participatory planning concerning inter-modal solutions in public transport, particularly park and ride was then implemented based on the good practices gathered. Knowledge on mobility preferences was also gathered via producing a mobility barometer. The measure had a regional approach and it reached a wider target group than Turku citizens alone in the neighboring municipalities (Turku, Raisio, Naantali, Kaarina and Lieto).

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data is gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-ante when impact of TUR 2.1. was measured. Data was derived from surveys, policy documents and from the Measure Leader.

Overall, the measure reached its objectives satisfactorily. Knowledge on mobility preferences in the region increased during the measures and the citizens felt they had gained slightly improved possibilities to participate in mobility planning. Participatory methods were tested in conjunction with developing the park-and-ride plan, which successfully provided the first development plan for park-and-ride of both private cars and bicycles in the Turku core region. It became evident during measure implementation that participatory planning as such has not become firmly established in local and regional planning yet. Changing this culture of planning is a complex process that requires time and continued efforts. According to evaluation results, integrating participatory methods into project/policy-based transport planning provides an opportunity to change planning culture little by little.

A. Introduction

A.1 Expected results of the measure

The measure objectives were as follows:

City level in relation to CIVITAS goals/ longer term:

- To formulate participation routines, participation methods and good practices into clear structures for active involvement of citizens and stakeholders, to facilitate local partnerships and cooperation with private sector actors in a planning process as well.
- To adopt new technologies and social networks (mobile apps, social media) as part of planning process.
- To remove the continuous lack of information concerning mobility preferences in Turku region.

Strategic level:

- To develop the mobility planning practices at a strategic planning level towards more participatory, transparent and interactive planning approach, in general to develop Finnish mobility planning practices towards more participatory SUMP process.
- To increase the valuation of sustainable mobility by offering real time information.
- To support the responsible and effective usage of public and private recourses for park-and-ride.

Measure level:

- To evaluate and adopt participatory methods and good practices developed e.g. in other SUMP projects.
- To produce a mobility barometer to be included in a continuing mobility planning process.
- To increase knowledge on mobility preferences.
- To test and utilize the possibilities brought by new technologies and social networks (mobile apps, social media) in the development of participatory mobility planning.
- To commit a case study in developing a concept for interactive and participatory planning concerning inter-modal solutions in public transport, particularly park and ride (car and bicycles).

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	Increased number of citizens and stakeholders involved in planning process						x				
2	The number of citizens and stakeholders involved in mobility barometer						x				

Table 1: Quantifiable impacts.

A.2 Measure description

In Measure 2.1., the Regional Council of Southwest Finland aimed to develop new planning approaches and test the possibilities brought by new technologies and social networks (mobile apps, social media) for interactive and participatory planning. Participatory planning methods and practices were to be mapped and reviewed. Supported by these new approaches and technologies Turku was to commit a case study to test and utilize the developed co-operation model and new technologies to enhance smart intermodal solutions in public transport planning, particularly park-and-ride, in the Turku region. A mobility barometer was also to be developed to increase knowledge on citizens' satisfaction on sustainable mobility infrastructure and mobility services.

The measure was of regional nature, the target area being not only Turku but also the municipalities Raisio, Naantali, Kaarina and Lieto. Together they form the core city region.

A.2.1 Measure outputs

As a concrete output of the measure, a plan for park-and-ride was developed and a mobility barometer survey performed.

A.2.2 Supporting activities

No supporting activities were identified for this measure.

A.2.3 Interactions with other ECCENTRIC measures

The measure was particularly connected with measures RUS 2.6., in which park-and-ride was piloted in a peripheral district, and TUR 2.2. "City District / Urban Corridor Cases as Pilots for Sustainable Urban Mobility". TUR 2.2. was focused on the Kupittaa laboratory area development and facilitated the planning process in TUR 2.1. by mapping out possible sites for park-and-ride within and nearby the Kupittaa area.

A.2.4 Interactions outside ECCENTRIC

In project "HEAT- Participatory urban planning for healthier urban communities" (Central Baltic Interreg 2018-2020) participative methods were going to be developed further.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents	Region	Residents in the Turku region
2	Car drivers / motorists	Region	Residents in the Turku region
3	Public transport users	Region	Residents in the Turku region

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role – Links

1	The Regional Council of South-West Finland	P	Other (regional actor)	L	Measure leader, regional authority
2	The City of Turku	P	C	P	Partner
3	Neighbouring municipalities	S	C	P	Stakeholders of regional mobility planning, including park-and-ride development
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Lack of participation in the regional mobility barometer	5	Well-planned communication in order to ensure that all relevant actors are reached	RCSW, City of Turku
No control sample possible for the regional mobility barometer	3	A baseline barometer with a large enough sample	RCSW, TUAS
Political changes in the regional administration as the first regional election will be held in 2018	1	Continuation of ongoing strategies and objectives is guaranteed at least to some extent by the permanent civil servants	RCSW

Table 4: Risk assessment.

B. Measure implementation

B.1 Situation before CIVITAS

In Finland, mobility planning is continuing, well established, structured and focuses on development of the transport system in all transport modes. Sustainable urban mobility planning takes particularly place within the structured, continuous work on regional mobility planning. This planning process is, however, rather professional-oriented and lacking of stakeholder involvement. Thereby challenges were identified in citizen participation processes and on some level also in institutional co-operation between sectors and disciplines. A need to develop the planning process and to gain information on new sustainable transport modes and modal share had also emerged. To further develop the planning process particularly from the point of view of citizen involvement, the Regional Council of Southwest Finland was to develop participatory procedures and fill the lack of information concerning sustainable mobility.

B.2 Innovative aspects

Planning for park-and-ride was a novel issue in Turku.

B.3 Research and Technology Development

No specific research and technology developments were at the focus of this measure.

B.4 Actual implementation of the measure

For the most part, the measure proceeded as planned. Measure leader was changed in spring 2019 as Marja Tommola took over from the first ML, Mari Sinn.

Phase 1: Research and measure planning milestones (100 % completed)

The research and planning phase of this measure commenced in September 2016 and was completed in August 2017. The following activities were carried out during this phase:

M1-M7

A detailed report on interactive and participatory planning was authored and published in March 2017 and promoted subsequently. The report described new ways and methods to carry out participatory and interactive planning processes. Related to the report, two seminars were organized for the region's municipalities with the aim of explaining the relevance of participation and interaction in planning. A total of 13 municipalities in the Turku region were surveyed about their level of experience with participatory planning concurrently. A walking forum was organized for regional planners in February 2017 to discuss planning approaches. RCSWF was responsible for these actions and Turku city provided content input for the report and organized a seminar for municipality employees to use the results of the report published.

M5-M12

The mobility barometer was developed during this phase to survey and examine the views and attitudes of the residents in Turku core region concerning the objectives and measures of the Turku regional traffic system plan. The survey was realised online in March-April 2017. The survey was promoted widely through social media and local media. In addition, more than 130

persons from schools and associations were informed about the survey and asked to encourage their members / school children to take the survey.

M6-M11

A work plan for the Park & Ride scheme was drafted partly based on the results from the report on participatory planning methods. A consultant was contracted to support the identification of the region's park-and-ride demand and to develop a concept for planning and implementation. The tender was launched in April 2017, the consultant was selected in June 2017 and the implementation started in August 2017

Baseline data was collected for evaluation purposes.

Phase 2: Procurement and implementation (100 % completed)

The procurement and implementation phase of this measure commenced September in 2017 and was completed in August 2018. The following activities were carried out during this phase:

M12-M23

Detailed planning process of the park-and-ride scheme and related participatory methods took place. RCSWF guided the consult company, WSP Finland, and actively participated in the steering group, meetings and workshops related to the scheme. The city of Turku was part of the steering group of the park-and-ride planning and took actively part in workshops organized.

Information was prepared on mobility to the websites, social media and local authorities and spread to regional transport planning actors. A website called Kulje.fi was established during the European mobility week. The website was aimed at citizens, companies politicians and authorities, with the intention of making transport planning and various developments surrounding it visible in the Turku region.

The park-and-ride-plan was published May 2018. The purpose of the plan was to produce a feasible park-and-ride development concept for the region and to recognize the potential relevant park-and-ride locations in the region both on a short term and a long term time span.



Picture 1. The current status of park-and-ride in the region (excerpt from the scheme)

Phase 3: Demonstration and monitoring (100% completed)

The demonstration and monitoring phase of this measure commenced in September 2018 and completed in December 2019. The measure was well in advance in completing its activities and the main task during this phase was the second round of the mobility barometer. Based on evaluation requirements some questions were added to the barometer. The survey was open 21.10.-30.11.2019. Preliminary analysis of results took place.

The Kulje.fi website was further developed.



Picture 2. The Kulje.fi website.

Phase 4: Conclusions and recommendations (70% completed)

Conclusions and recommendations of this measure commenced in August 2019 and were to be completed in January 2020.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact						
Indicator name	Awareness	Acceptance	Satisfaction	Contribution to SUMP	Investment costs	Operational costs
Type	KPI	KPI	KPI	KPI	KPI	KPI
Category	Society	Society	Society		Economy	Economy
Subcategory	Acceptance	Acceptance	Acceptance		Costs	Costs
Aspect	Awareness	Acceptance	Acceptance	Governance	Costs	Operating costs
Definition	The awareness of the general public in Turku and 4 surrounding municipalities on sustainable mobility.	The percentage of the population who favourably receive or approve of the measure	Satisfaction in the participatory methods for mobility planning	Qualitative measurement on the process to modify SUMP in a significant and definitive way.	Capital investment costs of the measure	Average operating costs of the measure
Impact						
Indicator name	Participatory chances					
Type	Additional					
Category	Society					
Subcategory	Acceptance					
Aspect	Awareness					
Definition	The possibilities to participate in mobility planning.					

Table 5: Description of indicators.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	B – A	S	Turku region residents	Turku region
2	Acceptance	%	B – A	S	Turku region residents	Turku region
3	Satisfaction	Score (0-5)	A	S	Turku region residents	Turku region
4	Contribution to SUMP	Score (0-5)	B – A	DC	Decision makers	Turku region
5	Investment costs	€	A	DC	RCSWF, consulting company	Turku region
6	Operating costs	€	A	DC	RCSWF	Turku region
7	Participatory chances		B – A	S	Turku region residents	Turku region
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Measurements.

C.1.2 Baseline

The measure at hand was of regional nature, thus focusing not only on Turku, but also on the surrounding municipalities Raisio, Naantali, Kaarina and Lieto. The baseline was thereby formed of the situation in regional participatory mobility planning prior to the implementation of the measure in these municipalities. It was derived from several sources. As a main source of information, the Regional Council of South-West Finland performed a regionally oriented online survey, the mobility barometer (or traffic environment survey) in Finnish, in spring 2017. The survey report contained results and a summary of the Turku core regions traffic environment survey. The main objective of the survey was to examine the views and attitudes of the residents in Turku core region concerning the objectives and measures of the Turku regional traffic system plan. The target group was residents over 15 year of age in the Turku region. Altogether 3530 replies were recorded. It should be noted that the results could not be widely generalized and therefore the conclusions are considered to be only indicative.

The content of the Turku core region traffic environment survey was based around the following development policies in Turku region traffic system plan 2035+: an attractive and comfortable pedestrian and cycling city, high service public transport city, functional car traffic and safe traffic and wise choices. The residents' views on developing measures concerning sustainable traffic modes, such as cycling, pedestrian and public transport were especially taken into account in the survey as the regional traffic system plan pursues significant increase in cycling, walking and public transport users.

In addition to the survey, baseline data was derived from the SC and ML (investment and operating costs) and secondary data analysis (Contribution to Policies, Plans and Programs).

KPI 1: Awareness describes the awareness of the general public in Turku and four surrounding municipalities on sustainable mobility. According to the traffic environment survey, 19.7% of the respondents (n=3352) stated that environmental and sustainability issues had an impact on their preferred mode of travel.

KPI 2: Acceptance refers to the acceptance of participatory planning approaches in the region. According to the traffic environment survey, 70.3 % of the respondents (n=3236) felt that interactive cooperation between citizens and organisations should be improved to promote walking and cycling conditions in the Turku region.

KPI 3: Satisfaction describes the satisfaction in the opportunities to participate in traffic planning in one's home city. Due to the fact that the traffic environment survey was planned and distributed prior to the measure evaluation framework being set, the LEMs were not able to influence the questions. Hence there was no baseline data available for satisfaction.

KPI 4: Contribution to Policies, Plans and Programs relates to the impact the measure may have on policies or strategies to develop public participation in mobility planning processes. The state concludes agreements concerning land use, housing and transport (MAL) with the main city regions of Finland. These agreements enhance cooperation among the municipalities in the respective city regions and between the municipalities and the state in the steering of community infrastructure and coordination of land use, housing and transport. In the Turku region MAL agreement (2016-2019) it is mentioned that within the contract period open data access for different facets of the public transport system information shall be promoted. Nothing is mentioned on increasing public participation in mobility planning processes or filling the lack of information concerning sustainable mobility.

Transport system planning in South-West Finland (of which the Turku region is part) is guided by traffic system planning, comprised of Turku Region Traffic System Plan 2035 and the South-West Traffic Strategy 2035+, both from 2014. The plans support the fulfillment of the goals on traffic system development as stated in the above-mentioned MAL agreement. Nothing is mentioned on involving citizens in transport system planning in the Turku Region Traffic System Plan. In the South-West Traffic Strategy, development of methods for involvement of youth to promote safe and responsible traffic behavior and increasing opportunities for participation is mentioned once.

Overall it could be stated that participatory planning practices and stakeholder involvement were not very strongly promoted by policies on regional level. **Score: 2.**

Additional indicator 7: Participatory chances refers to the possibility to participate in mobility planning. According to the traffic environment survey, only 21.8% of the respondents felt that they had a possibility to participate in mobility planning in the Turku region. Nearly two out of three (60,8 %) of the respondents considered that there were not enough possibilities to participate in mobility planning although there would be a need for it.

C.1.3 The business-as-usual scenario

There were ongoing processes and projects in the Turku region which aimed to enhance communication on issues related to sustainable mobility, both towards the citizens and local politicians. A website Kulje.fi was being established to inform what and why was being done re. sustainable mobility in the Turku region –as well as what would happen if certain measures were not taken in this development process. The aim was to inform the people in an easy-to-understand, enticing manner. It was possible this would have been done without project input. Without the measure, it was therefore likely that sustainable mobility promotion would have been realized within other processes – however, a concerted effort to develop participatory planning practices was likely not to have happened within the near future.

Indicator	Unit	BaU	Date BaU
Awareness	%	Without the measure it was probable that awareness of sustainable mobility in the Turku region would have developed to some extent – however likely not in the same speed as it would as the result of the measure. Awareness would have been built via more traditional participatory methods, such as meetings, forums and planning cooperation. It was therefore assumed that the BaU was similar to baseline.	3/2018
Acceptance	%	The acceptance of participatory planning approaches has not been previously estimated. It can be assumed that BaU was the same as or very similar to baseline.	3/2018

Participatory chances	%	It was assumed that the BaU was similar to baseline.	10/2018
Satisfaction	Score (1-5)	Estimating the business-as-usual level for satisfaction on participatory planning approaches without the effect of the measure was challenging. It could be assumed that BaU was the same as or very similar to baseline.	3/2018
Contribution to Policies, Plans and Programs	Score (1-5)	It was assumed that the BaU was similar to baseline.	3/2018
Investment costs	€	It was assumed that the BaU was similar to baseline.	3/2018
Operating costs	€	It was assumed that the BaU was similar to baseline.	3/2018

C.2 Measure results

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	19.7	4/2017	19.7	3/2018	23.1	12/2019	3.4	3.4
Acceptance	%	70.3	4/2017	70.3	3/2018	67	12/2019	-3.3	-3.3
Participatory chances	%	21.8	4/2017	21.8	10/2018	26	12/2019	4.2	4.2
Satisfaction	Score (0-5)	N/A	2017	N/A	3/2018	29	12/2019	29	29
Contribution to Policies, Plans and Programs	Score (0-5)	2	3/2018	2	3/2018	4	12/2019	N/A	N/A
Investment costs	Tendering of the park-and-ride plan (€): 49 912,50								
Operating costs	RCSWF own working hours (hourly rate 35 €, average calculated from all the hourly rates of RCSWF Civitas employees): Park-and-ride plan: 3990€ (0,75PM) Mobility barometer: 29 260€ (5,5 PM)								

The ex-post data was derived from several sources in this measure:

- The regional mobility barometer, conducted by the Regional Council of South-West Finland 20.10.-30.11.2019, provides ex-post data on indicators awareness, acceptance, satisfaction and participatory chances.
- Secondary data analysis on was performed for assessing indicator Contribution to Policies, Plans and Programs.
- Data on investment and operating costs was derived from the ML.

According to the data from the regional mobility barometer, **awareness** of the general public in Turku and four surrounding municipalities on sustainable mobility had increased. According to the 2019 survey, 23.1% (n=2834) of the respondents stated that environmental and sustainability issues had an impact on their preferred mode of travel. There was a slight increase from the 2017 survey, where the share was 19.7%. **Acceptance** of participatory planning approaches in the region, on the other hand, had slightly decreased. According to the 2019 traffic environment survey, 67% of respondents (n=2713) felt that interactive cooperation between citizens and organisations should be improved to promote walking and cycling conditions in the Turku region, a three-percent drop from 2017.

According to the regional mobility barometer, 26% of the respondents felt they had at least some possibility to **participate** in mobility planning in the Turku region (n=2523). 61% of the respondents felt that there were not enough possibilities to participate in mobility planning although there would have been a need for it. The perception on the existing participatory chances of the citizens had thereby increased somewhat, as the respective figures from the 2017 survey were 21.8% and 66%. Unfortunately, as there was no data available on **satisfaction** in participatory planning chances, only assumptions could be made about satisfaction in participatory possibilities. In the 2019 survey, 29% of the respondents (n=2486) expressed that they were either satisfied or somewhat satisfied with the participatory opportunities in their home cities. Then again 31% of the respondents were dissatisfied and 17% somewhat dissatisfied with the participatory opportunities, which indicated that there was much room for improvement in the region. However, due to lack of ex ante data, no conclusions could be drawn on whether the activities on the measure had improved the situation or not.

It became clear that the measure had contributed to **policy level development** in the Turku region. Although in the MAL agreement draft for 2020-2023 citizen participation is not specifically mentioned, the measure has had a strong impact on the upcoming update of the South-West Finland transport system plans. Plans are now in place to develop a regional SUMP within the scope of another H2020 project and the SUMP requirements were to be added to the transport system plan updates. According to site coordinator Stella Aaltonen, this development can be directly attributed to this measure. In addition, the work done within the scope of the park-and-ride plan in this measure had an impact on the city parking policy development, approved by the City Board on the 19th of December 2019. To promote sustainable mobility, the city parking policies now support park-and-ride development via various principles in connection with public transport and supporting smooth travel chains.

Score: 4.

Investment costs in this measure covered subcontracting supervision costs for the park-and-ride plan. **Operating costs** covered PM spent for the park-and-ride plan and both rounds of the mobility barometer. Drafting the survey was made in cooperation with stakeholders in 2017. The second time (2019) there was only a bit of updating so the process was lighter. Communicational costs before and after executing the surveys as well as analysing and

reporting of the surveys were included. A stakeholder event was organised in 2017 after the report on survey results was finalized and the same kind of event will be held during the spring 2020. Costs for organizing the event were very minor, only a couple of hundred euros. For this reason, these expenses were not specified in the calculation.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	The number of citizens and stakeholders involved in the mobility barometer	*	No quantitative target was actually been set for the increase in involvement in the mobility barometer. In 2017, there were 3530 respondents, in 2019 3038 – a decrease of 8.6%. The reason for a lower number of participants has not been pinpointed; however, an equally extensive marketing of both survey rounds took place both in 2017 and 2019.
2	Increased number of citizens and stakeholders involved in the planning process	NA	This has not been assessed within the scope of the project.
3	Increased knowledge on mobility preferences	**	During the project, mobility preferences in the Turku region have been extensively reviewed twice.
4	Increased awareness of sustainable mobility policies	*	Work has been done to promote awareness of sustainable mobility policies in the region within the scope of the project. The Kulje.fi website was successfully launched.
5	Citizens' satisfaction in sustainable urban mobility, inter-modality and travel comfort	O	The full analysis of the second survey results is still in progress – therefore it is still inconclusive whether citizen satisfaction has increased.
6	The amount of open data sources in Aluetietopalvelu	NA	This objective is not relevant for the measure as the focus in terms of open data was changed to developing the kulje.fi website.
NA = Not Assessed O = Not Achieved in full * = Substantially achieved (at least 50%) ** = Achieved *** = Exceeded			

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the **Process Evaluation Report** of this Measure.

D.1 Deviations from the original plan

No relevant deviations from the original plan were made during the implementation of this measure. The measure proceeded ahead of schedule. The measure leader was changed in June 2019 as Marja Tommola took over from Mari Sinn.

D.2 Barriers

The following barriers were identified during measure planning, implementation and demonstration.

D.2.1 Involvement/communication

The measure was of regional nature, with the area of impact spanning both Turku and the neighbouring municipalities. The potential barrier of the surrounding municipalities not recognizing the benefit of the measure (in the form of increased participation in mobility planning etc.) was recognized. This was to be overcome via increased communication and interaction with the surrounding municipalities.

D.2.2 Political/strategic

Political barriers across the municipality boundaries were recognized as potential barrier for measure process. These were to be improved during the participation process related to the park-and-ride plan. Political or strategic barriers were also foreseen for measure realisation by project stakeholders, in particular the fact that there was a lack of overall vision among significant city-level stakeholders, such as real estate owners, on the needed transport system changes.

D.2.3 Problem-related

It was recognized that changing the culture of participation is a long process, the results of which might not be visible within the project duration. This may hinder the short-term realization of the goal of changing the participatory culture in traffic system planning.

D.2.4 Planning

The mobility barometer was realized online, which resulted in a slight underrepresentation of elderly people in the results. No actions were undertaken to correct this distortion – however it was emphasized by the ML that more emphasis was laid on future users (young and middle aged people) in any case.

D.3 Drivers

The following drivers were identified during measure planning, implementation and demonstration.

D.3.1 Involvement/communication

Successful communicative measures resulted in achieving a fair share of replies to the mobility barometer. Good communication and involvement, in particular between different stakeholder groups, was seen as an important driver for measure realization and an important contributor to the positional driver of having a sufficient consensus between key actors on the importance of reaching measure objectives.

D.3.2 Positional

From a positional point of view, the fact that the measure fit regional development goals and surrounding cities and municipalities were interested in measure objectives was seen as a strong driver. Frequent meetings were held and proper communication between stakeholders took place.

D.4 Supporting activities

No supporting activities were identified for this measure.

D.5 Recommendations on the implementation process

Some recommendations on implementation can be suggested based on process evaluation of the measure so far.

D.5.1 Emphasize communication

Proper communication of measure goals is needed to ensure both that the citizens are reached and that stakeholders are effectively involved in developing better mobility planning practices.

D.5.2 Recognize that change takes time

Changing the culture of participation is a long process, the results of which might not be visible within the project duration. This should not hinder setting goals for the shorter term and setting milestones for longer-term development goals.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

The measure achieved its main objectives satisfactorily. The following key results were identified:

- Information was gained on the views and attitudes of the residents in Turku core region concerning the objectives and measures of the Turku regional traffic system plan.
- Participatory methods were tested in conjunction with developing the park-and-ride plan.
- The park-and-ride plan was submitted, successfully providing a development plan for park-and-ride of both private cars and bicycles in the Turku core region.

E.2 Relevance of supporting activities

No supporting activities were identified for this measure.

E.3 Interaction with other measures

The measure made use of the experiences gained in Ruse on park-and-ride piloting in a peripheral district. In TUR 2.2., possible sites for park-and-ride within and nearby the Kupittaa laboratory area were mapped.

E.4 Main lessons learned

According to the ML, the main lessons learned were linked to the participatory planning approaches in particular.

- Participatory planning as such has not become firmly established in local and regional planning yet and to do so, planning culture needs to change. This is a complex process requiring time. Integrating participatory methods into project/policy-based transport planning, like in the example, can be a way to change planning culture little by little.
- When planning to use participatory methods in a development or planning process it is of great importance to identify target groups first and then select methods that respond to the needs and the envisaged level of discussion with each group. Using a mix of methods is crucial to be able to reach out to different groups. Online methods (web-based survey, mobile application) proved to be successful in this measure, in particular for involving young people and people who only have little time to participate.

E.5 Long term impact

- The mobility barometer will be developed further and it will be executed regularly in the future, most likely either every 2 or 4 years. Marketing of the survey will be planned

more carefully and the aim is to increase the number of participants to at least double of the level reached in 2017 and 2019. This is a step towards getting more inhabitants involved in regional traffic system planning.

- Experiences from the procurement process and executing the Park-and-ride plan were useful. There is no known cause, except for financial issues, why this kind of process could not be possible to repeat. A plan made by a consultant using participative methods can naturally be more expensive.
- Overall, the measure has pinpointed the importance of participatory planning also on regional traffic planning level. Work for developing more participatory regional traffic planning will continue through other projects and through RCSWF's own day-to-day work.

E.6 Potentials for up-scaling in the city

As the measure was of regional nature to begin with, it reached a wider target group than Turku citizens alone. The mobility barometer could still be expanded to include municipalities outside the Turku core city region (Turku, Raisio, Naantali, Kaarina and Lieto). There are strong connections to sustainable mobility planning in other municipalities in South-West Finland as a lot of people commute daily to Turku from the region.

F. Additional information

F.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

The evaluation approach of TUR 2.1. can be regarded as somewhat satisfactory from the point of view data collection and analysis of results. Data was gathered mainly via the mobility barometer, carried out both ex-ante and ex-post, giving a consistent set of data to utilize in this measure and some of the other Turku measures. The barometer reached a fair share of respondents, although a better representation of age groups should have been reached. As such, the results cannot be widely generalized and therefore the conclusions are considered to be only indicative.

The administration of the survey was done prior to the Turku evaluation plan being set. Consequently, the LEMs did not get the chance to adjust the questions to data collection purposes. This is regarded as a failure on the LEMs part to properly communicate the data collection plan and needed timing to the ML.

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

- The Kulje.fi website should be promoted further to gain a wider audience for regional traffic system planning and to better inform citizens on ongoing processes regarding sustainable mobility.
- The plan for park-and-ride is very thorough and presents alternative scenarios for its potential development, dependent of the development of parking and public transport policies in the Turku region in the future. It should be ensured that different elements related to these scenarios. e.g. different types of feeder transport, are piloted, whether with project or city/municipal funding. So far, no proper piloting for park-and-ride has been done in the region.
- Communicative measures should be planned for the promotion of the following mobility barometer. These measures should include methods to reach also those groups that might not be reached via an online survey.



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TUR 2.2

City District / Urban Corridor Case as a Pilot for Sustainable Urban Mobility Measure Evaluation Report

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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Jari Hietaranta	
Stella Aaltonen	

Table of Contents

ABSTRACT.....	134
A. INTRODUCTION.....	135
A.1 EXPECTED RESULTS OF THE MEASURE	135
A.1.1 Quantifiable impacts.....	135
A.2 MEASURE DESCRIPTION	136
A.2.1 Measure outputs.....	136
A.2.2 Supporting activities	136
A.2.3 Interactions with other ECCENTRIC measures.....	136
A.2.4 Interactions outside ECCENTRIC	136
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	136
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	137
A.5 IDENTIFIED RISKS	137
B. MEASURE IMPLEMENTATION	138
B.1 SITUATION BEFORE CIVITAS	138
B.2 INNOVATIVE ASPECTS.....	138
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	138
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	138
C. IMPACT EVALUATION FINDINGS	144
C.1 EVALUATION APPROACH.....	144
C.1.1 Expected impacts and indicators.....	144
C.1.2 Baseline.....	146
C.1.3 The business-as-usual scenario.....	151
C.2 MEASURE RESULTS.....	153
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	157
D. PROCESS EVALUATION FINDINGS	159
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	159
D.2 BARRIERS	159
D.2.1 Financial	159
D.2.2 Planning.....	159
D.2.3 Problem-related	159
D.2.4 Organizational	160
D.3 DRIVERS	160

D.3.1	<i>Political/strategic.....</i>	160
D.3.2	<i>Involvement/communication.....</i>	160
D.4	SUPPORTING ACTIVITIES.....	160
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	160
D.5.1	<i>Plan ahead and secure funding.....</i>	160
D.5.2	<i>The more complex an issue, the more planning is needed.....</i>	160
D.5.3	<i>Map out potential risks and be prepared for them.....</i>	160
E.	EVALUATION CONCLUSIONS	162
E.1	VALIDATED DIRECT IMPACT	21
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	162
E.3	INTERACTION WITH OTHER MEASURES.....	162
E.4	MAIN LESSONS LEARNED	22
E.5	LONG TERM IMPACT	22
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	163
F.	ADDITIONAL INFORMATION	165
F.1	APPRAISAL OF EVALUATION APPROACH	165
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	165

List of Figures

Figure 1. Modal share in Turku, 2016	148

List of Tables

Table 1: Quantifiable impacts.....	135
Table 2: Target groups or affected parties.....	136
Table 3: Measure stakeholders.....	137
Table 4: Identified risks.....	137
Table 5: Description of indicators.....	145
Table 6: Measurements	146

Project	City		
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8.5.2020	Stella Aaltonen	stella.aaltonen@turku.fi	+358 44 9075983

Abstract

Measure TUR 2.2. aimed to develop intelligent mobility services and solutions by creating a mobility node for seamless transport and advising companies and housing companies located in the district of Kupittaa (the living laboratory area) on intelligent mobility solutions in the region. The integration of smart mobility branding and marketing into urban communications was also part of this measure. In the Kupittaa district, a mobility node was to be created that would combine cycling and bike sharing, car sharing, public transport and information boards and provide year-round seamless cycle and walking connections. Via the node, MaaS (Mobility as a Service) services were also to be tested in the region. Target groups of this measure included students, companies and housing companies based in the laboratory area.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 2.2. is measured. Data was derived from local and national surveys, secondary city statistics, policy documents and the Measure Leader.

Housing companies and private companies were surveyed, contacted and concrete information materials planned. As a result, awareness of sustainable mobility increased in the area. On average, 66% of the companies surveyed in the laboratory area were aware ECCENTRIC measures. 20% of the companies and housing companies in the area had used the measures tested in the laboratory area. Actions to improve traffic safety in the laboratory area were taken in form of blocking access to a thoroughfare, still ongoing at the time of writing this report. The measure significantly contributed to policy level development in the city, making smart mobility more deeply ingrained into the city planning processes. The main output of the measure, the mobility node, was not realized, however. Plans for the mobility node were made but due to a complex array of issues related mostly to land-ownership and securing financing, it could not be implemented during the project lifetime. Due to this partial failure of the measure, ex-post data could not be obtained on many of the indicators. The failure to implement the mobility node however provided a valuable viewpoint into the complexity and time and resource consuming nature of implementing infrastructure-related projects in an already densely populated urban area.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

To promote and implement sustainable, clean and (energy) efficient urban transport measures and to change transport behavior, thereby enabling a car independent lifestyle in the city of Turku.

(2) Strategic level:

- To develop planning processes in order to enable and support a car independent lifestyle in the district and to turn this into a common practice in the future planning processes in the city.
- To integrate smart mobility as part of the city's communication, marketing and branding.
- To shift company trips into more sustainable modes in order to improve their ecological and economic performance.
- To support smooth travel chains with the region and the TEN-T corridor.

(3) Measure level:

This measure develops intelligent mobility services and solutions by creating a mobility node for seamless transport and advising companies located in the district of Kupittaa on smart mobility solutions in the region.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives										
		Reduce:				Improve:						
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy	
ID	Quantifiable Impacts											
1	One mobility node has been created and evaluated	x	x								x	
2	20% of the companies in the area have used the measures tested in the laboratory area.	x						x				
3	The use of public transportation has increased during the project time.	x	x						x			
4	20% of the companies and housing companies in the laboratory area accept the mobility change	x	x						x			
5	10% - 30% decrease of average driving speed in living lab after safety plans implementation			x								

Table 1: Quantifiable impacts.

A.2 Measure description

This measure aimed to develop intelligent mobility services and solutions by creating a mobility node for seamless transport and advising companies located in the district of Kupittaa (Turku's 'living lab' in CIVITAS ECCENTRIC) on intelligent mobility solutions in the region. The integration of smart mobility branding and marketing into urban communications was also part of this measure. In the Kupittaa district, a mobility node was to be created that would combine cycling and bike sharing, car sharing, public transport and information boards and provide year-round seamless cycle and walking connections. Via the node, MaaS (Mobility as a Service) services was also to be tested in the region. Target groups of this measure included students, companies and housing companies based in the laboratory area.

A.2.1 Measure outputs

As a concrete output of the measure, a mobility node was to be created in the laboratory area.

A.2.2 Supporting activities

There were ongoing processes to renew parking policies in the city of Turku. Developments in this area were essential for the promotion of car sharing, an integral part of the mobility node.

A.2.3 Interactions with other ECCENTRIC measures

Measure 2.2. had interactions with the following measures within ECCENTRIC:

- MUN 5.9. "Intermodal (E-) Mobility stations": the Munich measure was to be explored when planning the Turku mobility node.
- STO 6.7. "Promote installation of EV-charging multifamily houses": the measure was to provide insights into the promotion of electric vehicle charging at apartment buildings, useful for the promotion of e-mobility at the laboratory area housing companies.
- MAD 4.6 "Pedestrian friendly public space outside the city center": experiences were to be shared on improving cycling and walking connections.

A.2.4 Interactions outside ECCENTRIC

The Kupittaa area, the living lab, is facing notable changes in the future led not only by ECCENTRIC but also by several spearhead projects and development strategies. These include the brownfield area redevelopment next to Kupittaa (Itäharju), the upcoming formulation of The Turku Science Park spearhead project, and the potential superstructure being planned between Kupittaa and Itäharju, covering the motorway and providing a seamless connection between the two areas.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents		Laboratory area
8	Companies		Laboratory area
3,4	Commuters		Turku & surrounding region

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	Organizations in the Kupittaa laboratory area	S	PR	P	Main target group f measure activities
2	Housing companies in Kupittaa laboratory area	S	other	P	Main target group f measure activities
3	City of Turku	P	C	L	Lead partner
4	Föli, Turku Region Traffic	S	PT	P	Regional PT operator
5	Valonia, Regional Council of Southwest Finland	S	other	O	Partner in the measure, involved in developing the information material for households/companies and analysing mobility campaigns.
6	Tampere University of Technology	S	KI	O	Provides diploma workers for the project
7	Turku Technology Properties Ltd	S	PR	O	A significant property owner in the laboratory area
8	Private land owners in Kupittaa	S	PR	O	Private landowners are addressed when planning for the location of the mobility node
Type: P:CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Problems of getting data for evaluation, data not statistically good enough	7	Triangulation of data via other sources	ML
Passenger data are not available or insufficient on evaluation	4	Data providers (operators, city council are well informed beforehand about the need of evaluation	ML
Surveys to households/businesses fail to reach enough respondents	7	Pre- information about the survey, increasing of awareness	ML
Problems in finding a suitable location for the mobility node	1/7	Continuous mapping and discussions with land owners	ML/SC

Table 4: Identified risks.

B. Measure implementation

B.1 Situation before CIVITAS

The Kupittaa area is a multifunctional district under redevelopment (11.790 inhabitants, 17.000 jobs). It suffers from poor provision of transport and mobility services and an enormous pressure on parking spaces. The development of the brownfield area was planned, aiming to avoid urban sprawl and to reach a denser city structure. The district also includes a large and fragmented University Campus area that influences the profile and the needs of the district, putting pressure especially to the large-scale transport routes dividing the district and causing problems to accessibility and safety.

B.2 Innovative aspects

The development of a mobility node was a new approach to sustainable mobility promotion in Turku. The sharing of mobility modes was also a novel issue in the city.

B.3 Research and Technology Development

Not applicable in this measure.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning milestones (100% completed)

The research and planning phase of this measure commenced in September 2016 and was completed in April 2017. The following activities were carried out during this phase:

- Planning of the mobility node. Sketches of the mobility node were prepared by an architecture student of Tampere University of Technology. The mobility node concept was presented to stakeholders, city representatives and citizens in a special event in May 2017. Negotiations between the city and the private landowners about the placement of the mobility node took place. (M1-M8)
- Planning of information events. The topics of the four information events in the laboratory area were decided. Two information and discussion events were held in February, one for companies and one for housing cooperatives. (M6-M8)
- Baseline data was collected for measure and evaluation purposes. A mobility survey was sent to the companies and housing companies in the laboratory area. (M1-M8)

Phases 2: Procurement and implementation (100 % completed)

The procurement and implementation phase of this measure commenced in May 2017 and was completed in April 2018. The following activities were carried out during this phase:

- A master's thesis about the Kupittaa mobility node was published in February 2018. The thesis mapped existing mobility nodes or hubs and contained two proposals: a simpler design of a mobility node to improve the circulation of pedestrians and bicyclists and to support the use of public transport, and a design of a bigger scale public transport junction or a mobility station to support the same aims and to work as a mobility hub for future forms of mobility. Blueprints for both are presented below.



Picture 3: The blueprint of the mobility node (Kääriä 2018)



Picture 4. The blueprint of the mobility hub (Kääriä 2018)

- Four information events were held in the area. These smart mobility events were focused on biogas, car sharing, winter cycling and e-mobility. The events aimed to bring together citizens (potential customers) and companies (service providers). (M9-M15)

- Impact on planning visions: the measure contributed significantly to the spearhead projects Kupittaa Vision, City Centre Vision and the development of a new spearhead project portfolio of the city of Turku: Smart and Wise. This overarching project was to bring together several key measures in the city of Turku and have a strong emphasis on smart traffic and mobility development. (M9-M12)
- Planning of mobility offers for the laboratory area: a mobility information package was created covering the topics in which the companies and housing cooperatives were interested. This package contained general mobility information, package information of PT and bike sharing and offers from other mobility providers. The target was that the companies and housing co-operations would renew their mobility policies and offer other means of transportation to their users. (M15-M20)
- The housing co-operations and companies who responded to the Kupittaa Mobility Survey were contacted in order to plan and start different smart mobility pilots with them. Material for the pilots was developed and mobility campaigns analyzed. (M15-M20)

Phase 3: Demonstration and monitoring (90% completed)

The demonstration and monitoring phase of this measure commenced in May 2018 and was completed in August 2020. A significant change took place during this phase as despite several negotiations between the city and private landowners about the location of the mobility node, no common ground was reached and the node was not realised. In essence, the issue boiled down to the fact that the landowners of the potentially strongest site were not interested in providing part of their land for the mobility node. The city of Turku does not own the land at the location suitable for the junction, a reality which significantly hampered the measure process. This barrier and the reasons behind it are explored further in the detailed process evaluation of this measure.

The following activities were carried out during this phase:

- Promoting smart mobility to the companies in the Kupittaa area. This included visits in the companies and distributing the info material created in the previous phase. (M21-M40)
- Work on execution of the mobility node.
- A year-round seamless cycle and walking connection was implemented in the Kupittaa laboratory area. Improvements were made to the bicycle and walking connection between the student campus and the university campus. The improved connection was established in autumn 2018. (M20-M36)
- Initial discussions with companies in the laboratory area took place, based on the interest expressed in the mobility survey. These led to better visibility of public transport timetables and services like information screens in the lobbies and information channels of stakeholders. (M20-M42)
- Mobility communication in Turku was improved greatly during this phase. Prior to the start of the measure, mobility communication was on the periphery of marketing and urban communication in the city of Turku. With the integration of the CIVITAS ECCENTRIC Local Communication Manager into the weekly communication sessions of the city, the situation changed fundamentally. The next step was to create Turku's mobility website. (M20-M48)

- Due to the unsuccessful efforts on mobility node, another course of action was taken in the lab area, focusing on improving traffic safety. A part of the measure MAD 4.6. “Pedestrian friendly public space outside the city center” was replicated when the first-ever experimentation on blocking access to a thoroughfare was realized in the laboratory area in mid-August 2019. This idea was concretized through a study carried out on what kind of experiments could be done in the Kupittaa area. The Tahkonkuja street runs past the Kupittaa sports hall. Passage has been forbidden on the street (apart for service and maintenance) for 20 years but only few adhere to this prohibition, despite speed bumps and traffic signs prohibiting access to the street. Traffic on the street has been heavy as its location serves well for dropping kids off to hobbies, and thereby poses a safety hazard to the people walking and cycling past to the numerous sports facilities and fields in the area. In order to improve traffic safety, it was decided that a pilot would be realized for a year, blocking access to the street with different types of traffic obstacles. The pilot was to be monitored every three months and feedback gathered from the citizens via the city’s feedback portal. So far, feedback on the pilot has been mainly positive, despite the initial outrage on part of some citizens. After the pilot in the autumn 2020, a decision will be made on whether the experiment will become a permanent arrangement in the area. (M32-M48)



Picture 5. The Tahkonkuja thoroughfare pilot.



Picture 6. Traffic obstacles at Tahkonkuja.

Phase 4: Conclusions & Recommendations (50% completed)

The measure was fraught with challenges due to the land-ownership related issues of establishing a mobility node, which are explored in more detail in the measure process evaluation. Some preliminary conclusions and recommendations based on experiences gathered and challenges faced could be highlighted at this point.

Research & Planning

- It would be helpful to find more accurate ways to create a living lab company 'directory' in the future. Names and contact details of companies had to be collected manually in the field. GDPR requirements had an even tighter impact on this. In addition to the resources required for doing this, it might be that some companies were missed and therefore not reached due to the cumbersomeness of the task. One useful way could be to include property managers or/and the Finnish Real Estate Federation in the planning phase so that their contacts and expertise could be utilized better in contacting the household companies.
- Smart mobility services are still new and unfamiliar to many, whereas the private car still plays an important role. This has been clearly highlighted by the survey results in the laboratory area.
- Kupittaa-Itäharju area, the living lab, will face notable changes in the future led not only by ECCENTRIC but also by Turku's City Development Department. Developing an area where many different stakeholders have varying and sometimes conflicting interest is a challenging feat.

Procurement & Implementation

- First negotiations with key players in the Kupittaa area took place in spring 2017 and as a result of these meetings, the visibility of the public transportation timetables and offers was increased in the actors' lobby screens and information channels.

Demonstration & Monitoring

- The biggest challenge was finding a suitable piece of land for the mobility node. There were several negotiations with private landowners and an alternative site was also identified for the node. The node should be centrally located near train stations and bus lanes, which is difficult to achieve if the node was not situated in Kupittaa.
- The optimal site for the node is owned by the State Railways. Other potential areas are not in the possession of the city either. The mobility node is a completely new concept in Turku and therefore previous examples do not exist. The sharing of mobility modes is also completely new and creates much doubt and hesitation. Therefore, it was not easy to justify the use of the land. The success factor is to find the right actor in an area that can provide a suitable location for the node.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact				
Indicator name	Awareness	Acceptance	Satisfaction	Access to mobility services
Type	KPI	KPI	KPI	KPI
Category	Society	Society	Society	Society
Subcategory	Acceptance	Acceptance	Acceptance	People
Aspect	Awareness	Acceptance	Acceptance	Accessibility
Definition	The awareness of the Kupittaa area companies and households on CIVITAS measures	The acceptance of CIVITAS measures in Kupittaa	The satisfaction on the CIVITAS measures in Kupittaa	Percentage of population living within walking distance of public transport (stop or station) or shared mobility (car or bike) system

Impact				
Indicator name	Relative travel cost	Mode shift	Vehicle-Km travelled	Contribution to Policies, Plans and Programs
Type	KPI	KPI	KPI	KPI
Category	Society	Transport system	Transport system	
Subcategory	People	General	General	
Aspect	Accessibility	Modal Split	Total travel	Governance
Definition	The average travel cost (for the PT or other service) as a percentage of the average personal available income	Percentage of passengers which changed permanently of transportation mode for doing the same trip (same origin and destination, time, and frequency)	Sum of all kilometres travelled by a fleet or a group of users	Qualitative measurement on the process to modify SUMP in a significant and definitive way

Impact				
Indicator name	System usage	Investment costs	Operating costs	Car ownership
Type	KPI	KPI	KPI	KPI
Category	Transport System	Economy	Economy	Transport
Subcategory	General	Costs	Costs	Car
Aspect	System demand	Costs	Operating costs	Car ownership
Definition	Average system usage (bookings, rentals, deliveries, users, passengers, etc.), in a given unit of time	Capital investment costs of the measure	Average operating costs of the measure	All cars owned per 1000 of the population aged 18 or over. % of households that have no car, preferably disaggregated by city district

Impact				
Indicator name	Job/sales impact	CO ₂ emissions	NOx emissions	PM emissions
Type	KPI	KPI	KPI	KPI
Category	Economy	Environment	Environment	Environment
Subcategory	Benefits	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance
Aspect	Economic development	Emissions	Emissions	Emissions
Definition	Average monthly sales and yearly number of employees of businesses 100 meters around the transportation node (for public transport or station-based systems), along the intervened street (for roads/bike lanes/sidewalks, parking, etc), or covered area.	The total CO ₂ emissions by city residents / system users	The total NOx emissions by city residents / system users	The total PM emissions by city residents / system users

Table 5: Description of indicators

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	B-A	S	Companies and housing companies	Laboratory area
2	Acceptance	%	B-A	S	Companies and housing companies	Laboratory area
3	Satisfaction	Score (0-5)	A	S	Companies and housing companies	Laboratory area
4	Access to mobility services	%	B-A	DC	Residents	Laboratory area
5	Relative travel cost	%	B-A	DC	Residents	City of Turku
6	Mode shift	%	B-A	S	Residents	City of Turku
7	Vehicle-Km travelled	Kilometers	A	S	PT fleet	City of Turku
8	Contribution to Policies, Plans and Programs	Score (0-5)	B-A	DC	Decision makers	City of Turku
9	System usage	Frequency (users/unit of time)	A	E	Residents	City of Turku
10	Investment costs	€	A	DC		
11	Operating costs	€	A	DC		
12	Car ownership	Cars to inhabitants ratio (0-1000*)	B-A	DC	Residents	Laboratory area
13	Job/sales impact	Euros and employees	B-A	DC	Companies	Laboratory area
14	CO ₂ emissions	Tons of CO ₂	B-A	E	Residents	City of Turku
15	NOx emissions	Tons of NOx	B-A	E	Residents	City of Turku
16	PM emissions	Tons of PM	B-A	E	Residents	City of Turku

Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period
Method: DC: Data collection – E: Estimation – S: Survey

Table 6: Measurements

C.1.2 Baseline

The baseline in this measure represents the situation prior to the project in terms of sustainable mobility development in the laboratory area. The data collection methods for the baseline included:

- The Kupittaa housing company and company surveys formed the main qualitative baseline data collection method in this measure. The housing company survey was conducted as an open survey between September 2016 and April 2017. It was sent to approximately 180 housing companies in the laboratory area of Kupittaa. Altogether 34 housing companies replied to the survey. The company survey was sent to 900 companies and received 118 replies. The surveys provided data for indicators *awareness* and *acceptance*.
- Baseline data for indicator *car ownership* in the city and the Kupittaa laboratory area was obtained via secondary data analysis, performed on data from Traficom (The Finnish Transport and Communications Agency), the main authority in permit, licence, registration, approval, safety and security matters.
- The National Travel Survey from 2016 provided baseline statistics on indicator *Mode shift* and *vehicle-km travelled*. The National Travel Survey provides an overall picture of Finnish passenger mobility and its background as well as demographic, geographic and temporal variations in mobility. The 2016 survey was conducted by interviewing over 30 000 Finns by telephone, an online form and a mail survey throughout the year 2016. The research report was completed in March 2018. For Turku, the n=3997. The previous national travel survey dates back to 2008.
- Data for *relative travel cost* was derived from Turku city statistical overview and the PT annual report for 2015.
- Secondary data analysis was performed on indicator *Contribution to Policies, Plans and Programs*.
- Data for the review of *job and sales impact* was derived from the company registries maintained by Kauppalehti and Fonecta.fi.

KPI 1: Awareness assesses the awareness of the Kupittaa area companies and households on sustainable mobility. According to the **housing company** survey (n=34), none of the housing companies informed the inhabitants about sustainable mobility. According to the **company** survey, 14.3 % (n=118) of the companies promoted sustainable mobility among their employees.

KPI 2: Acceptance in this measure describes the willingness of laboratory area companies and households to take part in sustainable mobility pilots. According to the **housing company** survey, 64 % (n=34) of the respondents were willing to take part in sustainable mobility pilots

in the Kupittaa area. According to the **company** survey, 54 % (n=118) of the respondents were willing to take part in sustainable mobility pilots in the Kupittaa area.

KPI 3: **Satisfaction** refers to the satisfaction in various types of mobility services in the laboratory area. Baseline data for this indicator was not available, however, as the survey to households and companies was sent already in the autumn of 2016, months before the Turku evaluation plan and indicators were finalized and the LEMs did not have the opportunity to formulate the survey questions.

KPI 4: **Access to mobility services** refers to the percentage of the population living within walking distance of public transport (stop or station) or shared mobility (car or bike) system. In order to assure a high enough level of service, the standardized walking distance of 300 meters is applied here. The laboratory area is covered by a dense public transport network and it was estimated that practically 100% of the population living in the area had a maximum of 300m to a nearest bus stop. This can be observed on the map below, presenting the bus stops (red dots) and the laboratory area (blue line). The areas where the density of the bus stops is lower are such where there are no residential buildings – e.g. the university area (Yliopistonmäki), the Kupittaa park or the Itäharju industrial area.



Picture 7. Access to mobility services

KPI 5: **Relative travel cost** refers to the average travel cost (for the PT or other service) as a percentage of the average personal available income. Relative travel cost was calculated from the average income of Turku citizens, derived from a Turku city statistical review. In 2015, the average earned yearly income per income earner was 27 294€. The only mode of transport addressed by the measure with ticket sales on baseline level is the city bus transport. The pricing of bus tickets varies according to type of ticket product. Below is presented the pricing and the percentage of yearly average income for adults (no discount groups included).

Ticket type	Price (€)	% of yearly average income
Single ticket (adult, daytime)	3	0.01
30-day ticket	52	0.02
90-day ticket	140	0.5
180-day ticket	260	0.95

Table 7: Relative travel cost.

KPI 6: **Mode shift** refers to the share of travel modes in percentage of passengers which changed permanently of transportation mode for doing the same trip. The National Travel Survey from 2016 presents the following modal split for the Turku region for the baseline. All in all, the share of sustainable travel modes in the region was 48%.

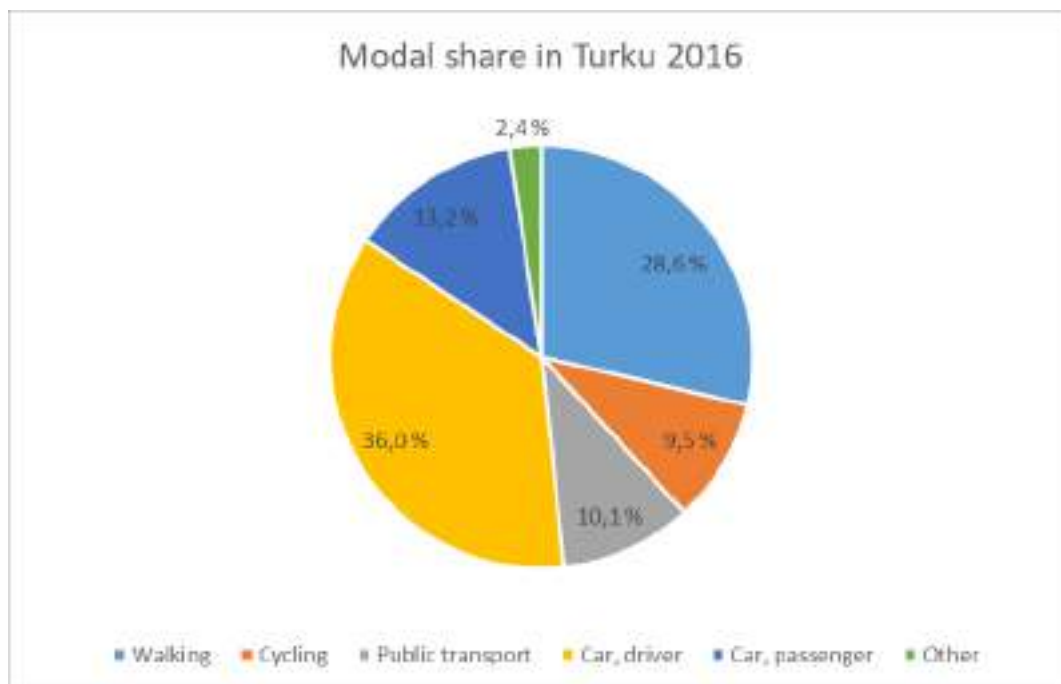


Figure 2. Modal share in Turku, 2016

KPI 7: Vehicle-Km travelled in this measure refers to the sum of all kilometers travelled by a fleet or a group of users. For this measure, all transport modes (walking, cycling, public transport, train, car) were applicable. Approximately half of the laboratory area is situated within the city center walking zone (in red) and approximately half within the sub-center walking zone (in brown). Thereby an average of the two was applied when estimating vehicle-km travelled. There was no data available on VKT for the laboratory area specifically – hence figures for the city center/sub-center need to be applied.



Picture 8. Inner city zones

Average trip lengths (km/person/day) according to the National Travel Survey. For the city center walking zone, n=319, for the sub-center n=68.

	Walking	Cycling	Bus	Train	Car	Other
City center walking zone	1.7	1.0	1.1	0.2	13.7	0.7
Sub-center walking zone	1.0	0.9	2.1	0.0	15.2	0.3
Average	1.35	0.95	1.6	0.1	14.45	0.5
Km/YEAR/person	493	347	584	37	5274	182

Table 8: Vehicle-Km travelled

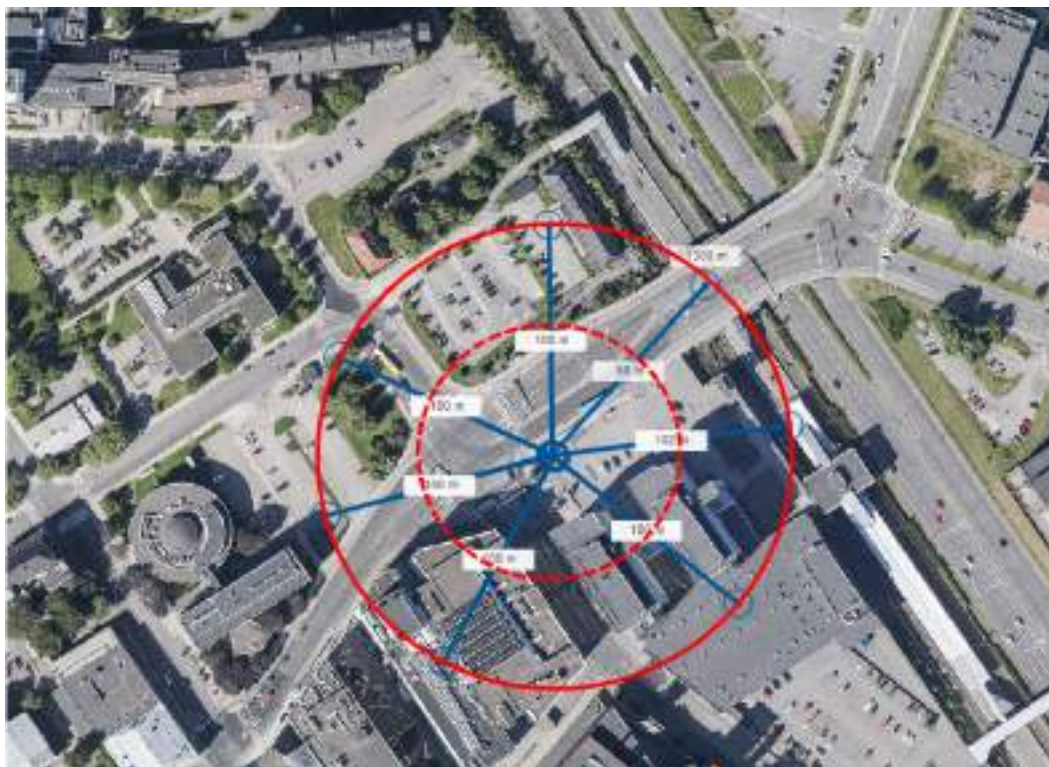
KPI 8: Contribution to Policies, Plans and Programs relates to the impact the measure may have on policies or strategies to promote sustainable mobility, develop planning processes and the development of a mobility node combining various sustainable transport modes and relevant information. The state concludes agreements concerning land use, housing and transport (MAL) with the main city regions of Finland. These agreements enhance cooperation among the municipalities in the respective city regions and between the municipalities and the state in the steering of community infrastructure and coordination of land use, housing and transport. In the Turku region MAL agreement (2016-2019), the Kupittaa area was already mentioned as one of the focal areas of development. The development of jobs, services, housing, transport, accessibility and public city space at Kupittaa are considered essential for the area due to its location and subsequent nature as transport node. Integration of travel chains and development of transport, supporting the One Hour Train project, are seen as one of the key aspects, and it is recognized that walking, cycling and public transport are important modes of transport in the densely populated area. It could be thereby stated that even prior to

the project, the need and the potential of the laboratory area as a mobility node were recognized also on policy level to a fair extent. **Score: 3,5.**

KPI 9: **System usage** refers to the average system usage in a given unit of time. Baseline data was not available for this indicator as the smart mobility measure to be implemented in the area were to be launched in spring 2018 the earliest.

KPI 12: **Car ownership** refers to the number of passenger cars per 1000 residents. In Turku, there were approximately 408 passenger cars per 1000 residents in 2017. In the laboratory area specifically, there were 280 passenger cars per 1000 residents in 2017. The lower than city-average number could most likely be accounted for by the proximity to the city center, as well as the fact that there are many students living in the laboratory area. It should be noted that data on population in the laboratory area was indicative as the data was available by postage numbers. The laboratory area does not, however, cohere completely with these postage number areas completely and hence some of households may have been left out of the total population number.

KPI 13: **Job/sales impact** addresses the average monthly sales and yearly number of employees of businesses 100 meters around the transportation node. For the baseline, a review of this impact took place 100 meters around the planned location of the mobility node, presented in the picture below.



Picture 9. Jobs and sales impact

For some businesses, specific information on sales at that location of the business was not available, only the total yearly turnover in the whole country. This included, for example, the state railways VR-group and some big healthcare companies. These companies were left out of the baseline as there was no information available on their turnover at the future location of the node. The total amount of sales for the companies reviewed was 3 064 879€/year, or 255 407€/month, and they employed 361 people in total.

KPI 14: CO₂ emissions refers to the average emissions per person per year in the city of Turku. Annual CO₂ emissions were calculated in connection with the national travel survey 2016 for the different city zones. For the city centre walking zone, (n=319) this equalled 487kg/person/year, for the sub-centre (n=68) 541kg/person/year. For the laboratory area, an average of these two zones is applied (514kg/person/year). The calculations were based on the LIPASTO unit emissions database provided by VTT, Technical Research Centre of Finland Ltd.

KPI 15 & 16: NO_x emissions and PM emissions refers to the average NO_x/PM emissions per person per year in the city of Turku. Information on this was derived from the National Travel Survey of 2016 where average daily travelled kilometers by different modes per person are presented. Average emissions by vehicle/mode were derived from the LIPASTO unit emissions database provided by VTT, Technical Research Centre of Finland Ltd, applying 2016 average figures.

The share of kilometers travelled by different modes of travel (km/person/day) in Turku was the following, with daily emissions for both NO_x and PM emissions:

Km traveled / Turku region	km/day	%	NO _x (g/km)	NO _x (g/day)	PM (g/km)	PM (g/day)
Walking	1,2	3,8	0	0	0	0
Cycling	0,9	2,8	0	0	0	0
Public transport*	7,2	22,6	0,29	2,088	0,006	0,0432
Car, driver**	15	47	0,19	2,85	0,0065	0,098
Car, passenger**	6,4	20	0,19	1,2	0,0065	0,04
Other***	1,2	3,8	0,19	0,23	0,0065	0,0078
Total	31,9	100		6,37		0,19

*Here an average figure per person in a city bus with 18 passengers is applied (g/pkm).

**Share of urban mileage 27%, Average (highway + urban), car occupancy 1.7 persons (g/pkm)

***For category "other", the average emissions of a passenger car are assumed.

The yearly average **NO_x** emissions thus amounted to **2,3kg/person**. The yearly average **PM** emissions thus amounted to **0,07kg/person**.

C.1.3 The business-as-usual scenario

It could be assumed that the developments related to the urban corridor would have taken place in some time span in the laboratory area regardless of external funding, e.g. after five years. The area is one of the so-called spearhead projects in Turku, with a focus on innovative development of jobs, services, housing, transport, and public city space in Kupittaa in co-

operation with e.g. businesses and universities. The project would, however, give an extra boost to the development of sustainable mobility in the area and the goals were to be reached earlier.

Indicator	Unit	BaU	Date BaU
Awareness	%	N/A without project influence.	2016
Acceptance	%	N/A without project influence.	2016
Satisfaction	0-5	N/A without project influence.	2016
Access to mobility services	%	N/A without project influence.	2016
Relative travel cost	%	BaU is estimated to be somewhat similar to baseline.	2016
Mode shift	%	According to the Turku Climate plan, the share of sustainable transport modes is expected to rise to 66% by 2030. Looking at 2016 levels from the National transport survey, sustainable transport modes make up 48.2% of all modes. An 18% rise in walking, cycling and PT use is thereby expected. The growth in specific modes has not been specified, however.	2016
Vehicle-Km travelled	Km	BaU is estimated to be similar to baseline.	2016
Contribution to policies, plans, and programs	Score (0-5)	BaU is estimated to be similar to baseline.	2016
System usage	Frequency (users/unit of time)	N/A without project influence.	2016
Investment costs	€	N/A without project influence.	2016
Operating costs	€	N/A without project influence.	
Car ownership	Cars to inhabitants ratio (0-1000*)	Overall, car ownership numbers are on the rise in Finland. From 2016 to 2017, the total number of passenger cars rose by 1.5%. It is thus estimated that at the end of 2019, following this yearly growth rate, the number of passenger cars would be 284/1000 inhabitants.	2017
Job/sales impact	Euros and employees	For 2017 and 2018, an average of 1% growth in production and a 0.4% employment rate was estimated by Statistics Finland in 2016. Contrasted with the baseline figures, this would mean 257 961€ and 362,4 jobs.	2016
CO2 emissions	Tons of CO2	According to the Turku Climate plan, the amount of greenhouse gas emissions is expected to be reduced by 50% from 2015 levels by 2029. As for the baseline the year 2016 emission levels are applied, it can be stated that BaU is 50% of the baseline figures.	2016
NOx emissions	Tons of NOx	According to the Turku Climate plan, the amount of greenhouse gas emissions is expected to be	2016

		reduced by 50% from 2015 levels by 2029. As for the baseline the year 2016 emission levels are applied, it can be stated that BaU is 50% of the baseline figures.	
PM emissions	Tons of PM	According to the Turku Climate plan, the amount of greenhouse gas emissions is expected to be reduced by 50% from 2015 levels by 2029. As for the baseline the year 2016 emission levels are applied, it can be stated that BaU is 50% of the baseline figures.	2016

C.2 Measure results

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness (HC= housing companies, PC= private companies)	%	HC: 0 PC: 14.3	12/ 2016	N/A	2016	HC: 5.41 PC: 45.7	12/ 2019	HC: 5.41 PC: 31.4	N/A
Acceptance	%	HC: 64 PC: 54	12/ 2016	N/A	2016	HC: 57 PC: 39	12/ 2019	HC: -7 PC: -15	N/A
Satisfaction	Score (0-5)	N/A	12/ 2016	N/A	2016	HC: 2.3 PC: 3.0	01/ 2020	N/A	N/A
Access to mobility services	%	100	2016	N/A	2016	N/A	1/ 2020	N/A	N/A
Relative travel cost	%	Single ticket 0.01 30-day ticket 0.02 90-day ticket 0.5 180-day ticket 0.95	2015	Single ticket 0.01 30-day ticket 0.02 90-day ticket 0.5 180-day ticket 0.95	2015	N/A	2019	N/A	N/A
Mode shift	%	Walking 28.6 Cycling 9.5 PT 10.1 Car, driver 36 Car, passenger 13.2 Other 2.4	2016	Walking+ Cycling + PT 66 Car, driver+ passenger + other 36	2016	N/A	1/ 2020	N/A	N/A
Vehicle-Km travelled	Km	Walking 493	2016	Walking 493	2016	N/A	1/ 2020	N/A	N/A

		Cycling 347 Bus 584 Train 37 Car 5274 Other 182		Cycling 347 Bus 584 Train 37 Car 5274 Other 182					
System usage	Frequency (users /unit of time)	N/A	2016	N/A	2016	N/A	1/ 2020	N/A	N/A
Investment costs	€	13 146 € (personnel costs for planning the mobility node)							
Operational costs	€	58 000€ (personnel costs)							
Car ownership	Cars to inhabitants ratio (0-1000*)	280	2017	284	2016	309	10/ 2019	29	25
Job/sales impact	Euros and employees	255 407€ 361 people	2016	257 961€ 362.4 jobs	2016	N/A	1/ 2020	N/A	N/A
CO2 emissions	Kg of CO2	514	2016	257	2016	N/A	1/ 2020	N/A	N/A
NOx emissions	Kg of NOx	2.3	2016	1.15	2016	N/A	1/ 2020	N/A	N/A
PM emissions	Kg of PM	0.07	2016	0.035	2016	N/A	1/ 2020	N/A	N/A
Contribution to policies, plans, and programs	Score (0-5)	3.5	2016	3.5	2016	4.5	2019	1	1

When looking at measure results, what is being evaluated could be divided into two categories: attributes connected to the promotion of sustainable mobility among companies and households in the laboratory area, and attributes connected to the realization of the mobility node. Now, as many of the indicators chosen originally were connected to the realization of the mobility node, has its failure lead to the redundancy of several of them. There simply was no project impact to be observed and measured upon on many of the indicators.

The ex-post data was derived from several sources:

- Similarly to the baseline phase, information on indicators *awareness*, *acceptance* and *satisfaction* was gathered via a survey to the housing companies and private companies in the laboratory area. The surveys were conducted as an online survey between in early December 2019 and they were closed 31.1.2020. The housing company survey was sent to 185 housing companies in the laboratory area with

altogether 37 replies received. The company survey was sent to 681 companies and received 164 replies.

- Data for indicator *Car ownership* in the city and the Kupittaa laboratory area was again obtained via secondary data analysis, performed on data from Traficom (The Finnish Transport and Communications Agency), the main authority in permit, license, registration, approval, safety and security matters.
- Secondary data analysis was applied on assessing *Contribution to Policies, Plans and Programs*.
- Data on *investment* and *operating costs* was derived from the Site Coordinator.

When in 2016 none of the housing companies had informed the inhabitants about sustainable mobility, in 2019 two out of 37 housing companies (5.41%) stated that they had informed their residents about sustainable mobility. There was a slight increase in **awareness** which can, however, possibly be attributed within the margin of error for a survey with such a small sample (n=37).

According to the private company survey, 14.3 % of the companies promoted sustainable mobility among their employees in 2016. In 2019, the share had risen to 45.7% (n=164). This increase could at least partly be attributed to project efforts on promoting sustainable mobility actively to the laboratory area companies.

When in 2016 64 % of the respondents were willing to take part in sustainable mobility pilots in the Kupittaa area according to the housing company survey, in 2019 57% of the respondents expressed their interest in sustainable mobility pilots. **Acceptance** of sustainable mobility pilots had thereby somewhat decreased – however, due to the small size of the sample (n=37), it is likely that the difference was not statistically significant.

When inquired about the willingness to take part in sustainable mobility pilots in the Kupittaa area, 39% of the private companies expressed a positive willingness (n=164). This marked a clear downturn in interest as in 2016 the respective amount was 54%.

Satisfaction in this measure refers to the satisfaction in various types of mobility service offered in the laboratory area. No comparison to baseline could be made unfortunately due to lack of baseline data. Awareness of mobility services was overall rather low among the companies, with only 27 companies stating their awareness of various mobility service offered in the area. The respondents of the private companies who were familiar with these services (n=27) rated the services they had used with an average **score of 2.3** on a scale of 1-5. Due to the low number of respondents, however, no far-reaching conclusions could be made from this data.

Looking at the housing companies surveyed, the satisfaction in mobility services used was a bit higher as the respondents of the housing companies who were familiar with mobility services (n=10) rated the services they had used with an average **score of 3.0** on a scale of 1-5. Again, the sample is so small that making any conclusions was somewhat impossible. In order to gain any insight into the satisfaction in mobility services, the samples should have been significantly higher and the employees/households should have been addressed directly.

Car ownership in Turku has increased during the project lifetime. Car ownership refers to the number of passenger cars per 1000 residents. In Turku, there were approximately 414

passenger cars per 1000 residents in 2019. This marked a 1.5% rise from 2017, a slight increase from the baseline year when the same number was 408 cars per 1000 residents. This development was in line with the current overall trend in car ownership in Finland. In the laboratory area specifically, an even more rapidly growing trend could be observed: in 2019, there were 309 passenger cars per 1000 residents compared to the 280 in 2017. This marks a 10.4% increase in car ownership.

When looking at the **Contribution to Policies, Plans and Program**, the impact brought about by the measure was evident. TUR 2.2. had particularly contributed to the development of the city spearhead projects “Turku Science Park” and “Smart & Wise”. The Turku Science Park spearhead project is one of the city’s three spearhead projects and an important component in developing the appeal and competitiveness of Turku. The objective is to use new networked operating models to create an internationally attractive and boldly experimental cluster of expertise with versatile functions and logistic appeal. The Science Park covers the laboratory area, reaching from the university campus to the Kupittaa business cluster and further to Itäharju. Its aim is to be seamlessly connected to the city center. The goal of the spearhead project is to combine the projects of land use, building, and transport with innovation activities. Smart & Wise Turku is another city spearhead project developed during ECCENTRIC, combining the strategic goal of regional carbon neutrality in 2029 with the Smart City concept. Traffic and Mobility is one of the focal points in Smart & Wise, including the development of a mobility node. The development of this spearhead project can be attributed to ECCENTRIC impact to a large extent.

In the MAL agreement for 2016-2019, the Kupittaa area is already mentioned as one of the focal areas of development. In the MAL agreement draft for 2020-2023, it is stated that “the city of Turku and the state will promote public transport connection and city development project realization that connects the Kupittaa-Itäharju region”. In addition, smart mobility pilots will be promoted in the area, including the Smart&Wise spearhead project and an autonomous vehicle pilot in Kupittaa. It should however be noted that the 2020-2023 version of the MAL agreement used here was still a draft.

The share of walking, cycling and public transport will be increased through active measures in accordance with objectives of Turku master plan 2029. The objective for the share of sustainable means of transport according to the Turku master plan and the Structural Model 2035 for the Turku Urban Region is over 66% in 2030. It is stated in the plan that “Walkers and cyclists will be provided with uninterrupted main connections of high quality, safe routes and convenient city center arrangements.”

In the Turku Climate Plan (SECAP) from 2018, sustainable mobility is promoted via several measures and actions although the mobility node is not directly mentioned. It is perhaps fair to say that the integration of the node on policy level either in the SECAP or the MAL agreement would have created the needed momentum for its realization. Otherwise, it could be estimated that the measure policy level influence has been significant. **Score: 4.5.**

Investment costs in this measure refers to the costs related to the planning of the mobility node by a diploma worker (working hours), which amounted to 13 146 €.

The **Operating costs** of TUR 2.2. covered the personnel costs related to the running of the measure during implementation. This equaled 58 000€ according to the Site Coordinator.

The following indicators were directly connected to the realization of the mobility node. Due to its failure, no ex-post data could be derived for the said indicators.

- Job/sales impact
- CO₂, NO_x, PM emissions
- Access to mobility services
- Mode shift
- Vehicle-Km travelled
- System usage
- Relative travel cost

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	One mobility node has been created and evaluated	O	Plans for the mobility node were made but due to various reasons, it was not realized during the project time span.
2	20% of the companies and housing companies in the area have used the measures tested in the laboratory area.	**	According to the 2019 surveys, 18.2% of the companies have used ECCENTRIC measures. Among the housing companies, the share was even higher at 31.5%. The measures included were bike share, the winter cycling route and e-buses. The objective was thus achieved according to the survey results, at least among the housing companies.
3	The use of public transportation has increased during the project time.	NA	As no mobility node was created and the other activities in the measure did not address use of PT, there has been no direct impact on the use of public transport.
4	20% of the companies and housing companies in the laboratory area accept the mobility change	**	Acceptance of sustainable mobility pilots in the laboratory area was high in principle: Private companies: 57% Housing companies: 39% However, the sample was small and the companies were not addressed with a specific question accepting the mobility change.
5	10% - 30% decrease of average driving speed in living lab after safety plans implementation	NA	No changes to driving speed were implemented in the laboratory area. Traffic safety measures in the area concentrated on blocking access to a thoroughfare.

6	More than 60% of the companies in the laboratory area are aware of the measures created in the ECCENTRIC.	**	On average, 66% of the companies surveyed in the laboratory area were aware ECCENTRIC measures (bike share system, winter cycling pilot route, electric city buses, biogas as a traffic fuel).
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★★ = Exceeded			

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

One significant deviation occurred from the original plan. In the Kupittaa district, a mobility node combining bicycle, car sharing, public transport and information boards and providing year-round seamless cycling and walking connections was to be created during the project. Sketches of the mobility hub were prepared by an architecture student from Tampere University of Technology in spring and summer 2017. The concept of the mobility node was presented to stakeholders, city representatives and citizens at a special event in May 2017 and participants were asked to suggest ideas for services that the node could offer. During two years, several negotiations took place between the city and private landowners about the location of the node. However, in the end, the landowners of the potentially strongest site were not interested in providing part of their land for the mobility node. The mobility node was also integrated into a new city flagship project called Smart and Wise Turku. Despite these efforts, the mobility node was not created during the project, resulting in a major setback for the measure realisation and subsequently for impact evaluation as well. Some preliminary barriers and drivers related to the measure are presented below.

D.2 Barriers

The following barriers for measure realisation have been identified so far.

D.2.1 Financial

Already at the planning stage, it was acknowledged that there was a gap between planning and actual realisation of the mobility node due to financing. In essence, no budget was reserved for the actual realisation of the node within ECCENTRIC, just for planning. Due to this, there was a possibility that the plans would not be actualised as the funding of the node would need to come from other sources. In retrospect, the planning should also have been started much earlier to overcome the several political and strategic challenges related to the realisation of the measure.

D.2.2 Planning

The further planning of the mobility node has encountered some significant land-use related issues. The issue boils down to land ownership and how the city is able to assign some of its functions on privately owned land. In order to resolve this problem within project duration, the measure planning and preparations should have started earlier.

D.2.3 Problem-related

The measure was rather complex and involved various stakeholder groups with differing interests, as well as several city administrative sectors. Its success was connected to several highly political issues, such as reducing parking spaces and land-ownership, which naturally generated hindrances for measure planning. Continuous efforts to address these issues with key stakeholders, land-owners and city politicians took place during measure implementation. It is worth noting that the renewal of the whole city's parking policy was under way, however it

was formulated and implemented too late considering the realization of measure objectives. The timing was thus not optimal considering TUR 2.2. success.

D.2.4 Organizational

Lack of resources in measure TUR 5.5 (personnel changes) affected TUR 2.2 development for some time as personnel resources had to be transferred temporarily.

D.3 Drivers

The following drivers for measure realisation have been identified so far.

D.3.1 Political/strategic

The Turku Science Park Masterplan for 2050, prepared as part of the Campus and Science Park spearhead project set by the Turku City Council in 2016, created momentum for laboratory area development. The Kupittaa laboratory area and its surroundings will be heavily developed within the coming years, which will create an urgent need for sustainable mobility development. In addition, another spearhead project, Smart and Wise Turku, which combines the strategic goal of regional carbon neutrality in 2029 with the Smart City concept has traffic and mobility as one of its focal points.

D.3.2 Involvement/communication

During the first reporting period a systematic increase in sustainable mobility communication was observed, partly due to project and measure influence. The project has managed to give added momentum to sustainable mobility communication in the city despite the fact that mobility issues are spread under different administrative sectors and directors. This has acted as a strong driver in reaching the target groups and stakeholders in the laboratory area.

D.4 Supporting activities

No supporting activities were identified for this measure.

D.5 Recommendations on the implementation process

Some recommendations on implementation can be suggested based on process evaluation of the measure so far.

D.5.1 Plan ahead and secure funding

When planning to implement resource-intensive, potentially expensive endeavours such as a mobility node, sufficient funding should be secured already prior to planning to ensure the realisation of said plans. This will create momentum for relevant decision-making processes.

D.5.2 The more complex an issue, the more planning is needed

When implementing a measure that involves urban infrastructure related changes, potential barriers to locations should be mapped already at the pre-planning stage.

D.5.3 Map out potential risks and be prepared for them

Not an easy feat as such, planning a complex measure such as TUR 2.2. necessarily entails risks for its realisation. In order to ensure realisation, potential risks related to it should be mapped as thoroughly as possible already at the pre-planning stage. Naturally cities are fluctuating entities within which there is always an element of risk which sometimes is close to impossible to foresee. Essentially, however, a proper risk mapping from all possible aspects

– financial, planning, political, cultural, organizational, etc. – may at best ameliorate or even prevent major deviations to measure realisation.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- Housing companies and private companies were surveyed, contacted and concrete information materials planned. As a result, awareness of sustainable mobility increased in the area.
- 20% of the companies and housing companies in the area have used the measures tested in the laboratory area.
- Plans for the mobility node were made and are ready when the realisation of such becomes feasible.
- The measure significantly contributed to policy level development in the city, making smart mobility ingrained more deeply into the city planning processes.
- Actions to improve traffic safety in the laboratory area were taken.

E.2 Relevance of supporting activities

The development of car share in connection to the mobility was closely connected with the development of parking policies in the city. A process to modify these policies took place during the project and resulted in permit-based parking policies allowing for a better operating environment for shared cars via more flexible parking possibilities. This development has been essential for the future of car sharing in the city and would have been particularly useful in Kupittaa, had the mobility node been realised.

E.3 Interaction with other measures

- Interaction with MAD 4.6. "Pedestrian friendly public space outside the city center" proved particularly fruitful as the first-ever experimentation on blocking access to a thoroughfare was realized in the laboratory area in mid-August 2019.
- MUN 5.9. "Intermodal (E-) Mobility stations": the Munich measure was explored when planning the Turku mobility node particularly from the point of view of promoting multimodality.
- STO 6.7. "Promote installation of EV-charging multifamily houses" provided insights into the promotion of electric vehicle charging at apartment buildings. The existing alternatives for EV-charging were surveyed among the laboratory area housing companies and private companies.

E.4 Main lessons learned

- The measure has proven, first and foremost, that planning and implementing mobility measures that require take-over of urban space in an already densely-populated area

can be a daunting endeavour. The issues related to land-ownership proved too challenging to overcome within project duration, which ultimately resulted in the failure to implement the mobility node. The risks for this were not foreseen. It has particularly been shown that these types of processes are very long if, as in this case, the necessary site for the mobility node does not belong to the city. Ideally, a mobility node should be planned in a location that is both suitable and owned by the city.

- When planning to implement resource-intensive, potentially expensive endeavours such as a mobility node, sufficient funding should be secured already prior to planning to ensure the realisation of said plans. This will create momentum for relevant decision-making processes.
- Complex issues such as those included in this measure have shown the need for increase staffing levels. This is the case, for example, in the field of cooperation between companies and apartments. Also, a lot of time should be devoted to do coordination and persuasion work.
- Company mobility management requires the active participation of the companies themselves. They are not obliged to cooperate, although mobility management for companies is especially beneficial for the employees. It is therefore important to find the right approach and motivate companies to participate. First small successes could be registered in this measure with information screens about public transport and information channels of stakeholders.

E.5 Long term impact

- The impact of the measure cannot be underestimated, despite the failure to realise its main planned output, the mobility node. It could even be stated, with a positive attitude, that the learnings from the measure would have been significantly lower without its partial failure. The failure to implement the mobility node has provided a valuable viewpoint into the complexity and time-consuming nature of implementing infrastructure-related projects in an already densely populated urban area.
- As a result of the measure, traffic and mobility are now better embedded on policy level (Smart&Wise Turku) and mobility communication on city-level has improved greatly. These impacts are likely to benefit sustainable mobility promotion and development projects on city level in the future.
- For the first time, companies and housing companies were contacted systematically in order to map out their most relevant concerns and needs in terms of smart mobility planning. This provided a beneficial learning opportunity on how to proceed with company mobility management in the future.

E.6 Potentials for up-scaling in the city

The city of Turku still lacks a mobility node, despite painstaking efforts for its realisation. Yet, the Kupittaa area is facing ever-growing pressure for development. Addressing these challenges requires constant efforts to keep sustainable mobility at the forefront of city communication and efforts to discourse with the area's main stakeholders. Most importantly, a concerted effort to reconcile the varying interest and conflicting needs of different stakeholders into a coherent whole is still needed. Potential for upscaling is thus abound in

this measure, if not just for the need for a mobility node but also for the need of addressing households and companies on their needs and views on promotion of sustainable mobility.

F. Additional information

F.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

- Due to the partial failure of the measure, ex-post data could not be obtained on some of the indicators. This was naturally a clear setback for the impact evaluation approach.
- Another clear setback for measure evaluation was the fact that the Kupittaa mobility questionnaires to companies and housing companies were devised and realised before the evaluation framework and the measure indicators were set. This meant that there was no opportunity to formulate the questions to derive data for the baseline.
- Another critical aspect related to evaluation quality was the format of the Kupittaa mobility survey directed at the housing companies. The housing company survey was sent to housing company representatives, not individual households. In the 2016 survey, for example, 74% of the respondents were apartment owners who might not even live in the said apartment building. The rest, 26%, were property managers of the housing companies. In the 2019 survey, either the building manager (7), an apartment owner (29) or, in one case, a tenant responded to the survey. Their opinions should therefore be viewed critically as there was no way of knowing whether they represented their own interests or the interests of the majority of tenants in the building. In retrospect, the LEMs should have pushed more vehemently for a household survey in the laboratory area, subcontracted in the similar manner as was done with e.g. the cycling barometer survey.
- The measure underwent changes and corrective actions, which in retrospect would have required a partial change of the evaluation approach.
- The measure has been subject to a detailed process evaluation and frequent interviews with the SC. These actions have helped formulate a better view on the barriers and drivers and overall learnings related to the planning and implementation of the measure.

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

- The creation of the mobility node should be explored further, with a thorough analysis of possible locations now and the coming years taking into account the recent and forthcoming developments regarding the use of urban space within the area.
- A concerted effort to influence the land-owners in the laboratory area should be taken to convince them of the benefits (particularly financial) a mobility node would bring. This could be done within the scope of Smart& Wise Turku. By communicating the added benefits of the node to the companies in the area, an added push could be created for

harnessing space to the purpose, despite the negative attitudes of the land owners so far. In essence, lobbying for the node should become a priority in the area.

- The forthcoming analysis of the Tahkonkuja experiment will hopefully shed light on the safety impacts of thoroughfare restrictions. For this purpose, the incident/accident rates in the area should be evaluated further and the residents' and companies' views on the experiment be reviewed.
- In order to get a better grasp of the views of the residents on mobility development needs in the area, a proper survey should be conducted. This is particularly important as the area is the spearhead project and will be under continuous restructuring and heavy development within the coming years. In addition, commute to the laboratory area will only increase as more and more companies are focusing their functions in the district. This brings an added pressure to the already sensitive issue of parking places and creates an even more evident need for the development of park-and-ride.

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<https://trepo.tuni.fi/bitstream/handle/123456789/25561/Kaaria.pdf?sequence=4&isAllowed=y>



2020
CiViTAS
Cleaner and better transport in cities

ECCENTRIC



MAD 2.3

Adaptive parking management based on energy efficiency and occupancy Measure Evaluation Report

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2020
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ECCENTRIC



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Project Partners

Partner nº	Organization	Country	Abbrev.
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2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consorcio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures BV.formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
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	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
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19	Green City Projekt GmbH	Germany	GCP
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21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Ana Rosa Llorente	Ayuntamiento de Madrid
Luis Fernández Heredia	Ayuntamiento de Madrid
Alberto Muñoz Rodríguez	Ayuntamiento de Madrid
Irene Blázquez	EMT
Sergio Fernández	EMT

Table of Contents

ABSTRACT.....	174
A. INTRODUCTION.....	176
A.1 EXPECTED RESULTS OF THE MEASURE	176
A.1.1 Quantifiable impacts.....	176
A.2 MEASURE DESCRIPTION	176
A.2.1 Measure outputs.....	178
A.2.2 Supporting activities	178
A.2.3 Interactions with other ECCENTRIC measures.....	178
A.2.4 Interactions outside ECCENTRIC	178
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	179
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	179
A.5 IDENTIFIED RISKS	179
B. MEASURE IMPLEMENTATION	180
B.1 SITUATION BEFORE CIVITAS	180
B.2 INNOVATIVE ASPECTS.....	180
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	180
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	180
C. IMPACT EVALUATION FINDINGS	183
C.1 EVALUATION APPROACH.....	183
C.1.1 Expected impacts and indicators.....	183
C.1.2 Baseline.....	184
C.1.3 The business-as-usual scenario.....	188
C.2 MEASURE RESULTS.....	188
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	190
C.4 UP-SCALING	191
D. PROCESS EVALUATION FINDINGS	192
HERE THE MAIN FINDINGS OF THE PROCESS EVALUATION ARE SUMMARISED. MORE DETAILS ARE AVAILABLE IN THE PROCESS EVALUATION REPORT OF THIS MEASURE.	192
D.1 DEVIATIONS FROM THE ORIGINAL PLAN.....	192
D.1.1 Changes in the measure demonstration site.....	192
D.1.2 Access conditions to the parking facility.....	192
D.2 BARRIERS	192
D.2.1 Planning stage: lack of involvement of some stakeholders.....	192

D.3	DRIVERS	193
D.3.1	<i>Political and strategic driver: EMT management</i>	193
D.3.2	<i>Technological driver</i>	193
D.4	SUPPORTING ACTIVITIES.....	193
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	193
D.5.1	<i>Alternative survey methods</i>	193
E.	EVALUATION CONCLUSIONS	194
E.1	VALIDATED DIRECT IMPACT	24
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	194
E.3	INTERACTION WITH OTHER MEASURES	194
E.4	MAIN LESSONS LEARNED	24
E.5	LONG TERM IMPACT	24
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	195
F.	ADDITIONAL INFORMATION	196
F.1	APPRAISAL OF EVALUATION APPROACH	196
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	196

List of Figures

Figure 1: DAVAO System	181

List of Tables

Table 1: Quantifiable impacts.....	176
Table 2: Target groups or affected parties.....	179
Table 3: Measure stakeholders.....	179
Table 4: Description of risks.....	179
Table 5: Description of key performance indicators (KPI).....	183
Table 6: Description of key performance indicators (KPI) (cont).....	184
Table 7: Measure's indicators	184
Table 8: Modal split and daily trips at EMT headquarters (February 2018)	185
Table 9: Composition of the car fleet	186
Table 10: Average travel time (minutes)	187
Table 11: Emissions and energy consumption of the car fleet (baseline).....	187
Table 12: Access control system performance	188
Table 13: Modal split of EMT staff.....	189
Table 14: Measure's indicators: before and after results	190
Table 15: Summary assessment of measure's objectives	191

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2.3	Adaptive parking management based on energy efficiency and occupancy		
Last update	Responsible	e-mail	telephone
02/12/2019	Ana Rosa Llorente	llorentebar@madrid.es	

Abstract

This measure has been implemented in parking facilities of the EMT headquarters (the municipal transport company known as *Empresa Municipal de Transportes de Madrid*), located outside, but very close (just 600 m away) to the ECCENTRIC city lab (Vallecas). The possibilities for upscaling this innovative solution are quite high, as EMT is currently managing 23 car parks in Madrid (10,958 parking spaces, spread out over 7 resident car parks, 4 short-term car parks, 9 mixed-use car parks and 3 P+R car parks).

The EMT staff working at the central office amounts to 1,357 people. There are 149 parking places within the building, i.e., 9.1 persons per each parking place. Access to the parking is limited to authorised vehicles, and is controlled by an automatic license plate recognition system. During the implementation of the measure, authorisations have been awarded based on a set of criteria that included, inter alia, vehicle occupancy and vehicle technology.

With the implementation of the measure, access to the parking was controlled with a technology based on image processing, and making it possible to identify cars with more than one passenger.

The reliability of the access control system during the demonstration period has been fair: The results achieved during the demonstration do not provide the necessary reliability to establish a completely automated parking control access system. The percentage of vehicles correctly detected (i.e. identifying the plate number and the right number of occupants) reached 86% in February 2019. The number of days without disruption increased until March 2019 (90%). Since April 2019, the system was subject to more frequent disruptions due to a variety of technical failures (insufficient capacity of the hard disk saving images, failure of the laser detector...). Performance improved in the following three months (July to September 2019), with more than 94% of vehicles correctly detected, and slightly decreased in October 2019, to 85%.

The measure objectives have been partially achieved, as summarised in the table below. It is worth recalling that the initial site of this measure was changed, from a peripheral office tertiary area to the EMT headquarters. As a result of this change in location, the objective 2 (reduction of parking offences) became irrelevant, as the EMT headquarters had not an influence on parking offences in the area; additionally, as the size of the parking facility is small, its impact on traffic in the surrounding area would be very low, if relevant at all.

The reduction in car travel, measured in the access to the EMT headquarters has been substantial, as measured by the occupancy of the parking facility: 13.2 percentage points: however, this has not resulted in noticeable changes in traffic conditions in the surrounding

area. An increase in car occupancy in the cars accessing the parking lot has been measured (from 1.12 in December 2018 to 1.15 in February 2019 and 1.18 in October 2018, although with some up and downs from month to month; this is confirmed by the increase in the modal share of car-pooling (from 4.2% to 8.3%). Four key lessons can be learned from this demonstration:

- Parking management measures are effective in encouraging modal change; this includes changes in the criteria to grant access to parking facilities in a company's premises. In particular, car-pooling can be promoted through parking management measures.
- A priority parking access measure in itself does not provide an incentive strong enough to change users' car choice: the staff is not likely to change their car purchase decisions at the light of the new parking access policy.
- The environmental impacts (emissions and energy consumption) of car-pooling are likely to be modest compared to the resources required to support car-pooling, as modal change is more likely to happen in shorter than in longer trips (probably due to the difficulties to find a trip partner and the more rigid conditions (e.g. timing) associated to long trips).
- Automated control of car occupancy remains a technical challenge, that cannot provide fully-satisfactory control of parking access.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- To decrease traffic levels in the areas affected by parking management regulations.

(2) Strategic level:

- To reduce private car use among the targeted population, achieving a modal shift towards public transport and non-motorized modes.
- To reduce energy consumption and emissions from traffic.

(3) Measure level:

- At least one car park managed by a smart parking approach.
- To reduce the number of parking offences in the area.
- To improve safety conditions for active modes and to reduce conflicts between road users, as well as to contribute to other municipal objectives (green areas, leisure places) in the area.
- To improve the quality of public space formerly occupied by illegal parking.
- To increase car occupancy levels among the targeted population.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
1	6% reduction of car travel in the affected area	X	X								
2	Reduction of parking offence levels in the affected area										
3	Increase of car occupancy in the affected area	X	X								

Table 1: Quantifiable impacts.

A.2 Measure description

Parking regulation as a demand management strategy has been mostly used in urban city centres, linked to commuting mobility. However, on-going decentralisation trends in cities such as Madrid, with peripheral districts losing their traditional residential character and hosting an increasing number of office and commercial space, requires the implementation of parking management strategies and measures in these districts, as a mean to reduce car pressure.

The situation prior to ECCENTRIC is characterised in the peripheral districts of Madrid by poorly regulated parking, insufficient enforcement of parking rules, with invasion of some sidewalks by parked cars creating potentially hazardous situations for pedestrians, cyclists and drivers, and lack of use of smart parking management systems, including criteria such as energy efficiency of vehicles, occupancy rates, parking demand levels in the area, etc.

Within this measure, the City of Madrid envisaged to design and implement a smart parking management scheme that will be tested in one parking area within the living lab. Initially, the following management strategies were expected to be tested in the chosen site:

- Parking priority for high occupancy vehicles (HOV).
- Parking priority for clean vehicles.
- Specific parking regulation for urban good delivery operations.

In order to guarantee the continuation of the scheme after the termination of ECCENTRIC, a particular effort was expected to be placed in the effective engagement of the managers of the corresponding trip generator centres.

The identification of an area well-suited for implementing these approaches is fundamental to ensure the success of this measure. The testing environment must provide the adequate conditions for the use of carpooling, in terms of schedules and destinations.

As a first step of this measure, parking management and regulation options in the living lab and other peripheral districts in the city have been studied. Initially, a municipal parking was identified in the peripheral district of Hortaleza (northeast of the city centre), with quite attractive traits: serving a business area (Ribera del Loira) with thousands of jobs, including some local and national government buildings and a large park (Juan Carlos I); some of the companies in the area were developing their own mobility plans, and some collaborative measures were already being carried out; furthermore, the area is well served by the public transport system, offering alternatives to those that would not use the car park under the new management rules.

However, this option was not supported by the decision makers in charge of the municipal services located in the area and making use of the car park, and a new place was identified: the central offices of EMT (the municipal transport company known as Empresa Municipal de Transportes de Madrid), located outside, but very close (just 600 m away) to the ECCENTRIC city lab (Vallecas). Besides running the municipal bus network, EMT is also in charge of the public bike service, tow trucks (cranes for parking enforcement) and public parking facilities in the city. The possibilities for upscaling this innovative solution are quite high, as EMT is currently managing 23 car parks in Madrid (10,958 parking spaces, spread out over 7 resident car parks, 4 short-term car parks, 9 mixed-use car parks and 3 P+R car parks).

The EMT staff working at the central office amounts to 1,357 people. There are 149 parking places within the building, i.e., 9.1 persons per each parking place. Access to the parking is limited to authorised vehicles, and is controlled by an automatic license plate recognition system. The parking places have been distributed among the different departments in the building, and each department is free to choose the procedure to allocate them to individuals within their staff (and in some cases even to individuals belonging to other departments): permanent assignment, monthly rotation, etc.

The site selected will allow to consider separately the impact of priority measures on vehicle occupancy and on the use of clean vehicles. Interaction between these two priority measures is expected to be low, if existent at all, as they target different mobility behaviour decisions: in the first case, the basic decision is to share the ride; in the second case, the basic decision is to purchase a different vehicle. Regarding freight delivery management, the site is located in an area with no particular pressure from freight delivery operations; therefore, management strategies on the latter will not be considered within the measure.

A.2.1 Measure outputs

The measure outputs are the following:

- At least one car park managed by a smart parking approach.
- An automatic control system (including recognition of the vehicle and the number of occupants) implemented and tested.

The management system is implemented in the central offices of EMT (the municipal transport company known as Empresa Municipal de Transportes de Madrid), located outside, but very close (just 600 m away) to the ECCENTRIC city lab (Vallecas). Besides running the municipal bus network, EMT is also in charge of the public bike service, tow trucks (cranes for parking enforcement) and public parking facilities in the city. The possibilities for upscaling this innovative solution are quite high, as EMT is currently managing 23 car parks in Madrid, as mentioned above.

The EMT staff working at the central office amounts to 1,357 people. There are 149 parking places within the building, i.e., 9.1 persons per each parking place. Access to the parking is limited to authorised vehicles, and is controlled by an automatic license plate recognition system. The parking places have been distributed among the different departments in the building, and each department is free to choose the procedure to allocate them to individuals within their staff (and in some cases even to individuals belonging to other departments): permanent assignment, monthly rotation, etc.

With the implementation of the new access control system provided by the measure, new rules for the assignment of parking places have been established. The new rules take into consideration, inter alia, whether the car is carrying more than one person and whether it is a zero-emission car. These rules are combined with the more traditional ones regarding commuting distance or number of children.

The access control system is based on an image processing technology. The automatic control makes it possible to positively discriminate cars with more than one passenger. The image processing system controls the first rang of seats and also the back part of the car. It is programmed for diverse weather conditions, especially for the more difficult ones (rain, fog, winter low visibility days or hours in the sunset or dawn, artificial lighting...). More information is provided in section B.4.

A.2.2 Supporting activities

There are no supporting activities linked to this ECCENTRIC measure.

A.2.3 Interactions with other ECCENTRIC measures

There are no interactions with other ECCENTRIC measures.

A.2.4 Interactions outside ECCENTRIC

This measure has a significant interaction with the preparation and implementation of a Green Mobility Plan (GMP) by EMT during 2018. Its preparation included a mobility survey, completed in February 2018. The GMP was approved at the end of 2018, and its implementation started

on January 1, 2019. This was a needed pre-requisite to implement this ECCENTRIC measure, as the GMP and its measures had to be agreed with the staff's representatives. Besides the new parking management system, the GMP includes the operation of a ride matching platform to support the EMT staff in their search for a partner to share the ride to the working place.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
10	Staff at EMT central office		EMT central office, close to Vallecas

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role Links –
1	CRTM. Head of planning	<u>O</u>	<u>Other</u>	<u>O</u>	
2	Madrid. Environment and mobility councillor	<u>O</u>	<u>C</u>	<u>O</u>	
3	Madrid. Director urban regeneration strategy	<u>O</u>	<u>C</u>	<u>O</u>	
4	Madrid. Director traffic management	<u>O</u>	<u>C</u>	<u>O</u>	
5	Madrid. Local traffic police	<u>O</u>	<u>C</u>	<u>O</u>	
6	EMT. CEO	<u>O</u>	<u>PT</u>	<u>O</u>	
7	EMT. Unions' Board	<u>O</u>	<u>PT</u>	<u>O</u>	
8	Madrid. Measure leader	<u>P</u>	<u>C</u>	<u>L</u>	
9	EMT. Measure participant	<u>P</u>	<u>PT</u>	<u>P</u>	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
EMT staff unaware or critical with the measure	3-4	The measure is supported by the implementation of a Company Green Mobility Plan	EMT
Insufficient involvement of EMT executives	2	Close cooperation between the municipality and EMT	Madrid
Automatic access control system unable to identify vehicles' occupancy	10 (Technological)	Involvement of an experienced system provider (INDRA)	Madrid

Table 4: Description of risks

B. Measure implementation

B.1 Situation before CIVITAS

Contrary to the city centre, parking is poorly regulated in the peri-central districts of Madrid. This translates in the occupation of sidewalks and other public space by illegally-parked cars, and potentially hazardous situations for pedestrians, cyclists and drivers.

The introduction of smart parking management measures and strategies in Madrid has been limited, thus far, and applied only in the central districts: on-street parking fares are higher for older vehicles, parking fares are higher in areas with high demand, and residents benefit from lower fares.

The demonstration site (EMT headquarters) provides 149 parking places, assigned to some of their 1,357 employees (2018 data) with disparate criteria by the different departments hosted in the building.

B.2 Innovative aspects

There are different innovative aspects associated with the measure:

- Smart parking management: implementation of occupancy criteria for parking allocation, encouraging ride-sharing among EMT staff. Additionally, priority to clean vehicles, i.e. vehicles with the government's environmental label "zero" (awarded to electric vehicles) or "eco" (awarded to hybrid and other low-emitting vehicles) vehicles will also be considered.
- Technological innovation: Demonstration of a vehicle recognition technology allowing the identification of the number of persons in the vehicle.

Initially, it was also envisaged to undertake increased parking enforcement and improvement of public space in the surroundings of the parking facility. However, the site selected does not offer any opportunities for this: on one side, on-street parking in the area is not significantly affected by the location of the EMT headquarters, and is not requiring targeted enforcement actions; on the other side, the quality of the public space in the area surrounding the EMT headquarters is not suffering from on-street parking pressure.

B.3 Research and Technology Development

There are no R&T developments associated to this measure.

B.4 Actual implementation of the measure

As a first step of this measure, parking management and regulation options in the living lab and other peripheral districts in the city have been studied. Initially, a municipal parking was identified in the peripheral district of Hortaleza (northeast of the city centre), with quite attractive traits: serving a business area (Ribera del Loira) with thousands of jobs, including some local and national government buildings and a large park (Juan Carlos I); some of the companies in the area were developing their own mobility plans, and some collaborative measures were already being carried out; furthermore, the area is well served by the public transport system, offering alternatives to those that would not use the car park under the new management rules.

However, this option was not supported by the decision makers in charge of the municipal services located in the area and making use of the car park, and a new place was identified:

the central offices of EMT (the municipal bus company), located outside, but very close (just 600 m away) to the ECCENTRIC city lab (Vallecas). Besides running the municipal bus network, EMT is also in charge of the public bike service and manages several public parking facilities in the city. The possibilities for upscaling this innovative solution are quite high, as EMT is currently managing 23 parking facilities in Madrid, as mentioned above.

The EMT staff working at the central office amounts to 1,357 people. There are 149 parking places within the building, i.e. 9.1 persons per each parking place. These places are distributed in 3 floors, with 13, 68 and 68 places respectively. Access to the parking is limited to authorised vehicles, and is controlled by an automatic license plate recognition system. The parking places have been distributed among the different departments in the building, and each department is free to choose the procedure to allocate them to individuals within their staff (and in some cases even to individuals belonging to other departments): permanent assignment, monthly rotation, etc.



Figure 1: DAVAO System

This technology uses an image processing system. The automatic control will make it possible to positively discriminate cars with more than one passenger. This policy could eventually be complemented with other conditions, such as access restricted to clean vehicles, or to vehicles fulfilling other criteria.

The image processing system controls the first rang of seats and also the back part of the car. It is programmed for diverse weather conditions, especially for the more difficult ones (rain, fog, winter low visibility days or hours in the sunset or dawn, artificial lighting...).

The requirements for the new technology include supply and installation of the following systems and devices:

- Vehicle detection and license plate reading subsystem: OCR camera, vehicle detection sensor/camera shot and OCR software license.
- Front seat occupancy counting system, including front camera, optical, filters and infrared light source and other required installation elements.
- Back seat occupancy counting system, including front camera, optical, filters and infrared light source and other required installation elements;
- Information unit of Process (server) including a cupboard for equipment, LAN communication boards (Ethernet) and WAN, serial converter/Ethernet and an uninterruptible power supply (UPS);
- Software for high occupancy detection system, including product license and ad hoc development for parking environment;

Software such as Business intelligence (BI) for high occupancy detection system reports, including product license and *ad hoc* development to comply with project requisitions.

The design phase took place between January 2017 and June 2018. The implementation phase took place between July 2018 and October 2018. The operational phase started with some trials in November 2018, and the new parking access system officially started on 1 January 2019; operations will continue until October 2019.

Once the location and stakeholders were decided, the measure leader prepared the contracts for the development of the new technology and the installation of the control at the parking gates, based on the number of passengers in every vehicle. A second contract to analyse the data gathered was also developed.

A first campaign of data collection for cars entering the park was undertaken at the end of 2018. After this first test, the system was reviewed and the demonstration phase started on January 1, 2019.

The second data collection was completed in June 2019 (six months after the implementation). This short delay in the evaluation plans, due to the change of the site, does not compromise the robustness of the evaluation of this measure within the project period. As data collection in the first months were disturbed by different technical contingencies, data collection was subsequently expanded until October 2019.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1,3	2			
Indicator name	Mode shift	Systems usage	Awareness	Acceptance	Satisfaction
Type	KPI	KPI	KPI	KPI	KPI
Category	Transport system	Transport system	Society	Society	Society
Subcategory	General	General	Acceptance	Acceptance	Acceptance
Aspect	Modal split	Transport System Utilisation	Awareness level	Acceptance level	Fulfilment of Expectations
Definition	Number of car trips changing mode from single car occupancy to car-pooling	Average system (i.e. parking lot places) usage per day	% of target groups aware of the measure	% of target groups favourable to the measure	Average satisfaction score provided by users
Unit	Number of trips	%Parking places occupied, morning peak hour	%	%	Score (1-5)
Method of data collection	Survey to employees within the area of influence of the new parking lot (after implementation)	On-site counts (visual inspection) of park places in the new parking lot (1 week, one hour every day)	Survey to employees within the area of influence of the new parking lot (after impl.)	Survey to employees within the area of influence of the new parking lot (after impl.)	Survey to employees within the area of influence of the new parking lot (after impl.)
Target group	Employees at EMT headquarters	Parking places in the area of study	Employees at EMT headquarters	Employees at EMT headquarters	Employees at EMT headquarters
Domain	Demonstration area (EMT headquarters)	Demonstration area (EMT headquarters)	Demo area (EMT headquarters)	Demonstration area (EMT headquarters)	Demonstration area (EMT headquarters)
Control sample	No	No	No	No	No
Related measures, activities, and interference sources	Impact of EMT mobility plan and illegal parking enforcement	Measurement of parking occupancy and illegal parking in surrounding streets. Focus on long-stay (more than 2 hours) parking	Company mobility plan in progress at EMT headquarters	Company mobility plans in progress at EMT headquarters	Company mobility plans in progress at EMT headquarters
References					

Table 5: Description of key performance indicators (KPI)

Impact						
Indicator name	CO2 emissions	NOx emissions	PM emissions	Energy	Capital costs	Operating costs
Type	KPI	KPI	KPI	KPI	KPI	KPI
Category	Environment	Environment	Environment	Environment	Economy	Economy
Subcategory	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Costs	Costs
Aspect	Emissions	Emissions	Emissions	Energy	Costs/Operating costs	Operating costs
Definition	t per year of CO2 saved by change to ride sharing	t per year of NOx saved by change to ride sharing	t per year of PM saved by change to ride sharing	Energy (MJ) saved by change to ride sharing	Capital total costs	Average operating costs
Unit	Tons	Tons	Tons	MJ	EUR	EUR
Method of data collection	Estimated from mode shift results	Estimated from mode shift results	Estimated from mode shift results	Estimated from mode shift results	Provided by EMT and P operator	Provided by EMT and P operator
Target group	Employees changing mode	Employees changing mode	Employees changing mode	Employees changing mode	P operator	P operator
Domain	Demonstration area (EMT headquarters)	Demonstration area (EMT headquarters)	Demonstration area (EMT headquarters)	Demonstration area (EMT headquarters)	Demonstration area (EMT headquarters)	Demonstration area (EMT headquarters)
Control sample	No	No	No	No	No	No
Related measures, activities, and interference sources	None	None	None	None	None	None
References						

Table 6: Description of key performance indicators (KPI) (cont)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Mode shift	Number of trips	A	S	EMT staff	EMT headquarters
2	Systems usage	%Parking places occupied at peak time	B-A	DC	EMT P users	EMT headquarters
3	Awareness	%	A	S	EMT staff	EMT headquarters
4	Acceptance	%	A	S	EMT staff	EMT headquarters
5	Satisfaction	Score (1-5)	A	S	EMT staff	EMT headquarters
6	CO2 Emissions	tons	A	E	EMT staff	EMT headquarters
7	NOx Emissions	tons	A	E	EMT staff	EMT headquarters
8	PM Emissions	tons	A	E	EMT staff	EMT headquarters
9	Energy	MJ	A	E	EMT staff	EMT headquarters
10	Capital costs	EUR	A	DC	EMT staff	EMT headquarters
11	Operating costs	EUR	A	DC	EMT staff	EMT headquarters
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 7: Measure's indicators

C.1.2 Baseline

The baseline is based on current parking occupancy. Data referring to the parking use was collected in September 2018, before the installation of the new access control system had started, to avoid any interference or overlapping with the measure implementation, while

avoiding the rather unusual conditions linked to the summer period (June to August, with a significant share of the staff on annual leave).

Information on the EMT staff's mobility practices had already been collected for the preparation of the Company Green Mobility Plan in February 2018, and was also used for this baseline.

Systems usage

The EMT parking lot offers 149 places, distributed in three separate levels (with respectively 13, 68 and 68 places), with one single access at the street level. The upper level is used by service vehicles, and is not included in this analysis. Parking occupancy was measured in the morning during one week (17-21 September 2018), with measures at 8:00, 10:00 and 12:00. The experience showed that the higher parking occupancy rates occur in the 10:00-12:00 period for two reasons: on the one hand, parking occupancy in the afternoon is significantly lower than in the morning, as most of the EMT staff are working during the morning shift (7:00-15:00); on the other hand, although most of the parked cars stay for the whole morning period, there can be some occupancy changes due to outside activities of some of the staff (particularly in the first and last hours of the shift); this was confirmed by the data collected, which showed higher occupancy rates during 10:00 and 12:00 counting. The measured average occupancy was 83.5%.

The high percentage of car users benefiting from the parking places at the headquarters can be partially explained by the fact that there are different working shifts, so that some parking places can be used successively by different cars.

Modal split

The survey administered in February 2018 to all the employees at EMT headquarters was answered by 143 persons (10.5%). Modal split is summarised in the table below. Private car users predominantly make use of the headquarters parking places (76.9%); 15.4% make use of paid parking facilities outside the headquarters and the rest (7.7%) make use of public, on-street parking places.

Transport mode	%
Walking	2.1%
Cycling	3.5%
Motorbike	57.3%
Public transport	5.6%
Car (1 occupant)	27.3%
Car (2+ occupants)	4.2%
TOTAL	100%

Table 8: Modal split and daily trips at EMT headquarters (February 2018)

Only 4.2% of EMT staff (or 13% of the car users) share their car ride. Based on these figures, it can be estimated that approximately 7% of the cars parking in the EMT premises are occupied by more than one person.

Emissions

The technical characteristics of the vehicles making use of the EMT parking facility are presented in the table below.

Vehicle Technology	Mini (A)	Small (B)	Medium (C)	Large (D and above)	TOTAL
Euro 1. Gasoil	0	0	0	0	0
Euro 1 Gasoline	0	0	1	0	1
Euro 2. Gasoil	0	0	0	0	0
Euro 2. Gasoline	0	1	0	3	4
Euro 3. Gasoil	0	2	0	5	7
Euro 3. Gasoline	0	2	1	0	3
Euro 4. Gasoil	0	1	10	11	22
Euro 4. Gasoline	1	2	12	1	16
Euro 5. Gasoil	0	1	10	6	17
Euro 5. Gasoline	0	6	3	2	11
Euro 6. Gasoil	0	0	4	5	9
Euro 6. Gasoline	0	1	2	0	3
Euro 6+. Gasoil	0	1	4	4	9
Euro 6+. Gasoline	1	2	3	1	7
Hybrid. Euro 5	0	0	0	1	1
Hybrid. Euro 6	0	2	2	1	5
Electric	0	1	0	0	1
TOTAL	2	22	52	40	116

Table 9: Composition of the car fleet

COPERT v.5.1⁴ provides average emission and energy consumption coefficients for each car group above. The coefficients are obtained for urban traffic conditions with an average speed

⁴ COPERT (Calculation of Emissions from Road Transport) is a computer programme developed by EMISIA with the support of the European Environment Agency, currently used for the estimate of emissions in national inventories. <https://www.emisia.com/utilities/copert/>

of 30 km/h. Hybrid cars are included in the COPERT model, but electric cars are not. There is one electric car in this fleet, with a reported average consumption of 19 kW/100 km (26% higher than the official energy consumption for this model: 15 kW/100 km). Considering the CO₂ emissions of electricity generation in Spain (0.265 tCO₂/MWh, 2015-2018 average, REE) and estimated loss in the distribution grid of 9.7% (2017 estimate, CNMC), this results in 60.81 g CO₂/km. As pollutants (NO_x, NO₂, PM) emissions from electricity generation are not produced in the city, there is no need to consider the contribution of the electric vehicles for these pollutants.

Average travel time and travel distances were also collected in the February 2018 survey. The average trip distance travelled by car users is 19 km for a round trip; average travel times are presented in the table below.

Travel time	%
< 15 min	13.29%
15 - 30 min	27.97%
30 - 45 min	33.57%
45 - 60 min	17.48%
60 – 75 min	6.99%
> 75 min	0.70%

Table 10: Average travel time (minutes)

Based on the coefficients above and the average car trip distance, it is possible to calculate average emissions and energy consumption for the whole fleet of 116 vehicles. The results are presented in the Table below, which provides specific values (the emissions and energy consumption levels per kilometre), values for an average 19-km trip (the average daily round trip made by EMT staff using cars, as obtained from the survey) and for a whole year (assuming 200 working days per year).

Category	Specific value	Per trip	Whole fleet (one year)
NO _x emissions	0.3587 g/km	6.815 g	156.736 t
NO ₂ emissions	0.1407 g/km	2.673 g	61.479 t
PM emissions	0.02392 g/km	0.454 g	10.452 t
CO ₂ emissions	139.24 g/km	2646 g	61,145.5 t
Energy consumption	1.8836 MJ/km	35.789MJ	827.417 TJ

Table 11: Emissions and energy consumption of the car fleet (baseline)

C.1.3 The business-as-usual scenario

The BAU scenario assumes no changes in current mobility practices within EMT staff; therefore, travel patterns, including modal split, measured in February 2018 would not change. The composition of the staff's car fleet would also remain the same.

C.2 Measure results

Technical system performance

The reliability of the access control system during the demonstration has been fair, and has not significantly improved during the testing period. The percentage of vehicles correctly detected (i.e. identifying the plate number and the right number of occupants) reached 86% in February 2019. The number of days without disruption increased until March 2019 (90%).

Since April 2019, the system was subject to more frequent disruptions due to a variety of technical failures (insufficient capacity of the hard disk saving images, failure of the laser detector...).

Indicator	12/2018	1/2019	2/2019	3/2019	4/2019	5/2019
% vehicles detected	84,4%	84,2%	86,2%	84,3%	75,8%	-
% days without disruption	64,5%	80,6%	89,3%	90,3%	60,0%	0,0%
% 2+ vehicles	11,3%	12,9%	14,2%	12,3%	13,4%	-
Average occupancy (pass/car)	1,12	1,14	1,15	1,13	1,14	-
Indicator	6/2019	7/2019	8/2019	9/2019	10/2019	
% vehicles detected	34,6%	97,0%	94,7%	95,4%	85,3%	
% days without disruption	40,0%	87,1%	87,1%	90,0%	96,8%	
% 2+ vehicles	11,8%	15,3%	10,1%	12,5%	17,2%	
Average occupancy (pass/car)	1,12	1,20	1,10	1,13	1,18	

Table 12: Access control system performance

The results achieved during the demonstration do not provide the necessary reliability to establish a completely automated parking control access system.

System usage

The access control system detected a slight increase in the number of vehicles with 2 or more occupants: from 11% in December 2018 to 13%-15% once the system was installed, although with significant ups and downs from month to month (table above).

The survey to EMT staff showed a significance decrease in the occupancy of the EMT parking places: from 83.5% in September 2018 to 70.3% in September 2019 (Table). This change would suggest that, after the implementation of the measure, the profile of parking users has changed, and the rules for assignment of parking places has excluded some daily car users by employees that do not use their cars on a daily basis.

Modal change

In accordance with the 2019 survey to EMT staff, 8.2% of the respondents have changed their transport mode between 2018 and 2019, resulting in a decrease in the modal share of cycling and car (single occupant) and an increase in the modal share of public transport and car-

pooling. This means that, out of a total staff of 1391 workers, 111 had changed their transport mode, and 55 had changed to car-pooling (i.e. 110 daily trips or 4.1%). These trips result in a number of cars (19) only slightly lower than the number of 2+ cars registered by the system (between 20-30 per day in March 2019), which would suggest that some of the car-poolers do not have access to a parking place. This is due to the parking assignment criteria in the Green Mobility Plan, which includes other considerations apart from car-pooling. The share of car-poolers would have doubled, from 4.2% to 8.3%. A comparison of modal split in February 2018 and March 2019 is provided in the table below.

Transport mode	2018	2019
Walking	2,1%	2,1%
Cycling	3,5%	1,5%
Public transport	57,3%	61,4%
Motorcycle	5,6%	5,6%
Car (single occupant)	27,3%	21,2%
Car pooling	4,2%	8,3%

Table 13: Modal split of EMT staff

As for the reasons to change mode, 45% of the respondents mentioned the ECCENTRIC measure (changes in the assignment of parking places) and 27% the other measures included in the EMT Green Mobility Plan.

Emissions and energy consumption

The balance of emissions and energy consumption savings is made based on trips for which changes in transport mode were identified in the 2019 survey. The results are presented in [Table 14](#).

The changes in emissions and energy consumption are lower to what could be initially expected considering the changes in modal split mainly due to the fact that those EMT workers changing to more sustainable modes are travelling shorter distances than those changing to more polluting modes.

Measure acceptance

The level of awareness among EMT staff members was high (72% of respondents declared to have a medium-to-detailed knowledge of the ECCENTRIC measure), with a 3.2 average score on a 1-5 scale.

The level of acceptance of this ECCENTRIC measure was relatively low: only 48% of respondents agreed partially-to-totally with the measure, whereas 49% were totally in disagreement with it. The average acceptance score on a 1-5 scale was 2.3, compared to a score of

The level of satisfaction with the ECCENTRIC measure was also relatively low: 51% of respondents were partially-to-fully satisfied with the measure. The average satisfaction score was 2.6, compared with a score of 3.3 with the former system of assignment of parking places.

Costs

The capital cost of this measure is €39,806 (excluding VAT). The operating costs are €15,000 per year.

The values of KPI are summarised in the table below.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Mode shift	trips	0	2/2018	0	3/2019	110	3/2019	110	110
Systems usage	%	83.5%	9/2018	83.5%	9/2019	70.3%	9/2019	-13.2	-13.2
Awareness	%	-	-	-	3/2019	72.0%	3/2019	-	-
Acceptance	%	-	-	-	3/2019	48.0%	3/2019	-	-
Satisfaction	Score	3.3	2/2018	3.3	3/2019	2.6	3/2019	-0.7	-0.7
CO2	tons	61146	2/2018	61146	3/2019	61136	3/2019	-0.015%	-0.015%
NOx	tons	156.74	2/2018	156.74	3/2019	155.98	3/2019	-0.484%	-0.484%
PM	tons	10.5	2/2018	10.5	3/2019	10.4	3/2019	-0.293%	-0.293%
Energy	MJ	827.42	2/2018	827.42	3/2019	827.39	3/2019	-0.003%	-0.003%
Capital cost	EUR	0	-	0	2019	39806	2019	39806	39806
Operating cost	EUR	0	2019		2019	15000	2019	15000	15000

Table 14: Measure's indicators: before and after results

The measure has been effective in achieving modal shift (110 trips per day or 4.1%) and has reduced the occupancy of the EMT parking facility (from 83.5% to 70.3%). However, the level of acceptance and satisfaction among the EMT staff is not high, reflecting the resistance that demand management measures usually face within companies.

Modal shift has not resulted in significant reductions in emissions or energy consumption. This is explained by the fact that those trips changing to a more sustainable mode have largely been short-distance trips, whereas some changes in the opposite direction (towards individual car use) have occurred in long-distance trips.

Considering these results, the capital and operating costs. Although low, can hardly be justified, especially considering the operational problems faced by the system during the demonstration stage.

C.3 Summary: achievement of objectives

The measure objectives have been partially achieved, as summarised in the table below. It is worth recalling that the initial site of this measure was changed, from a peripheral office tertiary area to the EMT headquarters. As a result of this change in location, the objective 2 (reduction of parking offences) became irrelevant, as the EMT headquarters had not an influence on parking offences in the area; additionally, as the size of the parking facility is small, its impact on traffic in the surrounding area would be low, if relevant at all.

No.	Objective and target	Rating	Comment
1	6% reduction of car travel in the affected area	***	The affected area is reduced to the EMT headquarters access
2	Reduction of parking offence levels in the affected area	0	Objective not relevant in the new demonstration site
3	Increase of car occupancy in the affected area	**	

NA = Not Assessed	O = Not Achieved in full	★ = Substantially achieved (at least 50%) ★★★ = Exceeded	★★ = Achieved

Table 15: Summary assessment of measure's objectives

The reduction in car travel, measured in the access to the EMT headquarters has been substantial, as measured by the occupancy of the parking facility: 13.2 percentage points: however, this has not resulted in noticeable changes in traffic conditions in the surrounding area.

An increase in car occupancy in the cars accessing the parking lot has been measured (from 1.12 in December 2018 to 1.15 in February 2019 and 1.18 in October 2018, although with some up and downs from month to month; this is confirmed by the increase in the modal share of car-pooling (from 4.2% to 8.3%).

C.4 Up-scaling

Considering the results obtained in terms of system reliability and emission reduction, this measure is not retained for upscaling.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the **Process Evaluation Report** of this Measure.

D.1 Deviations from the original plan

D.1.1 Changes in the measure demonstration site

During the implementation phase, five potential locations were initially assessed for the smart parking facility; the assessment criteria included the study of the infrastructure, transport alternatives for accessing the area, demand, users' profile and expected impacts. The first choice was a peripheral business park located in Hortaleza District, 12-km north of the living lab. The site was currently used for parking by employees of the municipality (there are several municipal services in the area) and of some private companies, interested in establishing their own green mobility plans. However, the concept faced unsurmountable barriers, including the lack of urban planning permissions and the fears of some municipal decision-makers about the acceptability of the concept by the municipal civil servants using the parking lot. After extensive search for alternatives, the measure team identified at the end of 2017 the EMT central office (with a good number of parking places for its employees) as an adequate location. The reason for involving EMT was the decision of the City Council (in the context of its Air Quality Plan or "Plan A", approved in September 2017) to shift responsibilities and control of public parking management to EMT since the beginning of 2018. As EMT is also one of the ECCENTRIC partners, its involvement in this measure could be arranged quickly, and the measure's results could serve as a basis for future management of public parking in the city.

D.1.2 Access conditions to the parking facility

In the initial site, it was envisaged to reserve a number of parking places to car-poolers. This concept could not be made operational at the final demonstration site in the EMT headquarters; the option retained was to establish a system of permanent parking place assignment, based on a range of criteria, including car-pooling.

D.2 Barriers

The following barriers were identified and dealt with during the measure implementation and demonstration stages.

D.2.1 Planning stage: lack of involvement of some stakeholders

Delays in the selection of the demonstration site resulted in relatively late involvement of EMT managers and staff representatives. This barrier was overcome thanks to the integration of the measure within the EMT activities for the preparation of its Green Mobility Plan, which included the involvement of all these stakeholders.

D.3 Drivers

The following drivers facilitated the measure implementation and demonstration stages.

D.3.1 Political and strategic driver: EMT management

The supporting attitude of EMT managers greatly facilitated the materialisation of this measure, once the initial location selected for demonstration failed to be approved by the municipality. The measure team was quick in identifying the opportunity provided by the launching of the EMT Green Mobility Plan, and could adapt the technical specifications to the requirements of the new location.

D.3.2 Technological driver

There was a strong interest by some private stakeholders to develop parking access control systems with the ability to count the number of car occupants. This interest facilitated the quick definition of technical specifications and the development of the solutions to be used during the demonstration.

D.4 Supporting activities

No supporting activities were conducted during the measure demonstration.

D.5 Recommendations on the implementation process

Based on the implementation experience, the following recommendation can be highlighted.

D.5.1 Alternative survey methods

Mobility surveys within EMT were administered through Internet, as this was found as a non-intrusive procedure, respecting the willingness of the staff to answer. However, this procedure may have produced biased samples in 2018 and 2019, mobilising those staff members with a stronger motivation in keeping or changing accessibility conditions to the EMT headquarters, particularly in what refers to the assignment of free parking space.

For future surveys linked to Companies' Green Mobility Plans, it is recommended to make use of a random sample and to conduct personal interviews, to facilitate data collection.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed through structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the following measure evaluation conclusions have been formulated.

E.1 Validated direct impact

Based on the observed impacts and the interpretation and comments provided in this report, the measure has achieved the following key results:

- This measure has been effective in achieving some modal change towards car-pooling and in increasing average car occupancy.
- This measure has also been effective in reducing the average occupancy of the EMT parking facility.
- The influence of this measure on vehicles' characteristics has not been demonstrated: plug-in hybrid and electric cars remain marginal within the staff's cars.
- The environmental impacts (emissions and energy consumption) of car-pooling are likely to be modest compared to the resources required to support car-pooling, as modal change is more likely to happen in shorter than in longer trips (probably due to the difficulties to find a trip partner and the more rigid conditions (e.g. timing) associated to long trips).
- The reliability of the automated system for car occupancy control has not been sufficiently demonstrated, and remains a technical challenge.

E.2 Relevance of supporting activities

There were no supporting activities linked to this measure

E.3 Interaction with other measures

There has not been interaction with other ECCENTRIC measures.

E.4 Main lessons learned

The main lessons learned are linked to the measure impacts identified in section E.1 above:

- Parking management measures are effective in encouraging modal change; this includes changes in the criteria to grant access to parking facilities in a company's premises. In particular, car-pooling can be promoted through parking management measures.
- A priority parking access measure in itself does not provide an incentive strong enough to change users' car choice: the staff is not likely to change their car purchase decisions at the light of the new parking access policy.

- The environmental impacts (emissions and energy consumption) of car-pooling are likely to be modest compared to the resources required to support car-pooling, as modal change is more likely to happen in shorter than in longer trips (probably due to the difficulties to find a trip partner and the more rigid conditions (e.g. timing) associated to long trips).
- Automated control of car occupancy remains a technical challenge, that cannot provide fully-satisfactory control of parking access.

E.5 Long term impact

Two long-term impacts can be anticipated for this measure, if maintained by the EMT management:

- EMT can make a more effective use of the available parking space. Establishing more rational parking access rules, EMT has reduced the parking occupancy rate, as some non-qualifying employers (probably with long daily stays and daily car-use) have found alternative solutions (public transport, paid parking outside the premises), liberating space for employees with more flexible travel behaviour (occasional car users, flexible working routines, including trips outside the EMT premises...). The additional space liberated opens an opportunity to further explore more environmentally efficient parking access in future (e.g. without attributing fixed parking places to particular employees), or to look for alternative use of the liberated space (e.g. storage, basic equipment...).
- Car-poolers could expand in the future, if the incentives to them are strengthen (e.g. full access to the parking facility, instead of the current bonus in the allocation of fixed spaces), considering the favourable results obtained. However, the environmental benefits of such trends remain uncertain, considering the results obtained in this project.

E.6 Potentials for up-scaling in the city

The potential to up-scale this measure at the city level is low. Although car-pooling could be encouraged through it, the project has shown that the environmental benefits of such trend is uncertain, as at least some carpoolers can be former public transport or non-motorised users. Furthermore, car-poolers tend to travel short-distance trips, as long-distance commuters are less likely to find a suitable ride partner; this reduces the environmental impact of the modal change achieved.

Lack of technical reliability is another reason preventing upscaling. The automated system has not provided a sound evidence about its ability to effectively control the number of car occupants. This prevent this technology to be expanded in the network of EMT public parking facilities in Madrid.

F. Additional information

F.1 Appraisal of evaluation approach

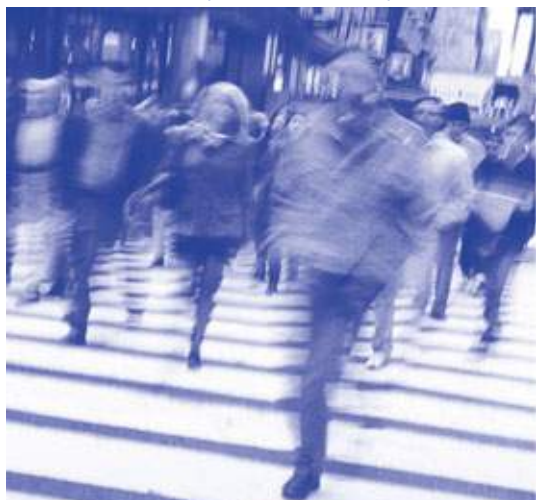
The evaluation approach for this measure has been effective in monitoring its relevant potential impacts. The daily monitoring of the automated control system has provided detailed information on its technical performance, on the occupancy of the cars accessing the facility and on the use of the parking places. The internet surveys have provided the necessary information on the EMT staff mobility behaviour. The evaluation system has required moderate resources, well aligned with the measure's scope.

Three elements could have improved evaluation with reduced additional cost: the automated control system could have provided information on the vehicle's technology (as it is in fact already made for on-street parking in Madrid), in order to monitor eventual progress in the share of clean (electric and plug-in hybrid) vehicles. The system could also monitor the parking time of each vehicle (providing a more accurate estimate of the facility's occupancy), by recording each vehicle's exit time. Finally, the internet surveys could have been replaced by personal interviews of a random sample of EMT staff, in order to avoid the risk of obtaining biased results, with a disproportionate share of respondents opposed to the measure.

F.2 Future activities relating to the measure

The following recommendations are addressed to EMT and other measure partners:

- Further development of the automated control system is recommended, including- besides car occupancy- recording of the timing of the stay in the parking facility and vehicles' emission characteristics.
- To benefit from the lower parking occupancy rates achieved by the measure, EMT could consider to dedicate part of the parking facility to alternative uses, or to establish an alternative system for granting access to it, eliminating the assignment of fixed places.



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RUS 2.6

Park and Ride in the peripheral district

Measure Evaluation Report

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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
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	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Nikolay Simeonov	
Margarita Tsekova	
Lachezar Rossenov	

Table of Contents

ABSTRACT.....	204
A. INTRODUCTION.....	206
A.1 EXPECTED RESULTS OF THE MEASURE	206
A.1.1 Quantifiable impacts.....	206
A.2 MEASURE DESCRIPTION	206
A.2.1 Measure outputs.....	208
A.2.2 Supporting activities	208
A.2.3 Interactions with other ECCENTRIC measures.....	209
A.2.4 Interactions outside ECCENTRIC	209
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	209
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS	209
A.5 IDENTIFIED RISKS	210
B. MEASURE IMPLEMENTATION	211
B.1 SITUATION BEFORE CIVITAS	211
B.2 INNOVATIVE ASPECTS.....	211
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	211
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	212
C. IMPACT EVALUATION FINDINGS	213
C.1 EVALUATION APPROACH.....	213
C.1.1 Expected impacts and indicators.....	213
C.1.2 Baseline.....	214
C.1.3 The business-as-usual scenario.....	215
C.2 MEASURE RESULTS.....	216
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	221
D. PROCESS EVALUATION FINDINGS	222
E. EVALUATION CONCLUSIONS	223
E.1 VALIDATED DIRECT IMPACT	226
E.2 RELEVANCE OF SUPPORTING ACTIVITIES	223
E.3 INTERACTION WITH OTHER MEASURES.....	223
E.4 MAIN LESSONS LEARNED	224
E.5 LONG TERM IMPACT	224
E.6 POTENTIALS FOR UP-SCALING IN THE CITY	224

F.	ADDITIONAL INFORMATION	225
F.1	APPRAISAL OF EVALUATION APPROACH	225
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	225

List of Figure

Fig. 1. Druzhba P&R facility	207
Fig. 2. Advertising in the PT	208
Fig. 3. Ticketing machine at the P&R entrance	212
Fig. 4. Modal split Druzhba	215
Fig. 5. Interview at the P&R station	216
Fig. 6. Interview at the LUKOIL fuel station.....	217
Fig. 7. Modal split Druzhba (Jan.2020)	217
Fig. 8. Parking turnover	218
Fig. 9. Parking occupancy in September 2019	219
Fig. 10. Parking occupancy in December 2019	219
Fig. 11. Level of emissions.....	220

List of Tables

Table 1. Quantifiable impacts.....	206
Table 2. Supporting activities	208
Table 3. Target groups or affected parties	209
Table 4. Measure stakeholders.....	210
Table 5. Risks	210
Table 6. Innovative aspects	211
Table 7. Impacts and indicators	213
Table 8. Indicators and measurements.....	214
Table 9. Emissions level	221
Table 10. Achievements of objectives.....	221

Project	City		
ECCENTRIC	Ruse		
Measure code	Measure name		
RUS 2.6	Park and Ride in the peripheral district		
Last update	Responsible	e-mail	telephone
30.04.2020	Lucia Ilieva	mail@csdcs.org	+359 888871208

Abstract

This measure describes the implementation of the Park&Ride (P&R) concept that took place for the first time in the City of Ruse. The P&R was implemented in the Ruse Living Lab – the peripheral Druzhba district, affected by high traffic volumes and having deteriorated public space due to the big number of cars parked everywhere around the buildings and on the streets. The P&R station is situated on the main road from Varna to Ruse at the entrance in the city in order to allow visitors to leave their cars at the parking and to travel by PT to the city centre.

The ultimate goal was to promote the modal shift towards public transport by reducing the use of cars by commuters and visitors to reach the city centre. The P&R station relieves road congestions along the routes regularly taken from Druzhba to the centre. Many PT stops are situated nearby providing easy connections. The measure also helps to reduce the number of cars parked on the public spaces in Druzhba, as well as in the central part of Ruse.

The key challenge of this measure was the identification and selection of a suitable location of the P&R facility. It was not easy to do, as there were not so many free municipal terrains that were close to the entrance of the city, had good connections with PT and were big enough to serve as a P&R station. This issue has been overcome by carrying out an exhaustive analysis of the territory in the laboratory area. Additionally, we put this question for discussion during meetings and informational events with representatives of the local citizens and experts working in the field of parking policy.

The P&R station having 41 slots was officially opened in May 2019 but the setup of the ticketing system and the deployment of the information and promotion campaign took time, so only during the last quarter of 2019 the facility was functioning with good capacity. Nowadays it is visible that the measure turns out to be a success and we have plans to upscale it by introducing it in other parts of the city (i.e. at the main entrances from Sofia and from Bucharest). It will be done in the frames of the Ruse SUMP (that is actually in stage of

implementation) and after the introduction of the new transport scheme of Ruse, because it is important that the new P&R stations are situated closely to the PT stops.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals / longer term:

- Increase the use of public transport (PT). To encourage the different actors to embrace sustainable mobility habits leaving their cars on the peripheral parking and using PT.
- Decreased the use of private cars. To create awareness of the need for and benefits of sustainable mobility in the City of Ruse and its importance for increasing the quality of life.

(2) Strategic level:

- Mode shift towards PT and away from private cars;
- Decrease emissions from cars.

(3) Measure level:

- Acceptance of the implemented P&R measure in Druzhdza;
- Satisfaction with the implemented measure.

A.1.1 Quantifiable impacts

Expected impacts	ID	Quantifiable Impacts	CIVITAS ECCENTRIC Objectives								
			Reduce:				Improve:				
Increase the use of PT Decrease the use of private cars and taxis Reduce the air pollution			Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight
	1	20% decreased use of private cars in Druzhdza	X								
	2	20% increased use of PT in Druzhdza	X					X	X		
	3	10% decreased emissions from private cars and taxis		X							

Table 1. Quantifiable impacts

A.2 Measure description

The City of Ruse implemented a Park & Ride strategy in the Druzhdza peripheral district, that has been affected by high traffic volumes and whose public space was deteriorated due to the big number of cars parked on streets and other public areas. The facility is situated on the main road from Varna to Ruse at the entrance in the city in order to allow visitors to leave their car at the parking and continue to the city center by PT. The ultimate goal was to promote a

modal shift towards public transport by reducing the need of commuters and guests of Ruse to use the car for daily connections to the city centre and allowing an easy connection with public transport services.

It was expected that this pilot P&R facility will contribute to change the travel behavior to commuters and they will use more the PT services. The Druzhba district situated along the main road to the seaside area (cities of Varna, Dobrich and Shumen) and being one of the entrances of Ruse with high traffic volumes was used as a pilot site for the implementation of the first P&R system in the city. The measure also helps reducing the number of cars parked on the streets and public spaces in Druzhba and in the city center.

The P&R facility was designed and constructed on a municipal terrain as a demonstration measure in order to show how this type of parking strengthens the use of PT. The available surface of only 1178 m² allowed the construction of 41 slots (4 of them for disabled).

There is a ticket machine situated at the entrance providing drivers with 2 tickets for PT daily for the price of 2.5 BGN (1.30 euro). The parking is free-of-charge if the user buys tickets and places the receipt in a prominent position in a dashboard of the car.



Fig. 1. Druzhba P&R facility

A.2.1 Measure outputs

- **Output 1** – Constructed P&R place with 41 slots
- **Output 2** – Parking connected to PT (a machine selling tickets to car drivers)

A.2.2 Supporting activities

	Type of supporting activity	Activity	Target group	Main objectives
1.	Information	Media and non-media campaign in Ruse	Large public (social media, municipal site), transport professionals (via the site of the National Coordinator on mobility and the SUMP focal point CSDCS, as well as via the SUMP /ENDURANCE BG network maintained by CSDCS)	• To raise the awareness about the P&R as a component of sustainable mobility • To support the ECCENTRIC measure
2.	Promotion	Media campaign in other cities (Varna, Dobrich, Shumen)	Visitors of Ruse (Publications in local newspapers and on the municipal sites)	• To inform about the new possibility for P&R and to invite using it when visiting Ruse
3.	Promotion	Direct advertising via posters, leaflets and billboards)	PT-commuters (via information posters in the buses and trolleys); Visitors of Ruse (via billboards and brochures at the fuel stations nearby)	• To raise the awareness about the P&R as a component of sustainable mobility • To support the ECCENTRIC measure

Table 2. Supporting activities



Fig. 2. Advertising in the PT

A.2.3 Interactions with other ECCENTRIC measures

Being situated in Druzhba, the success of the P&R scheme strongly relies on successful realisation of the following CIVITAS ECCENTRIC measures Ruse:

- RUS 4.3 and RUS 4.4, which envisaged the construction of safe crossings and pavements leading to the city centre;
- RUS 5.3: Achieving the goals of the new facility is also strongly reliant on the realisation of the measure 5.3 under which the public transport (bus and trolleybus) lines in Druzhba will be reorganised in order to better serve the needs of residents, commuters and visitors to the city;
- RUS 5.4: Introduction of the new bus night line connecting Druzhba with the city centre that will complement further the services of the P&R facility;
- RUS 3.6. Mobile app and Internet portal for public transport (PT): the P&R will be included in the information with the timetables of the PT stopping nearby.

A.2.4 Interactions outside ECCENTRIC

There will be an important interaction with the Ruse SUMP implemented in the moment outside of ECCENTRIC. The pilot P&R facility in Druzhba will be a part of the new parking policy in the city aiming to decrease the use of cars and to strengthen the use of PT.

A.3 Target groups and/or affected part of the city or region

Target groups			Affected area		
Type		comment	Type		comment
1	Druzhba citizens	27 000	0	Ruse citizens	140 000
2	Ruse visitors from outside the city	10 000	0	Citizens	500 000

Table 3. Target groups or affected parties

A.4 Stakeholders: ECCENTRIC project partners and other important actors

Main stakeholders are participants from the target group. In the following table, the stakeholders are summarized by function.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR- other	Level of activity L-P-O	Role - Links

1	Municipality of Ruse	P	C	L	Project partner
2	Ruse PT Company	S	PT	P	PT provider – provides transport from the P&R station to the city centre
3	Druzhba citizens	S	other	P	Beneficiaries – users of P&R station
4	Visitors of Ruse	S	other	P	Beneficiaries – users of P&R station
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 4. Measure stakeholders

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Measure Progress Reports are not delivered on time	Process	Standardized forms should be filled in instead	Nikolay Simeonov (ML)
Low use of the P&R station because of the lack of information and promotion	Process	Close cooperation with the communication manager	Nikolay Simeonov (ML)
The facility to be used as a free-of-charge parking for residents of the Druzhba neighbourhood	Process	Parking is only permitted if the driver buys 2 PT tickets	Nikolay Simeonov (ML)

Table 5. Risks

B. Measure implementation

B.1 Situation before CIVITAS

During the last decades Ruse suffers of lack of free public spaces. There is very high traffic of private cars and taxis coming from outside the city (mainly via Sofia and Varna highways) towards the city centre, which leads to congestion, air pollution, noise and high risk of road accidents. The historical center has an unattractive appearance because of the cars parked along the narrow streets and on the public areas. The regulated parking spaces in the city center are insufficient to handle the additional cars of the Ruse visitors, so people use to park improperly and randomly wherever they find an open spot. There are no buffer parking places in Ruse and the notion of P&R was unknown before ECCENTRIC.

B.2 Innovative aspects

Ranking	Innovative aspect	Description
1	New approach for parking policy	Introduction of P&R concept for the first time in Ruse
2	Automatic service for the users of the P&R station (providing tickets for the PT)	The software was elaborated and introduced especially for this first P&R facility in Ruse

Table 6. Innovative aspects

B.3 Research and Technology Development

The key challenge of this measure was the task for identification and selection of a suitable location for the P&R station. It was not easy to do, as there were not so many free municipal terrains that were close to the entrance of the city, that had good connections to the public transport and that were big enough to serve as a parking. This issue has been overcome by carrying out an exhaustive analysis of the territory in Druzhba. Additionally, this question was discussed during meetings and informational events with representatives of the citizens living in Druzhba and experts working in the field of parking policy.

An initial study of the mobility habits and needs in Druzhba (before the implementation of the measure) was performed using as primary sources panel interviews and direct questionnaires and as secondary sources - reports from the completed projects TRANSDANUBE and BUMP.

B.4 Actual implementation of the measure

The “Research and planning” phase was performed in the period 01.12.2016 – 28.02.2018. It took a longer term than what was initially planned because it was necessary to find the convenient terrain owned by the municipality and to obtain the approval by the City Council and the local citizens. During this phase meetings with local transport experts and with experts from other municipalities who have been implemented P&R strategies were organized. The idea of P&R was promoted among the local population and stakeholders during a series of training and discussion events. The results of this phase were detail technical specifications (ToR) necessary for starting the public procurement procedures for the implementation of the measure.

The Phase 2: “Procurement and implementation” started in March 2018 and was completed by the end of April 2019. During this stage after the public procurement procedures the design and building of 41 parking slots were performed and the software system for ticketing was elaborated and installed as a special machine.

The Phase 3: “Demonstration and monitoring” of the P&R started with the official opening of the P&R facility in May 2019. The station is successfully functioning till present reaching more and more clients. In parallel an intensive promotional and information campaign was conducted in Ruse and other cities (Varna, Dobrich, Shumen).

The last Phase 4: “Conclusions and recommendations” by evaluating the impact of this first initiative was done in the beginning of 2020.



Fig. 3. Ticketing machine at the P&R entrance

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

	Impact category	Expected impacts	Aspect of this category	Indicators	No.
1.	Environment	Emissions	Decrease of CO ₂ , NO _x and PM emissions	Pollutions	23
2.	Transport system	Decrease use of private cars and taxis	Increased use of PT with 20% (including by night)	Use of PT	1
3.	Society	Use of PT by local residents	Increased use of PT by residents with 20%	Mobility behavior	1

Table 7. Impacts and indicators

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
23	CO ₂ emissions	mg/m ³	B – A	DC	Druzhba neighborhood	Druzhba neighborhood (measured by the mobile station Ruse)
24	NO _x emissions	µg/m ³	B – A	DC	Druzhba neighborhood	Druzhba neighborhood (measured by the mobile station Ruse)
25	PM emissions	µg/m ³	B – A	DC	Druzhba neighborhood	Druzhba neighborhood (measured by the mobile station Ruse)
23	CO ₂ saved	t/year	A	E	Druzhba neighborhood – city centre	Calculated
24	NO _x saved	t/year	A	E	Druzhba neighborhood 0 city centre	Calculated
25	CH ₄ saved	t/year	A	E	Druzhba neighborhood 0 city centre	Calculated
1	Modal shift	%	B – A	S	Druzhba citizens	Druzhba neighborhood
19	Awareness	%	B – A	S	Druzhba citizens, visitors	Druzhba neighborhood
20	Acceptance	%	B – A	S	Druzhba citizens, visitors	Druzhba neighborhood
5	System usage	%	B – A	DC	P&R users	P&R facility
4	Parking turnover	Number of cars/average monthly	B – A	DC	P&R users	P&R facility
28	Investment costs	EUR	B – A	DC	Municipal budget	P&R facility

29	Operational Costs	EUR/month	B - A	DC	Municipal budget	P&R facility
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 8. Indicators and measurements

C.1.2 Baseline

As a baseline we used:

1. **The level of CO, NO_x and PM emissions in Druzhba:** this data indicating the air and the content of pollutants was obtained by the mobile station of the Regional Inspectorate of the Ministry of Environment and Waters (MOEW) in Ruse. They measure the emissions' level in Druzhba every day and publish the average daily data for each month. Although the impact of such a small P&R facility would be insignificant over the district with 27 000 inhabitants, initial data was collected for the month before opening the parking (April 2019) and they were as follows:
 - CO - 10 mg/m³;
 - NO_x – 106.4 µg/m³;
 - PM – 52.3 µg/m³.
2. **Modal shift** - For defining the baseline data, the data from the first research in May/June 2017 was used aiming to establish the initial modal split in Druzhba. The estimations were that this P&R facility will be used by local citizens living in Druzhba as well as by incoming visitors to Ruse (mainly from the north-east region). First was conducted a local citizens' survey. The methodology for the selection of respondents was quota-based, with a sample size of 215 people randomly selected and evenly distributed in the three neighborhoods of Druzhba district (Druzhba 1, Druzhba 2 and Druzhba 3), which guaranteed its representativeness. Subjects of the survey were individuals from all age groups of 15 and over, i.e. people who actually use public transport services and could give an objective assessment of both the advantages and disadvantages they face in their daily lives. For this purpose the following methods of registration of the information were used:
 - direct group poll (participants in the citizens trainings) - 65 people;
 - standardized face-to-face interview - 150 people random selected in the three Druzhba neighbourhoods;
 - A supplementary group of 10 local leaders were interviewed orally by extended questionnaires (audio-registered conversations).

After processing the interviews' results, it was possible to establish the mobility habits of Druzhba citizens and the modal split:

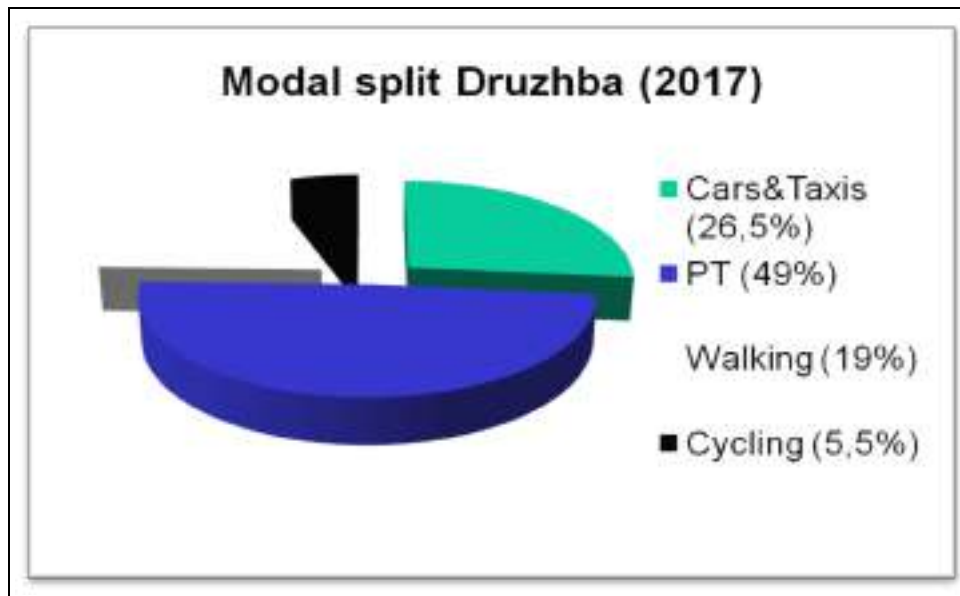


Fig. 4. Modal split Druzhba

3. **Awareness and Acceptance** - During the study aiming at defining the baseline data, the awareness and acceptance were totally absent, because people didn't know what P&R meant. It was concluded that a lot of training, information and promotional events would be necessary in order to introduce the P&R concept and to make people using the future facility.

C.1.3 The business-as-usual scenario

The BAU scenario was discussed during the meeting with stakeholders held in the Ruse Municipality on 7th of May 2019. In our analysis of such a model, the results were discouraging. Transport demand would increase in line with population ageing and the internal migration from rural to urban areas, and greenhouse-gas (GHG) emissions could rise proportionally. City dwellers would travel in mostly the same ways as they do now, and private cars would continue to account for about 35 percent of passenger-kilometers. Average travel times would increase by 15 percent because capacity would be strained.

Even if the e-cars would be largely introduced in every day trips, they also need places for parking and are not a solution for the public spaces in the city.

The presentations of the Ruse PM Mr. S. Karapchanski, the Dep. Mayor on Environment and the Chief-on-Architect of Ruse demonstrated that if the measure 2.6 was never implemented

as a pilot and the P&R concept was not adopted at the territory of Ruse, the city would be soon overloaded of vehicles and its streets would not be livable.

It was mentioned that the ECCENTRIC P&R model of the measure 2.6 will be introduced for the first time in Bulgaria. Because of the lack of any experience, the audience needed a lot of information and promotional materials in order to start using the P&R facility.

C.2 Measure results

For evaluating the final results, primary and secondary data was used as follows:

1. Evaluation of the **modal shift** according to the data obtained by the survey made in the period 18.11.2019 - 15.12.2019 in Druzhba with the established 150 panel respondents. They were contacted by the interviewers face-to-face or by phone and answered to similar questions as in the initial survey made in May 2017 concerning their travel mode, their opinion and use of the new measures, implemented in Druzhba, etc. For obtaining the same number of 215 respondents as for the baseline study, oral interviews were conducted (registered by smart phones) with 50 people at the P&R station and the LUCKOIL fuel station nearby, as well as with 15 people from Ruse during the 3rd Conference (held in Varna on 8th of November 2019).

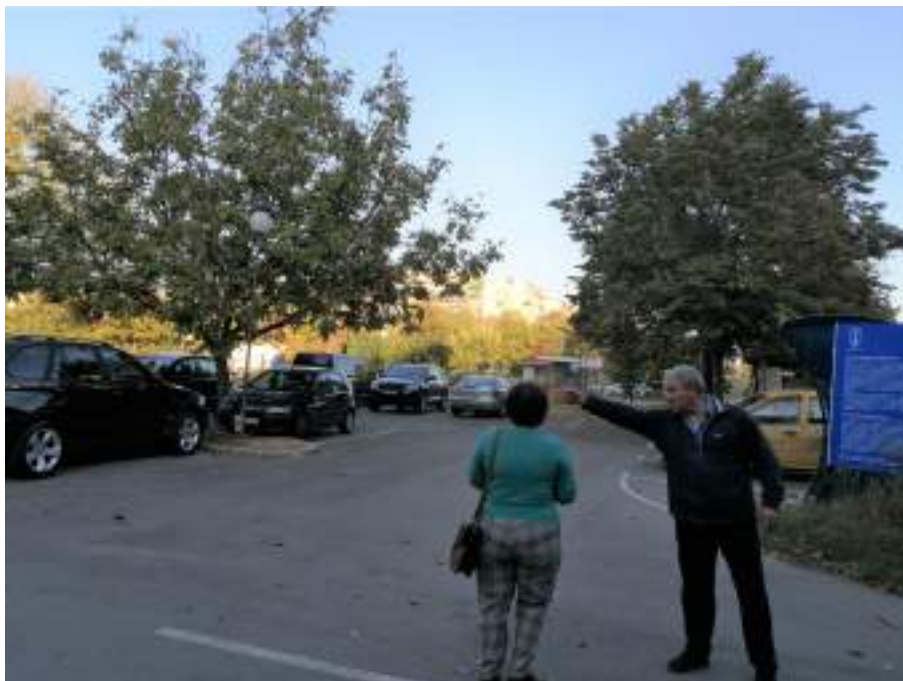


Fig. 5. Interview at the P&R station



Fig. 6. Interview at the LUKOIL fuel station

The results obtained from the 215 respondents show that already 76% of the local population use for their every-day trips PT, walking or cycling. It means that there is a shift to more sustainable way of moving. The initial percent of 73.5% increased with 2.5% and now the sustainable commuters are already 76%. The picture obtained was as follows:

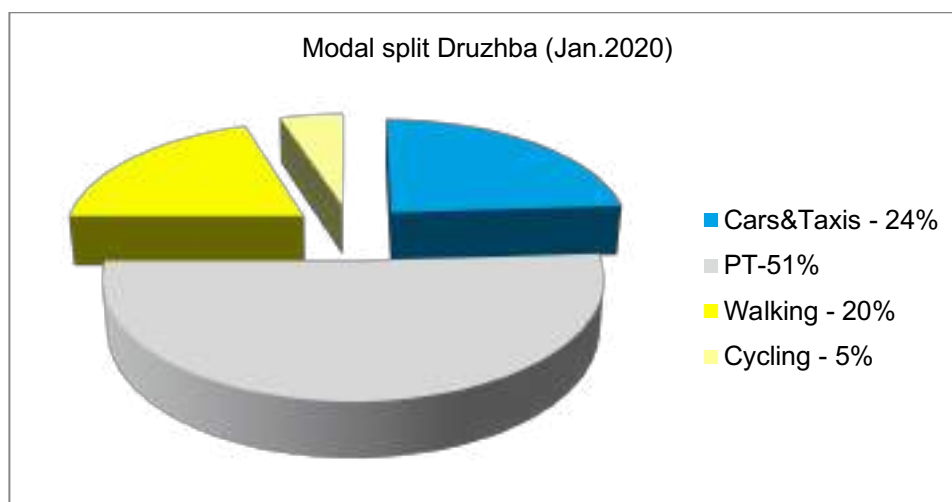


Fig. 7. Modal split Druzhba (Jan.2020)

The PT use increased also with 2% - from 49% to 51%. The walking – with 1% from 19% to 20%. There is a small decrease with 0.5% of the cycling but it is estimated that

it is due to the cold weather in the winter in Ruse. In general the trend is positive, although due to the late implementation of the technical measures in Ruse, they were in use only for several months and couldn't influence much the travel habits of the citizens. But we can see that even for 5 months of existence, the P&R facility had a positive impact on the behaviour of commuters.

2. For evaluating the **Awareness, Acceptance and Satisfaction**, the data from the above mentioned survey was used and the results were as follows:
 - a. Awareness – 76%. The negative answers came mainly from visitors of Ruse that were not informed about the new P&R possibility. Some elderly people from the panel (that were not drivers) were also not aware of the facility;
 - b. Acceptance – 80%, which show that people recognize the positive impact of the P&R concept;
 - c. Satisfaction – 64% (3.2 scores). Some respondents scored lower because they estimated that the measure is too limited as surface and number of slots and wanted to spread it at the other main entrances of the city.
3. **Parking turnover and system usage** – The number of cars parked daily was regularly observed (2-3 times per week) and counted by our team during 6 months (July-December 2019). We calculated the following average daily data:
 - July – 10;
 - August – 15;
 - September – 24;
 - October – 31;
 - November – 36;
 - December – 40 (full capacity).

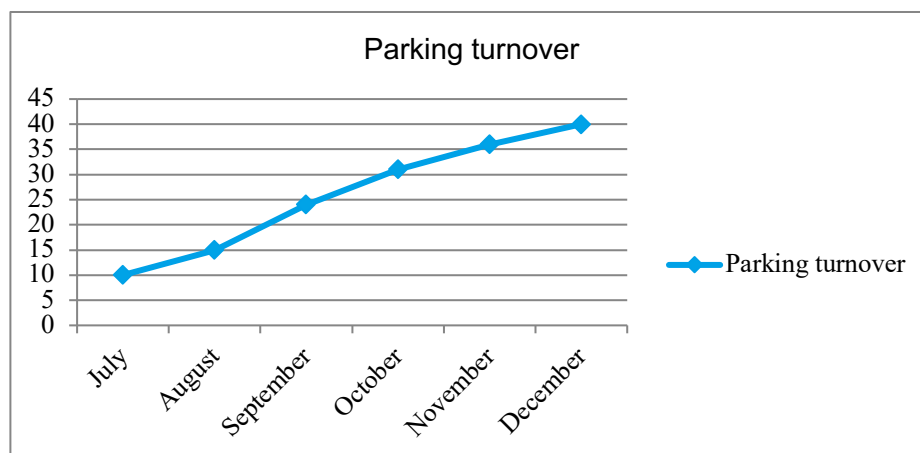


Fig. 8. Parking turnover

The average turnover for the first 6 months of exploitation was 26 cars, which means that the average system usage was 65%. The good point is that the use of parking increases every month and more and more cars from other cities use it.



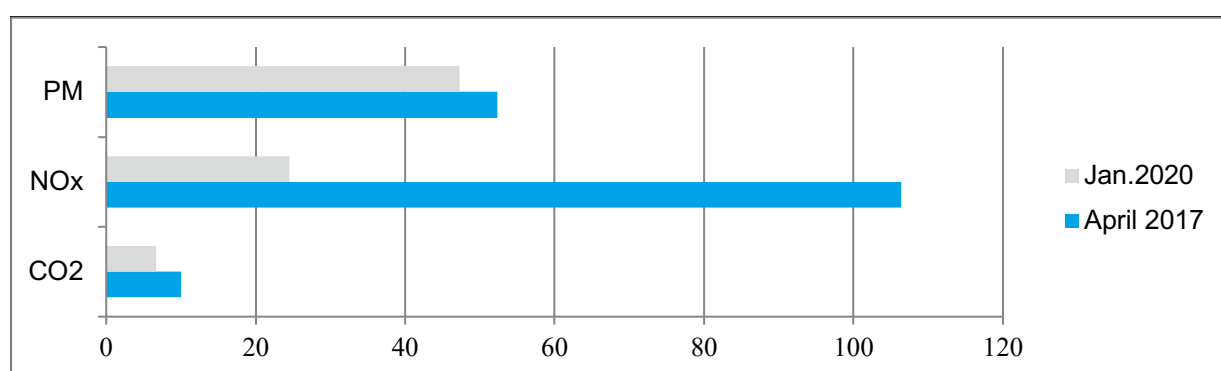
Fig. 9. Parking occupancy in September 2019



Fig. 10. Parking occupancy in December 2019

4. **Investments and operational costs:** The investments in the P&R stations are of € 54105 and the operational costs are € 20/month.
5. **The level of CO₂, NO_x and PM emissions in Druzhba:** the data was obtained by the mobile station of the Regional Inspectorate of the Ministry of Environment and Waters (MOEW) in Ruse. They measure the emissions' level in Druzhba every day and publish the average daily data for each month. For January 2020 the data are:
 - CO₂ – 6.7 mg/m³;
 - NO_x – 24.5 µg/m³;
 - PM – 47.3 µg/m³.

There is a slight improvement of the air quality partly due to the new measures. It is shown on the graph below:



(Data from <https://www.riosv-ruse.org/danni-punktove/>)

Fig. 11. Level of emissions

The emissions saved in t/year are calculated in the Annex 1.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
23 – CO ₂ emissions	mg/m ³	10	April 2019	10	May 2019	6.7	Jan. 2020	3.3	3.3
24 – NO _x emissions	µg/m ³	106.4	April 2019	106.4	May 2019	24.5	Jan. 2020	81.9	81.9
25 - PM emissions	µg/m ³	52.3	April 2019	52.3	May 2019	47.3	Jan. 2020	5	5
23-CO ₂ - saved	t/year	0	April 2019	0	May 2019	25344	Jan. 2020	25344	25344
24- NO _x - saved	t/year	0	April 2019	0	May 2019	0.009	Jan. 2020	0.009	0.009
25 – CH ₄ saved	t/year	0	April 2019	0	May 2019	0.0043	Jan. 2020	0.0043	0.0043
1 - Modal split	%	49- PT; 26.5 - car	June 2017	49 - PT; 26.5 - car	May 2019	51-PT 24 - cars	Jan. 2020	+2 – PT -2.5-cars	+2 – PT -2.5-cars
19-Awareness	%	0	May. 2017	0	May 2019	76%	Jan. 2020	76%	76%
20 - Acceptance	%	0	May. 2017	0	May 2019	80%	Jan. 2020	80%	80%

21 - Satisfaction	% (0-5 scores) %	0	May. 2017	0	May 2019	64% (3.2)	Jan. 2020	64% (3.2)	64% (3.2)
5 - System usage	%	0	May 2019	0	May 2019	100%	Jan. 2020	100%	100%
4 - Parking turnover	N of cars/average daily	0	May 2019	0	May 2019	26 (average)	Jan. 2020	26	26
28 - Investment costs	EUR	0	May 2019	0	May 2019	54105	Jan. 2020	54105	54105
29 - Operational Costs	EUR/month	0	May 2019	0	May 2019	140	Jan. 2020	140	140

Table 9. Emissions level

C.3 Summary: achievement of objectives

Due to technical and political reasons this measure was implemented by the Ruse municipality later than planned. The P&R station was officially opened in May 2019 but the setup of the ticketing system and the deployment of the information and promotion campaign took time, so only during the last quarter of 2019 the facility was functioning with good capacity. The achievement of the objectives below was made at a reduced rate with the expectation that after a long run they will be achieved together with the other ECCENTRIC measures. Such a small pilot P&R station can't change radically the indicators but as a whole the trends are positive.

The quality of the air was improved that is partly due to the combination of new mobility measures. CO2 emissions decreased with 33%. 2.5 % less car usage was registered thus providing a decrease by 10.4% comparing to the initial value. 2 % more use of PT was shown thus providing an increase by 4% comparing to the initial value.

One can report that this measure also contributed to the social inclusion and livability in Druzhba. 80% of the citizens accept it and estimate that it will improve their living conditions. 64% are satisfied with the P&R because it will lead to the more intensive usage of PT thus decreasing the social inequality and contributing to the social inclusion.

No.	Objective and target	Rating	Comment
1	Decrease the CO2 emissions with 10%	★★	CO2 emissions decreased with 33%
2	Decrease the use of cars with 20%	★	Registered 2.5 % less car usage thus providing a decrease by 10.4% comparing to the initial value
3	Increase the use of PT with 20%	O	Registered 2 % more use of PT thus providing an increase by 4% comparing to the initial value
4	Improve social inclusion	★	64% are satisfied with the measure
5	Improve livability	★	80% acceptance of the measure
6	CO2 emissions saved (t/year)	★	25344 t/year saved
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★★ = Exceeded			

Table 10. Achievements of objectives

D. Process Evaluation findings

N/A

E.Evaluation conclusions

The observed impacts of the measure has been reviewed, by having well-structured discussions with the Measure Leader/Site Coordinator, transport experts and stakeholders. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

The P&R station is very small but already has some positive local impact, described in the C3 section.

E.2 Relevance of supporting activities

The supporting activities were relevant and contributed to:

- support the ECCENTRIC measures;
- rising the awareness about the P&R as a component of sustainable mobility.

E.3 Interaction with other measures

There are interactions with:

- RUS 4.3 and RUS 4.4, which envisaged the construction of safe crossings and pavements leading to the city centre;
- RUS 5.3: Achieving the goals of the new facility is also strongly reliant on the realisation of the measure 5.3 under which the public transport (bus and trolleybus) lines in Druzhba will be reorganised in order to better serve the needs of residents, commuters and visitors to the city;
- RUS 5.4: Introduction of the new bus night line connecting Druzhba with the city centre that will complement further the services of the P&R facility;
- RUS 3.6. Mobile app and Internet portal for PT: the P&R will be included in the information with the timetables of the PT stopping nearby.

E.4 Main lessons learned

This pilot station is only the first step to the construction of a set of P&R stations at the main entrances of the city.

E.5 Long term impact

- Reduction of the car flow to the city centre of Ruse

E.6 Potentials for up-scaling in the city

The Ruse plan was to introduce the new P&R service and to carry out promotional activities in order to demonstrate this new measure and to stimulate the visitors and locals to use it. Nowadays it is visible that the measure turns out to be a success and we have plans to upscale it and introduce it also in other parts of the city (i.e. at the main entrances from Sofia and from Bucharest). It will be done in the frames of the Ruse SUMP (that is actually in stage of implementation) and after the introduction of the new transport scheme of Ruse, because it is important that the new P&R stations are situated closely to the PT stops.

The city might also think about additional incentives as providing free-of-charge parking for e-cars, enriching the parking with some places for e-bikes, etc.

The initiative could also be up-scaled to other cities and regions of Bulgaria. Till present only in Sofia there are buffer parking stations near the main underground terminals, but the hourly fee for parking there is quite high and it is not connected with a purchase of PT tickets.

F. Additional information

F.1 Appraisal of evaluation approach

- The measure used relevant evaluation methods that could provide more reliable results in a long-term run.

F.2 Future activities relating to the measure

- Observation and support of the parking station.

G. Annex 1

The Table 9 indicates the greenhouse gas pollution reported in the target region of Ruse according to the data from the Mobile station for measuring the **indicators of air quality**. The units of GHG are provided in and they show the difference in the air pollution before and after the measure, i.e. how the air pollution has decrease after the introduction of the measure RUS 2.6.

The required quantities **in tones/year** represent the **GHG emissions saved** as a result of the introduction of the measure RUS 2.6. They can be calculated theoretically on annual basis only after the introduction of the measure, so in the Table 9 there are no any data 'before' the measure.

The calculation of the saved greenhouse gas emissions as a result of the implemented measure RUS 2.6 has been made according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (<https://www.eea.europa.eu/themes/air/air-pollution-sources-1/emep-eea-air-pollutant-emission-inventory-guidebook>), using the general formula:

$$E_i = \frac{AD_i * EF_i}{10^6}$$

where:

E_i - greenhouse gas emissions in t;

AD_i - data on the total annual mileage of vehicles (in km);

EF_i - emission factor for the respective category (in g/km).

For the estimation of greenhouse gas (GHG) emissions, the following emission factors have been used, which were calculated as weighted average values on the basis of the data used for the preparation of the National Greenhouse Gas Inventory (<http://eea.government.bg/bg/dokladi/unfccc>):

CO₂ g/km – 220

CH₄ g/km – 0,037

N₂O g/km – 0,008

The total number of cars that used the buffer parking is 4 745 pcs. for a 6-month period, or an average of about 800 cars a month. The average annual number of cars in this trend of parking use is 9 600.

The distance from the parking lot to the center is 12 km in both directions / car / day. This is the average daily mileage that would drive a car from the parking lot to a central city area.

The annual average mileage (km) is:

9 600pcs. x 12 km mileage / car / day = 115 200 km mileage

Table 10

Number of vehicles reported by the system on a monthly basis (2019 data)

Reported data \ Month	July	August	September	October	November	December	Total
Number of cars registered	310	465	720	930	1085	1240	4750

Average car fuel consumption: 10lt / 100 km (urban);

Total Fuel Consumption: 11 520 lt (11,520 t)

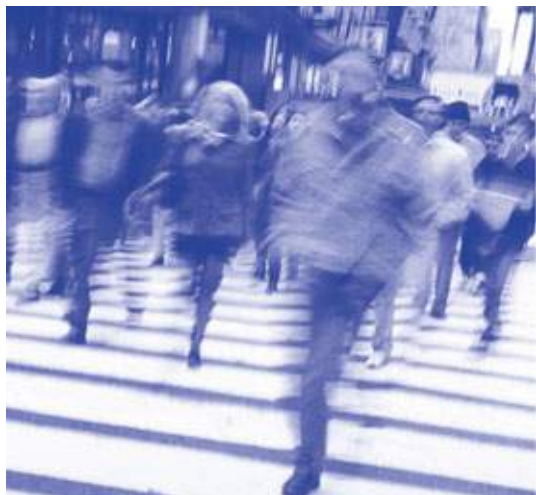
The reduction of greenhouse gas emissions resulting from the built-in buffer car park is as follows:

$115\,200 \text{ km / year} \times 220 \text{ CO}_2 \text{ g/km} / 10^6 = \mathbf{25,344 \text{ t/year of CO}_2\text{/year saved;}}$

$115\,200 \text{ km / year} \times 0.037 \text{ CH}_4 \text{ g/km} / 10^6 = \mathbf{0.0042624 \text{ t/year of CH}_4\text{/year saved;}}$

$115\,200 \text{ km / year} \times 0.008 \text{ N}_2\text{O g/km} / 10^6 = \mathbf{0.0009216 \text{ t/year of N}_2\text{O /year saved.}}$

These estimates show a high potential for annual savings. Indicative of this are lower levels of greenhouse gas pollution reported in the region (Table 9. Emissions level) during the period.



2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



MUC 2.7

Community information and participation portal

Measure Evaluation Report

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2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consorcio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
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25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Maria Knorre	

Table of Contents

ABSTRACT.....	235
A. INTRODUCTION.....	237
A.1 EXPECTED RESULTS OF THE MEASURE	237
A.1.1 Quantifiable impacts.....	237
A.2 MEASURE DESCRIPTION	237
A.2.1 Measure outputs.....	238
A.2.2 Supporting activities	238
A.2.3 Interactions with other ECCENTRIC measures.....	238
A.2.4 Interactions outside ECCENTRIC	238
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	238
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	238
A.5 IDENTIFIED RISKS	239
B. MEASURE IMPLEMENTATION	240
B.1 SITUATION BEFORE CIVITAS	240
B.2 INNOVATIVE ASPECTS.....	240
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	240
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	240
C. IMPACT EVALUATION FINDINGS	242
C.1 EVALUATION APPROACH.....	242
C.1.1 Expected impacts and indicators.....	242
C.1.2 Baseline.....	245
C.1.3 The business-as-usual scenario.....	252
C.2 MEASURE RESULTS.....	255
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	264
D. EVALUATION CONCLUSIONS	265
D.1 VALIDATED DIRECT IMPACT	265
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	265
D.3 INTERACTION WITH OTHER MEASURES.....	265
D.4 MAIN LESSONS LEARNED	27
D.5 LONG TERM IMPACT	27
D.6 POTENTIALS FOR UP-SCALING IN THE CITY	266
E. ADDITIONAL INFORMATION.....	267

E.1	APPRAISAL OF EVALUATION APPROACH	267
E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	267

List of Figures

Figure 1: Satisfaction comparison, 2018.....	245
Figure 2: Information browsed on the website, 2018	246
Figure 3: Monthly visitors 02/2017-10/2018	247
Figure 4: Daily visitors, 2017 vs. 2018	247
Figure 5: Visitors by weekday, 2018	248
Figure 6: Average site visit duration over time (blue: liner trend line), 2017-2018	248
Figure 7: Number of cars per household, 2018.....	249
Figure 8: Modal Split of Domagkpark residents 2017	249
Figure 9: VKT by household (density plot), 2018	250
Figure 10: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)	250
Figure 11: Modal Split in Munich (2008+2017)	252
Figure 12 Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)	253
Figure 13: Satisfaction comparison, 2019.....	257
Figure 14: Information browsed on the website, 2019	258
Figure 15: Monthly visitors 10/2018-09/2019	258
Figure 16: Comparison MER-1 and MER-2: Monthly visitors	259
Figure 17: Daily visitors, 2017-2019.....	259
Figure 18: Average site visit duration over time, 2018.2019 (blue: trend line)	260
Figure 19: Modal split of MUC 2.7 users, 2019.....	261
Figure 20: Number of cars per household in Domagkpark, 2018	261
Figure 21: Number of cars per household of MUC 2.7 users, 2019.....	262
Figure 22: VKT by household (density plot) of MUC 2.7 users, 2019	262

List of Tables

Table 1: Quantifiable impacts.....	237
Table 2: Target groups or affected parties.....	238
Table 3: Measure stakeholders.....	239
Table 4: Risks.	239
Table 5: Emission Factors (HBEFA, 2017)	251
Table 6: Domagkpark Emissions 2017	251
Table 7: Emission Factors (HBEFA, 2020)	253
Table 8: Domagkpark Emissions 2020	254
Table 9: Emission comparison MUC 2.7 users, 2018	263
Table 10: Domagkpark emission comparison	263

Project	City		
ECCENTRIC	Munich		
Measure code	Measure name		
MUC 2.7	Community information and participation portal		
Last update	Responsible	e-mail	telephone
15.10.2019	Maria Knorre	m.knorre.genossensch aft@domagkpark.de	+49-176-444 509 73

Abstract

The measure MUC 2.7 aims to implement a community information and participation portal accessible for all Domagkpark residents and other interested visitors. The website provides information about current events and topics within Domagkpark. Website users can find information about any kind of (sustainable) mobility options in the Living Lab and general facts about the housing area.

As a central information hub, not only for local developments, but also for the ECCENTRIC project as a whole and other measures being implemented within the Living Lab, it plays an important role for the information gathering behavior of all residents having access to internet. Data from several user online surveys and the evaluation of a web analytics tool show that there is a high awareness and satisfaction among Domagkpark residents which are using the website to browse events, mobility options and general Domagkpark information.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measures' implementation and the ex-post data, which focuses on the impact of MUC 2.7.

Evaluation results for MUC 2.7 were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019), two online surveys with the website users, interviews with the ML and a statistical data analysis via the website's backend.

Evaluation results show that about 80% of all Domagkpark residents actually know about the community portal www.domagkpark.de, while one third also actively used the website to get helpful information. About 75% stated to be "satisfied" or "very satisfied" with the website and the information which is provided. The system is used by about 2.500 visitors per month and the number slightly increased within 2 years of backend data observation.

It comes out that measure MUC 2.7 is a very good example for replication and upscaling due to its high impact and relatively low implementation and maintenance costs. Regarding the objectives to be achieved with the measure, it's hard to tell about their accomplishment because there are other measures influencing objectives like reduction of emissions or congestion. But the improvement of livability and accessibility of Living Lab information for all

residents can clearly be traced back to the implementation of the website www.domagkpark.de.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- Reduce energy use, CO₂ emissions, and air pollution
- Reduce road congestion
- Improve accessibility for all
- Improve social inclusion and equal opportunity
- Improve Liveability

(2) Strategic level:

- Modal shift towards more sustainable modes → reduction of vehicle kilometres travelled (VKT)
- Reduction of car ownership

(3) Measure level:

- Better information for residents/visitors about the mobility services available in Domagkpark in order to increase awareness and acceptance about alternative options to private cars.

A.1.1 Quantifiable impacts

Expected Impacts	ID	Quantifiable Impacts	CIVITAS ECCENTRIC Objectives									
			Reduce:				Improve:					
			Energy use, CO ₂ emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight	Local economy
	1	Increased awareness of sustainable mobility options for all residents					X	X				
	2	Acceptance and satisfaction among the residents (platform is useful and enjoyable)					X	X	X			
	3	Mode shift towards sustainable mobility options and away from private cars	X	X		X						
	4	Reduction of car kilometers	X	X								
	5	Reduction of CO ₂ emissions	X									
	6	Reduction of NO _x and PM emissions		X								
	7	Increased social equity and vehicle occupancy through easy networking					X	X	X			

Table 1: Quantifiable impacts.

A.2 Measure description

The existing portal www.domagkpark.de was specifically realigned for residents living in Munich's laboratory area, the Domagkpark district. It provides a central platform for communication and participation in the area. It combines all local mobility-related information about services and booking options, trying to be up-to-date at the best possible rate

- for the mobility stations and their services,
- the concierge system and its services,
- the flexible/shared use of private parking lots,
- special offers for public transport,

- about the multimodal apps of the public transport providers as well as ride sharing opportunities,
- the opportunity of a shared co-working space within the area, and
- information about safe ways to the local elementary school.

For this measure, only the Domagkpark-residents are taken into account, because only they benefit from the websites content, not the entire Living Lab (Parkstadt Schwabing residents are excluded).

A.2.1 Measure outputs

The output of the measure is a web portal (www.domagkpark.de) that serves residents and visitors of Domagkpark.

A.2.2 Supporting activities

The website was advertised in residents' assemblies and in newsletters.

A.2.3 Interactions with other ECCENTRIC measures

The website serves as a tool to access information about other ECCENTRIC and to advertise the projects' dissemination actions. Measures which were planned but could not yet be linked due to delays regarding the implementation are: MUC 3.7 The App for the City lab (called: Luftlotse) and MUC 7.5 Neighbourhood oriented concierge system at the development area Domagkpark. The measure MUC 5.6 Intermodal (E-) Mobility stations is successfully advertised and displayed on the website.

A.2.4 Interactions outside ECCENTRIC

None

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1 – Residents	The website is a service mainly for residents	Residential Area	Living Lab/Domagkpark

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	Domagkpark Genossenschaft eG	P	NG	L	
2	Domagkpark Verein e.V	P	NG	P	
3	ARG.NET GmbH	S	PR	P	
4	Green City e.V.	P	PR	O	
5	MVG München	P	PT	O	
6	STATTAUTO München	S	PR	O	
7	Website users	S	other	O	

Type: P: CIVITAS partner – S: other stakeholder
 Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company
 Level of activity: L: Leading role – P: Principle participant – O: Occasional participant

Table 3: Measure stakeholders.

A.5 Identified risks

At the moment, the measure is up and running. After ECCENTRIC, the financial situation is to be dealt with. Right now the Measure Leader of MUC 2.7 is dealing with financial possibilities that the website can outlive the project (as of 10/2019).

Identified risk	Category	Mitigation actions	Responsible
Inclusion of real-time departure information from the public transport (PT) operator is not possible due to financial and technical issues.	Technological, Financial, Involvement	As an alternative, the integration of an embedded map with departure information was possible.	ML, web developer
Delays with the combination of the Living Lab App (MUC 3.7).	Organisational	The integration into the app is not crucial. As soon as MUC 3.7 is running, MLs coordinates the possible integration.	ML

Table 4: Risks.

B. Measure implementation

B.1 Situation before CIVITAS

There was a website existing in Domagkpark which was designed to provide information on the planning and construction phase of the newly developed neighbourhood. During ECCENTRIC the website was developed to a platform which bundles all information on the area's mobility services as well as related offers in the adjacent neighbourhood.

Before residents did not have the possibility to gain a comprehensive overview and up-to-date information about mobility (and other issues) in their neighbourhood or a platform for discussion and exchange.

B.2 Innovative aspects

New conceptual approach

While other residential areas have had their own websites for quite some time, the Domagkpark.de is the first integrated one, that aims at providing not only static information, but also plans to display dynamic real-time information about various means of transport, including shared mobility (via links/embedded maps).

New organisational arrangements

The DomagkPark Genossenschaft is actively seeking the role of integrating all relevant information about the area. This model is an upcoming trend, but still very innovative. In general, the website is created and maintained by a subcontractor who is specialized in setting up websites and providing suited data. The Measure Leader of MUC 2.7 is responsible for the arrangements with the technical subcontractor.

B.3 Research and Technology Development

The measure is implemented with existing technologies.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning milestones

- 11/2016 – 01/2017: Research of best practices and suitable services for web-based community portals.
- 10/2016 – 12/2016: Research of residential situation in the Living Lab (field work and statistical assessment).
- 10/2016 – 07/2017: Involvement of local stakeholders for planning and concept development of the website.
- 02/2017: Tender and subcontracting of IT service partner.
- 05/2017 – 07/2017: Meetings with local mobility providers discussing involvement.
- 01/2017 – 04/2017: Collaboration for the finalization of the Local Evaluation Plan (D 8.2) in cooperation with LEM. Set up of measure evaluation, data collection and survey design.
- 03/2017 – 07/2017: Regularly meetings with website developer

Phases 2: Procurement & Implementation

The official launch of the portal was on July 22, 2017. Since then, several additional features have been added, e.g.:

- 08/2017: Description of the CIVITAS ECCENTRIC measures
- 09/2017: Description of the Concierge DomagkWerk Service
- ab 01/2018: Optimized overview maps
- ab 01/2018: Tab with business information
- ab 06/2018: Optimized event calendar
- 08/2018: Information about the mobility station launch
- 10/2018: Tab with information about culture and social affairs
- Finalisation of the “Abfahrtsmonitor” (Information screen for nearby public transport): 10/2017
- 11/2017: Implementation of Newsletter service for residents. The newsletter is planned as a minimum of six times a year. In 2018 there was a monthly newsletter (12 times a year). In addition, the website was advertised among the target population and local businesses.
- 11/29/2017: Grand citizen meeting: Drawing the residents' attention to the new portal and its services
- 03/2018: Website marketing activities: Info event for trades people in the Living Lab Domagkpark
- Further data collection for evaluation purposes (user surveys) were obtained in 11/2018 and 09/2019

Furthermore: To keep the website running it has to be updated and maintained frequently.

Phase 3: Next steps

- Building new connections to the surrounding residential areas (integration of further content and partners)
- Probably adding new languages to the website (currently German only)
- The process of establishing a basic financing through the participation of the commercial enterprises in the quarter has been started.
- The objective is to enable the measure to finance itself. In the future, there will also be an active attempt to acquire public funds for the measure, so that the measure MUC 2.7 can outlive CIVITAS ECCENTRIC.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Awareness	Acceptance	Satisfaction	Mode shift	Car ownership
Type	KPI	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	SOCIETY-PEOPLE	SOCIETY-PEOPLE	TRANSPORT SYSTEM	SOCIETY-PEOPLE
Subcategory	Acceptance	Acceptance	Acceptance	General	Accessibility
Aspect	Awareness level	Acceptance level	Satisfaction	Modal split	Physical accessibility to transport services
Definition	Percentage of residents with knowledge about the information provided in the website	Percentage residents who favorably receive or approve the website	User/provider/stakeholder average reported satisfaction with the service/performance of the information portal.	Percentage of residents who permanently changed modes for the same trip (same origin and destination, time, and frequency). The main mode of a trip is that used for the longest stage of the trip by distance. For instances with stages of equal length, the mode of the last stage is used.	Cars owned per 1000 inhabitants of the populations aged 18 and over (with driver's license?)
Unit	Percentage	Percentage	Score (0-5)	Percentage (various values)	Cars to inhabitants ratio
Method of data collection	Survey of Domagkpark residents (baseline and follow ups) and focus groups	Survey of Domagkpark residents (baseline and follow ups) and focus groups	Regular short online surveys to be answered while using the website	Survey of Domagkpark residents (baseline and follow ups) and focus groups	Survey of Domagkpark residents (baseline and follow ups) and focus groups
Target group	Living Lab residents	Living Lab residents	Website users	Living Lab residents	Living Lab residents

Impact	6	7	8	9	INPUT
Indicator	VKT	CO2 Emissions	NOx emissions	PM emissions	System Usage
Category	KPI	KPI	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ENVIRONMENT	ENVIRONMENT	ENVIRONMENT	TRANSPORT SYSTEM
Subcategory	General	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	General
Aspect	Total Travel	Emissions	Emissions	Emissions	Transport System utilization
Definition	Kilometers traveled by individuals	Total CO2 emissions produced by residents' mobility	Total NOx emissions produced by residents' mobility	Total PM emissions produced by residents' mobility	Number of website unique users per hour, day, week, month and year. Time on page, download / activity on the website, and other relevant statistics as well.
Unit	Kilometers	Tons	Tons	Tons	# Unique visitors per time period
Method of data collection	Survey of Domagkpark residents and focus groups (baseline and follow ups)	Estimation based on VKT (or PKT) and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) and average emission factors for the different transport modes available in the area	Processing of system statistics: number of unique users per unit of time (day, week, month, year), time on page, activity, returning visitors, IP addresses, etc
Target group	Website users	Living Lab residents	Living Lab residents	Living Lab residents	Website users

Impact	INPUT	INPUT
Indicator	Investment Costs	Operating Costs
Category	KPI	KPI
Category	ECONOMY	ECONOMY
Subcategory	Costs	Costs
Aspect	Investment costs	Operating Costs
Definition	Total capital costs for purchase of equipment related to running the website. Preparation and design cost is defined as total costs expended setting up the measure covering a time period from the initiation of the measure preparation until the start of the measure implementation.	Personnel and maintenance costs for running the website divided per time period
Unit	Euro	Euro / (time or usage unit)
Method of data collection	Data from financial reports, controlling	Data from financial reports, controlling
Target group		

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	B-A	S	Residents	Domagkpark
2	Acceptance	%	B-A	S	Residents	Domagkpark
3	Satisfaction	Score (0-5)	I; B-A	S	Users	Domagkpark

4	Mode Shift	%	B-A	S	Residents	Domagkpark
5	Car Ownership	Ratio (cars/inh.)	B-A	S	Residents	Domagkpark
6	VKT	Km	B-A	S	Residents	Domagkpark
7	CO2 Emissions	Tons	B-A	E		Domagkpark
8	NOx emissions	Tons	B-A	E		Domagkpark
9	PM emissions	Tons	B-A	E		Domagkpark
	System Usage	Unique visitors/time	Continuous	DC	Users	Domagkpark
	Investment Costs	€	Continuous	DC		ML
	Operating Costs	€	Continuous	DC		ML
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

C.1.2 Baseline

The baseline was conducted as a household survey which was addressed to all 2.100 households within the Living Lab (Domagkpark and Parkstadt Schwabing). The survey took place from 04/2018-05/2018. The participation rate was 27%, what means that 935 people from 572 households answered the online survey or participated via telephone. The survey answered most of the KPIs while other KPIs are estimated by interviews with the Measure Leader or by information material delivered by the subcontractor or other sources like measure individual surveys.

Awareness, Acceptance, and Satisfaction among the target population

Addressing Indicators "1 – Awareness", "2 – Acceptance", "3 – Satisfaction", and "System Usage".

To conduct data for the following indicators, two different surveys took place to obtain the user experience of the website:

- Household online survey where all Living Lab residents were addressed: in 05/2018, 572 households took part, participation rate: 27%
- User online survey, spread by a link via newsletter (by Domagkpark associations) and was embedded on the website www.domagkpark.de: in 11/2018, 81 persons took part

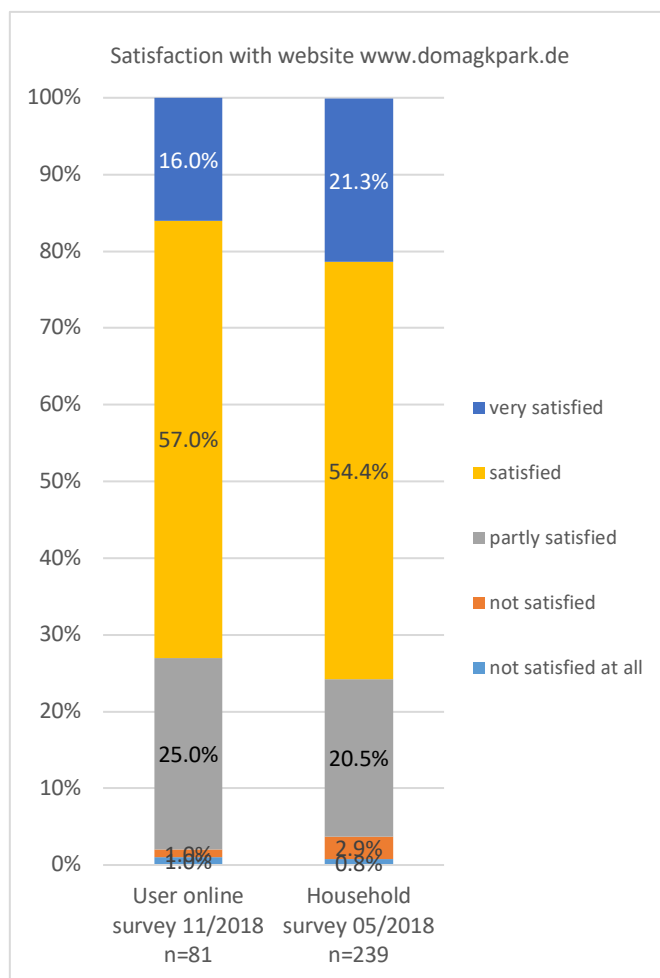


Figure 1: Satisfaction comparison, 2018

Among the Domagkpark residents, 17.2% do not know the website. The **awareness** in the target population is thus **82.8%** (household survey, 05/2018).

The **acceptance** (= the share of residents using the platform) is at **33.9%** (household survey, 05/2018).

The **satisfaction** was measured twice:

- Household survey in 05/2018
- User online survey in 11/2018

The score for the KPI Satisfaction is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI.

To name a reliable score for satisfaction, both results are taken into account (see [Figure 1](#)). Overall it can be seen that in both surveys 73% (user online survey) and 75.8% (household survey 1) are "satisfied" or "very satisfied" with the

Domagkpark-website. Only a minority, 2% (user online survey) and 3.7% (household survey

1) is "not satisfied" or "not satisfied at all". Therefore, regarding the high degree of satisfaction (73% - 76%) a score of 4 out of 5 can be given.

To take a closer look on the website usage, data about the frequency of information attempts can be evaluated from the user online survey (11/2018). [Figure](#) shows that website users of Domagkpark.de mostly visit the website regularly to get information about event in Domagkpark (42%) and to look up general information about the district (39%). Only a minority visits the website with the purpose of getting mobility information, in fact 52% "do not know" or "never" browse for mobility information. Note: The initial idea was to embed real-time mobility information on the website. Since this cannot be offered, website users use the more general mobility information of the website and then go directly to the MSP (mobility service providers) websites for further use.

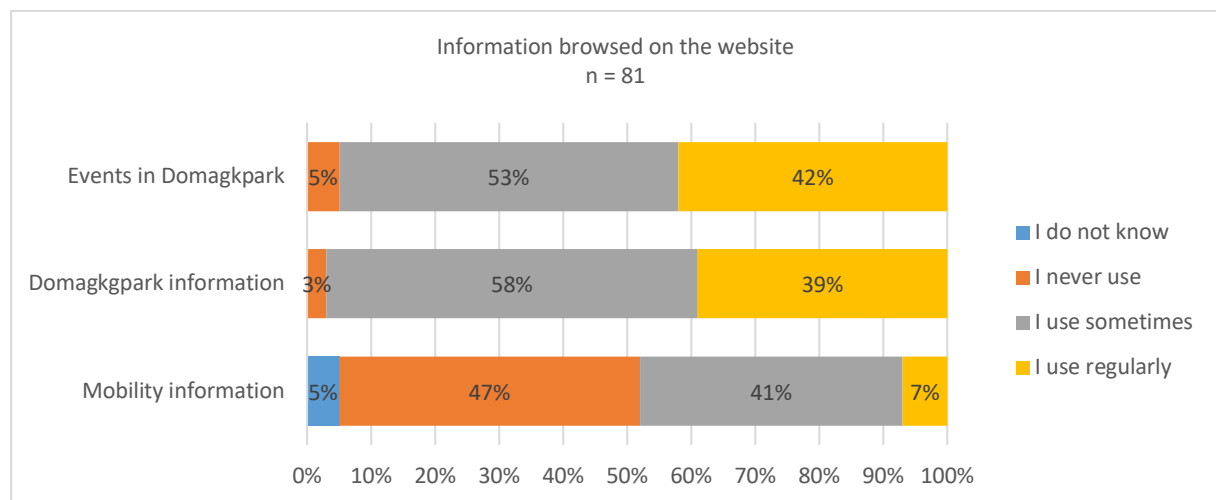


Figure 2: Information browsed on the website, 2018

The system usage statistics are collected by the Web Analytics Platform called Matomo (before: Piwik) and analyzed regarding different factors (e.g. monthly/daily visitors, visits by weekday).

The analysis of **system usage** statistics does not show an obvious trend over the observation period. It seems like the website is used less in August (vacation period in Germany) and in December. The mean of all monthly visitors in the period 02/17 until 10/18 is 2.498,810.

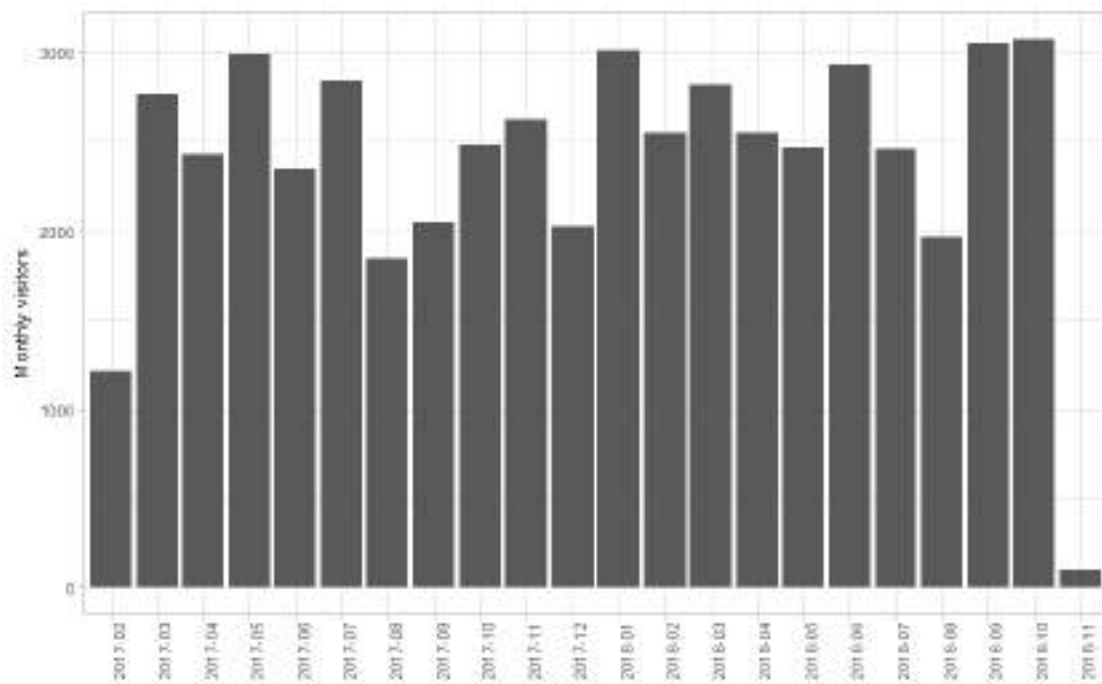


Figure 3: Monthly visitors 02/2017-10/2018

Comparing the year 2017 and 2018, however, there is a statistically significant ($p < .001$) mean difference, with a higher mean number of visitors per day in 2018 (Figure).

Another significant observation is the number of visitors by weekday: Monday to Thursday, the number of visitors is relatively equal, while on Fridays and especially on weekends, less people use the website (Figure).

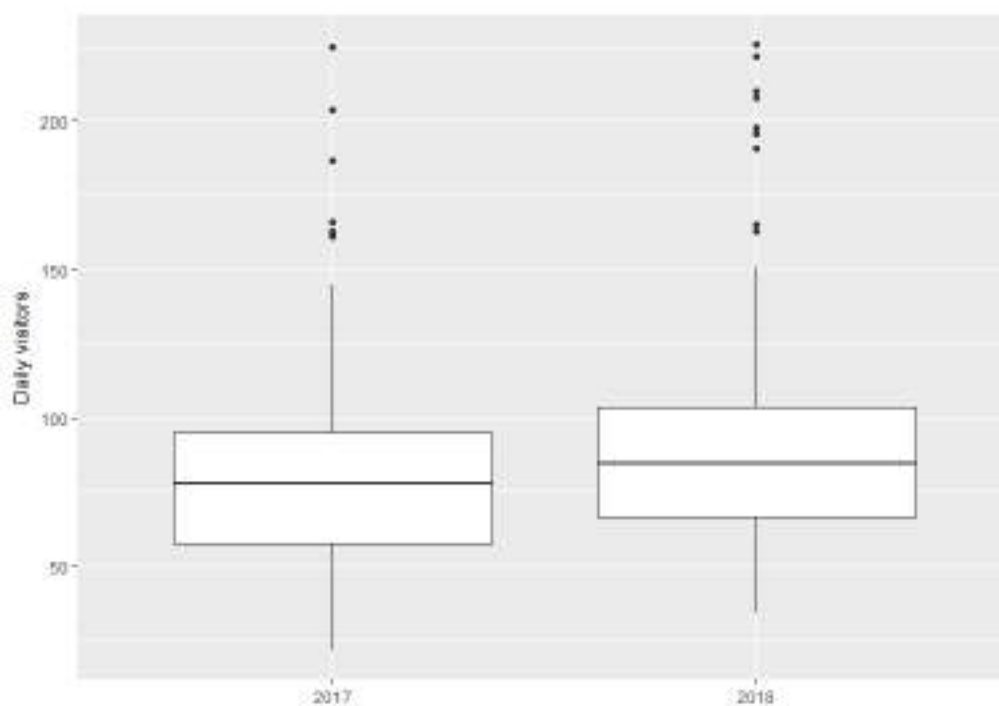


Figure 5: Daily visitors, 2017 vs. 2018

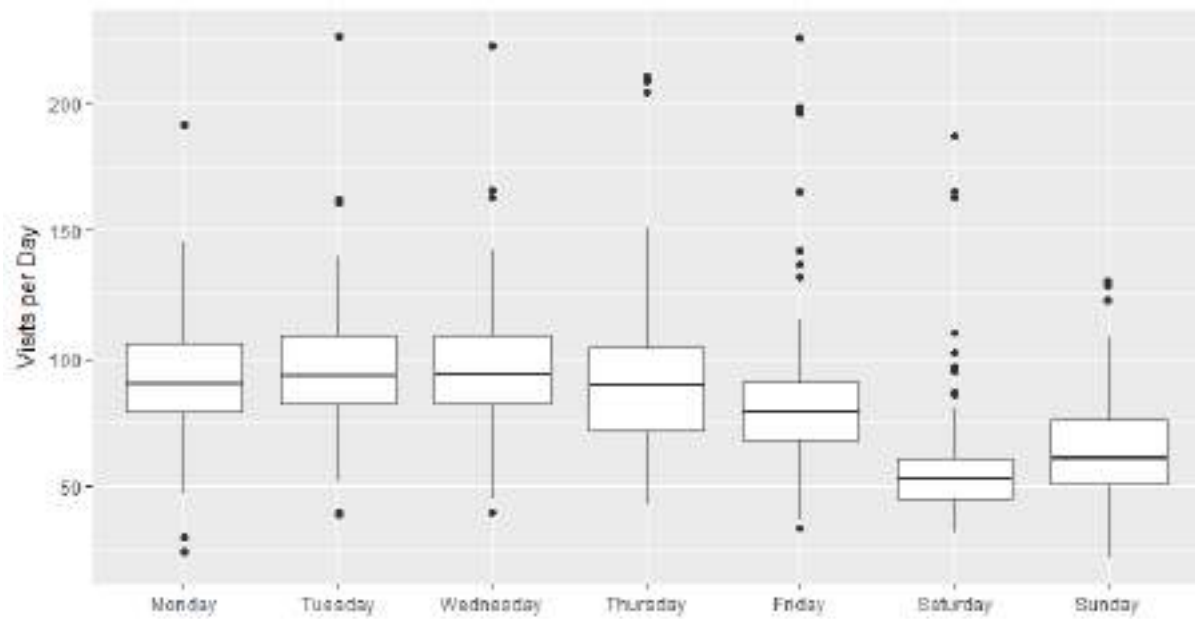


Figure 5: Visitors by weekday, 2018

Another important metric is the average duration of a website visit. As shown in [Figure 6](#), this number is slightly decreasing over time. However, this does not provide any information about the reasons, which were further evaluated in the intermediate measurements. A hypothesis is that users are getting used to the website and are faster in finding the information they need.

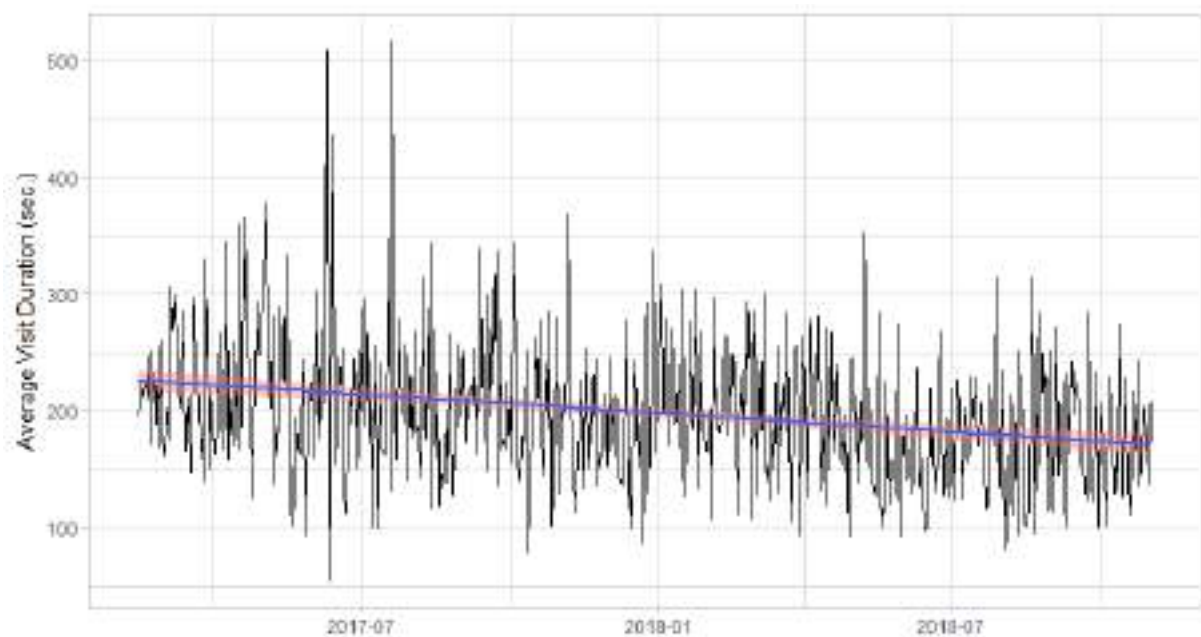


Figure 6: Average site visit duration over time (blue: liner trend line), 2017-2018

Mobility behavior of the target population

Addressing indicators "4 - Mode Shift", "5 - Car Ownership", and "6 - VKT"

Car ownership in Domagkpark is with 0.83 cars per household slightly below the city-wide average of 0.9 (infas, 2010), while another, smaller study found the same car ownership in a Munich control group (cf. Schreier, Becker, & Heller, 2015).

In detail, around a third of the households are car-free, 60% do have one car and only few have two or more (Figure). These data origins from the household survey 05/2018. 298 households in Domagkpark responded.

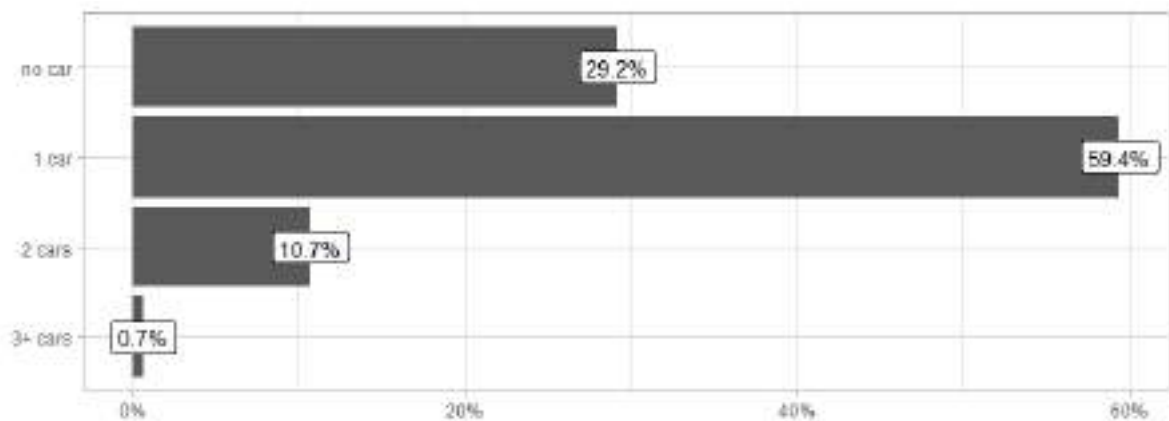


Figure 7: Number of cars per household, 2018

The Domagkpark population is with 4.37 trips per day and person on average more mobile than the German average of 3.1 (infas, 2018).

The **modal split** (trip-based) of this group is visualized in Figure, based on the answers of 493 persons who reported about 2157 trips in April/May 2017 as part of the ECCENTRIC household survey (conducted in 05/2018).

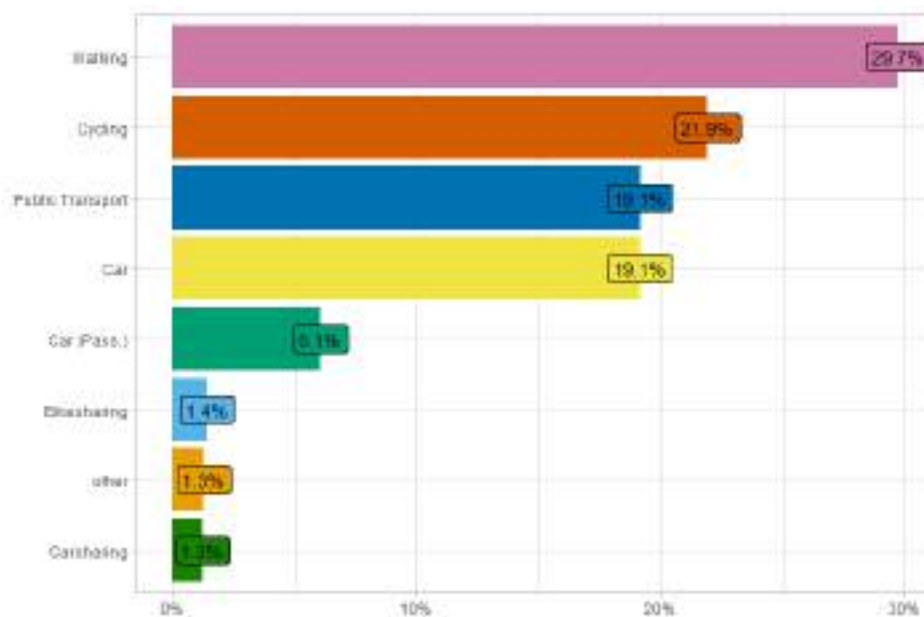


Figure 8: Modal Split of Domagkpark residents 2017

The average **VKT** per household (including also those without a car) is at 9.121 km per year (see [Figure](#) for the distribution), summing up to a total VKT in Domagkpark of approx. 14.6 million VKT per year (numbers obtained with household survey in 05/2018).

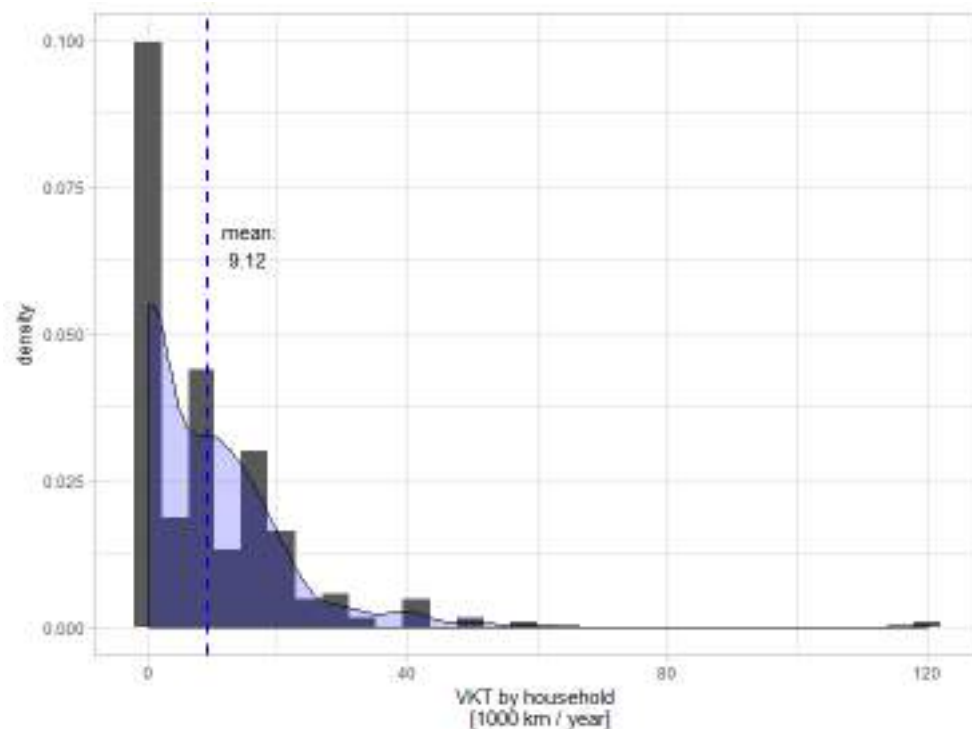


Figure 9: VKT by household (density plot), 2018

Transport-related emissions

Addressing indicators "7 - CO₂ Emissions", "8 - NO_x emissions", and "9 - PM emissions"

Emissions are calculated based on emission factors from the standard database "HBEFA" (*Handbook Emission Factors for Road Transport*) and information about both VKT and the vehicles in the Living Lab. See [Table](#) for the used factors, based on the German fleet average.

The number of hybrid/electric cars is too low to be considered as a separate category.

In 2017 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

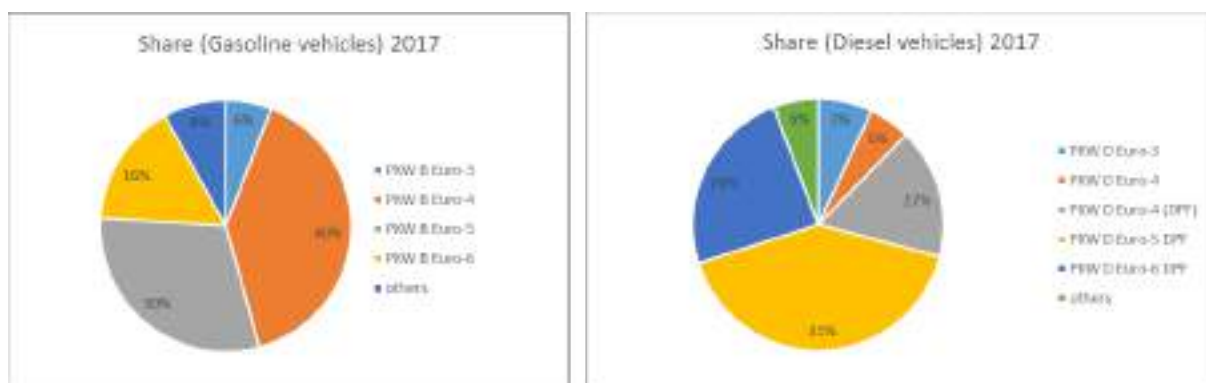


Figure 10: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)

The highest share among Gasoline vehicles consists of Euro 4 (40%) and Euro 5 (30), followed by Euro 6 (16%). Regarding the Diesel vehicle share, there are 41% Euro 5 and 24% Euro 6. Euro 4 has a smaller share of 17%.

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	127,837 g/km
NO _x	Gasoline	0,060 g/km
PM	Gasoline	0,00102 g/km
CO ₂	Diesel	118,911 g/km
NO _x	Diesel	0,589 g/km
PM	Diesel	0,00675 g/km

Table 5: Emission Factors (HBEFA, 2017)

The following calculations are based on the HBEFA factors of 2017 and the annual VKT kilometres, differentiated by car type (first or second car) and fuel type (gasoline or diesel). The amount of kilometres is then multiplied with the HBEFA factors and number of cars mentioned in the household survey (conducted in 05/2018).

Thus, the total annual emissions (based on VKT) for all 1.600 households in Domagkpark⁵ sum up to the following totals:

Pollutant	Emissions Domagkpark (2017)	Emissions Domagkpark/ household (2017)
CO ₂	1.708 t	1.068 kg
NO _x	5,06 t	3,16 kg
PM	59,9 kg	37,45 g

Table 6: Domagkpark Emissions 2017

Data on **investment and operational cost** was obtained for the ex-post evaluation when the implementation phase was completed.

⁵ For this measure, only the Domagkpark-residents are taken into account, because only they benefit from the websites content, not the entire Living Lab.

C.1.3 The business-as-usual scenario

For **Awareness, Acceptance, and Satisfaction**, no significant changes are expected in the BaU-scenario.

Car Ownership does not show big changes on the nationwide level (2002-2008-2017), while the ratio cars per inhabitants in the relevant part of the city ("between middle ring road and city boundary") has been decreasing slightly over the last 10 years, from approx. 430 cars per 1000 inhabitants in 2005 to 412 in 2015 (-1%). However, for the reporting period until 2020 stable conditions are to be expected.

Mode Shift & VKT

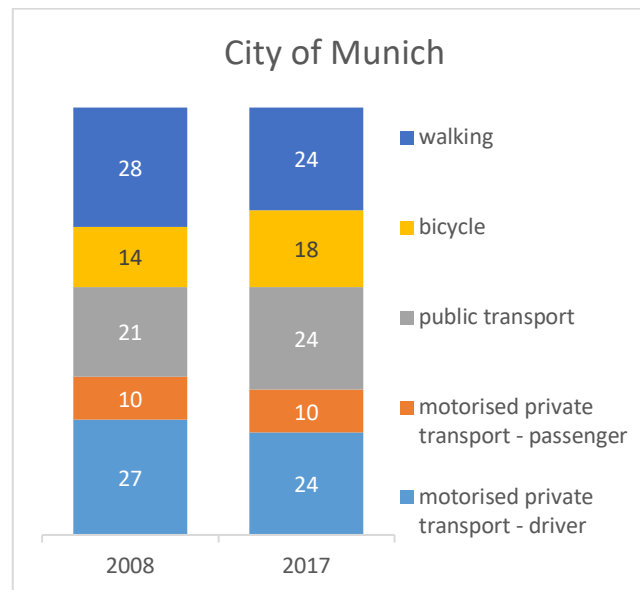


Image: City of Munich, Data: infas edited (2018)

Figure 11: Modal Split in Munich (2008+2017)

The nationwide mobility survey "Mobilität in Deutschland" acts as a reference to determine trends and future mobility behaviour in Munich.

In general, the Munich population drives less and walks less, while public transport (PT) and cycling increase over time (see Figure: change 2008-2017: car -3%, PT +3%, cycling +4%, walking -4%). Extrapolating this trend from 2008 to 2020, it can be assumed the following **mode shifts** in the BaU Scenario for 2020:

Car: -1%; PT: +1%; Bike: +1%; Walking: -1%

These changes will be reflected in **VKT** as well, so that VKT is expected to decrease by 1% as well, being cautious because nationwide, the km per vehicle are slightly decreasing (2017: -0,7%, Kraftfahrtbundesamt (2018) and the emissions are as well decreasing regarding the data of HBEFA 2020 scenario.

Note: A recent study by the Center Automotive Research (CAR) of the University of Duisburg-Essen published in 12/2019 that the number of cars is constantly increasing within the last ten years with regard to Germany's larger cities. Comparing the number of cars from 2009 until 2019, there is an increase of 18,5% in car ownership measured in Munich (cf. CAR, 2019). This resembles a different trend then expected above in the BaU scenario assumptions of 2018.

Emissions

In order to estimate BaU-emissions, the HBEFA projected emission factors for 2020 are used as well as the by 1% increased VKT that is assumed in the section " Mode Shift & VKT".

Thus, the following factors are used:

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	117,785 g/km
NO _x	Gasoline	0,049 g/km
PM	Gasoline	0,00108 g/km
CO ₂	Diesel	110,410 g/km
NO _x	Diesel	0,484 g/km
PM	Diesel	0,0045 g/km

Table 7: Emission Factors (HBEFA, 2020)

Note: These emission factors assume technological progress and a renewal of the average fleet in Germany until 2020. In the light of "*Dieseldgate*" and great uncertainties in the accuracy of emission information by the car manufacturers, the HBEFA assumptions have to be verified. New HBEFA assumptions are to be published in the end of 2019 (after MER2).

In 2020 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

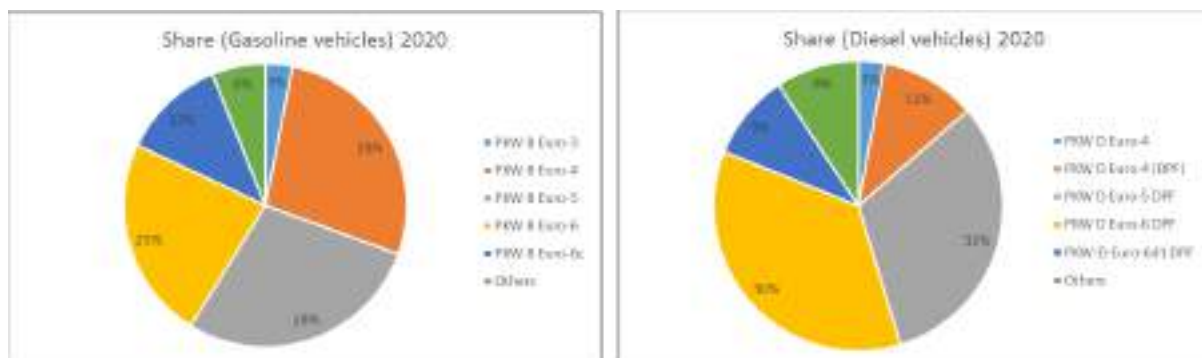


Figure 12: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)

Regarding the Gasoline Euro classes in 2020, there are about two-thirds of all Gasoline vehicles to be found with Euro 4 (28%), Euro 5 (28%) or Euro 6 (23%). The share of Diesel vehicles is similar but compared to HBEFA 2017 assumptions, Euro 6 has the biggest share in 2020 (36%, 24% in 2017).

This results in the following emissions for 2020:

Pollutant	Emissions Domagkpark (2020)	Emissions Domagkpark/ household (2020)	% change to 2017
CO ₂	1.587 t	992 kg	-7%
NO _x	4,16 t	2,60 kg	-18%
PM	42,4 kg	26,53 g	-29%

Table 8: Domagkpark Emissions 2020⁶

⁶ For this measure, only the Domagkpark-residents are taken into account, because only they benefit from the websites content, not the entire Living Lab.

C.2 Measure results

The following table shows the measure results of MUC 2.7. In some cases, the Business as Usual scenario is valued as not assessed (NA) because there would not be any other developments without the implementation of this measure.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	82,8	05/2018	NA	-	74,3	10/2019	-8,5	NA
Acceptance	%	33,9	05/2018	NA	-	32,0	10/2019	-1.9	NA
Satisfaction	Score 0-5	4 = 73%-76% "satisfied" and "very satisfied"	05/2018 11/2018	NA	-	4 = 71%-73% "satisfied" and "very satisfied"	05/2018 11/2018	-2%.-3%	NA
Modal split/ Mode shift	%	Modal split Domagkpark: Walking: 29,7 Cycling: 21,9 PT: 19,1 Car: 19,1 Bikesharing: 1,4 Carsharing: 1,3	05/2018	Modal split Munich: Walking 23% Cycling 19% PT 25% Car: 33%	2020	Modal split MUC 2.7 users: Walking: 33,9 Cycling: 27,5 PT: 17,4 Car: 15,5 Bikesharing: 0 Carsharing: 0,9	10/2019	Mode shift: Walking: +4,2 Cycling: +5,6 PT: -1,7 Car: -3,6 Bikesharing: -1,4 Carsharing: -0,4	Mode shift: Walking +10,9 Cycling +2,5 PT -7,6 Car: -17,5
Car ownership	%	Car ownership Domagkpark: No car: 29,2 1 car: 59,4 2 cars: 10,7 3+ cars: 0,7 0,83 cars per household	05/2018	Overall: -1%: No car: 28,2 1 car: 58,4 2 cars: 9,7 3+ cars: <0,7	2020	Car ownership MUC 2.7 users: No car: 27,9 1 car: 59,0 2 cars: 13,1 3+ cars: 0 0,85 cars per household	10/2019	No car: -1,3 1 car: -0,4 2 cars: +2,4 3+ cars: -0,7	No car: -0,3 1 car: +0,6 2 cars: +3,4 3+ cars: -0,7

VKT	km/year	VKT Domagkpark: 9.121 km/year/ household	05/2018	14,6 million/km/year - 1%	2020	VKT MUC 2.7 users: 7.100 km/year/household	10/2019	-2.021 km/year/ household	NA
Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After–BaU
CO2 Emissions	kg/ household	889	2017	992	2020	777	10/2019	-27%	-22%
NOx Emissions	kg/ household	1,90	2017	2,60	2020	1,94	10/2019	-39%	-25%
PM Emissions	g/ household	20,33	2017	26,53	2020	20,00	10/2019	-47%	-25%
System Usage	visitors/ month	2.499	02/2017- 11/2018	NA	2020	2.687	11/2018- 08/2019	+288	NA
Investment Costs	costs related to people and their time (in €) period: technicians or engineers: 423 maintenance personnel: 148 program and web developers: 11648 other investment costs: 1401 costs of equipment (in €): equipment 2127 infrastructure 2136 material 323 cost of energy resources 10 rental or leasing cost 90 marketing campaigns 392 other investment costs 309								
Operating Costs	Period 01/18-12/18 personnel costs 2033,33 € maintenance cost: 5289,26 € other operating costs 693,13 €								

The following ex-post data was obtained from three different data sources:

- The second household survey which took place in the Living Lab in September and October 2019. 2.095 households were contacted and 328 households participated, this resembles a total number of 563 persons and a participation rate of 16% (27% in the first household survey, 05/2018).
- User online survey, spread by a link via newsletter (by Domagkpark associations) and was embedded on the website www.domagkpark.de: in 09/2019, 51 persons took part
- System statistics of the website collected by the Web Analytics Platform called Matomo (before: Piwik).

Addressing Indicators "1 – Awareness", "2 – Acceptance", "3 – Satisfaction", and "System Usage".

The ex-post household survey of 2019 (n = 253) states that 25.7% of the Domagkpark residents “do not know” the website. The **awareness** in the target population is thus **74,3%** (household survey, 10/2019). This means that there is loss of 8,5% of website visitors which “do know” the website. Reason for the decreasing number of the KPI awareness can be found in the fact that people who took part at the household survey just recently moved to Domagkpark and are not yet aware of the offers within the Living Lab.

The **acceptance** (= the share of residents using the platform) is at **32,0%** (household survey, 10/2019). This is 1,9% less than there were people using the platform in 2018.

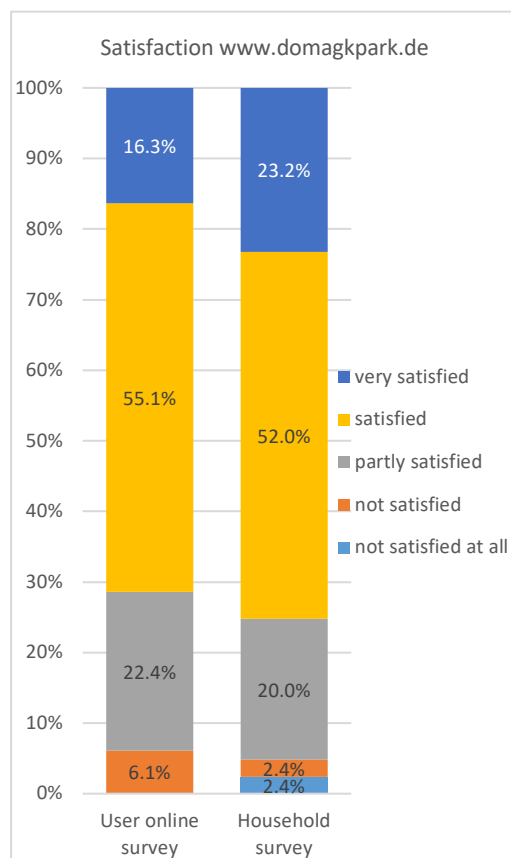


Figure 13: Satisfaction comparison, 2019

The score for the KPI Satisfaction is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure Five stands for the highest degree of fulfillment of the KPI.

Analogue to the Baseline surveys, the satisfaction can be measured with the help of two different survey approaches: user online survey (09/2019) and household survey 2 (10/2019).

Looking at the development of the **satisfaction** it can be seen that there is before and after the measure implementation a score of 4 out of 5 which resembles that in both cases more than 71% of all respondents (user online surveys, 11/2019 and household survey 2, 10/2019) are “satisfied” or “very satisfied” with the website. A closer look at the number of users being (very) satisfied shows that the percentage of website users being “satisfied” is slightly decreasing (1,9% and 2,5%) whereas the number of people being “very satisfied” increased in both, from 16% to 16,3% (users online surveys, 2018/2019) and from 21,3% to 23,2% (household surveys, 2018/2019)

(see Figure). The numbers of users being “not satisfied” and “not satisfied at all” are increasing as well, when comparing Figure 1 (p. 16) and Figure.

Because of these numbers detected it's worth to take a closer look into the sort of information which is searched via www.domagkpark.de. Most of the websites visitors look at information for events in Domagkpark (80% regularly or sometimes) or for information about Domagkpark (94% regularly or sometimes). 44% of all respondents never browse the website to get mobility information. But still 50% use the mobility information regularly or sometimes (see Figure).

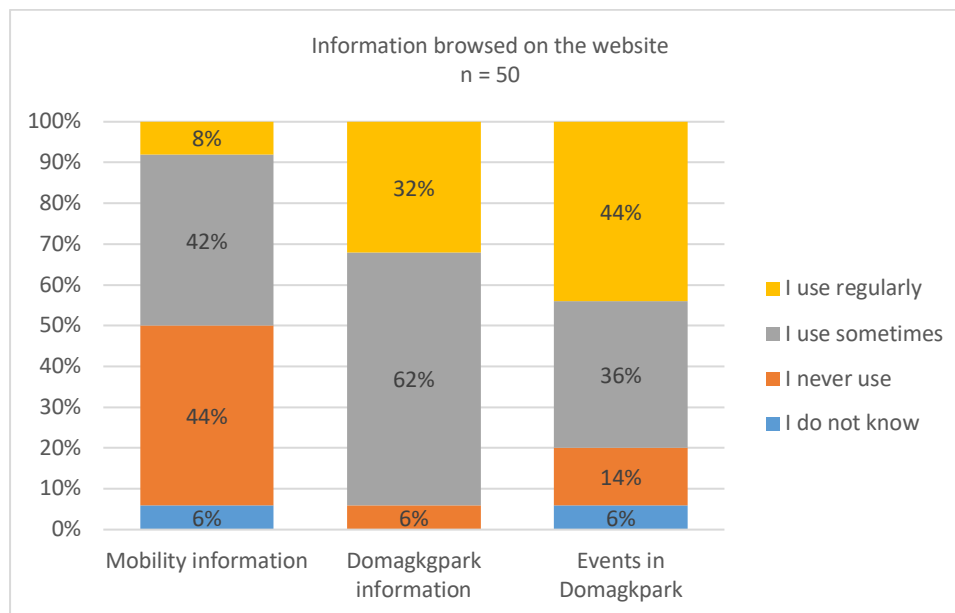


Figure 14: Information browsed on the website, 2019

The **system usage** of the webpage www.domagkpark.de regarding monthly visitors is slightly increasing. Whereas in the first reporting period the number of monthly visitors was 2.499, for the second period the statistics tell about 2.687 visitors. Those statistics are collected by the Web Analytics Platform called Matomo (before: Piwik).

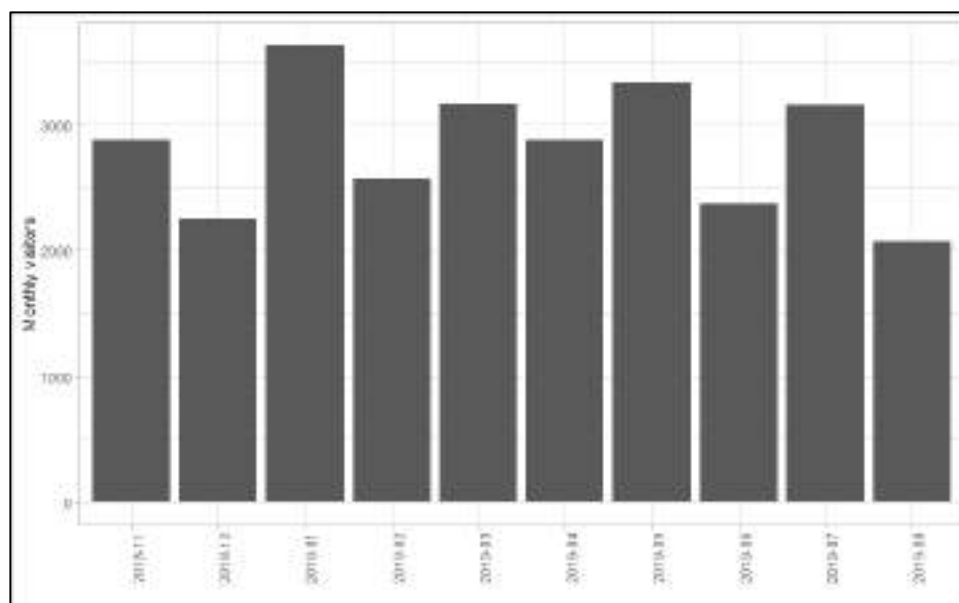


Figure 15: Monthly visitors 10/2018-09/2019

Figure shows a comparison between the number of visitors per month of the evaluation periods MER-1 and MER-2. A two sample t-test shows that there is no significance ($t = -0,92$) between both evaluation periods.

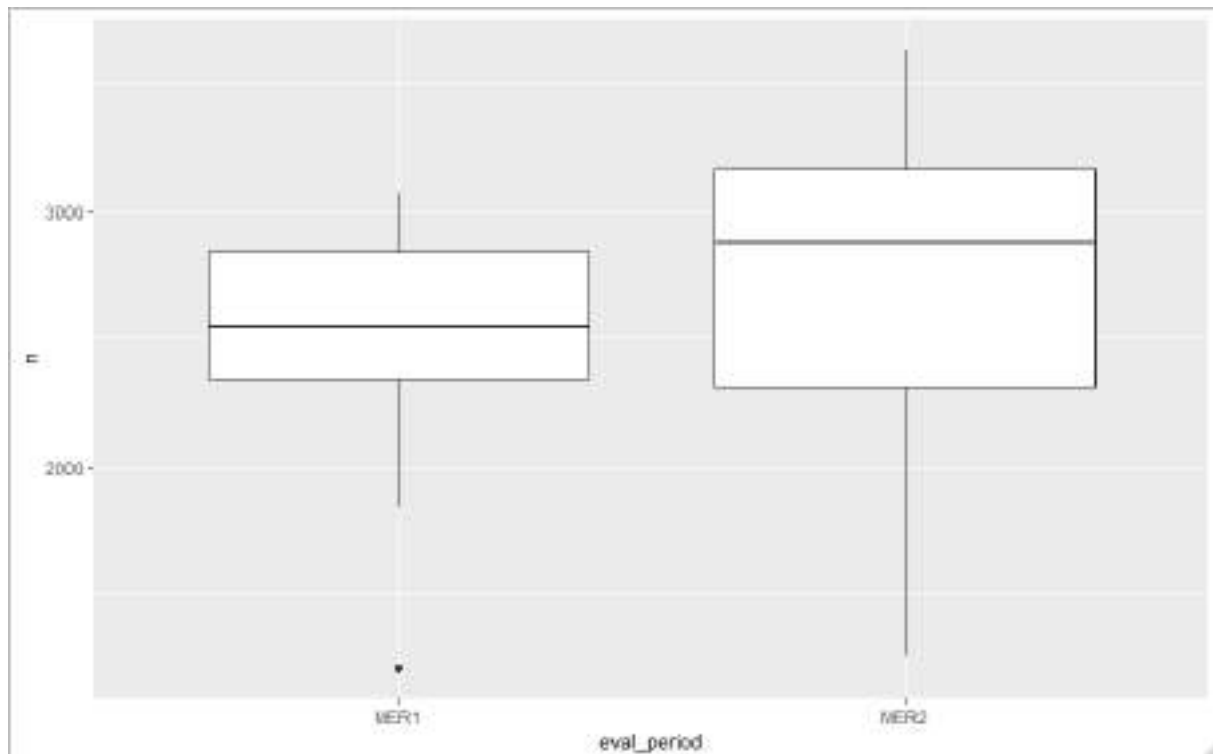


Figure 16: Comparison MER-1 and MER-2: Monthly visitors

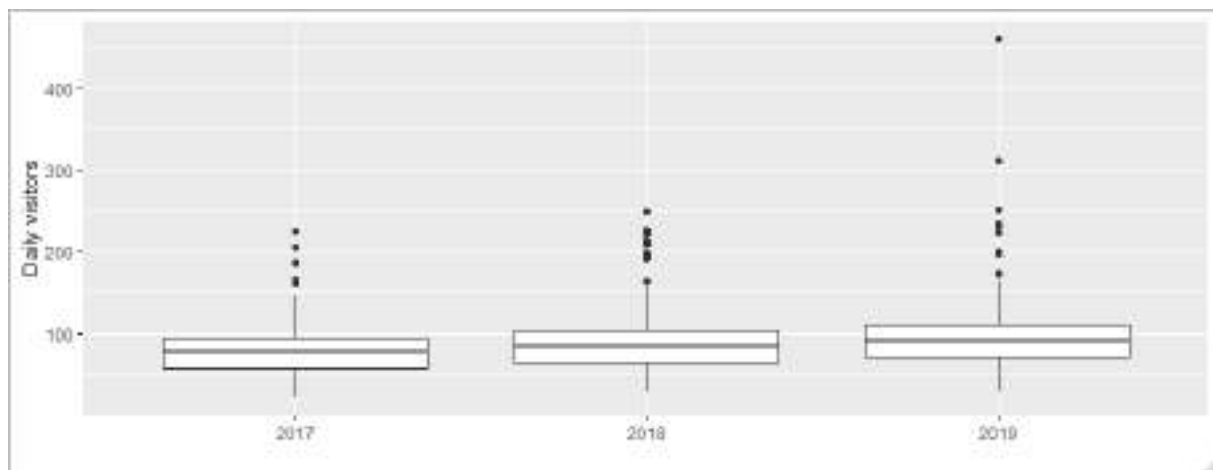


Figure 17: Daily visitors, 2017-2019

Regarding the daily visitors of the website, there is only a slight increase of visitors. For better interpretation of this development it is important to look at the metric “average duration of a website visit”. The duration is conspicuously decreasing over time (see Figure). As a result of an interview with the Measure Leader of MUC 2.7 it is said that residents who use the website can find the information faster because the website is by now well-known. Especially for website users who browse on a regular basis. In total there were 325.736 page views since 02/2017 until 08/2019. But still, the number of visitors who quit the website after the first page view is about 42%. A reason for that could also be the more clearly arranged navigation after

the relaunch and the more prominent place of “News” and important information at the starting page of the website.

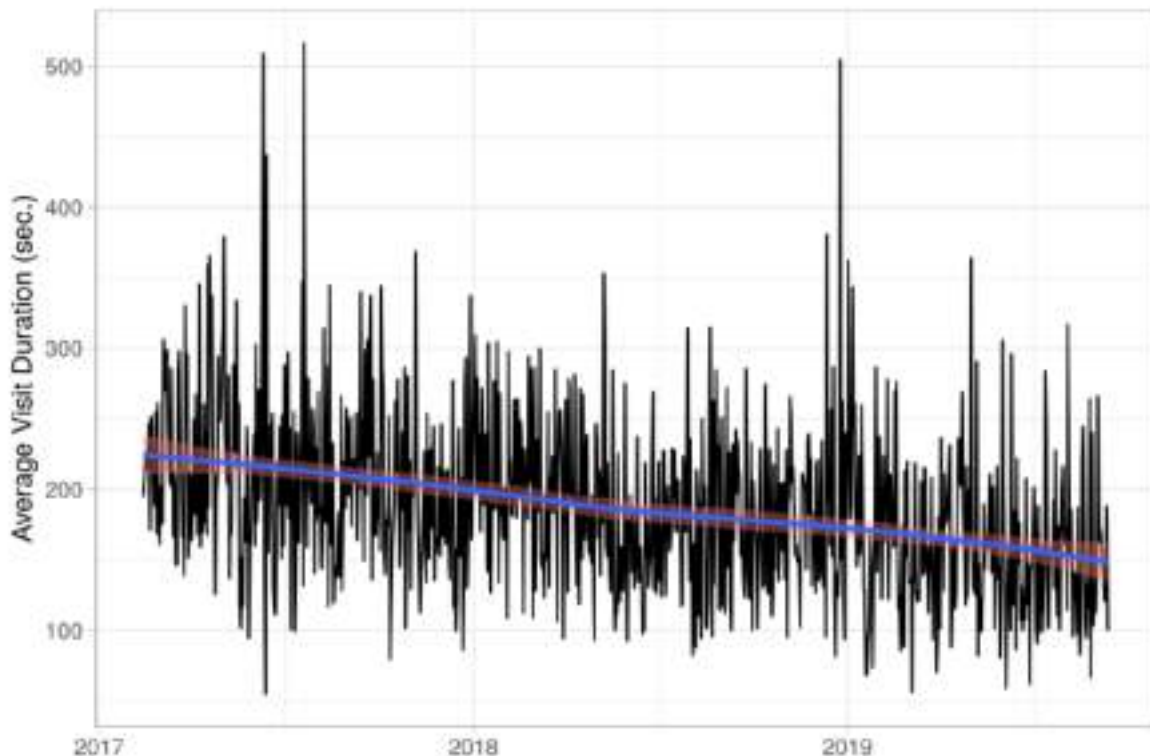


Figure 18: Average site visit duration over time, 2018.2019 (blue: trend line)

In the end there is a difference of almost 300 more visitors per month which spent less time searching for information, measured from the baseline to the after observations. Regarding the BaU scenario there is an increase of 100%, because in the BaU there would not be such website.

Addressing indicators "4 - Mode Shift", "5 - Car Ownership", and "6 - VKT"

Regarding the following indicators, the group of households/ residents which stated to make use of the measure MUC 2.7 are extracted and compared to the Baseline scenario. There are in total 61 households and respectively 81 residents which use the website www.domagkpark.de.

To describe the **mode shift** from the first household survey (05/2018, n = 493 Domagkpark residents) to the second household survey (10/2019, n = 81 Domagkpark residents), the following mode split can be taken into account (see. [Figure](#)):

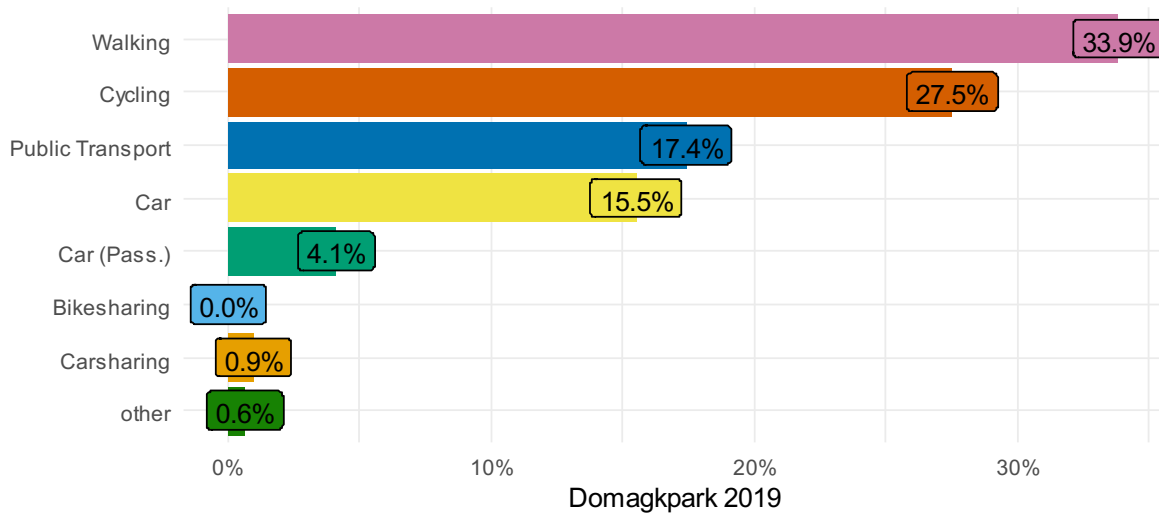


Figure 19: Modal split of MUC 2.7 users, 2019

Whereas the survey in 2018 had a similar distribution of Domagkpark residents using PT and their own car, there is a noticeable shift in 2019 towards walking (+4,2%) and cycling (+5,6%). The number of residents using PT decreased by 1,7% and residents using their car decreased by 3,6%. People in Domagkpark using sharing options like bike- or carsharing decreased as well from 2,7% to 0,9%. It can be said that residents using the community portal in total shift in favor of more sustainable modes.

The **car ownership** within Domagkpark was about 0,83 cars per household in 2018 (household survey 05/2018). Household survey #2 gave information about the number of households which use the portal www.domagkpark.de. The car ownership of these 61 households is shown in Figure . In total there are less cars per household with a ratio of 0,85 cars/household compared to before (see Figure). None of the website users has three or more cars.

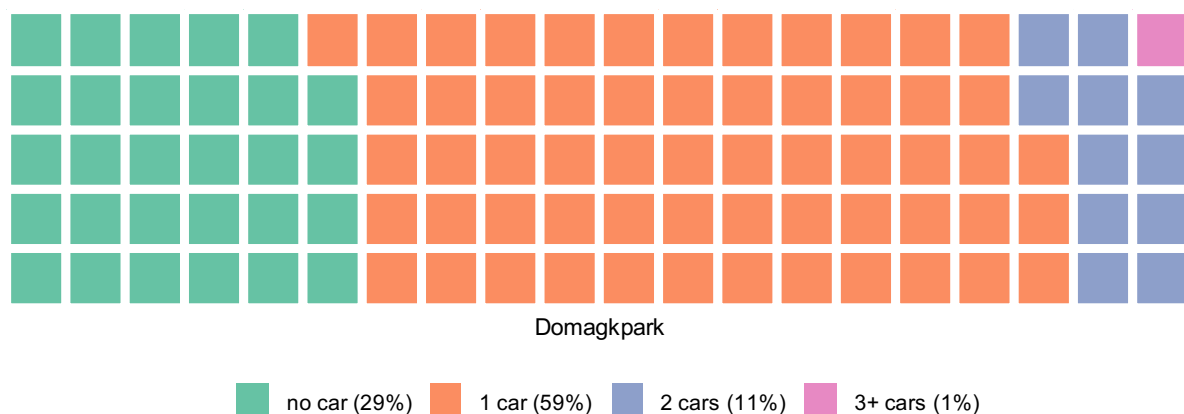


Figure 20: Number of cars per household in Domagkpark, 2018

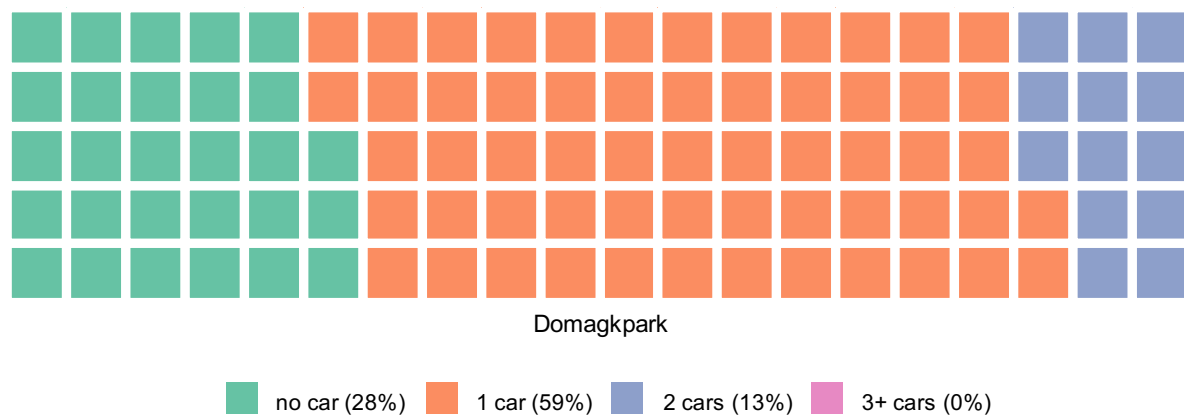


Figure 21: Number of cars per household of MUC 2.7 users, 2019

The VKT by the 61 households in 2019 which used the website www.domagkpark.de, slightly decreased to 7.100 km per year regarding the number in 2018 (9.121 km/year). Figure 22 shows a density plot of the indicator vehicles kilometers traveled by the 61 households. The data was obtained during the household survey in 10/2019.

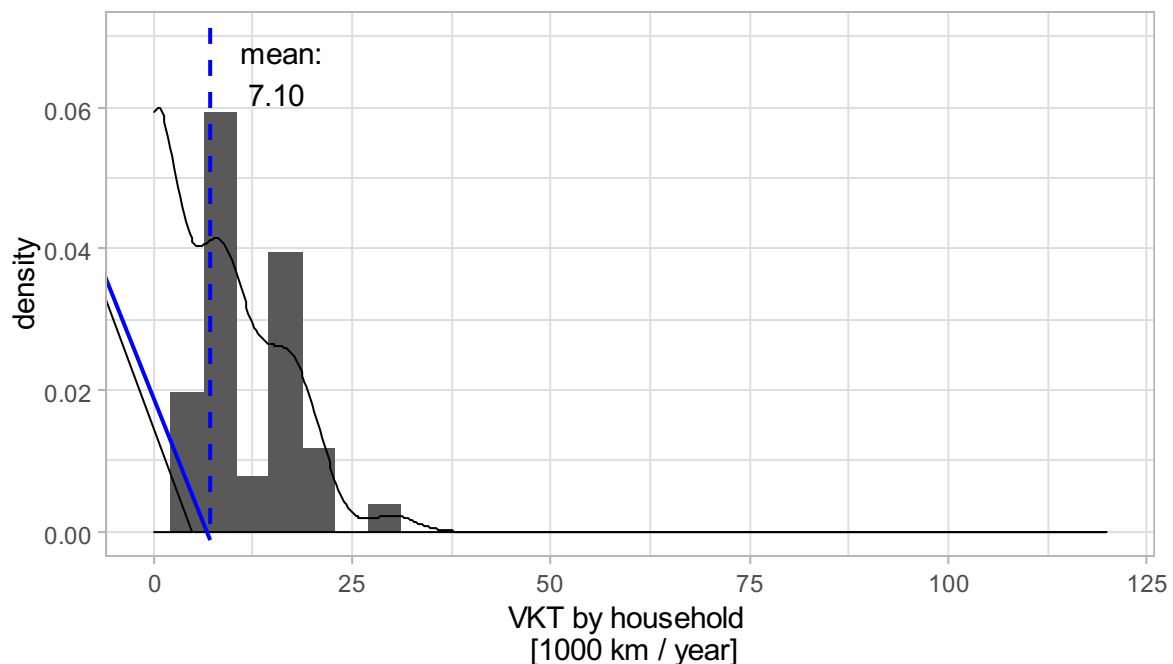


Figure 22: VKT by household (density plot) of MUC 2.7 users, 2019

Addressing indicators "8 - CO₂ Emissions", "9 - NO_x emissions", and "10 - PM emissions"

Similar to the indicators above, the emissions are calculated by looking at the group of households using the measure's output, the community portal www.domagkpark.de. At this point it must be said that there are households which have interactions with other measures as well. But the number of households, which are making active use of all measure is assumed to be not representative enough. Therefore, the emissions are specifically calculated for the website-users. This is contrasted with the emissions of the non-website-users to see the difference between these two groups.

The emissions are obtained similar to the procedure described in section C.1.2 Baseline (p.250). Based on the emission factors already used for the BAU scenario for 2020, emissions

could be calculated analogue for the ex-post scenario, based on the VKT and car ownership numbers for Domagkpark residents. For emission factors see [Table](#) (p. 253).

The following [Table](#) shows the emissions per household for three different groups: MUC 2.7-users, households not using the community portal and the entire Domagkpark. This allows a comparison of the emission values of the Baseline scenario and the After scenario. This projection is calculated for the total of 1.600 households in Domagkpark.

Pollutant	Emissions/ household MUC 2.7 users (2018)	Emissions/ household MUC 2.7 non- users (2018)	Emissions/household Domagkpark (2018)
CO ₂	777 kg	904 kg	883 kg
NO _x	1,94 kg	1,81 kg	1,90 kg
PM	20,00 g	19,72 g	20,33 g

Table 9: Emission comparison MUC 2.7 users, 2018

It can be seen that the emissions regarding the CO₂ decreased during the measure implementation among the ones which actually made use of the website. NO_x and PM emissions values are slightly higher than the households which are not using the community portal.

Regarding the actual change of the emissions from Baseline/ BAU to the After scenario, all three emission factors are decreasing. See [Table](#) for details:

Pollutant	Emissions/ household MUC 2.7 users ex-post	% change to Baseline (2017)	% change to BAU (2020)
CO ₂	777 kg	-27%	-22%
NO _x	1,94 kg	-39%	-25%
PM	20,00 g	-47%	-25%

Table 10: Domagkpark emission comparison

Addressing Indicators "Investment costs" and "Operational costs".

The KPI cost is divided into **investment cost** and **operating cost**. Those costs were obtained in 10/2019 when the measure was up and running for almost 2,5 years. The biggest costs during the implementation phase was induced by program and web developers setting up the website (about 11.600 Euro). Some more money was spent on technicians and engineers (423 Euro). Another big part of Investment costs is made of several equipment costs, such as IT infrastructure and computers (ca. 4.250 Euro) or marketing campaigns to advertise the website accordingly (ca. 400 Euro). Yearly operating costs to keep the website running consist of personnel costs, maintenance costs and other. Summed up the website costs about 8.000 Euro per year (data for the year 2018).

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Reduce energy use, CO2 emissions, air pollution and road congestion	★	There is a decrease of all emission factors (CO2, NOx and PM emissions) to be observed within Domagkpark but it's presumably not mainly attributed to the portal www.domagkpark.de . Same goes for the objective road congestion. But it can be assumed that the website and its information about sustainable and efficient mobility options has marginally contributed to the decrease of emissions.
2	Improve accessibility for all and therewith social inclusion and equal opportunity	★★	The portal is accessible for all groups of residents and such as visitors, as long they own a computer or any other mobile device connected to the internet. The website is used to publish several kind of information about mobility, events and background information about the Living Lab.
3	Improve livability	★★	Due to the various information which is offered at the Domagkpark-portal, an improved livability can be given. There is more information which can potentially lead to a better knowledge about sustainable mobility and moving around in general and to be more informed about things going on in the Domagkpark community.
4	Modal shift towards more sustainable modes → reduction of VKT	★	Among the Domagkpark households which use the website, a reduction of VKT/year per household is to be observed. But it is to be assumed that the reason for that cannot solely be found in the community portal www.domagkpark.de . Regarding the mode shift among the extracted group of website users, there are more people walking and cycling and slightly less people using their car(s) or PT.
5	Reduction of car ownership	O	The car ownership ratio regarding the households using the website, slightly increased from 0,83 to 0,85 cars per household. There are less households owning 3 or more cars but slightly more owning 2 cars.
6	Increase awareness and acceptance about alternative option to private cars	★★	Regarding the awareness and acceptance of more sustainable transport modes, there is no big increase to be attributed to the website. Comparing the number of website visitors using the webpage to browse mobility information, the number remains relatively low but still there are people getting their information about mobility options on the website.
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded			

D. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

- Due to its low investment and operational costs, the measure MUC 2.7 has a very high impact on the Domagkpark community because the website delivers up-to-date information about sustainable mobility option within the Living Lab, events and general information about Domagkpark.
- The access to this portal is very easy and can be used by everyone living in Domagkpark or visitors being interested in current topics.
- The factors of awareness and acceptance of the community portal is not constantly high but this is mainly due to the fact that the people are well informed already and do have a very strong community life apart from the digital world.
- Factors like reduction of emissions or mode shift within Domagkpark cannot conclusively be attributed to the website but nevertheless is the portal a helpful tool to inform the residents about current trend in sustainable mobility.
- The website is used very regularly by its residents and fulfils the user's needs by giving the most relevant information, links and important contacts.

D.2 Relevance of supporting activities

- Activities which support the website and the usage are regular neighbourhood assemblies and the website-newsletter which is send out several times a year.
- This keeps all users and potential users informed on a regular basis.

D.3 Interaction with other measures

- MUC 2.7 can be described as a central information base within the Living Lab, as it is a platform where everyone can look up news, events, general Domagkpark information and sustainable mobility options.
- As the website is public and reachable by all residents which have access to the internet, it's the optimal platform to publish information about other ECCENTRIC measure. This usage is not used to the extent to which it was initially planned due to delays and changes in the process of other measures, such as for instance MUC 3.7 The App for the City lab (called: Luftlotse).
- But: Interaction with others measures or the attempt to cooperate with and advertise other services will continue.

D.4 Main lessons learned

- A website for the Living Lab is a very helpful and important tool to keep residents informed about current developments regarding events and other news occurring.
- A website is easy to access by residents and used regularly to browse any kind of information.

- For the promotion of other ECCENTRIC measures, it's a very helpful platform because information can be spread easily.
- Regarding the relatively low investment and maintaining costs of MUC 2.7 the launch of a website like www.domagkpark.de is highly recommendable regarding the reach of the website.

D.5 Long term impact

- Domagkpark residents might use the website regularly to get actual information about what is going on within the Living Lab.
- If there are things to implement within Domagkpark, the website can be used an efficient tool to promote those new topics.
- Regarding the shift to more sustainable mobility option in the long run, it is desirable to pursue the initial idea to provide real-time mobility information by the local mobility operator (MVG).

D.6 Potentials for up-scaling in the city

- The potential to upscale the launch of a website for a special living area is very high regarding its relatively low costs and high impact on the other side.
- Standard technologies are used to set up and maintain the website and with the help of local associations or motivated or volunteering residents, a homepage can easily be filled with relevant information.

E. Additional information

E.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

The evaluation approach of MUC 2.7 can be regarded as successful from the LEM's perspective due to the multi-layered method approach. The approach includes the following tools to measure user experience and system usage:

- Household online survey conducted at two different times: 05/2018 and 10/2019.
- User online survey conducted at two different times: 11/2018 and 09/2019
- Using the Web Analytics Platform called Matomo to conduct statistical data of the websites' usage
- Interviews with the ML

The surveys and web analytics were conducted on a regular basis which gives very good insights into the development of the websites usage. Surveys like the household survey and a more detailed online user survey gave very good information about the awareness and acceptance of the website in general and the topics provided for the Domagkpark residents.

Due to the personal commitment of the ML to the whole project, several qualitative interviews and informal meetings with the ML gave very helpful insights to get an impression of what residents actually think of the website.

E.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

Web analytics should be observed on a regular basis to see, if the users are still satisfied and using the website. To conduct such user online surveys is also advisable to keep the websites' content interesting for the users. The results of such surveys simplify a more targeted maintenance content wise.

Regarding the financial aspect to keep www.domagkpark.de running after ECCENTRIC ends in August 2020, the ML already is taking actions. It is planned to activate local businesses within Domagkpark to finance the websites maintenance. As in November 2019 there is a very positive response by key-stakeholders being able to finance the community portal.

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2020
CiViTAS
Cleaner and better transport in cities

ECCENTRIC



MAD 2.8

Mobility management strategies for vulnerable groups

Measure Evaluation Report

Deliverable No.:	8.5
Project Acronym:	CIVITAS ECCENTRIC
Full Title:	Innovative solutions for sustainable mobility of people in suburban city districts and emission free logistics in urban centres
Grant Agreement No.:	690699
Workpackage/Measure No.:	02.08
Workpackage/ Measure Title:	Mobility management strategies for vulnerable groups
Responsible Author(s):	Ángel Aparicio
Responsible Co-Author(s):	Pilar Martín de Castro
Date:	November 2020
Status:	Draft
Dissemination level:	Confidential

2020
CiViTAS
Cleaner and better transport in cities
ECCENTRIC



THE CIVITAS INITIATIVE
IS CO-FINANCED BY THE
EUROPEAN UNION

Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático SL	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures BV,formerly Flexidrive Sverige AB	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Comm.	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

Document History

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27.09.2019	Ángel Aparicio	MER-3.First draft	Draft	
10.01.2020	Ángel Aparicio	MER-3.Second draft	Draft	SC,EM
10.02.2020	Helber López	Review	Final	PC, TC
13.03.2020	Ángel Aparicio	Final	Final	Public

Status: Draft, Final, Approved, and Submitted (to European Commission).

Dissemination Level: PC = Project Coordinator, SC=Site Coordinator, TC=Technical Coordinator, EM=Evaluation Manager.

List of Co-authors

Pilar Martín de Castro	Measure leader
Isabela Velázquez	Measure technician
Carlos Verdaguer	Measure technician

List of Acronyms

- ECC Elderly Community centres (municipal centres for leisure, training and other activities organised for elderly people in all the Madrid neighbourhoods).
- IEE Intelligent Energy for Europe.
- SUMP Sustainable Urban Mobility Plans.
- STARS Sustainable Travel Recognition and Accreditation for Schools, an IEE project developed in 2013-2016 in eight European cities led by London European Projects.

Table of Contents

ABSTRACT.....	276
A. INTRODUCTION.....	279
A.1 EXPECTED RESULTS OF THE MEASURE	279
A.1.1 Quantifiable impacts.....	280
A.2 MEASURE DESCRIPTION	280
A.2.1 Measure outputs.....	281
A.2.2 Supporting activities	281
A.2.3 Interactions with other ECCENTRIC measures.....	281
A.2.4 Interactions outside ECCENTRIC	282
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	282
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	282
A.5 IDENTIFIED RISKS	283
B. MEASURE IMPLEMENTATION	284
B.1 SITUATION BEFORE CIVITAS	284
B.2 INNOVATIVE ASPECTS.....	284
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	284
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	285
C. IMPACT EVALUATION FINDINGS	287
C.1 EVALUATION APPROACH.....	287
C.1.1 Expected impacts and indicators.....	287
C.1.2 Baseline.....	288
C.1.3 The business-as-usual scenario.....	293
C.2 MEASURE RESULTS.....	294
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	296
C.4 UP-SCALING	297
D. PROCESS EVALUATION FINDINGS	299
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	299
D.2 BARRIERS	299
D.2.1 Institutional barrier.....	299
D.2.2 Cultural (problem-related) barrier	299
D.2.3 Organisational barrier.....	300
D.3 DRIVERS	300

D.3.1	<i>Political driver</i>	300
D.3.2	<i>Institutional driver</i>	300
D.3.3	<i>Cultural driver</i>	301
D.3.4	<i>Financial driver</i>	301
D.3.5	<i>Technological driver</i>	301
D.3.6	<i>Spatial driver</i>	301
D.4	SUPPORTING ACTIVITIES	301
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	302
D.5.1	<i>Build upon previous experience and projects</i>	302
D.5.2	<i>Anticipate the bureaucratic procedures for investment approval and design your co-creation activities accordingly</i>	302
E.	EVALUATION CONCLUSIONS	303
E.1	VALIDATED DIRECT IMPACT	303
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	303
E.3	INTERACTION WITH OTHER MEASURES	303
E.4	MAIN LESSONS LEARNED	303
E.5	LONG TERM IMPACT	304
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	304
F.	ADDITIONAL INFORMATION	306
F.1	APPRAISAL OF EVALUATION APPROACH	306
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	306

List of Figures

Figure 1: Measure 2.8 receives the 2018 “Muévete Verde” award	280
Figure 2: Learning History Workshop, 2019.....	283

List of Tables

Table 1: Quantifiable impacts.....	280
Table 2: Target groups or affected parties.....	282
Table 3: Measure stakeholders.....	283
Table 4: Measures' risks	283
Table 5: Description of key performance indicators (KPI).....	288
Table 6: Measures' indicators	288
Table 7: ECCENTRIC's participating schools	289
Table 8: Modal split in ECCENTRIC's participating schools October 2016	289
Table 9: Average distance travelled at baseline	290
Table 10: Average emissions per trip (g/passenger), car	290
Table 11: Average emissions per trip (g/passenger), urban bus	291
Table 12: Split of elderly's travel by purpose and mode	292
Table 13: Split of elderly's travel by purpose and mode (EDM, 2004).....	292
Table 14: Safety perception by travel mode.....	293
Table 15: Average distance travelled by transport mode (km).....	293
Table 16: Average emissions per average trip (g/passenger)	293
Table 17: Change om modal split in ECCENTRIC's participating schools (various baselines and "after" years, depending on each school.....	294
Table 18: Measure's indicators: before and after results	295
Table 19: Summary assessment of measure's objectives	297
Table 20: Number of primary and secondary schools in Madrid.....	297
Table 21: Expected annual results from upscaling (children)	298
Table 22: Expected annual results from upscaling (elderly)	298

Project	City		
ECCENTRIC	Madrid		
Measure code	Measure name		
MAD 2.8	Mobility Management strategies for vulnerable groups		
Last update	Responsible	e-mail	telephone
27/09/2019	Pilar Martín de Castro	martincpi@madrid.es	+34 915 884 611

Abstract

This measure develops and implements a participative process targeted at vulnerable groups (elderly and children), in order to support the design and decision making processes of mobility policies. Following a bottom-up collaborative approach, specific mobility management actions and methods are developed and implemented for the targeted groups, including tailored peer-to-peer (P2P) analysis and communication strategies. In the participating schools, the methodological approach follows the successful experience of the previous project IEE_STARS, based on an accreditation scheme where peer-to-peer communication is placed at the core. This genuine P2P bottom-up participation at schools has also inspired the methodology that the measure has successfully tested with the elderly.

A total number of 45 events (workshops, cycling and walking activities, intergenerational activities and massive participation at the European Mobility Week in 2017, 2018 and 2019, among others) have been organised, engaging almost 700 persons. In particular, the project activities were successful in the co-creation of successful P2P campaigns by seniors and in the implementation of a pilot project to complete the renovation of Constitución Square, meeting the concerns and suggestions of the elderly participating in the co-design process. The measure also achieved the implementation of real-time bus information boards in some Elderly Community Centres (ECC), and encouraged and significantly expanded walking and cycling among pupils at the participating schools.

The measure achieved good results in terms of expanding the share of sustainable mobility modes among pupils and the elderly. In the case of the elderly, private car trips accounted for only 6.2% of the trips, and this low share has been maintained. On top of that, the share of walking trips has increased by 8.5 percentage points, from 66.7% to 75.3%, replacing public transport trips. In the case of children, the increase in the use of sustainable transport modes has been 3.4 percentage points, mainly replacing car trips by public transport trips and walking. In terms of acceptance, all the persons interviewed expressed their full support to the actions undertaken. In terms of satisfaction, the scores were always high in both social groups. The subjective perception of mobility safety by the elderly has significantly increased during the period, from 3 in 2017 to 3.9 over 5 in 2019.

The emissions saved are very significant in the case of the elderly, particularly when the BAU scenario is considered. The CO₂ emissions saved per year are estimated at 540 tons or a 36% reduction compared to BAU. A similar percentage of reduction is achieved in the case of

NOx and PM. In the case of children, emission savings are much lower, due to the much smaller size of the population targeted in this case (3,950 pupils in the 7 schools), but they are more significant in relative terms. The annual reduction in CO2 emissions is estimated at 24 tons or 36%; similar relative reductions are estimated for NOx (39%) and PM (36%).

Other relevant social effects achieved by this measure relate to active ageing, fighting loneliness and increased autonomy of seniors, as illustrated by the consolidated experience of one local Walker's Club established during the measure, with almost one hundred seniors who continue organising their bi-weekly walks into their neighbourhood and other active meetings after the measure was completed.

Overall, most of the objectives have been achieved in both vulnerable groups, children and elderly. The project has clearly outperformed in the objectives related to participation (objective #1) and to visibility (objective #4). The project campaigns in this measure have reached 684 people, and the measure has organised 45 events until the end of August 2019; activities have continued after the European financial support to this project measure was over, thanks to municipal support and voluntary commitment. The project has also exceeded its initial target in what refers to the perception of mobility safety by the elderly (objective #3), moving from 3 to 3.9 on a 1-5 scale (or a 30% increase) between 2017 and 2019.

Regarding modal shift, the project activities have had a positive effect in seniors' walking, which increased by 8.5 percentage points, mainly due to trips that were formerly made by public transport. In the case of children, the share of sustainable transport modes increased from an already high 72.7% to 74.3% or 1.6 percentage points, below the 5-point target.

The following lessons can be highlighted:

- Self-organising activities to promote sustainable mobility have a strong potential and capacity to mobilize the targeted social groups when they address the topic with an integrated approach close to the interests and points of view of these groups, e.g. including the dimensions of health, autonomy and empowerment in the use of public space of senior and children groups.
- It seems reasonable to establish long-term programmes with dedicated personnel and resources, that can be continued through time in schools and ECCs, and embed these activities within the schools' and ECCs' programmed activities. The measure team already achieved this in the case of schools, and is following this approach in the upscaling to additional ECCs.
- The difficulties faced to get actions included in the municipality's investment pipeline suggest the need to establish internal bureaucratic procedures within the city services, that can be able to provide a more flexible and tailored response to the bottom-up proposals coming from these participatory activities so that, without compromising transparency and accountability, these proposals can be assessed and implemented within reasonable deadlines. In this case the coincidence of the project measure with the Participatory Budgeting Process, a wide online individually-led bottom-up process competing for the same investment funds, has been an unexpected barrier, reinforced by the municipal budget constraints derived from the austerity rules imposed to local governments.

- Modal share for children is possible, but there seems to be a ceiling of a few percentage points in what can be achieved. It is also worth noticing that most of the modal change from car use is likely to move towards public transport rather than to walking. The schools in the Living Lab have faced specific barriers related the uptake of car use after the economic crisis, a car-friendly culture in some low-income groups and-at least in one case- a car-oriented urban environment in the new built-up urban areas.
- The promotion of cycling among children (and even more for the elderly) seems a long-term battle, with no visible achievements in the short-term. This is probably due to the still low share of cycling and the insufficient coverage of the cycling infrastructure network in Madrid.
- Actions aiming at encouraging modal change among these social groups need a favourable environment and policy framework. In this sense, they need to be framed within bold policies supporting sustainable mobility at the city level, as happened during the implementation of this measure in Madrid.
- Urban planning has a strong influence in mobility conditions, particularly in the case of children and seniors. The school which presented lower results in terms of climate change (Loyola de Palacio) was located in a recently developed area with a strongly car-oriented design. Actions in such neighbourhoods are hardly effective without more comprehensive strategies to redesign the urban space. The pilot action for public space improvement in *Constitución* Square, based in the diagnosis made by the elderly, showed a sharp contrast with many business-as-usual urban design decisions, which fail to take into account the needs of the elderly.

A. Introduction

A.1 Expected results of the measure

The measure objectives are as follows:

(1) City policy level in perspective of CIVITAS goals/ longer term:

To change transport behaviour... on a wider scale by... testing new innovative measures in so-called “living laboratories” to tackle the problems cities are facing.

(2) Strategic level:

A shift in the daily mobility behaviour of children and elderly people, with positive results both in health, independence and care solutions.

Positive impact at neighbourhood level: change towards more sustainable and safe mobility.

Specific strategic goals:

- To get meaningful policy guidelines to address mobility management for vulnerable groups in Sustainable Urban Mobility Plans (SUMP), especially on the level of districts' SUMP defined with bottom up information, a gender approach and participation at a neighbourhood level
- To shift urban mobility in the outskirts from the dominance of motorised travels to active trips
- To increase safety and perception of security in the outskirt areas of the city

(3) Measure level:

- Society: Guidelines for addressing mobility management of vulnerable groups with a gender approach.
- Behavioural change: Empowerment of vulnerable groups in mobility plans.
- Energy: Support of active modes, with less use of energy by children and the elderly.
- Environment: emission savings as a result of modal shift.
- Governance: inclusive and participatory processes; mainstreaming of gender and age perspectives.

Specific short-term goals:

- Punctual improvements of safety and quality of public space in areas frequented by vulnerable groups: i.e. schools, parks and playgrounds, sport centres, health centres, day care centres for the elderly
- Increase in independence and perception of safety for vulnerable groups, both children and senior citizens, where a high percentage old people with disabilities is included.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:					Improve:				
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	More participation: at least 40 persons involved in the campaigns						X				
2	Decrease of car trips by 5-6 percentage.points for children trips and 4 points for the elderly's, in the districts targeted	X									
3	Increase of the elderly's safety perception by 15%			X							
4	Increased visibility: 12 events organised along the project with vulnerable groups						X				
5	Reduction of CO2 and other emissions	X	X								

Table 1: Quantifiable impacts.

A.2 Measure description

With this measure, the Municipality of Madrid aims at reinforcing the SUMP planning process by developing a participative process targeted at vulnerable groups (elderly and children in this case, people with disabilities indirectly), complemented with a gender approach, in order to support decision making and the design of measures. Following this bottom-up participative approach, a specific mobility management strategy has been developed, containing not only special information and communication strategies, but also physical improvements of the accessibility conditions to special facilities such as schools and ECCs. The methodology used for it has improved and adapted to aged people the successful experience of the previous project IEE_STARS, based on an accreditation scheme where peer-to-peer communication is placed at the core.



Figure 1: Measure 2.8 receives the 2018 “Muévete Verde” award

A.2.1 Measure outputs

A) Activities for elderly people/ senior citizens

A.1 Campaign to promote inclusive, independent, sustainable and active mobility of the elderly: it will be carried out by the elderly and directed to the elderly, in a peer-to-peer (P2P) approach, in order to promote sustainable and active mobility among older people. A group of senior citizens has received support to act as campaign leaders and develop strategies and content with special emphasis on: claiming the figure of the elderly by breaking current stereotypes; empowering them to have a proactive attitude towards mobility options and public space conditions; raising awareness about the advantages of an independent and active life and a sustainable mobility behaviour; using municipal media to disseminate content (websites, radio, blogs, etc.); evaluating the measure in cooperation with the elderly.

A.2. Participation of the elderly in the organization of the yearly mobility events such as: European Mobility Week, International Day Against Climate Change (October 24), International Day of Elderly, Dutch National Cycling Day, etc. Integration of senior residents in the organization and promotion of active mobility events and their evaluation.

B) Activities with children and teenagers:

B.1 Recognize and assess schools with a sustainable mobility strategy, according to STARS project standards.

B.2 Carry out sustainable mobility campaigns at each STARS school, involving teachers, families, pupils and principals in the activities aiming to achieve active participation of children in increasing sustainable mobility.

B.3 Hold workshops about communication techniques for students in order to build up communication skills, in a P2P approach.

B.4 Build up a network of committed teachers in every school, organising teacher workshops to support their leadership in sustainable mobility at schools.

B.5 Organize weekly walking and cycling buses.

B.6 Organize massive cycle rides, together with other schools following the STARS approach in Madrid, with the support of families and the elderly as volunteers. More than one thousand students have joined, cycling on the streets and parks of Madrid in every EMW.

A.2.2 Supporting activities

No supporting activities have been identified.

A.2.3 Interactions with other ECCENTRIC measures

Modest interaction with measure MAD 5.8 (bus information on elderly activity centres) and measure MAD 4.6 (pedestrian-friendly public space).

A.2.4 Interactions outside ECCENTRIC

Interaction has been relevant with the local follow-up to the STARS project in Madrid. STARS (Sustainable Travel Recognition and Accreditation for Schools) was financed by the EU in the framework of the Intelligent Energy Europe (IEE) initiative during 2013-2016, and concluded in March 2016. However, the municipality of Madrid has continued carrying on activities in schools following the project's principles. Accordingly, there has been some exchange of information on the activities carried out among the ECCENTRIC schools and other schools making use of the STARS methodology, although this is not resulting in an impact on ECCENTRIC results.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
10	Elderly residents attending elderly centres in the area		Areas in Vallecas served by the participating Elderly Centres
10	Children residents attending schools in the area		Areas in Vallecas served by the participating schools

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR- other	Level of activity L-P-O	Role - Links
1	R04-R07. Directors or "champions at participating schools	S	O	P	
2	M01 & M02. District councillor-chair	S	C	O	
3	M03. City councillor for environment and mobility	S	C	O	
4	M09. Local police	S	C	O	
5	M10-M12. Coordinators of elderly social centres	S	O	P	
6	F01. Local participatory forum. PdV	S	C	O	
7	F02. Local participatory forum. VdV	S	C	O	
8	F03. Local mobility board	S	C	O	
9	C01-C06. Residents' associations	S	NGO	O	
10	C09-C12. Parents' Associations at participating schools	S	NGO		
11	P01. Partido Popular PdV	S	O	O	
12	P02. Partido Popular VdV	S	O	O	
13	P03. PSOE. PdV	S	O	O	
14	P04. PSOE. VdV	S	O	O	
15	P05. Ciudadanos. PdV	S	O	O	
16	P06. Ciudadanos. VdV	S	O	O	
17	E01. Ayuntamiento de Madrid	P	C	L	
18	E02. GEA21	P	PR	L	

19	001. EMT CEO (<i>Gerente</i>)	P	PT	O	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

In practice, the political parties (partners 11 to 16) have not been involved in the measure.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Administrative structures unable to deliver answers to the residents' proposals, particularly those involving public space improvements	2	ECCENTRIC measure partners identify and approach the relevant structures within the municipality	Measure leader, site leader

Table 4: Measures' risks

At the early stages of measure design other potential risks were identified: lack of interest in mobility as a relevant topic, lack of attendance to proposed events, lack of critical mass of people participating in the process. It was soon noticed that they were not relevant, and did not require any mitigation actions.

**Figure 2:** Learning History Workshop, 2019

B. Measure implementation

B.1 Situation before CIVITAS

Prior to the ECCENTRIC project, the municipality had gained some previous knowledge on the challenges of children's daily mobility to school through the STARS project, developed between 2013 and 2016. STARS had a positive impact in the participating schools, but these were too few to get an impact at the city level, although the number is growing every year. It is worth noticing also that children, youngsters and the elderly enjoy special concession fares in the public transport system since 1988.

B.2 Innovative aspects

The 2013-2016 STARS project was successfully implemented in individual schools in other Madrid districts, and was followed by replication activities after its completion. The ECCENTRIC project pushed forward this trend: it was the first time that schools in Vallecas districts, the ECCENTRIC Living Lab would work on sustainable mobility following the STARS methodology, and for the first time in Madrid, activities at schools were merged within a sustainable mobility strategy at the neighbourhood level.

Before the ECCENTRIC projects, no activities focusing on the mobility of the elderly had been carried out. Once ECCENTRIC was started, there were a few actions on mobility included in the 2017 'Plan for Elderly People in Madrid' (*Plan de Acción de Madrid Ciudad amigable con las personas mayores 2017-2019*) to improve walkability in the vicinity of ECCs, Health Care Centres and other facilities strongly used by the elderly, and to improve the usability of public transport buses. This Plan was based on the results of some questions on age-friendliness that were included in the general survey on the citizens' perception of city life. In this sense, ECCENTRIC provided an innovative participatory methodology to materialize the municipality's ambitions.

It is also worth highlighting that ECCENTRIC provided strong synergies between age and gender issues in sustainable mobility, which had not been explored in previous initiatives.

B.3 Research and Technology Development

There is no particular R&T development linked to this measure. Measure implementation builds upon lessons learned from STARS (Sustainable Travel Accreditation and Recognition for Schools, starseurope.org), a 3-year project finished in March 2016 and supported through the Intelligent Energy Europe programme. STARS takes the tried and tested behaviour change approaches of accreditation and peer-to-peer engagement to achieve a modal shift away from the car to cycling and other active modes for the journey to and from school. This experience inspired the approach developed in this measure to sustainable mobility management with elderly people.

Evidence on the relevance of peer-to-peer engagement and recognition (accreditation) as effective ways to achieve modal change is provided and discussed, e.g. by [Buliung et al \(2011\)](#), and [Mammen et al \(2014\)](#). Effects of the built environment, the social environment and gender have also been largely documented.

B.4 Actual implementation of the measure

A) Relevant milestones accomplished within the elderly component of the measure:

A collaborative bottom-up approach has been applied to involve seniors in active co-creation of campaigns on active mobility and healthy practices, with good results: five videos on the use of public transport and the conditions for an age-friendly public space, one permanent and extremely active Walker's Club self-managed by a group of seniors, one pilot proposal for improving the public space according the elderly's needs (accessibility conditions and banks, playgrounds, trees,...) of one square, and a wide communication campaign focused on the elderly's mobility.

The STARS-inspired methodology followed by ECCENTRIC is based on social psychology, citizen participation and the realization of communication products, made by people for their peers (made by seniors for seniors and made by children for children), on a scheme of "commitment between equals" or "contagion of behaviour between equals", based on the potential of "identification" with the sender to imitate behaviour (Bandura, 1983⁷) and in the maintenance of behaviours only when there is a subjective benefit (Prochaska and DiClemente, 1983⁸). In the case of ECCENTRIC, this methodology was complemented with campaigns made from seniors to seniors. What children and adults do, in addition to making their own diagnosis of the problems in their area, are campaigns aimed at their peers to promote good practices in mobility (pedestrians, public transport, bike...) for adults and children.

In one of the Elderly Community Centres (ECC Santa Eugenia) one screen was installed providing real time information on the bus lines serving the place in May 2018; this was followed by similar actions in three additional centres.

Some particular measure milestones and accomplishments:

- Initial meetings in all the Elderly centres in Vallecas (Madrid Living lab) (Jan-Feb 2017).
- participative definition of activities (March- May 2017).
- Co-creation of video scripts and production of 5 short films about Elderly and the Bus in Vallecas (June 2017).
- Information screen at the Community Centre "Santa Eugenia", providing real time information of EMT bus lines serving the facility (May 2018); similar screens were subsequently installed in three additional ECCs.
- The seniors' club "*Anda con nosotros*" has been established. It has organized two community walks per week within the neighbourhood and other walking activities since 2018 and co-designing workshops to define the club's t-shirt with logo and name.
- Intergenerational neighbourhood co-diagnosis of the and suggestions for a more age-friendly city. Pilot project for the Constitution square in spring 2017.
- Public space analysis and subsequent funny video production, discussing a variety of walking mobility challenges (March-June 2018).
- *Muévete Verde* award received by ECCENTRIC senior initiative (September 2018).

⁷ BANDURA, Albert (1983). *Principios de modificación de conducta*. Salamanca: Ed. Sígueme.

⁸ PROCHASKA, James O. and Carlo DICLEMENTE (1983). Stages and processes of self-change of smoking: Towards an integrated model of change. *Journal of Consulting Clinical Psychology*, 51, pp. 390-395.

- Public transport, walking, and process evaluation workshops following a Learning History methodology (2018-2019).
- Improvement works in Constitucion Square finished (February 2019).
- Critical walking (*walkabouts*) activities and “clean sidewalks” campaign (from February to June 2019).
- Mobility surveys to the elderly: Baseline in Mars 2017 and final survey in 2019.
- Dissemination activities in a variety of Fora (2016, 2017, 2018 and 2019) y radio stations (2018 and 2019)

B) Relevant milestones accomplished by children and teenagers:

Madrid has implemented the successful methodology tested in the STARS project, improving some tools and adapting it to the conditions in the Living Lab. More than 128 activities have been organised by the “school committees” established in 7 schools, including students, teachers, and families. During the 2017/2018 course, gender differences in the use of bicycles by teenagers have also been addressed.

Some particular measure milestones:

- Launching of activities in European Mobility Week (EMW) (September 2016).
- Communication workshop for high school Mobility Ambassadors (November 2016, November 2017 and subsequent years until 2020).
- Cycle rides in Christmas Parade (January 2017 and January 2018) and celebration of International Bicycle Day with the Dutch Embassy (April 2017 and April 2018).
- REALE (insurance Company) donates 40 bicycles to Vallecas schools.
- ‘Urban planning and bicycle’ workshop for Mobility Ambassadors (March 2017 and March 2018, and subsequent years until 2020).
- Neighbourhood presentation of measures and massive cycle ride of schools EMW 2017, with more than 700 participants.
- Dissemination of communication campaigns (autumn 2017 and subsequent years).
- Workshops and lectures at schools (photography, biking, mobility and town planning, teachers, climate change, building bike racks, communication techniques, etc). (September 2017 to September 2019).
- School contests on cycling-themed graphic design, photography, video and tale competitions. (September 2017 to June 2018, and subsequent years).
- Bike rides and bike breakfast (June 2018, September 2018, May 2019, June 2019).
- European Mobility Week: Great Bike Ride and Occupy-Parking Day (September 2018 and September 2019).
- Jane’s walk activity in Vallecas (February 2019).

The activities above continue to be organised in 2019 and 2020.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	2	3	3	3	5
Indicator name	Modal shift	Awareness	Acceptance	Satisfaction	CO2 and other emissions
Type	KPI	KPI	KPI	KPI	KPI
Category	Transport system	Society and People	Society and People	Society and People	Environment
Subcategory	General	Acceptance	Acceptance	Acceptance	Pollution and nuisance
Aspect	Modal split	Acceptance	Acceptance	Acceptance	Emissions
Definition	Number of trips changing mode within each target group (children, elderly)	% of target groups aware of the measure	% persons in target groups favourable to the measure	Average satisfaction score provided by participants in the process	Emissions (t per year of CO2, NOX, PM) saved by modal change
Unit	Number of trips, % of total trips	%	%	Score (1-5)	Tons
Method of data collection	Survey to the elderly (in social centres or on the street) and children (in participating schools)	Id.	Id.	Id.	Estimate based on survey results
Target group	Children at targeted schools and elderly at targeted social centres	Id.	Id.	Id.	Id.
Domain	Social centres (7) and schools (4) in the area	Social centres (7) and schools (4) in the area	Social centres (7) and schools (4) in the area	Social centres (7) and schools (4) in the area	Social centres (7) and schools (4) in the area
Control sample	None	None	None	None	None
Related measures, activities, and	STARS project in other schools in Madrid	STARS project in other schools in Madrid	STARS project in other schools in Madrid	STARS project in other schools in Madrid	STARS project in other schools in Madrid

interference sources					
References					

Table 5: Description of key performance indicators (KPI)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Modal shift (elderly)	Trips/%	B-A	S	Attendants to / Elderly centres	City lab
2	Modal shift (children)	Trips/%	B-A	S	Pupils in 4 schools	City lab
3	Awareness (elderly attending social centres)	%	B-A	S	Attendants to / Elderly centres	City lab
4	Awareness (children in participating schools)	%	B-A	S	Pupils in 4 schools	City lab
5	Acceptance (elderly attending social centres)	%	B-A	S	Attendants to / Elderly centres	City lab
6	Acceptance (children in participating schools)	%	B-A	S	Pupils in 4 schools	City lab
7	Satisfaction (elderly attending social centres)	Score	B-A	S	Attendants to / Elderly centres	City lab
8	Satisfaction (children in participating schools)	Score	B-A	S	Pupils in 4 schools	City lab
9	CO2 emissions (elderly attending social centres)	Tons/year	B-A	E	Attendants to / Elderly centres	City lab
10	NOx emissions (elderly attending social centres)	Tons/year	B-A	E	Attendants to / Elderly centres	City lab
11	PM emissions (elderly attending social centres)	Tons/year	B-A	E	Attendants to / Elderly centres	City lab
12	CO2 emissions (children in participating schools)	Tons/year	B-A	E	Pupils in 4 schools	City lab
13	NOx emissions (children in participating schools)	Tons/year	B-A	E	Pupils in 4 schools	City lab
14	PM emissions (children in participating schools)	Tons/year	B-A	E	Pupils in 4 schools	City lab
15	Subjective safety perception (elderly attending social centres)	Score	B-A	S	Attendants to / Elderly centres	City lab
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Measures' indicators

C.1.2 Baseline

Schools

Surveys to children have been conducted in October 2016 at 4 schools in the city lab. One additional school (IES Antonio Domínguez Martín) joined the action in the scholar year 2017/18. Two or three more schools are expected to join in the scholar year 2018/19. Baselines and results for these schools will be integrated in the final Measure Evaluation Report.

School	Age Group	Total pupils	Sample size
Loyola de Palacios	Primary (6-13)	890	849
El Madroño	Primary (6-13)	179	144
Valdecás	Secondary (13-16)	550	161
IES Villa de Vallecas	Secondary (13-16)	753	618
Asturias	Primary (6-13)	417	261
Eduardo Rojo	Primary (6-13)	446	129
IES Antonio Domínguez	Secondary (13-16)	715	460

Table 7: ECCENTRIC's participating schools

The Table below shows modal split for trips to school in the participating schools. The last row refers to the results of the last regional household survey available in Madrid (*Encuesta Domiciliaria de Movilidad*, EDM, 2004), taking into consideration trips made within the Living Lab (i.e. *Puente de Vallecas* and *Vallecas Villa*) by residents with ages between 4 and 17.

School	Car	Public Transport	Cycling	Walking
Loyola de Palacios Palacios=	47.0%	4.8%	1.5%	46.7%
El Madroño	27.1%	5.5%	0.0%	67.4%
Valdecás	13.7%	14.3%	0.0%	72.0%
IES Villa de Vallecas	10.4%	12.6%	0.7%	42.6%
Asturias (2018)	30.6%	19.2%	0.4%	49.8%
Eduardo Rojo (2018)	18.6%	14.7%	0.8%	65.9%
IES Antonio D. Ortiz (2017)	16.3%	19.8%	1.5%	62.4%
Average 4 schools Oct. 2016	27.3%	9.6%	0.8%	62.3%
Average 7 schools at baseline	24.7%	13.0%	0.9%	61.4%
EDM-2004	15.4%	16.2%	0.0%	68.3%

Table 8: Modal split in ECCENTRIC's participating schools October 2016

Data would suggest a strong modal change trend (10 percentage points in average) since 2004 from walking and public transport towards car use.

The baseline surveys also provide information on average distance travelled, which can be used to estimate emissions. This information is provided in the table below.

School	Average all modes (m)
Loyola de Palacio Palacios	1481
El Madroño	993
Valdecás	1027
IES Villa de Vallecás	1394
Asturias	1323
Eduardo Rojo	1438
IES Antonio Domínguez Ortiz	1114

Table 9: Average distance travelled at baseline

The table below provides average emission ratios for the emission of pollutants for car trips. A round trip is considered, with an average speed of 20 km/h and an average car occupancy of 2 persons. The emission factors are an average of those for medium-size diesel and gasoline cars with the current (EURO 6) technology. Emission factors have been estimated with the COPERT⁹ version 5.1 model.

	CO ₂	NO _x	NO ₂	PM ₁₀	PM _{2.5}
El Madroño	316,82	0,459	0,126	0,029	0,017
Valdecás	315,78	0,457	0,125	0,029	0,017
CEIP Loyola de Palacio	378,31	0,548	0,150	0,035	0,020
IES Villa de Vallecás	363,52	0,527	0,144	0,033	0,019
Asturias	326,93	0,474	0,130	0,030	0,017
Eduardo Rojo	353,92	0,513	0,141	0,033	0,019
IES Antonio D. Ortiz	289,05	0,419	0,115	0,027	0,015
Average all schools	338,87	0,491	0,135	0,031	0,018

Table 10: Average emissions per trip (g/passenger), car

⁹ COPERT (Calculation of Emissions from Road Transport) is a computer programme developed by EMISIA with the support of the European Environment Agency, currently used for the estimate of emissions in national inventories. <https://www.emisia.com/utilities/copert/>

The table below provides average emission ratios for the emission of pollutants for bus trips. A round trip is considered, with an average speed of 20 km/h and an average bus occupancy of 40 persons. The emission factors are those estimated with the COPERT¹⁰ version 5.1 model for 12-m urban buses con EURO IV technology (the most frequent one in the public buses serving the area), with an average occupancy of 40 passengers and an average speed of 15 km/h.

	CO ₂	NO _x	NO ₂	PM ₁₀	PM _{2.5}
El Madroño	71,59	0,485	0,068	0,008	0,006
Valdecás	71,36	0,483	0,068	0,008	0,006
CEIP Loyola de Palacio	85,49	0,579	0,081	0,010	0,007
IES Villa de Vallecas	82,14	0,556	0,078	0,010	0,007
Asturias	73,88	0,500	0,070	0,009	0,006
Eduardo Rojo	79,97	0,541	0,076	0,009	0,007
IES Antonio D. Ortiz	65,32	0,442	0,062	0,008	0,006
Average all schools	76,57	0,518	0,073	0,009	0,006

Table 11: Average emissions per trip (g/passenger), urban bus

Emissions per bus trip compared to car trip are 4.4 times lower for CO₂, almost the same for NO_x, 1.9 times lower for NO₂, 3.5 lower for PM₁₀ and 2.8 times lower for PM_{2.5}.

Elderly Community Centres

Surveys to the elderly have been administered at 7 Elderly Community Centres (ECC), and have been complemented by on-street surveys in March 2017. In total, 611 surveys were successfully completed for a total population of 55,209 persons above 65 years old living in the living lab, with a sample error below 4%. 70% of the surveys were obtained in the ECCs, and 30% on street. Results are summarised in the table below.

¹⁰ COPERT (Calculation of Emissions from Road Transport) is a computer programme developed by EMISIA with the support of the European Environment Agency, currently used for the estimate of emissions in national inventories. <https://www.emisia.com/utilities/copert/>

Travel Purpose	Split by purpose	Modal split			
		Walking & Cycling	PT	Car	Taxi
Return home	46,84%	66,67%	27,24%	5,87%	0,22%
Shopping	9,65%	73,66%	19,35%	6,99%	0,00%
Leisure, culture...	31,28%	72,97%	24,21%	2,82%	0,00%
Friends & Family	4,72%	41,76%	34,07%	24,18%	0,00%
Other	7,52%	37,93%	51,03%	10,34%	0,69%
Total		66,74%	27,08%	6,06%	0,11%

Table 12: Split of elderly's travel by purpose and mode

The last household survey (EDM-2004) also provides some information on the mobility of the elderly (population of 65 years and above) in the living lab (districts of Puente de Vallecas and Villa de Vallecas), and in the whole municipality and region. This survey was completed in October- November 2004. The total number of persons surveyed was 84,317 (from 34,942 households), distributed in 898 transport zones in the region. The results are provided with a sample error of 0.4%. Both districts in the living lab include several transport zones.

Travel Purpose	Split by purpose	Modal split			
		Walking & Cycling	PT	Car	Taxi
Return home	49,5%	45,3%	8,9%	44,9%	0,9%
Shopping	11,9%	58,5%	5,5%	36,0%	0,0%
Leisure, culture...	9,9%	45,5%	2,4%	52,1%	0,00%
Friends & Family	12,4%	17,0%	13,9%	69,1%	0,00%
Other	16,3%	38,3%	10,8%	48,1%	2,8%
Total	100,00%	42,3%	8,8%	48,0%	0,9%

Table 13: Split of elderly's travel by purpose and mode (EDM, 2004)

Both surveys are separated by a period of more than twelve years, and any comparisons have to be taken cautiously. Differences among them seem however, reasonable, in particular it what refers to the much higher relevance of active modes and public transport in the project's sample compared to EDM-2004. These differences can be explained by (1) a general trend to more active life among the elderly nowadays compared with 2004 and (2) the fact that the survey undertaken by the project is targeting those people with more prone to use this modes (those participating in elderly community centres).

The baseline survey included a question on current safety perception per transport mode. The results are summarised in the Table below.

	Walking	Cycling	Car	PT
Score (0-10)	5.5	1.4	6.5	6.7

Table 14: Safety perception by travel mode

Average travel distances have been estimated for the trips declared in the survey. They are presented in the Table below, as they should serve to estimate emissions during the evaluation process.

	Car	PT Bus	PT (All means)	Average all modes
Men	6.20	2.35	3.32	1.71
Women	5.87	3.25	3.95	2.09
General	6.02	2.88	3.69	1.91

Table 15: Average distance travelled by transport mode (km)

The table below provides average emission ratios for the emission of pollutants for car trips. A round trip is considered, with an average speed of 20 km/h and an average car occupancy of 2 persons. The emission factors are an average of those for medium-size diesel and gasoline cars with the current (EURO 6) technology. Emission factors have been estimated with the COPERT¹¹ version 5.1 model.

	CO ₂	NO _x	NO ₂	PM ₁₀	PM _{2.5}
Car trip	781.01	1.1313	0.3103	0.0718	0.0414
Bus trip	18.68	0.0214	0.0038	0.0017	0.0010

Table 16: Average emissions per average trip (g/passenger)

C.1.3 The business-as-usual scenario

¹¹ COPERT (Calculation of Emissions from Road Transport) is a computer programme developed by EMISIA with the support of the European Environment Agency, currently used for the estimate of emissions in national inventories. <https://www.emisia.com/utilities/copert/>

Under the business as usual scenario, the assumption is that no changes are expected in the mobility practices of the groups targeted by this measure. Minor changes can be expected in the emissions, due to the reductions expected by technological progress after 2020. The changes are only significant in what refers to NO_x and NO₂ emissions, thanks to progress in diesel technology, and results in a reduction of NO_x emissions by 63% and a reduction of NO₂ emissions by 75%. Assuming that the current petrol to diesel ratio (50%) is maintained, savings per car trip would be of 31% and 37% respectively.

Before ECCENTRIC it was not planned to implement the STARS project in Vallecás, STARS was only implemented in the central almond of Madrid, where mobility is somehow easier by bike (narrow streets with calm traffic, public BIKE, etc.) and mobility is also easier on foot (shorter distances). There is also a mobility behaviour issue in Vallecás and in other peripheral districts with a low cultural level, since, for some residents, the car still enjoys a status symbol and it is well seen to give a ride to the children to the school's door.

The measure team has not identified any policy or programme in the city or in the living lab that could have an effect on the objectives (and KPIs) of this measure during the implementation of ECCENTRIC.

C.2 Measure results

Ex-post measures have been taken in March 2019 for the elderly and in June 2017, June 2018 and June 2019 for children. For the purpose of this section only the 2019 data are considered.

School	Car	Public Transport	Cycling	Walking
El Madroño	27.1% / 23.5%	5.6% / 11.8%	0.0% / 0.0%	67.4% / 64.7%
Valdecás	13.7% / 9.1%	14.3% / 15.1%	0.0% / 0.9%	64.7% / 74.9%
Loyola de Palacios	47.0% / 48.7%	4.8% / 6.1%	1.5% / 1.0%	46.6% / 44.2%
IES Villa de Vallecás	14.1% / 11.0%	12.6% / 15.4%	0.7% / 1.2%	72.6% / 72.4%
Asturias	30.6% / 22.0%	19.2% / 14.2%	0.4% / 0.8%	49.8% / 63.0%
Eduardo Rojo	18.6% / 9.9%	14.7% / 13.6%	0.8% / 2.3%	65.9% / 74.2%
IES Antonio D. Ortiz	16.3% / 13.4%	19.8% / 22.3%	1.5% / 1.2%	62.4% / 63.2%
Weighted Average	24.7% / 21.3%	13.0% / 14.0%	0.9% / 1.1%	61.4% / 63.6%
EDM-2004, age 9-17	15.4%	16.2%	0.0%	68.3%

Table 17: Change om modal split in ECCENTRIC's participating schools (various baselines and "after" years, depending on each school¹²

The table above summarises modal split in the seven schools that have participated in ECCENTRIC at the year of starting their activities and at the year of conclusion. The average

¹² Baseline is October 2016 for El Madroño, Valdecás, Loyola de Palacios and IES Villa de Vallecás; October 2017 for IES Antonio D. Ortiz; October 2018 for Asturias and Eduardo Rojo. Final year is June 2019 for all schools except Loyola de Palacios, IES Villa de Vallecás (June 2018 in both cases).

changes have been good, with car use losing 3.4 percentage points to the benefit of public transport and walking.

The differences among schools have been substantial. The car share has actually increased (1.7 percentage points) in *Loyola de Palacios*, while it decreased in all the other schools. This school is located in the newest residential area within Vallecas, with urbanisation patterns that discourage the use of sustainable transport modes, even for short distances. The negative results in this particular school has a strong impact in the average, due to the big number of pupils attending it.

The values measured for the different KPIs are summarised in the table below.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Modal share, sust.modes (elderly)	%	93.8%	2017	93.8%		93.8%	2019	0.0%	0.0%
Modal share walking (elderly)	%	66.7%	2017	66.7%		75.3%	2019	8.5%	8.5%
Modal share, sust.modes (children)	%	75.3%	2016	75.3%		78.7%	2019	3.4%	3.4%
Awareness (elderly)	Score 1 – 5	NA		NA		1.9	2019	NA	NA
Awareness (children)	Score 1 – 5	NA		NA		5.0		NA	NA
Acceptance (elderly)	Score 1 – 5	NA		NA		5.0	2019	NA	NA
Acceptance (children)	Score 1 – 5	NA		NA		5.0		NA	NA
Satisfaction (elderly)	Score 1 – 5	NA		NA		4.9	2019	NA	NA
Satisfaction (children)	Score 1 – 5	NA		NA		4.8	2019	NA	NA
CO2 emissions (elderly)	t/year	1248	2017	1508	2019	968	2019	-280	-540
NOx emissions (elderly)	t/year	1.78	2017	2.16	2019	1.39	2019	-0.39	-0.77
PM emissions (elderly)	t/year	0.1148	2017	0.1386	2019	0.0890	2019	-0.0258	0.0497
CO2 emissions (children)	t/year	66.15	2016	66.15	2019	42.20	2019	-24.0%	-24.0%
NOx emissions (children)	t/year	0.1310	2016	0.1310	2019	0.0801	2019	-0.0509	-0.0509
PM emissions (children)	t/year	0.0062	2016	0.0062	2019	0.0040	2019	-0.0023	-0.0023
Subjective safety perception (elderly)	Score 1 – 5	3	2017	3	2019	3.9	2019	0.9	0.9

Table 18: Measure's indicators: before and after results

Overall, the measure has achieved good results in terms of expanding the share of sustainable mobility modes in both groups, in spite of their already high share before the measure was implemented. In the case of the elderly, private car trips accounted for only 6.2% of the trips, and this low share has been maintained. On top of that, the share of walking trips has increased by 8.5 percentage points, from 66.7% to 75.3%, replacing public transport trips. In the case of children, the increase in the use of sustainable transport modes has been 3.4 percentage points, mainly replacing car trips by public transport trips and walking.

There is a big difference in the degree of awareness about this ECCENTRIC measure among the targeted population. All the children in the participating school were aware about the

measure, as it was a part of the school activities; in the case of the elderly population of Vallecas, the awareness about the measure was significantly lower (1.9 over 5), which is probably linked to the big size of the city compared to the resources available for the measure.

In terms of acceptance, all the persons interviewed expressed their full support to the actions undertaken.

In terms of satisfaction, the scores were always high in both social groups. In the case of the elderly (4.9 over 5) even those that had not directly participated in the measures and were even not aware of them considered that it was highly positive to undertake this actions in the neighbourhood. In the case of the participating schools (4.8 over 5), those interviewed were also highly satisfied with the actions, which in most schools had run for 3 whole school years.

The emissions saved are very significant in the case of the elderly, particularly when the BAU scenario is considered. The CO₂ emissions saved per year are estimated at 540 tons or a 36% reduction compared to BAU. A similar percentage of reduction is achieved in the case of NO_x and PM.

In the case of children, emission savings are much lower than those of the elderly in absolute terms, due to the much smaller size of the population targeted in this case (3950 pupils in the 7 schools), but they are more significant in relative terms. The annual reduction in CO₂ emissions is estimated at 24 tons or 36%; similar relative reductions are estimated for NO_x (39%) and PM (36%).

The subjective perception of mobility safety by the elderly has significantly increased during the period, from 3 in 2017 to 3.9 over 5 in 2019.

C.3 Summary: achievement of objectives

The achievement of the project objectives for this measure is summarised in the table below. Overall, most of the objectives have been achieved in both vulnerable groups, children and elderly.

The project has clearly outperformed in the objectives related to participation (objective #1) and to visibility (objective #4). The project campaigns in this measure have reached 684 people, and the measure has organised 45 events until the end of August 2019.

The project has also exceeded its initial target in what refers to the perception of mobility safety by the elderly (objective #3), moving from 3 to 3.9 on a 1-5 scale (or a 30% increase) between 2017 and 2019.

No.	Objective and target	Rating	Comment
1	More participation: at least 40 persons involved in the campaigns	***	
2a	Decrease of car trips by 5-6 percentage points for children trips, in the districts targeted	O	
2b	Decrease of car trips by 4 points for the elderly trips	*	
3	Increase of the elderly's safety perception by 15%	***	
4	Increased visibility: 12 events organised along the project with vulnerable groups	***	
5a	Reduction of CO2 and other emissions (children)	O	
5b	Reduction of CO2 and other emissions (elderly)	***	
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded			

Table 19: Summary assessment of measure's objectives

The modal shift has evolved in a different way than initially expected. In the case of the elderly, the extremely low initial share of car use (just 6.2%) made it difficult to get further reductions, and in fact this share did not change between 2017 and 2019. However, the project activities seem to have had a positive effect in walking, which increased by 8.5 percentage point during the same period, mainly due to trips that were formerly made by public transport. In the case of children, the share of sustainable transport modes increased from an already high 72.7% to 74.3% or 1.6 percentage points, below the 5-point target.

Modal split results translate into different emissions reductions for the two target groups. Reductions have been substantial in the case of the elderly, and to tiny changes in the case of children.

C.4 Up-scaling

The total number of primary and secondary schools in the municipality of Madrid is presented in the table below. Keeping the resources dedicated thus far to ECCENTRIC it seems that a programme on school mobility could mobilise 3 additional schools per year or 1110 pupils, considering the average size of schools in Madrid (370 pupils).

	Public	Private-Public funded	Private	Total
Primary School	799	1	3	803
Secondary School	350	37	77	464
Primary and Secondary	2	434	165	601
Total	1151	472	245	1868

Table 20: Number of primary and secondary schools in Madrid

Considering the average project achievements in terms of modal split and emissions, the annual results expected from upscaling are summarised in the table below. The results from upscaling would add, every year, to those obtained from ECCENTRIC.

	Car trips avoided	CO2 saved (t/year)	NOx saved (t/year)	PM saved (t/year)
ECCENTRIC	68	23,95	0,0509	0,0112
Upscaling (1100 pupils)	19	6,67	0,0142	0,0031

Table 21: Expected annual results from upscaling (children)

Concerning elderly mobility, further action in Elderly Community Centres is envisaged. There are 89 of such centres in Madrid. Keeping the current resources, it would be possible to add 2 additional Centres to the programme every year. However, the significant impact achieved on elderly mobility should be couple with some actions improving walking conditions for the elderly within the area of influence of each Centre.

Considering the population in Madrid (667,714 above 64 years old or 20.4% of the total population) and the number of Elderly Community Centres in the city (89), the average population per Centre is 7,500. Based on existing mobility surveys, ECCENTRIC considered that 54% of that population was making daily trips (resulting, in the case of the ECCENTRIC living lab in a “mobile” elderly population of 30,000 persons in the living lab). Modal change occurred mainly from motorised trips to walking (8.6 percentage points). Applying these values to the average elderly population covered per Centre, the impacts expected from upscaling are presented in the table below.

	Car trips avoided	CO2 saved (t/year)	NOx saved (t/year)	PM saved (t/year)
ECCENTRIC	1548645	540,00	0,7700	0,0497
Upscaling (2 Centres)	418106	13,34	0,0283	0,0062

Table 22: Expected annual results from upscaling (elderly)

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

There are no deviations to report from the original plan: the initial plans on the design and implementation of the campaigns and activities in the various participating schools and Elderly Community Centres have been completed as envisaged.

D.2 Barriers

The following barriers were identified during the measure process evaluation.

D.2.1 Institutional barrier

Investment decisions within the municipality were slowed-down by the strict budget-control rules approved by the national government to meet the austerity targets imposed by the European Union. In many cases substantial dedication of the measure team was required, not only to move forward the actions in the decision-making chain, but also to keep the elderly participants engaged in spite of the administrative hurdles.

The participatory budgeting process implemented by the Municipality since 2017 is likely to have penalized bottom-up proposals like those identified by seniors in the ECCENTRIC project, as elderly persons usually have difficulties to participate in on-line procedures and have to rely in traditional and time-consuming alternatives, such as signature collection and submission of proposals at the municipal registry offices.

Institutional barriers have been more challenging at the time that the conclusions from the implementation process had to be translated into concrete actions in the field. This has not occurred in the case of children mobility, in which actions have been of an educational nature, not needing to mobilise other municipal services or requiring procurement procedures. However, in the case of elderly mobility, the implementation of actions has required significant time and efforts from the ECCENTRIC team. The municipal administrative procedures have had difficulties to accommodate the suggestions provided by ECCENTRIC, as they were not following the usual participatory and decision-making channels. The success achieved by the measure in getting actions implemented and integrating new actors in the participatory channels (particularly those as children and the elderly that cannot rely solely on on-line participatory tools) provides valuable lessons for municipal management.

D.2.2 Cultural (problem-related) barrier

The measure team encountered some challenges related to the lack of familiarity of the seniors with on-line surveys and written material (a significant part of them had not completed primary studies) and the need to look for alternative communication channels. Otherwise, it is fair saying that vulnerable groups, such as children and elderly, are already well aware of sustainable mobility practices and keen to explore them. During this period, initially unforeseen gender differences were identified in the attitude of teenagers towards cycling: this cultural

barrier was taken into consideration in the remaining of the project with specific actions addressing it.

Another cultural barrier was the initial scepticism and lack of confidence of some of the members of the Elderly Community Centre steering boards about the institutional response that would result from their involvement in the ECCENTRIC. Initially, these stakeholders complained that participatory processes like the one proposed in this case was unlikely to result in implementation of the conclusions by decision-makers. This barrier was overcome through a quick implementation of the two pilot actions (the bus information screen and the improvement of Plaza de la Constitución), which made these stakeholders eager to continue participating in the process to achieve the implementation of other actions. The quality of the campaigns (videos...), the recognition of their work (prizes, media,...) and the truly participative process have been also appreciated as trust-builders in the conclusions of the learning history workshop.

D.2.3 Organisational barrier

Organisational barriers have been relevant, due inter alia to the lack of pre-existent formal structures to frame the interaction with local stakeholders and the targeted population. These barriers were properly handled by the project team. Organisational barriers may have appeared as a consequence of the lack of stable structures to support the project's actions in the city lab. The management option followed by the team had the advantage of offering considerable flexibility and room for adaptive management; however, it proved to require significant additional efforts from the ECCENTRIC team and probably did not mobilise the full potential of local stakeholders, which although supportive to the project, played a relatively secondary role. The support of municipal staff (e.g. at the ECCs) was particularly valuable to overcome this barrier.

D.3 Drivers

The main drivers encountered during the implementation of this measure are described in the sections below.

D.3.1 Political driver

The main political driver was the commitment of the local government for both sustainable mobility in the whole city and urban regeneration in the urban periphery. This driver facilitated the implementation of most of the ECCENTRIC measures.

D.3.2 Institutional driver

The lack of institutional arrangements and the limited explicit support of city councillors were partially compensated by the measure team by relying on informal networks among local civil servants placed in different municipal services to reach across bureaucratic boundaries and sectoral silos and to accelerate approval procedures. These informal networks have proved to be very supportive of innovations, and very keen in pushing forward bottom-up actions like the ones co-created within this ECCENTRIC measure with the elderly.

D.3.3 Cultural driver

Some of the members of the Elderly Community Centres participating in this measure have a rich background as active citizens in Vallecas, a neighbourhood with a long tradition of grassroots activism to improve living conditions. This background has been of great value in the design and implementation of actions within the project.

Most of Vallecas residents, including the children and elderly, share a widespread feeling of belonging and identification with the neighbourhood. They consider themselves as the main figures in the fight for the improvement of Vallecas since the 1960s, asking at that time for basic urban services (electricity, sewage, transport...) to be improved and social facilities to be provided. This background facilitates their engagement in the activities of this ECCENTRIC measure.

D.3.4 Financial driver

Although the funding provided by ECCENTRIC is modest, compared with the city lab needs, and with the ambition of many of the actions identified during the measure implementation stage, it has been decisive to provide the necessary technical expertise in communication to complement and channel the suggestions of the participants and to transform them into feasible projects, to be subsequently presented to the municipality for approval and implementation.

D.3.5 Technological driver

The current commitment of the municipal bus company (EMT, an ECCENTRIC partner, although initially not involved in this measure) with technologies providing new channels of information to the user was instrumental for the implementation of the information screens in ECCs suggested by the participants at co-creation workshops.

D.3.6 Spatial driver

There has been a favourable environment for the improvement of the public space in Vallecas: the municipality has been developing during 2018 its city-wide regeneration plan *Madrid Regenera (MADRE)* including actions in the two districts included in the city lab.

D.4 Supporting activities

No supporting activities have been identified. The lack of external supporting activities has been compensated by the effort the measure team has made to reach out to residents and targeted users. One good example are the activities undertaken to involve the senior residents in the neighbourhood in the process of diagnosis and definition of pilot actions, as a way to increase the acceptance and satisfaction with the activities organized. There have also been many initiatives to expand the involvement of families and teachers in the actions targeting schools, although in this case their involvement is more challenging, as many of them have quite busy daily agendas in which it is difficult to accommodate these participatory activities. All the actions implemented within this measure have included carefully-organised participatory processes, and the lessons learnt will be summarised in the SUMP guidelines to be provided at the end of the measure.

D.5 Recommendations on the implementation process

The main lessons learnt and recommendations concerning the implementation process are summarised below.

D.5.1 Build upon previous experience and projects

The excellent results achieved by this measure with children has been facilitated by the previous experience gained by the measure team in the EU-funded project STARS. Building upon that experience, ECCENTRIC could establish a robust planning cycle with the participating schools, imbed its activities within the school activities and create strong partnerships with teachers and other key stakeholders.

D.5.2 Anticipate the bureaucratic procedures for investment approval and design your co-creation activities accordingly

Approval procedures for investments, big or small, may be cumbersome and rigid. When engaging vulnerable groups in co-creation processes, as ECCENTRIC did with the elderly in the living lab, there is a risk of not getting things done, and raising frustration and scepticism about public action. The boundaries of the project (what was feasible to get done and what was not or too difficult) were clearly identified and communicated to the participants, so that- even with considerable effort- the agreed proposals were implemented by the municipality.

E. Evaluation conclusions

The evaluation conclusions are summarised below.

E.1 Validated direct impact

- The ECCENTRIC activities aiming at raising awareness on urban mobility among children and at increasing the share of sustainable transport results have substantially achieved their expected targets. However, it is worth noticing that the share of car use remains substantial in all cases, and that there are schools in which, particular social and land use characteristics jeopardise modal change in spite of the educational efforts and children willingness to try alternative modes.
- Whereas the reduction in car use among pupils results in an increase in the modal share of public transport and walking, the share of cycling hardly changes, and remains very low. This suggests that encouraging cycling for school trips remains a medium to long-term goal, that has to be sustained beyond the school-year cycle of ECCENTRIC activities. Furthermore, it needs to be supported by adequate framework conditions in the city, such as bold pro-cycling policies, and adequate infrastructure for safe cycling.
- In the case of seniors, the aim of the measure moved from reducing car use (as baseline data showed that it was already very low) to the improvement of public transport conditions for them, and to the promotion of walking, based on healthy, autonomy and psycho-social considerations as well as sustainable mobility goals.
- Urban seniors make a very limited use of cars, at least in high-density residential neighbourhoods in the periphery such as Vallecas. However, their mobility can be significantly supported through improvements in the quality of the public space and walking conditions.

E.2 Relevance of supporting activities

No relevant supporting activities were identified in this measure.

E.3 Interaction with other measures

Interaction with other measures was limited. In the case of the elderly, the significant increase in the share of walking trips can be partially associated to measure MAD 4.6, if not in the concrete pedestrian itineraries implemented by the measure, in the supportive policy to pedestrians championed by the municipality in the city at large, and improvement of the general maintenance and cleanness of public space.

This measure has got a fruitful interchange of knowledge with measure MUC 2.9, on intergenerational training of senior people on on-line mobility tools.

E.4 Main lessons learned

The following lessons can be highlighted:

- Self-organising activities to promote sustainable mobility have a strong potential and capacity to mobilize the targeted social groups when they address the topic with an integrated approach close to the interests and points of view of these groups, e.g.

including the dimensions of health, autonomy and empowerment in the use of public space of senior and children groups.

- Concerning the implementation process of measures targeting children and the elderly. The project showed the limited impact of “one-shot” activities and the need to engage with these groups in lengthy processes. For this reason, it seems reasonable to establish long-term programmes with dedicated personnel and resources, that can be continued through time in schools and ECCs, and embed these activities within the schools’ and ECCs’ programmed activities.
- The difficulties faced to get actions included in the municipality’s investment pipeline suggest the need to establish internal bureaucratic procedures within the city services, that can be able to provide a more flexible and tailored response to the bottom-up proposals coming from these participatory activities so that, without compromising transparency and accountability, these proposals can be assessed and implemented within reasonable deadlines.
- Modal share for children is possible, but there seems to be a ceiling of a few percentage points in what can be achieved. It is also worth noticing that most of the modal change from car use is likely to move towards public transport rather than to walking.
- The promotion of cycling among children (and even more for the elderly) seems a long-term battle, with no visible achievements in the short-term. This is probably due to the still weak share of cycling in Madrid.
- Actions aiming at encouraging modal change among these social groups need a favourable environment and policy framework. In this sense, they need to be framed within bold policies supporting sustainable mobility at the city level, as happened during the implementation of this measure in Madrid.
- Urban planning has a strong influence in mobility conditions, particularly in the case of children. The school which presented lower results in terms of climate change (Loyola de Palacio) was located in a recently developed area with a strongly car-oriented design. Actions in such neighbourhoods are hardly effective without more comprehensive strategies to redesign the urban space.

E.5 Long term impact

The main expected long-term impacts of this measure are the following ones:

- The embedment of sustainable mobility practices within the activities of an increasing number of schools and ECCs in the city.
- An increase in the autonomy of children and the elderly, facilitated by more friendly environments and better mobility conditions; unsurprisingly, children seem likely to prefer using public transport, whereas the elderly have a strong tendency to increase the number of their walking trips.

E.6 Potentials for up-scaling in the city

The potential for up-scaling of this measure is strong due to the following reasons:

- The modest resources required by this measure, and its strong support from school principals and staff, and from those in charge of the ECC.

- Its positive impact in terms of modal change and increase of the autonomy of children and the elderly, in the framework of an active-life concept.
- The wide municipal policy to improve public space, public transport and walking conditions in the city.
- The high number of primary and secondary schools and ECCs in the city.
- The growing number of elderly people in good health conditions in an ageing Europe and Madrid.

F. Additional information

F.1 Appraisal of evaluation approach

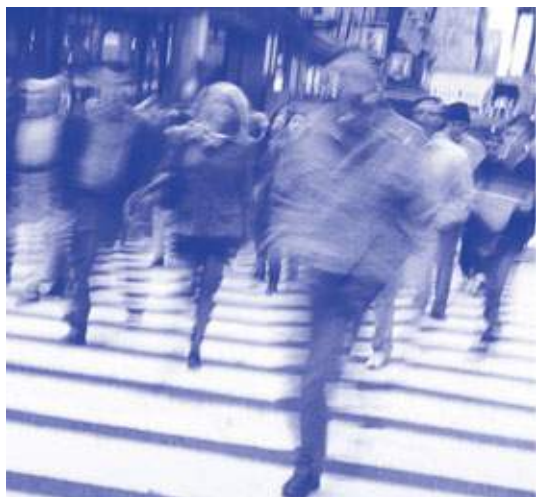
Based on the evaluation assessment for this measure, the following weak and strong points and recommendations can be highlighted for similar evaluation work in the future:

- A strong point of the evaluation assessment approach has been the collection of mobility information. Surveys at the participating schools were conducted in cooperation with the teachers and following a well-established administration procedure. In the case of the elderly, the procedure was based on the practice of the Regional Household Survey, and adjusted to the characteristics of the population targeted.
- Data collection on distances travelled and the technologies of the vehicles used (to estimate emissions) have proved more difficult to collect. The data can be improved with more detailed surveys to a reduced group within the surveyed sample.

F.2 Future activities relating to the measure

Based on this measure experience, the project team recommends the following activities for the future of the measure after the project lifetime:

- To revise the questionnaires in the surveys addressed to children and the elderly, in order to collect more precise information on modal change and travel distance.
- To expand these activities to other schools and ECCs, based on the available resources in the municipality.
- To produce supporting materials to facilitate the implementation of these measures by the teachers and ECC staff on their own, with some supportive role from the municipality, when necessary.



2020
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ECCENTRIC



MUC 2.9a

Neighbourhood oriented marketing of sustainable multimodal mobility services: **Direct and dialogue marketing**

Measure Evaluation Report

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1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
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11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
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27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Elisabeth Nagl	

Table of Contents

ABSTRACT.....	314
A. INTRODUCTION.....	316
A.1 EXPECTED RESULTS OF THE MEASURE	316
A.1.1 Quantifiable impacts.....	316
A.2 MEASURE DESCRIPTION	317
A.2.1 Measure outputs.....	317
A.2.2 Supporting activities	317
A.2.3 Interactions with other ECCENTRIC measures.....	317
A.2.4 Interactions outside ECCENTRIC	317
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	318
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	318
A.5 IDENTIFIED RISKS	318
B. MEASURE IMPLEMENTATION	319
B.1 SITUATION BEFORE CIVITAS	319
B.2 INNOVATIVE ASPECTS.....	319
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	319
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	319
C. IMPACT EVALUATION FINDINGS	321
C.1 EVALUATION APPROACH.....	321
C.1.1 Expected impacts and indicators.....	321
C.1.2 Baseline.....	323
C.1.3 The business-as-usual scenario.....	330
C.2 MEASURE RESULTS.....	333
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	347
D. EVALUATION CONCLUSIONS	349
D.1 VALIDATED DIRECT IMPACT	349
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	349
D.3 INTERACTION WITH OTHER MEASURES.....	349
D.4 MAIN LESSONS LEARNED	349
D.5 LONG TERM IMPACT	350
D.6 POTENTIALS FOR UP-SCALING IN THE CITY	350
E. ADDITIONAL INFORMATION.....	351

E.1	APPRAISAL OF EVALUATION APPROACH	351
E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	351

List of Figures

Figure 1: Wish to order trial offers, 08/2019	323
Figure 2: Received trial offers, 08/2019	324
Figure 3: Ordered information material, 08/2019	325
Figure 4: Number of cars per household, 2018.....	326
Figure 5: Modal Split of Living Lab residents, 2018	327
Figure 6: VKT by household (density plot), 2018	327
Figure 7: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017). 328	
Figure 8: Modal Split in Munich (2008+2017)	330
Figure 9 Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020).. 331	
Figure 10: Awareness of the mobility-post, 2019	336
Figure 11: Reasons for not ordering trial offers, 10/2019.....	337
Figure 12: Wish to order trial offers, 10/2019.....	337
Figure 13: Received trial offers, 10/2019	338
Figure 14: Acceptance of the Mobility mail	339
Figure 15: Satisfaction with the order process, 2019	340
Figure 16: Satisfaction with the ordered material.....	340
Figure 17: Satisfaction with test offers	341
Figure 18: Number of cars per household of MUC 2.9a users, 2019.....	342
Figure 19: Modal split of households using the marketing material, 2019	342
Figure 20: Mode shift according to information material and test offers, 12/2019	343
Figure 21: VKT by household (density plot) of MUC 2.9a users, 2019	344

List of Tables

Table 1: Quantifiable impacts.....	316
Table 2: Target groups or affected parties.....	318
Table 3: Measure stakeholders.....	318
Table 4: Risks.	318
Table 5: Emission Factors (HBEFA, 2017)	328
Table 6: Living Lab Emissions 2017	329
Table 7: Emission Factors (HBEFA, 2020)	331
Table 8: Living Lab Emissions 2020	332
Table 9: Emission comparison MUC 2.9a, 2018.....	345
Table 10: Living Lab emission comparison.....	345

Project	City		
ECCENTRIC	Munich		
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MUC 2.9a	Neighbourhood oriented marketing of sustainable multimodal mobility services: Direct and dialogue marketing		
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15.10.2019	Elisabeth Nagl	elisabeth-nagl@muenchen.de	+49 (0)89 / 233-39965

Abstract

The measure MUC 2.9 is divided into three sub-measures which aim to implement neighbourhood-oriented marketing of sustainable, multimodal mobility services in Domagkpark and Parkstadt Schwabing. Sub-measure MUC 2.9c focuses on a comprehensive mobility management for companies, actually carried out with the help of a ride sharing app called JobRide. The mobility management for local schools (MUC 2.9b) offers mobility education and training to children and their parents in order to strengthen active, independent and sustainable trips to school and leisure activities.

This measure MUC 2.9a focuses on a direct and dialogue marketing which is addressed to all residents of the ECCENTRIC Living Lab – Domagkpark and Parkstadt Schwabing. The targeted marketing campaign aims to support local residents to change their mobility behaviour into a less car-dependant lifestyle. The customized marketing actions consist of various materials which are designed in a very modern and appealing way and also have a direct connection to their own neighbourhood. There are information brochures, handy maps of the Living Lab and an order form where interested residents can order additional information about different mobility options and free trial offers and vouchers to actually incentivise to make use of those mobility choices.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measures' implementation and the ex-post data, which focuses on the impact of MUC 2.9a.

Evaluation results for MUC 2.9a were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019), statistical data delivered by the measure's subcontractor about general campaign respondents, interviews with the ML and an online survey about general satisfaction and awareness of the mobility marketing campaign.

The direct dialogue marketing campaign was successfully launched in June 2019. The first of a total of three rounds was running for about six months. Evaluation data was obtained several times during this timeframe. The actual usage rate is lower than initially expected, although the interest of the residents can be classified as high based on their feedback on the mobility mail. An important result is therefore the high inhibition threshold of users to actually use new offers, although their interest is very high.

The impact assessment of measure MUC 2.9a showed that about 15% of the residents which received the marketing material via post, responded to the campaign by ordering further mobility related information. About 52% to 55% ordered trial offers for the local public transport and e-scooter sharing. About 43% were interested in information about bike sharing and 37% to 40% were asking for more information about car sharing. Those who actually made use of the trial offers which were sent to them, mainly used bike sharing (51%), the e-scooter sharing (44%) or public transport (PT) offers like the local IsarCard (44%). The car sharing trial offer which was used the most, was the stationary car sharing (26%). Free-floating mobility service providers have lower usage numbers (about 16%).

Nevertheless, 87% of the residents who are actually ordering information material and redeeming their vouchers are highly satisfied with the entire process and the individual consultation via telephone by the subcontracted marketing and sales firm.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

City policy level in perspective of CIVITAS goals / longer term:

- Reduced energy use & CO2 emissions
- Reduced air pollution
- Reduced road congestion
- Improved accessibility for all
- Better social inclusion and equal opportunity
- Improved liveability

Strategic level:

- New approach of providing mobility management to an entire housing/business area was tested, i.e. embracing all mobility needs, interests and patterns
- It was analysed how mobility behaviour of citizens already resident in the city could be changed towards more sustainable modes and whether this neighbourhood approach could be transferred to other development areas

Measure level:

- The plan was to encourage residents to test mobility offers and services that are new to them and to reduce barriers that inhibit making use of the offers (e.g. lack of knowledge, uncomfortable situations, insecurity)
- At least 30% of the contacted households were planned to make use of the offer and order further material or incentives to test mobility services
- All three mobility management components (sub-measures a), b), c)) were planned to achieve a reduction of 5% in car use, a reduction of CO2 emissions of 180 tons per year and a reduction of car kilometres of at least 870.000 km per year in the laboratory area
- In addition, the measure should have contributed to a reduction of NOx and PM emissions in the laboratory area, an increase in traffic safety and a decrease of accidents on the way to school

A.1.1 Quantifiable impacts

Expected Impacts	Wide awareness and acceptance of mobility services in the area. Increased use of the various existing and new sustainable mobility services. Increase of use of active modes. Reduced individual car use in Domagpark and Parkstadt Schwabing (for both way-to-school trips and commuters). The large majority of children (and their parents) go to day care/ school by sustainable modes, i.e. on foot, by bike or public transport.	CIVITAS ECCENTRIC Objectives								
		Reduce:				Improve:				
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight
1	Awareness about the mobility services among the residents and targeted groups					X	X			
2	Acceptance of mobility offers, sustainable mobility is a priority among residents and targeted groups					X	X	X		
3	Mode shift towards more sustainable modes by residents and targeted groups	X	X		X					
4	Reduction of car ownership among residents and targeted groups							X		
5	Reduction of VKT of residents and targeted groups	X	X							
6	Reductions of CO2 emissions from residents and targeted groups	X								
7	Reductions of NOx and PM emissions from residents and targeted groups		X							

Table 1: Quantifiable impacts

A.2 Measure description

The measure aimed to implement neighbourhood-oriented marketing of sustainable, multimodal mobility services in the newly built residential districts “Domagkpark” and “Parkstadt Schwabing”. Both areas are home to more than 8.000 people, over 200 companies, schools, educational institutes and other facilities. Various innovative mobility offers and services as well as amenities (grocery shops etc.) are present in the neighbourhood. However, people need support in order to put car-independent lifestyles into practice.

Therefore, the City of Munich implemented a customised marketing campaign for the residents of both districts encouraging them to learn more about mobility and test mobility services available in the neighbourhood. As part of this measure, direct and dialogue marketing for sustainable mobility was offered, i.e. providing all households with encouraging, target group specific material about the mobility services (public transport, walking, cycling, (e-)car sharing, (e-)bike sharing, cargo bike-sharing, (e-)scooter sharing etc.) in the neighbourhood. Additionally, personalised mobility counselling and incentives to test offers and services are included.

Mobility management activities went hand in hand with the implementation of other CIVITAS ECCENTRIC measures in Munich (e.g. the mobility stations (Measure MUC 5.9), e-mobility (Measure MUC 6.3) or the concierge (Measure MUC 7.5)), i.e. promote these measures to their target groups, keep people updated about recent developments and ensure that all residents were aware of the mobility possibilities available to them.

The sub-measure was complemented by sub-measures b) mobility management for local schools and day care facilities and c) mobility management for companies – see separate MERs/ PERs for details.

A.2.1 Measure outputs

The outputs from this sub-measure are:

- A concept for direct and dialogue marketing for sustainable mobility in the Living Lab was developed.
- About 3.000 households in the laboratory area received personalized information, guidance and motivation in form of the marketing campaign (by mail and telephone contact).

A.2.2 Supporting activities

None

A.2.3 Interactions with other ECCENTRIC measures

The marketing campaign advertised the Intermodal (E-) Mobility stations (Measure MUC 5.9), e-mobility (Measure MUC 6.3 “Electric light-weight vehicles – one for all”), and the concierge (Measure MUC 7.5 Neighbourhood oriented concierge system at the development area Domagkpark).

A.2.4 Interactions outside ECCENTRIC

The dialogue campaign was carried out in close coordination with the Munich New Citizen Project. New approaches, which were tested within CIVITAS ECCENTRIC, were therefore incorporated into the New Citizen project, and vice versa. This concerned for example the variety of test offers of the mobility service providers.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
6	All 3.100 households in the Living Lab received the mobility marketing material	Living Lab	Domagkpark and Parkstadt Schwabing

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

For a better overview, the stakeholders are grouped by sub-measure

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG- PR-other	Level of activity L-P-O	Role - Links
1	City of Munich (Department of Public Order, KVR)	P	C	L	Measure leader
2	MVG - Public transport and mobility services	P	PT	O	Public transport provider and mobility service provider
3	Mobility service providers (Car sharing, ride sharing, multi-modal services)	P/S	PR	O	Mobility service provider
4	Neighbourhood associations (e.g. Quartiersverein DomagkPark eV, Nachbarschaftstreff Parkstadt Schwabing)	P	NG	O	Representation of residents, multiplier
5	Housing associations	S	PR / NG	O	Representation of residents, multiplier
6	Marketing and sales company (Omniphon)	S	PR	P	Company carrying out the marketing actions, designing the material and consulting residents
7	Politics, District committee	S	other	O	Process support
8	Residents	S	other	O	Users / beneficiaries
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Good outreach is necessary for the measure's success.	Involvement	Cooperation with neighbourhood associations	ML
Number of residents using the mobility offers is too low	Involvement	Cooperation with neighbourhood associations (prominent information in their newsletters) Provide attractive materials to engage citizens	ML

Table 4: Risks.

B. Measure implementation

B.1 Situation before CIVITAS

The Domagkpark is a newly developed housing area, and the new inhabitants have not received targeted information on sustainable mobility services.

B.2 Innovative aspects

New organisational arrangements or relationships

The mobility marketing serves three different pillars: *test offers* provided by multiple mobility providers, *information material* like maps or brochures about local mobility possibilities and the chance to perceive a *personal mobility consulting*.

Targeting specific user groups

Sub-measure MUC 2.9a targets all residents of the Living Lab.

New policy instrument

The City of Munich worked together with a consultancy which supports the whole marketing and dialogue process. It is their first and innovative attempt to bring mobility advertisement into people's hands to make them use the mobility offers in the Living Lab.

B.3 Research and Technology Development

No new technology was developed. However, material for the mobility management was developed by a subcontractor of the City with an individual focus on the district.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning milestones

In the summer 2018, the City of Munich developed the concept of the Mobility Management for the local residents. The concept is based on the identified user needs of the ex-ante survey of all households and on several discussions with residents in the Living Lab during the European Mobility Week in September 2018.

The tender procurement for the dialogue marketing campaign has been carried out in September 2018, which is oriented towards the general new citizenship project of the City of Munich. The contract has been awarded to a dialogue marketing company with vast experience in mobility management. The sub-measure has completed the planning phase by the end of the year 2018.

Phase 2: Procurement & Implementation

In order to achieve a personalised welcome mailing, a municipal data protection audit has been carried out and the process for the technical provision of data needed has been initiated in December 2018.

In addition, various information products and incentives have been completely new developed in detail by the City of Munich and the dialogue marketing company. For this purpose, all acting mobility service providers in the Living Lab area have been contacted to participate in the marketing campaign. This enabled the residents to receive an informative map of various services in their neighbourhood as well as information and test material on various mobility services, which could be ordered via an attached order form in the so-called Mobility mail.

The implementation of the first round was planned for May 2019. The procurement and implementation phase for the sub-measure has been concluded in June 2019, due to some delays regarding the data acquisition. Based on the complexity of the offers and the completely new development of the products, the start of the campaign shifted slightly. In addition, the start of the campaign was compared with the school holidays to achieve an increased coverage. Thus, the campaign was launched in June 2017 with great success.

Phase 3: Demonstration & Monitoring

The demonstration of the sub-measures is on-going. The mobility campaign for residents in both districts started in June 2019. About 3.000 households have been reached. The campaign is evaluated in Q4 2019 by an online-survey of the residents and feedback of the mobility service providers. Another round of the so-called mobility mail was rolled out in autumn 2019 with a slight delay, where all new residents in the district were contacted.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Awareness	Acceptance	Satisfaction	Mode shift	Car ownership
Type	KPI	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	SOCIETY-PEOPLE	SOCIETY-PEOPLE	TRANSPORT SYSTEM	SOCIETY-PEOPLE
Subcategory	Acceptance	Acceptance	Acceptance	General	Accessibility
Aspect	Awareness level	Acceptance level	Satisfaction	Modal split	Physical accessibility to transport services
Definition	Percentage of residents with knowledge about the mobility services promoted as part of the mobility management campaign	Percentage residents who favorably receive or approve of the mobility management campaign	User/provider/stakeholder average reported satisfaction with the mobility management program.	Percentage of residents who permanently changed modes for the same trip (same origin and destination, time, and frequency). The main mode of a trip is that used for the longest stage of the trip by distance. For instances with stages of equal length, the mode of the last stage is used.	Cars owned per 1000 inhabitants of the populations aged 18 and over.
Unit	Percentage	Percentage	Score (0-5)	Percentage (various values)	Cars to inhabitants ratio
Method of data collection	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Individual survey on satisfaction with the direct and dialogue marketing campaign to a representative group of residents (e.g. through a questionnaire or focus groups).	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Survey of Domagkpark residents
Target group	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents

Impact	6	7	8	9	10
Indicator	VKT	CO2 Emissions	NOx emissions	PM emissions	Contribution to policies, plans and programs
Category	KPI	KPI	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ENVIRONMENT	ENVIRONMENT	ENVIRONMENT	SOCIETY-GOVERNANCE
Subcategory	General	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Planning
Aspect	Total Travel	Emissions	Emissions	Emissions	Planning process
Definition	Kilometers traveled by individuals	CO2 emissions produced by residents' mobility	Total NOx emissions produced by residents' mobility	Total PM emissions produced by residents' mobility	Qualitative measurement on the process to modify policies, plans and programs in a significant and definitive way.
Unit	Kilometers	Tons	Tons	Tons	Score (0-5)
Method of data collection	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Estimation based on VKT (or PKT) of different target groups and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) of different target groups and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) of different target groups and average emission factors for the different transport modes available in the area	Surveys and interviews to decision makers
Target group	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Decision makers

Impact	INPUT	INPUT
Indicator	Investment Costs	Operational Costs
Category	KPI	KPI
Category	ECONOMY	ECONOMY
Subcategory	Costs	Costs
Aspect	Investment costs	Operating Costs
Definition	Total capital costs for purchase of equipment related to running the mobility making campaign. Preparation and design costs is defined as total costs expended setting up the measure covering a time period from the initiation of the measure preparation until the start of the measure implementation.	Personnel and maintenance costs for running the measure per time period
Unit	Euro	Euro / (time or usage unit)
Method of data collection	Data from financial reports, controlling	Data from financial reports, controlling
Target group		

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	I – A	S	Residents	Living Lab
2	Acceptance	%	I – A	S	Residents	
3	Satisfaction	Score 0-5	I – A	S	Residents	
4	Mode Shift	%	B – (I) – A	S / E	Residents	
5	Car Ownership	Cars/Inh.	B – (I) – A	S / E	Residents/Users	
6	VKT	Km	B – (I) – A	S / E	Residents/Users	
7	CO2 Emissions	Tons	B – A	E	Residents//Users	
8	NOx Emissions	Tons	B – A	E	Residents /Users	
9	PM Emissions	Tons	B – A	E	Residents//Users	
10	Contribution to policies, plans, and programs	Score 0-5	A	E	City	City
	Investment costs	Euro	I	DC	ML	Living Lab
	Operational costs	Euro	I	DC	ML	Living Lab
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

C.1.2 Baseline

The baseline was conducted as a household survey which was addressed to all 3.100 households within the Living Lab (Domagkpark and Parkstadt Schwabing). The survey took place from 04/2018-05/2018. The participation rate was 27%, which means that 935 people from 572 households answered the online survey or participated via telephone. The survey answered most of the KPIs while other KPIs are estimated by interviews with the Measure Leader.

Additional Baseline data was obtained by the measure's subcontractor who organizes the campaign and records statistics about the usage of the mobility marketing offers. 2.950 households have been addressed by the campaign in June 2019. 6,1% (179) of the mails were undeliverable. The mail contains the following marketing material:

- Cover letter from the mayor of the City of Munich
- Data protection declaration
- Map of the Living Lab
- Order sheet (+back envelope)
- Information material
- Desk calendar

Baseline data refers to the first wave of information material which was spread between 06/2019-08/2019. Data was delivered by the subcontractor in the beginning of 08/2019.

Addressing Indicators "1 – Awareness", "2 – Acceptance" and "3 – Satisfaction".

The indicator **awareness** can be defined by the number of residents with knowledge about the dialogue marketing actions. As of 08/2019 13,4% of all households replied to the Mobility-mail. 48,7% of them have answered in writing and 51,3% online via link or QR-code.

Acceptance can be measured by the percentage of residents who favorably receive material from the mobility management campaign. 13,4% of all households ordered trial offers, among these offers, the following ones were mostly ordered:

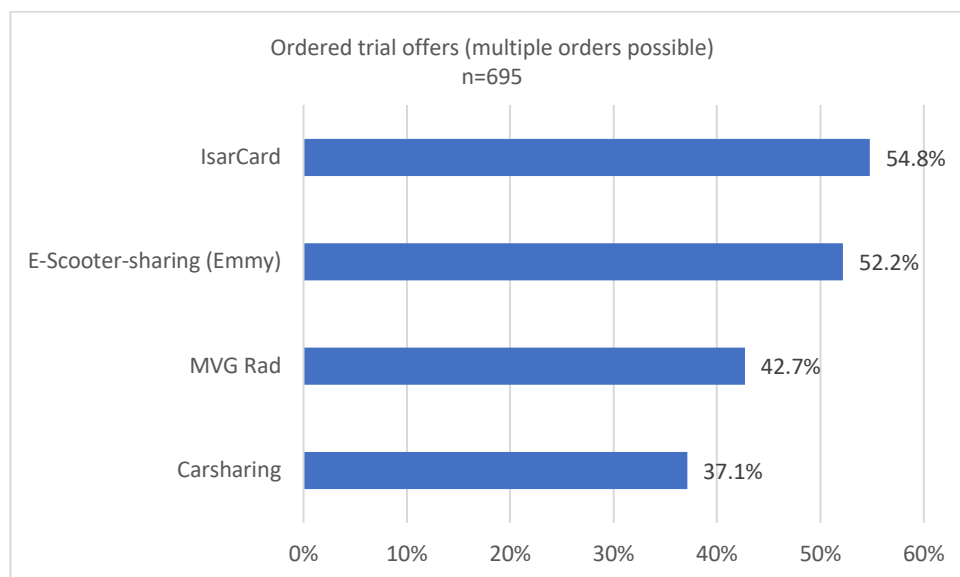


Figure 1: Wish to order trial offers, 08/2019

Knowing that every household could order several different offers, the wish to get test trials for E-scooter-sharing (Emmy) and IsarCard were mentioned from more than half of all households (Figure 1). 43% are also interested in more information about the MVG bikesharing and 37% in carsharing offers. In total 695 mobility trials were ordered, this includes households which are interested in more than one mobility offer.

It is not only conducted how many trial offers were ordered, but how many of them have been received. In total there are 40% of ordered material handed out. Figure 2 shows a detailed distribution of received trial offers:

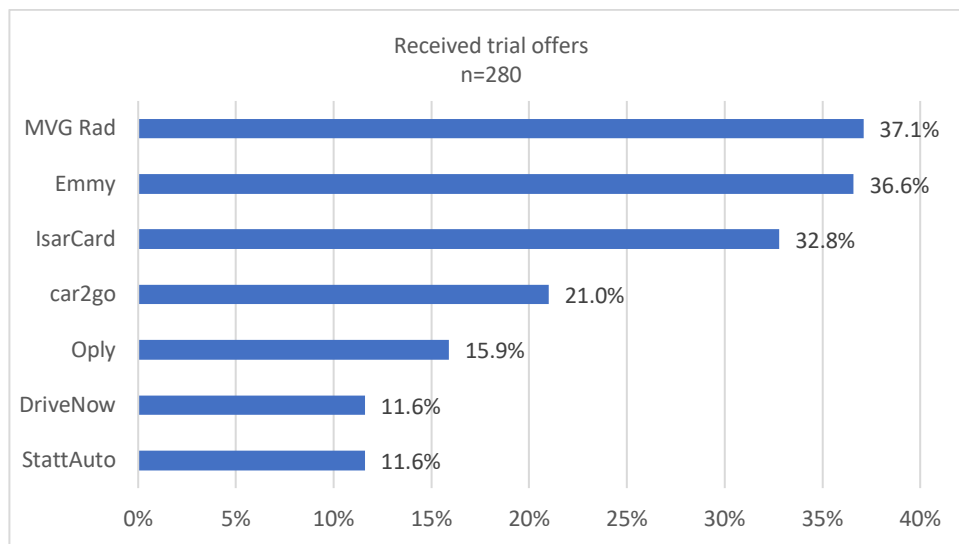


Figure 2: Received trial offers, 08/2019

Whereas the IsarCard and the E-scooter-sharing (Emmy) had the highest interest, the test trial for MVG bikesharing and Emmy was actually received most frequently (MVG: 37,1%; Emmy: 36,6%). The IsarCard was sent by 32,8% to all households. Further beaten off, other carsharing offers can be found, whereas car2go has the biggest share of all carsharing companies (21,0%).

Other information material which has been ordered, but did not end up in a test trial or subscription, can be found in the following Figure 3:

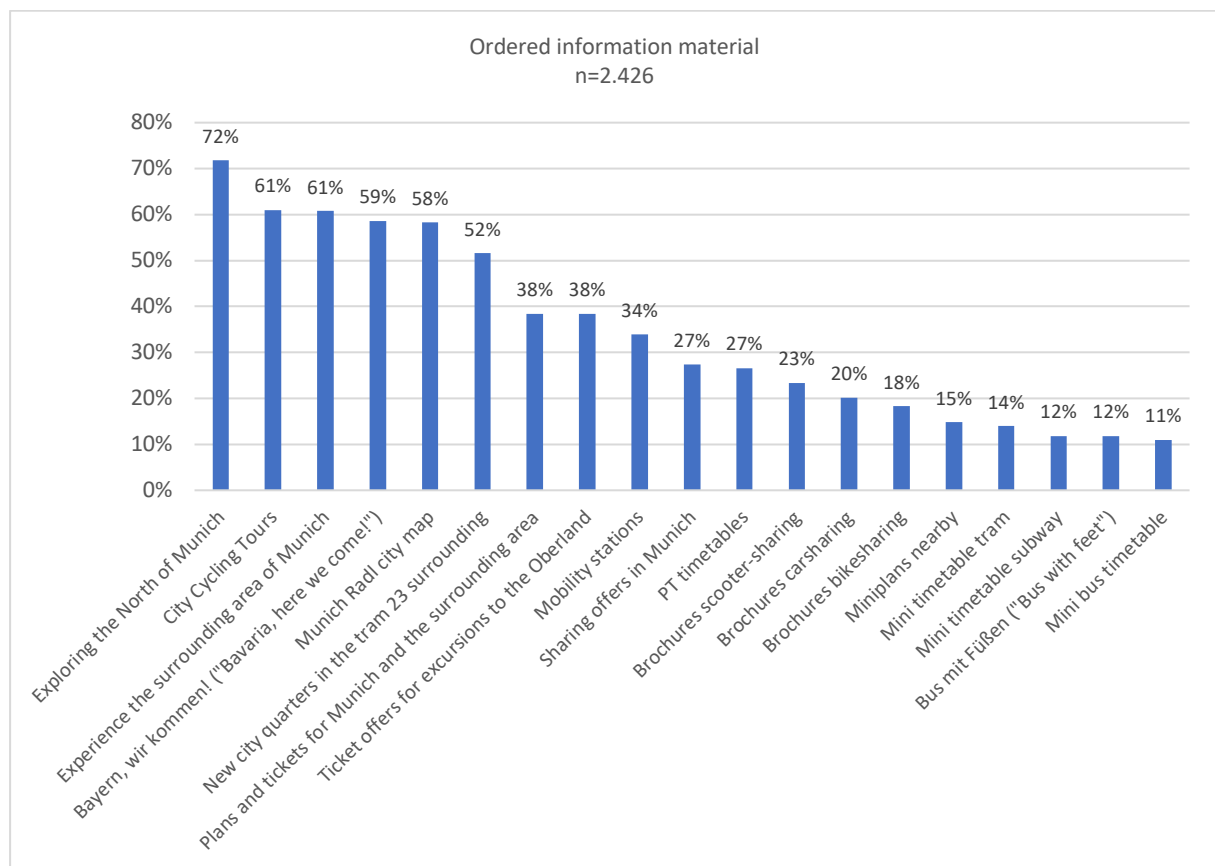


Figure 3: Ordered information material, 08/2019

In total, 2.426 orders for general information material were conducted by the households within the Living Lab. Most households are interested in exploring their surroundings, e.g. the “North of Munich” (72%), “surrounding area of Munich” (61%) or the “Tram 23 surrounding” (52%). Other information material which is ordered most often is about “City cycling tours” (61%) and the “Munich Radl city map” (58%). Mobility stations, sharing offers in Munich and brochures about scooter-, car- and bikesharing are ordered as well by almost a quarter of all interested households.

The score for the KPI **satisfaction** is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI.

Satisfaction with the mobility management program is conducted in a more qualitative way, means through phone calls carried out by the measures’ subcontractor. The interviews take place with residents which received the mail and are interested in the mobility offers. The biggest share of the households was very satisfied with the mobility campaign and appreciated the different trial offers and the individual consulting via telephone. The layout and design of the dialogue marketing material was rated as very nice and appealing. Because of this very positive qualitative feedback a satisfaction score of 4 out of 5 can be given. Some residents respond that they used the trial offers but they will not change their mobility behavior due to reasons like cost intensive PT or a confusing registration procedure regarding the carsharing options.

Mobility behavior of the target population

Addressing indicators "4 - Mode Shift", "5 - Car Ownership", and "6 - VKT"

The numbers for the following KPI come from the household survey, which was obtained in May 2018.

The **car ownership** in Domagkpark is with 0.83 cars per household slightly below the city-wide average of 0.9 (infas, 2010), while another, smaller study found the same car ownership in a Munich control group (Schreier, Becker, & Heller, 2015). The car ownership ratio for Parkstadt Schwabing is with 1,03 cars per household slightly higher than the city-wide average.

In detail, around a quarter of the 572 households, that answered the question about the number of owned cars, stated to be car-free, about 60% answered to have one car and 16% answered to have 2 or more (Figure 7).

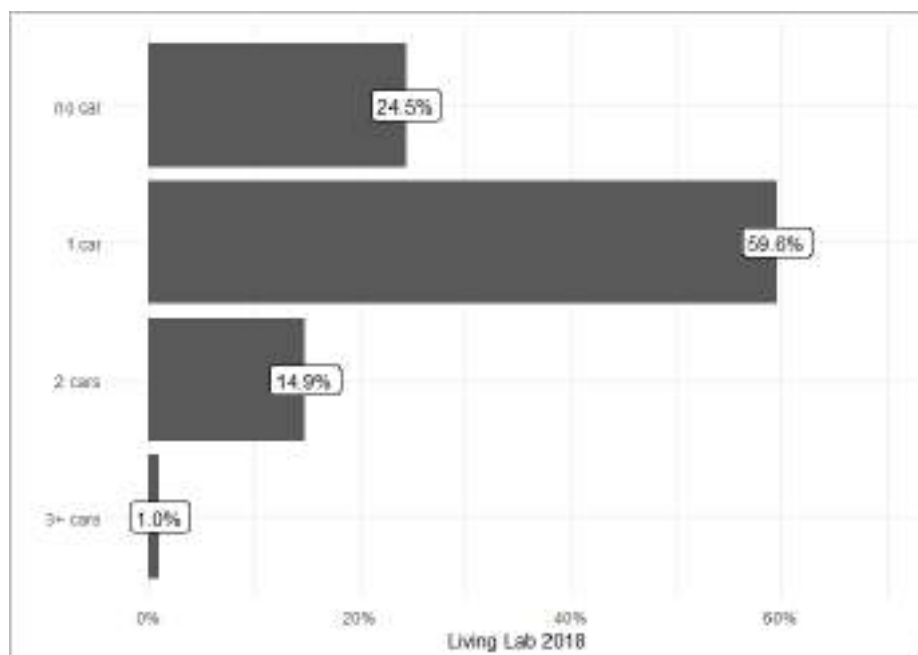


Figure 4: Number of cars per household, 2018

The **modal split** (trip-based) of this group is visualized in Figure 5, based on the answers of 572 households who reported about 2.419 trips in April/May 2017 as part of the ECCENTRIC household survey (05/2018). About one third of all Living Lab inhabitants is walking and 21,4% cycling. 19,4% are using their own car and slightly less, 17,8%, are using PT. Only two percent are using sharing options like bikesharing or carsharing.

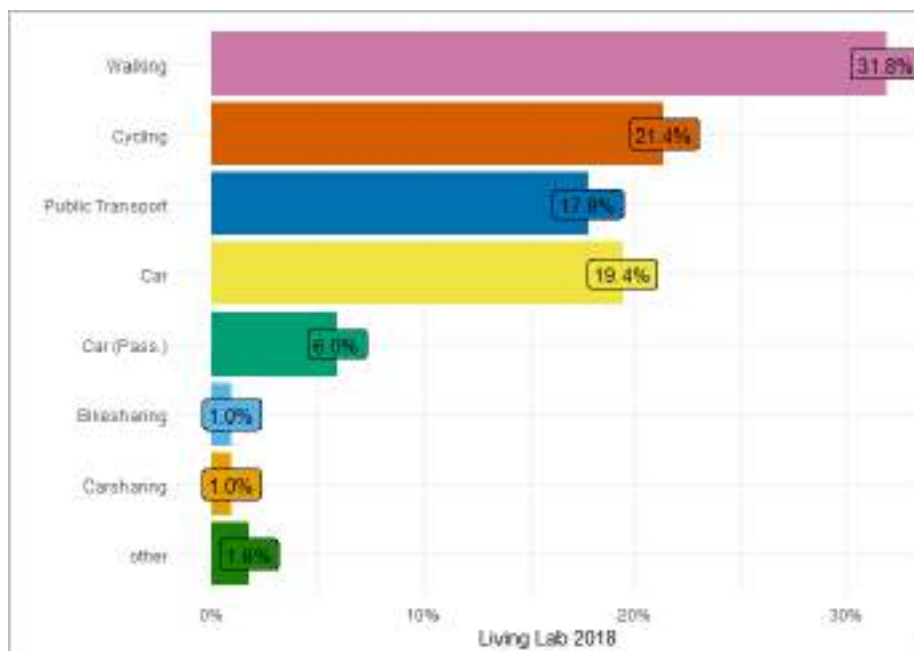


Figure 5: Modal Split of Living Lab residents, 2018

The average **VKT** per household (including also those without a car) is at 9.810 km per year (see Figure 9 for the distribution), summing up to a total VKT in Domagkpark and Parkstadt Schwabing of approx. 4,89 million VKT per year. The data was obtained with the household survey in May 2018.

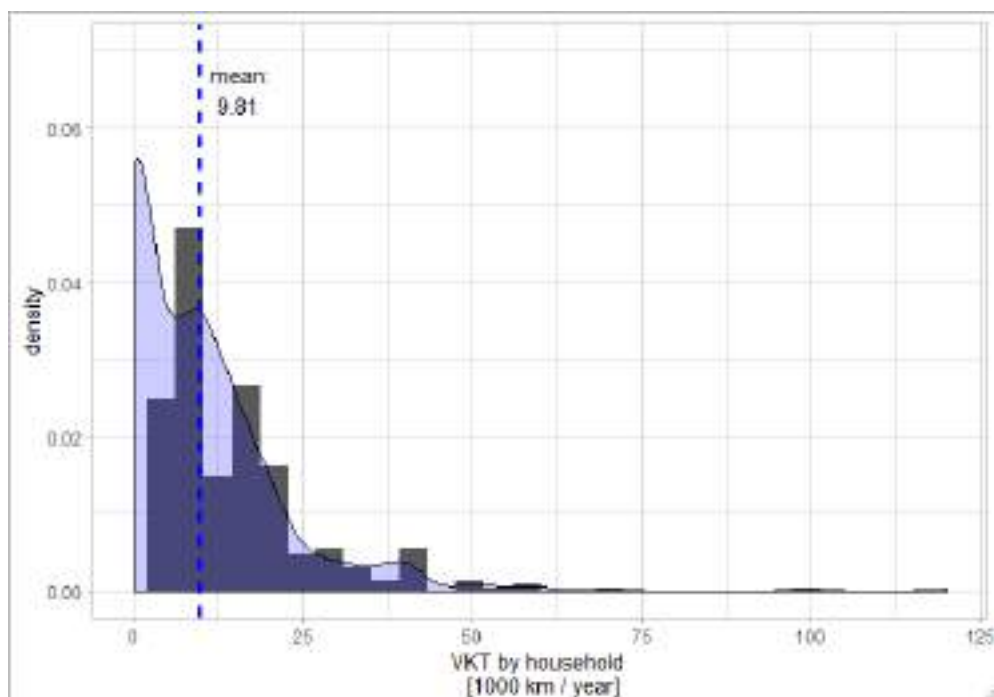


Figure 6: VKT by household (density plot), 2018

Transport-related emissions

Addressing indicators "7 - CO₂ Emissions", "8 - NO_x emissions", and "9 - PM emissions"

Emissions are calculated based on emission factors from the standard database "HBEFA" (*Handbook Emission Factors for Road Transport*) and information about both VKT and the vehicles in the Living Lab. See Table 5 for the used factors, based on the German fleet average.

The number of hybrid/ electric cars is too low to be considered as a separate category.

In 2017 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

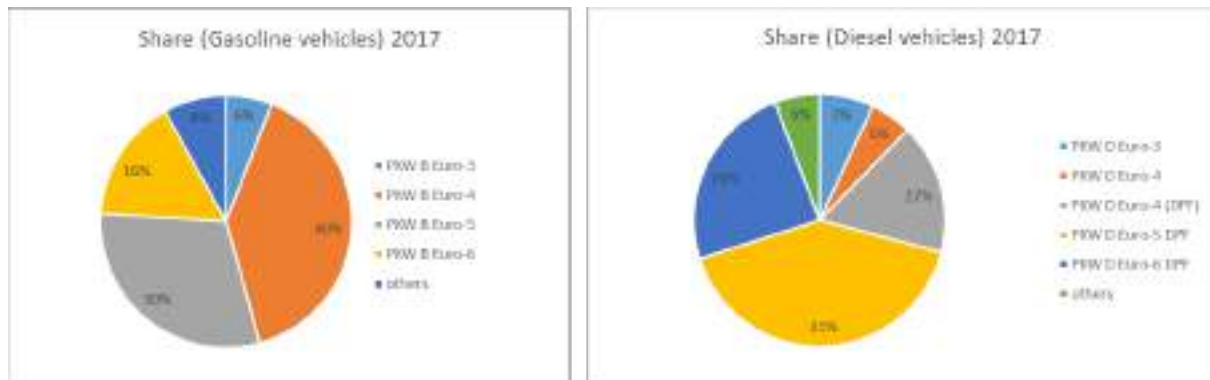


Figure 7: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)

The highest share among Gasoline vehicles consists of Euro 4 (40%) and Euro 5 (30%), followed by Euro 6 (16%). Regarding the Diesel vehicle share, there are 41% Euro 5 and 24% Euro 6. Euro 4 has a smaller share of 17%.

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	127,837 g/km
NO _x	Gasoline	0,060 g/km
PM	Gasoline	0,00102 g/km
CO ₂	Diesel	118,911 g/km
NO _x	Diesel	0,589 g/km
PM	Diesel	0,00675 g/km

Table 5: Emission Factors (HBEFA, 2017)

The following calculations are based on the HBEFA factors of 2017 and the annual VKT kilometres, differentiated by car type (first or second car) and fuel type (gasoline or diesel). The amount of kilometres is then multiplied with the HBEFA factors and number of cars mentioned in the household survey (conducted in 05/2018).

Thus, the total annual emissions (based on VKT) for all 3.100 households in Domagkpark and Parkstadt Schwabing sum up to the following totals:

Pollutant	Emissions Living Lab (2017)	Emissions Living Lab/ household (2017)
CO ₂	3.864 t	2.415 kg
NO _x	10,22 t	6,39 kg
PM	122,252 kg	76,41 g

Table 6: Living Lab Emissions 2017

The measure MUC 2.9 a **contributes to policies, plans, and programs** of the City of Munich. An initiative called “Inzell, Modellstadt 2030” (cf. Inzell Initiative) aims to find solutions for the first and last mile transport and a better accessibility within a flexible local transport system. Another goal is to strengthen the more divers mobility options. By offering and showing other mobility options, the dialogue marketing measure contributes to Munich’s climate protection strategy, which aims to have a (almost) climate neutral city by 2050 (cf. City of Munich, Klimaschutzstrategie). Regarding those important policies and programs within the city of Munich, the contribution of the measure can be given a score of 4/5.

Data on **investment and operational cost** was obtained for the ex-post evaluation when the implementation phase was completed.

C.1.3 The business-as-usual scenario

For **Awareness, Acceptance, and Satisfaction**, no significant changes were expected in the BaU-scenario. Without the mobility marketing actions there were also no bigger changes expected regarding the mobility behavior, because the residents of the Living Lab were not aware of the mobility offers in their surroundings.

Car Ownership does not show big changes on the nationwide level (2002-2008-2017), while the ratio cars per inhabitants in the relevant part of the city ("between middle ring road and city boundary") has been decreasing slightly over the last 10 years, from approx. 430 cars per 1000 inhabitants in 2005 to 412 in 2015 (-1%). However, for the reporting period until 2020 stable conditions were to be expected.

Mode Shift & VKT

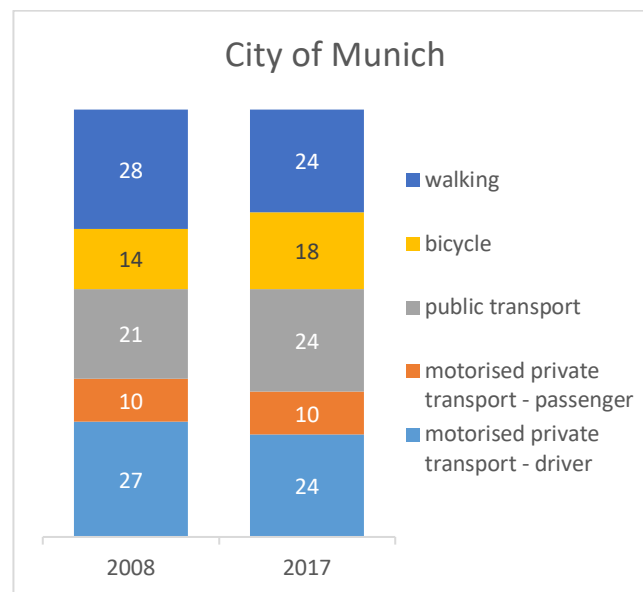


Image: City of Munich, Data: infas edited (2018)

Figure 8: Modal Split in Munich (2008+2017)

The nationwide mobility survey "Mobilität in Deutschland" acted as a reference to determine trends and future mobility behaviour in Munich.

In general, the Munich population drives less and walks less, while public transport (PT) and cycling increase over time (see Figure 11: change 2008-2017: car -3%, PT +3%, cycling +4%, walking -4%). Extrapolating this trend from 2008 to 2020, it can be assumed the following **mode shifts** in the BaU Scenario for 2020:

Car: -1%; PT: +1%; Bike: +1%; Walking: -1%

These changes were reflected in **VKT** as well, so that VKT is expected to decrease by 1% as well, being cautious because nationwide, the km per vehicle are slightly decreasing (2017: -0,7%, Kraftfahrtbundesamt (2018) and the emissions are as well decreasing regarding the data of HBEFA 2020 scenario.

Note: A recent study by the Center Automotive Research (CAR) of the University of Duisburg-Essen published in 12/2019 that the number of cars is constantly increasing within the last ten years with regard to Germany's larger cities. Comparing the number of cars from 2009 until 2019, there is an increase of 18,5% in car ownership measured in Munich (cf. CAR, 2019). This resembles a different trend than expected above in the BaU scenario assumptions of 2018.

Emissions

In order to estimate BaU-emissions, the HBEFA projected emission factors for 2020 are used as well as the by 1% increased VKT that is assumed in the section " Mode Shift & VKT".

Thus, the following factors are used:

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	117,785 g/km
NO _x	Gasoline	0,049 g/km
PM	Gasoline	0,00108 g/km
CO ₂	Diesel	110,410 g/km
NO _x	Diesel	0,484 g/km
PM	Diesel	0,0045 g/km

Table 7: Emission Factors (HBEFA, 2020)

In 2020 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

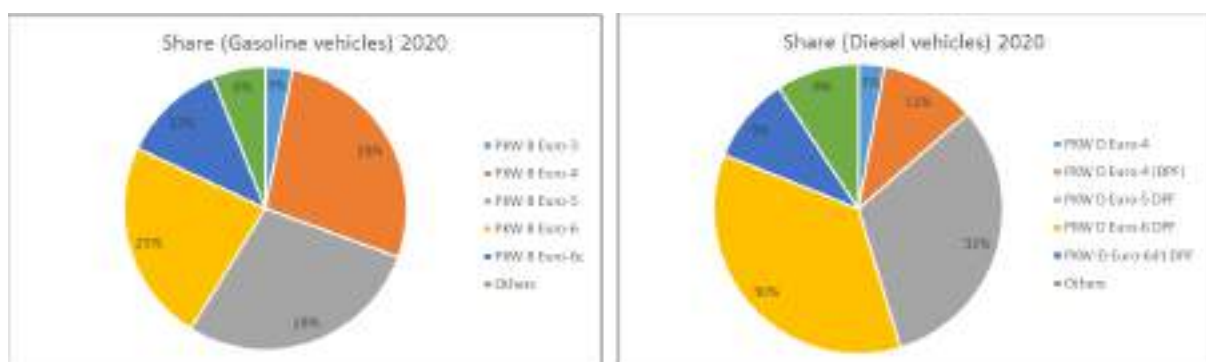


Figure 9: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)

Regarding the Gasoline Euro classes in 2020, there are about two-thirds of all Gasoline vehicles to be found with Euro 4 (28%), Euro 5 (28%) or Euro 6 (23%). The share of Diesel vehicles is similar but compared to HBEFA 2017 assumptions, Euro 6 has the biggest share in 2020 (36%, 24% in 2017).

Note: These emission factors assume technological progress and a renewal of the average fleet in Germany until 2020. In the light of "*Dieselpgate*" and great uncertainties in the accuracy of emission information by the car manufacturers, the HBEFA assumptions have to be verified. New HBEFA assumptions are to be published in the end of 2019 (after MER-2).

This results in the following emissions for 2020 (the calculation is analogue to the one in C.1.2):

Pollutant	Emissions Living Lab (2020)	Emissions Living Lab/ household (2020)	% change to 2017
CO ₂	3.610 t	2.256 kg	-7%
NO _x	8,49 t	5,31 kg	-17%
PM	88,76 kg	55,47 g	-27%

Table 8: Living Lab Emissions 2020

The KPI **Contribution to policies, plans, and programs** could best be evaluated at the end of the CIVITAS operation period. There is no baseline information available about this KPI.

Data on **investment and operational cost** was obtained at a later date for the after evaluation when the implementation phase was completed.

C.2 Measure results

The following table shows the measure results of MUC 2.9a, direct and dialogue marketing. In some cases, the Business as Usual scenario is valued as not assessed (NA) because there would not be any other developments without the implementation of this measure

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	13,4	05/2018	NA	-	15,4	10/2019	+2	NA
Acceptance	%	Ordered trial offers: IsarCard: 54,8 E-Scooter-sharing: 52,2 MVG bike: 42,7 Carsharing: 37,1 Received trial offers: MVG bike: 37,1 Emmy: 36,6 IsarCard: 32,8 car2go: 21,0 Oply: 15,9 DriveNow: 11,6 StattAuto: 11,6	05/2018	NA	-	Ordered trial offers: IsarCard: 54,9 E-Scooter-sharing: 51,9 MVG bike: 43,9 Carsharing: 39,9 Received trial offers: MVG bike: 51,3 Emmy: 43,9 IsarCard: 43,6 car2go: 10,6 Oply: 17,1 DriveNow: 15,9 StattAuto: 25,9	10/2019	Ordered trial offers: IsarCard: +0,1 E-Scooter-sharing: -0,3 MVG bike: +1,2 Carsharing: +2,8 Received trial offers: MVG bike: +14,2 Emmy: +7,3 IsarCard: +10,8 car2go: -9,4 Oply: +1,2 DriveNow: +3,9 StattAuto: +14,36	NA
Satisfaction	Score 0-5	Qualitative feedback: Satisfaction level: 4 “Very satisfied” and “satisfied”: Bikesharing: 4 = 70,2% Carsharing: 4 = 72,8%	05/2018	NA	-	Qualitative feedback: Satisfaction level: 4 “Very satisfied” and “satisfied”: Bikesharing: 4 = 62,8% Carsharing: 4 = 74,5%	10/2019	Qualitative feedback: Satisfaction level: +-0 “Very satisfied” and “satisfied”: Bikesharing: 4 = -7,4 Carsharing: 4 = +2,3	NA

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Modal split/ Mode Shift	%	Modal split Living Lab: Walking: 31,8 Cycling: 21,4 PT: 17,8 Car: 19,4 Bikesharing: 1,0 Carsharing: 1,0	05/2018	Modal split Munich: Walking 23 Cycling 19 PT 25 Car: 33	2020	Modal split MUC 2.9a users: Walking: 36,3 Cycling: 23,8 PT: 16,0 Car: 15,2 Bikesharing: 0,0 Carsharing: 0,2	10/2019	Mode shift: Walking: +4,5 Cycling: +2,4 PT: -1,8 Car: -4,2 Bikesharing: -1,0 Carsharing: -0,8	Mode shift: Walking: +13,3 Cycling: +4,8 PT: -9 Car: -17,8
Car ownership	%	Living Lab: No car: 24,5 1 car: 59,6 2 cars: 14,9 3+ cars: 1,0 → 1,03 cars/household	05/2018	No car: 23,5 1 car: 58,6 2 cars: 13,9 3+ cars: <1,0 Overall: -1%:	2020	MUC 2.9a users: No car: 29,3 1 car: 58,7 2 cars: 10,9 3+ cars: 1,1 →0,84 cars/household	10/2019	No car: +4,8 1 car: -0,9 2 cars: -4,0 3+ cars: +0,1 → -0,19 cars/ household	No car: +5,8 1 car: +0,1 2 cars: -3,0 3+ cars: +0,1
VKT	km/ year	9.810 km/year/ HH	05/18	-1%	2020	MUC 2.9a users: 8.550 km/year/ HH	10/2019	-1.260 km/year/ HH	NA
CO2 Emissions	kg/ household	2.415	2017	2.256	2020	1.357	10/2019	-44%	-40%
NOx Emissions	kg/ household	6,39	2017	5,31	2020	2,31	10/2019	-64%	-56%
PM Emissions	g/ household	76,41	2017	55,47	2020	26,36	10/2019	-65%	-52%
Contribution to policies, plans, and programs	Score 0-5	4	2017	NA	-	4	11/2019	+0	NA

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After–BaU
Investment costs (net)	Euro	costs related to people and their time period:				costs of equipment:			
		trainers		630,00 €		material (production)		10.823,00 €	
		program and web developers		5.980,00 €					
		project managers		16.522,50 €					
		graphic designers		12.816,00 €					
Operational costs (net)	Euro	Personnel cost				Equipment cost			
		Controlling	36,00 € / month	540,00 € total		test tickets for public transport	35,70 € / ticket		9.282,00 € total
		dialogue marketing for material orders	8,64 € / order	5.702,40 € total		mail redirection	320,00 € / month		4.800,00 € total
		dialogue marketing for mobility advice	15,08 € / order	3.468,40 € total		storage	33,33 € / month		500,00 € total
						equipment costs: shipment	1,07 € / household		3.540,00 € total

The following ex-post data was obtained from three different data sources:

- The second household survey which took place in the Living Lab in September and October 2019. 2.095 households were contacted, and 328 households participated, this resembles a total number of 563 persons and a participation rate of 16% (in comparison: 27% in the first household survey, 05/2018).
- Statistical data delivered by the measure's subcontractor, working in the field of marketing and sales and organizing the dialogue marketing campaign for the Living Lab. Ex-post data is from October 2019.
- Online survey about general satisfaction and awareness of the mobility marketing campaign. The link to the online survey was sent via post to the residents which ordered material. The survey took place over three weeks in 12/2019 and was carried out after the second wave of sending material to the households. 426 residents¹³ were contacted and 36 of them took part in the survey. This resembles a participation rate of 8,5%.
- Statistical data about redeemed mobility vouchers delivered by the mobility service providers in 12/2019

Addressing Indicators "1 – Awareness", "2 – Acceptance" and "3 – Satisfaction".

Analogue to the Baseline data, the indicator **awareness** resembles the number of residents, which actually know about the marketing campaign. As of 10/2019 15,4% of all households replied to the Mobility-mail. Means that within two months, 54 more households replied (before: 372, after: 426).

Figure 10 resembles another awareness indicator which was obtained with the online survey in 12/2019: Did the residents who received the mobility mail take a closer look into the material? Half of the recipients (50%) read through the entire marketing material and another 47% at least read through parts. Only 3% did not take a closer look at the mobility post. This shows a quite high awareness among the residents of the Living Lab.

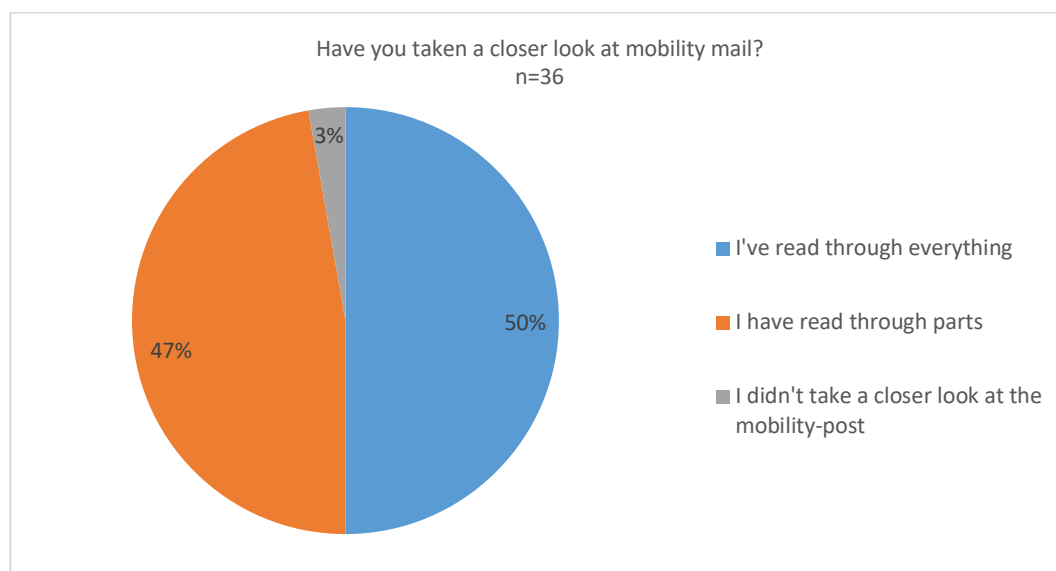


Figure 10: Awareness of the mobility-post, 2019

¹³ Those 426 residents actually have made use of the mobility post. In total 2095 households were contacted by the marketing campaign.

The household survey of 10/2019 asked if the households received the Mobility-mail. 82% (205 households) stated that they received the marketing material. But still 44 households said that they did not get any email. 36% of the 205 households which received the post ordered test trials, 63% did not due to several reasons:

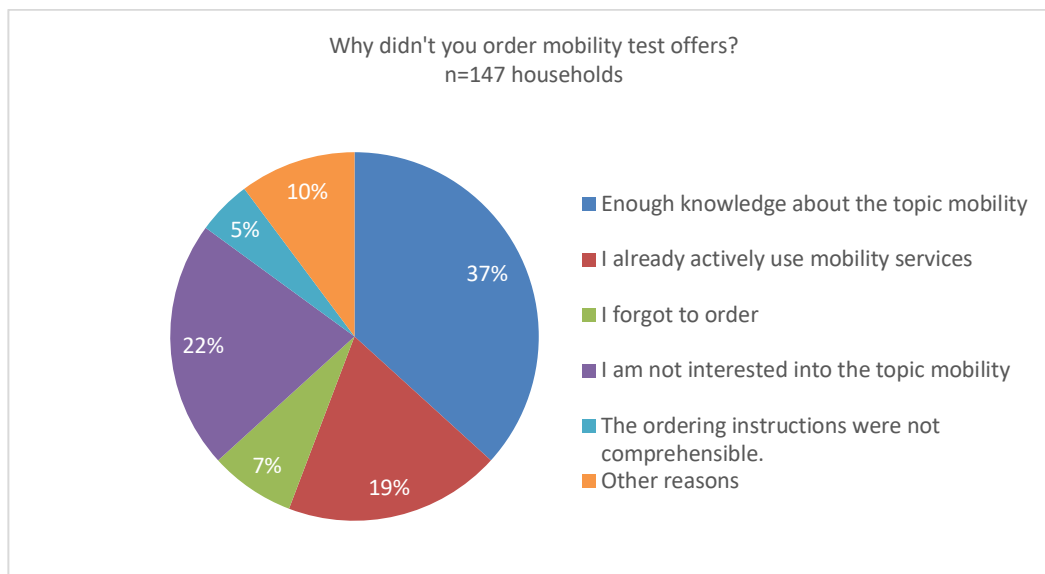


Figure 11: Reasons for not ordering trial offers, 10/2019

Most of the questioned households answered to have already enough knowledge about mobility (37%) or they are not interested in this topic (22%). Another share stated that they already actively use mobility services. Only 7% simply forgot to order a test trial within the given timeframe and only 5% found the ordering instructions too complicated. That speaks for a good organized marketing campaign.

A closer look into the percentage of residents who ordered trial offers and actually received them regarding the second wave of the marketing campaign, is to be displayed in Figure 11 and Figure 12.



Figure 12: Wish to order trial offers, 10/2019

Figure 12 shows the share of residents being interested in IsarCard, emmy, MVG bike or Carsharing did not significantly change during two months of campaigning. Only the number of people being interested in carsharing increased about almost three percent. In total 812 orders were done in October 2019, that's 117 more than in August 2019.

Regarding the number of inhabitants who actually received a trial offer (see [Figure](#)), there are some bigger changes to be noticed. From 280 received offers in 08/2019, there are 413 offers in total being requested. Where in August 2019, 37,1% received their MVG bike voucher, in October 2019 more than 50% got one. Regarding the other subscription or voucher options, the number is increasing except for car2go (-9,2%). There are more people requesting vouchers for emmy (+7,3%), IsarCard (+10,8%) and carsharing companies like Oply, DriveNow and STATTAUTO.

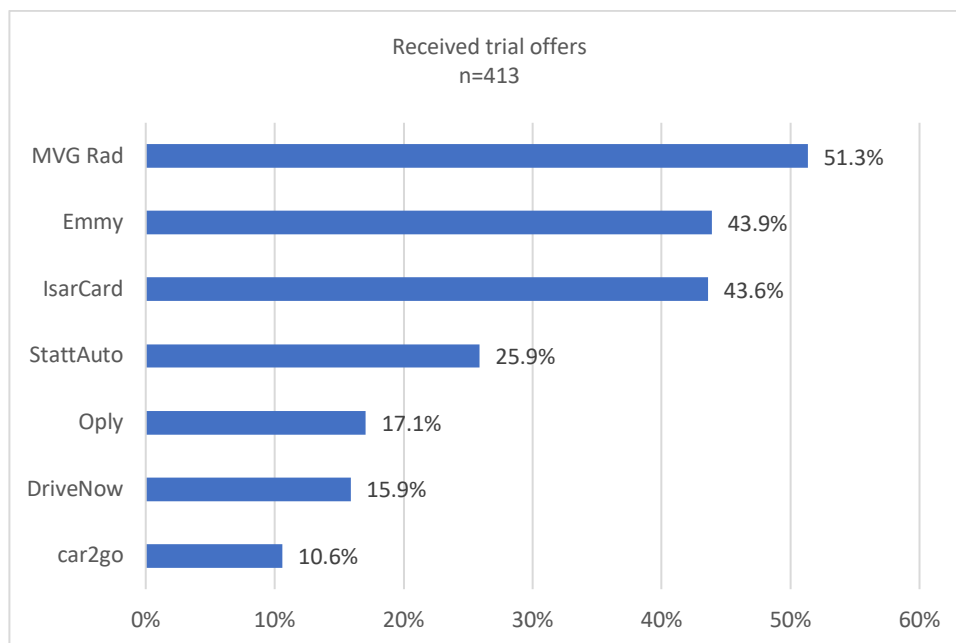


Figure 13: Received trial offers, 10/2019

Other information material which has been ordered but did not end up in a test trial or subscription can be summed up to 2.687 orders by October 2019. The percentage within two months campaigning only varies between one and two percent (see. Figure 3, p.325). There are 261 additional orders to be recorded since August.

The KPI **acceptance** can be measured by the percentage of residents who favorably approve the mobility post. Important for the acceptance is the evaluation of the design and comprehensibility with the material. This is shown in Figure 14.

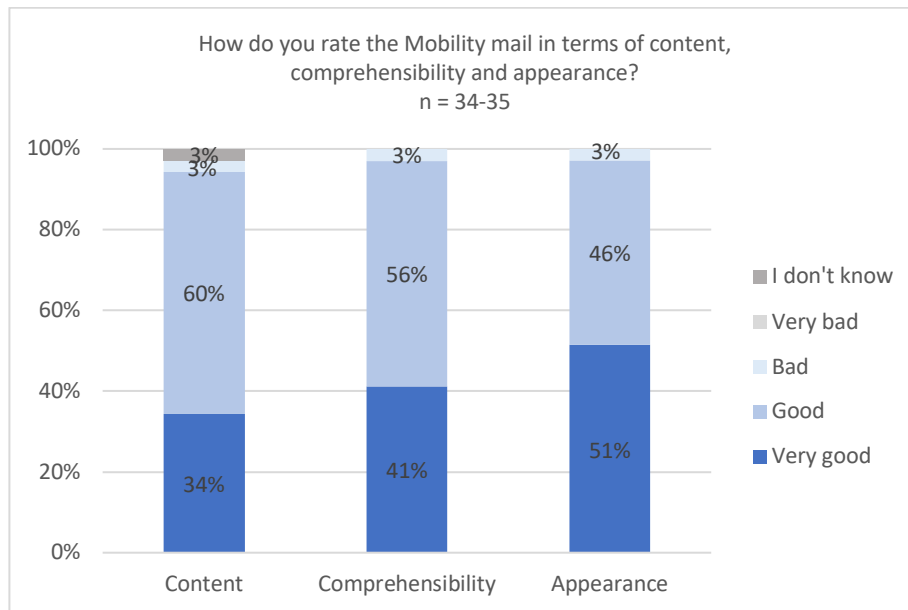


Figure 14: Acceptance of the Mobility mail

The majority of participants rated the Mobility mail as good and very good according to its content (94%), comprehensibility (97%) and appearance (97%). Only a small percentage (3%) rated the Mobility mail as bad in the mentioned categories.

The score for the KPI **satisfaction** is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI. A percentage value of zero means as well that there are no other developments without the implementation of the measure. Regarding the qualitative survey of the level of satisfaction there has been no change in information. The residents using the dialogue marketing and its offers are still very content about the actions. The score for satisfaction therefore remains at 4/5.

To enrich the KPIs mentioned above, there is some data to be evaluated from the online survey which was conducted with a link which was sent via post to the households which ordered information material. The survey took place three weeks in 12/2019.

Figure 15 shows the general satisfaction with the ordering procedure. 87% of all recipients stated to be “satisfied” and “very satisfied” with the order process which they have done online (online order platform reachable via QR-code), via post (with enclosed back envelope) or via telephone. Three online survey participants were “not satisfied” or “not satisfied at all” with the procedure of ordering information or test material.

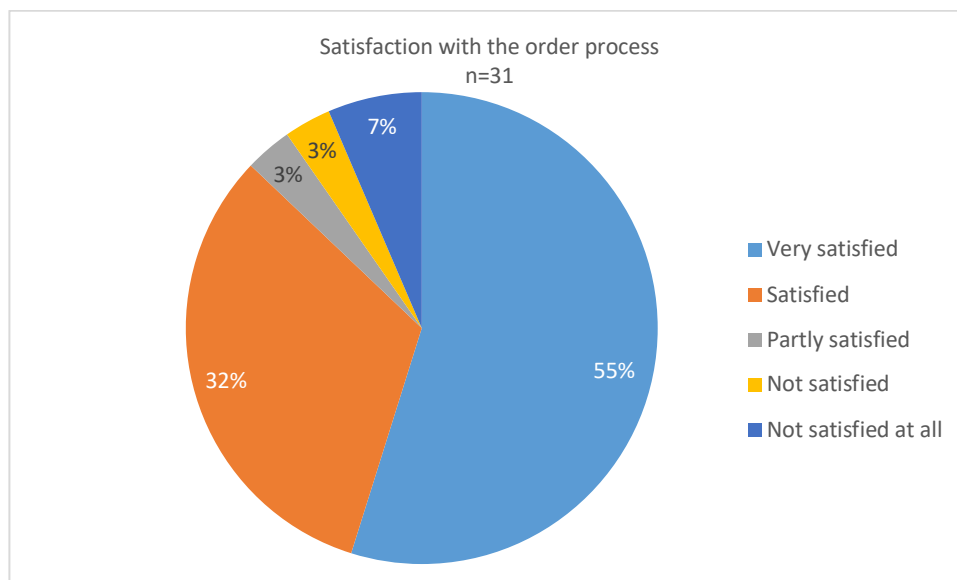


Figure 15: Satisfaction with the order process, 2019

Figure 16 shows how satisfied the customers were with the information material they ordered.

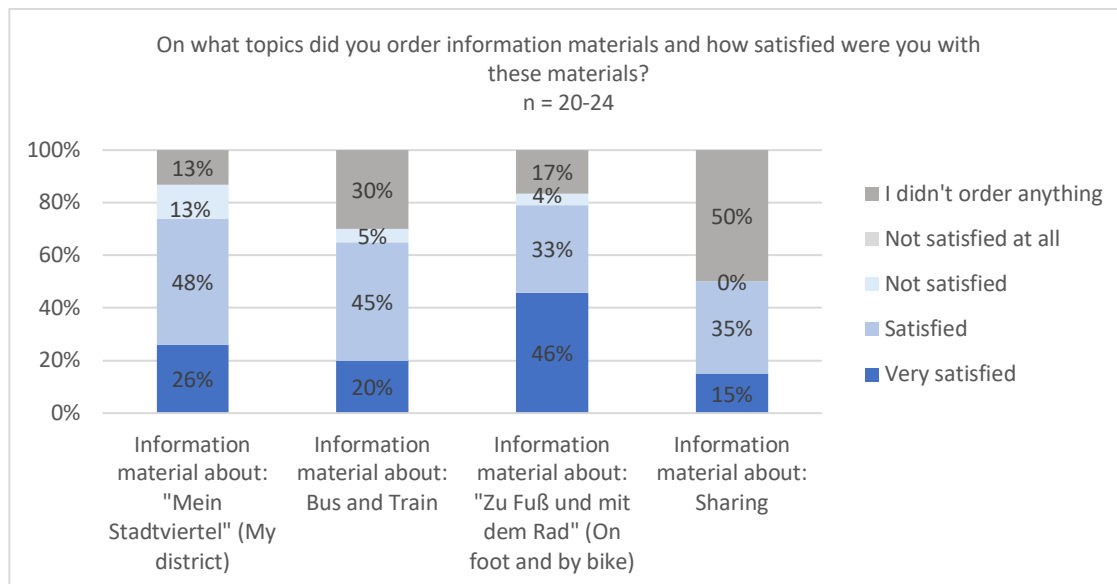


Figure 16: Satisfaction with the ordered material

Most of the participants who ordered information material were satisfied or very satisfied with it. Only a small percentage was not satisfied with some of the provided material: 4% of the participants were not satisfied with the material "Zu Fuß und mit dem Rad" about neighborhood mobility, 5% were not satisfied with the material about bus and train and 13% were not satisfied about the material "Mein Stadtviertel" with information about the city district.

Figure 17 shows the satisfaction of the customers with the trial offers. In this case only participants who actually ordered one of the test offers were asked about their satisfaction with the corresponding one. There were no participants who tested the carsharing test offers of car2go, DriveNow or STATTAUTO, accordingly the percentage of satisfaction is zero. Please note that the number of survey participants of this question is very low.

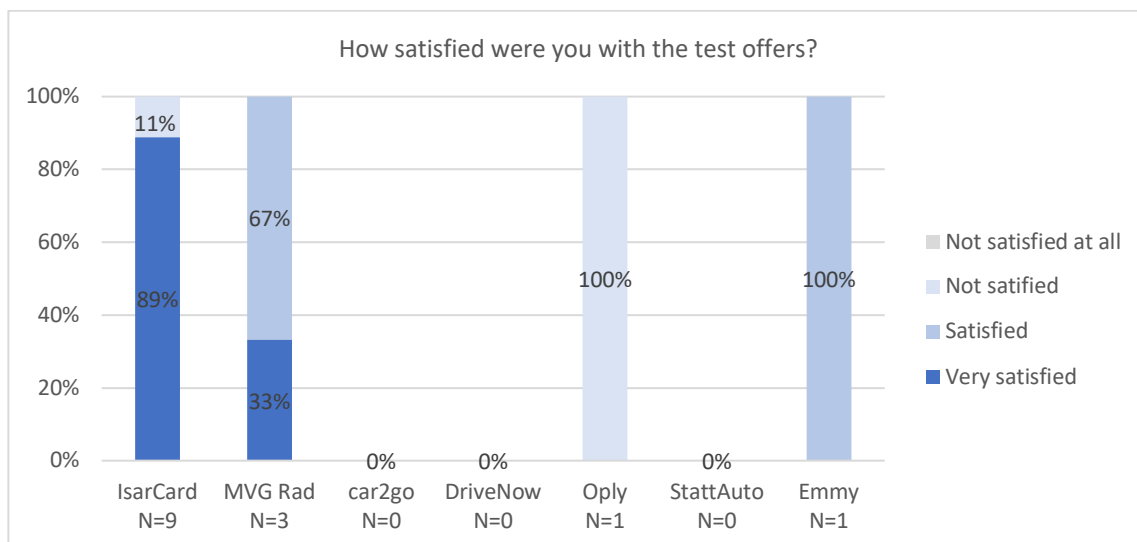


Figure 17: Satisfaction with test offers

All participants who tested the offers of emmy (n=1) and MVG Rad (n=3) were “satisfied” or “very satisfied” with it. With the test offer of IsarCard 89% were very satisfied and 11% (corresponds to one participant) were “not satisfied”. The only participant who tested carsharing by Oply was not satisfied with it.

One question in the online survey of 12/2019 asked if the personal and individual consulting by the marketing company was helpful. Only four persons answered to this question, saying that they were very satisfied or satisfied with the additional service. 30 survey participants did not reply any answer which means that they perhaps do not attach much importance to that individual advice.

Addressing indicators "4 - Mode Shift", "5 - Car Ownership", and "6 - VKT"

Regarding the following indicators, the group of households/ residents which stated to make use of the measure MUC 2.9a are extracted and compared to the Baseline scenario. There are in total 92 households and respectively 125 residents which the dialogue marketing material.

The **car ownership** in the Living Lab did not develop too much from the first (05/2018) until the second household survey (10/2019). Within the Living Lab the household/car decreased from 1,03 to 0,84. Note, that the numbers extracted from the second household survey refer to the group of 92 households, which are using the marketing material of MUC 2.9a.

Looking at the number of cars, there are 4,8% less of all 92 questioned households which making use of MUC 2.9a, who do not own at least one car (see Figure 18). The number of households owning at least one car decreased from 59,4% to 58,7% and households owning 2 cars decreases as well by 4,0%. The percentage of households owning three or more cars slightly increased about 0,1%.

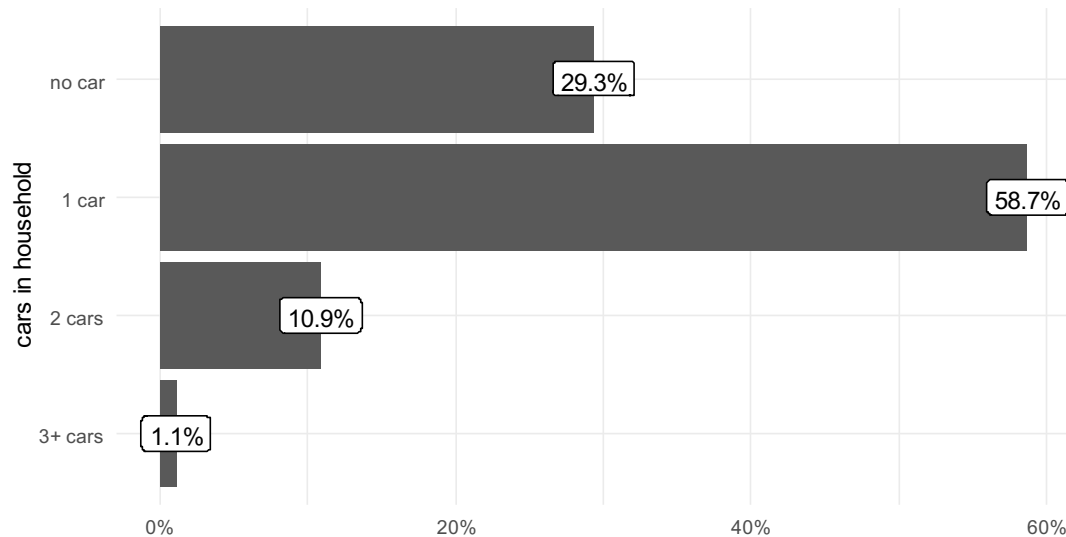


Figure 18: Number of cars per household of MUC 2.9a users, 2019

Comparing the modal split of 05/2018 of the entire Living Lab (n=935 residents) with the 92 households which used the marketing material of MUC 2.9a of 10/2019, it can be seen that there is a slight **mode shift** towards more walking (+4,8%) and cycling (+2,4%) (see Figure 19). A decrease can be found in the share of households using their own car (-4,2%) and using PT (-1,8%).

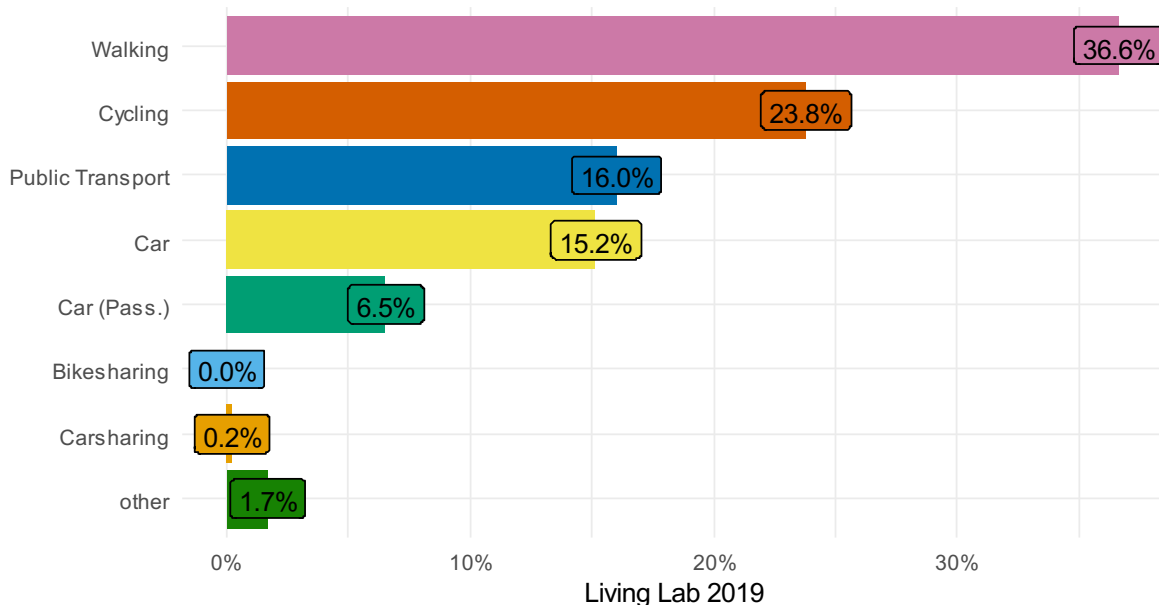


Figure 19: Modal split of households using the marketing material, 2019

To support the mode shift stated in the second household survey, the mobility behaviour was also answered within the online survey (12/2019). Figure 20 shows which modes were used more frequently, constantly or less frequently. The following numbers are retrieved from the online user survey which was conducted in 12/2019.

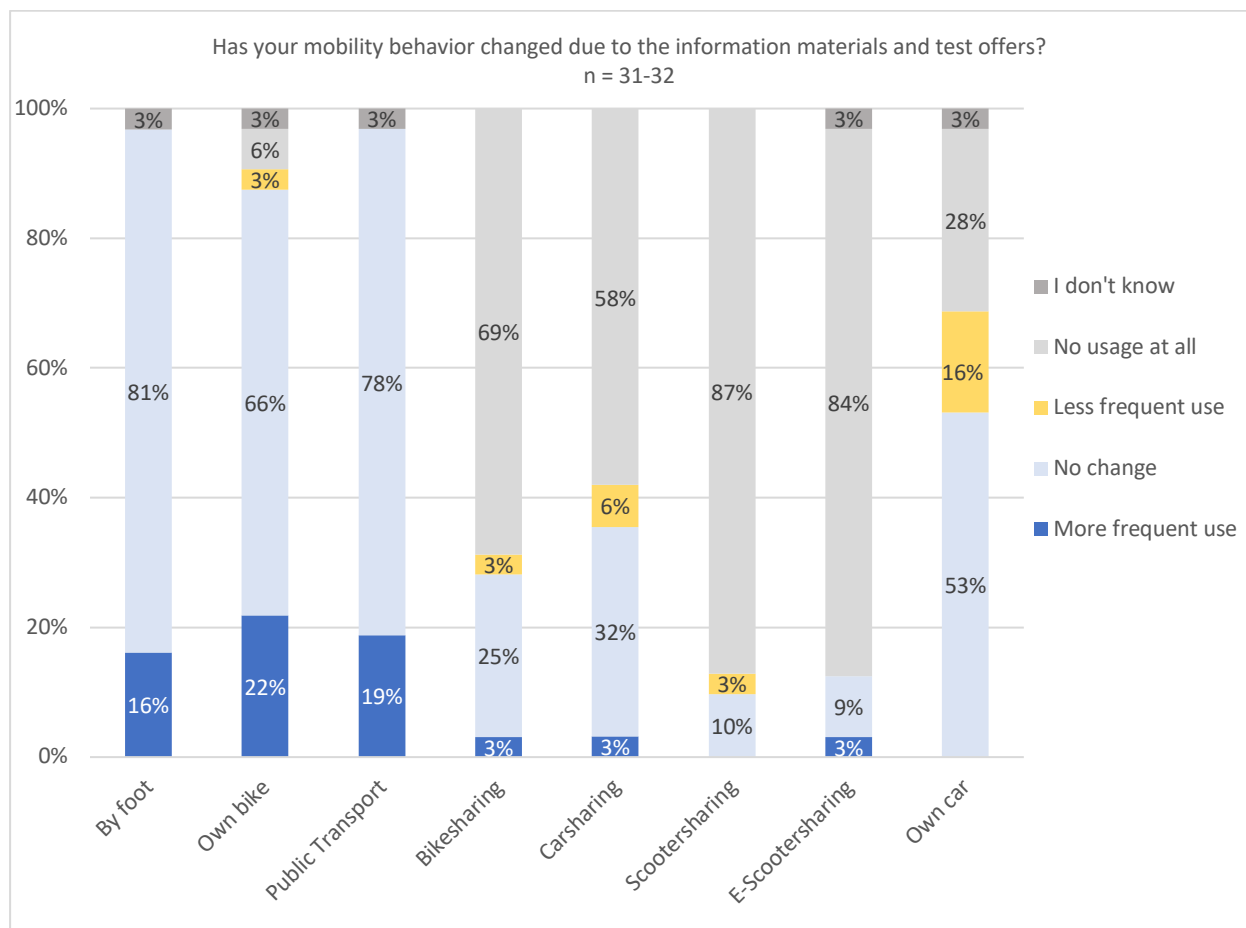


Figure 20: Mode shift according to information material and test offers, 12/2019

Overall it seems like the measure influenced the participants to shift to more sustainable mobility options. Walking (+16%), biking (with own bike overall +19%) and public transport usage (+19%) increased, while car usage (carsharing overall -3%), especially of their own cars (-16%) decreased. Same applies for the scooter sharing: while the sharing with conventional scooters, which are rich in local emissions, decreased (-3%), the usage of low emission e-scooters increased (+3%).

The average **VKT** by the 92 households (including also those without a car) which are making use of MUC 2.9a is at 8.550 km per year. Figure 21 shows a density plot of the indicator vehicles kilometers traveled by the 92 households. The data was obtained during the household survey in 10/2019.

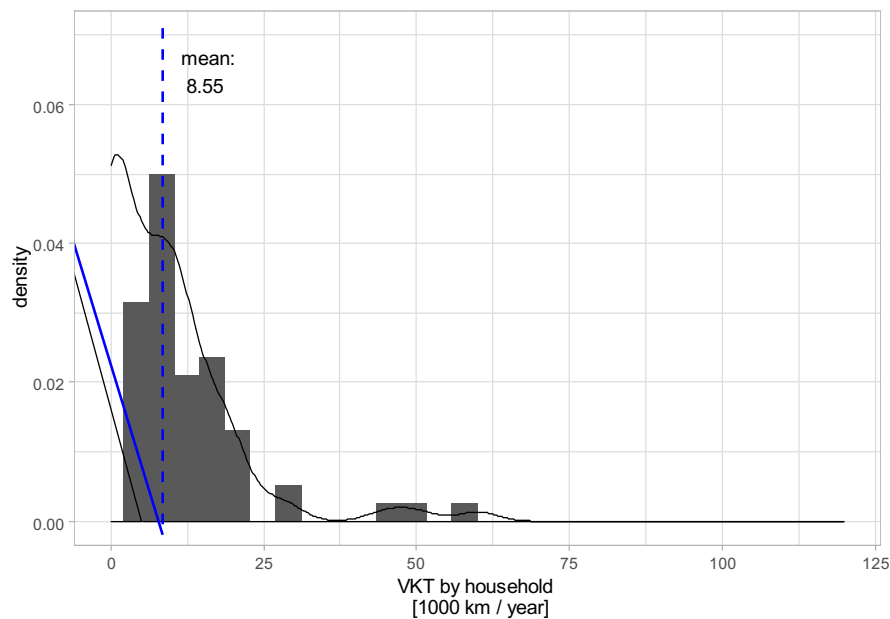


Figure 21: VKT by household (density plot) of MUC 2.9a users, 2019

Addressing indicators "7 - CO₂ Emissions", "8 - NO_x emissions", and "9 - PM emissions"

Similar to the indicators above, the emissions are calculated by looking at the group of households using the measure's output, the dialogue marketing material. At this point it must be said that there are households which have interactions with other measures as well. But the number of households, which are making active use of all measure is assumed to be not representative enough. Therefore, the emissions are specifically calculated for the marketing material users. This is contrasted with the emissions of the non-users to see the difference between these two groups.

The emissions are obtained similar to the procedure described in section C.1.2 Baseline (p.323). Based on the emission factors already used for the BAU scenario for 2020, emissions could be calculated analogue for the ex-post scenario, based on the VKT and car ownership numbers for Domagkpark residents. For emission factors see [Table](#) (p.251).

The following Table 9 shows the emissions per household for three different groups: MUC 2.9a-users, households not using the marketing material and the entire Living Lab. This allows a comparison of the emission values of the Baseline scenario and the After scenario. This projection is calculated for the total of 3.100 households of the Living Lab because the marketing campaign is addressing all residents.

Pollutant	Emissions/ household MUC 2.9a users (2018)	Emissions/ household MUC 2.9a non-users (2018)	Emissions/household Living Lab (2018)
CO ₂	1.357 kg	2.679 kg	2.308 kg
NO _x	2,31 kg	6,29 kg	5,17 kg
PM	26,36 g	65,80 g	54,74 g

Table 9: Emission comparison MUC 2.9a, 2018

It can be seen that the emissions regarding all three factors of the group which is using the marketing material, are lower than the households which are not using the community portal. The biggest difference is among the NO_x and PM, there the marketing material users only owe a share about one third in contrast to the residents which did not make use of the marketing material.

Regarding the actual change of the emissions from Baseline/ BAU to the After scenario, all three emission factors are decreasing. See Table 10 for details:

Pollutant	Emissions/ household MUC 2.9a users ex-post	% change to Baseline (2017)	% change to BAU (2020)
CO ₂	1.357 kg	-44%	-40%
NO _x	2,31 kg	-64%	-56%
PM	26,36 g	-65%	-52%

Table 10: Living Lab emission comparison

The **contribution to policies plans and programs** can generally be scored with a 4 out of 5 during the baseline because advertising innovative and sustainable mobility within the Living Lab are important goals for the City of Munich. The implementation of the dialogue and direct marketing actions is one big step towards a possible city-wide marketing campaign which could shift more people from their own car towards sharing options or PT, etc.

The City of Munich pursues these goals with various municipal guidelines. These include also new guidelines like the city-wide Sharing and Cycling Directive. In general, the City of Munich committed itself in 2019 to an even more sustainable transport planning. This idea of sustainability will also be increasingly incorporated into the Department of Mobility, which will be founded in 2021 in Munich and will focus, among other things, on mobility management. The contents of these guidelines are reflected in the mobility campaign and thus brought closer to the citizen.

Regarding the KPI **costs**, there are higher costs during the implementation phase than later during the operational phase. The biggest share being part of the **investment** are costs related to people and their time, means trainers (630,00 €), program and web developers (5.980,00 €), project managers (16.522,50 €) and graphic designers (12.816,00 €). The equipment costs

during the implementation mainly consist of material production (10.823,00 €). During the **operation** there was especially a high amount of money spent on equipment cost. About half of the ca. 18.000 Euro are spend on test tickets for public transport. This is the main focus of the project to incite the Living Lab residents to use PT. Another amount for using different sharing options on a test basis, was sponsored by the different mobility service providers.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Reducing energy use & CO2 emissions, air pollution and reducing road congestion	**	Emission factors decreased during the project but due to the late implementations of MUC 2.9a, this success can probably not be only attributed to this measure.
2	Improving accessibility for all, better social inclusion and equal opportunity	**	The dialogue marketing material was sent to all households of the Living Lab, means that every residents got information about different mobility options, this improves the accessibility for all and includes all residents.
3	Improved liveability	**	The measure MUC 2.9a) improves the livability of all Living Lab residents by providing various information about mobility options in their surroundings and beyond that. Information and customized advice by the subcontracting firm show how easy and accessible modern mobility options are.
4	To test the new approach of providing mobility management to an entire housing/business area	**	The approach of providing mobility information for the entire Living Lab is to be reviewed very positive by the residents which make use of the test trials which are being offered with the marketing campaign. Telephone interviews which are conducted by the subcontracting marketing and sales firm show a positive feedback.
5	To analyse how mobility behaviour of citizens already resident in the city can be changed towards more sustainable modes	*	Regarding the modes there is a shift towards more sustainable options, like walking and cycling among the residents which made use of MUC 2.9a. PT and car are less used among this group. Probably this change cannot be solely attributed to the implementation of the dialogue marketing measure due to its late implementation but also to other measures within the Living Lab.
6	To make residents aware of the great variety of transport offers available to them and provide them with customized advice how to organize their individual mobility more sustainably and efficiently	***	A raise of awareness of different sustainable mobility options is definitely given by the implementation of the Mobility-mail which was sent to all households within the Living Lab.
7	To encourage residents to test mobility offers and services that are new to them and to reduce barriers that inhibit making use of the offers	**	By providing various information material and offering individual consulting and support for the usage of the test trials, residents are highly encouraged to make use of the offers.
8	At least 30% of the contacted households will make use of the offer and order further material or incentives to test mobility services	*	Within the rolling out of the marketing campaign in two months, about 15,4% responded to the test trials and ordered information material to test mobility services. The percentage of actually redeemed trial offers is a bit lower than

			the number of total orders but still increasing over time.
9	All three mobility management components (sub-measures a), b), c)) will achieve a reduction of 5% in car use, a reduction of CO2 emissions of 180 tons per year and a reduction of car kilometers of at least 870.000 km per year in the laboratory area	NA	Regarding sub-measure MUC 2.9a) there is a notable reduction of emissions among the residents, which ordered further marketing material. The VKT decreased as well. Both developments cannot solely be attributed to the implementation of the dialogue marketing actions, though. However, an evaluation of the target for the measure can hardly or not at all be given, since the campaign started shortly after the start of the household survey. Due to the short duration of the campaign, it is not possible to give a scientifically representative statement on the objectives.
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded			

D. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

- Information about sustainable and efficient mobility options was sent to all 2.950 households in the Living Lab. This provided information leads to a high number of test trials orders which are carried out online or via telephone.
- The response rate of residents ordering mobility information material or vouchers is at 15,4% (10/2019).
- The trial offers which have been ordered the most are IsarCard for using PT, E-scooter-sharing and the MVG bikesharing. Carsharing test trials are the least ordered.
- Actually received (and not just ordered) vouchers for different sharing options or IsarCard are especially the MVG bikesharing offer, E-Scooter-sharing (emmy) and the IsarCard for Munich's PT. Carsharing test trials are redeemed less due to a more complicated registration procedure (cf. interviews with local residents).
- Actually used (and not just received) vouchers for different sharing options or IsarCard are comparably low to the amount of trial offers which have been ordered and actually received.

D.2 Relevance of supporting activities

- There were no supporting activities but the positive political landscape in the City of Munich to implement such measure to increase the awareness of people towards more sustainable mobility options as well as the willingness of mobility service providers to support the campaign directly.

D.3 Interaction with other measures

- There was no direct interaction with other measures but the marketing campaign also provided information about the measure MUC 5.9 Intermodal (E-) Mobility stations. The mobility stations are a core part of the dialogue marketing because they provide several mobility modes at different places within the Living Lab.

D.4 Main lessons learned

- Data acquisition and protection of sensitive data as well as the completely new development of information material has been time-consuming.
- The perfect timing of the marketing campaign for new residents is very important. It should not start during summer holiday season or parallel to other festivities like Munich's Oktoberfest or other surveys being conducted for other ECCENTRIC measures in the Living Lab.
- Public dissemination and advertisement of the dialogue marketing actions on social media platforms like Facebook and YouTube is important to have a greater outreach than just sending the Mobility-mail via post.
- Personal mobility consultation and individual advice given by the subcontractor is to be mentioned as a very good way to organize such campaign. Residents feel well treated and individually consulted.

- However, since the vouchers for the test tickets were sent out only after a personal mobility consultation, the redemption rate was sometimes very low, as not all residents gave their telephone numbers. In the next round, the vouchers will therefore be sent to all interested residents, even if they do not want a personal mobility consultation via phone. Thus the redemption rate will increase significantly.
- It is very important to involve all key stakeholders right from the beginning, as there are ML, subcontractor marketing and sales, various MSP (mobility service providers), mobility managers of Munich, local neighbourhood organisations and politicians.
- Feedback of residents using the trial offers stated that the balance between the amount information material and individual communication was well organized.

D.5 Long term impact

- Residents of the Living Lab have plenty of material to inform themselves about different sustainable mobility options in their surrounding and can change their mobility behaviour at any time.
- The incentive system is intended to lower the hurdle to take up new mobility services. After a one-time trial period, it is expected that the long-term use of these mobility services would continue.

D.6 Potentials for up-scaling in the city

- The holistic and attractive concept developed by the ML and the subcontractor doing marketing and sales can easily be up scaled in the city of Munich
- Regarding the costs, it should be mentioned that the campaign is relatively cost-intensive due to the complexity of the offers and newly developed products. However, the continuation is largely simple and cheap. A campaign in reduced form would be possible.
- In the case of an up-scaling in Munich, the potential is to be evaluated as very large, since the products and processes are easily transferable.
- In this respect, a transfer of the measure is already planned in another new development area in Munich, called “München Freiamt”.
- A further replication is planned for the city-wide New Citizen project in Munich, with regard to the entirety of the multimodal sharing providers.

E. Additional information

E.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

The evaluation approach of MUC 2.9a can be described a multi-layered method approach. The approach includes the following tools to measure the effects of the dialogue marketing campaign:

- Household online survey conducted at two different times: 05/2018 and 10/2019.
- Collecting statistics of response rates, orders and redeemed vouchers at two different times: 08/2019 and 10/2019
- Collecting statistics of redemption quotes of the mobility service providers after six months of campaigning: 12/2019
- Online survey conducted after six months of campaigning: 12/2019
- Regular interviews with the ML

The household survey turns out not to be the most reliable tool to measure the impact of MUC 2.9a. Because of the delay of the whole dialogue marketing campaign, the effects could not yet be precisely measured because the campaign was just up and running when the second household survey took place. In addition to that, the household survey was actually designed content-wise and planned time-wise before the campaign concept was clear. If the campaign had started as planned, the household survey could have substituted the additional online survey which is conducted very late in Q4 2019. This could have prevented an overstrain of the Living Lab residents who are constantly being involved in the evaluation of different ECCENTRIC measures.

The statistical information of the subcontractor was delivered within maximum two days and could be extracted by them at any time during the campaign. These statistics gave helpful insights about the response rates and orders which have been done by the residents.

The additional online survey was conducted in December 2019, which was kind of late to put all the results into this measure evaluation report. Furthermore, the response rate is quiet low due to the analogous procedure of sending the link of the online evaluation via paper to the residents. This interruption between paper and digital online platform can be seen as a high barrier for the residents and in addition to that the link typing is quiet error-prone.

E.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

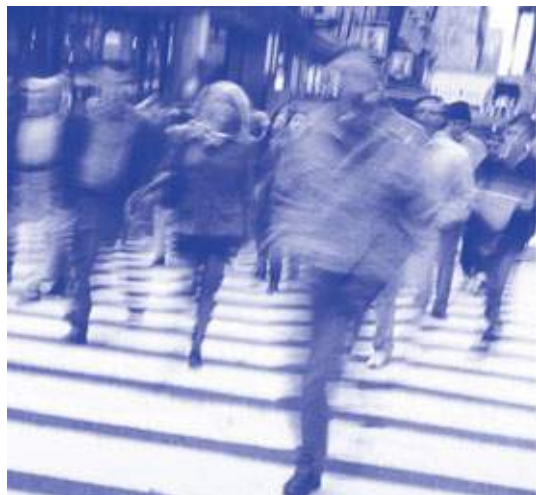
The actual impact should be measured with another survey being conducted after several more months because a change in mobility behavior usually needs more time than half a year to occur.

Other online channels could advertise more mobility marketing actions and provide information about various MSP or other mobility related topics. A platform for those actions could be the community portal www.domagkpark.de (MUC 2.7 Community information and participation portal).

Regarding the next rounds of the marketing campaign and city-wide replication of the project, new sharing providers are continuously addressed and involved in the campaign. This ensures that the campaign always includes all current relevant mobility offers.

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2020
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MUC 2.9b

Neighbourhood oriented marketing of sustainable multimodal mobility services: **Mobility management for local schools**

Measure Evaluation Report

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2020
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3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
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13	Mobility Motors Sweden AB	Sweden	MM
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26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Maximilian Pfertner	

Table of Contents

ABSTRACT.....	362
A. INTRODUCTION.....	364
A.1 EXPECTED RESULTS OF THE MEASURE	364
A.1.1 Quantifiable impacts.....	364
A.2 MEASURE DESCRIPTION	365
A.2.1 Measure outputs.....	365
A.2.2 Supporting activities	365
A.2.3 Interactions with other ECCENTRIC measures.....	366
A.2.4 Interactions outside ECCENTRIC	366
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	366
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	367
A.5 IDENTIFIED RISKS	367
B. MEASURE IMPLEMENTATION	368
B.1 SITUATION BEFORE CIVITAS	368
B.2 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	368
B.3 ACTUAL IMPLEMENTATION OF THE MEASURE	368
C. IMPACT EVALUATION FINDINGS	371
C.1 EVALUATION APPROACH.....	371
C.1.1 Expected impacts and indicators.....	371
C.1.2 Baseline.....	373
C.1.3 The business-as-usual scenario.....	383
C.2 MEASURE RESULTS.....	386
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	398
D. EVALUATION CONCLUSIONS	400
D.1 VALIDATED DIRECT IMPACT	34
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	34
D.3 INTERACTION WITH OTHER MEASURES.....	34
D.4 MAIN LESSONS LEARNED	34
D.5 LONG TERM IMPACT	35
D.6 POTENTIALS FOR UP-SCALING IN THE CITY	35
E. ADDITIONAL INFORMATION.....	402
E.1 APPRAISAL OF EVALUATION APPROACH	402

E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	402

List of Figures

Figure 1: Awareness of the term mobility of pupils at Situlistraße (Data: “Let’s Go!”, 02/2020)	373
Figure 2: Number of registrations of the scavenger hunt “kreuz & quer” (Data: “kreuz & quer”, 02/2020)	374
Figure 3: Number of registrations “Bus mit Füßen” (Data: Greimel 2018)	375
Figure 4: Feeling of safety of participants of the scavenger hunt “kreuz & quer” (Data: “kreuz & quer”, 02/2020)	375
Figure 5: Acceptance rate theatre play (Data: “Let’s Go!”, 02/2020)	376
Figure 6: Modal Split of participants of the scavenger hunt in Domagkpark and Parkstadt Schwabing (Data: “kreuz & quer”, 02/2020)	376
Figure 7: School district elementary school Bauhausplatz (Data: Bayerisches Staatsministerium für Unterricht und Kultus, 2020)	377
Figure 8: Modal Split of participants of the scavenger hunt in Domagkpark and Parkstadt Schwabing (Data: “kreuz & quer”, 02/2020)	378
Figure 9: Modal Split of pupils in Munich according to schoolyears classes (Data: MVV 2015/16)	378
Figure 10: Modal Split of pupils in Munich over time (Data: MVV 2015/16)	379
Figure 11: school district elementary school Bauhausplatz (Data: Bayerisches Staatsministerium für Unterricht und Kultus, 2020)	380
Figure 12: Number of cars per household, 2018	381
Figure 13: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)	381
Figure 14: Modal Split in Munich (2008+2017)	383
Figure 15 Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)	384
Figure 16: Awareness of the topic of transport, environment and climate in school (Data: “Let’s Go!”, 02/2020)	389
Figure 17: Assessment of Safety (Data: “Bus mit Füßen” 2020)	390
Figure 18: hotspots station use “kreuz & quer” in the Living Lab (zoom from the left to the right) Data: “kreuz & quer” 2020)	390
Figure 19: Registrations “Bus mit Füßen” in 2017/18 till 2018/19 (Data: Greimel 2018)	391
Figure 20: Routes of “Bus mit Füßen” in 2018/19 at primary school at Bauhausplatz (Data: Green City e.V., City of Munich)	391
Figure 21: Registrations “Bus mit Füßen” in 2017/18 till 2018/19 (Data: Greimel 2018)	391
Figure 22: Assessment of the safety to school (“Bus mit Füßen” 2020)	392
Figure 23: Registration rate per day “kreuz & quer” (Data: „kreuz & quer“ 2020)	393
Figure 24: Game intensity of “kreuz & quer” (Data: “kreuz & quer” 2020)	393

Figure 25: Satisfaction rate theatre play (Data: “Let’s Go!”, 02/2020).....	394
Figure 26: Satisfaction “Bus mit Füßen” (Data: “Bus mit Füßen” 2020).....	394
Figure 27: 2nd Census Modal Split “kreuz & quer” (Data: “kreuz & quer” 2020)	395

List of Tables

Table 1: Quantifiable impacts.....	364
Table 2: Target groups or affected parties.....	366
Table 3: Measure stakeholders.....	367
Table 4: Risks.	367
Table 5: Modal Split of pupils at elementary school (Data: “kreuz & quer” 6.02.20220).....	379
Table 6: Emission Factors (HBEFA, 2017)	382
Table 7: Living Lab Emissions 2017	382
Table 8: Emission Factors (HBEFA, 2020)	384
Table 9: Living Lab Emissions 2020	385
Table 10: Comparison 1 st and 2 nd Census Modal Split “kreuz & quer” (Data: “kreuz & quer” 2020)	395
Table 11: Modal Split of pupils at elementary school (Data: “kreuz & quer” 20.02.20220) ..	396

Project	City		
ECCENTRIC	Munich		
Measure code	Measure name		
MUC 2.9	Neighbourhood oriented marketing of sustainable multimodal mobility services: Mobility management for local schools		
Last update	Responsible	e-mail	telephone
15.10.2019	Elisabeth Nagl	elisabeth.nagl@muenc hen.de	+49 (0)89 / 233-39965

Abstract

The measure MUC 2.9 is divided into three sub-measures which aim to implement neighbourhood-oriented marketing of sustainable, multimodal mobility services in Domagkpark and Parkstadt Schwabing. Sub-measure measure MUC 2.9a focuses on a direct and dialogue marketing which is addressed to all residents of the ECCENTRIC Living Lab – Domagkpark and Parkstadt Schwabing. The targeted marketing campaign aims to support local residents to change their mobility behaviour into a less car-dependant lifestyle. Sub-measure MUC 2.9c focuses on a comprehensive mobility management for companies, actually carried out with the help of a ride sharing app called JobRide.

This measure MUC 2.9b mobility management for local schools offers mobility education and training to children and their parents in order to strengthen active, independent and sustainable trips to school and leisure activities. Several actions and projects are integrated in measure MUC 2.9b to reduce the number of parents picking up their children by car in the long-term as well as improve their feeling of security outside and their awareness of traffic and their own mobility behaviour. Due to the different mobility behaviour, motoric capabilities and possibilities of all age groups, different actions were implemented, focussing on a specific age group.

Four actions are part of the sub-measure:

- The action “Bus mit Füßen” is designed to enable school children to get to know their way to school safely in company with parents and other children and, in the long-term, to walk to school independently, without adults.
- Secondly, the school theatre play “Let’s Go!” is integrated into the measure, too, to deal with the topic of mobility in a playful way: different modes of traffic are presented and discussed regarding sustainability and safety.
- As a third action, the scavenger hunt “kreuz und quer” is integrated. This motivates the children to spend more time outside in public space and to get to know their neighbourhood on foot, by bicycle or scooter and thereby improve their movement and general safety on the road.
- The last actions, “Bambini” and “Bambini box” is also designed to introduce children to the topic of mobility in a playful way as early as kindergarten and to intensify it during school. Here, too, the children should learn about transport options and be encouraged to walk or cycle on their own, by promoting the joy of movement and environmentally friendly travel.

All actions were successfully implemented within the last months of 2019, except “Bambini” due to some strategic problems. All actions are still on-going.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the

implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measures' implementation and the ex-post data, which focuses on the impact of MUC 2.9b.

Evaluation results for MUC 2.9b were retrieved from different evaluation activities: Particular online questionnaires addressing the four actions being part of the sub-measure as well as analyses of registration numbers of the programs. In addition, there were some observing counting of pupils, qualitative observations and surveys taking place as well as interviews with relevant stakeholders.

The impact assessment of measure MUC 2.9b showed that there were for example about 900 participants joining scavenger hunt action and about 47 schools supporting the "Bus mit Füßen" action and among this particular program there are double the number of parents (666) being involved in the safe walking to school than in 2016 (316). Regarding the theatre play "Let's go", 52% of the visitor state that they want to hear more about the topic mobility.

Overall, the measure can be seen as positive, as even the youngest inhabitants are introduced to the topic of sustainable mobility and thus become aware of their mobility behavior and its effects in the long-term. In many activities, a gamification approach is used to motivate the children and introduce them to the topic in a playful way. It is important, however, to involve parents and childcare institutions at an early stage with this very sensitive target group, in order to make the measures transparent and achieve great acceptance. The actions carried out are easy to implement and do not require any elaborate preparations.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- Reduced energy use & CO2 emissions
- Reduced air pollution
- Reduced road congestion
- Improved accessibility for all
- Better social inclusion and equal opportunity
- Improved liveability

(2) Strategic level:

- New approach of providing mobility management to an entire housing/business area was tested, i.e. embracing all mobility needs, interests and patterns
- It was analysed how mobility behaviour of citizens already resident in the city could be changed towards more sustainable modes and whether this neighbourhood approach could be transferred to other development areas

(3) Measure level:

- The plan was to make residents aware of the great variety of transport offers available to them and provide them with customized advice how to organize their individual mobility more
- Residents should be encouraged to test mobility offers and services that are new to them and to reduce barriers that inhibit making use of the offers (e.g. lack of knowledge, uncomfortable situations, insecurity) sustainably and efficiently – not only the Living Lab but also in the entire city/region
- All three mobility management components (sub-measures a), b), c)) were planned to achieve a reduction of 5% in car use, a reduction of CO2 emissions of 180 tons per year and a reduction of car kilometres of at least 870.000 km per year in the laboratory area
- In addition, the measure should have contributed to a reduction of NOx and PM emissions in the laboratory area, an increase in traffic safety and a decrease of accidents on the way to school

A.1.1 Quantifiable impacts

Expected Impacts		Wide awareness and acceptance of mobility services in the area. Increased use of the various existing and new sustainable mobility services. Increase of use of active modes. Reduced individual car use in Domagapark and Parkstadt Schwabing (for both way-to-school trips and commuters). The large majority of children (and their parents) go to day care/ school by sustainable modes, i.e. on foot, by bike or public transport.	CIVITAS ECCENTRIC Objectives								
			Reduce:				Improve:				
			Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight
ID	Quantifiable Impacts										
1	Awareness about the mobility services among the residents and targeted groups						X	X			
2	Acceptance of mobility offers, sustainable mobility is a priority among residents and targeted groups						X	X	X		
3	Mode shift towards more sustainable modes by residents and targeted groups		X	X		X					
4	Reduction of car ownership among residents and targeted groups								X		
5	Reduction of VKT of residents and targeted groups		X	X							
6	Reductions of CO2 emissions from residents and targeted groups		X								
7	Reductions of NOx and PM emissions from residents and targeted groups			X							

Table 1: Quantifiable impacts.

A.2 Measure description

The measure MUC 2.9 aimed to implement neighbourhood-oriented marketing of sustainable, multimodal mobility services for residents, a mobility education training for children and a mobility management for companies in the newly built (in 2016) residential districts “Domagkpark” and “Parkstadt Schwabing”. Both residential areas are home to more than 8.000 people, over 200 companies, schools, educational and other facilities. Various public facilities and services are present in the neighbourhood. Especially amenities for children and young people (e.g. day care facilities, schools) are located in the district, wherefore a higher sensitization in mobility was required.

The measure aimed to raise awareness and sensitize children to sustainable mobility in a playful way. Mobility education and training were offered to children and their parents (e.g. walking buses, scavenger hunt or mobility education) in order to reduce the number of parents picking up their children by car and to strengthen active, independent and sustainable trips to school. By getting to know their neighbourhood and exploring the various transport options, the children should develop an awareness of what mobility can be and how to get around. As a best-case scenario this awareness raising creates sustainable mobility behaviour in the long-term. As soon as children spend more time in public places and on the streets, they develop a greater awareness of traffic and thus also of their own mobility behaviour and feeling of security.

Mobility training for children went hand in hand with the implementation of other CIVITAS ECCENTRIC measures in Munich (e.g. Community information and participation portal (MUC 2.7) and the Neighborhood oriented concierge system at the development area Domagkpark (MUC 7.5)), i.e. promoted these measures to their target groups directly in the neighbourhood, keep children and their parents updated about recent developments and ensured that all children could inform themselves and could take part in the offered actions.

The sub-measure was complemented by sub-measures a) *direct and dialogue marketing* and c) *mobility management for companies* – see separate MERs for details.

A.2.1 Measure outputs

The expected outputs from this sub-measure are:

- Mobility education and training for children and their parents
- Schools in the Living Lab and other educational facilities take part in the mobility management program
- Supporting activities and ideas for a concept for mobility management for schools and day care facilities

A.2.2 Supporting activities

Some of the actions are integrated into existing programs within the district. Especially for the action “kreuz & quer”, there was support from the children’s and youth facilities in the neighbourhood by planning joint actions. The aim was to increase the scope and awareness of the action and to intensify networking within the neighbourhood. So far, there was great response of all participants.

A.2.3 Interactions with other ECCENTRIC measures

The action “kreuz & quer” as a part of measure MUC 2.9b has interactions with measure MUC 2.7 of the “Community information and participation portal”. Based on the Domagkpark portals’s reach and network, the action could be communicated more widely and thus the measures support each other. Measure MUC 7.5 “Neighbourhood oriented concierge system at the development area Domagkpark” has been linked as well due to its social network and its spatial infrastructure and facilities in the neighbourhood.

A.2.4 Interactions outside ECCENTRIC

The action “kreuz & quer” is linked to the EU-Project METAMORPHOSIS, where the action has been implemented already in the district “Neuaubing-Westkreuz” and “Moosach” in Munich. Metamorphosis is on transforming neighbourhoods with a focus on children. In this context the action “kreuz & quer” has been taken place with great response. Due to the successful implementation, a lively exchange took place between the project partners of Metamorphosis and Civitas Eccentric. This enabled the campaign to be further improved and some lessons learned to be proactively integrated into the planning of ECCENTRIC. For example, communication between all involved partners took place much earlier in the Domagkpark and Parkstadt Schwabing compared to the Metamorphosis area. Target groups and/or affected part of the city or region. In this context a joint webinar of Metamorphosis and CIVITAS ECCENTRIC took place in February 2020.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
6	Children and parents in the Living Lab	Living Lab	Addressing all families in Parkstadt Schwabing and Domagkpark
10	Child- and youth care facilities	Living Lab	Addressing all social or educational institutions in Parkstadt Schwabing and Domagkpark

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

For a better overview, the stakeholders are grouped by sub-measure

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR- other	Level activity L-P-O	Role - Links
	City of Munich (Department of Public Order, KVR)	P	C	L	Measure leader
	Day care centres (e.g. Kindergarten, youth care institutions)	S	KI / PR	O	Target group
	Schools (primary, secondary)	S	KI	O	Target group
	Metamorphosis Project Associate	S	C	O	Multiplier
	Concierge service Domagkpark	P	S	O	Multiplier
	Community info- and participation portal Domagkpark eG	P	S	O	Multiplier
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Number of schools is too low	Involvement	Circle of acquisition could be extended within the Living Lab	ML
Interest and support of social institutions is too low	Involvement	Communication phase could start early	ML

Table 4: Risks.

B. Measure implementation

B.1 Situation before CIVITAS

The Domagkpark and Parkstadt Schwabing is a newly developed housing area with a great mixture of its residents. Many children live in the neighbourhood. Their movement space is limited to playgrounds and other firmly defined areas for children, which, however, do not exist in the neighbourhood in the quantity and quality needed to provide an attractive environment for children. The sub-measure is based on various elements of Munich's "mobility biography" concept, with a focus on children and teenagers. Some successful measures, already implemented before in other districts and educational facilities, have been identified and have been replicated for the neighbourhood of Domagkpark and Parkstadt Schwabing. The children have not received targeted mobility training before.

New organisational arrangements or relationships

For the introduction of sub-measure b) it would be helpful to bring several stakeholders from the educational sector together. This would probably need some organisational arrangement between the City of Munich, local stakeholders and educational facilities within the Living Lab (Child care facilities or schools).

Targeting specific user groups

This sub-measures targets a very specific user group:

- Families in general
- children and young adults in particular
- parents and grandparents
- social and educational facilities in the neighbourhood

New policy instrument

The educational training for parents and their children is a very good instrument to prevent accidents and teach them to live a more sustainable life, which has been tested and evaluated several times in the City of Munich. The teaching aspect in the early age can be seen as a very positive aspect.

B.2 Research and Technology Development

No new technology was developed but improved for some actions within the measure 2.9b). Especially for the action "kreuz & quer" new material for public relations has been developed and technical facilities and support has been improved.

B.3 Actual implementation of the measure

Phase 1: Research and measure planning milestones

In order to achieve a higher sensitization and awareness of mobility for younger people, all childcare and educational facilities in and around the Living Lab area have been identified. The sub-measure is based on various elements of Munich's "mobility biography" concept, with a focus on children and teenagers.

Within the Children's Forum of the City of Munich in 2019, some children have expressed how they would like to design their neighbourhood in the future and have made suggestions for

improvement. These considerations have been incorporated into the planning and selection of the actions.

Phase 2: Procurement & Implementation

After an intense planning and implementation phase for the other sub-measures of measure MUC 2.9a) and c), focus was to put on the sub-measure for mobility education and training. Procurement for this was completed in the beginning of 2020.

The tender procurement has been carried out in October 2019 to different stakeholders, like *Green City e.V.*, *Pironex GmbH* or *mobil.spiel*, that took over parts of the organisation of the actions. The sub-measure has completed the planning phase by the end of the year 2019.

In 2020 all actions could have been successfully launched, except the action **“Bambini”**. The action could not have been launched yet, due to a lack of interest from the local childcare facilities. And furthermore, due to the identified risk “interest and support of social institutions is too low” the action. There are still efforts to implement the action in public kindergartens in order to introduce the youngest target group to the topic of movement and mobility. Currently, some kindergartens within and outside the Living Lab are contacted to implement the action in a wider spatial context.

Regarding the Munich’s “Mobility Biography” concept, the action **“Bus mit Füßen”** already introduced in 2016/17 in the project area and was continuously continued. For this purpose, the schools received sufficient information and advertising material to launch the project, what was given to the interested parents afterwards. Currently 21 families take part in the action.

Due to the European Mobility Week the theatre project **“Lets’ Go!”** has already been taken place in the Domagkpark in September 2018. In consequence of the relatively small district, there is just one (elementary) school located within the neighbourhood. Due to the theatre play and its target audience of pupils of 5th till 7th grade, the action was expanded spatially. This is also based on the identified risk “number of schools is too low” and “interest and support of social institutions is too low”. Besides the spatial extension, there are also considerations to redesign the content of the play in order to increase the interest of the schools in the long-term. The play is currently being performed in three other schools around the project area in February and March 2020. Further interested schools have been already identified, where the play will be performed in spring 2020.

The action **“kreuz & quer”** has been launched on 14th of February with an opening party for families and children. The action lasted about six weeks till the end of March 2020. The tender procurement was given to a company, that supports the action technically with the needed infrastructure. For the actions, flyers and posters were distributed to schools, kindergartens and other educational facilities. In terms of public relations, the City of Munich has worked together with various social institutions that distributed the chip cards for the game to the children in the neighbourhood. These institutions also act as contact persons for the children during the game.

Another project, called **“Auf die Räder”** (“On the bicycles”) has been initiated without success in September 2019, due to a lack of interest from the local childcare facilities.

In summary, the conduction of almost all actions are going according the plan and the approval of the partners, children and adolescents is very high in the neighbourhood.

Phase 3: Demonstration & Monitoring

The demonstration of the sub-measures is on-going. All actions, except “Bambini” have already been launched and are currently demonstrated with great success. The given feedback during the actions is already very good. The Monitoring is, due to the on-going process, not concluded. All actions continued approximately till End of March 2020, depending on the on-going acquisition within the actions “Let’s Go!” and “Bambini”. Regarding the time management of the actions “Bus mit Füßen” it is planned that the action continues till the end of the school year. The action “kreuz & quer” lasted till end of March and. For both actions, a comprehensive evaluation will be done afterwards.

Due to the good feedback and implementation of action “kreuz & quer”, “Let’s Go!” and “Bus mit Füßen”, a replication is already planned for further districts and educational institutions in 2020.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Awareness	Acceptance	Satisfaction	Mode shift	Car ownership
Type	KPI	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	SOCIETY-PEOPLE	SOCIETY-PEOPLE	TRANSPORT SYSTEM	SOCIETY-PEOPLE
Subcategory	Acceptance	Acceptance	Acceptance	General	Accessibility
Aspect	Awareness level	Acceptance level	Satisfaction	Modal split	Physical accessibility to transport services
Definition	Percentage of residents with knowledge about the mobility services promoted as part of the mobility management campaign	Percentage residents who favorably receive or approve of the mobility management campaign	User/provider/stakeholder average reported satisfaction with the mobility management program.	Percentage of residents who permanently changed modes for the same trip (same origin and destination, time, and	Cars owned per 1000 inhabitants of the populations aged 18 and over.
Unit	Percentage	Percentage	Score (0-5)	Percentage (various values)	Cars to inhabitants ratio
Method of data collection	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Individual survey on satisfaction with the direct and dialogue marketing campaign to a representative group of residents (e.g. through a questionnaire or focus groups).	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Survey of Domagkpark residents
Target group	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees		Living Lab residents, pupils and employees	Living Lab residents

Impact	6	7	8	9	10
Indicator	VKT	CO2 Emissions	NOx emissions	PM emissions	Contribution to policies, plans and programs
Category	KPI	KPI	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ENVIRONMENT	ENVIRONMENT	ENVIRONMENT	SOCIETY-GOVERNANCE
Subcategory	General	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Planning
Aspect	Total Travel	Emissions	Emissions	Emissions	Planning process
Definition	Kilometers traveled by individuals	CO2 emissions produced by residents' mobility	Total NOx emissions produced by residents' mobility	Total PM emissions produced by residents' mobility	Qualitative measurement on the process to modify policies, plans and programs in a significant and definitive way.
Unit	Kilometers	Tons	Tons	Tons	Score (0-5)
Method of data collection	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Estimation based on VKT (or PKT) of different target groups and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) of different target groups and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) of different target groups and average emission factors for the different transport modes available in the area	Surveys and interviews to decision makers
Target group	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Decision makers

Impact	INPUT	INPUT	INPUT
Indicator	System Usage	Investment Costs	Operational Costs
Category	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ECONOMY	ECONOMY
Subcategory	General	Costs	Costs
Aspect	Transport System utilization	Investment costs	Operating Costs
Definition	Users and ride matches of the ride sharing sub-measure (sub-measure =1)	Total capital costs for purchase of equipment related to running the mobility marketing campaign. Preparation and design costs is defined as total costs expended setting up the measure covering a time period from the initiation of the measure preparation until the start of the measure implementation.	Personnel and maintenance costs for running the measure per time period
Unit	# of users, trip requests, and match rates	Euro	Euro / (time or usage unit)
Method of data collection	Documentation of the ride sharing users and trip statistics.	Data from financial reports, controlling	Data from financial reports, controlling
Target group	Ride sharing system users		

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	I - A	S	Residents/Children/Employees	Living Lab / Schools / Companies
2	Acceptance	%	I – A	S	Residents/Children/Employees	
3	Satisfaction	Score 0-5	I – A	S	Residents/Children/Users	
4	Mode Shift	%	B – (I) - A	S / E	Residents/Children/Users	
5	Car Ownership	Cars/Inh.	B – (I) – A	S / E	Residents/Users	
6	VKT	Km	B – (I) – A	S / E	Residents/Children/Users	
7	CO2 Emissions	Tons	B – A	E	Residents/Children/Users	
8	NOx Emissions	Tons	B – A	E	Residents/Children/Users	
9	PM Emissions	Tons	B – A	E	Residents/Children/Users	
10	Contribution to policies, plans, and programs	Score 0-5	A	E	City	City
11	System usage	# of users, trips, requests	I - A	S	Residents/Users	Living Lab
	Investment costs	Euro	I	DC	ML	Living Lab
	Operational costs	Euro	I	DC	ML	Living Lab
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

C.1.2 Baseline

The baseline was conducted by different empirical methods, depending on each action. Baseline data was obtained by the following methods:

- An online questionnaire about the modal split of the local children was done during the registration phase of “kreuz & quer” as well as the analysis of the registration numbers. The registration started on 14th of February 2014. It is technically possible to register online until the end of March, respectively till the end of the game. Additionally, an observing counting of pupils at the elementary school “Grundschule am Bauhausplatz” was done on 6th of March 2020, before the game “kreuz & quer” was implemented. Thus, the general modal split of the pupils could have been identified.
- Furthermore, a questionnaire of “Let’s Go!” was done on 5th of February 2020 at the middle school “Situlistraße”, next to the pilot area. In addition, a given report of “Let’s Go!” in 2013/14 were included for the baseline as well.
- Baseline data refers to the different actions in the beginning of January and February 2020. Data was delivered by the City of Munich. Most of the data is based on qualitative observations and surveys, although for such a target group (children and young people) this clearly must be taken into account in the evaluation. Furthermore, due to the target group, the selection of indicators is limited to the following parameters:

Addressing indicators "1 – Awareness", "2 – Acceptance", "3 – Satisfaction"

The indicator **awareness** is difficult to obtain for this sub measure MUC 2.9b because due to several delays the measure the corresponding actions were partially carried out in late January to February 2020. Nevertheless, the awareness about the measure/ topics of the measure can be answered by questionnaire of the theatre play “Let’s Go!”, which was carried out on 5th of February 2020 at the middle school next to the pilot area Domagkpark. 59 pupils watched the theatre play. 100% of all pupils have participated in the survey, which deals with the topic of mobility in general in in in particular with its impact on our mobility behaviour and environmental impact.

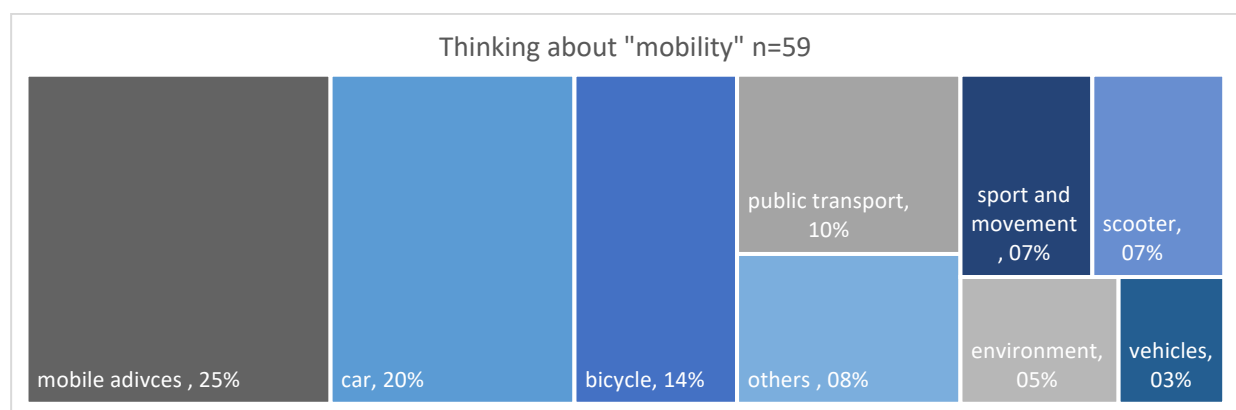


Figure 1: Awareness of the term mobility of pupils at Situlistraße (Data: “Let’s Go!”, 02/2020)

Based on the survey of the theatre play “Let’s Go!”, the pupils have a different understanding of the term “mobility”. Here it must be taken into account that the surveyed pupils are between 10 and 13 years old and therefore it is rather difficult to deal with this term in general. Nevertheless, it can be noted that mobility today is very much associated with the topic of mobile devices and less with means of transport. However, the term mobility is also very strongly associated with the car, see also [Figure](#) . This, in turn, means that children experience a formative influence on mobility by car at an early age.

The indicator of awareness can also be conducted in a more qualitative way, means through answers to open questions given by the pupils in the survey. For this purpose, the pupils were asked what they found particularly interesting about the topics of transport, environment and climate. The answers clearly show that children already deal with these topics and even see a dependency between the topics of transport and environment. The negative external effects are associated here as “exhaust fumes”, “many cars” or “climate change” and the future development of the environment and climate in general.

Awareness of the impact of transport and climate as well as the environment is already and in general very high. This is clearly described by the pupils as the fact that traffic has a bad effect on the environment: “air pollution and exhaust gases”, “climate change”, melting of the polar caps”, “sea level rise”, “CO₂ emission”, “effects on animals and plants” and, in general, “environmental damage”.

With regard to the indicator **Acceptance**, qualitative methods in particular were applied and interpreted. Not many data could have been assessed for the Baseline scenario, due to the launch of most of the measures in 02/2020.

An indicator that shows the acceptance of the target group towards mobility education is the number of participants or respectively the number of registrations at the scavenger hunt (see [Figure](#)).

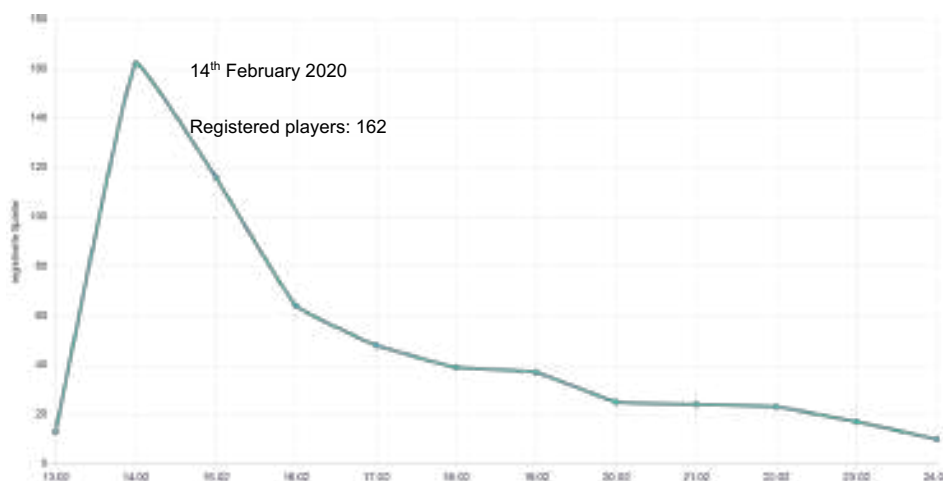


Figure 2: Number of registrations of the scavenger hunt “kreuz & quer” (Data: “kreuz & quer”, 02/2020)

Due to the start of the event, on 14th of February 2020, that was combined with an opening party for families and children, the registration rate on day 1 is particularly high. At the beginning of the scavenger hunt, 162 participants were registered, who have run 2.780 km. This is an appropriate indicator showing the acceptance of children towards mobility education.

With regard to the “Bus mit Füßen” campaign, 20 interested parents registered for the school year 2016/17. This was taking place there for the first time after the primary school at Bauhausplatz opens in 2016. In 2017/18 the campaign already has already been implemented in many other schools in Munich. There were 48 schools and 613 parents involved (see [Figure](#))

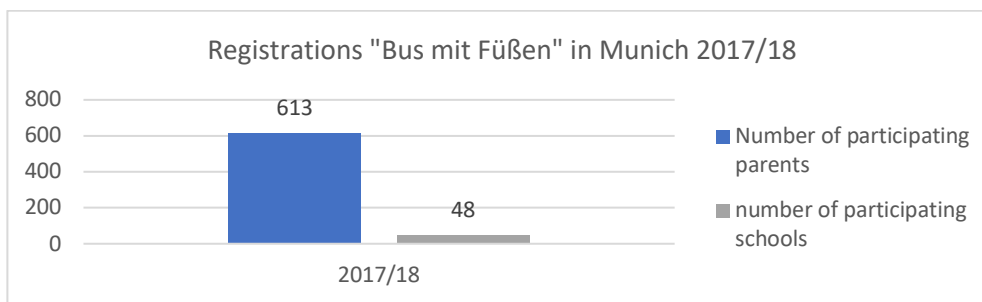


Figure 3: Number of registrations “Bus mit Füßen” (Data: Greimel 2018)

The score for the KPI satisfaction is to be chosen from a zero to a five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfilment of the KPI. A percentage value of zero means as well that there are no other developments without the implementation of the measure.

Satisfaction with the mobility training is conducted in a more qualitative way, means through experiences and opinion of the children with the offered training program. However, the general habit of mobility and respectively mobility offer can be measured by whether pupils feel safe on the way to school. In addition, the willingness of pupils to deal with topics such as the environment, climate and transport can be an indicator of how satisfied they are with their mobility behaviour.

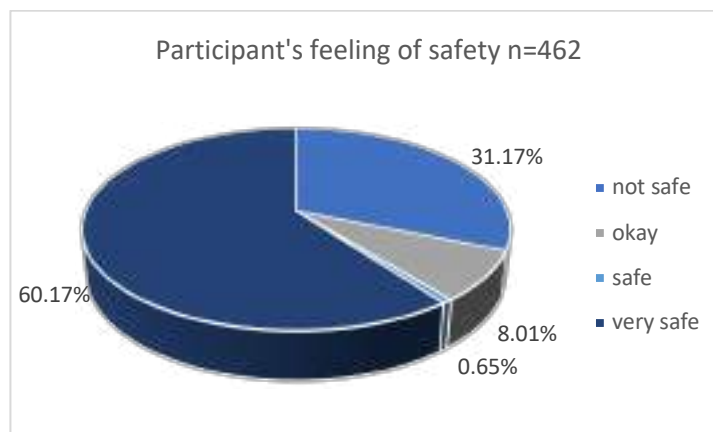


Figure 4: Feeling of safety of participants of the scavenger hunt “kreuz & quer” (Data: “kreuz & quer”, 02/2020)

Based on the survey of the theatre play “Let’s Go!” it appears that almost 80 % of the pupils liked the play in general. This in turns shows that the thematic discussion of topics such as transport, sustainability and environmental awareness is already accepted and play a major role among children.

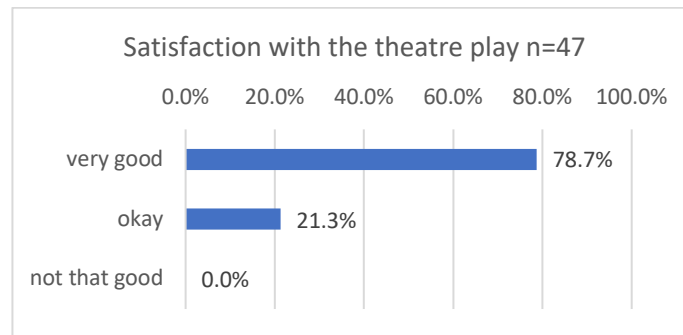


Figure 5: Acceptance rate theatre play (Data: “Let’s Go!”, 02/2020)

Due to the high level of satisfaction, it can be assumed that the children already see great acceptance of the topic of sustainable mobility.

Based on the questionnaire during registration for scavenger hunt, 281 participants stated that they feel safe on the streets in their neighbourhood. Assuming, that satisfaction correlates with the feeling of safety on the road, it appears relatively high. However, since children are a very sensitive target group, the figure of 31,17% respondents who do not feel safe seems very high and thus the satisfaction just on a medium level.

Because of the positive feedback on each action, a satisfaction score of 4 out of 5 can be given. It can be confirmed by children and teacher that mobility training combined with a playful approach ensures a high interest and satisfaction of the children.

Mobility behavior of the target group

Addressing indicators “4 - Mode Shift”, “6 – VKT” and “7 – Car ownership”

The Domagkpark population is with 4,37 trips per day (household survey, 05/2018) and person on average more mobile than the German average of 3.1 (infas, 2018).

According to a scientific study on the “Bus mit Füßen” in 2018, the biggest influence (strong to very strong) on choice of transport mode is the traffic situation with about 20%, followed by weather conditions and time with about 15%, measured by the answers of all respondents in the study (Greimel, 2018). The consideration of the modal split must therefore be done in the best-case scenario, when taking into account the feeling of safety of pupils and their parents (see Figure).

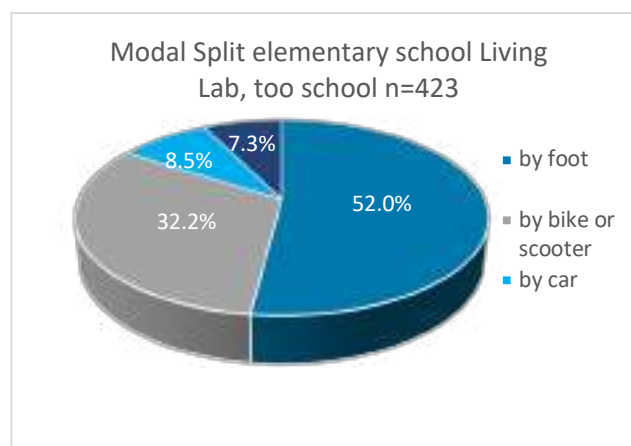


Figure 6: Modal Split of participants of the scavenger hunt in Domagkpark and Parkstadt Schwabing (Data: “kreuz & quer”, 02/2020)

Figure shows the modal split of the primary school at Bauhausplatz, in the Living Lab. The data has been surveyed on 6th of February 2020, taking all means of transport into account. It can be seen that more than half of the primary school pupils come to school on foot, a third by scooter or bicycle, but also almost a tenth of the pupils are transported by car. This also includes 2 small auto busses, with a capacity of up to 8 students.

The survey was also conducted for the way back home. A similar picture emerges, with 48% walking, 23,6% cycling or scooter riding, 2,4% being picked up by car and 0% using public transport.

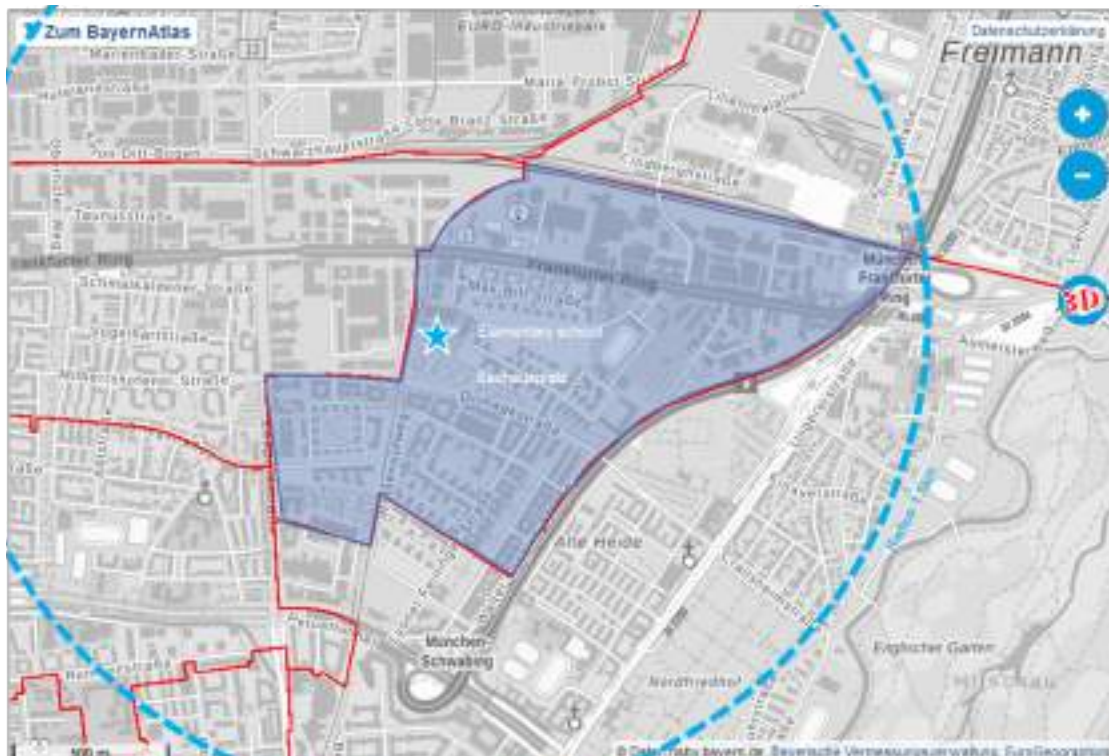


Figure 7: School district elementary school Bauhausplatz (Data: Bayerisches Staatsministerium für Unterricht und Kultus, 2020)

Considering the catchment area of the primary school at Bauhausplatz (see Figure, blue polygon), the maximum distance to school is around 1.5 km (radius). From a scientific point of view, distances of up to one kilometre are easy to cover on foot, from one to three-kilometre people normally choose the bicycle and only from a distance of five kilometres and more do people use the car. The fact that parents bring their children to school by car at 10% cannot be justified by the distance to school. Here the feeling of security probably plays an important role.

In addition to the modal split for the most sensitive group of young children (pupils of elementary school, age 5 to 10), the modal split of all children in the neighbourhood was also surveyed. This was done by evaluating the participants of the scavenger hunt “kreuz & quer”, who are on average 11.9 years old and thus pupils of from secondary schools.

The modal split of the target group of pupils of all grade within the Living Lab is visualized in Figure , based on the answer of 414 pupils.

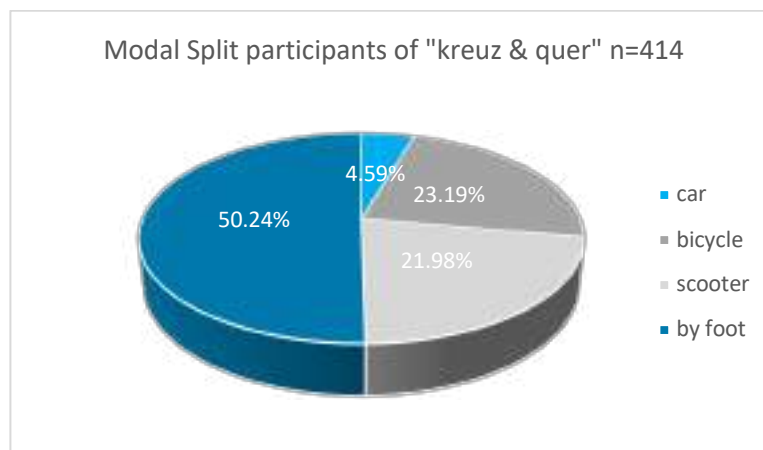


Figure 8: Modal Split of participants of the scavenger hunt in Domagkpark and Parkstadt Schwabing (Data: "kreuz & quer", 02/2020)

Due to the data protection of children, the participants did not have to respond to the questions, that have been asked during the registration of the scavenger hunt. Thus, there is a high amount of no data.

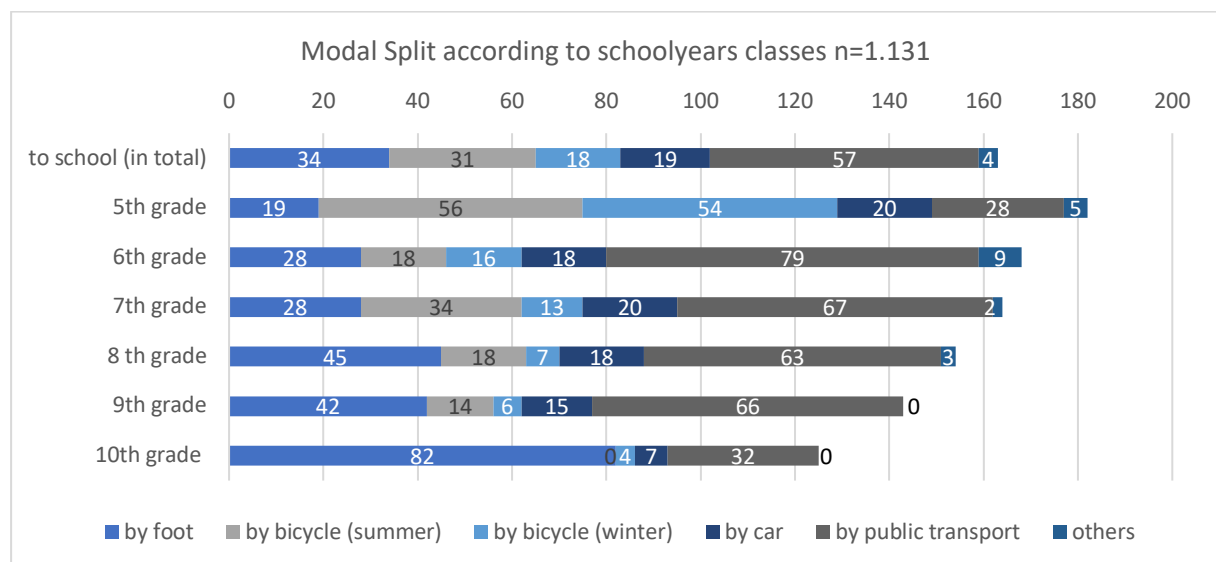


Figure 9: Modal Split of pupils in Munich according to schoolyears classes (Data: MVV 2015/16)

For an overview and closer examination of the modal split of children, the following graphic shows the modal split by class level. The data basis here are all surveyed pupils who saw the play "Let's Go!" in 2015/16 in Munich. The data has no direct reference to the pilot area Domagkpark and Parkstadt Schwabing but can serve as a statistically significant comparison.

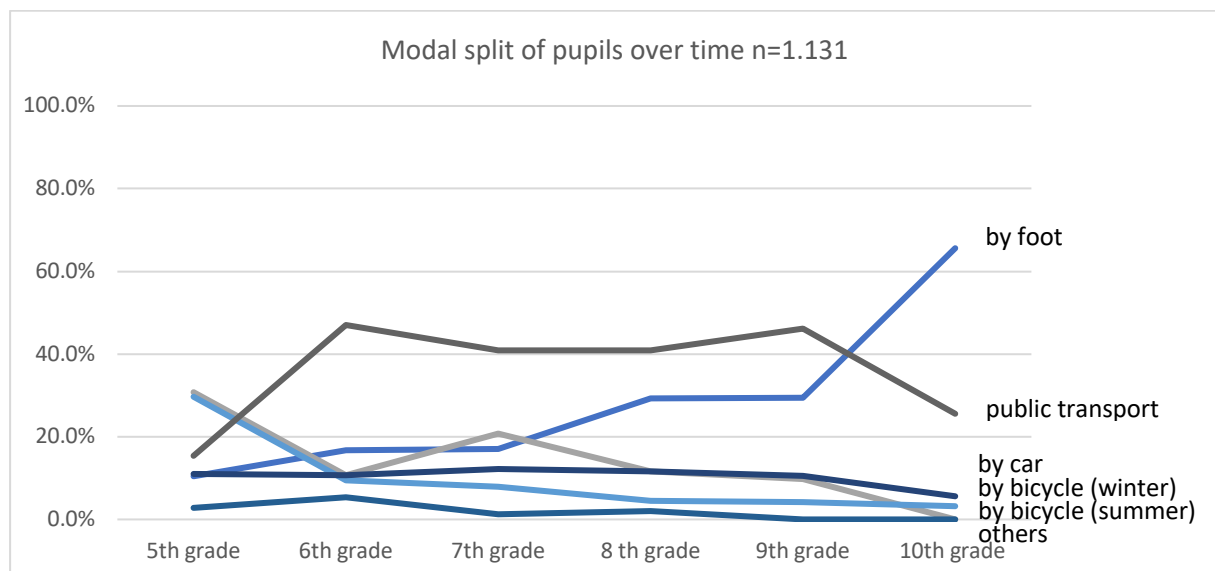


Figure 10: Modal Split of pupils in Munich over time (Data: MVV 2015/16)

Based on the data from the modal split survey in 2015/16 (compare [Figure](#)), it is shown that the mobility behaviour of children changes with age.

For example, the proportion of pedestrians increases by 55,2 percentage points from 5th to 10th grade. A possible correlation could be that children increasingly walk to school alone when they are older. Another reason for this is the change of elementary school to secondary school, which takes place in the 5th grade in Germany. It is interesting to note, that the proportion of cyclists decrease with increasing age – whether in winter (-26,5%) or summer (-30,8%). On the other hand, the proportion of children who come to school by public transport increases with age (+10,2%).

Since children and young people depend on their parents to cover long distances, they can only be considered as passengers in cars and thus only in this way for the **VKT** indicator.

For this purpose, reference is made to the survey on the modal split, which was carried out by a census at the primary school at Bauhausplatz on 6th of February (before “kreuz & quer” launch) and 20th of February (during “kreuz & quer” game). There, the means of transport used by the children to get to school and back home were surveyed. This produced the following results, for which particular reference should be made to the means of transport “car passenger”:

Transport mode	By foot	By bicycle or scooter	By car	By public transport
To school	52,0 %	32,2 %	8,5 %	7,3 %
Back home	48 %	23,6 %	2,4 %	0 %

Table 5: Modal Split of pupils at elementary school (Data: “kreuz & quer” 6.02.20220)

With regard to the school level, i.e. how the school children in the city are spatially assigned to a school, it is shown that the children in Domagkpark and Parkstadt Schwabing would have to

cover a maximum distance of 1.5 kilometres one way and 3 kilometres both ways (see [Figure 10](#)). On average, the distance to school is 0.7 km (one way) and 1.5 km (both ways).

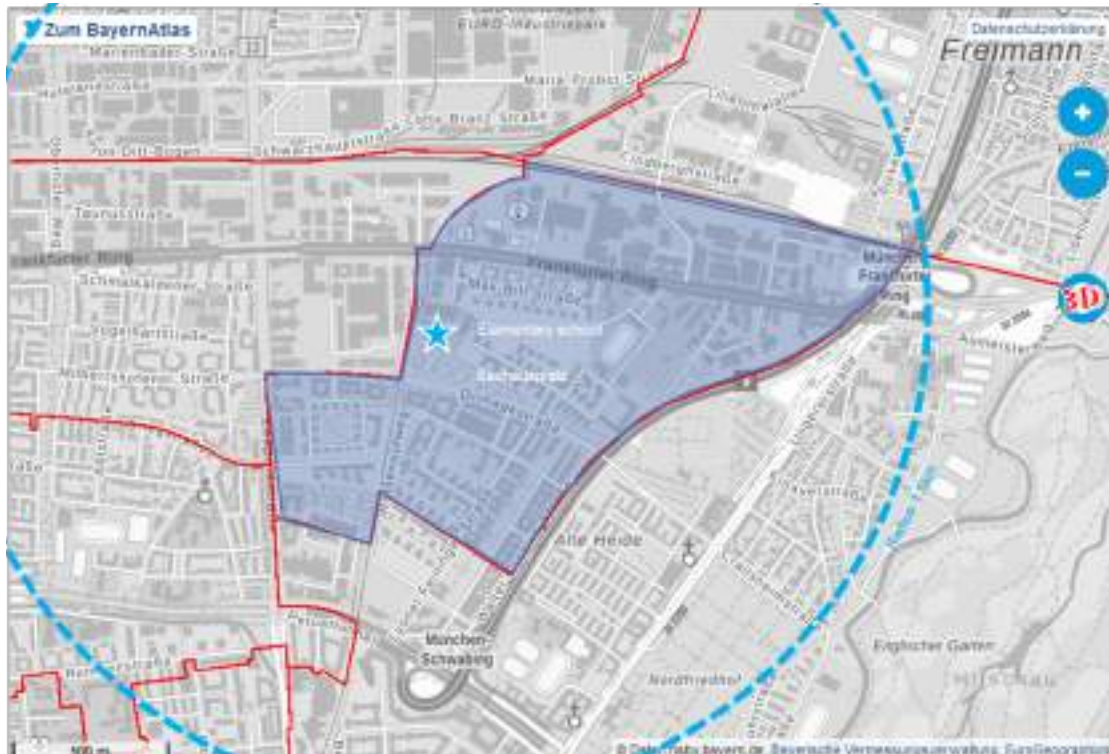


Figure 11: school district elementary school Bauhausplatz (Data: Bayerisches Staatsministerium für Unterricht und Kultus, 2020)

For the state of Bavaria 38 school weeks are counted for the year 2018/19. This in turn means an average of 190 days of school. The total number of pupils at the primary school is 404 and moreover, 8.5% are brought by car in the morning and respectively around 34 pupils every day by car. This in turn would mean a distance of 51.5 km per day in general and 9.787 km per school year. For the ways back home, based on the changed modal shift, the sum is 2.763 km per year. One explanation for the differences between the morning (to school) and afternoon (back home) modal shift could be that parents drop off their children at school on their way to work, but do not pick them up in the afternoon because they are still working.

To round off the picture of mode shift and VKT obtained for this particular sub measure MUC 2.9b, a general number for car ownership in the Living Lab can be given here. **Car ownership** in the Living Lab was obtained with the first household survey in 05/2018. With 0.92 cars per household the car ownership rate is equal to the city-wide average of 0.9 (cf. infas, 2010).

In detail, around 25% of the 572 questioned households are car-free, 60% do have one car and only few have 2 or more ([Figure 12](#)).

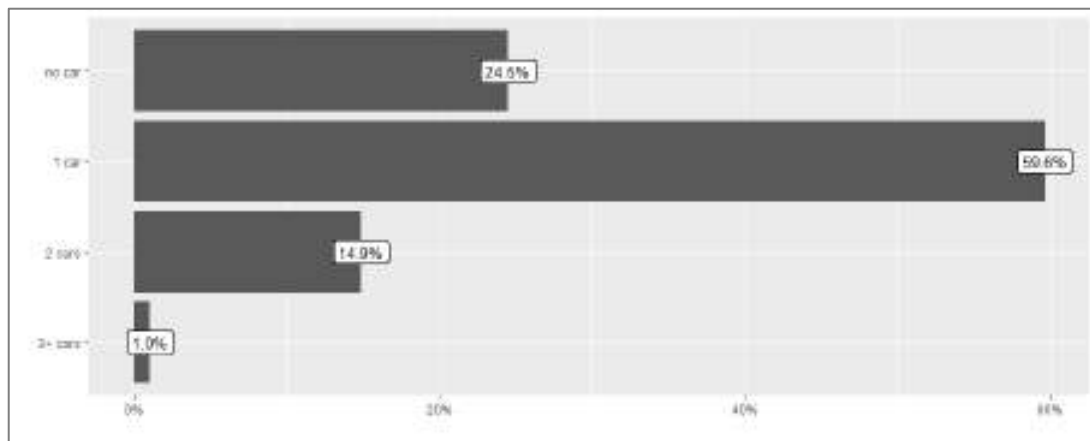


Figure 12: Number of cars per household, 2018

Transport-related emissions

Addressing indicators "7 - CO₂ Emissions", "8 - NO_x emissions", and "9 - PM emissions"

Emissions are calculated based on emission factors from the standard database "HBEFA" (*Handbook Emission Factors for Road Transport*) and information about both VKT and the vehicles in the Living Lab. See [Table](#) for the used factors, based on the German fleet average.

The number of hybrid/electric cars is too low to be considered as a separate category.

In 2017 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

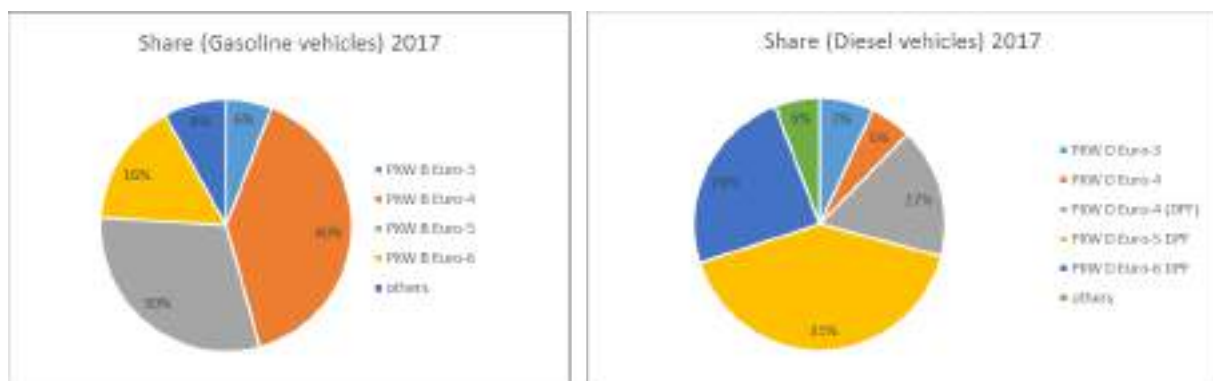


Figure 13: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)

The highest share among Gasoline vehicles consists of Euro 4 (40%) and Euro 5 (30%), followed by Euro 6 (16%). Regarding the Diesel vehicle share, there are 41% Euro 5 and 24% Euro 6. Euro 4 has a smaller share of 17%.

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	127,837 g/km
NO _x	Gasoline	0,060 g/km
PM	Gasoline	0,00102 g/km
CO ₂	Diesel	118,911 g/km
NO _x	Diesel	0,589 g/km
PM	Diesel	0,00675 g/km

Table 6: Emission Factors (HBEFA, 2017)

The following calculations are based on the HBEFA factors of 2017 and the annual VKT kilometres, differentiated by car type (first or second car) and fuel type (gasoline or diesel). The number of kilometres is then multiplied with the HBEFA factors and number of cars mentioned in the household survey (conducted in 05/2018).

Thus, the total annual emissions (based on VKT) for all 3.100 households in the Living Lab sum up to the following totals:

Pollutant	Emissions Living Lab (2017)	Emissions/ household Living Lab (2017)
CO ₂	3.864 t	2.415 kg
NO _x	10,22 t	6,39 kg
PM	122,25 kg	76,41 g

Table 7: Living Lab Emissions 2017

Addressing indicator “10 - Contribution to policies, plans and programs”

The measure MUC 2.9b contributes to policies, plans and programs of the City of Munich. The sub-measures are based on various elements of Munich’s “mobility biography” concept, with a focus on children and teenagers. For example, the “Bus mit Füßen” campaign has been implemented in Munich since the early 2000s. Another goal is to strengthen the more divers mobility options. By informing and testing new mobility options in a playful way, the actions of 2.9b contributes to Munich’s climate protection strategy, which aims to have a (almost) climate neutral city by 2050 (cf. City of Munich, Klimaschutzstrategie). Regarding those important policies and programs within the city of Munich, the contribution of the measure can be given a score of 4/5.

Data on **investment and operation cost** was obtained at a later date when the implementation phase was completed.

C.1.3 The business-as-usual scenario

For **Awareness, Acceptance, and Satisfaction**, no significant changes are expected in the BaU-scenario. On the one hand, this can be explained by the fact that even today children still typically associate mobility with a car. On the other hand, it can even be assumed that children's involvement with the topic of "mobility" will decrease further in the future. The reason for this is increasing digitization, which also has an impact on children's leisure activities, see also here [Figure](#) (association of "mobility" by 25,4% with mobile devices). This suggests that children's involvement with the topic of mobility will tend to decrease and that their sense of security will therefore decrease significantly in the future.

It can be suspected that even despite the mobility education, the children change their mobility habit a short notice during the action. A long-term change in mobility cannot be proven yet.

Due to the study "Mobilität in Deutschland" in Germany, the latter sees a lower mobility rate especially among children and adolescents compared to previous years. This suggests that awareness of mobility and transport in particular will also decrease (infas edited, 2018).

Mode Shift

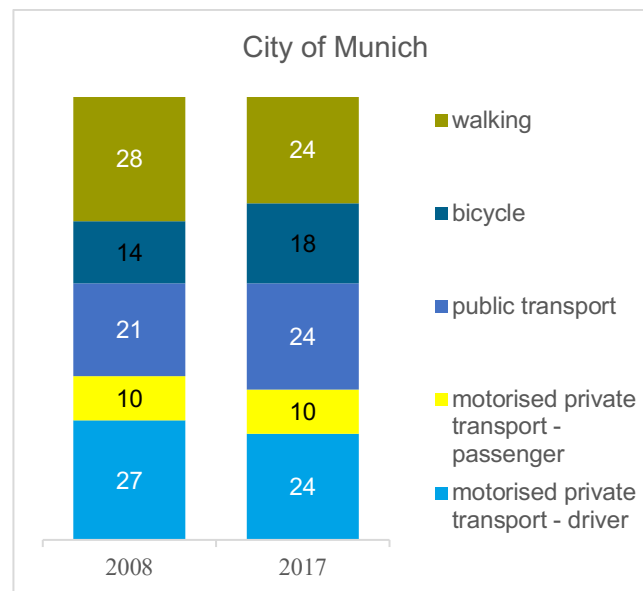


Image: City of Munich, Data: infas edited (2018)

Figure 14: Modal Split in Munich (2008+2017)

The nationwide mobility survey "Mobilität in Deutschland" acts as a reference to determine trends and future mobility behaviour in Munich.

In general, the Munich population drives less and walks less, while public transport (PT) and cycling increase over time (see [Figure](#): change 2008-2017: car -3%, PT +3%, cycling +4%, walking -4%). Extrapolating this trend from 2008 to 2020, it can be assumed the following **mode shifts** in the BaU Scenario for 2020:

Car: -1%; PT: +1%; Bike: +1%; Walking: -1%

These changes will be reflected in **VKT** as well, so that VKT is expected to decrease by 1% as well, being cautious because nationwide, the km per vehicle are slightly decreasing (2017:

-0,7%, Kraftfahrtbundesamt (2018) and the emissions are as well decreasing regarding the data of HBEFA 2020 scenario.

Note: A recent study by the Center Automotive Research (CAR) of the University of Duisburg-Essen published in 12/2019 that the number of cars is constantly increasing within the last ten years in Germany's larger cities. Comparing the number of cars from 2009 until 2019, there is an increase of 18,5% in car ownership measured in Munich (cf. CAR, 2019). This resembles a different trend then expected above in the BaU scenario assumptions of 2018.

Emissions

In order to estimate BaU-emissions, the HBEFA projected emission factors for 2020 are used as well as the by 1% increased VKT that is assumed in the section " Mode Shift & VKT".

Thus, the following factors are used:

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	117,785 g/km
NO _x	Gasoline	0,049 g/km
PM	Gasoline	0,00108 g/km
CO ₂	Diesel	110,410 g/km
NO _x	Diesel	0,484 g/km
PM	Diesel	0,0045 g/km

Table 8: Emission Factors (HBEFA, 2020)

In 2020 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

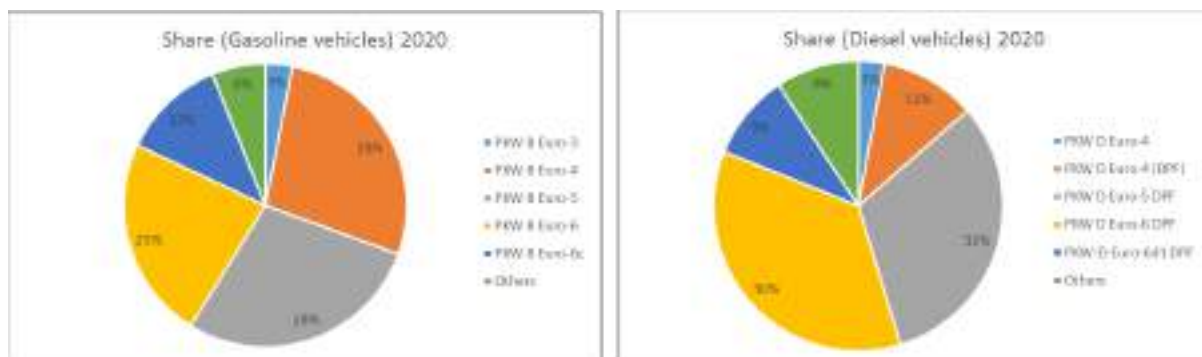


Figure 15 Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)

Regarding the Gasoline Euro classes in 2020, there are about two-thirds of all Gasoline vehicles to be found with Euro 4 (28%), Euro 5 (28%) or Euro 6 (23%). The share of Diesel

vehicles is similar but compared to HBEFA 2017 assumptions, Euro 6 has the biggest share in 2020 (36%, 24% in 2017).

Note: These emission factors assume technological progress and a renewal of the average fleet in Germany until 2020. In the light of "*Dieseldgate*" and great uncertainties in the accuracy of emission information by the car manufacturers, the HBEFA assumptions have to be verified.

This results in the following emissions for 2020:

Pollutant	Emissions Living Lab (2020)	Emissions/ household Living Lab (2020)	% change to 2017
CO ₂	3,610 t	2.256 kg	-7%
NO _x	8,49 t	5,31 kg	-17%
PM	88,76 kg	55,47 g	-27%

Table 9: Living Lab Emissions 2020

C.2 Measure results

The following table shows the measure results of MUC 2.9b, mobility management for local schools. In some cases, the Business as Usual scenario is valued zero because there would not be any other developments without the implementation of this measure.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	Data: “Let’s Go!” Awareness Mobility: 54.3 Awareness ext. effects: 11.9	02/2020	NA	-	NA	-	NA	NA
Acceptance	#	Data: “kreuz & quer” Participants: 162 Data: “Bus mit Füßen” Participants Munich: 48 schools, 316 parents Participants school at Bauhausplatz: 20 parents	14.02.2020 2016 2018/19	NA	-	Data: “kreuz & quer” Participants: 894 Data: “Bus mit Füßen” Participants Munich: 47 schools, 666 parents Participants school at Bauhausplatz: 22 parents Data: “Let’s Go!” 52% want to hear more about the topic	28.02.2020 2018/2020 2019/20 02/2020	+451.8 % - 2.1 % +8 % +10 % +52%	NA
Satisfaction	Score 0-5	Data: “kreuz & quer” Feeling of safety: 62% safe Overall assessment: 4	02/2020 2019/20	NA	-	Data: “Bus mit Füßen” Feeling of safety 75% safe Overall assessment: 5	02/2020 02/2020	+13 %	NA
Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU

Modal Split/ Mode Shift	%	Data: “kreuz & quer” Modal Split (to school): By foot: 52,0 by bike/scooter: 32,2 by car: 8,5 by public transport: 7,3 Modal Split (back home): By foot: 48,0 by bike/scooter: 23,6 by car: 2,4 by public transport: 0	6.02.2020	NA	-	Data: “kreuz & quer” Modal Split (to school): By foot: 53,0 by bike/scooter: 36,8 by car: 7,3 by public transport: 3,0 Modal Split (back home): By foot: 62,6 by bike/scooter: 34,1 by car: 3,3 by public transport: 0	20.02.2020	+1 % +4.6 % -1.2 % -4.3 % +14.6 % +10.6 % +0.8 % 0 %	
VKT	Km	Data: “kreuz & quer” To school: 9.787/a back home: 2.763/a collected km by foot: 2.780	6.02.2020	NA	-	Data: “kreuz & quer” To school: 8.405/a back home: 3.799/a collected km by foot: 17.171	20.02.2020	-14.1 % +37.5 % +417.7 %	NA
CO ₂ Emissions	kg/ house hold	2.415	2017	2.256	2020	186	10/2019	-	NA
Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU

NOx Emissions	kg/ house hold	6,39	2017	5,31	2020	0,40	10/2019	-	NA
PM Emissions	g/ house hold	76,41	2017	55,47	2020	4,28	10/2019	-	NA
Contribution to policies, plans, and programs	Score 0-5	4				5		+1	NA
Investment costs	Euro	Data as of 02/2020 Data: “Bus mit Füßen” 1.500 (net) Data: “Let’s Go!” 2.000 (net) Data: “kreuz & quer” 19.000 (net)							
Operational costs	Euro	Data not accessible							

The following ex-post data was obtained from different data sources:

- Questionnaire and results of the action “Bus mit Füßen”, collected in January 2020.
- Interview and field report with municipal employee on the “Bus mit Füßen” campaign in Munich, citywide in September 2018.
- Development of participants and the covered kilometres within the scavenger hunt “kreuz & quer”. Due to the digitized chip cards, the distances travelled between the boxes can be cumulated and calculated in total. Hotspots can be identified and thus places where the children often and probably like to stay.
- The second counting of pupils and their modal split “kreuz & quer” in front of the Bauhausplatz primary school, on 20.02.2020.
- Questionnaire “Let’s Go!”
- Report of questionnaire “Let’s Go!”

Addressing indicators "1 – Awareness", "2 – Acceptance", "3 – Satisfaction"

Analogue to the Baseline data, the indicator **awareness** illustrates the children’s involvement with the topic of mobility in the context of movement, environment or external effects. It is again pointed out, that due to the target group of children, the evaluation of the answers is mainly qualitative.

Awareness regarding the theatre play “Let’s Go!” can be measured by the percentage of pupils, who indicated in the survey that they would like to learn more often about topics such as transportation, environment and climate at school. The willingness to deal with the topic already at school with is 52% and is relatively high compared to “no interest” with 10% (compare [Figure](#)).

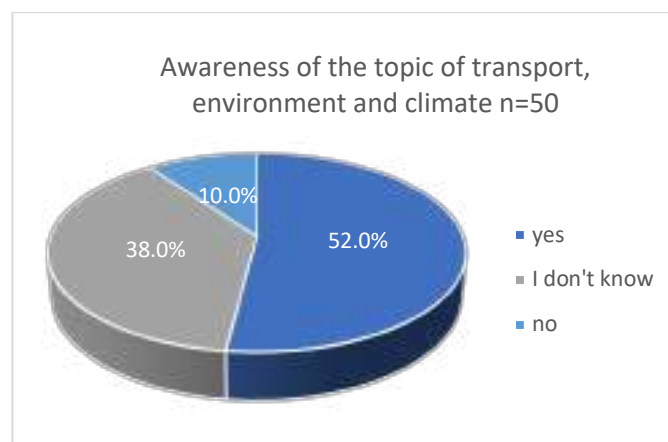


Figure 17: Awareness of the topic of transport, environment and climate in school (Data: “Let’s Go!”, 02/2020)

With regard to the “Bus mit Füßen” campaign, it can be seen that awareness is still rated as high. This can be explained by the continuous number of users of the project (see [Figure](#)) and the feedback of the initiators from the City of Munich. It is described, that the action “means more safety” and improves the “health, social skills, independence, better motor skills, getting to know non-motorised means of transport at an early stage” (Kaczor 2018).

Despite the measure, the feeling of security did not increase significantly (see [Figure 17](#)). Although the majority of the parents interviewed say that the way to school is considered rather safe, it is important for this sensitive target group that the feeling of safety is very high.

However, the statement is based on only eight parents and is therefore only moderately representative.

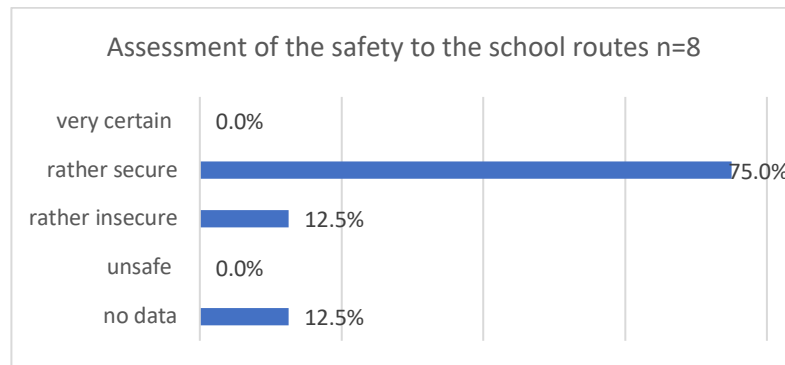


Figure 17: Assessment of Safety (Data: “Bus mit Füßen” 2020)

The action “kreuz & quer” is intended to remedy precisely this. By spending a lot of time in public space, the children get to know them better and develop a greater sense of security. In the following, the places where the children spend most of their time in the neighbourhood are shown. The data for this is provided by the scavenger hunt, by the boxes that are used most.



Figure 18: hotspots station use “kreuz & quer” in the Living Lab (zoom from the left to the right) Data: “kreuz & quer” 2020)

It can be seen that in the southern part of the neighbourhood “Parkstadt Schwabing”, there is less play activity. On the one hand, this may be due to the major federal highway that separates the northern part of Domagkpark from Parkstadt Schwabing. On the other hand, the only school within the neighbourhood is also located at Domagkpark, which means that the participating pupils play more in the northern part, next to school.

In terms of the KPI Awareness, the scavenger hunt proves to be very effective. After the boxes have been installed in the whole neighbourhood area and many children and teams are looking for them, this action is very visible in the neighbourhood. Other passer-by and children become aware of the action and also take part in the game.

In the same time, it can be expected that the increased visibility of the children in the neighbourhood will increase the consideration of the adults on the streets. The presence of children on the streets alone ensures greater attention from road users.

Based on the bachelor thesis on the “Bus mit Füßen” in 2018, the **acceptance** of the measure was evaluated. For this purpose, the registrations were analysed by participating schools and parents. This increased further in the last school years in the City of Munich (see [Figure](#)). This

generally shows a high level of acceptance of the “Bus mit Füßen” campaign and the subject matter.

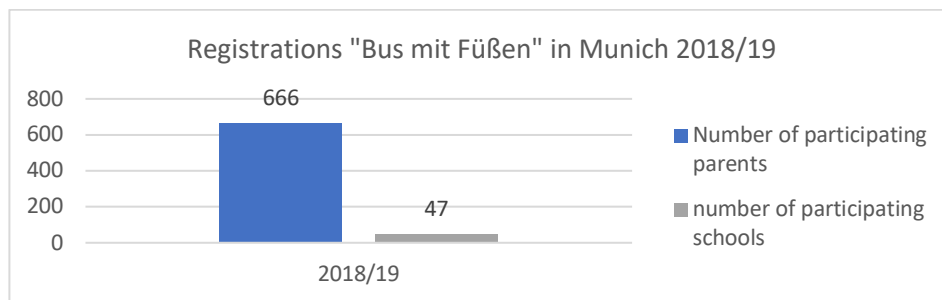


Figure 19: Registrations “Bus mit Füßen” in 2017/18 till 2018/19 (Data: Greimel 2018)

In the Living Lab, 22 families are currently participating in the “Bus mit Füßen” campaign. For better understanding, the current plan of the “Bus mit Füßen” is listed below:

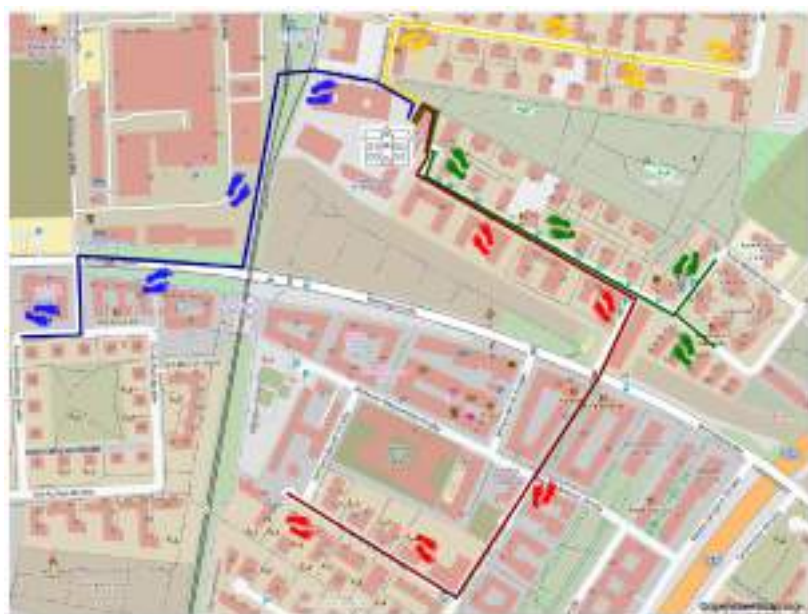


Figure 20: Routes of “Bus mit Füßen” in 2018/19 at primary school at Bauhausplatz (Data: Green City e.V., City of Munich)

The campaign has been running in the primary school at Bauhausplatz since 2016/17. Due to deficits in public relations, not many registrations were received in 2017/18 and 2018/19. Thanks to a new marketing strategy, the acceptance of the “Bus mit Füßen” increased again, to 22 registrations in 2019/20.

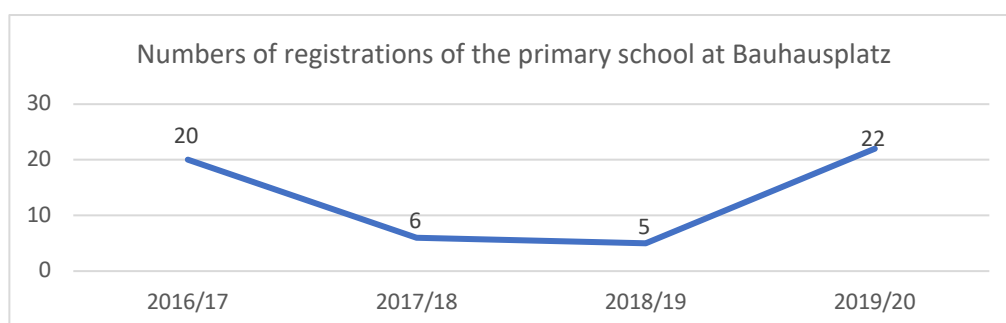


Figure 21: Registrations “Bus mit Füßen” in 2017/18 till 2018/19 (Data: Greimel 2018)

The steady registration of parents for “Bus mit Füßen” proves that the acceptance of the campaign is significantly dependent on marketing and public relations work. The high relevance of public relations work is also demonstrated during the implementation of the “Bus mit Füßen”. In the survey of the participating parents in January 2020, where 8 of 10 parents answered, three parents had some suggestions for improvement of the measure:

- Improvement of the communication
- Reminder of the project
- More information in general

Although acceptance of the campaign is high, many of the parents surveyed still burden their children to school (50%). One possible reason lies in the parent’s assessment of the safety of the school route, which is only classified as “rather secure” (see [Figure](#))

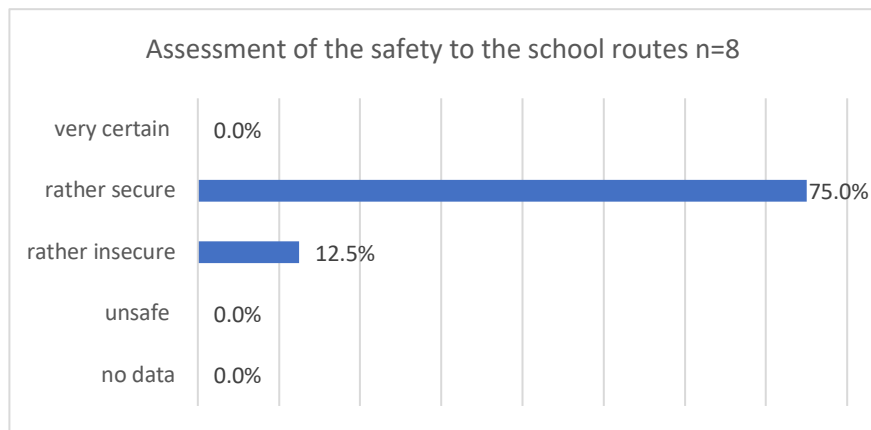


Figure 22: Assessment of the safety to school (“Bus mit Füßen” 2020)

As the same time, however, the measure is estimated to be high to very high. The following were mentioned as reasons for this:

- Relief for the parents, less concern about the child in terms of getting to school
- Children learn to be more independent and to orient oneself
- It is a good routine for the children
- parents can take turns to accompany the children
- To know which path to school the children chose

According to the pupils on Situlistraße, 78,8% have liked the play. That corresponds to 40 pupils. 52% of them said they would like to hear more about mobility, the environment and climate. This again corresponds to 20 pupils. A 40,9% increase in acceptance and interest in these topics can therefore be expected in the future.

The “kreuz & quer” action acts as a good indicator to describe the acceptance of the measure. Currently, 894 children and adolescents are involved in the campaign (607 actively). The number of users continues to rise, as shown in [Figure](#) . On 24th of February, there were still registrations on the game, similar to the previous days since the game was launched.

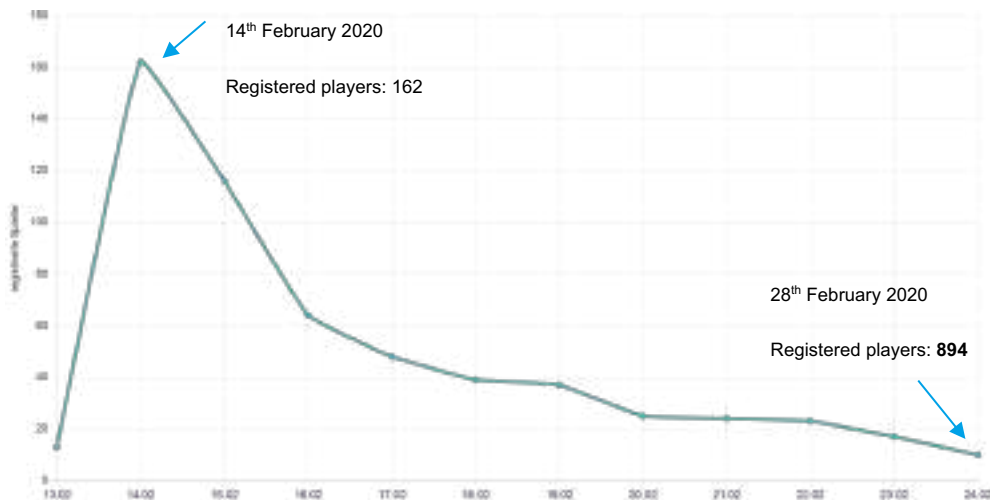


Figure 23: Registration rate per day “kreuz & quer” (Data: „kreuz & quer“ 2020)

Currently (28th February 2020) there are 890 active players, who participate in the game as individual players (19) or in a team (90). There are 33 boxes to be played in the neighbourhood. Some of the boxes are secret boxes or so-called speed boxes, which change their location after some time and have to be found again.

Since the start of the scavenger hunt, the children have run all of these 33 boxes and thus have already collected 16.773,6 kilometres or respectively 209.352 points.



Figure 24: Game intensity of “kreuz & quer” (Data: “kreuz & quer” 2020)

The game started on Friday, 14th of February 2020 and experienced its highest game participation the following weekend. During the week the turnout is lower. This is ultimately due to the fact that the children have more time to actively play at the weekend, but also because families proactively participate together in the game at the weekend. From Since 24th of February carnival holidays have been in Bavaria. Therefore, the intensity of play has increased relatively during the week. In summary, the scavenger hunt can be considered a great success. The children are actively moving around in the neighbourhood. The gamification approach shows great effect and motivates to move. A long-term effect cannot yet be determined due to the ongoing action. However, the gamification period was set until the end of March 2020 and thus for 6 weeks, as scientifically a change in behaviour only occurs after such a period.

To enrich the KPIs of **Satisfaction**, there is some data to be evaluated from the several actions, which was conducted by different methods. Most of the children were satisfied with the offered possibilities. This can be seen on the one hand in the continuous participation and satisfaction of parents in the “Bus mit Füßen” since the beginning of 2016 at the primary school, further in the satisfaction of the pupils with the play “Let’s Go!” and the constant booking of the play by the schools, and at least in the high number of registrations and participation, as well as kilometres run and points collected in the scavenger hunt.

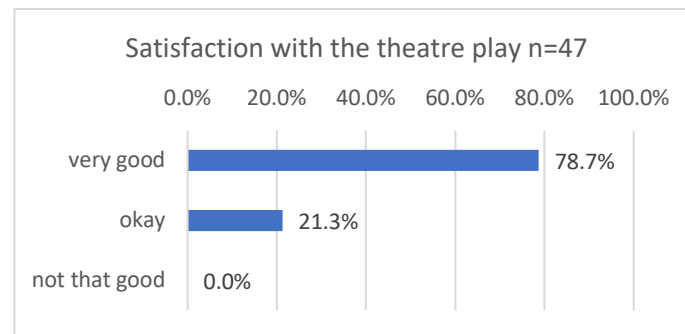


Figure 25: Satisfaction rate theatre play (Data: “Let’s Go!”, 02/2020)

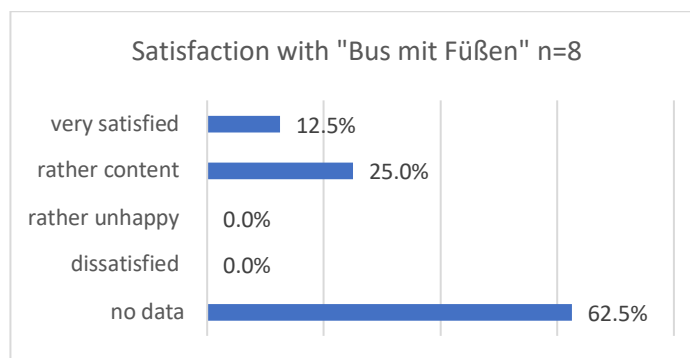


Figure 26: Satisfaction “Bus mit Füßen” (Data: “Bus mit Füßen” 2020)

According to the Bachelor Thesis, which refers to all participating schools in Munich, more than 90% of all participating parents are satisfied with the action (Greimer, 2018).

As in the case of the KPI acceptance, the intensity of the game “kreuz & quer” can be used as an indicator of satisfaction (see Figure 24). This has been given continuously since the beginning of the game. It should be mentioned here that technical problems in the beginning but also during the game, significantly limit the child’s satisfaction. Some boxes develop technical problems during the game progress and fail. Furthermore, there were difficulties with the registration mail and some e-mails did not arrive. This sometimes led to bad feedback. However, the general satisfaction with the scavenger hunt continues and can be considered as great success.

The score for the KPI satisfaction is to be chosen from a zero to a five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfilment of the KPI. A percentage value of zero means as well that there are no other developments without the implementation of the measure.

Regarding the qualitative experience of the children and teachers of the level of satisfaction there has been a change in information. The children using the offered games and training are still very content about the actions. Added value was even generated, for example by the children making new friends during the scavenger hunt by participating as a team. By getting to know their neighbourhood, they also get to know new corners. Finally, the gamification approach also plays an important role. In addition to the competitive idea of collecting points (“kreuz & quer”), the children can also win great prizes. This encourages the children to take part in the activities. The score for satisfaction therefore increases to 5/5.

Mobility behavior of the target group

Addressing indicators “4 - Mode Shift”

In order to evaluate the mobility behaviour and the possible changes caused by the actions, a further census was conducted two weeks after the first census. This took place on 20.02.2020 before the primary school at Bauhausplatz and thus after the start of the game “kreuz & quer”.

The results are presented as follows:

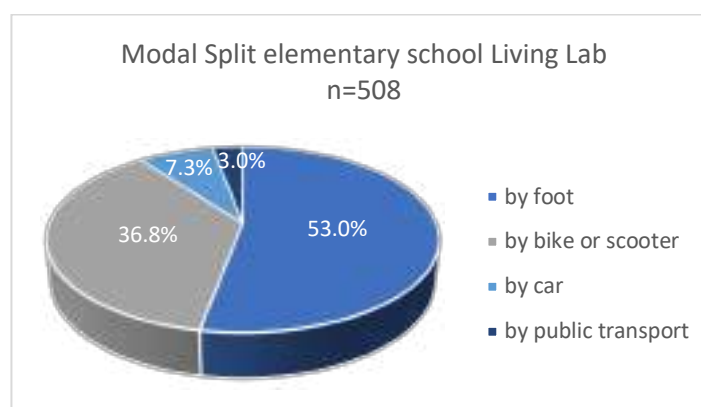


Figure 27: 2nd Census Modal Split “kreuz & quer” (Data: “kreuz & quer” 2020)

In order to determine a possible change in mobility behaviour, the difference between the respective means of transport was determined for the two censuses. These are shown in the table.

Means of transport	before	after	difference
by foot	52,0%	53,0%	1,0%
by bike or scooter	32,2%	36,8%	4,6%
by car	8,5%	7,3%	-1,2%
by public transport	7,3%	3,0%	-4,3%

Table 10: Comparison 1st and 2nd Census Modal Split “kreuz & quer” (Data: “kreuz & quer” 2020)

According to this, the proportion of pedestrians among primary school children has risen by 1% and that of cyclists and scooters by much as 4.6%. At the same time, however, the number of passengers in cars has also increased.

The survey was also conducted for the way back home from school. A similar picture emerges, with 62,6% walking, 34,1% cycling or scooter riding, 3,3% being picked up by car and 0% using public transport. According to this the proportion of pedestrians among primary school children has risen by 14,6% and that of cyclists and scooters by much as 10,6%. At the same

time, however, the number of children being picked up by car increased around 1%. There is no difference behaviour in using public transport.

Due to the short intervals between the counts and the start of the scavenger hunt, which started only a few days before, no representative statement can be made. Nevertheless, there is a slight increase in the number of pedestrians and cyclists or scooters. Especially in the afternoon, when the children are on their way back from school, the number of them on the streets increases during the scavenger hunt! However, the course of the scavenger hunts with more than 16.000 kilometres run shows that there is more exercise among children of all ages and that this may remain established in the long-term.

Since children and young people depend on their parents to cover long distances, they can only be considered as passengers in cars and thus only in this way for the **VKT** indicator.

For this purpose, reference is made to the survey on the modal split, which was carried out by a census at the primary school at Bauhausplatz on 6th of February (before “kreuz & quer” launch) and 20th of February (during “kreuz & quer” game). There, the means of transport used by the children to get to school and back home were surveyed. This produced the following results, for which particular reference should be made to the means of transport “car passenger”:

Transport mode	By foot	By bicycle or scooter	By car	By public transport
To school	53,0 %	36,8 %	7,3 %	3,0 %
Back home	62,6 %	34,1 %	3,3 %	0 %

Table 11: Modal Split of pupils at elementary school (Data: “kreuz & quer” 20.02.20220)

With regard to the school level, i.e. how the school children in the city are spatially assigned to a school, it is shown that the children in Domagkpark and Parkstadt Schwabing would have to cover a maximum distance of 1.5 kilometres one way and 3 kilometres both ways (see figure 11). On average, the distance to school is 0.7 km (one way) and 1.5 km (both ways).

For the state of Bavaria 38 school weeks are counted for the year 2018/19. This in turn means an average of 190 days of school. The total number of pupils at the primary school is 404 and moreover, 7,3% are brought by car in the morning and respectively around 29,5 pupils every day by car. This in turn would mean a distance of 44.2 km per day in general and 8.405 km per school year. For the ways back home, based on the changed modal shift, the sum is 3.799 km per year. As already mentioned, one explanation for the differences between the morning (to school) and afternoon (back home) modal shift could be that parents drop off their children at school on their way to work, but do not pick them up in the afternoon because they are still working.

Compared to the survey on 06th February, this indicates a reduction of 1.382 km per year (to school). In addition, this would also mean a reduction in the emissions caused.

Addressing indicators "7 - CO2 Emissions", "8 - NOx emissions", and "9 - PM emissions"

These emission indicators weren't assessed for measure MUC 2.9b. Because of its late implementation there cannot be any changes in the mobility behaviour to be expected.

Addressing indicator “10 - Contribution to policies, plans and programs”

The **contribution to policies plans and programs** can be generally being scored with a 5 out of 5 during the baseline because advertising and offering different actions for mobility education for children and adolescents within the Living Lab are important goals for the City of Munich. The implementation of those different actions is one big step towards a child-friendly and sustainable city, which is expected to have great impact in the long-term. The City of Munich pursues these goals with various municipal guidelines. This includes a firmly involved program and offer of children’s activities for all age groups and in all parts of the city. Politically, a separate department for mobility will be set up in the City of Munich in 2021, where the above-mentioned actions will be firmly implemented and even expanded. For this purpose, the “Munich Mobility Management” was created, whereby it is divided into different target groups, such as new citizen (cf. MUC 2.9a), senior citizens, companies (cf. MUC 2.9c) and at least children and young people. The City of Munich pursues these goals with various municipal guidelines. These include also new guidelines like the city-wide Sharing and Cycling Directive for parents. In general, the City of Munich committed itself in 2019 to an even more sustainable transport planning. This idea of sustainability will also be increasingly incorporated for the target group of children.

Addressing Indicators “Investment costs” and “Operational costs”.

Regarding the KPI **costs**, there are higher costs during the implementation phase than later during the operational phase. The biggest share being part of the investment are costs related to people and their time, means actors (“Let’s Go!” around 2.000 €; “Bus mit Füßen” around 1.500 €), program and web developers as well as equipment costs for game infrastructure (“kreuz & quer”, around 19.000 €). During the operation there was especially a high amount of money spent on the maintenance of the actions – especially for the scavenger game. Therefore, all boxes must be continuously checked for their operation.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1-3	Reducing energy use & CO ₂ emissions, reducing air pollution and reducing road congestions	NA	The level of emissions could not be determined because children themselves do not use motorized means of transport but are only passengers. However, the modal split shows a slight decrease in the distance travelled by car to school. However, this is not representative enough.
4	Improving accessibility for all	***	The mobility training addresses all children in all age in the Living Lab. By informing the children (education), gamification approaches (games) and accompanying the parents, the topic of sustainable mobility is brought closer in a safe and playful way.
5	Better social inclusion and equal opportunity	***	The children in the neighbourhood are approached through the support of local stakeholders (school, kindergarten, after-school care, at home by information provided by parents), thus all social groups can be reached. Due to the free offers in the school and local services, provided by the city, all groups are involved.
6	Improved liveability	**	As the results of the scavenger hunt show, the intensity of movement in public space increase through the actions (increasing health and safety feeling). However, a long-term change cannot yet be proven.
7	To test the new approach of providing mobility management to an entire housing/business area, i.e. embracing all mobility needs, interests and patterns	***	By involving all social institutions and stakeholders for child and youth work, all children in the neighbourhood could be reached. This was possible by the wide variety of actions.
8	To analyse how mobility behaviour of citizens and already resident in the city can be changed towards more sustainable modes and whether this neighbourhood approach can be transferred to other development areas	NA	As the actions are still ongoing, no long-term effect and change in behaviour can yet be measured. However, the participation in the actions proves a great success.
9	To make residents aware of the great variety of transport offers available to them and provide them with customized advice how to organize their individual mobility more sustainably and efficiently – not only the Living Lab but also in the entire city/region	**	The diversity of the measures and their methodological approach (information, communication and gamification) for all age groups significantly increased the visibility of the issue.
10	To encourage residents to test mobility offers and services that are new to them and to reduce barriers that inhibit making use of the offers (e.g. lack of knowledge, uncomfortable situations, insecurity)	***	The gamification approach and the playful nature of the activities in particular, show that the children are highly motivated to move around outside and to get around on foot, by bicycle or scooter. The children not only try out different means of transportation but also get to know their neighbourhood even better.
11	At least 30% of the contacted households will make use of the offer and order further material or incentives to test mobility services	NA	Not assessed in 2.9b

12	All three mobility management components (sub-measures a), b), c)) will achieve a reduction of 5% in car use, a reduction of CO2 emissions of 180 tons per year and a reduction of car kilometers of at least 870.000 km per year in the laboratory area	NA	Not assessed in 2.9b With children as passengers in the car, there is slight reduction in the modal shift, so it can be assumed that emissions will decrease slightly in the long-term. This is not a representative statement.
13	In addition, the measure will contribute to a reduction of NOx and PM emissions in the laboratory area, an increase in traffic safety and a decrease of accidents on the way to school	NA	Not assessed in 2.9b With children as passengers in the car, there is slight reduction in the modal shift, so it can be assumed that emissions will decrease slightly in the long-term. This is not a representative statement.
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded			

D. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

- During the implementation phase all actions show a great influence and impact on the mobility behaviour of the children
- The awareness and acceptance (cf. “Let’s Go!”: 78,8% liked the play, 52% evaluate it as an interesting topic, high understanding in the external effects of traffic; “Bus mit Füßen”: registrations 22 in 2019/20 and 37,5% satisfied parents 01/2020) of sustainable mobility for children and adolescents is very high due to the implemented actions
- Parents also accept these actions and show a high level of satisfaction with the actions and their objectives (cf. “Bus mit Füßen”: relief of parents, less concern, independence of children, knowledge about safety of children etc., 01/2020)
- Through the actions, the children move more actively outside in public space and thus develop a greater sense of security on the streets (cf. “kreuz & quer”: 894 registered players, increased walked distances: 16.773,6 km)

D.2 Relevance of supporting activities

- There were no supporting activities but the positive political landscape in the City of Munich to implement such measure to increase the awareness towards more sustainable mobility options
- There is less relevance of supporting activities, but high relevance of supporting stakeholders within the Living Lab

D.3 Interaction with other measures

- There was no direct interaction with other measures but the measure MUC 2.7 of the “Community information and participation portal” supported the action through the local network and communication platforms.

D.4 Main lessons learned

- Due to the very sensitive target group of children, it is necessary to set very high standards for data protection and a safe implementation of the actions in general (cf. “kreuz & quer”).
- Furthermore, with regard to the sensitive user group, the background and the course of the actions must be transparently communicated to parents and institutions. For this purpose, personnel is necessary who can take over this task continuously.
- The implementation of such measures benefits from a large network and cooperation with local organisations. Therefore, it is necessary to involve the stakeholders at an early stage
- Within the action “kreuz & quer”, technical expertise is necessary. Here, a continuous learning process is evident: learning by doing! A test of the game in advance is absolutely necessary.
- A continuous information and communication strategy with local child care facilities and parents is crucial: many actions have lost participation because after some time there was less information about them (cf. “Bus mit Füßen”).

- It is necessary to develop the actions over time. Especially with topics such as mobility, which is currently undergoing major changes, continues review and adaption is important. For example, the content of the theatre play must be further adapted.
- In summary, these actions are easy to implement and carry out, as children and young people are motivated to participate in the measures. This requires little infrastructure and costs, but much time for planning and communication with the child-care facilities.

D.5 Long term impact

- The long-term effect of the actions cannot be determined yet. However, there are already experiences of the actions in other urban areas. There, no direct dependency can be statistically determined. However, it is assumed that the awareness raising by these measures is nevertheless given.
- Due to the satisfaction and successful implementation of the measures, a continuation of these measures in the Living Lab and also outside of it is desirable and is being sought by the City of Munich.

D.6 Potentials for up-scaling in the city

- The holistic and attractive concept developed by the ML and the City of Munich can easily be up scaled in the City of Munich. The potential for up-scaling is given for all of the mentioned actions. In the case of up-scaling in Munich, the potential is to be evaluated as very large, since the lessons learned are already made and the actions are now easily transferable.
- In this respect, a transfer of the measure “kreuz & quer” is already planned in two other districts of Munich “Giesing” and “Trudering” in 2020
- As mentioned before, the time factor in particular is an essential factor for upscaling and less financial or infrastructural prerequisites.
- The “kreuz & quer” action in particular has great potential, as the measure is very well received by children and is easy to implement. Even though, this measure is, compared to other, the most expensive one.

E. Additional information

E.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

The evaluation of MUC 2.9b can be describe as a multi-layered method approach. One reason for this is the sensitive and therefore difficult to reach target group. The approach includes the following tools to measure the effects of the mobility training:

- Interview with parents “Bus mit Füßen”: 01/2020
- Study on the “Bus mit Füßen” (bachelor’s thesis) for long-term effect: 09/2018
- Interview with former ML “Bus mit Füßen”: 09/2018
- Interview with children “Let’s Go!”: 02/2020
- Study on the theatre play “Let’s Go!”: 2017/18
- Online survey of children, while registration for “kreuz & quer”: 02/2020
- Ongoing participant statistics “kreuz & quer”: 02/2020

All methods have a focus on qualitative methods. Due to the short-term implementation of all measures in late 2019 and 2020, there was no structured data collection. Some of the data are only available as a baseline or after-survey. This means that the changes in behaviour can only be calculated to a limited extent. In the future, a good organisation of the evaluation is essential.

Overall, a longer period between the baseline survey and the after-survey is necessary to obtain representative results at all.

Moreover, due to the short-term implementation in 2019 and 2020, no long-term effect is yet apparent. The measures only give a first impression of their effects while on-going. But cannot yet be statistically proven.

E.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

Due to the successful implementation of the actions (except “Bambini”) and the satisfaction of the children and their parents, all measures will be continued and expanded.

Based on the Lessons Learned, the continuation can be done quick and easy. Within the planned Mobility Department, the City of Munich will increasingly focus on the topics and promotion of child and youth mobility.

The actual impact should be measured with another survey being conducted after several more months because a change in mobility behaviour usually needs more time than a few weeks to occur.

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2020
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MUC 2.9c

Neighbourhood oriented marketing of sustainable multimodal mobility services: **Mobility management for companies**

Measure Evaluation Report

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THE CIVITAS INITIATIVE
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Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Elisabeth Nagl	

Table of Contents

ABSTRACT.....	411
A. INTRODUCTION.....	412
A.1 EXPECTED RESULTS OF THE MEASURE	412
A.1.1 Quantifiable impacts.....	412
A.2 MEASURE DESCRIPTION	413
A.2.1 Measure outputs.....	413
A.2.2 Supporting activities	413
A.2.3 Interactions with other ECCENTRIC measures.....	413
A.2.4 Interactions outside ECCENTRIC	413
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	414
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	414
A.5 IDENTIFIED RISKS	414
B. MEASURE IMPLEMENTATION	415
B.1 SITUATION BEFORE CIVITAS	415
B.2 INNOVATIVE ASPECTS.....	415
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	415
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	415
C. IMPACT EVALUATION FINDINGS	417
C.1 EVALUATION APPROACH.....	417
C.1.1 Expected impacts and indicators.....	417
C.1.2 Baseline.....	419
C.1.3 The business-as-usual scenario.....	426
C.2 MEASURE RESULTS.....	429
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	435
D. EVALUATION CONCLUSIONS	436
D.1 VALIDATED DIRECT IMPACT	436
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	436
D.3 INTERACTION WITH OTHER MEASURES	436
D.4 MAIN LESSONS LEARNED	436
D.5 LONG TERM IMPACT	436
D.6 POTENTIALS FOR UP-SCALING IN THE CITY	437
E. ADDITIONAL INFORMATION.....	438

E.1	APPRAISAL OF EVALUATION APPROACH	438
E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	438

List of Figures

Figure 1: Number of activated app users, 03/2019	419
Figure 2: Number of ride requests and actual rides carried out, 03/2019	420
Figure 3: Modal Split of Parkstadt Schwabing residents, 05/2018.....	421
Figure 4: Car ownership of Parkstadt Schwabing residents, 05/2018	422
Figure 5: VKT by household in Parkstadt Schwabing (density plot), 05/2018	422
Figure 6: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017). 423	
Figure 7: Saved distance (in km) in comparison to saved CO2 emissions (in kg), 03/2019	424
Figure 8: Modal Split in Munich (2008+2017)	426
Figure 9 Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)..	427
Figure 10: Number of activated app users, 10/2019	432
Figure 11: Number of ride requests and actual rides carried out,10/2019	432
Figure 12: Saved distance (in km) in comparison to saved CO2 emissions (in kg), 10/2019	433

List of Tables

Table 1: Quantifiable impacts.....	412
Table 2: Target groups or affected parties.....	414
Table 3: Measure stakeholders.....	414
Table 4: Risks.	414
Table 5: Modal split Fujitsu GmbH and Strabag AG	421
Table 6: Emission Factors (HBEFA, 2017)	423
Table 7: Parkstadt Schwabing Emissions, 2017	424
Table 8: Emission Factors (HBEFA, 2020)	427
Table 9: Parkstadt Schwabing Emissions 2020	428

Project	City		
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MUC 2.9c	Neighbourhood oriented marketing of sustainable multimodal mobility services: Mobility management for companies		
Last update	Responsible	e-mail	telephone
15.10.2019	Elisabeth Nagl	elisabeth-nagl@muenchen.de	+49 (0)89 / 233-39965

Abstract

The measure MUC 2.9 is divided into three sub-measures which aim to implement neighbourhood-oriented marketing of sustainable, multimodal mobility services in Domagkpark and Parkstadt Schwabing. Sub-measure MUC 2.9a deals with a direct and dialogue marketing which is organized through the ML's institution and conducted by a subcontracted firm which is preparing the marketing material and carrying out the marketing actions. The mobility management for local schools (MUC 2.9b) offers mobility education and training to children and their parents in order to strengthen active, independent and sustainable trips to school and leisure activities.

This Measure Evaluation Report shows the developments of MUC 2.9c which focuses on a comprehensive mobility management for companies, actually carried out within the campaign JobRide and the help of an existing ride sharing app called "TwoGo". The new programme is implemented and tested within four participating companies in the business area of the Living Lab, Parkstadt Schwabing using the app TwoGo cooperatively. The app aims to bring together employees which could possibly share their rides to and from work/home, in order to reduce congestion, emissions and alleviate the general parking pressure in Parkstadt Schwabing.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measures' implementation and the ex-post data, which focuses on the impact of MUC 2.9c.

Evaluation results for MUC 2.9c were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019) and statistical data provided by the subcontractor SAP who controls and maintains the used app TwoGo.

The JobRide campaign successfully found four interested testing companies. The biggest difficulty is the activation of potential users, though. If there is no investment in major marketing actions the app is not very intensively used. Due to a quiet low usage rate, there cannot be any reductions to be attributed to the implementation of the cooperation JobRide. The number of ride intents is very high (about 170 ride requests) compared to the number of rides actually carried out (about 2,5 rides) during the project lifetime. Nevertheless, by taking the lessons learned into account for the planned relaunch in 2020, it is expected that the number of trips will increase and the reduction of emissions will decrease significantly.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- Reduced energy use & CO2 emissions
- Reduced air pollution
- Reduced road congestion
- Improved accessibility for all
- Better social inclusion and equal opportunity
- Improved liveability

(2) Strategic level:

- New approach of providing mobility management to an entire housing/business area was tested, i.e. embracing all mobility needs, interests and patterns
- It was analysed how mobility behaviour of citizens already resident in the city could be changed towards more sustainable modes and whether this neighbourhood approach could be transferred to other development areas

(3) Measure level:

- The plan was to animate companies and their employees to decrease car use and shift to sustainable modes for commuting, local business travels and company fleets
- Furthermore, encourage employees working in the Living Lab to share rides / carpool to and from work in order to reduce motorised commuter traffic in the region and the Living Lab and reduce parking pressure at local level.
- All three mobility management components (sub-measures a), b), c)) were planned to achieve a reduction of 5% in car use, a reduction of CO2 emissions of 180 tons per year and a reduction of car kilometres of at least 870.000 km per year in the laboratory area
- In addition, the measure should have contributed to a reduction of NOx and PM emissions in the laboratory area, an increase in traffic safety and a decrease of accidents on the way to school

A.1.1 Quantifiable impacts

Expected Impacts	Wide awareness and acceptance of mobility services in the area. Increased use of the various existing and new sustainable mobility services. Increase of use of active modes. Reduced individual car use in Domagapark and Parkstadt Schwabing (for both way-to-school trips and commuters). The large majority of children (and their parents) go to day care/ school by sustainable modes, i.e. on foot, by bike or public transport.	CIVITAS ECCENTRIC Objectives								
		Reduce:				Improve:				
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight
1	Awareness about the mobility services among the residents and targeted groups					X	X			
2	Acceptance of mobility offers, sustainable mobility is a priority among residents and targeted groups					X	X	X		
3	Mode shift towards more sustainable modes by residents and targeted groups	X	X		X					
4	Reduction of car ownership among residents and targeted groups							X		
5	Reduction of VKT of residents and targeted groups	X	X							
6	Reductions of CO2 emissions from residents and targeted groups	X								
7	Reductions of NOx and PM emissions from residents and targeted groups		X							

Table 1: Quantifiable impacts.

A.2 Measure description

The measure aimed to implement neighbourhood-oriented marketing of sustainable, multimodal mobility services in the newly built areas “Domagkpark” and “Parkstadt Schwabing” (in 2016). Both residential areas are home to more than 8.000 people. In addition, over 200 companies are located in the business area of “Parkstadt Schwabing”. To achieve car independent lifestyles, people and companies need sustainable mobility concepts and the ability to make use of the mobility offers available.

Sub-measure c) offered mobility management to companies located in the business area of “Parkstadt Schwabing”. Following a wider company mobility management programme, the City of Munich initiated a cross-company ride sharing cooperation, called “JobRide” in order to reduce commuter traffic and emissions in the district and region.

The sub-measure is complemented by sub-measures a) *direct and dialogue marketing* and b) *mobility management for local schools* – see separate MERs/ PERs for details.

A.2.1 Measure outputs

The outputs from this sub-measure are:

- A mobility management concept for companies, mainly in the form of a joint ride-sharing platform for companies in the Living Lab (app, website, plus marketing/information for employees).

A.2.2 Supporting activities

Currently a parking management scheme is developed for the area. On-street parking will be reduced significantly, which could make ridesharing more attractive. In addition, families and children have joined forces in the neighbourhood to draw attention to the high volume of traffic in the neighbourhood. The City of Munich will deal with this request in 2020 and will develop further solutions, which will lead to a reduction in traffic in the long term.

The cooperation JobRide is based on the activities of the Munich Corporate Mobility Management and the Munich Climate Pact, which aim to promote ridesharing on a city-wide basis.

A.2.3 Interactions with other ECCENTRIC measures

Measure MUC 2.9c, known as the mobile application “JobRide” could possibly be announced within MUC 2.7 (Community information and participation portal). Measure MUC 2.7 is a community information and participation portal supervised by the ran by DomagkPark Genossenschaft eG. The website could promote the JobRide app in the section “News” or put the information into the regular newsletter.

A.2.4 Interactions outside ECCENTRIC

None

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
6	Commuters working in the Parkstadt	Living Lab	Parkstadt Schwabing

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	City of Munich (Department of Public Order, KVR)	P	C	L	Measure leader
2	City of Munich, Economic development	S	C	O	Coordinating authority for economic / business issues
3	BMM Companies, Company mobility	S	PR	P	Role model, multiplier, target group
4	Other Companies, Company mobility	S	PR	O	Target group
5	Ride sharing Provider	S	PR	O	Mobility service provider
6	Politics	S	C	O	Process support
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Number of companies is too low	Involvement	Circle of acquisition will be extended within the living lab, cooperation with companies to recruit users	ML
Number of active users is too low			

Table 4: Risks.

B. Measure implementation

B.1 Situation before CIVITAS

The Domagkpark and Parkstadt Schwabing are a newly developed housing area, and the new inhabitants have not received targeted information on sustainable mobility services and there was no such ride sharing app provided.

B.2 Innovative aspects

New organisational arrangements or relationships

For JobRide, it was a new approach to unite individual companies in an area for a joint car ridesharing platform. The aim was to bring employees together which commute on a daily basis with their car departing from the same part of the city or Munich's outer region and heading to the same company. The idea was to share rides and costs with other colleagues.

Targeting specific user groups

The specific user group is mainly consisting of employees of the companies in the Living Lab, Parkstadt Schwabing.

New policy instrument

The City acts as the platform provider for a multi-company cooperation. This is an innovative approach in influencing workplace mobility.

B.3 Research and Technology Development

An existing ridesharing app is used; the name is TwoGo. The application is maintained and set up by SAP.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning milestones

Based on the work of the Department of Labour and Economic Affairs of Munich, the interests and user needs of employees and companies in the project area could be analysed in order to reduce motorised private transport in the long term.

An operational mobility management programme has been carried out with several companies located in "Parkstadt Schwabing" in 2016 by the Department of Labour and Economic Affairs. Within this programme, the initiative of "JobRide" was created.

Phase 2: Procurement & Implementation

In cooperation with the department of Labour and Economic Affairs and the District Administration Office of Munich, the carpooling initiative "JobRide" has been fully prepared and officially launched in February 2018 with four participating companies. Through this initiative, 2.500 employees have already been reached as potential users. The initiative was launched with the help of a broad marketing campaign by the companies and the City of Munich.

Due to the communication and marketing strategy of the City of Munich and the participating companies, further interested parties could be won for "JobRide", who were invited to a network meeting in October 2018. For this purpose, a relaunch was discussed, which was scheduled for the beginning of 2019.

Due to some uncertainties of the software provider, the relaunch has been postponed and no new official licenses have been issued since March 2018. A continuation of existing customers was successfully implemented and was welcomed by the companies involved. In summer 2019, the software provider announced that the software “TwoGo” was sold, but that it would continue to be used. Nevertheless, the acceptance and thus the use of the App decreased.

In spring 2020, a new provider took over the existing software and in cooperation with the City of Munich, the “JobRide” initiative was continued and the planned relaunch will be implemented.

Phase 3: Demonstration & Monitoring

“JobRide” has reached the demonstration phase and is running continuously. Due to the successful demonstration of “JobRide” till summer March 2018, it was planned to re-launch the scheme in order to expand its outreach and open-up the cross-company collaboration for businesses located outside the pilot area in 2020.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Awareness	Acceptance	Satisfaction	Mode shift	Car ownership
Type	KPI	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	SOCIETY-PEOPLE	SOCIETY-PEOPLE	TRANSPORT SYSTEM	SOCIETY-PEOPLE
Subcategory	Acceptance	Acceptance	Acceptance	General	Accessibility
Aspect	Awareness level	Acceptance level	Satisfaction	Modal split	Physical accessibility to transport services
Definition	Percentage of residents with knowledge about the mobility services promoted as part of the mobility management campaign	Percentage residents who favorably receive or approve of the mobility management campaign	User/provider/stakeholder average reported satisfaction with the mobility management program.	Percentage of residents who permanently changed modes for the same trip (same origin and destination, time, and frequency). The main mode of a trip is that used for the longest stage of the trip by distance. For instances with stages of equal length, the mode of the last stage is used.	Cars owned per 1000 inhabitants of the populations aged 18 and over.
Unit	Percentage	Percentage	Score (0-5)	Percentage (various values)	Cars to inhabitants ratio
Method of data collection	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Individual survey on satisfaction with the direct and dialogue marketing campaign to a representative group of residents (e.g. through a questionnaire or focus groups).	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Survey of Domagkpark residents
Target group	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents

Impact	6	7	8	9	10
Indicator	VKT	CO2 Emissions	NOx emissions	PM emissions	Contribution to policies, plans and programs
Category	KPI	KPI	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ENVIRONMENT	ENVIRONMENT	ENVIRONMENT	SOCIETY-GOVERNANCE
Subcategory	General	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Planning
Aspect	Total Travel	Emissions	Emissions	Emissions	Planning process
Definition	Kilometers traveled by individuals	CO2 emissions produced by residents' mobility	Total NOx emissions produced by residents' mobility	Total PM emissions produced by residents' mobility	Qualitative measurement on the process to modify policies, plans and programs in a significant and definitive way.
Unit	Kilometers	Tons	Tons	Tons	Score (0-5)
Method of data collection	Survey (one survey for each targeted group, residents, pupils, employees) baseline and follow ups. Focus groups to understand the findings further	Estimation based on VKT (or PKT) of different target groups and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) of different target groups and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) of different target groups and average emission factors for the different transport modes available in the area	Surveys and interviews to decision makers
Target group	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Living Lab residents, pupils and employees	Decision makers

Impact	INPUT	INPUT	INPUT
Indicator	System Usage	Investment Costs	Operational Costs
Category	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ECONOMY	ECONOMY
Subcategory	General	Costs	Costs
Aspect	Transport System utilization	Investment costs	Operating Costs
Definition	Users and ride matches of the ride sharing sub-measure (sub-measure =1)	Total capital costs for purchase of equipment related to running the mobility marketing campaign. Preparation and design costs is defined as total costs expended setting up the measure covering a time period from the initiation of the measure preparation until the start of the measure implementation.	Personnel and maintenance costs for running the measure per time period
Unit	# of users, trip requests, and match rates	Euro	Euro / (time or usage unit)
Method of data collection	Documentation of the ride sharing users and trip statistics.	Data from financial reports, controlling	Data from financial reports, controlling
Target group	Ride sharing system users		

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	I – A	S	Residents/Children/Employees	Living Lab / Companies
2	Acceptance	%	I – A	S	Residents/Children/Employees	
3	Satisfaction	Score 0-5	I – A	S	Residents/Children/Users	
4	Mode Shift	%	B – (I) – A	S / E	Residents/Children/Users	
5	Car Ownership	Cars/Inh.	B – (I) – A	S / E	Residents/Users	
6	VKT	Km	B – (I) – A	S / E	Residents/Children/Users	
7	CO2 Emissions	Tons	B – A	E	Residents/Children/Users	
8	NOx Emissions	Tons	B – A	E	Residents/Children/Users	
9	PM Emissions	Tons	B – A	E	Residents/Children/Users	
10	Contribution to policies, plans, and programs	Score 0-5	A	E	City	City
	System usage	# of users, trips, requests	I – A	S	Residents/Users	Living Lab / Companies
	Investment costs	Euro	I	DC	ML	ML
	Operational costs	Euro	I	DC	ML	ML
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

C.1.2 Baseline

Baseline was obtained with two different sources:

- Statistical data provided by the subcontractor SAP who controls and maintains the app TwoGo. The data was extracted by the subcontractor and provided as excel sheet. Those statistics were obtained in 03/2019.
- Baseline data was conducted as a household survey which was addressed to all 2.100 households within the Living Lab (Domagkpark and Parkstadt Schwabing). The survey took place from 04/2018-05/2018. The participation rate was 27%, what means that 935 people answered the online survey or participated via telephone. The survey answered most of the KPIs while other KPIs are estimated by interviews with the Measure Leader.

Addressing Indicators "1 – Awareness", "2 – Acceptance", "3 – Satisfaction" and "System usage".

The **awareness** level can be described with the number of active users or so called system registrations of JobRide. Regarding three of the four (MAN, OSRAM and STRABAG) participating companies, the number of system registrations from the October 2017 until February 2019 has its highest peak in April 2018, when 71 active users were registered (see [Figure 2](#)). For one of the companies (Fujitsu) it wasn't possible to include the data because it was obtained in the wrong format. Overall, the number of active users is relatively low compared to the number of employees working in the testing companies, who could actually make use of the ride sharing application. Data origins from SAP statistics, obtained in 03/2019.

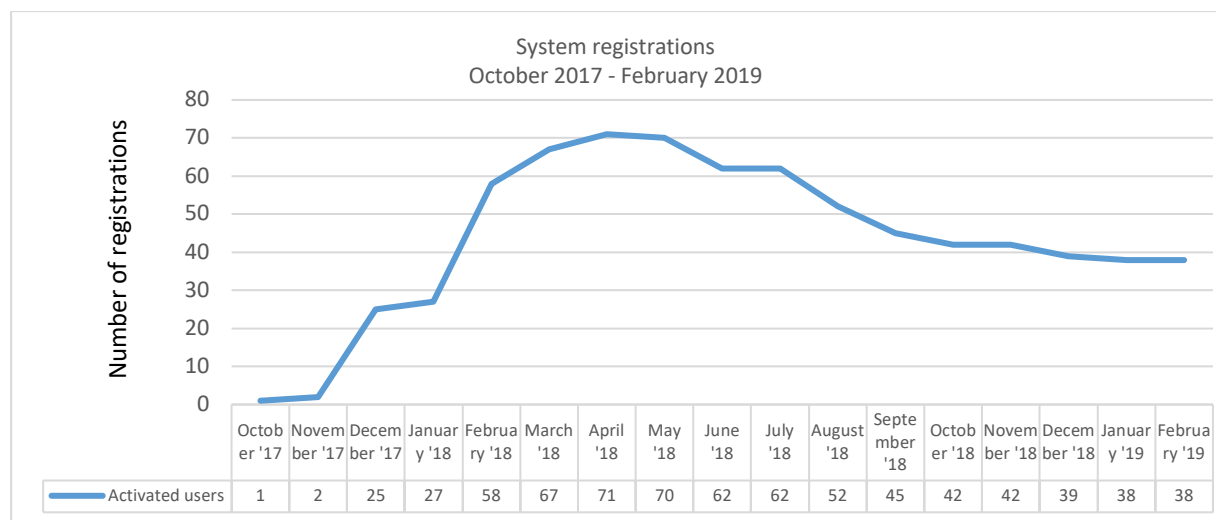


Figure 1: Number of activated app users, 03/2019

Acceptance can be described by the percentage share of activated users and the number of rides actually carried out. An assumption is that users have a higher acceptance to use the app if they successfully carry out rides and not only request them. Given these assumptions, the acceptance is at 1,48% (data: SAP, 03/2019).

The KPI **system usage** can be measured by the number of ride requests and the number of rides which were actually carried out. Otherwise it would just be a match and telling nothing about its accomplishment. Figure 2 shows that there is a huge difference between the number of ride requests (highest in May 2018 with 173 requests) compared with actual rides carried out (highest in March 2018 with 2,5 rides carried out). The number of carried out rides of 2,5

means that there was probably more than one passenger which was only joining part of the distance from A to B.

It could be said that the acceptance and **satisfaction** level of the JobRide application is not yet very high. The number of active users is strikingly decreasing after a period of six months, the reason for that is that users which are not actively using the application are deactivated from the system (see Figure 2). Due to the change of the software provider and the decreasing promotion activities, the use of the app was decreasing additionally. Data origins from SAP statistics, obtained in 03/2019. The score for the KPI **satisfaction** is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI. Due to the very low number of app users and very little rides being carried out, the score for satisfaction is assumed to be low, at 1 out of 5.

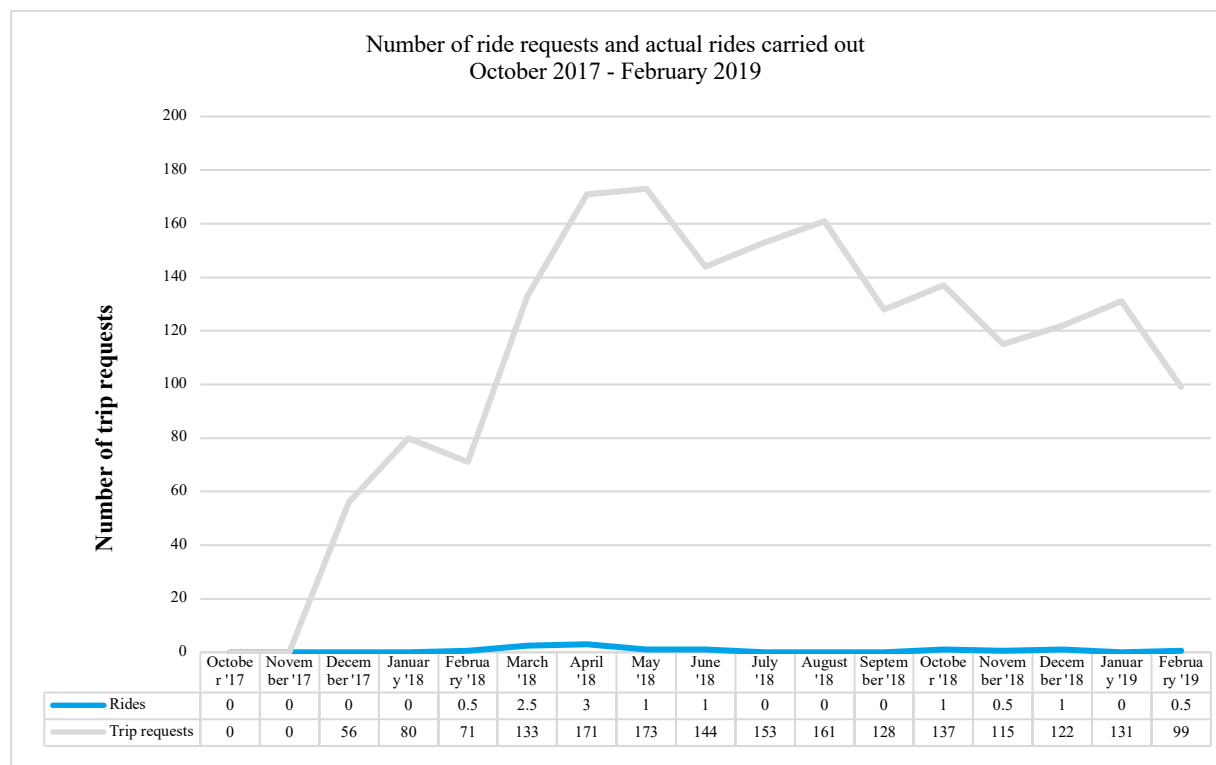


Figure 2: Number of ride requests and actual rides carried out, 03/2019

Mobility behavior of the target population

Addressing indicators "4 - Mode Shift/ Modal split", "5 - Car Ownership", and "6 - VKT"

There are only two of the participating companies, who carry out statistics about **modal split**. Fujitsu Technology Solutions GmbH (1.100 employees) and Strabag AG (450 employees). Table 5 shows the modal split which was collected by the ML between 09/2016 and 07/2017:

Fujitsu Technology Solutions GmbH (Date: 09/2016)	Strabag AG (Date:07/2017)
Car 52%	Car 53%
Public transport 35%	Public transport 32%

Cycling 11%	Cycling 8%
Walking 2%	Walking 7%

Table 5: Modal split Fujitsu GmbH and Strabag AG

To support the numbers of the companies above, there is the **modal split** for Parkstadt Schwabing shown in Figure 3 (data: household survey, 05/2018). Based on the answers of 442 persons who reported about 1.789 trips in September/ October 2018 as part of the household survey (10/2019). Most of the residents state that they are walking and cycling (in total 55%) and 19,7% drive their own car and 16,1% use public transport. Another 7% use bike, car- or ridesharing options.

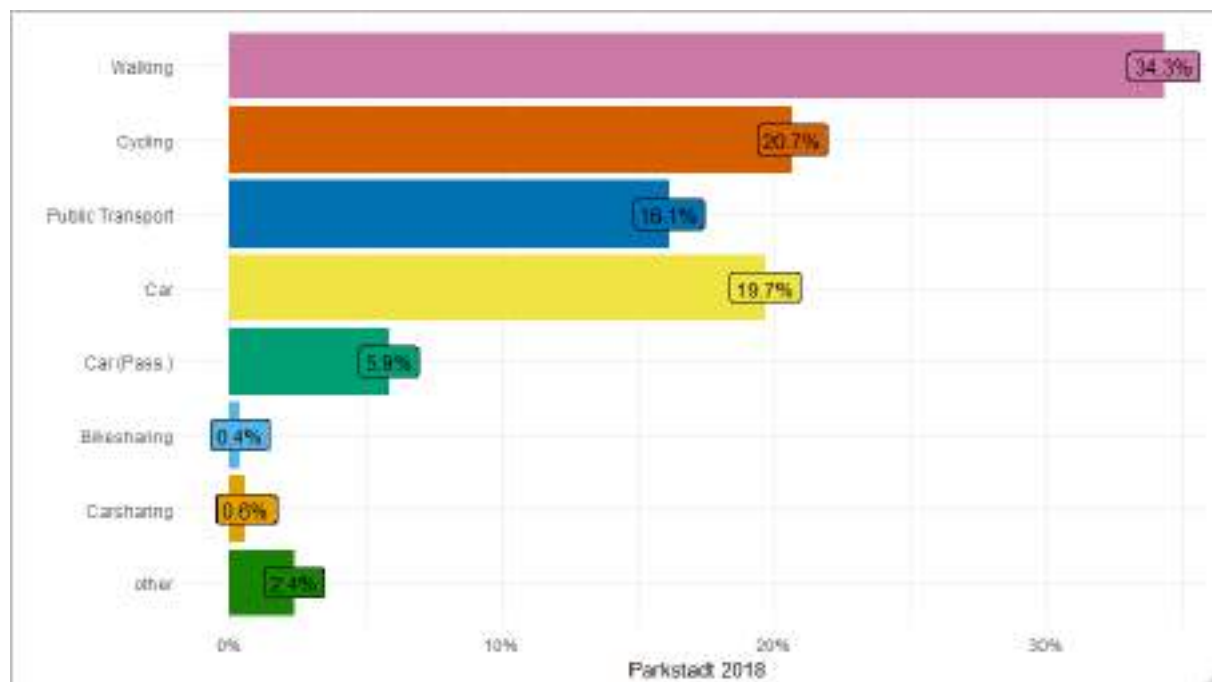


Figure 3: Modal Split of Parkstadt Schwabing residents, 05/2018

Regarding the number of employees using their car to get to their job, the **car ownership** ratio might be quite high. In both firms, Fujitsu Technology Solutions GmbH and Strabag AG, the share of people commuting by car is higher than 50%. About 32-35% are using public transport to get to work and less than 15% are commuting by bike or walking (see Table 5). When looking at the number of active users being registered having a car, there are only 98 employees in total (of all participating companies) to be mentioned (summed up from 02/2017-02/2019).

For a better comparison Figure 4 shows the **car ownership** for Parkstadt Schwabing conducted during the household survey in May 2018. 80,7% of all households own at least one car, 19,3% are without car. The average car ownership is at 1,03 cars per household (05/2018).

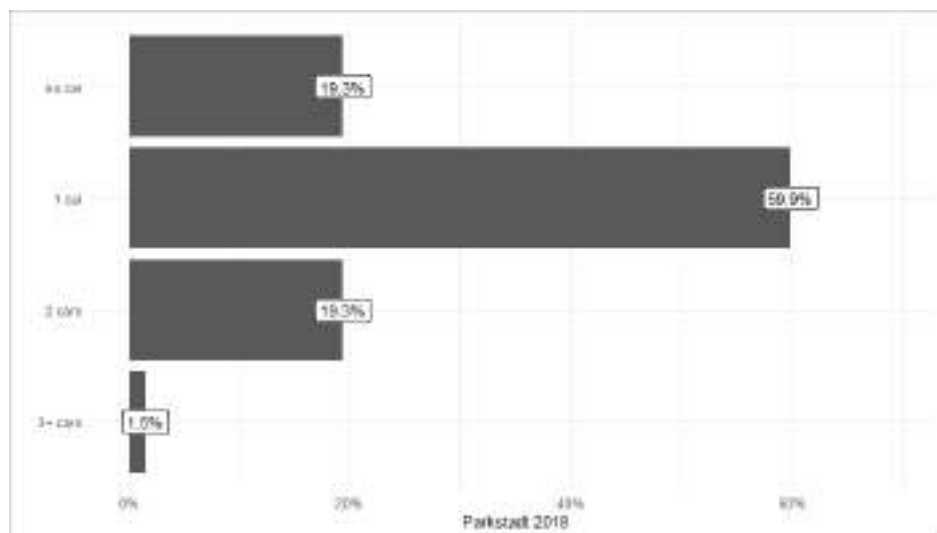


Figure 4: Car ownership of Parkstadt Schwabing residents, 05/2018

Regarding the **VKT** within the first two years after JobRide implementation (02/2017-02/2019) there are only 90,63 kilometers travelled via the ride share offer, measured by the distance travelled of the car driver (not the passenger). The kilometers measured could only be obtained from the MAN Truck & Bus Deutschland GmbH and Strabag AG. There were zero rides at the Osram company and again no adequate numbers from Fujitsu Technology Solutions GmbH company. On the other hand, 104 **VKT** in total have been saved within three of the four companies because of the use of the ride sharing application (data source: SAP, 01/2018-02/2019) (see Figure 7, p.424).

To support the **VKT** analysis of the SAP statistical data of JobRide there is the VKT by household for Parkstadt Schwabing shown in Figure 5. The average VKT per household (including also those without a car) is at 10.560 km per year, summing up to a total VKT in Parkstadt Schwabing (1.500 households with a car) of approx. 2,5 million VKT per year (whole Living Lab: 4,8 million VKT per year/household). The data was obtained with the household survey in May 2018.

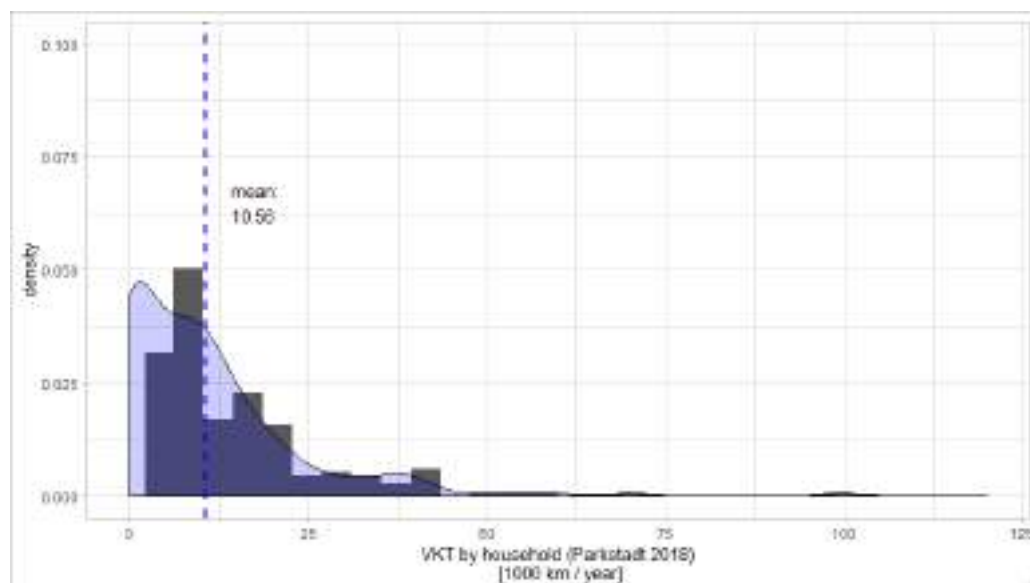


Figure 5: VKT by household in Parkstadt Schwabing (density plot), 05/2018

Transport-related emissions

Addressing indicators "7 - CO₂ Emissions", "8 - NO_x emissions", and "9 - PM emissions"

Emissions are calculated based on emission factors from the standard database "HBEFA" (*Handbook Emission Factors for Road Transport*) and information about both VKT and the vehicles in the living lab. See Table 5 for the used factors, based on the German fleet average.

The number of hybrid/electric cars is too low to be considered as a separate category.

In 2017 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

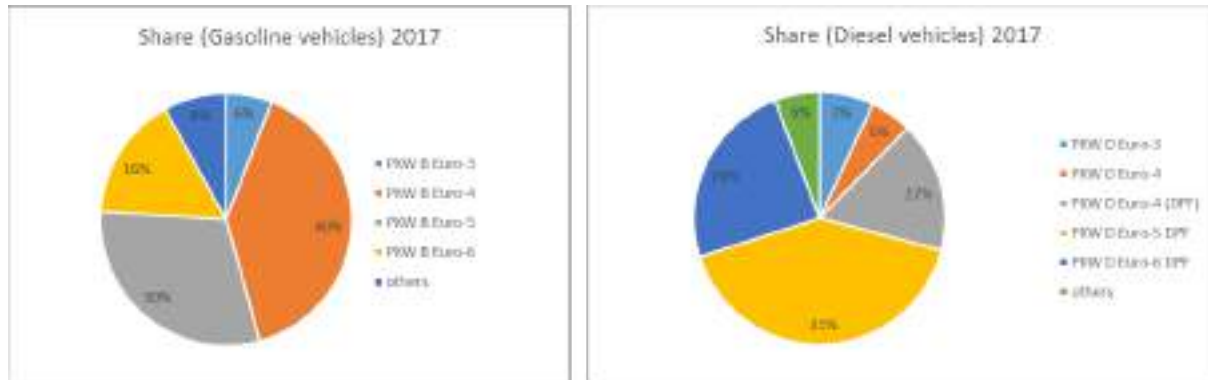


Figure 6: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)

The highest share among Gasoline vehicles consists of Euro 4 (40%) and Euro 5 (30%), followed by Euro 6 (16%). Regarding the Diesel vehicle share, there are 41% Euro 5 and 24% Euro 6. Euro 4 has a smaller share of 17%.

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	127,837 g/km
NO _x	Gasoline	0,060 g/km
PM	Gasoline	0,00102 g/km
CO ₂	Diesel	118,911 g/km
NO _x	Diesel	0,589 g/km
PM	Diesel	0,00675 g/km

Table 6: Emission Factors (HBEFA, 2017)

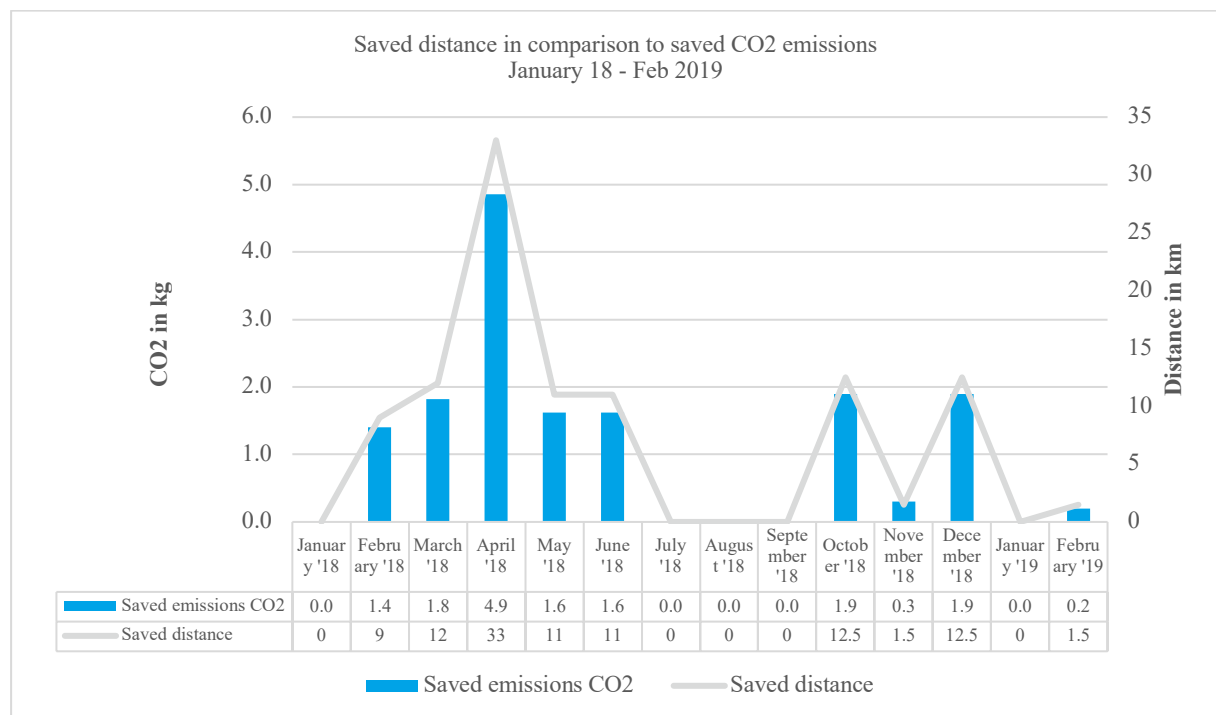
The following calculations are based on the HBEFA factors of 2017 and the annual VKT kilometres, differentiated by car type (first or second car) and fuel type (gasoline or diesel). The amount of kilometres is then multiplied with the HBEFA factors and number of cars mentioned in the household survey (conducted in 05/2018).

Thus, the total annual emissions (based on VKT) for all 1.500 households in Parkstadt Schwabing sum up to the following totals:

Pollutant	Emissions (2017)
CO ₂	2.213 t
NO _x	5,13 t
PM	62,109 kg

Table 7: Parkstadt Schwabing Emissions, 2017

In addition to the emissions factor assumptions by HBEFA, there is some data output regarding the **CO₂ emissions** which are saved with the help of the JobRide application. Figure 7 shows the saved distance in comparison the saved CO₂ emissions measured from January 2018 until February 2019 within three of the four participating firms (MAN, OSRAM and STRABAG). Throughout this period of 13 months 15,6 kg of CO₂ were saved. In April 2018 was the strongest month in terms of emission savings (4,9 kg) and in July and August there were no rides carried out because this is usually during Germany's summer break (school holiday). Data origins from SAP statistics, obtained in 03/2019.

**Figure 7:** Saved distance (in km) in comparison to saved CO₂ emissions (in kg), 03/2019

To get an overview about the companies which chose to join the JobRide project there is some basic information about the companies given.

Four companies decided to take part in the JobRide pilot, further companies were planning to join the project after the relaunch in Spring 2019. But because of complications with the app in 2018 and maintaining of the app services three interested companies withdraw from the project. Another big change occurred in 2019, when TwoGo was officially sold to another company.

The following data was collected by the Measure Leader in a small company-survey:

Fujitsu:

- 1100 employees in Parkstadt Schwabing
- 260 parking spots at the tower, further 70 rented in the surrounding (50 in parking garages at other companies, 20 outdoor)
- Modal Split of employees:
 - o 52% Private Car
 - o 35% Public Transport
 - o 11% Bicycle
 - o 2% Walking

MAN:

- 257 employees in Parkstadt Schwabing
 - o 121 parking spots in 4 locations
 - o No modal split information available

Osram:

- 800 employees in Parkstadt Schwabing
- 350 parking spots in shared facility with Amazon
- No modal split information available

Strabag:

- 450 employees in Parkstadt Schwabing
- 250 parking spots at the facility
- Modal Split of employees:
 - o 53% Private Car
 - o 32% Public Transport
 - o 8% Cycling
 - o 7% Walking

The **contribution to policies plans and programs** can generally be scored with a 3 out of 5 during the baseline because lowering emissions and pushing ride sharing are important goals for German companies. The implementation of the JobRide application is one good step forward for having a much more sustainable image as a company and lower the ecological footprint. The score could definitely be higher if more employees would use the system. Maybe some marketing actions could raise those number of active users.

Data on **investment and operational cost** was obtained for the ex-post evaluation when the implementation phase was completed.

C.1.3 The business-as-usual scenario

For **Awareness, Acceptance, and Satisfaction**, no significant changes are expected in the BaU-scenario. Without the JobRide application to foster ride sharing among commuting employees there will also be no change in the numbers of **system usage**, because the employees do not use any kind of ride sharing which is organized by their company, but maybe private organized ride sharing.

Car Ownership does not show big changes on the nationwide level (2002-2008-2017), while the ratio cars per inhabitants in the relevant part of the city ("between middle ring road and city boundary") has been decreasing slightly over the last 10 years, from approx. 430 cars per 1000 inhabitants in 2005 to 412 in 2015 (-1%). However, for the reporting period until 2020 stable conditions are to be expected.

Mode Shift & VKT

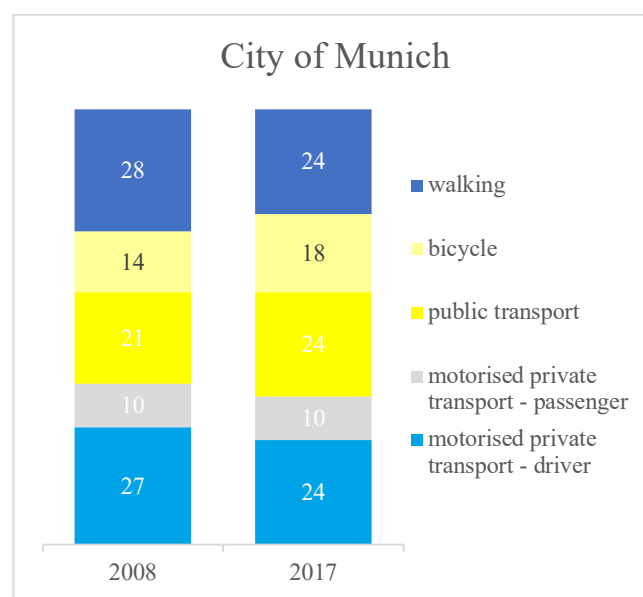


Image: City of Munich, Data: infas edited (2018)

Figure 8: Modal Split in Munich (2008+2017)

The nationwide mobility survey "Mobilität in Deutschland" acts as a reference to determine trends and future mobility behaviour in Munich.

In general, the Munich population drives less and walks less, while public transport (PT) and cycling increase over time (see Figure 14: change 2008-2017: car -3%, PT +3%, cycling +4%, walking -4%). Extrapolating this trend from 2008 to 2020, it can be assumed the following **mode shifts** in the BaU Scenario for 2020:

Car: -1%; PT: +1%; Bike: +1%; Walking: -1%

These changes will be reflected in **VKT** as well, so that VKT is expected to decrease by 1% as well, being cautious because nationwide, the km per vehicle are slightly decreasing (2017: -0,7%, Kraftfahrtbundesamt (2018) and the emissions are as well decreasing regarding the data of HBEFA 2020 scenario.

Note: A recent study by the Center Automotive Research (CAR) of the University of Duisburg-Essen published in 12/2019 that the number of cars is constantly increasing within the last ten years with regard to Germany's larger cities. Comparing the number of cars from 2009 until 2019, there is an increase of 18,5% in car ownership measured in Munich (cf. CAR, 2019). This resembles a different trend then expected above in the BaU scenario assumptions of 2018.

Emissions

In order to estimate BaU-emissions, the HBEFA projected emission factors for 2020 are used as well as the by 1% increased VKT that is assumed in the section " Mode Shift & VKT".

Thus, the following factors are used:

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	117,785 g/km
NO _x	Gasoline	0,049 g/km
PM	Gasoline	0,00108 g/km
CO ₂	Diesel	110,410 g/km
NO _x	Diesel	0,484 g/km
PM	Diesel	0,0045 g/km

Table 8: Emission Factors (HBEFA, 2020)

In 2020 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

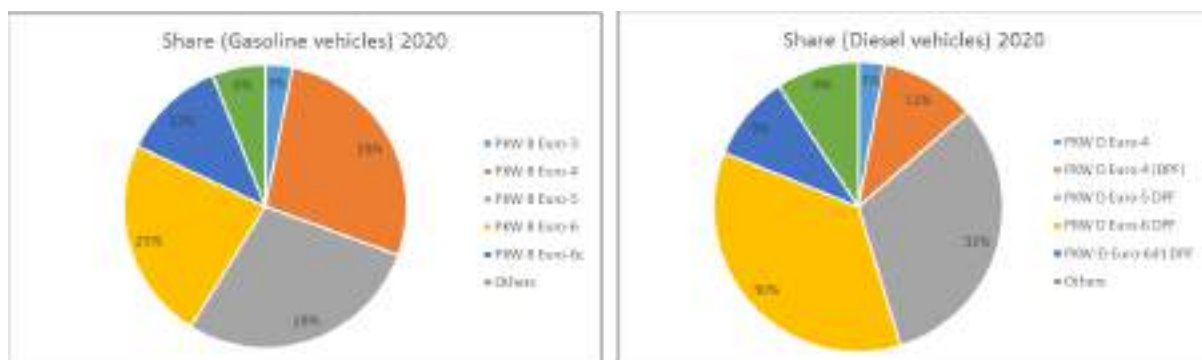


Figure 9 Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)

Regarding the Gasoline Euro classes in 2020, there are about two-thirds of all Gasoline vehicles to be found with Euro 4 (28%), Euro 5 (28%) or Euro 6 (23%). The share of Diesel vehicles is similar but compared to HBEFA 2017 assumptions, Euro 6 has the biggest share in 2020 (36%, 24% in 2017).

Note: These emission factors assume technological progress and a renewal of the average fleet in Germany until 2020. In the light of "*Dieselpgate*" and great uncertainties in the accuracy of emission information by the car manufacturers, the HBEFA assumptions have to be verified. New HBEFA assumptions are to be published in the end of 2019 (after MER2).

This results in the following emissions for 2020 (the calculation is analogue to the one in C.1.2) regarding Parkstadt Schwabing, where the measure mainly takes place:

Pollutant	Emissions (2020)	% change to 2017
CO ₂	2.055 t	-7%
NO _x	4,22 t	-18%
PM	45,648 kg	-27%

Table 9: Parkstadt Schwabing Emissions 2020

The KPI **Contribution to policies, plans, and programs** can best be evaluated at the end of the CIVITAS operation period. There is no baseline information available about this KPI.

Data on **investment and operational cost** was obtained at a later date for the after evaluation when the implementation phase was completed.

C.2 Measure results

The following table shows the measure results of MUC 2.9c, Mobility management for companies. In some cases, the Business as Usual scenario is valued as not assessed (NA) because there would not be any other developments without the implementation of this measure.

Indicator	Unit	Before		Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	4,7		10/2017-02/2019	NA	-	3,0	03/2019-10/2019	-1,7	NA
Acceptance	%	1,48		03/2018	NA	-	0,42	10/2019	-1,06	NA
Satisfaction	Score 0-5	Score: 1		02/2019	NA	-	1	10/2019	+0	NA
Modal split/ Mode Shift	%	Fujitsu: Car: 52% PT: 35% Cycling: 11% Walking: 2%	Strabag: Car: 53% PT: 32% Cycling: 8% Walking: 7%	Fujitsu: 09/2019 Strabag: 07/2017	NA	-	NA	-	NA	NA
		Modal split Parkstadt Schwabing: Walking: 34,3 Cycling: 20,7 PT: 16,1 Car: 19,7 Bikesharing: 0,4 Carsharing: 0,6		05/2018	Modal split Munich: Walking 23 Cycling 19 PT 25 Car: 33	2020	NA	-	NA	NA
Car Ownership	Cars/employees	98 cars/343 system users (employees)		02/2019	NA	-	NA	-	NA	NA
	%	No car: 19,3 1 car: 59,9 2 cars: 19,3 3+ cars: 1,5 1,03 cars/household		05/2018	NA		NA	-	NA	

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After–BaU
VKT	km/ year	Distance travelled: 45,31 km/year Distance saved: 104 km/year	10/2017-02/2019	Parkstadt Schwabing: -1%	2020	Distance travelled: 0 km/year Distance saved: 0 km/year	03/2019-10/2019	-45,31 km/year	NA
		Parkstadt Schwabing: 10.560 km/year	05/2018						
CO2 Emissions	tons	Parkstadt Schwabing: 2.213	05/2018	Parkstadt Schwabing: 2.055	2020	NA	10/2019	NA	NA
	kg	MUC 2.9c users: CO2 savings (by MAN, OSRAM, STRABAG): 15,6	01/2018-02/2019	NA	-	MUC 2.9c users: CO2 savings (by MAN, OSRAM, STRABAG): 3,7		CO2 savings (by MAN, OSRAM, STRABAG): 11,9	NA
NOx Emissions	tons	Parkstadt Schwabing: 5,13	05/2018	Parkstadt Schwabing: 4,22	2020	NA	-	NA	NA
PM Emissions	kg	Parkstadt Schwabing: 62,11	05/2018	Parkstadt Schwabing: 45,65	2020	NA	-	NA	NA
Contribution to policies and plans	Score 0-5	Score: 3	02/2019	NA	-	Score: 3	10/2019	+0	NA
System usage	No. of usage	Ride requests: 173	05/2018	NA	-	Ride requests: 169	10/2019	-4	NA
Investment costs	Euro	costs related to people and their time (in €) other cost: marketing agency 8.540,00			costs of equipment/ infrastructure and capital (in €) material (production of leaflets etc.)2.000,00				
Operational costs	Euro	other: software license cost 10,00 / employee							

Note: The second evaluation phase to measure the final impact of MUC 2.9c, is regarding a shorter time period compared to the first evaluation period. Therefore, the data is not always comparable and difficult to interpret. Due to restructuring of the subcontractor SAP and a future change of subcontracting conditions¹⁴ for the ML, the measures' progress was not always pushed forward as expected. The maintaining of the app and the corresponding services by the subcontractor have diminished over time due to these changes.

Remember:

- Baseline: 10/2017 – 02/2019
- After: 03/2019 – 10/2019

Another method to obtain ex-post data, was the second household survey which took place in the Living Lab in September and October 2019. 2.095 households were contacted and 328 households participated, this resembles a total number of 563 persons and a participation rate of 16% (27% in the first household survey, 05/2018).

Addressing Indicators "1 – Awareness", "2 – Acceptance", "3 – Satisfaction" and "System usage".

The **awareness** is measured by the total number of employees potentially being able to use the job ride app and the number of activated at its highest peak during a fixed period. The awareness level can be described with the number of active users or so called system registrations of JobRide. As stated in the baseline scenario the highest number of activated users was in April 2018 (71 registered users). In the second evaluation phase the number of active users is between 30 (in 10/2019) and 45 (in 05+06/2019) users (regarding MAN, OSRAM and STRABAG) (see Figure 10). For one of the companies (Fujitsu) it wasn't possible to include the data because it was obtained in the wrong format.

Overall, the number of active users is relatively low compared to the number of employees working in the testing companies, who could actually make use of the ride sharing application. The awareness is measured by the total number of employees (1.507 employees of MAN, Strabag and Osram, in summer 2018) and the number of activated users. This ratio gives an awareness level of 4,7% for the Baseline and 3,0% for the ex-post evaluation. The ratio for ex-post scenario assumes a constant number of employees working at the three participating firms. Data origins from SAP statistics, obtained in 10/2019 and by ML.

¹⁴ The application TwoGo was unexpectedly sold in autumn 2019. A new subcontractor is starting in 02/2020.

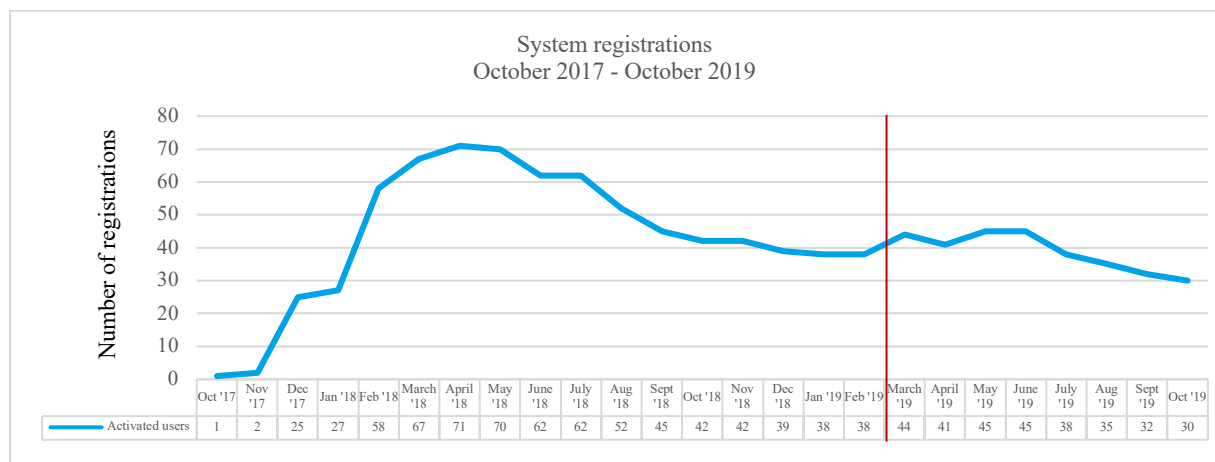


Figure 10: Number of activated app users, 10/2019

The **acceptance** is measured similar to the assumptions made in section C.1.2 Baseline (p. 419). Given these assumptions, the acceptance is at 0,42% (data: SAP, 10/2019). Before the percentage was at 1,4% (03/2018).

System usage can be measured by the highest number of requests and the number of rides actually carried out. The percentage can state how much users are willing to get involved with the system and actually book a shared ride via the application. The graphs in Figure 11 show a similar picture in the continuation after the first evaluation period (10/2017-02/2019) for the second period from February 2019 until October 2019. The most ride requests were in October 2019 (169 request) but the number of actual rides carried out is still very low with the highest in May and August with 0,5 rides. Data origins from SAP statistics, obtained in 10/2019

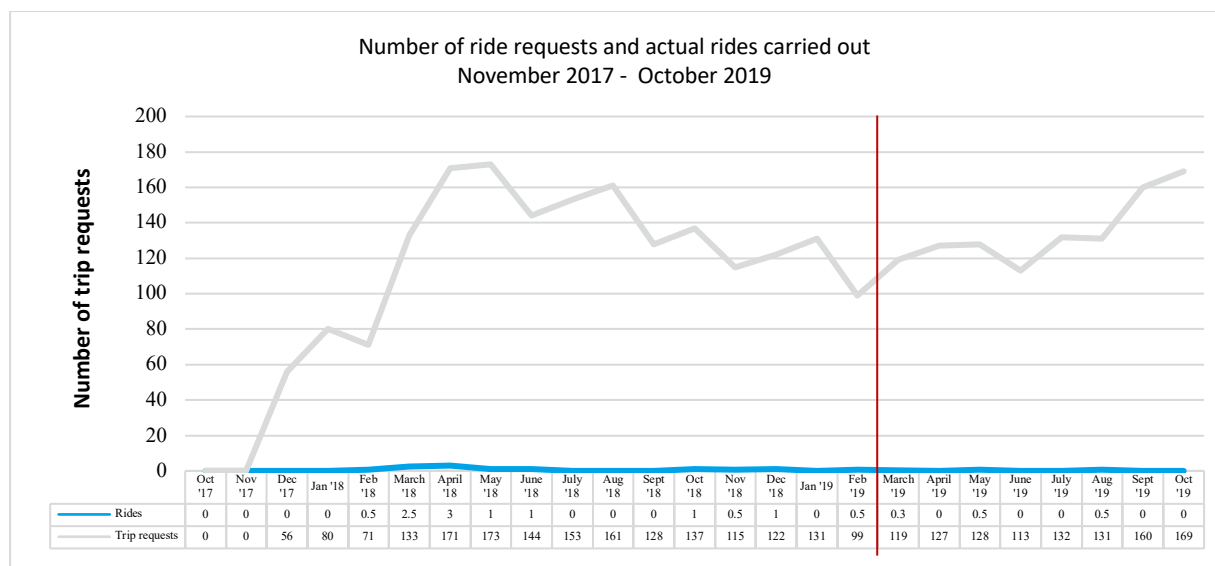


Figure 11: Number of ride requests and actual rides carried out, 10/2019

The scores for the KPI **satisfaction** is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI. In this case there is no visible development in the number of actual rides carried out, but still a quiet high number of ride request, therefore it can be assumed that the satisfaction rate is still very low with a score of 1 and didn't develop from the Baseline until the ex-post evaluation.

Addressing indicators "4 - Mode Shift/ Modal split" and "5 - Car Ownership"

Indicators could not be assessed in the after-scenario.

Addressing indicator "6 - VKT"

Statistical data of the measure's subcontractor shows that there were zero kilometers traveled by JobRide users in the second evaluation period of MUC 2.9c.

Addressing indicators "7 - CO2 Emissions", "8 - NOx emissions", and "9 - PM emissions"

The statistical data of the TwoGo app can be used to show the development of kilometres and CO2 which were saved by using the ride share offer. Figure 12 shows that there are only few months where actually rides were undertaken and therewith CO2 and distance saved. In August 2019 (regarding only the second evaluation period for ex-post, 02/2019-10/2019) there were 25 kilometres saved through a ride share and consequently 3,7 kg of CO2 saved. During months of school holidays (April, June, July) there are as expected less rides carried out. Data origins from SAP statistics, obtained in 10/2019.

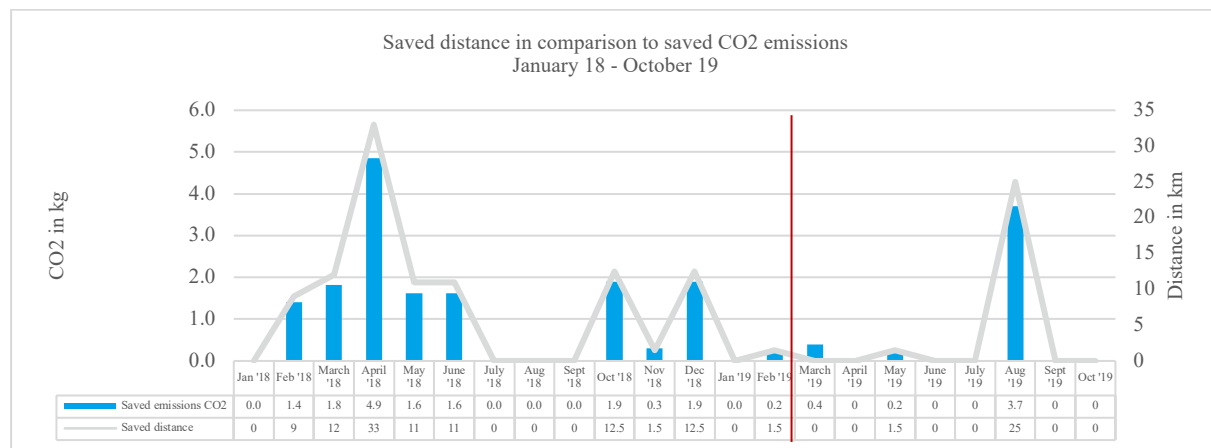


Figure 12: Saved distance (in km) in comparison to saved CO2 emissions (in kg), 10/2019

Other emission factors like PM and NOx haven't been tracked by the subcontractors' statistics and therefore couldn't be obtained for ex-post evaluation.

The **contribution to policies plans and programs** can generally be scored a bit better compared to the Baseline with a score of 4 out of 5, due to a higher commitment outside CIVITAS ECCENTRIC. The score could definitely be even higher if more employees would use the system. Maybe some marketing actions could raise those number of active users. Regarding the planned Relaunch in February 2020, it is expected, that the scope and acceptance of JobRide will increase significantly.

In addition, programs such as the European Metropolitan Region of Munich or the Inzell Initiative are trying to develop and promote similar strategies, which have been discussed recently in the context of JobRide. With regard to the corporate culture in Munich, companies again came together in 2019 to sign the second Munich Climate Pact in order, among other things, to achieve sustainable mobility.

Regarding the **investment and operational costs** there is not much to report but costs for a marketing agency about 8.540 Euro which was a one-time payment during the implementation phase to advertise the JobRide offer. In addition to that there are com material costs for producing marketing material like leaflets. Another expenditure which has to be spend during

the ongoing operation, are software license costs. That is about 10 Euro for employee using the system.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Reducing energy use, CO2 emissions, air pollution and road congestion	NA	The expected reduce of emissions and road congestions could presumably not fully be achieved by the implementation of the mobility management measure which offers internal ride shares via an app TwoGo. There is a certain number of employees using the app and sending ride requests but there is rarely a match and consequently a common ride carried out. However, the continuation of the measure was not possible within the planned scope due to the chance of the software provider. Thus, new licenses could no longer be issued and advertising was no longer placed by the companies. In case of an ongoing marketing strategy and a technical continuation of the app (software provider), better achievements are expected.
2	Improving accessibility for all, better social inclusion and equal opportunity	★★	The TwoGo app is available for all employees of the participating companies within the business area of the Living Lab, Parkstadt Schwabing. As there was no such ride sharing app before the accessibility of using more sustainable ways of transport, here ride sharing, has improved. The app also attracts people not owning a car and therefore ensures a social inclusion.
3	Improved liveability	*	The app should serve all employees of the participating companies and reduce road congestion in the busy Parkstadt Schwabing area and on the other hand improve the comfort level of sharing rides. All in all an improved livability can be partly ensured by the app implementation.
4	To test the new approach of providing mobility management to an entire business area	*	There are five companies in total which planned to test the mobility management with their employees. The ML was successful in promoting the project and find interested partners. But in the end the active participation level among the companies was very divers. Some companies did not promote the app as expected before and the usage is quiet low or zero compared to others.
5	All three mobility management components (sub-measures MUC 2.9a), b), c)) will achieve a reduction of 5% in car use, a reduction of CO2 emissions of 180 tons per year and a reduction of car kilometers of at least 870.000 km per year in the laboratory area	NA	Regarding sub-measure MUC 2.9c) there is no notable reduction of emissions or car ownership to be observed within Parkstadt Schwabing. Developments in the Living Lab cannot be attributed to the implementation of the JobRide cooperation, though. However, an evaluation of the target for the measure can hardly or not at all be given, since the campaign was on hold due to the change of the software provider. Thus, it is not possible to give a scientifically representative statement on the objectives, since the app couldn't be advertised.
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded			

D. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

- Four companies located in Parkstadt Schwabing joined the JobRide cooperation and used the given app in their companies.
- The number of activated users varies from month to month and is at all times relatively low, due to the low advertising capacities in the companies.
- There is a quiet high number of ride requests per month but a very low number of rides is actually carried out in the end.

D.2 Relevance of supporting activities

- In the case of the planned parking management scheme, a round table has already been set up in the “Parkstadt Schwabing”, where residents and companies as well as the City of Munich are discussing about solutions, to reduce traffic in the neighbourhood.
- There is no information if the planned parking management scheme within the Living Lab is positively influencing the implementation of the JobRide cooperation yet. However, it can be assumed that the planned restrictions on parking space for employees in 2020 will lead to an increased visibility for JobRide.
- The activities, such as the “Corporate Mobility Management”, the “Climate Pact Munich” or the “Inzell Initiative” continue to be regarded as a very important support for the JobRide cooperation, by raising its visibility and acquiring new members for the cooperation.

D.3 Interaction with other measures

- Due to its focus on companies in Parkstadt Schwabing and their employees, there is less interaction with other ECCENTRIC measures. The website www.domagkpark.de was used to promote the JobRide app and attract companies to participate in the app testing phase.
- Promotion material was handed out during events of other measures.

D.4 Main lessons learned

- Without an intense marketing campaign promoted by the companies, it is rather difficult to attract potential app users.
- If there is a contact person in the company who gives direct support for the app users and helps to inform potential users about the usage, the awareness and acceptance of the app will possibly improve.
- Above all, the contact to the app provider and companies must be maintained more intensively in order to be informed about possible changes at an earlier stage.

D.5 Long term impact

- If the app is used more intense than it is used now, there is presumably a long term impact measurable regarding the reduction of emissions or congestion.
- But currently there is no big long term impact to be foreseen due to a very low usage rate and a very low number of actual rides carried out as ride shares, caused by the change of the software provider.

D.6 Potentials for up-scaling in the city

- The JobRide cooperation has great potential to be up scaled in the city due to its already practiced approach and the simple app programming which is no innovative aspect in itself.
- As a result of the conducted evaluations, it is recommended to put more effort into marketing actions which promote the app and the measure as such.
- Based on the good cooperation and exchange with other initiatives (Corporate Mobility Management, Climate Pact Munich, Inzell Initiative etc.) an innovative parking management scheme will also be established within the pilot project area “Neumarkter Straße” in Munich, for which the JobRide theme shall also be incorporated.
- Due to the high registered interest of other companies and institutions in Munich, the general potential is seen as high. In particular, the relaunch appointment on 18th of February 2020 is considered as a milestone for the replicability and expansion of the measure.

E. Additional information

E.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

The evaluation approach included regular statistics given by the subcontractor which is supervising the app and the usage data. Due to unclear definitions, the companies' data about the system usage was delivered in different ways, e.g. monthly vs. daily data or less precise numbers on the companies' mode split.

In addition to that, there were several interviews with the ML about the current status of the project. To conduct more qualitative insights into the implementation of the JobRide app, it could be helpful to involve the Local Evaluation Manager (LEM) into all kinds of actions, meetings or information spread via email.

To summarize, the evaluation approach was probably too one-sided only relying on data delivered by the subcontractor, supervising the JobRide app. But on the other hand it wasn't easy to get in touch with the numerous companies taking part in the app testing. Often there is not enough willingness or time by single key contacts to promote the project or deliver data or even conduct an internal employee survey.

E.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

Because it's difficult to find partners within the companies who promote the app and argue on behalf of the measure, there could more marketing actions be implemented within the companies to make the project more visible.

Another very important activity is a user online survey which should be conducted to find out why employees are actually not using the app or more important why there are so many ride requests but almost no matches or rides carried out. This was mainly addressed with the Detailed Process Evaluation of MUC 2.9c.

Future activities are yet unclear because the JobRide app was sold to another firm which took over in February 2020. Based on an appointment with the City of Munich and the new software provider in December 2019, the app was planned to be continued in the same way and in the long run, the offerings would even be expanded, and usability increased. The provider showed great interest in continuing and improving the program together with all participants.

According to the planned parking management, which is to be implemented in the beginning of 2020, it is expected that the companies will deal more intensively with the topic of traffic and thus show greater willingness to cooperate within the initiative JobRide. Therefore, talks with the companies were already planned for February, 18th in 2020, to carry out the relaunch.

Based on the JobRide initiative, there are already further city-wide considerations to establish and advertise similar programmes, such as with the Munich transport associations. The objective is a future joint strategy based on the results of CIVITAS ECCENTRIC.

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2020
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ECCENTRIC



MUC 2.10

Transfer – Exchanging communication and information technology for everyday mobility between generations

Measure Evaluation Report

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2020
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3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
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	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
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24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Julia Fröbel	
Lea Wiser	

Table of Contents

ABSTRACT.....	447
A. INTRODUCTION.....	448
A.1 EXPECTED RESULTS OF THE MEASURE	448
A.1.1 Quantifiable impacts.....	448
A.2 MEASURE DESCRIPTION	449
A.2.1 Measure outputs.....	449
A.2.2 Supporting activities	449
A.2.3 Interactions with other ECCENTRIC measures.....	449
A.2.4 Interactions outside ECCENTRIC	450
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	450
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	450
A.5 IDENTIFIED RISKS	450
B. MEASURE IMPLEMENTATION	452
B.1 SITUATION BEFORE CIVITAS	452
B.2 INNOVATIVE ASPECTS.....	452
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	452
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	453
C. IMPACT EVALUATION FINDINGS	455
C.1 EVALUATION APPROACH.....	455
C.1.1 Expected impacts and indicators.....	455
C.1.2 Baseline.....	457
C.1.3 The business-as-usual scenario.....	463
C.2 MEASURE RESULTS.....	465
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	472
D. EVALUATION CONCLUSIONS	473
D.1 VALIDATED DIRECT IMPACT	38
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	38
D.3 MAIN LESSONS LEARNED	38
D.4 LONG TERM IMPACT	39
D.5 POTENTIALS FOR UP-SCALING IN THE CITY	39
E. ADDITIONAL INFORMATION.....	475
E.1 APPRAISAL OF EVALUATION APPROACH	475

E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	475

List of Figures

Figure 1: Seniors Bikesharing Awareness/ use Change	467
Figure 2: Seniors Carsharing Awareness/ use Change	467
Figure 3: Seniors Behavior Change Willingness	467
Figure 4: Students Behavior Change Willingness	467
Figure 5: Seniors Public Transport Information Change	468
Figure 6: Students Public Transport Information Change	468
Figure 7: Seniors Public Transport Ticketing Change.....	468
Figure 8: Students Public Transport Ticketing Change.....	468
Figure 9: Seniors Expectations met	469
Figure 10: Students Expectations met	469
Figure 11: Seniors Cooperation Evaluation	469
Figure 12: Students Cooperation Evaluation	469
Figure 13: Seniors Mode Shift.....	470
Figure 14: Students Mode Availability Change	470
Figure 15: Seniors Mode Availability Change	470

List of Tables

Table 1: Quantifiable impacts.....	448
Table 2: Target groups or affected parties.....	450
Table 3: Measure stakeholders.....	450
Table 4: Identified risks.....	451
Table 5: Overview baseline.....	457
Table 6: Participants by School (period 1+ period 2).....	458
Table 7: Gender.....	459
Table 8: Bikesharing.....	459
Table 9: Carsharing (only seniors).....	459
Table 10: Availability of modes.....	460
Table 11: Frequency of mode usage.....	460
Table 12: Seniors: Transfer vs. City of Munich.....	461
Table 13: Information and Ticketing.....	462

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04.11.2019	Lea Wiser	lea.wiser@greencity.de	0049 89 890 668 328

Abstract

The measure MUC 2.10 Transfer - Exchanging communication and information technology for everyday mobility between generations was implemented with the aim to give senior citizens a better understanding of the possibilities of modern communication devices in terms of sustainable mobility in everyday life. The setup for exchanging mobility knowledge between generations are workshops which take place in secondary schools, led by the Measure Leader and accompanied by the student's teacher.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measures' implementation and the ex-post data, which focuses on the impact of MUC 2.10.

Evaluation results for MUC 2.10 were retrieved from paper-based evaluations with the students and seniors conducted at different times: before the workshop started, right after the workshop and six months after the workshop took place. The participation rate was throughout very high, except for the ex-ante evaluation which was sent via post to the seniors and therefore had less answers.

The intergenerational exchange plays a big role within the measure and in the end exceeds the expectations of both measure target groups, secondary students from 13 to 17 years old and seniors living in Munich. More than 82% of the seniors and students stated that their expectations of the workshops were fully and predominantly met. Almost 95% of both groups found the cooperation between generations good and very good. Of originally planned 16 workshops, 15 already could be executed during the evaluation period and 11 of them are assessed for the ex-post evaluation. In total 400 participants from 7 different schools actively took part in the workshops.

In addition to an increasing awareness of the students and the seniors for a more sustainable way of transport, there is an increase to be recognized in the usage of "smart" devices, like smartphones, tablets and the internet (in total about +17%) used for getting ticket information in general, especially among the seniors.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/longer term:

Transfer sets an incentive to widen the range of mobility by showing how helpful smartphones and the internet can be to use other means of transport besides the own car. This is a direct contribution to reduce traffic and CO₂-emissions in urban areas.

(2) Strategic level:

Raise awareness on energy-efficient travel options (walking, public transport, cycling, car sharing and public bicycles) and promote them as alternatives to the private car.

(3) Measure level:

Short term objectives

- Increasing the attractiveness and safety of energy-efficient modes of transport for both target groups
- Empowering elderly people to use modern technologies and devices for planning their daily mobility
- Fostering intergenerational exchange and understanding

Long term objectives

- The main objective is to give senior citizens a better understanding of the possibilities of modern communication devices in terms of sustainable mobility in everyday life
- Knowledge of using applications makes it easier to use public transport and is likely to have an impact on the personal choice of transportation
- Raising awareness of energy-efficient travel options (walking, public transport, cycling, car sharing and public bicycles) and promoting them as alternatives to the private car.

A.1.1 Quantifiable impacts

		CIVITAS ECCENTRIC Objectives								
		Reduce:				Improve:				
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight
ID	Quantifiable Impacts									
1	Awareness about the mobility services among the target groups					X	X			
2	Acceptance of mobility offers, sustainable mobility has priority among residents					X	X	X		
3	A satisfactory and beneficial experience from the workshop					X	X			
4	Mode shift towards more sustainable modes by different target groups	X	X		X					
5	Train participants in the use of modern technologies and devices and use them for travel planning					X	X			

Table 1: Quantifiable impacts.

A.2 Measure description

In this measure, schoolgirls and boys aged between thirteen and seventeen taught senior citizens how to use web-based applications for organizing their daily mobility.

In the first workshop series the educational specialized staff of Green City e.V. prepared the pupils for the following interaction with elderly people: Contents were a coaching about technologies and devices for mobility planning, as well as background information about CO2 emissions of different means of transportation and their impacts on our environment and climate. The teenagers made themselves familiar with applications on smartphones, tablets and computers for sustainable mobility alternatives, and developed important principles and practices on how to interact with elderly people. Exercises with an old age suit helped the teenagers' imagination to put themselves into the position of the elderly to fully understand their limitations and needs.

In the next series of workshops, pupils imparted their knowledge to the senior participants. The teenagers now assumed the role of teachers and were responsible for the content and the extent of the learning effect. Working sheets were given to both pupils and senior participants to guide them through the workshops. The intergenerational exchange provided precious experiences for all participants and encouraged both social and environmental understanding.

The goal was to empower senior citizens to use modern technologies and devices for mobility and travel planning, especially for the use of public transport within the city and beyond. As a side effect, younger people improved their soft skills and abilities by interacting with people from an older generation. Expected effects were that both groups, teenagers and senior citizens, gathered information about various possibilities of sustainable mobility and were encouraged to change their current choice of motion towards more sustainable options like walking, cycling, public transport, and sharing solutions.

A.2.1 Measure outputs

Concrete measure outputs of MUC 2.10 are workshops with pupils and elderly people willing to learn more about web-based applications for organizing their daily mobility.

Over the project lifetime there were 16 workshops planned to be executed. About 400 participants were expected to join the workshops. Seven schools signed in to join the program and conduct workshops at their premises.

Two trainers from the ML's institution were provided to hold the workshops. Those two trainers were the current and the former ML.

A.2.2 Supporting activities

The cooperation with secondary schools facilitated to engage an adequate number of teenagers for the project. In addition, continuity was assured because schoolboys and girls were obliged to take part in the workshops in most cases.

A.2.3 Interactions with other ECCENTRIC measures

None

A.2.4 Interactions outside ECCENTRIC

The implementation of the measure was facilitated by existing contacts to potential schools which have cooperated with Green City e.V. in previous projects. This existing interaction was mainly beneficial for the whole implementation process, less for the impact of the measure MUC 2.10.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
Seniors (10 – other)	Seniors learn about the use of modern technologies and devices and how to use them for travel planning (mainly in PT)	Munich	While proximity to the living lab is an important category for the selection of participating schools and seniors, it is not possible to limit the scope of the measure to this area. Thus, the measure affects participants from the entire city.
Teenagers (10 – others)	Teenagers also learn about the use of modern technologies for travel planning in their preparation workshops. By teaching the content to the seniors, they also broaden their own knowledge.	Munich	While proximity to the living lab is an important category for the selection of participating schools and seniors, it is not possible to limit the scope of the measure to this area. Thus, the measure affects participants from the entire city.

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

Main stakeholders of *Transfer* are Green City e.V. as the organizer, the workshop participants (seniors and teenagers), and the participating schools.

Process evaluation focuses on Green City e.V. and on the schools, because the focus of surveys to workshop participants is on impact evaluation and participants are not expected to deliver important findings for the process aspects of the evaluation.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	Green City e.V.	P	NG	L	Measure Leader
2	Workshop Participants	S	Other	P	Seniors & teenagers participating in the measure
3	Schools	S	KI	P	Schools/teachers that decide to take part in the measure
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

#	Identified risk	Category	Mitigation actions	Responsible
1	Measure Progress Reports are not delivered on time.	Involvement	Standardized forms should be filled in instead.	ML
2	Standardized forms are not filled in by the relevant stakeholders.	Involvement	Measures leaders encourage stakeholders to do it.	ML
3	Stakeholders are not ready to take part in interviews and/or workshops.	Involvement	Measure Leaders can send a letter or talk to them directly to explain the importance of their participation in the evaluation activities.	ML
4	The acquisition of secondary schools is difficult.	Involvement	In addition to schools, teenagers' meeting points (youth centres) should be contacted.	ML
5	Lack of commitment and cooperation of workshop participants (drop-outs, surveys not filled,...).	Involvement	Reminders for ex-post surveys, support by teachers.	ML

Table 4: Identified risks.

As of autumn 2018, the status of the risks is uncritical, same applies for autumn 2019: The measure team was working well (no problems with risks 1, 2, 3). Especially in the beginning, it was not easy to recruit schools (risk 4), as many teachers struggle to include additional (time-intensive) workshops into their class schedules (see PER for details). However, successful workshops were a good advertisement for additional workshops and schools started asking for a second round of *Transfer*. Also, a local school mailing list ("*Schulverteiler*") could be used to spread the information among headmasters of schools in Munich. Until autumn '19 there were nine schools involved.

Additional media outreach helped to increase the awareness of the measure among seniors in the city, which helped to recruit a more-than-sufficient number of elderly people. There is a certain risk that participants drop out during the workshops (risk 5), but in general, the motivation to take part and also to fill the surveys is very high both among students and seniors.

B. Measure implementation

B.1 Situation before CIVITAS

Senior citizens generally do not know how to use technologies and devices for mobility planning (smartphones, tables, internet and mobility services). This lack of knowledge forces them to rely on other people for their mobility (being driven by someone else) or on the usage of their own cars instead of using other more sustainable options.

B.2 Innovative aspects

The measure developed an – to the best of the author's knowledge – unique and innovative approach to educate both teenagers and seniors about using modern technology for mobility-related purposes.

New conceptual approach

- 'Traditional' education programs about mobility options apply a traditional teacher – student model, where a teacher (expert in mobility) presents the course content to the participants. In *Transfer*, the first stage of the program applies exactly this model, where experts of the NGO Green City e.V. show the teenagers (guided by course material) how to use the internet and smartphones for travel planning. Then, the students become teachers themselves when they meet the group of seniors and teach them the same content they've learned in the previous stage. Thus, teenagers will memorize the course content not only passively by learning, but also actively in disseminating this information to others. The seniors have the luxury of a private teacher who explains exactly what they need to understand the course content and can ask as many questions as they want, by which technological barriers can be lowered as well.

Targeting specific user groups

- While the opportunities of ICT for travel planning are well-established and also well-known by society, the group of seniors has higher barriers to access these services. The program targeted specifically on this group helps to overcome these barriers.
- Teenagers are generally experienced with the use of websites and smartphones, but the typical use case for these technologies is not travel planning. The workshops help to promote sustainable mobility options and new mobility services (Bikesharing, Carsharing, intermodal trip planning, online ticketing) among this group.

New organisational arrangements or relationships

- The integration of *Transfer* into the school's curriculum makes it very attractive (or even mandatory) for students to take part in the program.
- For seniors, the schools are a very trustworthy, reliable workshop venue which increases the acceptance among the target group. Furthermore, seniors are curious how school life looks like today and are happy to be the student's guests.

B.3 Research and Technology Development

Previous experience of Green City e.V. with schools facilitated the planning of the measure. Apart from course materials (advertisement, worksheets and presentations), no extra technology development was necessary. However, this course material and the experience gained in the workshops is a valuable asset for similar projects.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning milestones

Relevant milestones accomplished:

Concept created for the workshops. The most important applications and their functions that have been transferred to the elderly people were chosen.

Implementation of a first workshop (8 units) in January 2017, a second round in January/February 2018.

ML has been looking for new partners for the implementation of more workshops. To have a better access to the target group of young people it was intended to cooperate with secondary schools. In a first step a list of relevant schools was made with following criteria:

- (4) The school is in or close to the Living Labs Domagkpark and Parkstadt Schwabing.
- (5) It is a secondary school.
- (6) There was already a successful cooperation between Green City e.V. and the school in a different project in the past.

In spring 2017 e-mails were sent out to each of the school's principals (about 25) and in May/June most of them were phoned again.

A new possibility was to cooperate with institutions and organizations where teenagers are spending their free time. In July 2017 there was a meeting with "Nachbarschaftszentrum Domagkpark" and "Funkstation", a new project developing in Domagkpark. Both are interested in a cooperation for the year when "Funkstation" will have started.

In the beginning of 2018 schools were informed about the project by personal e-mails to the headmasters and by using the local school distributor ("Schulverteiler") which regularly informs all schools in Munich about educational projects. One school (Mittelschule an der Cincinnatistraße) was acquired.

Phases 2: Procurement and Implementation

The first workshop was launched in January 2017, it was followed by 7 implementations in 2018 and 8 implementations in 2019. In total there were 15 workshops during the project lifespan.

It appears that the intention to cooperate with different types of secondary schools to have a better access to the target group of young people and using the school as a regular working sphere, was suiting very well. In addition to that, primarily the local press service, but also centers for elderly people were addressed to get seniors onboard for the workshops.

In the beginning the acquisition of new schools and institutions for elderly people to announce the workshops was demanding. Meanwhile, the project is established and well known in schools in Munich. Now teachers ask directly for participation without acquisition on behalf of Green City e.V. The continuous compilation of a list for interested senior citizens proves to come handy each time when new senior participants are needed.

Starting with 4 dates for the workshops with only the teenagers and 4 with pupils and elderly people together, it was realized that the expenditure of time and effort was too high. As a result, the adaption to only 2 dates for the first workshop series and 3 dates for the intergenerational workshops was tested successfully and was more adequate.

Based on former experiences and learnings new features for the workshops were established in 2019: An additional assignment for fast learners was created that is covering the topic of the ecological footprint to enhance the personal reflection on climate change. Occasionally, the pupils prepare easy movement games or a coffee break for their senior partners in between lessons that creates a comforting and close atmosphere.

Phase 3: Demonstration and Monitoring

The continuous evaluation is an inherent part of the workshops: In the beginning both young and senior participants are asked about their daily mobility habits and traffic routes in a questionnaire. After completing the measure, they specify if their choice of mobility changed during the course. For a long-time analysis all participants provided this information again after 6 months by a third postal question form. First intermediate data show positive changes respective the mobility behavior, especially the behavior of the elderly people.

The worksheets for the workshops were revised regularly due to changes in homepages and applications and have been adapted several times due to comments and suggestions for improvements of participants.

By the beginning of each school year a call for finding new engaged teachers and classes to participate was sent to every school in Munich.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Awareness	Acceptance	Satisfaction	Mode shift	Operational barriers
Type	KPI	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	SOCIETY-PEOPLE	SOCIETY-PEOPLE	TRANSPORT SYSTEM	SOCIETY-PEOPLE
Subcategory	Acceptance	Acceptance	Acceptance	General	Accessibility
Aspect	Awareness level	Acceptance level	Satisfaction	Modal split	Usage and operation capabilities
Definition	Percentage of participants with knowledge of sustainable mobility services.	Percentage of participants who favorably receive or approve of the mobility services proposed in the workshop.	Reported satisfaction with the content of workshop.	Percentage of participants who changed permanently of transportation mode for doing the same trip (same origin and destination, time, and frequency). The main mode of a trip is that used for the longest stage of the trip by distance. With stages of equal length the mode of the last stage is used.	Capability performing specified mobility planning tasks with the roomed information technologies.
Unit	Percentage	Percentage	Score (0-5)	Percentage (various values)	Score (0-5)
Method of data collection	Survey before workshop and after six months (one survey for each target group, seniors and pupils)	Survey before workshop and after six months (one survey for each target group, seniors and pupils)	Survey right after the workshop for all participants to evaluate the acceptance/satisfaction with the measure.	Survey to evaluate previous knowledge on mobility services and current mobility behaviour. Survey 6 months after to identify permanent changes in mobility behaviour.	Test on learnt skills towards the end of the workshop to evaluate the level of skills obtained pertaining to the use of different technologies and devices for mobility planning.
Target group	Participants of the workshop	Participants of the workshop	Participants of the workshop	Participants of the workshop	Participants of the workshop

Impact	INPUT	INPUT
Indicator name	Investment Costs	Operational Costs
Type	KPI	KPI
Category	ECONOMY	ECONOMY
Subcategory	Costs	Costs
Aspect	Investment costs	Operating Costs
Definition	Total capital costs for purchase of equipment related to running the training and workshops. Preparation and design cost is defined as total costs expended setting up the measure covering a time period from the initiation of the measure preparation until the start of the measure implementation.	Personnel and maintenance costs required for running the measure (per time period)
Unit	Euro	Euro / (time or usage unit)
Method of data collection	Data from financial reports, controlling	Data from financial reports, controlling
Target group		

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	% (1)	B – A (each round)	S	Seniors	Participants
2	Acceptance	% (1)	B – A (each round)	S	Seniors, Teenagers	Participants
3	Satisfaction	Score 0-5	A (each round)	S	Seniors, Teenagers	Participants
4	Mode Shift	%	B – A 6m (2) (each round)	S	Seniors, Teenagers	Participants
5	Operational Barriers	Score 0-5	I (each round)	DC/S	Seniors, Teenagers	Participants
	Investment costs	Euro	I	DC	ML	ML
	Operational costs	Euro	I	DC	ML	ML
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

- (1) As the measure was not limited to a spatial scope, it was not possible to measure Awareness and Acceptance within the Living Lab or another designated area. However, it was found out how people became aware of the measure and how they accept it. Also, the acceptance and awareness of the mobility services promoted in *Transfer* were measured.
- (2) A 6m = Survey 6 months after workshop

C.1.2 Baseline

Baseline data was conducted with a short paper-based survey right after the beginning of the workshop in class. Both groups of participants, students and seniors, were asked for their age, gender, mobility behaviour, the purpose and frequency of their trips. In addition to that, they were asked if they know about any kind of shared mobility options in their surroundings. The participation rate of this survey varies from workshop to workshop, but because of the attendance of the ML and the direct contact to the participants, the ratio is to be recorded as very high.

The **first round** of five participating schools was carried out from January 2017 until September 2018. The **second round** of eleven participating schools in total (includes 5 schools from period 1) can be reported as a second baseline period, from September 2018 until August 2019.

Participants and demography

Addressing Indicators "1 – Awareness", "2 – Acceptance" and "3 – Awareness"

To address the factor of **acceptance**, the number of participating schools, seniors and students can be taken into account.

In all evaluated¹⁵ rounds of *Transfer* (period 1: 01/2017-09/2018, period 2: 10/2018-08/2019), a total of 156 seniors (median age: 80) and 237 students (median age: 15,8) participated in the project. [Table 5](#) shows an overview of the sample compilation for the baseline period.

School	Seniors	Students
No. of participants	156	237
Median age	80	16
No. of schools/ courses	11	11

Table 5: Overview baseline

[Table](#) shows the number of participants per school/class for both baseline periods (period 1: 01/2017-09/2018 and period 2: 10/2018-08/2019). The number of students is most of the times higher than the seniors but that means, in reverse, that the support key for the seniors is very good and advantageous for the elder people. Only one school had quite few seniors (CVLR8e). The reason can be found in the advertisement, which should have been promoted by the local press, but the time and date information was not accurate enough, so that the participants missed the workshop dates.

¹⁵ In January 2017, an additional non-evaluated first workshop took place with 10 seniors and 10 students.

School	Seniors		Students	
	n	%	n	%
Period 1				
Carl von Linde Realschule (CVLRS)	25	16%	27	11,4%
Carl von Linde Realschule 8e (CVLRS8e)	8	5,1%	26	11%
Mittelschule Cincinnatistraße (MSCC)	17	10,9%	23	9,7%
Rudolf Diesel Realschule (RDRS)	16	10,3%	21	8,9%
Theodolinden Gymnasium (TLG)	19	12,2%	22	9,3%
Additional schools in period 2				
Asam Gymnasium (ASG)	11	7,1%	26	11,0%
Berthold Brecht Gymnasium (BBG)	11	7,1%	20	8,4%
Jules-Verne Campus (JVC)	20	12,8%	12	5,1%
Mittelschule Blumenau (MSB)	8	5,1%	13	5,5%
Rudolf Diesel Realschule 2019 (RDRS2019)	14	9,0%	23	9,7%
Theodolinden Gymnasium 2019 (TLG2019)	7	4,5%	24	10,1%
Total	85	100%	237	100%

Table 6: Participants by School (period 1+ period 2)

Interestingly, significantly more female seniors took part in the project (76% vs. 24%), while the gender distribution among students was relatively balanced (see [Table 5](#)). Reasons for that distribution could be found in the fact that it was mandatory for all students to take part in those workshops, because their teacher decided them to. Among the elderly participants, however, this shows that women seem to be more open/interested towards the workshop topics. The ML stated that the female senior generation reported to be very interested in current technology trends in combination with mobility developments.

Age	Seniors	Students
female	74,7%	52,4%
male	25,3%	47,6%

Table 7: Gender

Participants were also asked explicitly about their knowledge (and use) of bikesharing (both groups, [Table](#)) and carsharing (only seniors, [Table](#)) which can be summed up under the KPI **awareness**.

Bikesharing	Seniors	Students
I know & use bikesharing	4,8%	1,3%
I know bikesharing (but don't use it)	66,2%	85,2%
I don't know bikesharing	29%	13,5%

Table 8: Bikesharing

Most participants are aware of bikesharing, but only a minority (5% of seniors and 1% of students) is also using the service. Roughly a third of the seniors does not know bikesharing, while this number is smaller among the students (14%).

Carsharing is slightly more known and used among seniors (22% do not know carsharing while 29% do not know bikesharing), but still the vast majority has heard of the service but does not use it ([Table](#)).

Carsharing	Seniors
I know & use carsharing	8,6%
I know carsharing (but don't use it)	69,3%
I don't know carsharing	22,2%

Table 9: Carsharing (only seniors)

The score for the KPI Satisfaction is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI.

For the first workshop period, there was no quantitative evaluation of the KPI **satisfaction**. The score of 5 comes from interviews with the ML and a site visit of the LEM in one of the *Transfer*-workshops. The participants are highly satisfied with the workshop setup and the tasks given by the ML. The cooperation between students and seniors seems very constructive and without any bigger barriers.

Mode availability and mobility behavior

Addressing Indicator "4 – Modal Split/ Mode Shift" and "5 - Operational barrier".

In order to enable future calculations of mode shift, the baseline survey collected data both on the availability of modes ([Table](#)) as well as on the actual mobility behavior. [Table](#) shows the frequency of use for these modes which resemble reliable numbers for **mode split**. These

data were conducted in the first round of workshops from 01/2017 until 09/2018 in five participating schools. A short paper-based survey was assessed during the workshop.

Mode	Seniors	Students
Driver's License	91,0%	-
Private Car (in household)	71,8%	83,3%
IsarCard	50,3%	38,1%
Bike	87,4%	91,1%
E-Bike	10,5%	2,7%
Motorbike	5,3%	6,3%

Table 10: Availability of modes

Similar to the findings of the latest nationwide mobility survey "*Mobilität in Deutschland*" (infas, 2018), a high share of seniors has a driver's license and also the share of households with a private car is as high as expected for the age group (IfD Allensbach, 2012).

The amount of monthly public transport passes ("IsarCard") is in both groups relatively similar to the city-wide average of approx. 43% and the ownership of bicycles, e-bikes and motorbikes is as well close to the average for these demographics (City of Munich, 2017).

Table shows the frequency of use for a variety of modes of transport. *Bikesharing*, *Skateboard/Kickboard*, and *others* were omitted due to a very low number of users.

	Walking		Cycling		PT	
Frequency	seniors	students	seniors	students	seniors	students
(almost) daily	75,0%	80,9%	29,3%	27,6%	35,6%	62,8%
1-3x per week	17,1%	11,9%	30,8%	22,4%	32,9%	29,1%
1-3x per month	1,4%	2,6%	7,5%	12,1%	20,5%	6,0%
less than monthly	3,6%	1,7%	10,5%	15,1%	10,3%	2,1%
(almost) never	2,9%	3,0%	21,8%	22,8%	0,7%	0,0%
Total	100,0%	100,1%	99,9%	100,0%	100,0%	100,0%

	Car (Driver)		Car (Pass.)
Frequency	seniors	seniors	students
(almost) daily	15,3%	3,6%	17,9%
1-3x per week	33,6%	13,4%	43,6%
1-3x per month	17,5%	18,8%	20,5%
less than monthly	5,1%	19,6%	9,8%
(almost) never	28,5%	44,6%	8,1%
Total	100,0%	100,0%	99,9%

Table 11: Frequency of mode usage

For both groups, walking is the most-frequently used means of transport, followed by public transport and cycling. To extract trends from this overview, a simplified comparison with a

recent study about mobility behaviour in Munich (City of Munich, 2017) is shown in [Table](#) . Only the share of "(almost) daily" use is taken into account for this comparison, and the comparison is limited to seniors due to limitations in the available third-party studies for the local context:

(almost) daily use	Seniors (Transfer)	Seniors (Munich, >60)
Car	15,3%	15%
Cycling	29,3%	15%
Public Transport	35,6%	25%

Table 12: Seniors: Transfer vs. City of Munich

While the amount of daily car-users is the same, the share of frequent cycling and PT-users is considerably higher among the *Transfer*-participants. This indicates that the elderly participants in the project are more mobile than their city-wide peers, especially by cycling and public transport.

The KPI **operational barrier** shows the accessibility for deficiency groups which have reduced knowledge about transport or transport services in general. The target groups of this measure MUC 2.10 give a good representation of the typical mobility pattern of the system users. The score (0-5) results from the indicators mentioned above: availability of mode and frequency of use for different modes. A score of zero means there are no operational barriers for both target groups and a score of five equals the fact that there is no access to the city-wide transportation systems.

Regarding the modes car, PT, cycling and walking it seems as there would not be any barrier for seniors and students to use them (see [Table](#)). Besides that, the offered sharing options (car- and bikesharing) are hardly used (see [Table](#) and [Table](#)). Therefore, there is a score of one out of five given for the operational barrier of the students, which means that there is no bigger operational barrier to overcome but the segment of sharing options could be better exploited. The seniors get a score of three because they are less able to use PT on a regular basis, probably due to difficulties of the ticketing or other physical limitations.

Information and ticketing in public transport

Addressing Indicators 1 – "Awareness", 2 – "Acceptance" and indirectly "4 – Mode Shift"

Information and education about digital means of public transportation information and ticketing is an essential part of *Transfer*. To measure the status quo, both groups were asked which options they have used before the workshop to get information and tickets for local public transport ([Table](#)).

option	Information		Tickets	
	seniors	students	seniors	students
Counter	24,4%	3,4%	32,1%	10,3%
Machine	16,5%	4,4%	46,5%	65,9%
Operator/Driver	1,7%	2,8%	0,0%	1,1%
Online	29,0%	29,8%	4,4%	5,5%
Smartphone	12,5%	45,8%	0,6%	6,6%
other	15,9%	13,8%	16,4%	10,6%

Table 13: Information and Ticketing¹⁶

There are significant differences regarding the preferred means of information and ticketing between students and seniors: To gather **information** about public transport, seniors ask at the counter (24%), use the ticket machine (17%), but a surprisingly large number is already using the internet (29%) for this purpose. However, the smartphone is used only by a few (13%).

The students are more smartphone-oriented, as 46% use it to get information. 30% also use web services, while "offline" services like asking at the counter, ticket machine or the driver are not popular among students.

For **ticketing**, the classical vending machine is still the most commonly used option in both groups. Especially students (66%) use it for most ticket purchases, but also 47% of seniors. Digital tickets (app or online) are not used by many: 4% of seniors buy tickets online, and 7% of students use their smartphone. The ticket counter is still relevant for seniors (32%), but also some students (10%) buy tickets at a counter.

Data on **investment and operational cost** was obtained for the ex-post evaluation when the implementation phase was completed. See impact evaluation, section C.2.

¹⁶ Multiple responses → sums >100%

C.1.3 The business-as-usual scenario

While car-use is decreasing and multimodality is on the rise among the young, a strong growth in the mobility of seniors is one of the drivers for increasing overall traffic volumes in Germany (Follmer et al., 2010; infas, 2018). Thus, a trend is expected towards more private vehicles among the seniors, and ongoing use of ICT for students.

Awareness and Acceptance as a proxy for mode shift

The comparisons with general studies about the mobility behavior of seniors shows that the *Transfer* participants are prone to a certain selection bias, as they are using public transport and cycling already more often than the average senior in Munich (see [Table](#) , p. 461). This hints at a high potential to be open towards new services that facilitate sustainable mobility behavior (such as ICT-services), but also at a lower potential for actual mode shift, because the usage of sustainable mobility is already relatively high.

In the BaU-scenario, no significant changes are expected in the target population in terms of **awareness** and **acceptance** of the measure's promoted services within the ECCENTRIC time frame. On the long run, the generational shift will lead to seniors that are more used to ICT and their application for mobility. Perhaps a trend towards more sharing could be noticed during the BaU because it is not very much used yet.

Especially regarding carsharing options the usage of seniors is assessed as being very low (infas, 2018). This alternative mobility has not yet found its way into everyday mobility, especially with this growing group of people and its corresponding significance for future transport. But with new and simpler technologies there is a high chance of increasing the number of users among seniors. The nationwide mobility survey reports that carsharing options are mainly used by young people. Regarding the young target group of MUC 2.10, there is a high chance that this number of carsharing usage is increasing as the underage group has their driving license (infas, 2018).

Mode Shift

The nationwide mobility survey (infas, 2018) shows an ongoing trend towards a higher car ownership and more car-use among seniors, especially in higher ages. But the same survey states the fact that some of them will be forced to give up their cars for health reasons. Car ownership prognosis models (based on cohort effects), without taking health restrictions into account, will therefore initially overestimate the motorization of older people (infas, 2018).

As this is a demographic trend, it is expected to be also visible in the study area and a decrease in car use until 2020 is estimated. Scenarios which go beyond the BaU timeframe of 2020 could on the contrary show a different development towards a higher motorization because of technical progress in the course of vehicle automation (infas, 2018).

Among young people in Germany, a modal split shifting towards a higher usage of public transportation and carsharing options and less car ownership in general is expected. The Center of Automotive Management stated this trend in a study from 02/2018.

Operational barrier

Regarding the BaU scenario the operational barrier could be assumed as being lower in 2020 than today. Reasons for that could be found in better technological process and an increasing

awareness about mobility topics in general because of more reporting about current trends and technologies in the field of transport by federal or local stakeholders and the media.

C.2 Measure results

The following table shows the measure results of MUC 2.10. In some cases, the Business as Usual scenario is valued as not assessed (NA) because there would not be any other developments without the implementation of this measure or there are no numbers to be taken into account for a valid analysis.

Indicator		Unit	Before		Date Before	BaU		Date BaU	After		Date After	Difference After-Before		Net im-pact After-BaU
			Seniors	Students		Seniors	Students		Seniors	Students		Seniors	Students	
Awareness	Bike-sharing	%	66,2	85,2	09/18	NA	NA	-	86,6	83,2	08/19	+20,4	-2,0	NA
	Car-sharing	%	69,3	NA	09/18	NA	NA	-	92,4	NA	08/19	+23,1	-	NA
Acceptance	Behaviour change	%	NA	NA	-	NA	NA	-	Definitely: 42,9 Probably: 37,0 Maybe: 17,6 Rather not: 0,8 Certainly not: 1,7	Definitely: 12,7 Probably: 24,3 Maybe: 26,5 Rather not: 25,4 Certainly not: 11,1	08/19	Definitely: +42,9 Probably: +37,0 Maybe: +17,6 Rather not: +0,8 Certainly not: +1,7	Definitely: +12,7 Probably: +24,3 Maybe: +26,5 Rather not: +25,4 Certainly not: +11,1	NA
	Transport Information	%	Information-desk: 24,4 Machine: 16,5 Driver: 1,7 Internet: 29,0 Mobile phone: 12,5 Others: 15,9	Information-desk: 3,4 Machine: 4,4 Driver: 2,8 Internet: 29,8 Mobile phone: 45,8 Others: 13,8	09/18	NA	NA	NA	Information-desk: 10,9 Machine: 10,1 Driver: 3,6 Internet: 31,9 Mobile phone: 38,4 Others: 10,9	Information-desk: 5,1 Machine: 16,8 Driver: 1,0 Internet: 34,7 Mobile phone: 23,8 Others: 12,9	08/19	Informationdesk: -13,5 Machine: +0,4 Driver: -0,7 Internet: +5,7 Mobile phone: +11,3 Others: -3,0	Informationdesk: +1,6 Machine: +5,8 Driver: +0,8 Internet: +2,1 Mobile phone: -7,4 Others: -2,9	NA
	Transport Ticketing	%	Information-desk: 32,1 Machine: 46,5 Driver: 0,0 Internet: 4,4 Mobile phone: 0,6 Others: 16,4	Information-desk: 10,3 Machine: 65,9 Driver: 1,1 Internet: 5,5 Mobile phone: 6,6 Others: 10,6	09/18	NA	NA	NA	Information-desk: 25,3 Machine: 53,3 Driver: 1,3 Internet: 2,7 Mobile phone: 0,0 Others: 17,3	Information-desk: 12,4 Machine: 68,6 Driver: 2,9 Internet: 2,9 Mobile phone: 4,8 Others: 8,6	08/19	Informationdesk: -6,7 Machine: +6,8 Driver: +1,3 Internet: -1,7 Mobile phone: -0,6 Others: +1,0	Informationdesk: +2,1 Machine: +2,7 Driver: +1,8 Internet: -2,6 Mobile phone: -1,8 Others: -2,1	NA
Satisfaction		Score 0-5	5	5	09/18	NA	NA	-	Expectations met: 5 = 82% “predominantly” and “fully” Cooperation: 5 = 95% “good” and “very good”	Expectations met: 5 = 88% “fully” and “predominantly” Cooperation: 5 = 94% “good” and “very good”	08/19	Expectations met: +-0 Cooperation: +-0	Expectations met: +-0 Cooperation: +-0	NA

Indicator	Unit	Before		Date before	BaU		Date BaU	After		Date after	Difference After-Before		Net im-pact After-BaU
		Seniors	Students		Seniors	Students		Seniors	Students		Seniors	Students	
Mode Shift	%	Modal split (daily): Walking: 45,5 Cycling: 17,8 PT: 21,6 Car (driver):9,3 Car (pass.): 2,2 Motorbike: 1,1 Bikesharing: 1,1 Others: 1,4	Modal split (daily): Walking: 40,4 Cycling: 13,8 PT: 31,4 Car (passenger): 9,0 Motorbike: 1,1 Bikesharing: 0,4 Skateboard: 1,5 Others: 2,4	09/18	Modal split Munich: Walking: increasing Cycling: increasing PT: increasing Car: decreasing		2020	Modal split (daily): Walking: 50,2 Cycling: 24,2 PT: 22,5 Car (driver): 3,1 Car (passenger): 0,0 Motorbike: 0,0 Bikesharing: 0,0 Others: 0,0	Modal split (daily): Walking: 40,3 Cycling: 14,0 PT: 29,5 Car (passenger):9,9 Motorbike: 0,5 Bikesharing: 1,5 Skateboard: 2,0 Others: 2,4	08/19	Modal split (daily): Walking: +4,6 Cycling: +6,4 PT: +0,9 Car (driver): -6,2 Car (passenger): -2,2 Motorbike: -1,1 Bikesharing: -1,1 Others: -1,4	Modal split (daily): Walking: -0,1 Cycling: +0,2 PT: -1,9 Car (passenger): +0,9 Motorbike: -0,6 Bikesharing: +1,1 Skateboard: +0,5 Others: 0,0	Trend: Walking: increasing Cycling: increasing PT: increasing Car: decreasing
Operational Barriers	Score 0-5	Students: 1 Seniors: 3		09/18	NA		Score 0-5	Students: 1 Seniors: 2		08/19	Students: +/- 0 Seniors: +1		NA
Investment Costs (Brutto)	costs related to people and their time period: technicians or engineers: 0 € maintenance personnel: 0 € program and web developers: 0 € other costs: 3.200 €												costs of equipment: equipment 6.700 € marketing campaigns 500 €
Operating Costs (Brutto)	personnel costs 4.000 € maintenance cost 0 € other operating costs 1.000 €												

The following ex-post data was obtained with a short paper-based survey six months after the workshops in class took place. Students were asked in class by their teacher and seniors were sent a paper-based questionnaire via post with a back envelope. The participation rate of this survey varies a lot. There are more students responding to the ex-post survey than seniors because they were contacted by post and not personally.

Addressing indicators “1 – Awareness”, “2 – Acceptance” and “3 – Satisfaction”

The surveys of participants show that the **awareness** of new mobility offers could be increased by the measure, especially among senior citizens. [Figure](#) shows the change in usage and knowledge of bikesharing among seniors, taking their levels before and after the measure into account. [Figure](#) shows the same for the mobility offer carsharing.



Figure 1: Seniors Bikesharing Awareness/ use Change

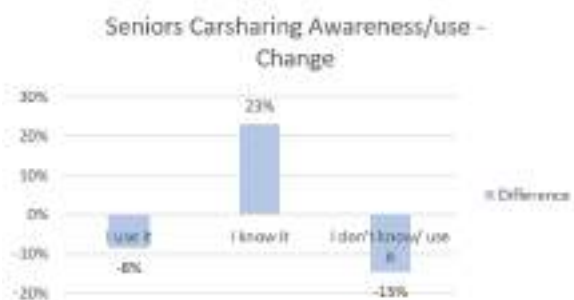


Figure 2: Seniors Carsharing Awareness/ use Change

In both cases the awareness could be significantly increased (+20% for bikesharing and +23% for carsharing). The decrease in the use of these services cannot be clearly explained but is probably only due to the change in the composition of the study group. The participants' survey on bikesharing among students shows no relevant changes.

The **acceptance** of the measure can be shown by the willingness of the participants to change their mobility behavior and their application of newly learned knowledge about public transport information and ticketing.



Figure 3: Seniors Behavior Change Willingness



Figure 4: Students Behavior Change Willingness

The willingness of the participants to change their own mobility behavior in the future was questioned shortly after the workshops. Figure shows that a large majority of seniors (43% definitely and 37% probably) shows great willingness to change their behavior, a smaller percentage is still uncertain (17%) and only 3% are likely not to change their behavior. Figure shows that the willingness of students is more balanced, 27% want to change their behavior, 27% are uncertain and 36% do not intend to change their behavior. Considering the modal split of students (see C.2), it can be assumed that students do not want to change their mobility behavior because they already use sustainable means of transport e.g., they do not drive their own cars. In addition, students often have less power than adults to make such decisions as the purchase and removal of means of transport, tickets, etc.



Figure 5: Seniors Public Transport Information Change

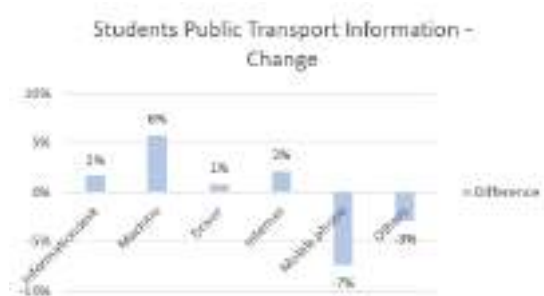


Figure 6: Students Public Transport Information Change

The survey shows that the participants accepted and adopted new methods for public transport information and ticketing. In case of the seniors, information procurement via conservative methods, such as the information desk (-14%), is declining significantly. More modern methods such as the internet (+6%) and the mobile phone (+11%) are used instead (see Figure). Among students, information via conservative methods increased (see Figure): information desk (+2%), machine (+6%) and driver (+1%). Whereas the mobile phone as a modern method decreased (-7%).



Figure 7: Seniors Public Transport Ticketing Change



Figure 8: Students Public Transport Ticketing Change

The ticketing of the seniors in Figure mainly shows, that the machine (+7%) is obviously used more often instead of the information desk (-7%). This suggests that seniors no longer need personal support from a real person after the workshop. After the measure, the ticketing is handled by students, similar to the information procurement, more via conservative methods

and less via modern methods (Figure). Apparently, a generational exchange in both directions has taken place in the course of this measure. While seniors used more modern methods to obtain information and ticketing, students used more conservative methods afterwards.

The score for the KPI Satisfaction is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI. A percentage value of zero means as well that there are no other developments without the implementation of the measure.

The indicator **satisfaction** is measured within a short paper-based survey right after the workshop in class. Each group, students and seniors, is questioned if the expectations of the workshop are met. Additionally, the level of cooperation between the generations was valued from both sides.

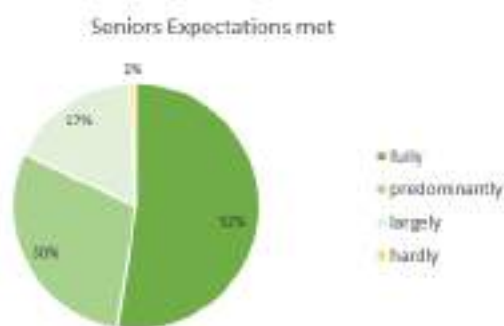


Figure 9: Seniors Expectations met

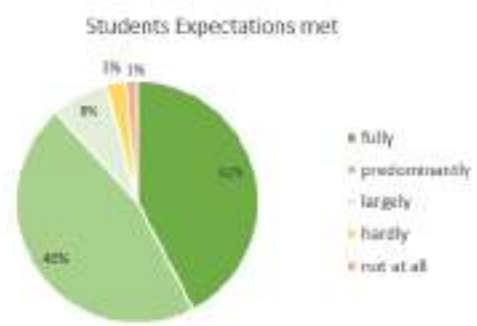


Figure 10: Students Expectations met

The participants' survey directly after the workshop shows, that the expectations of a large majority of seniors (82%) and students (88%) was predominantly or fully met (see Figure and Figure). This corresponds to a satisfaction score of 5/5 points.

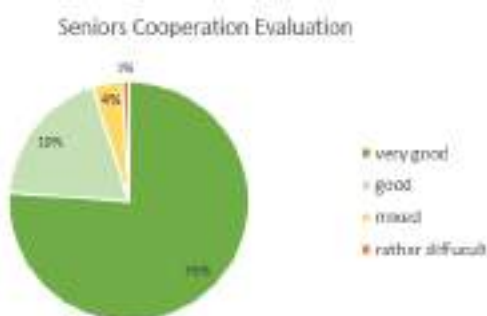


Figure 11: Seniors Cooperation Evaluation

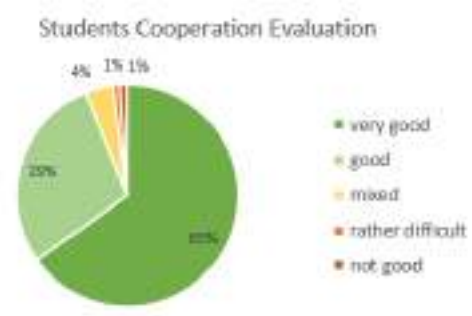


Figure 12: Students Cooperation Evaluation

Also, the cooperation between seniors and students was done to the complete satisfaction of both parties. It was rated by 95% of the seniors and 94% of the students as good and very good (see Figure and Figure). This also corresponds to a score of 5/5 points.

Addressing indicator “4 – Mode shift/ Modal split”

Figure shows the seniors' **mode shift** of transport means of daily use. These data are derived from the surveys of mode use frequency before and after the workshops. It can be observed, that especially the sustainable modes such as walking (+5), cycling (+6%) and public transport (+1%) have increased, while less sustainable modes such as car as driver (-6%), car as passenger (-2%) and motorbike (-1) have decreased.

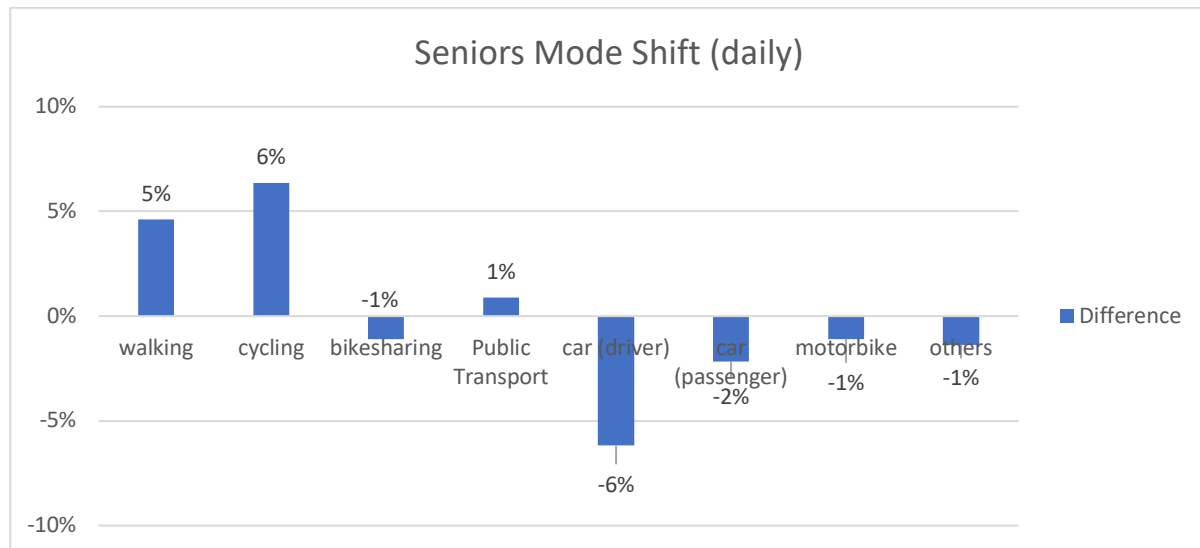


Figure 13: Seniors Mode Shift

The mode use of the students is nearly stable. Only marginal changes in bikesharing (+1%), car use (+1%) skateboard use (+1%) and public transport (-2%) are observed. This is not sufficient to draw further conclusions.

In addition, the change in the availability of modes was surveyed, showing which kind of transport means and tickets were purchased and disposed after the workshops in the households (see Figure and Figure).



Figure 14: Students Mode Availability Change



Figure 15: Seniors Mode Availability Change

The availability of bicycles and electric bikes increases among seniors (+5% and +2%) and students (+5% and +3%) alike. IsarCard ownership and thus the potential frequent use of public transport increases among seniors more (+7%) than among students (+4%). This development is accompanied by a reduced availability of the less sustainable MIV. In particular, the ownership of motorbikes is declining (-8% for students and -4% for seniors).

While the availability of a private car among seniors also tends to decrease (-1%), a slight increase (+2%) is recorded among students. This can be explained by the fact that the availability of a private car in the household was questioned here, for which students are usually not the decision-makers. As the measure raises participants' awareness to use more sustainable means of transport, these are increasingly purchased as hoped. This provides a good insight into which extent people actually plan to use other means of transport in the future and are willing to invest in them.

Addressing indicator “5 – Operational barrier”

Comparing the **operational barrier** from the baseline observation with the after data obtained during and six months after the workshop, the score almost stays the same. Whereas students do not have huge operational barriers right from the start because of their affinity to mobile devices, they were scored 1 in the baseline and stay at the same score after the measure implementation. Due to their young age they in fact do have some operational barrier because they cannot use the full scale of transport modes available in their surroundings, that's the only reason they are not scored a zero –having no operational barriers at all. Seniors operational barrier was scored 3 in the beginning of the project but can now be increased to 2. The numbers of the workshop surveys show clearly that the understanding and usage of more sustainable modes is increasing (e.g. walking, cycling, PT) and that they more likely search for travel information online. But regarding the purchase of tickets, there is no change to be observed yet.

Addressing indicators “Investment costs” and “Operational costs”

The **investment costs** of the measure MUC 2.10 are relatively low because there was only cost of equipment (6.700 € gross), e.g. workshops material like tablets, smartphones or the age simulation suit and additional insurance costs. Several marketing campaigns cost about 500 Euro for the entire project lifetime. Other costs related to people and their time make about 32.000 Euro, among those are costs for conception, research, preparation of workshop materials and networking. The **operating cost** are also very low with about 4.000 Euro for personnel. Other operational costs occurred with traveling, more material like worksheets, postage, W-Lan router installation for the workshop to have internet connection, or other equipment. This means that there are no big expenses necessary to keep the measure running.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Widen the range of mobility by showing how helpful smartphones and the internet can be to use other means of transport besides the own car.	**	The range of mobility was definitely widened for both groups, students and seniors. The awareness for sharing options increased significantly and actions like ticket information via mobile phone or internet in general increased.
2	Raise awareness on energy-efficient travel options and promote them as alternatives to the private car.	**	The knowledge of the availability of sharing options increased for students and seniors. A mode shift towards walking, cycling and slightly more PT usage can also be observed.
3	Increasing the attractiveness and safety of energy-efficient modes of transport for both target groups	**	Regarding the willingness to a behavior change, both groups most definitely (or probably) are prepared to do so. This trend can be seen in the increasing number of seniors walking or cycling
4	Empowering elderly people to use modern technologies and devices for planning their daily mobility	**	There is a visible increase in the number of seniors planning their trips with the help of mobile phones or the internet in general.
5	Fostering intergenerational exchange and understanding	***	The exchange between students and seniors can be described as successful. The expectations of both groups are fully and predominately met and the cooperation was valued very good and good by both groups.
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded			

D. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

- Raised awareness for sharing options like bike- and carsharing for students and seniors.
- Great willingness for a mobility behaviour change by both groups.
- The workshop format meets the expectations of the seniors and students. Also, the cooperation between both generations can be described as successful.
- Seniors more likely search for transport information via mobile phone or the internet than they did before taking part at the measure.
- Mode shift is developing towards more sustainable modes: walking, cycling, PT. Especially the number of seniors using a car is decreasing.
- Both target groups tend to use more sustainable transport modes: shown with the higher number of bicycles, e-bikes and IsarCard ownerships (IsarCard is used for Munich's PT).

D.2 Relevance of supporting activities

- The ML good contacts to secondary schools facilitates the cooperation and recruiting of schools.
- The cooperation with motivated teachers helped to execute the workshops during class.

D.3 Main lessons learned

- The cooperation between students and seniors is very successful as both sides can learn from each other.
- Students are the right group to teach seniors about using modern technology due to their affinity to digital media.
- Secondary schools give a suiting surrounding to foster the intergenerational exchange.
- The workshops executed by the ML are the right format to deliver content and work together in an interactive way.
- There is a huge demand from seniors to take part in the workshop format and learn about digital devices connected to the mobility and transport topic.
There is a very good understanding and way of getting along between the generations, students and seniors.
- A reliance on press for advertisement for participants should be minimized or kept in mind as sometimes wrong statements were published or no article was released.

D.4 Long term impact

- Hopefully all workshop participants are more sensitive towards more sustainable transport modes.
- Private contact between student-senior pairs was kept upright after the workshops in a few cases. Those contact between seniors was also fostered, for example meetings for a coming city trip with the local public transport.

D.5 Potentials for up-scaling in the city

- The measure MUC 2.10 is easy to up-scale in the city due to low costs and high impact possibilities among the target group.
- More schools within the city could be attracted by the positive evaluation outcome.

E. Additional information

E.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

The evaluation was done by the ML and well suited for the workshop format and the participants. Conducting paper-based surveys before and right after the workshop were very easy to execute and had a successful participation rate. The six months after survey was sent via post to the former participants. Here, the participation level was low among the seniors. Maybe another six months after the workshop or a simple gathering of the participants could have increased the participation rate and the exchange about experiences for both groups.

E.2 Future activities relating to the measure

Here the recommendations for the future of the measure after the project lifetime are presented:

The measure should be continued after the project lifetime because it is easy to organize the workshops because there is already a pile of workshop material available. Another big plus are relatively low costs which are necessary to operate the measure.

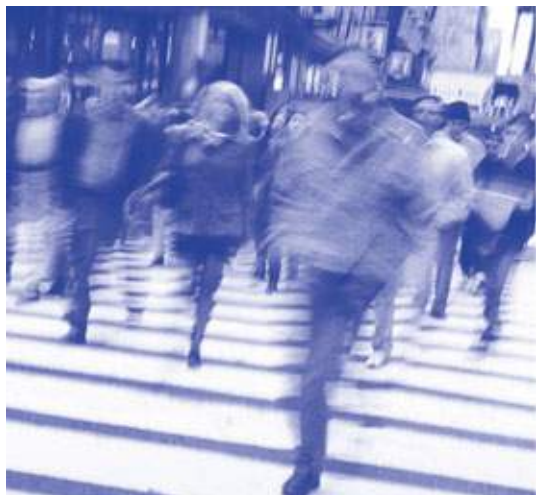
There could be an informal information meetup planned by the ML with secondary schools which already participated before and exchange their positive experience with other potential facilities.

Another idea to continue the project is to enable schools to execute their own workshops and help them to set up a teaching concept and prepare information material.

Furthermore, the ML is currently seeking for other funding options to extend the project and keep the “Transfer” measure running and meet the high demand among the citizens.

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2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



RUS 2.11

Information, training and awareness
raising

Measure Evaluation Report

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2020
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EUROPEAN UNION

Project Partners

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1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
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18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Lora Sarkisyan	
Ivaylo Yakimov	

Table of Contents

ABSTRACT.....	484
A. INTRODUCTION.....	486
A.1 EXPECTED RESULTS OF THE MEASURE	486
A.1.1 Quantifiable impacts.....	486
A.2 MEASURE DESCRIPTION	487
A.2.1 Measure outputs.....	487
A.2.2 Supporting activities	488
A.2.3 Interactions with other ECCENTRIC measures.....	488
A.2.4 Interactions outside ECCENTRIC	488
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	489
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS	489
A.5 IDENTIFIED RISKS	490
B. MEASURE IMPLEMENTATION	491
B.1 SITUATION BEFORE CIVITAS	491
B.2 INNOVATIVE ASPECTS.....	491
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	491
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	492
C. IMPACT EVALUATION FINDINGS	494
C.1 EVALUATION APPROACH.....	494
C.1.1 Expected impacts and indicators.....	494
C.1.2 Baseline.....	495
C.1.3 The business-as-usual scenario.....	496
C.2 MEASURE RESULTS.....	497
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	501
D. PROCESS EVALUATION FINDINGS	504
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	504
D.2 BARRIERS	504
D.2.1 Barrier 1.....	504
D.2.2 Barrier 2.....	504
D.3 DRIVERS	505
D.3.1 Driver 1.....	505
D.3.2 Driver 2.....	505

D.3.3	Driver 3	505
D.3.4	Driver 4	505
D.4	SUPPORTING ACTIVITIES	505
D.4.1	Supporting activity 1	505
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	505
E.	EVALUATION CONCLUSIONS	506
E.1	VALIDATED DIRECT IMPACT	506
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	506
E.3	INTERACTION WITH OTHER MEASURES	506
E.4	MAIN LESSONS LEARNED	40
E.5	LONG TERM IMPACT	507
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	507
F.	ADDITIONAL INFORMATION	508
F.1	APPRAISAL OF EVALUATION APPROACH	508
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	508

List of Figures

Fig. 1. Opening event in Ruse.....	484
Fig. 2. Training event in Ruse	485
Fig. 3. Druzhba modal split	496
Fig. 4. Modal split Druzhba (Jan.2020)	499
Fig. 5. Accidents and dead.....	500
Fig. 6. Thank you letter	502

List of Tables

Table 1. Quantifiable impacts.....	486
Table 2. Measure outputs	488
Table 3. Target groups or affected parties	489
Table 4. Measure stakeholders.....	490
Table 5. Risks	490
Table 6. Innovative aspects	491
Table 7. Impacts and indicators	494
Table 8. Indicators and measurements.....	494
Table 9. Accidents and dead.....	501
Table 10. Achievement of objectives	503

Abstract

The main objective of this measure was to create awareness of the benefits of sustainable mobility in Ruse and its importance for increasing the quality of life. One seminar was organised for public transport personnel, six workshops - for citizens and NGOs, three mobility conferences and a large media campaign for stakeholders and the school community. The aim was to encourage the different actors to embrace sustainable mobility habits, to increase the use of public transport, and to make walking and cycling safer and transforming them into a desirable way of moving in the city. A special focus on traffic safety was made, with the aim of sensitizing the population in order to reduce the risk of road accidents.

The most important challenges in the implementation were related to the interest of the participants. After so many events since 2000 in the frames of various EU projects that have ended almost without visible results, the Bulgarian stakeholders were tired and disinterested. It was difficult to involve them in further project events.

The final evaluation of the measure shows very encouraging results. The objectives of 2.11 were successfully achieved at higher level than expected. All important target groups were involved: local authorities, transport professionals, local citizens and their organizations, NGOs, disadvantaged groups, youth, academia and school children. Therefore, the new mobility measures foreseen in the CIVITAS ECCENTRIC project were widely discussed and promoted in order to change the mindset of all stakeholders.

The most important success factors of this measure were the good cooperation with the municipality, and the participative approach to the events proposing tailor-made seminars for each target group, together with perfect planning and conducting – well-organized distribution of the invitations, attractive agendas and catering and a lot of possibilities for the participants to express themselves and to share their opinion. A long-term co-operation of CSDCS with the local and regional media was also very helpful.



Fig. 1. Opening event in Ruse



Fig. 2. Training event in Ruse

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals / longer term:

- To create awareness of the need for sustainable mobility and its benefits for the City of Ruse as an important factor for improving the quality of life;
- To encourage the different actors to embrace sustainable mobility habits, making walking and cycling safer and the use of PT - more desirable way of travelling in the peripheral district Druzhba and in the whole city.

(2) Strategic level:

- Mode shift towards public transport (PT), walking and cycling and away from private cars;
- Rising the awareness about the traffic safety with the aim of sensitizing the population in order to use the new crosswalks and sidewalks and to reduce the risk of road accidents.

(3) Measure level:

- Acceptance of the implemented ECCENTRIC measures in Ruse;
- Satisfaction with the provided training and information.

A.1.1 Quantifiable impacts

Expected impacts	Increase the use of PT Decrease the use of private cars and taxis Reduce the air pollution	CIVITAS ECCENTRIC Objectives								
		Reduce:				Improve:				
ID	Quantifiable impacts	Energy use, CO ₂ emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight
1	80% of the citizens informed about the sustainable mobility					X	X	X		
2	10% decreased number of road incidents in Druzhba			X				X		
3	70% of satisfaction of citizens with new mobility measures						X	X		
4										
5										
6										
7										
8										
9										
10										

Table 1. Quantifiable impacts

A.2 Measure description

This measure consists of providing training and awareness raising activities in Ruse. The main objective was to create awareness of the benefits of sustainable mobility in Ruse and its importance for increasing the quality of life. One seminar was organised for public transport personnel, six workshops - for citizens and NGOs, three mobility conferences and a large media campaign for stakeholders and the school community. The aim was to encourage the different actors to embrace sustainable mobility habits, to increase the use of public transport, and to make walking and cycling safer and transforming them into a desirable way of moving in the city. A special focus on traffic safety was made, with the aim of sensitizing the population in order to reduce the risk of road accidents.

In the Application form of the project were planned the following activities: one seminar for public transport personnel; six workshops for Druzhba citizens and other stakeholders including NGOs and the school community; three mobility conferences and a large information and promotional campaign targeted to the general public.

During the different events organized in the frames of 2.11 the new mobility measures (implemented in Ruse as part of the CIVITAS ECCENTRIC project) were explained, discussed and promoted in order to change the people's perceptions concerning the urban mobility, and to increase their knowledge about the benefits of using sustainable modes of transportation.

A.2.1 Measure outputs

The planned outputs of the measure 2.11 were to conduct one seminar for transport professionals, six workshops for different target groups in Ruse and three Conferences on mobility.

During the project lifetime were conducted:

- **Output 1** – One seminar for professionals
- **Output 2** – Six workshops for different target groups in Ruse
- **Output 3** – Three Conferences, Participation in Danube Forum 2019 and in Automotive Forum 2019 (planned a 4th Conference and a participation in the Ruse Tourism Fair 2020 till the end of the project).

A.2.2 Supporting activities

	Type of supporting activity	Activity	Target group	Main objectives
1.	Promotion	Opening event with a press-conference	Ruse citizens, media, SMEs, academia	- To raise the awareness about the sustainable mobility - To support the ECCENTRIC measures
2.	Promotion	Media and non-media campaign	- Large public (radio, TV, newspapers, social media) - Transport professionals and academia (CSDCS-site, ENDURANCE BG network)	- To raise the awareness about the sustainable mobility - To support the ECCENTRIC measures
3.	Promotion	International transport events	International Transport Community (participation with presentations in CIVITAS Forums, ETC2019, TRA2020)	To inform the international transport community about the ECCENTRIC implementation in Bulgaria

Table 2. Measure outputs

A.2.3 Interactions with other ECCENTRIC measures

This measure has interactions with all the other Ruse measures. From one hand, the technical measures for Ruse (2.6, 3.6, 4.3, 4.4. and 5.4) were promoted and used as examples for discussions during the training events and were presented during the Conferences. From the other hand, the seminars, workshops and meetings were used for collecting part of the baseline data for the evaluation of the new mobility measures in WP8.

A.2.4 Interactions outside ECCENTRIC

There was an interaction and important synergy with the TDP project TRANSDANUBE pearls aiming to introduce regional SUMPs in Danube tourism regions. The training and awareness rising activities in both projects aim to change the public perceptions about the use of public transport (PT) instead of private cars and taxis and to promote the sustainable modes of transportation in the region.

A.3 Target groups and/or affected part of the city or region

Target groups			Affected area		
	Type	comment		Type	comment
1	Druzhba citizens	27 000	0	Ruse citizens	140 000
3	Public transport users (49%)	13 720		Ruse PT users (60%)	84 000
8	PT-companies, municipal transport department	30	8	Transport professionals	300
10	Professors and doctoral students of Ruse University – Transport Faculty; Varna Free University and Sofia Technical University	50	10	Academia	300
10	School children (Druzhba secondary schools, Leonardo da Vinci School)	70	10	Schools	300

Table 3. Target groups or affected parties

A.4 Stakeholders: ECCENTRIC project partners and other important actors

Main stakeholders are participants from the target group. In the following table, the stakeholders are summarized by function.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR- other	Level of activity L-P-O	Role - Links
1	Municipality of Ruse	P	C	P	Project partner
2	Cycling and environmental NGOs	S	NG	P	Contribute to the surveys; Participate in the workshops and measure discussions
3	Nature park "Rusenski Lom"	S	NG	O	Contributes to the surveys; Participate in the workshops and measure discussions
4	Ruse Chamber of Commerce	S	NG	O	Contributes to the surveys; Participate in the workshops and measure discussions
5	Ruse, Varna and Sofia Universities	S	KI	P	Contribute to the surveys; Participate in the Conferences, workshops and measure discussions
6	Ruse schools	S	KI	P	Contribute to the surveys;

					Participate in the workshops and measure discussions
7	Association of Disabled people – Ruse Branch		NG	P	Contributes to the surveys; Participate in the workshops and measure discussions
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 4. Measure stakeholders

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Low interest from the part of the local community to participate in the training activities	Process	Preliminary face-to-face meetings with the leaders of the different target groups; Disseminating on-time the invitations with an agenda containing topics of interest; Giving participants possibility to express themselves and to share their opinion; Attractive place for conducting the events, materials and catering.	Lucia Ilieva (ML)
Low interest from the part of the academia to participate in the training activities	Process	Preliminary face-to-face meetings with the Universities' rectors; Disseminating on-time the invitations with an agenda containing topics of interest; Giving participants possibility to make presentations and publications; Using universities' conference facilities for conducting the events, providing good materials and catering.	Lucia Ilieva (ML)
Stakeholders are not ready to take part in interviews or surveys.	Process	Explaining by media publications and by direct talks the importance of their participation in the evaluation activities; Applying different methods of primary data collection (direct interviews, letters to home address, written questionnaires, common discussions, observations, etc.)	Lucia Ilieva (ML)

Table 5. Risks

B. Measure implementation

B.1 Situation before CIVITAS

The Ruse citizens and transport experts didn't have much information about sustainable mobility and its importance for the quality of life in the city. Only few municipal experts have taken part in a SUMP training conducting by CSDCS in the frames of a previous EU Project (BUMP).

As in Bulgaria "Mobility" is not included in the university curricula, it does not exist in the Ruse University. There is a lack of school programs related to mobility education and road safety for pupils and students thus contributing to the high risk of road accidents involving pedestrians. The whole ECCENTRIC approach to mobility and the measures foreseen to be implemented needed to be largely explained, discussed and promoted at all levels in order to change the perceptions of the people and the manner of thinking of decision makers and transport experts.

B.2 Innovative aspects

Ranking	Innovative aspect	Description
1	New conceptual approach	Introduction of Sustainable mobility and SUMP in Bulgaria
2	New social approach	Introduction of Mobility as a Right (MaaR) in Bulgaria, reporting on CIVITAS Forum 2017

Table 6. Innovative aspects

B.3 Research and Technology Development

In the frames of this measure the following research and technologies have been developed:

- Preparation of stakeholders' list. Updated twice after political changes in the country – in April 2017 and in November 2019;
- Study of the training needs of Ruse transport professionals (using as secondary sources past projects' reports – TRANSDANUBE and BUMP and as primary sources – direct and telephone interviews, and e-questionnaires);
- Public procurement procedure for selecting a subcontractor for organizing the training events (invitations, training materials, room and equipment, catering);
- The newest EU trends and concepts in the mobility area were always included into the topics for presentation and discussion during the conducted events;

- The measure's events were organized using the most advanced technologies for anterior and posterior communication with the stakeholders, for presentations during the events, and for filming the events and communicating with media;
- New technologies used in the transport and mobility area were always presented and discussed during the Conferences.

B.4 Actual implementation of the measure

The measure was implemented following the 4 stages adopted by the project management, but because of its specifics CSDCS was implementing the four phases together for each event (before, during and after its implementation).

The main activities on the Research and planning phase were conducted in the period 01.12.2016 – 28.02.2017 when the initial preparation for the training and awareness raising activities was held. First the main stakeholders and target groups for training were established, lecturers were selected and several specific curricula and the main project presentations were prepared. Later on before each specific event the agenda, the materials, presentations and discussion topics were adapted according to the specific interests and needs of the target auditory. This was the key for successful implementation of the RUS 2.11 measure and kept the interest of the stakeholders high till the end of the project.

The Procurement and implementation phase started on 01.03.2017. CSDCS subcontracted with the company "Communication 1" the tasks related to the technical organization of the events and their promotion in media. As this stage was developing in parallel with the Stage 3 "Demonstration and monitoring", CSDCS included in the training materials the implementation of the ECCENTRIC measures and disseminated evaluation questionnaires to the participants after each event. The questionnaires were collected on site thus ensuring 100% of feedback and were processed later by our marketing experts.

The obtained results from the evaluation allowed to perform the 4th stage "Conclusions and recommendations" after each training and to permanently improve our performances. By the end of the measure CSDCS was able to summarize the results of the evaluations and to reach the final results.

In 2017 4 training events were performed: for transport professionals – 26 p.; for the "living lab" Druzhba citizens – 43 p.; for environmental NGOs – 17 p. and for school children – 30 p. In 2018 CSDCS organized a seminar for professors and doctoral students from the Ruse University. In 2019 a workshop was conducted for the members of the Association of Disabled people in Ruse - 20 p. The total number of trained people is 165. In 2020 one more seminar

with the Druzhba citizens and the new-elected (in Nov.2019) municipal staff is planned. CSDCS expects to reach the total number of 200 participants in the seminars.

The First Conference was organized in Oct.2018 in Ruse (in the Ruse University A.Kantchev” with the main theme “Social aspects of mobility” and 45 participants). The second was held in Sofia in May 2019 at the Conference hall of the “Federation of Scientific and Technical Unions in Bulgaria” with the active participation of the Sofia Technical University, the Ministry of Transport and Road Agency). Its main theme was “The mobility and the youth” and we had 75 p. The third took place in the Varna Free University “T.Hrabar” in November 2019 with the topic “E-mobility and urban planning”. We registered 45 p.

As there was a rising interest in the academic circles to mobility and SUMP, CSDCS plans to organize one more Conference till the end of the project. The total number of participants in the first three conferences was 175 and the expectations are to reach 250 people after the 4th Conference.

CSDCS co-organized and presented the project at two important transport forums: the Automotive Forum in Sofia (Sept.2019) and the Danube Forum in Ruse (Oct.2019), both with more than 100 participants each. In 2020 we are presenting ECCENTRIC at a Discussion forum during the Ruse Tourism Fair in May.

The Mobility as a Right (MaaR) concept was raised as a result of the measure RUS 2.11 and till present works very well – people are ready to control the implementation and are in permanent contact with the project team of the Ruse municipality.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

	Impact category	Expected impacts	Aspect of this category	Indicators	No.
1.	Society-people	Increase with 60% the awareness about sustainable mobility	Awareness level	Awareness (%)	19
1.	Society-people	Achieve 70% of acceptance and satisfaction	Acceptance level	Acceptance (%)	20
2.	Transport system	Reduced by 10% the road accidents	Transport safety	Number of incidences (injuries, dead)	11

Table 7. Impacts and indicators

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
19	Awareness	%	B – A	S	Local citizens	Druzhba, Ruse
20	Acceptance	%	B – A	S	Local citizens	Druzhba, Ruse
21	Satisfaction	% (0-5 score)	B – A	S	Local citizens	Druzhba, Ruse
11	Road accidents	Units/year	B – A	DC	Data from Road Police	Druzhba
10	Road fatalities	Units/year	B – A	DC	Data from Road Police	Druzhba
	Support for SUMP	%	B – A	S	Local citizens	Druzhba, Ruse
1	Change of modal split (shift to PT, cycling and walking)	%	B – A	S	Local citizens	Druzhba
	Participation in the events of 2.11	Number of p.	B – A	DC	Participants in events	Druzhba, Ruse
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 8. Indicators and measurements

C.1.2 Baseline

During the research and planning phase, CSDCS prepared two questionnaires for collecting data for evaluation purposes. The first one contained 6 questions and was dedicated to the participants in the training events. It was disseminated on paper, fulfilled after the end of each event and collected by the organizer for processing. Thus CSDCS wanted to collect reliable data about the satisfaction of the trainees with the conducted events, their awareness about mobility before and after the training, their level of acceptance of Ruse mobility measures and their eventual recommendations.

The second questionnaire having 11 questions was more general aiming to establish the modal split in Druzhba, the perceptions of local citizens about the transport and mobility, their needs, fears and expectations from the project and their support to Ruse SUMP. For collecting data CSDCS subcontracted a marketing agency that established a panel of local citizens for questioning. The initial results were collected in May 2017 in Druzhba district when the implementation of the Ruse measures has not been started yet. The methodology for the selection of respondents was quota-based, with a sample size of 215 people randomly selected and evenly distributed in the three neighbourhoods of Druzhba district, which guaranteed its representativeness. The subject of the survey were individuals from all age groups of 15 and over, i.e. people who actually needed to move to the city center, use public transport services and could give an objective assessment of both the advantages and disadvantages they were facing in their daily trips. This survey was enriched in December 2017 with baseline data from 70 school children. During the school seminar adapted especially for pupils aged 11-13, CSDCS disseminated evaluation sheets with questions about children's satisfaction with the event, road safety, walking, cycling, etc.

After processing the general questionnaires, CSDCS obtained the following results:

Modal split: Before the project (in 2017) the Druzhba modal split was: 49% of citizens use PT; 19 % walk; 5.5 % cycle; 26.5 % use car/taxi.



Fig. 3. Druzhba modal split

Awareness: Only 14% (mainly young people) were aware about the sustainable mobility, SUMP and the planned ECCENTRIC measures in Druzhba. People were complaining of the quality of the PT in Ruse, didn't feel safe on the streets and estimated to be deprived of good transport connections to the city centre.

Road accidents and fatalities: The data for road accidents in Druzhba obtained by the Ministry of Internal Affairs – Ruse Road Police were:

- 2014 – 87 accidents, 3 dead;
- 2015 – 89 accidents, 3 dead;
- 2016 - 25 accidents, 1 dead;
- 2017 - 26 accidents, 1 dead.

The results from the survey in the Ruse schools were:

- 73% of school children didn't feel safe when cycling in the city;
- 73% of school children didn't feel safe when walking and crossing the streets;
- 85% of the children estimated that their quality of life would improve if the transport environment was better and accepted the new mobility measures.

C.1.3 The business-as-usual scenario

The BAU scenario was discussed during the meeting with stakeholders held in the Ruse Municipality on 7th of May 2019. In the CSDCS analysis of such a model, the results were discouraging. Transport demand would increase in line with population ageing, the internal migration from rural to urban areas, and greenhouse-gas (GHG) emissions could rise proportionally. City dwellers would travel in mostly the same ways as they do now, and private

cars would continue to account for about 35 percent of passenger-kilometers. Average travel times would increase by 15 percent because capacity would be strained.

There were presentations of the Dep. Mayor of Ruse and PM Mr. S. Karapchanski, the Dep. Mayor on Environment and the Chief-on-Architect of Ruse. They all stressed that if the measure RUS 2.11 would be never implemented, the target groups would not recognize the importance of the sustainable mobility for their every-day life and it would be difficult to implement the other measures successfully. They would not realize that the transport mode is closely related with their health and wellbeing and would not change their perceptions in favor of public transport, walking and cycling.

This scenario permitted CSDCS to make several important conclusions and to forecast the further development. People declared to be very satisfied with the conducted training and information campaign on ECCENTRIC. Because of the lack of any materials on mobility and SUMP, the audience required a lot of information and printed materials and the interest to the ECCENTRIC project was very high. One could forecast a permanent interest from the part of citizens to mobility in general and to the project measures in particular.

C.2 Measure results

For evaluating the measure results, CSDCS aggregated the data collected from the beginning of the 2.11 activities till the end of 2019.

1. For evaluating **the participation**, CSDCS counted the number of participants in the Attendance lists of the 6 seminars (S) and 3 conferences (C) conducted in the frames of the project. **The total number of participants was 329** (S1 – 26 p., S2 – 43 p., S3 – 17 p., S4 – 30 p., S5 - 28 p., S6 – 20 p. , C1 – 45 p., C2 – 75 p. , C3 – 45 p.) As the team is intended to organize more events in 2020 (at least one seminar and/or one supplementary Conference), CSDCS expect to reach over 400 trained people till the end of the project.
2. For evaluating the **Awareness, Acceptance, Satisfaction and Support for SUMP**, CSDCS aggregated the data obtained from the questionnaires collected after the events and calculated the average percents of 329 respondents.
 - a. Awareness about mobility - (S1 – 100%, S2 – 100%, S3 – 100%, S4 – 100%, S5 – 100%, S6 - 100%, C1 – 100%, C2 – 100%, C3 – 100%). The average percentage is 100 indicating that everybody of our auditory became aware about the project, the sustainable mobility and the Ruse measures.
 - b. Acceptance of new mobility measures - (S1 – 100%, S2 – 72%, S3 – 80%, S4 – 90%, S5 – 100%, S6 - 72%, C1 – 96%, C2 – 90%, C3 – 85%) The average

percent of acceptance is quite high – 87%. The main remark was that such trainings are not able to radically change the behaviour of local decision-makers.

- c. Satisfaction with the training - (S1 – 100%, S2 – 80%, S3 – 84%, S4 – 100%, S5 – 100%, S6 - 80%, C1 – 94%). The average percent of satisfaction is very high – 91%. Some participants scored lower because they wanted to have more time for mutual communications between them during the events. Some estimated that the measures were too limited as number and scope and insisted to spread them all over the city.
 - d. Support for SUMP - (S1 – 98 %, S2 – 80%, S3 – 85%, S4 – 90%, S5 – 100%, S6 - 86%, C1 – 94%). CSDCS used the same methodology described above. The average percent of support is very high – 90%. Some participants expressed their doubts that the local governments in Bulgaria will be able to implement the SUMP as planned.
3. **Modal shift** – CSDCS evaluated the modal shift according to the data obtained by the survey made in the period 20.11.2019 - 20.12.2019 in Druzhba with the established 150 panel respondents. They were contacted by the interviewers face-to-face or by phone and answered to similar questions as in the initial survey made in May 2017 concerning their travel mode, their opinion and use of the new measures, implemented in Ruse, etc. For obtaining the same number of 215 respondents as for the baseline study, oral interviews were conducted (registered by smart phones) with 30 school children from “V.Levski” school in Druzhba, with 20 pedestrians using the new infrastructure in the Druzhba centre (“V.Levski” Blvd) and with 15 participants from Ruse during the 3rd ECCENTRIC Conference.

The results obtained from the 215 respondents showed that already 76% of the local population use for their every-day trips PT, walking or cycling. It means that there was a shift to more sustainable way of moving. The initial percent of 73.5% increased with 2.5% and now the sustainable commuters are already 76%. The picture obtained was as follows:

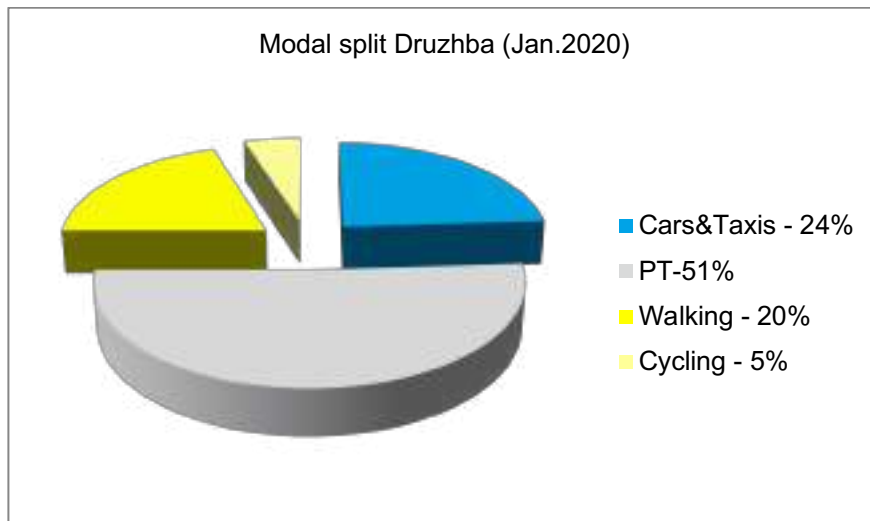


Fig. 4. Modal split Druzhba (Jan.2020)

The PT use increased also with 2% - from 49% to 51%. The walking – with 1% from 19% to 20%. There is a small decrease with 0.5% of the cycling but CSDCS estimates it is due to the cold weather when people were interviewed. In general the trend is positive, although due to the late implementation of the technical measures in Ruse, they were in use only for several months and couldn't influence much the travel behaviour of the citizens. The local population was well informed about them and persuaded in the benefits of the sustainable mobility for their health and wellbeing.

4. **Road accidents and fatalities:** For evaluating the road accidents and fatalities, CSDCS used data from the Ministry of Internal Affairs – Ruse Road Police:
- 2017 - 26 accidents, 1 dead;
 - 2018 – 25 accidents, 1 dead;
 - 2019 – 20 accidents, 0 dead

It is visible, that the trend is positive and it is due partly to the information and educational activities of CSDCS in the frames of ECCENTRIC and partly to the implementation of the new mobility measures for pedestrians (4.3 and 4.4) in the district. Below the positive trend is shown on a chart:

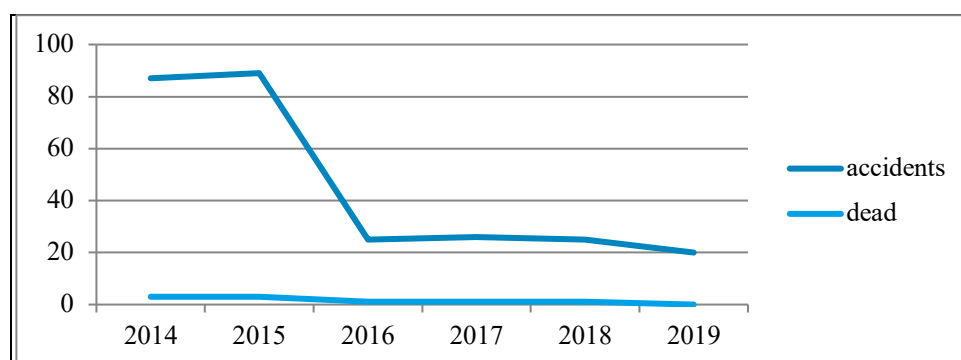


Fig. 5. Accidents and dead

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness about mobility	%	14	June 2017	14	May 2019	100	Jan. 2020	86	86
Acceptance of mobility measures	%	0	June 2017	0	May 2019	0	Jan. 2020	87	87
Satisfaction with the training	% (0-5 score)	0	June 2017	0	May 2019	91 (4.5)	Jan. 2020	91 (4.5)	91 (4.5)
Road accidents in Ruse	Units/year	234	Jan. 2017	209	May 2019	204	Jan. 2020	-30	-23
Road accidents in Druzhba district	Units/year	26	Jan. 2017	25	May 2019	20	Jan. 2020	-6	-5
Road fatalities In Ruse	Units/year	7	Jan. 2017	8	May 2019	4	Jan. 2020	-3	-4
Road fatalities in Druzhba district	Units/year	1	Jan. 2017	1	May 2019	0	Jan. 2020	-1	-1

Support for SUMP	%	0	Jan. 2017	0	May 2019	0	Jan. 2020	90	90
Change of modal split (shift to PT, cycling and walking)	%	73.5	June 2017	73.5	May 2019	76	Jan. 2020	2.5	2.5
Participation in the events of 2.11	Persons number	0	March 2017	0	May 2019	0	Jan. 2020	329	329

Table 9. Accidents and dead

C.3 Summary: achievement of objectives

In summary, CSDCS can report that according to the impact evaluation after 3.5 years of work this measure has fully achieved its objectives, even for most of them the results exceeded the expectations. The measure RUS 2.11 has increased the knowledge, the understanding and the support for the sustainable mobility among local population, has obtained their support for the implementation of SUMP and has changed radically their perceptions by introducing the MaaR concept. The measure has informed as much citizens as possible about the ECCENTRIC project and the efforts of CSDCS team were highly appreciated by all the stakeholders, including the City Council and the Ruse Regional Administration. CSDCS team received two Thank you letters with congratulations for the performed work from the highest level of the Ruse region – the Governor Mr. G.Grigorov (shown below):



Fig. 6. Thank you letter

No.	Objective and target	Rating	Comment
1	60% of the citizens informed about the sustainable mobility	***	New 86% of citizens are informed about the sustainable mobility thus providing 100% of informed citizens.
2	10% decreased number of road incidents in Druzhba	***	The number of road incidents decreased with 23%
3	70% of satisfaction of citizens with new mobility measures	***	91% of people declare to be satisfied with the measures
4	Acceptance of new measures	***	87% accept the new measures
5	Support of SUMP	***	90% declare to support SUMP
6	Change of modal split (shift to PT, cycling and walking)	*	New 2.5 % adopted sustainable mode of transportation (increase by 3.4% from original value)
NA = Not Assessed O = Not Achieved in full * = Substantially achieved (at least 50%) ** = Achieved *** = Exceeded			

Table 10. Achievement of objectives

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

There were no any deviations from the original plan.

D.2 Barriers

All the barriers were successfully overcome.

D.2.1 Barrier 1

The social/cultural barrier was to involve the participants in the events and to establish a dialogue with them. There were so many projects in Ruse (mainly funded by the Operational and Cross-Border Cooperation Programs) accompanied with so many trainings that Ruse people were already bored and tired from all these events with limited positive results.

People have seen many plans and strategies for improving the living conditions of citizens that were only written on paper and had no follow up after the end of the projects. Citizens first asked shall they see some real results from our current project.

To overcome this barrier CSDCS decided to involve different target group and to provide tailor-made training programs for each of them and it has worked successfully. CSDCS has used the workshops for collecting the opinions of the participants not only about the event but for the ECCENTRIC measures in Ruse in general. Finally, after the deployment of the measure everybody in the city was informed about the project and was supportive. People became aware of their responsibilities and started calling the Mayor asking how the project was progressing.

D.2.2 Barrier 2

An organizational barrier was to involve media that used to ask for scandals and bad news. Successful events were not of great interest for them.

CSDCS asked for support the municipality and the Ruse Governor. The team launched a large media campaign, participated in the main Ruse international event (as The Tourism Fair under the auspice of the Minister of Tourism), often appeared at the regional TV channel and finally achieved to provoke a large discussion about mobility, sustainability and climate change in the city.

D.3 Drivers

CSDCS has detected four main drivers for the successful implementation of this measure: planning, organizational, financial and positional.

D.3.1 Driver 1

Technical planning of the measure was carried out meticulously and with strong stakeholders' involvement. Each event met the needs and requirements of the specific target group thus contributing to the awareness raising and support of the Ruse ECCENTRIC measures.

D.3.2 Driver 2

The organization of the event was perfect. The key personnel involved in planning the measure were highly committed to achieving the measure objectives. The project team and the subcontractor prepared the events in a high professional way in order to keep the interest of the target groups and to ensure many of participants.

D.3.3 Driver 3

The funding from the ECCENTRIC project allowed to engage as lecturers high professionals and to carry out the events in attractive conditions (convenient invitations, cosy conference rooms, good catering, useful training materials and supplies, etc.).

D.3.4 Driver 4

As a positional driver CSDCS can mention the fact that the measure RUS 2.11 is part of the awareness raising campaign of Ruse in the frames of their SUMP.

D.4 Supporting activities

As supporting activities CSDCS qualifies the promotion of the new mobility measures performed with the common efforts of the Ruse Municipality and CSDCS.

D.4.1 Supporting activity 1

The opening press-conference with the participation of Ruse politicians, the media and non-media campaign and the permanent information provided on the sites of the municipality and CSDCS contributed to the success of this measure.

D.5 Recommendations on the implementation process

The measure RUS 2.11 has been successfully implemented and has increased the knowledge, of the local population about the sustainable mobility by obtaining their support for the implementation of SUMP and introducing the MaaR concept.

The only recommendation is to use the elaborated training materials and curricula to further enlarge the stakeholders' knowledge on urban sustainability after the end of the project as a civic education contributing to the mitigation of the climate change.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

According to the impact evaluation after 3.5 years of work this measure has fully achieved its objectives, even for most of them the results exceeded the expectations. The measure RUS 2.11 has increased the knowledge, the understanding and the support for the sustainable mobility among local population, has obtained their support for the implementation of SUMP and has changed radically their perceptions by introducing the MaaR concept. The measure has informed as much citizens as possible about the ECCENTRIC project and the efforts of CSDCS team were highly appreciated by all the stakeholders, including the City Council and the Ruse Regional Administration.

E.2 Relevance of supporting activities

The supporting activities were relevant and contributed to:

- Support the ECCENTRIC measures;
- Raising the awareness about the P&R as a component of sustainable mobility.

E.3 Interaction with other measures

This measure has interactions with all the other Ruse measures. From one hand, the technical measures for Ruse (2.6, 3.6, 4.3, 4.4. and 5.4) were promoted and used as examples for discussions during the training events and were presented during the Conferences. From the other hand, the seminars, workshops and meetings were used for collecting part of the baseline data for the evaluation of the new mobility measures in WP8.

E.4 Main lessons learned

Technical planning of such measures should be carried out meticulously and with strong stakeholders' involvement. Each event met the needs and requirements of the specific target group.

E.5 Long term impact

In general, the education and promotion campaign contributed to the recognizing the importance of the sustainable mobility and SUMP for climate change mitigation of the cities.

E.6 Potentials for up-scaling in the city

The educational activities of RUS 2.11 can be easily up-scaled moreover some of them already included citizens not only from Druzha district but from the whole city of Ruse (the seminars for transport professionals, for NGOs, for academia and the Conferences). CSDCS is the owner of all the materials and presentations and can continue organizing seminars and workshops if the interest from the stakeholders exists and the municipality can finance the future events.

CSDCS estimates that the Conferences were already up-scaled because the last two of them were held beyond Ruse (in Sofia and Varna) and the supplementary forth one is prepared to be conducted in Gabrovo.

The information and promotion activities were also up-scaled – a large media campaign for ECCENTRIC and Ruse measures was conducted in other cities (Varna, Dobrich, Shumen, Tutrakan, etc.).

The MaaR concept was promoted at the CIVITAS Forms and ECOMM. The Bulgarian ECCENTRIC team will exchange experience with Mexico on this topic, visiting the city of Merida in February 2020.

F. ADDITIONAL INFORMATION

F.1 Appraisal of evaluation approach

The evaluation approach for this measure has been successful in providing accurate monitoring and reporting of the results achieved. The strong points include the 100% of feedback received and the convenience of the data collection process for those KPI related to the measure.

F.2 Future activities relating to the measure

The elaborated training materials and curricula will be used in further trainings in order to enlarge the stakeholders' knowledge on urban sustainability after the end of the project as a civic education contributing to the mitigation of the climate change.



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TUR 3.1 & TUR 3.2

Smart Multimodal Mobility Services:
Applying Mobility as a Service concept
Integrated Ticketing and Information
System for Mobility

Measure Evaluation Report

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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Jari Hietaranta	
Stella Aaltonen	

Table of Contents

ABSTRACT.....	516
A. INTRODUCTION.....	518
A.1 EXPECTED RESULTS OF THE MEASURE	518
A.1.1 Quantifiable impacts.....	518
A.2 MEASURE DESCRIPTION	519
A.2.1 Measure outputs.....	519
A.2.2 Supporting activities	519
A.2.3 Interactions with other ECCENTRIC measures.....	519
A.2.4 Interactions outside ECCENTRIC	520
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	520
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	520
A.5 IDENTIFIED RISKS	521
A.6.....	521
B. MEASURE IMPLEMENTATION	522
B.1 SITUATION BEFORE CIVITAS	522
B.2 INNOVATIVE ASPECTS.....	522
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	522
B.4 ACTUAL IMPLEMENTATION OF THE MEASURES	522
C. IMPACT EVALUATION FINDINGS	531
C.1 EVALUATION APPROACH.....	531
C.1.1 Expected impacts and indicators.....	531
C.1.2 Baseline.....	532
C.1.3 The business-as-usual scenario.....	533
C.2 MEASURE RESULTS.....	534
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	539
D. PROCESS EVALUATION FINDINGS	541
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	541
D.2 BARRIERS	541
D.2.1 Organizational	541
D.2.2 Problem related	541
D.2.3 Planning.....	541
D.2.4 Political / strategic.....	541

D.2.5	<i>Institutional</i>	542
D.3	DRIVERS	542
D.3.1	<i>Planning</i>	542
D.3.2	<i>Positional</i>	542
D.3.3	<i>Planning</i>	542
D.3.4	<i>Technological</i>	542
D.4	SUPPORTING ACTIVITIES.....	542
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	542
D.5.1	<i>Have a back-up plan in case of personnel changes</i>	543
D.5.2	<i>Try and find a common ground for the division of roles and responsibilities</i>	543
E.	EVALUATION CONCLUSIONS	544
E.1	VALIDATED DIRECT IMPACT	544
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	544
E.3	INTERACTION WITH OTHER MEASURES	544
E.4	MAIN LESSONS LEARNED	544
E.5	LONG TERM IMPACT	545
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	545
F.	ADDITIONAL INFORMATION	546
F.1	APPRAISAL OF EVALUATION APPROACH	546
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	546

List of Figures

Figure 1. Awareness of Maas services in the laboratory area/ companies.....	535
Figure 2. Awareness of Maas services in the laboratory area / housing companies	536
Figure 3. Acceptance of Maas services in the laboratory area / companies.....	536
Figure 4. Acceptance of Maas services in the laboratory area / housing companies	537
Figure 5. System usage / joint tickets sold.....	539

List of Tables

Table 1: Quantifiable impacts measure TUR 3.1.	518
Table 1: Quantifiable impacts measure TUR 3.2.	519
Table 2: Target groups or affected parties of TUR 3.2 measure.....	520
Table 3: Measure stakeholders of TUR 3.2 measure.	520
Table 4: Identified risks	521
Table 6: Description of key performance indicators (KPI) (cont.).....	531
Table 7: Measure’s indicators	532

Project	City		
ECCENTRIC	Turku		
Measure code	Measure name		
3.1. & 3.2.	Smart Multimodal Mobility Services: Applying Mobility as a Service concept Integrated Ticketing and Information System for Mobility		
Last update	Responsible	e-mail	telephone
23.1.2020	Stella Aaltonen	stella.aaltonen@turku.fi	+358 44 9075983

Abstract

Measures TUR 3.1. and 3.2. aimed to have a functioning Maas ecosystem in place with at least three Maas operators running in the city of Turku by the end of the project. Prior to the project, the user could either buy means (a car or a bike) or tickets for transport (bus ticket, train ticket etc.) separately for each mode. In these measures, the development of MaaS system and services in the city of Turku was to be piloted. This included the creation of business models that enabled cooperation with different existing service providers and attracting new Maas operators to come to the city by creating different service packages and marketing them through a variety of communication channels. A new open data interface and platform into which the ticketing system of the public transport system was incorporated was also to be developed. This enabled the integration of other local service providers into the Maas ecosystem, such as taxis, parking houses etc. The ticketing system for the bike sharing system was also integrated into the data interface as a demonstration of how the new information system and open integration enabled new business opportunities and models. All this was to result in easy and accessible multimodal services to citizens and tourists.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of measures TUR 3.1. & 3.2. was measured. Data was derived from local surveys, secondary city statistics, policy documents, the PT operator Föli and the Measure Leader.

As a result of the two measures, several MaaS operators have provided or are providing their services in the city. Combined tickets are being sold through the integrated ticketing system and the ticketing system of PTA functions also as a ticketing system to the bike sharing system (TUR 5.5.). There are open interfaces available to the MaaS operators and also to the mobility service providers wanting to bring their service visible together with public transportation. Cooperation models have been created and tested between different parties. In essence, MaaS services are available to the citizens, although awareness of these services still needs concerted promotional activities. Measure evaluation showed that awareness of MaaS is still rather low in the city and due to this, not many conclusions can be drawn on their acceptance or satisfaction. It was also clearly demonstrated that the complexity of MaaS calls for the

continuous involvement of external and internal stakeholders, vital for the understanding of differing motivations, drivers and barriers that surround the issue and the various actors involved. Moreover, the success of MaaS endeavors at this point seems to culminate in the public actor vs. private actor role/responsibility conundrum - an issue in most need of further research in addition to the business-case aspect from the consumer's point of view.

A. Introduction

A.1 Expected results of the measure

The measure objectives were:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- To promote sustainable, clean and efficient urban traffic and car-independent lifestyles
- To implement integrated packages of technology to allow for transport behaviour change and subsequent change in the modal split

(2) Strategic level:

- Setting up a MaaS ecosystem to enable a variety of services to the citizens and to have a variety of services linked to the open platform of public transportation, e.g. several type of bikes and electric vehicles
- Promote creation of business models enable cooperation with different existing service providers and attract new MaaS operators to come to the city

(3) Measure level:

- To bring first MaaS services available to the citizens
- To create co-operation models between different parties
- The have the ticketing system of public transport working also as a ticketing system for the bike sharing system
- To have open interfaces available to the MaaS operators and also to the mobility service providers that want to bring their service visible together with public transportation

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	At least three MaaS operators operating in the Kupittaa laboratory area	x							x		
2	Car ownership: the number of cars per residents starts to fall	x			x						

Table 1: Quantifiable impacts measure TUR 3.1.

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
1	At least 3 MaaS operators are providing their services	x							x		
2	The number of customers/tickets sold using services through the integrated ticketing system	x									

Table 2: Quantifiable impacts measure TUR 3.2.

A.2 Measure description

The aim of measures 3.1. and 3.2. was to have a functioning Maas ecosystem in place with at least three Maas operators running in the city of Turku by the end of the project. In the previous model, the user was either able to buy a means (a car or a bike) or tickets for transport (bus ticket, train ticket etc.). In these measures, the development of MaaS system and services in the city of Turku were to be piloted. This included the creation of business models that would enable cooperation with different existing service providers and attracting new Maas operators to come to the city by creating different service packages and marketing them through a variety of communication channels. A new open data interface and platform into which the ticketing system of the public transport system is incorporated was also to be developed. This would enable the integration of other local service providers into the Maas ecosystem, such as taxis, parking houses etc. The ticketing system for the bike sharing system was also to be integrated into the data interface as a demonstration of how the new information system and open integration enables new business opportunities and models. All this was to result in easy and accessible multimodal services to citizens and tourists.

A.2.1 Measure outputs

In these measures, a new open data interface and platform into which the ticketing system of the public transport system is incorporated were to be created. This would enable a functioning MaaS ecosystem into which at least three MaaS operators were to be integrated.

A.2.2 Supporting activities

No supporting activities were identified for these measures.

A.2.3 Interactions with other ECCENTRIC measures

Measures 3.1. and 3.2. were to have interactions with the following measures within ECCENTRIC:

- STO 3.5. “Develop smart choice of mobility services”: comparing the measures was been discussed, since the cities had different ways of doing the platform. Also the measures would work together try to sell each other’s PT (bus and shared bikes) tickets to travellers from STO to TUR via the shipping lines.
- MUC 3.4. “Beacon based indoor routing as a mobility service app”: the results of this measure were to be compared with the beacon based cultural path.
- TUR 5.5. “Bike-sharing and Car-Sharing Schemes”: the bike share system was to be integrated into the Turku city PT platform “Föli”.

A.2.4 Interactions outside ECCENTRIC

No interactions were identified for this measure.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents	City of Turku	MaaS services should be made known to all Turku residents
3	Public transport users	City of Turku	PT users are one of the main target groups for MaaS services connected to the PT platform
6	Commuters	Turku region	Commuters from around the Turku region will benefit from development of mobility services
2	Car drivers	Turku region	Particularly car drivers should be targeted when aiming to reduce private car use via improved mobility services

Table 3: Target groups or affected parties of TUR 3.2 measure.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	Turku Region Traffic Föli	P	PT	P	Provider of the platform for MaaS services development
2	City of Turku	P	C	L	Lead partner
3	VR Group	S	PT	O	Railway operator
4	Tuup Ltd.	S	PR	O	MaaS operator
5	MaaS Global	S	PR	O	MaaS operator
6	Reittikioski	S	PR	O	A software developer and an essential MaaS operator
7	Western Systems Ltd.	P	PR	P	A Finnish software vendor specializing in travel card applications. Responsible for software development in the MaaS process
8	Region of South-West Finland, Lounaispaikka	P	Other (regional authority)	O	Region of South-West Finland maintains the open data of the region and develops the use of it.
Type: P:CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 4: Measure stakeholders of TUR 3.2 measure.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Surveys to households/businesses may fail to reach enough respondents	5	pre- information about the shortcoming survey, increase of awareness, small incentives	ML, LEM
MaaS operators may not be willing to answer to the survey	5	Informing operators about the necessity to answer	ML
Lack of economic data from private companies	9	The operators should be well informed about the economic data needed	ML, SC
Turku is not appealing for MaaS operators	2	Larger cooperation with the Region, creating larger market possibilities	ML, SC
MaaS system failure; integrated ticketing system cannot be established	7	Sufficient preparation pre-implementation for possible technical obstacles and challenges. Administration is well informed about the technical solutions and alternatives.	ML

Table 5: Identified risks

B. Measure implementation

B.1 Situation before CIVITAS

At the start of the project, there were no real MaaS services of any type available in the Turku region. The vast majority of all PT tickets (city buses) were sold through traditional channels (the Föli system). No other travel modes were connected to the PT system. In public transportation, a new ID based ticketing system had only taken to full scale production in the summer 2016. When the measures started, only one demo project had been realised to open the interfaces to different service providers. In addition, there was only a very limited number of shared cars available in the city and co-operation between different mobility service providers was still in its initial stages.

B.2 Innovative aspects

MaaS was a novel concept worldwide. Few services were available that would allow the customer to purchase tickets for several available transportation services without the need of making individual purchases through different websites or apps. The development of such MaaS ecosystems was still in the very early phases with little information available on good practices, functioning business models or technological solutions. The Turku measures were thereby to entail innovation potential both in terms of creation of MaaS ecosystems and technological developments. Innovative aspects included e.g. the following:

- Beacon based marketing and communication of the city, cultural and information paths from stations to centers.
- Platform development models and business-public co-operation models to multiply and scale the platform to different sized cities.
- Opening anonymous PT and bike and route data through API's for commercial etc. use.

B.3 Research and Technology Development

Measure 3.2. aimed to create a harmonized public transportation authority (PTA) ticketing system that was also compatible with a bike sharing system (BSS). The measure also aimed to increase open interfaces available to the Mobility as a Service (MaaS) operators and to the mobility service providers that wanted to link their service with public transportation (PT). In the long run, it was envisaged to gain a wide variety of services linked to the open platform of PT, such as several different bike types or electrical vehicles. Furthermore, the objective was to make MaaS operators co-operate with PTAs.

B.4 Actual implementation of the measures

Some changes occurred during both measures' implementation. Both measure's leadership was in the hands of the same ML from the start and this leadership underwent several changes during the project. The first ML, Jari Paasikivi, left his position in spring 2017 and was replaced by Päivi Kynkäänniemi. Then the following spring, Roope Virta took over the measure leadership. After a year, measure leadership was taken over by SC Stella Aaltonen. All these changes naturally caused some delays. In addition, the fact that the second measure leader temporarily had to place more emphasis on another, effort-consuming measure she was leading (TUR 5.5.) lead to less emphasis being placed on MaaS development.

In TUR 3.2., phase 2 “Procurement and implementation” was prolonged with three months as the first integration to the platform was for the bike sharing system, and the system was launched in May 2018.

The proceeding of both 3.1. and 3.2. is presented below.

Phase 1: Research and measure planning (100 % completed)

TUR 3.1.

Research and planning of the measure commenced in September 2016 and was completed in April 2017. The following activities were carried out during this phase:

- Identifying the MaaS situation in Turku and clarifying the stakeholder situation. This included identifying the existing stakeholders and finding out the potential actions in the city of Turku. (M1-M12)
- Creating a MaaS identity in the city of Turku with visual elements. Visual materials were created explaining MaaS and they were included in the future communication packages in measure 2.2. (M1-M12)
- Planning the MaaS readiness level Indicators and identifying the situation in Turku. (M1-M12)
- Negotiations with new MaaS Operators in Turku. Negotiations took place with the MaaS operators. A new MaaS operator started providing its service in Turku as the company Tuup’s Kyyti service started officially in June 2017 after a test period in year 2016. (M1-M12)
- Compiling baseline data for the measure. This included planning and executing the Kupittaa mobility questionnaire, as well as analyzing data on car ownership in Turku from the data acquired from the national car registry Trafi. Instructing data collection activities in regards with the baseline and BaU also took place with TUAS. (M7-M12)

TUR 3.2.

Research and planning of the measure commenced in September 2016 and was completed in April 2017. The following activities were carried out during this phase:

- Choosing FÖLI PT system as the platform. The FÖLI PT system was chosen to become the platform that will be developed in the measure. The role of the public party was therefore bigger than if the platform was in private hands. (M1-M10)
- Guiding and planning the needed changes to FÖLI ticket sales and public transportation (PT) system with Westerns Systems Ltd. Developing API:s for FÖLI backend. Developing databases and functionalities for transaction handling. (M1-M12)
- PT ticket sales agreement with different companies. The PTA of the city of Turku, FÖLI, made agreements with four MaaS operators to enable them to sell PT tickets and to create travel chains as well as combining transportation services. The companies were: VR - Public Railways, Kyyti, Reittikioski, and Whim (MaaS Global). In doing so, the main measure goal for the CIVITAS ECCENTRIC project was already fulfilled. (M1-M6)
- MaaS readiness level Indicators planned. Taking part in creating the MaaS readiness level indicators and clarifying the situation in Turku. (M1-M12)

- Baseline data collection for evaluation with TUAS. (M1-M11)

Phase 2: Procurement and implementation (100% completed)

TUR 3.1.

Procurement and implementation of the measure began in September 2017 and was completed in May 2018. The following activities were carried out during this phase:

- Changing and influencing city policy and strategy making. This encompassed influencing the update of the parking policies in the city of Turku in order to increase car-sharing friendly parking policies and temporary subventions; incorporating park-and-ride (a bus or a city bike) hubs into the plans; and incorporating MaaS as a topic into the strategies of the city of Turku. (M10-M20)
- MaaS questionnaire for MaaS operators: planning and executing a MaaS questionnaire for MaaS Operators to acquire more detailed information and in particular feasible ideas on how the city could help MaaS companies create MaaS markets in Turku. (M15-M20)
- Establishing internal coordination and information exchange on MaaS issues within the city administration was another ongoing process during this phase. This involved e.g. meeting officials from different branches of city administration to check the status of current MaaS related activities and discussing the possibilities of incorporating a MaaS-friendly approach. (M12-M20)
- Creating a plan for the next steps in MaaS in Turku. The company and household survey under measure 2.2. were analysed from the MaaS perspective and the next steps to take in MaaS readiness level indicators were clarified. M16-M20
- Negotiations with new MaaS operators in Turku took place. In spring 2018, OP Kulku started operations in Turku. (M13-M20)
- A liaison and cooperation group representing municipal, regional and state administration was set up to find solutions for multimodal door-to-door intercity travel. The focus was on the first/last mile transfer between local and long distance modes of mobility. The gaps in the beginning and ending chains of long distance travel chains were also analysed. (M15-M20)
- The regional administration, the company Valmet Automotive and the city of Turku piloted a regional bus service on route Turku-Uusikaupunki, mainly targeted for commuters to the Valmet factory in Uusikaupunki. The local PTA contributed by making its mobile ticketing platform available to facilitate special commuter tickets aimed exclusively for the automotive workers. For trips starting and/or ending in the PTA's area of operation, this also enabled integrated ticketing for first/last mile trips in the PTA's local traffic. One of the aims of the pilot was to test applying and targeting the MaaS service for a limited group of customers in intercity travel. It also provided valuable experiences in multi-party ticketing cooperation between carriers, the platform provider and ticketing operators. (M10-M20)

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TUR 3.2.

Procurement and implementation of the measure began in September 2017 and were completed in May 2018. The following activities were carried out during this phase:

- Planning changes to FÖLI Ticket sales system. FÖLI and IT architects planned the changes needed for FÖLI ticket sales and public transportation (PT) systems, additional servers, as well as the mobile app. (M13-M18)
- Implementation of changes to the FÖLI Ticket sales system (adding bikes and API's). Leading the implementation process and synchronizing it with the IT architecture of the city of Turku. Western systems Ltd. focused on planning and researching requirements for Maas the platform, including the following aspects: (M13-M21)
 - Planning APIs for FÖLI system
 - Planning specifications for system registration
 - Planning specifications for customer profiles
 - Planning specifications to payment transactions
 - Planning specifications to transactions
- Planning and tendering a beacon based information and cultural pathway to the city. A beacon based digital information and cultural path was planned in connection with the bike sharing system. This was to partially fund the bike sharing system and also to create a new communication channel in the city. The cultural path was to provide information on the PT and air quality, educate users on local biology, geography and history, and provide information on local events and festivals. The provider of this service was procured and first implementations of the path started in May 2018. (M12-M21)
- Finding out and using MyData in the future: creating the basis for using MyData and taking into account the GDPR requirements in the city bike system. (M16-M21)
- Improving the open data interfaces for biking and walking. A real-time map to follow buses and city bike availability on stations was implemented. A digitransit map and real-time info on buses and shared bike availability was to be used. The gaps of existing open source datasets were also identified, finding ways to improve the situation and to improve the use of existing data. PT ticket sales contracts with MaaS operators were expanded. FÖLIX, a first/last mile service in nearby town Raisio combining taxi rides with the bus trip was launched. (M17-M21)
- Expanding PT ticket sales contracts with MaaS operators. Discussions were started with MaaS Global to expand their PT ticket sales contract to shared bikes as well. Negotiations were also ongoing with Nextbike to use their selling channel for the bike sharing system. (M18-M21)
- National survey on cycling and walking route planning (Digitransit). Results were received from a national survey (by Digitransit, Turku city participated in it) realised on the cycling and walking route planning needs that cities had. The survey was to be used to develop a national platform for route planning which already had information

on local and long-distant buses, trains, trams, metros, airplanes etc. and was already used by many cities, including Turku. (M15-M16)

Phase 3: Demonstration and monitoring (90% completed)

TUR 3.1.

Demonstration and monitoring of the measure commenced in March 2018 and were completed in June 2019. The following activities were carried out during this phase:

- Carrying out the actions in the implementation plan created in phase 2. (M21-M36)
- Clarifying possibilities to survey MaaS paths of the youth and taking part in National Travel chain work. (M21-25)
- Negotiations with New MaaS operators in Turku, starting with Über, which was to start its services in the fall of 2018 when the taxi regulation was to be freed. (M20-M36)
- Incorporation of MaaS actions into the Turku strategies. Finding synergies, creating a long term plan for MaaS and finding out co-operations to create a MaaS ecosystem that takes Turku to the next levels on the MaaS readiness indicators. Acceptance of the new parking policies and their impact on the market. Identifying the gaps in travel chains and making an action plan to address them. (M21-M36)
- Development of instructions for e-scooter operators and taking care of gathering feedback on these new services. (M30-M42)
- Creating a MaaS development plan for Turku. (M40-46)
- Leading the MaaS development process on the Finnish national level. (M32-M46)
- Creating a better understanding of MaaS business models and their potential impact in Turku. (M40-M46)

TUR 3.2.

Demonstration and monitoring of the measure commenced in June 2018 and were completed in April 2020. The following activities were carried out during this phase:

- Expanding MaaS operators' PT ticket sales and the shared bike system ticket sales to other MaaS operators and selling channels. Negotiations were to take place with MaaS companies and other service providers about co-operation and co-ordinating the services through our FÖLI platform and also giving our partners a chance to sell our PT tickets. (M21-M44)
- Incorporation of the bike share system into the Föli app. (M21-M44)
- Negotiating new PT ticket sales agreements with different companies and expanding the co-operation. Turku negotiated with shipping lines and hotels on selling Turku PT tickets to travellers. The aim was to try to expand the ticket sales. The city theatre ticket co-operation started in September 2018. A theatre ticket could also be used as a bus ticket that was valid for three hours before and two hours after the show. After the city theatre, similar contracts were made with the TFO at the Shipyard! festival, the Turku Music Festival and the city orchestra. First tests with the hotel cooperation were also carried out. (M21-M42)

- Implementing new layers on the digital information and cultural pathway of the city. The aim was to create layers to the digital cultural and information pathway that gives customers information on PT and educates them about the history, geography and biology in the area as well as brings income from sponsors to the system. Extensive co-operation with local businesses that were to sponsor the pathway took place. (M21-M36)
- Improving the API interfaces and ticket sales channels (mobile app) of Föli. Increasing the use of API interfaces by different service providers. Improving the use of data by visualizing data for the planning and decision-making. (M22-M44)

Phase 4: Conclusions & Recommendations (50% completed)

TUR 3.1.

Some preliminary conclusions and recommendations based on experiences gathered could be highlighted at the time of writing.

Conclusions

- MaaS as a term is not understood yet. The entire concept of MaaS needs to be opened on many levels and through practical examples.
- The MaaS readiness level indicators developed in WP 3 have turned out to be a good way to explain MaaS. There is very little research (or any form of proven data) available that could be used to form a framework when attempting to e.g. give policy recommendations and guidelines on MaaS issues. This presents a challenge to developing a model for applying the concept in the context of local administration and policymaking. It relates to several key issues:
 - Evaluating the state of the market and business environment
 - Setting goals for developing the market and business environment
 - Evaluating the progress made in developing the market and business environment
- The development of MaaS requires holistic thinking and different skill sets than traffic planning. This is important to take into account.
- The market demand can change very rapidly with the new services coming to the market. A good example of this are the e-scooters entering the city of Turku in spring 2019.

Stakeholder involvement

- The overall approach of this project, including the choice and application of research methods has been effective and is very replicable. It is strongly recommended to pay special attention to the careful planning and execution of the research phase.
- A key factor in this type of a project is continuous involvement of external and internal stakeholders. Without this, it is not possible to understand all the different types of drivers and constraints that come into play or anticipate the multiple technical, financial and administrative issues that require attention.

- Discussions with all stakeholders have been on a very positive, enthusiastic and encouraging. There is clear indication that it is possible to contribute positively to the development of the local mobility market with this type of measure. However, it is more realistic to expect for a slow overall progress instead of immediate results in the form of e.g. rapid increase in the availability of new services.
- In the long term view, perhaps the most important achievement is that contact with stakeholders and a continuous discourse of cooperation is established. It is vital to create an environment of open communication and interaction where knowledge and ideas are shared for mutual benefit.

Communicating MaaS to the customers and beyond

- The customer needs to be seen from a broad perspective instead of focusing only on the end user. The customer is more and more often a group/community of potential end-users such as a family, a company (as e.g. an employer), a housing community etc.
- Queries are a good method for providing an overall view or a cross section of a situation, but generally require a good basic understanding of the subject. With a new and/or less researched subject, it is necessary to combine queries with other methods, such as direct interviews and/or more informal face-to-face discussions. This allows for forming a preliminary idea of relevant issues and then testing and expanding that with queries.
- Innovative service offers generate public awareness and interest and eventually translate to expectations and demand. Visibility increases the appeal of any service and is vital to a new concept such as MaaS. Pilots and launches of new services, features etc. at regular intervals is a good strategy to keep the customers interested and expecting more.
- A role for which the city is well suited is networking and facilitating networking on different levels (project, city, national) to involve potential partners, to create awareness and to bring together parties who share a common interest.
- The city is in a good position to reach the public and in most cases has skilled communication personnel at its disposal and a good coverage of different channels of communication. Also, organizing and coordinating different kinds of promotional events is something cities usually have a lot of experience and good knowledge of.

Recommendations

- Involve internal stakeholders as early as possible and ensure firm ownership of development duties. MaaS issues relate to a number of municipal activities and departments. It is essential to identify common goals as well as potential legal, administrative, technical and financial restraints.
- Identify and contact external stakeholders to find out what they can provide, what they need and expect. Prepare for a lot of legwork.
- Read available research and if necessary do your own by e.g. recruiting suitable students doing their thesis/diploma work. This applies particularly to understanding the customer when attempting to promote a customer oriented approach.
- Any attempt to develop markets and/or business environments requires at the very least basic data about demand and supply. Measure 3.1 dealt with a textbook case of

potential demand and supply, with ambitions of transforming them into a thriving market. Fortunately there were proven methods for researching market potential.

- A very efficient solution to this type of research is cooperation with e.g. the local business or polytechnic college. The staff can advise on the choice of research methods and graduate students are available to perform the research as their thesis work.
- In the R&P phase three queries and numerous interviews and meetings were conducted. Two of the queries were targeted at potential customers (people living and working in the target area and their housing communities and employers). One query was targeted at the Finnish mobility operators. The results were analyzed in the thesis of Tiiu Tuomainen from Turku University of Applied Sciences. Some of the most significant conclusions from the thesis were:
 - There is interest in (new modes of) sustainable mobility, but mobility choices are largely determined by ease of use and long-term, firmly established habits.
 - Awareness of available mobility offers is a key barrier to the change of mobility patterns.
 - Continuous innovation and piloting of mobility concepts is a key driver in development of the mobility market.

TUR 3.2.

Some preliminary conclusions based on experiences gathered could be highlighted at the time of writing.

Research & Planning:

- It was found that there is not necessarily a need for an app since web pages can be made scalable and progressive enough to be able to use it with a mobile device. An app was still created since many people will want to use one.
- There is a need to create open API's to be able to publish open data.
- The APIs need to be made as standardized as possible to enable access. True openness of API interfaces is important.
- One update on the operator side can affect all the other companies connected to it. Good and up-to-date information is needed from all the different actors. This is a learning process especially when a new service, such as a bike system is brought into an established PTA and all parts of the process need to be integrated.

Procurement & Implementation

- It was found out that the city can get income from advertising and sponsorship.
- The beacon-based digital cultural and information pathway opens a new way of communicating with citizens and tourists. Different technologies, games, study materials for schools and new ideas on how to guide people to where they want to go can be tested in conjunction with the pathway.
- Scalable and progressive web pages eliminate the need for mobile apps, but not the demand for them. The development of mobile apps is both money and time consuming and might not be worth the use.

- The large number of parties involved in the ticketing system slows down the development work. Especially if the partners are foreign companies, there is usually also many communication barriers as none of the actors are native English speakers.

Demonstration and monitoring

- Although the PT has an open API, this does not necessarily lead to its use. Even a contract with the company does not automatically lead to the use of it, as each of the companies work with their own logic and determine their timetable based on the market situation.
- It takes a long time for the users to find new ticket options.
- Interdependency of different actors. If one actor fails – all the actors connected also fail to keep the timetable. The development work needs to be agile, open and well-coordinated.
- Satisfying the demand for new ticket options so that they generate enough income to cover the development cost. This needs to include marketing actions and constant communication to users.
- Turku is not a market big enough for operators to prioritize it. This can lead to delays in launch and can stop the process entirely.
- Continuous development of ticketing options is necessary to attract customers and generate income.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

The two Turku city MaaS measures, 3.1. and 3.2., shared similar goals albeit with TUR 3.1. focusing more on the development of the MaaS ecosystem and TUR 3.2. on the technological realization of the new open data interface and platform into which the public transport ticketing system was to be incorporated. It was decided that the measures would be combined for evaluation purposes. For that purpose, the list of indicators of the measures was also combined. The original indicators were nearly identical in both measures, with some differences on whether the target group was MaaS operators or MaaS system users in the living lab area. The target group in question will be explained in more detail in the baseline/follow-up data descriptions.

Impact					
Indicator name	Awareness	Acceptance	Satisfaction	Car ownership	Contribution to policies, plans, and programs
Type	KPI	KPI	KPI	KPI	KPI
Category	Society	Society	Society	Transport	
Subcategory	Acceptance	Acceptance	Acceptance	Car	
Aspect	Awareness	Acceptance	Acceptance	Car ownership	Governance
Definition	Awareness of MaaS measures	Acceptance of MaaS measures	Satisfaction in the MaaS measures	All cars owned per 1000 of the population aged 18 or over. % of households that have no car, preferably disaggregated by city district.	Qualitative measurement on the process to modify policies, plans, and programs (including SUMPs) in a significant and definitive way.
Impact					
Indicator name	System usage	Investment costs	Operating costs		
Type	KPI	KPI	KPI		
Category	Transport system	Economy			
Subcategory	General	Costs	Costs		
Aspect	System demand	Costs	Operating costs		
Definition	Joint tickets sold / month	Capital investment costs of the measure	Average operating costs of the measure		

Table 6: Description of key performance indicators (KPI) (cont.)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement
1	Awareness	%	A	S	Companies and households	Living lab
2	Acceptance	%	A	S	Companies and households	Living lab
3	Satisfaction	Score 0-5	A	S	Companies and households	Living lab
4	Car ownership	Cars to inhabitants ratio (0-1000*)	B-A	DC	Residents	Living lab
5	Contribution to policies, plans, and programs	Score 0-5	B-A	E	Decision makers	City of Turku
6	System usage	Frequency (users/unit of time)	A	DC	System users	City of Turku
7	Investment costs	€	A	DC		
8	Operating costs	€	A	DC		
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 7: Measure's indicators

C.1.2 Baseline

The baseline in this measure represents the situation prior to the project in terms of mobility as a service. MaaS development had two distinct target groups: the operators and the users. In these measures, both groups were addressed. The data collection methods for the baseline included:

- Baseline data for the indicator *Contribution to SUMP* was collected via secondary data analysis of existing policies.
- Baseline data for indicator *Car ownership* at the Kupittaa laboratory area was obtained via secondary data analysis, performed on data from Traficom (The Finnish Transport and Communications Agency), the main authority in permit, license, registration, approval, safety and security matters.
- The numerical data needed *on investment and operational costs* of the measure was derived from the ML.
- Data for *system usage* was derived from measure partner Western Systems Ltd.

KPI 1: **Awareness** describes the level of awareness of MaaS measures among housing companies and companies in the Kupittaa laboratory area. Baseline information for this indicator was not available, however, as the survey to housing companies and private companies was sent already in the autumn of 2016, months before the Turku evaluation plan and indicators were finalized.

KPI 2: **Acceptance** refers to the level of acceptance of MaaS measures among housing companies and companies in the Kupittaa laboratory area. Baseline information for this indicator was not available, however, as the survey to housing companies and companies was sent already in the autumn of 2016, months before the Turku evaluation plan and indicators

were finalized. Interest towards pilot related to combined mobility services was inquired in the company survey, however. Out of the 87 respondents, 35% were interested in such pilots, 32% stated they might be interested and 33% stated they were not interested.

KPI 3: **Satisfaction** describes the level of satisfaction with the available MaaS services in the city of laboratory area. Again, baseline information for this indicator was not available as the survey to housing companies and companies was sent already in the autumn of 2016, months before the Turku evaluation plan and indicators were finalized.

KPI 4: **Contribution to Policies, Plans and Programs** relates to the impact the measure may have on policies or strategies to promote MaaS in the city. The state concludes agreements concerning land use, housing and transport (MAL) with the main city regions of Finland. These agreements enhance cooperation among the municipalities in the respective city regions and between the municipalities and the state in the steering of community infrastructure and coordination of land use, housing and transport. In the Turku region MAL agreement (2016-2019) the state has allocated 6,7M€ to the city region for PT procurement and for promoting the ticketing, payment and information system compatibility and renewal, and the creation of transport services. It is also stated that “within the regional PT the tariff and ticketing system, passenger information, feeder transport, travel chains will be developed according to MaaS principles”. Overall it could thus be stated that prior to the project, promotion of MaaS development was already somewhat visible on policy level. **Score: 3,5.**

KPI 5: **Car ownership** refers to the number of passenger cars per 1000 residents. In Turku, there were approximately 408 passenger cars per 1000 residents in 2017. The data for the whole city is used here as the measure route is not limited to the laboratory area alone.

C.1.3 The business-as-usual scenario

It is unlikely that a concerted effort to develop MaaS services on city level would have taken place without project influence. Although MaaS was also embedded on policy level when the project started, development in a similar extent and depth would not have taken place, particularly not by the PT operator Föli. Different ticketing combos would not have been connected with PT tickets. Readiness level indicators would not have been developed, nor would MaaS exist in the city spearhead project Smart & Wise as one of the main themes. Hence BaU is mostly similar to baseline.

Indicator	Unit	BaU	Date BaU
Awareness	#	N/A without project influence.	2016
Acceptance	%	N/A without project influence.	2016
Satisfaction	0-5	N/A without project influence.	2016
Car ownership	Cars to inhabitants ratio (0-1000*)	Overall, car ownership numbers are on the rise in Finland. From 2016 to 2017, the total number of passenger cars rose by 1.5%. It is thus estimated that at the end of 2019, following this yearly growth rate, the number of passenger cars would be 420/1000 inhabitants.	12/2016
System usage	Frequency (users/unit of time)	N/A without project influence.	2016

Contribution to Policies, Plans and Programs	Score (0-5)	BaU is estimated to be similar to baseline.	2016
Operating costs	€/year	N/A without project influence.	2016
Investment costs	€/project	N/A without project influence.	2016

C.2 Measure results

Values obtained for the selected KPIs are summarised in the table below.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	N/A	2016	N/A	12/ 2016	16	12/ 2019	N/A	N/A
Acceptance	%	N/A	2016	N/A	12/ 2016	84	12/ 2019	N/A	N/A
Satisfaction	Score 0-5	N/A	2016	N/A	12/ 2016	2.3 (companies) 3.0 (housing companies)	12/ 2019	N/A	N/A
Car ownership	Cars to inhabitants ratio (0-1000*)	408	12/20 17	420	12/ 2017	414	12/ 2019	6	-6
Contribution to policies, plans, and programs	Score 0-5	3.5	12/ 2016	3.5	2016	4.5	1/ 2020	1	1
System usage	Frequency (users/ unit of time)	N/A	12/ 2016	N/A	12/ 2016	871	01/ 2020	N/A	N/A
Investment costs	€	TUR 3.2: 107 600€							
Operating costs	€	TUR 3.1: 54 264€ TUR 3.2: 30 000€ + 500€ monthly							

The ex-post data was derived from several sources:

- The Kupittaa mobility surveys to companies and housing companies. The company survey was sent to 681 companies and the housing company survey to 180 housing companies in the Kupittaa laboratory area. Both surveys were open between 1.12.2019-31.1.2020. The surveys provided data for indicators *awareness*, *acceptance* and *satisfaction*.
- Data for indicator *car ownership* at the Kupittaa laboratory area was obtained via secondary data analysis, performed on data from Traficom (The Finnish Transport and Communications Agency), the main authority in permit, license, registration, approval, safety and security matters.
- Secondary data analysis was performed on indicator *Contribution to Policies, Plans and Programs*.
- Data on *system usage* was derived from measure partner Western Systems Ltd, based on sales of joint tickets.
- Data on *investment and operating costs* were derived from the Site Coordinator.

The **awareness** and **acceptance** of MaaS services among the housing companies and the private companies in the Kupittaa laboratory area were surveyed during the autumn of 2019 with a directed online survey for both target groups. Based on survey results, mobility services were still relatively unknown among the laboratory area **companies**. When inquired “Are different types of mobility services (MaaS) familiar to you?” only 16% replied “yes” (n=164).

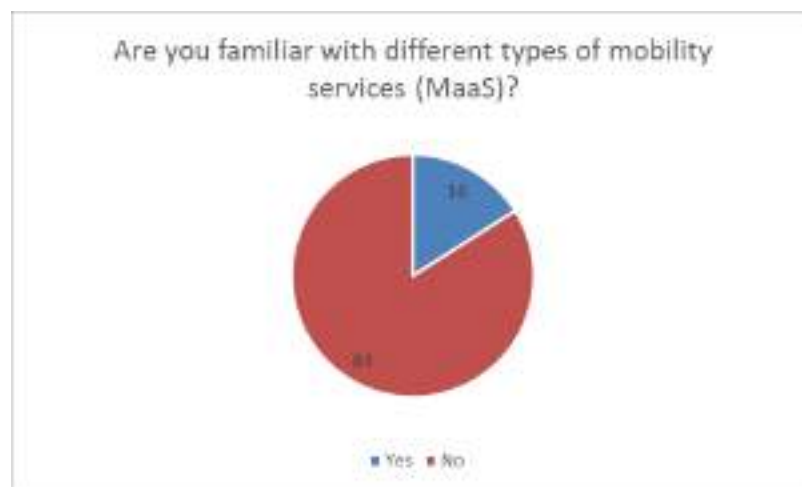


Figure 1. Awareness of Maas services in the laboratory area / companies

Among the **housing companies**, awareness of MaaS services was somewhat higher as 27% of the respondent replied “yes”. The sample, however, was very small as there were only 37 responses to this question.

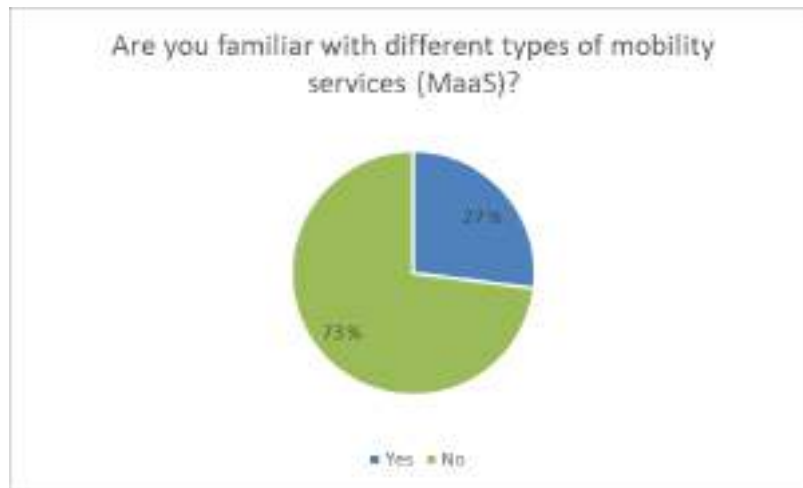


Figure 2. Awareness of Maas services in the laboratory area / housing companies

The **acceptance** of mobility services was rather high among the **companies** in the laboratory area. When inquired about the interest to use packaged mobility services, 84% (n=164) of the respondents replied positively. Only 16% clearly stated they were not interested in such services.

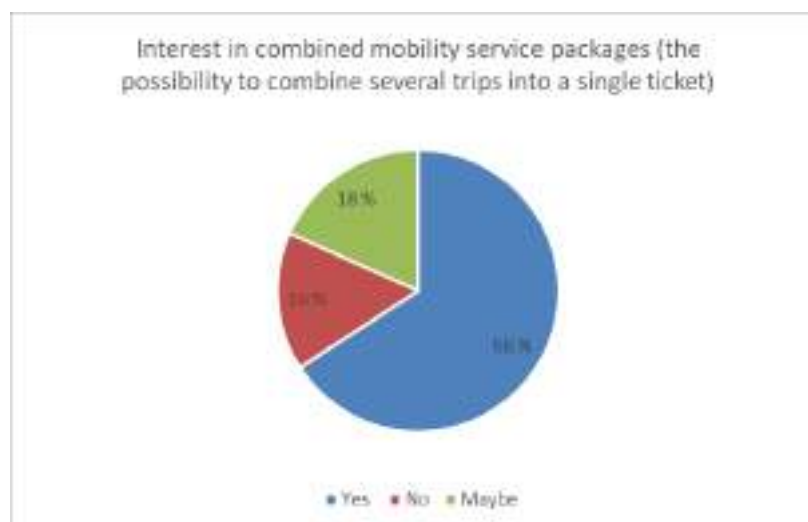


Figure 3. Acceptance of Maas services in the laboratory area / companies

Among the **housing companies**, **acceptance** of mobility services was also rather high. When inquired about the interest to use packaged mobility services within households in the housing company, 87% (n=27) of the respondents replied positively. Only 13% clearly stated they were not interested in such services. Again, as the sample was very small with only 37 responses to this question, no far-reaching conclusions could be made on acceptance of MaaS services among housing companies, let alone households.

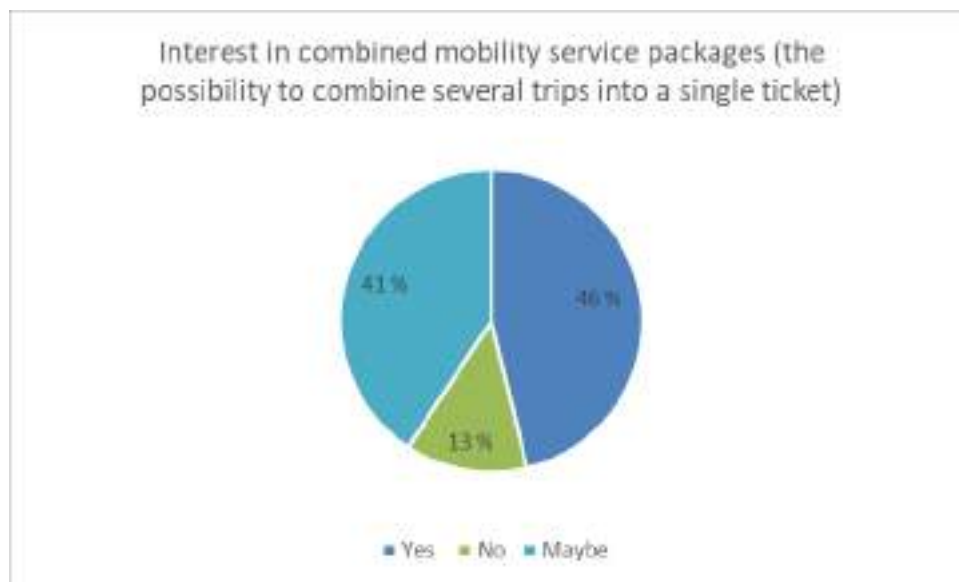


Figure 4. Acceptance of MaaS services in the laboratory area / housing companies

Satisfaction describes the level of satisfaction with the available MaaS services in the laboratory area. This was surveyed in the laboratory area among companies and housing companies. As shown above, awareness of MaaS services was rather low in the area. The respondents of the companies who were familiar with MaaS services (n=27) rated the services they had used with an average **score of 2.3** on a scale of 1-5. Due to the low number of respondents, however, no far-reaching conclusions could be made from this data.

Looking at the housing companies surveyed, the satisfaction in MaaS service used was a bit higher as the respondents of the housing companies who were familiar with MaaS services (n=10) rated the services they had used with an average **score of 3.0** on a scale of 1-5. Again, the sample was so small that making any conclusions was somewhat impossible. In order to gain any insight into the satisfaction in MaaS services, the samples should have been significantly larger. Still, it is worth mentioning that as there are fairly few MaaS services available in any case, it is not very likely that a more far-reaching survey within laboratory area companies/residents would have produced much more valid results. The approach should have been city-wide with a large sample to gain a better view of the awareness/acceptance/satisfaction of MaaS.

Car ownership in Turku increased during the project lifetime. Car ownership refers to the number of passenger cars per 1000 residents. In Turku, there were approximately 414 passenger cars per 1000 residents in 2019. This marked a 1.5% rise from 2017, a slight increase from the baseline year when the same number was 408 cars per 1000 residents. This development was in line with the current overall trend in car ownership in Finland. It is perhaps fair to say that before MaaS services are well-rooted into the consumer society and there are several service options available, their impact on car ownership will be marginal.

When looking at the **Contribution to Policies, Plans and Program**, the impact brought about by the measure was evident. In the MAL agreement for 2016-2019, MaaS development was already promoted. In the MAL agreement draft for 2020-2023, it is stated that “combined ticketing will be investigated and implemented if possible within the agreement jurisdiction”. Somewhat surprisingly, MaaS development is not mentioned in any more detail than this,

having had more emphasis on the previous MAL agreement. It should of course be noted that the 2020-2023 version is still a draft.

In the Turku Climate Plan (SECAP) from 2018, however, MaaS is among the actions to be taken to promote active mobility and development of public transport to reach carbon-neutrality by 2029. It is stated that “Investments in Mobility as a Service solutions help renew means of transport and steer the market towards lower emissions. Simultaneously, development of new innovations based on digitality is supported and market is created for them.” When discussing the improvement of the service capacity of public transport, MaaS is also mentioned: “Public transport is a strong and natural part of trip chains and development and implementation of Mobility as a Service concepts. Innovative businesses and developers have a significant role as solution makers.”

Smart & Wise is one of the city’s spearhead projects developed during ECCENTRIC, combining the strategic goal of regional carbon neutrality in 2029 with the Smart City concept. Traffic and Mobility is one of the focal points in Smart and Wise and development of Mobility as a Service model one of its main themes. The development of this spearhead project can be attributed to ECCENTRIC impact to a large extent. Overall, it could be estimated that the measure policy level influence was significant. **Score: 4.5.**

System usage in this measure denotes to the number of joint tickets sold via the Föli app. The PTA Föli makes contracts with each of the MaaS operators for ticket sales. Tickets to Turku City Theatre performances, the TFO at the Shipyard! Festival and the Turku Music Festival also include a public transport ticket. Tickets to these events function as Föli tickets, allowing the ticket-holder to travel on Föli buses and water buses before and after the event in question without the need for a separate bus ticket. The Föli bus ticket included in an event ticket can be used for three hours before the performance in question and two hours after it. Each ticket can be used for a total of four trips, meaning that you can transfer between buses once each way, if necessary.

The core of MaaS lies within a platform providing seamless transport services by combining different transport modes and services. This ticketing type was chosen as a demonstration of system usage to accentuate the “service” aspect of the MaaS development – to build a business case for MaaS services, it is essential that the service aspects are piloted in addition to merely adding more and more transport modes to a MaaS platform.

Selling of these joint tickets started in September 2018. Total number of joint tickets sold between 1.9.2018 and 31.12.2019 was 13 941. This was contrasted with the total number of tickets sold. A monthly average for joint tickets sold since 09/2018 was 871 tickets.

Theatre / period	Total number of joint tickets	Total number of theatre tickets	% of total sales
1.9.-31.12.2018 (only the Turku City Theatre)	2295	34 575	6.6%
1.1.-31.12.2019 (Turku city Theatre, TFO, Linna Theatre, Turku Music Festival)	11 646	220 000	5.3%
TOTAL	13 941	254 575	5.4%

Figure 5. System usage / joint tickets sold

KPI 7: **Investment costs** in this measure referred to the costs related to the realization of the ticketing system in measure 3.2. (personnel hours), which amounted to 107 600€.

KPI 8: **Operating costs** of both measures cover the personnel costs related to the running of the measures during implementation. For TUR 3.1., this equaled 54 264€. For 3.2., the personnel costs in the measure amounted to 30 000€ with an additional monthly fee of 500€ for running the ticketing platform.

C.3 Summary: achievement of objectives

On the face of it, measures 3.1. and 3.2. have reached their (to a large extent) shared objectives satisfactorily. MaaS operators have provided their services in Turku. Tickets are being sold through the integrated ticketing system and the ticketing system of PTA Works also as a ticketing system to the bike sharing system. The PT (Föli) interface is open to MaaS operators and other service providers and MaaS services are available to the citizens. Cooperation models have been created between different parties. However, it should be emphasized that MaaS is not “ready” yet, not by far. Much development is still needed to fully realize its potentials and, most importantly, to reach a common understanding among different parties, both public and private, on roles and responsibilities. This conundrum is something that will receive more emphasis in the detailed process evaluation of measure 3.1.

No.	Objective and target	Rating	Comment
1	At least 3 MaaS operators are providing their services	***	Various mobility services were connected to the public transport Föli portal during the project: Kyyti/Tuup VR Fölix Joint tickets to events
2	The number of customers/tickets sold using services through the integrated ticketing system	**	No quantitative target was set for this measure. Hence it was difficult to assess the fulfillment of this objective. An average of 871 joint PT & theatre tickets per month were sold during 16 months.

3	The ticketing system of PTA Works also as a ticketing system to the bike sharing system	★★	The bike share system was integrated to the Föli interface.
4	There are open interfaces available to the MaaS operators and also to the mobility service providers that want to bring their service visible together with public transportation	★★	The Föli interface was open to MaaS operators and other service providers.
5	Cooperation models have been created between different parties	★★	During the project, cooperation models were created and implemented between MaaS operators and other service providers.
6	MaaS services are available to the citizens	★★	Several MaaS services were available to the citizens, both connected to the PT system and ones offered by independently operating companies.
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★ = Exceeded			

D. Process Evaluation findings

Here the main findings of the process evaluation for both measures are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

No major deviations took place within either measure, apart from the frequent changes in measure leadership as described in section B4. In TUR 3.2., phase 2 “Procurement and implementation” was prolonged with three months as the first integration to the platform was for the bike sharing system, which was launched in May 2018.

D.2 Barriers

The following barriers were identified during measure planning, implementation and demonstration.

D.2.1 Organizational

Recurrent measure leader changes caused delays in the measure implementation. The impact of these changes was mitigated with the SC actively transferring knowledge to the new measure leaders.

D.2.2 Problem related

The complexity of MaaS, as well as the fact that there were no established models for MaaS ecosystems due to the novelty of the concept caused some challenges for the measure. For example, there were no established roles for private and public actors and especially at the beginning of the measure there was uncertainty as to what could be expected from different stakeholders. Interests vary between the actors, as well as the amount of risk these actors are willing to take. Business models are still taking shape. The whole MaaS ecosystem and the actors within it are in constant flux and the determination of roles and responsibilities is ongoing. Suffice to say that the private and public parties have somewhat differing views on these, a challenge that will have to be solved within the coming years to allow for functioning MaaS ecosystems to flourish. Naturally, this conundrum is not for Measure TUR 3.1. to solve alone, yet will still quite likely impact whether all the objectives in this measure are reached or not.

D.2.3 Planning

The measure could have used more precise objectives and sub-objectives. Having clearer objectives could have helped the transitioning from one measure leader to another. This barrier applied to measure 3.1. in particular.

D.2.4 Political / strategic

All in all, the political climate in Turku has been favorable to MaaS. Still, many of the issues related to MaaS are governed by different city departments, which has brought challenges to finding a common ground for the needed co-operation models. Some of these issues, such as parking policies, are also politically sensitive. In the words of the second ML, it seems that “the world is not quite ready for MaaS yet, although Turku city itself has created a fertile ground for its further development.” On national level, though, the 2017 Act on Transport Services

contributed to the measure development as the creation of new service models and their market access is now part of Finnish legislation, better enabling the implementation of MaaS.

D.2.5 Institutional

An institutional barrier regarding tendering issues – or a lack of thereof with project partner Western Systems Ltd. – caused a minor issue for measure process. The city legal department has considered the lack of official tendering for the data interface and platform in TUR 3.2. an issue and discussions on the matter took place during the second reporting period. However, in the end this matter did not cause hindrances to achieving measure objectives.

D.3 Drivers

The following drivers were identified during measure planning, implementation and demonstration.

D.3.1 Planning

A clear planning-related driver was the design of the measure and delineation of its contents: despite personnel changes, the measures proceeded smoothly from the planning to implementation and demonstration phase. This was largely due to the strong leadership of the SC. Also the fact that the city organization, including the PT operator, are favourable for the development process has been a significant driver for development.

D.3.2 Positional

Other projects and developments in the city have supported the realization of the measure and MaaS has been strongly embedded on the policy and strategy level as well. This has led to MaaS problematics being kept continuously kept under discussion. The development of the laboratory area as a city spearhead project, for example, created a positive background for MaaS development.

D.3.3 Planning

The impact of the open data interface and platform developed in measure 3.2. has been nationally significant. The city of Turku has been a forerunner in the standardization of the system. The Turku model of has already been copied to other cities in Finland.

D.3.4 Technological

Technological maturity has been a clear driver for measure 3.2. The implementation of changes to Föli Ticket sales system (adding bikes and API's) with open interfaces proceeded in without any major technological hindrances

D.4 Supporting activities

No supporting activities were identified for these measures.

D.5 Recommendations on the implementation process

Some recommendations on implementation could be suggested based on process evaluation of the measure so far.

D.5.1 Have a back-up plan in case of personnel changes

In a complex measure dealing with a multi-faceted issue such as MaaS, it is important that changes in measure leadership do not halt the development process. It is thereby important that a team of several persons leads such measures, or that at least the site coordinator is well aware of all relevant measure aspects to avoid loss of information, contacts or established cooperation models. This is a risk management strategy more than anything else – when dealing with complex issues placing too much emphasis on the role of one person is just too risky for continuity.

D.5.2 Try and find a common ground for the division of roles and responsibilities

Currently there are no established models for MaaS ecosystems and there are differing views on the roles for private and public actors – mostly depending on whether you ask the public or the private actor. This discussion, however controversial, on responsibilities and risks related is still very much necessary in order to develop a common understanding and a subsequent creation of commonly accepted business models. This aspect will be subject to more thorough discussion in the process evaluation report of these measures.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- Several MaaS operators have provided or are providing their services in the city.
- Combined tickets are being sold through the integrated ticketing system
- The ticketing system of PTA functions also as a ticketing system to the bike sharing system (TUR 5.5.).
- There are open interfaces available to the MaaS operators and also to the mobility service providers that want to bring their service visible together with public transportation.
- Cooperation models were created and tested between different parties.
- MaaS services are available to the citizens, although awareness of these services still needs concerted promotional activities.

E.2 Relevance of supporting activities

No supporting activities were identified for these measures.

E.3 Interaction with other measures

- TUR 5.5. “Bike-sharing and Car-Sharing Schemes”: the bike share system was integrated into the PT platform Föli.
- TUR 2.2.: The mobility survey realized within the scope of the measure provided data for measures 3.1. and 3.2.

E.4 Main lessons learned

The main lessons learned from the measure are summarized below:

- Awareness of MaaS is still rather low in the city. Therefore, not many conclusions can be drawn on their acceptance or satisfaction. Generating public awareness is vital to a novel development such as MaaS. Further pilots and launches of new services therefore need to be combined with efficient communicative measures.
- The availability of MaaS services has had no effect on levels of car ownership in the city. As its rise is an increasing trend country-wide, it will take many years of established MaaS services to be able to attribute any decrease in car ownership to improved levels of service.
- As there are no established models for MaaS ecosystems due to the novelty of the concept, continued emphasis needs to be placed on development and testing of cooperation models, in addition to mere technical development.
- The complexity of MaaS calls for the continuous involvement of external and internal stakeholders. This is vital for the understanding of differing motivations, drivers and

barriers that surround the issue and the various actors involved. Without stakeholder involvement, it is unlikely that the technical, financial and governance-related issues surrounding MaaS can be solved satisfactorily to all parties relevant.

- The success of MaaS endeavours at this point seems to culminate in the public actor vs. private actor role/responsibility conundrum. This is an issue in most need of further research in addition to the business-case aspect from the consumer's point of view. It is critical that these two seemingly opposing sides do not see each other as having opposing interests. Therefore, emphasis needs to be placed on creating an environment of open communication and interaction where knowledge and ideas are shared for mutual benefit between all relevant parties.

E.5 Long term impact

Previously, the consumer has needed to use various service providers' websites or applications to find information and purchase tickets or services. Combining services and information into joint platforms is said to promote multimodality and, ultimately, change the model of ownership in transport as the eased access to different modes leads to decreased need for private cars, for example. By providing the first open PT-integrated ticketing system in Turku and by developing cooperation models between different actors, a process to reach these goals has been initiated. However, the long-term impact of these measures is to the most part up to the establishment of functioning business models. Without these, it is unlikely that MaaS will develop into a serious rival for private car ownership.

E.6 Potentials for up-scaling in the city

As the open interface has now been established within the PT operator's platform, there are plenty of opportunities to offer various services to be integrated into it. It is thereby up to the ability to demonstrate the business case of combined ticketing and better access of information to the citizens to fully unveil the potential of MaaS services in the city. All in all, the following questions should be solved at least to some extent before MaaS can flourish in the city – or in any city, for that matter.

- What is the presumed role of the public transport providers in MaaS? Do they have the responsibility to support and facilitate MaaS development, financially or otherwise?
- How much risk-taking do private actors need to tolerate when trialling with MaaS? Should this risk be alleviated with public funding?
- What is the added benefit of MaaS services to consumers if not for the price? Does the ease of use of e.g. combined ticketing surpass the higher cost of the ticket? In essence, can the way we move really be altered via improved services?

F. Additional information

F.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

- A clear setback for measure evaluation was the fact that the Kupittaa mobility questionnaires to companies and housing companies were devised and realized before the evaluation framework and the measure indicators were sent. This meant that there was no opportunity to formulate the questions to derive data for the baseline.
- Another critical aspect related to evaluation quality was the format of the Kupittaa mobility survey directed at housing companies. The housing company was sent to housing company representatives, not individual households. In the 2016 survey, for example, 74% of the respondents were apartment owners who might not even live in the said apartment building. The rest, 26% were property managers of the housing companies. Their opinions should therefore be viewed critically as there is no way of knowing whether they represent their own interests or the interests of the majority of tenants in the building. In retrospect, the LEMs should have pushed more vehemently for a household survey in the laboratory area, subcontracted in the similar manner as was done with e.g. the cycling barometer survey.
- Being such a complex measure with many conflicting interests, fully understanding the issue has necessitated a thorough review of stakeholder interests. Hence the process evaluation of particularly TUR 3.1. has frankly proven more important in terms of learning than the impact evaluation. Quantitative objectives are just numbers, they are reached, sometimes not, but what is interesting and most worth of one's attention is what is happening behind those numbers – particularly within the differing views of the public and private parties involved. It was therefore a well-reasoned choice to work on a detailed process evaluation of measure 3.1.

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

- Increased service level is the ultimate driving force behind the idea of MaaS. In order to find out what type and level of service allures passengers best, business models need to be established and piloted, with thorough mapping of contributing factors of success or failure. Thereby it is recommended that funding be searched also in the future for further trials and development.
- As experiences of improved service levels reducing car ownership are still limited, emphasis needs to be placed on finding potential business models for MaaS services particularly in mid-sized cities such as Turku.
- Changing attitudes is challenging, and changing behaviour patterns even more so. A person's affinity to comfort is hard to surpass, even when evident financial savings are demonstrated. Any future MaaS trials should therefore be combined with not only information about the CO₂ or financial savings obtained but also other incentives or

even disincentives, such as parking limitations. These should be explored further in the city.



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MAD 3.3

Open platform for multimodal mobility information and services

Measure Evaluation Report

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Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático SL.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V.formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Nuria Blanco	

Table of Contents

ABSTRACT.....	555
A. INTRODUCTION.....	557
A.1 EXPECTED RESULTS OF THE MEASURE	557
A.1.1 Quantifiable impacts.....	557
A.2 MEASURE DESCRIPTION	558
A.2.1 Measure outputs.....	558
A.2.2 Supporting activities	558
A.2.3 Interactions with other ECCENTRIC measures.....	558
A.2.4 Interactions outside ECCENTRIC	558
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	559
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	559
A.5 IDENTIFIED RISKS	560
B. MEASURE IMPLEMENTATION	561
B.1 SITUATION BEFORE CIVITAS	561
B.2 INNOVATIVE ASPECTS.....	561
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	561
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	562
C. IMPACT EVALUATION FINDINGS	563
C.1 EVALUATION APPROACH.....	563
C.1.1 Expected impacts and indicators.....	563
C.1.2 Baseline.....	564
C.1.3 The business-as-usual scenario.....	565
C.2 MEASURE RESULTS.....	565
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	566
C.4 UP-SCALING	567
D. PROCESS EVALUATION FINDINGS	569
THE MAIN FINDINGS OF THE PROCESS EVALUATION ARE SUMMARISED IN THIS SECTION. MORE DETAILS ARE AVAILABLE IN THE PROCESS EVALUATION REPORT OF THIS MEASURE.....	569
D.1 DEVIATIONS FROM THE ORIGINAL PLAN.....	569
D.1.1 Scope of the open data platform	569
D.2 BARRIERS	569
D.2.1 Involvement: lack of commitment of relevant agents.....	569
D.3 DRIVERS	569

D.3.1	<i>Cultural driver</i>	569
D.3.2	<i>Planning driver</i>	570
D.3.3	<i>Leadership driver</i>	570
D.4	SUPPORTING ACTIVITIES.....	570
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	570
D.5.1	<i>Involvement of disruptive mobility providers</i>	570
D.5.2	<i>Involvement of app developers</i>	570
E.	EVALUATION CONCLUSIONS	571
E.1	VALIDATED DIRECT IMPACT	571
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	571
E.3	INTERACTION WITH OTHER MEASURES	571
E.4	MAIN LESSONS LEARNED	571
E.5	LONG TERM IMPACT	571
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	572
F.	ADDITIONAL INFORMATION	573
F.1	APPRAISAL OF EVALUATION APPROACH	573
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	573

List of Figures

Figure 1: Welcome screen to the Open-Data Portal 562

List of Tables

Table 1: Quantifiable impacts.....	557
Table 2: Target groups or affected parties.....	559
Table 3: Measure stakeholders.....	559
Table 4: Identified risks.....	560
Table 5: Description of key performance indicators (KPI).....	563
Table 6: Measure's indicators	564
Table 7: Measure's results	566
Table 8: Assessment of measure's objectives	567

Project	City		
ECCENTRIC	Madrid		
Measure code	Measure name		
3.3	Open platform for multimodal mobility information and services		
Last update	Responsible	e-mail	telephone
17/12/2019	Nuria Blanco	Nuria.blanco@madrid.org	

Abstract

This measure has developed an integrated Open Data mobility platform, gathering and providing information from all transport modes, prioritizing the more sustainable ones. Some information was already publicly available before the project, but only partially and without including real-time information for most services.

The information, analysed with a business intelligence approach, includes multimodal travel options and a consolidated database of public transport services in real time.

Initially, an open data portal with multimodal information from different sources was also planned (information on public bicycles, parking, car sharing, congestion, pollution, alternative modes and the main road network); however, this information was finally not provided by the relevant public and private actors.

The platform, with information of the whole region, will increase the attractiveness of PT services, as well as, enable the designing of mobility services for different kinds of user types and to promote new business models. The main innovative aspect of the measure is to make available to potential app developers real-time information on public transport and other services.

The main changes in the measure contents during this period are due to the unsuccessful attempts to engage some mobility serviced providers to make their real-time data publicly available in the platform. This has resulted in a more flexible concept, with different levels of integration. In those cases, in which information is available in open data format, platform users are allowed to access and download the information for their own use (this is the case mainly for public transport data); in other cases, the platform provides access points to the operators' websites. At this stage, no particular plans have been established to contact again reticent stakeholders. This could also expand to the future to new "emerging" providers of mobility solutions (on-street shared bikes and motorbikes, electric scooters...).

The project could not achieve its objective to increase the number of data providers, as a way to expand the mobility information available in the platform. The mobility providers that were approached by the measure team argued that real-time data information was commercially sensitive for them, as competitors could identify their commercial strategies (e.g. deployment of vehicles in certain places in the city). These concerns can be due to the fact that new mobility providers are still trying to consolidate their position in the mobility market, with limited resources, and are keen to preserve their own identity, rather than getting integrated in the general mobility system.

The increase in the number of queries to the new open data portal (with substantial improvement in terms of real-time information) compared to the old one has increased by 11% in a little more than 2 years. ECCENTRIC has been successful in mobilising the developers' community and in supporting the development or improvement of more than 18 mobile apps and 9 websites providing information on the mobility system in Madrid.

The quality of the information has been positively assessed by public transport users, with an average score of 3.8. Websites and apps are being used to estimate of waiting times ("always" by 46.9% "and sometimes" by 18.3% of respondents, respectively), for trip planning ("always" by 32.9% "and sometimes" by 29.7% of respondents, respectively), and for on-route verification ("always" by 15.4% "and sometimes" by 19.1% of respondents, respectively).

The following lessons have been learned from this measure:

- Open data platforms can be an excellent tool for app developers to get interested in urban mobility and develop innovative applications providing real-time information for users.
- Users appreciate the availability of a variety of mobility apps, as they can look for those better tailored to their particular expectations.
- Users are primarily interested in getting information on waiting times, trip planning and to a lesser extent, on-route confirmation of the itinerary.
- New mobility operators, providing services outside the traditional transport system such as car or bike sharing and micromobility are reluctant to share their information in such platforms. Efforts to do so are likely to require early involvement of these stakeholders and an adequate framework to gain their trust.

The platform is already covering the whole metropolitan region, and is expected to remain operational after the termination of the project. CRTM intends to keep working with reluctant mobility providers in order to integrate them in the platform.

A. Introduction

A.1 Expected results of the measure

The measure objectives are as follows:

(1) City policy level in perspective of CIVITAS goals/ longer term:

The measure is related to the following general policy objectives:

- To increase public transport quality (Mobility as a service approach).
- To improve users' experience.
- To promote economic activity through entrepreneurs who will generate added value to the information gathered on the platform.

(2) Strategic level:

- To increase the quantity and quality of information given to users in order to improve the users' experience.

(3) Measure level:

In the short term:

- To create cooperation between different actors (public and private) involved in mobility issues, including private entrepreneurs.
- To establish the basis for the subsequent development of Mobility as a Service (MaaS) services for citizens.

In the long term:

- Giving high quality MaaS to citizens that increase the modal split from private to public transport.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	Number of data sources integrated in the platform (static and dynamic, by provider)										
2	Increase in the number of queries (visits) to the CRTM information sites (open data portal) (in percentage).										
3	Number of queries to the portal from the implantation of the portal to the end of the project. (increase the monthly queries).										
4	Number of open data licenses signed and new mobile applications developed with data from the portal.										
5	Increase the quality perceived by clients related to public transport information systems (surveys to users in the City Lab)					X					

Table 1: Quantifiable impacts.

A.2 Measure description

This measure has developed an integrated Open Data mobility platform, gathering and providing information from all transport modes, prioritizing the more sustainable ones. Some information was already publicly available before the project, but only partially and without including real-time information for most services.

The information, analysed with a business intelligence approach, includes multimodal travel options and a consolidated database of public transport services in real time.

Initially, an open data portal with multimodal information from different sources was also planned (information on public bicycles, parking, car sharing, congestion, pollution, alternative modes and the main road network); however, this information was finally not provided by the relevant public and private actors.

The platform, with information of the whole region, will increase the attractiveness of PT services, as well as, enable the designing of mobility services for different kinds of user types and to promote new business models.

A.2.1 Measure outputs

The measure has been divided into three different subtasks (as defined on the measure description available in the Grant Agreement) with the following outputs:

- Integrated Open Data mobility platform, gathering and providing information from all transport modes. A SPARQL portal¹⁷ with open data information about demand of all the public transport modes will be developed within this task.
- Consolidated database of public transport services in real time with information of suburban buses (information of around 30 private companies operating 36 concessions). Integration of information related to EMT and other public transport modes is being studied.
- Open data portal with multimodal information from different sources (information on public bicycles, parking, car sharing, congestion, pollution, alternative modes and the main road network).

The open data portal is intended for the use of developers, professionals and researchers, which in their turn are expected to provide specific applications for final users.

A.2.2 Supporting activities

No supporting activities are identified for this measure.

A.2.3 Interactions with other ECCENTRIC measures

This measure has no interaction with other ECCENTRIC measures.

A.2.4 Interactions outside ECCENTRIC

This measure has no interaction with measures outside ECCENTRIC.

¹⁷ SPARQL is an RDF query language—that is, a semantic query language for databases—able to retrieve and manipulate data stored in Resource Description Framework (RDF) format.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
0 (All)		Region	The service is targeting all residents and visitors to the Region of Madrid
1	The assessment of mobility information services by residents in the city lab will be assessed specifically, and compared to regional average.	City Lab	
10 (Other)	Private entrepreneurs providing added value services based on the open data platform information	Region	

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level activity L-P-O	of	Role - Links
	CRTM	P	PTA	L		Meas. Coord.
	EMT	P	PT	P		Info provider
	ICCA	P	PR	P		Developer
	Blue Move	S	Car-sharing company	O		Info providers
	EMOV	S	Car-sharing company	O		Info providers
	Getafe Municipality	S	Bike-sharing service	O		Info providers
	ADIF	S	PT	O		Info providers
	DGT (Nat. Traffic Directorat.)	S	Other (nat. govern.)	O		Info providers
	Taxi companies	S	PT	O		Info providers
	Madrid Municipality	P	C	P		Info provider
Type: P:CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company – PTA: Public transport authority Level of activity: L: Leading role – P: Principle participant – O: Occasional participant						

Table 3: Measure stakeholders.

The stakeholders highlighted in yellow and red have declined to include their information in the open data platform, due to concerns about sharing what they consider to be sensitive commercial information or by lack of interest in the concept.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Identification of adequate contact persons for each stakeholder	5 Involvement		CRTM
Political decisions needed for the integration of taxi (and other) information in the platform	1 Political/ Strategic	Taxis may not be included in the platform	CRTM
Private companies' strategies incompatible with the open data platform concept	1 Strategic	Further interaction with them to show the compatibility of the concept and advantages of being included, once the platform becomes operational	CRTM

Table 4: Identified risks.

B. Measure implementation

B.1 Situation before CIVITAS

Some open data platforms already exist in Madrid with segregated information by mode or organization. Furthermore, organization has additional information which is not available on a published or an open data format. The result is that there is not an open data platform of a multimodal character and with the features envisaged for the proposed solution.

CRTM, through its innovation and management control centre (CITRAM), has integrated all the information related to public transport. The expansion of its activities is one of the actions included in The Strategic Sustainable Mobility Plan of the Madrid Region, Vision 2025. Furthermore, the strategic lines of the ICT Master Plan of CRTM for the upcoming years includes the improvement of open data, big data and business intelligence.

EMT implemented its open data policy in 2006 and since 2011 it provides an open data portal, with more than 40 apps developed by third parties and external developers. Taking advantage of, among others, COSMOS FP7 project¹⁸, EMT is also working on additional services related to Internet of Things, working on the development of a multipurpose open platform (framework) called “MobilityLabs” with the purpose of building applications and developing services. This open platform currently integrates many data collections and will include shortly many others, such as the public bike scheme from Madrid city.

ICCA has been collaborating with the CRTM since 2008, developing systems and applications for the management and supervision of public transport, integrating information from the different transport agents that CRTM supervises through CITRAM. The integration of this data has been used mainly in CITRAM transport management and monitoring applications; although data have also been used in projects such as OPTICITIES¹⁹ with which mobile applications have been developed for travellers.

B.2 Innovative aspects

The main innovative aspect of the measure is to make available to potential app developers real-time information on public transport and other services.

B.3 Research and Technology Development

No specific R&T developments are identified in this measure.

¹⁸ COSMOS (Cultivate resilient smart Objects for Sustainable city applicatiOnS) was a research project financed by the European Commission through the 7th Framework Programme between 2013 and 2016. It aimed at providing data and information management mechanisms to handle the exponentially increasing “born digital” data.

¹⁹ OPTICITIES (Optimise Citizen Mobility and Freight Management in Urban Environments) was a research project financed by the European Commission through its 7th Framework Programme between 2013 and 2016. It aimed at the optimisation of transport networks through the development of public/private partnerships and the experimentation of innovative ITS services.

B.4 Actual implementation of the measure

The measure was deployed in three stages (design, implementation and operation):

- The design phase took place from September 2016 to January 2018.
- The implementation phase took place from January 2018 to October 2018.
- The operation phase began in September 2018 and is expected to run to August 2019 (extended subsequently until October 2019).

The main changes in the measure contents during this period are due to the unsuccessful attempts to engage some mobility serviced providers to make their real-time data publicly available in the platform. This has resulted in a more flexible concept, with different levels of integration. In those cases, in which information is available in open data format, platform users are allowed to access and download the information for their own use (this is the case mainly for public transport data); in other cases, the platform provides access points to the operators' websites. At this stage, no particular plans have been established to contact again reticent stakeholders. This could also expand to the future to new “emerging” providers of mobility solutions (on-street shared bikes and motorbikes, electric scooters...).



Figure 1: Welcome screen to the Open-Data Portal

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

The indicators initially selected are included in the Table below.

Impact	2,3	4	4	
Indicator name	System usage	Satisfaction	Satisfaction	Data comprehensiveness
Type	KPI	KPI	KPI	No KPI
Category	Transport system	Society	Society	
Subcategory	General	Acceptance	Acceptance	
Aspect	Transport system utilisation	Fulfilment of expectations	Fulfilment of expectations	
Definition	Number of information providers making use of the platform	Average satisfaction score about PT information availability of information providers making use of the platform	Average satisfaction score about PT information availability of general public	Number of data sources integrated in the platform (static and dynamic)
Unit	Number of users/month	Score (1-5)	Score (1-5)	Quantity
Method of data collection	Data collected from the open data platform and licenses signed	Survey to information providers	Survey to general public transport users	Provided by CRTM
Target group	Information providers and general public	Information providers	General public	Data owners
Domain	Demonstration area (vs. whole region)	Whole region	Demonstration area (vs. whole region)	Whole region
Control sample	No	No	No	No
Related measures, activities, and interference sources	Unlikely	Unlikely	Unlikely	Unlikely
References				

Table 5: Description of key performance indicators (KPI)

Subsequently, it was found that it would more convenient to collect data on an annual basis, as monthly variations were significant, and it was difficult to monitor differences against the baseline on a monthly basis.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement
	System usage	Users/month	A	DC	Developers	Region
	System usage	Users/month	A	DC	Public	Living lab and region
	Satisfaction	Score (1-5)	A	S	Developers	Region
	Satisfaction	Score (1-5)	A	S	Public	Region
	Number of data sources	Quantity	A	DC	Data owners	Region
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Measure's indicators

C.1.2 Baseline

Prior to the implementation of the measure, CRTM is already providing the following services:

- One app known as “Mi Transporte” providing real-time information to users on all public transport systems under the responsibility of CRTM (buses, metro and commuter railway) in the whole region.
- An open source portal with static information on the public transport system (i.e. stops, lines and, in some cases, planned schedules) as well as other static information (P+R, public bike sharing stations, cycling lanes...). Thus far, there is no information on demand or on real-time supply,

Both services have been taken as the baseline reference for this measure, as they can serve to assess the impact of the new portal compared to the previous situation in terms of users. “Mi transporte” is targeting public transport users, The open data portal provides information useful to APP developers and to a wide array of professionals. Each service addresses different target groups and needs, although their use can be affected in both cases by the ECCENTRIC platform. This baseline will be completed with a satisfaction survey to be conducted at the end of the demonstration.

“Mi Transporte” app was made available to the public in May 2015. For the purpose of establishing a baseline, the following information has been gathered for 2017:

- Number of downloads. The total downloads since the service started until December 2017 is 550,319. The number of downloads in 2017 is 145,527. The number of monthly downloads varies between a maximum of 20,574 in September 2017 and a minimum of 8841 in December 2017²⁰.
- Number of users (users are not required to register; the number of users is provided by the identification of the device accessing the system). The total number of users in 2017 was 278,790. The monthly average was 63,237.
- Number of sessions. The total number of sessions in 2017 was 6,810,781, with a monthly average of 567,565.

²⁰ The IOS version of the app was not available in November and December 2017, reducing the number of downloads significantly.

The open data portal (datos.crtm.es) started in 2016, and was officially presented in October 2016. The number of users, sessions and pages visited during that first year was respectively 4,020, 5,115, and 12,536 in that period. In 2017 (first year of full operation) these figures increased significantly: to 6,638 users, 8,461 sessions and 20,013 pages visited. The number of downloads reached almost 35 million in 2017. The most popular information downloaded referred to transport cards sell points (4 million), interurban bus lines (9 million), and Madrid urban bus lines (EMT, 8 million).

Prior to ECCENTRIC, the municipal bus company, EMT, offers its own open data portal and its own real time information system to users. Together, the number of accesses in 2017 was 476 million (separate figures for each channel are not available).

C.1.3 The business-as-usual scenario

The business as usual (BAU) scenario assumes no further improvements in the availability of mobility information services in Madrid. “Mi transporte” and “Portal Datos Abiertos” would remain the main sources of information to the public and to professionals, respectively. Both platforms are well established since 2017, and it would be expected that they would raise moderately the average number of users and sessions per month in a percentage similar to population growth in the region (1% per year).

Satisfaction levels will be measured at the end of the demonstration, asking developers and users about their current level of satisfaction on the availability and quality of the mobility information available and their level of satisfaction in 2018 (i.e. before the new platform was in place). In the area of mobility, as in many other areas related to access to data, expectations of users and developers have been growing. Therefore, it could be argued that the level of satisfaction measured in time could be affected, as users and developers become more demanding. However, it is difficult to accept that changes in expectations will be significant in just one year. In the survey, people are asked to report about two situations (the previous one in 2018, and the situation in 2019 with the new platform) at the same time, thus eliminating the effect of this growth in expectations, if any.

C.2 Measure results

Measure results are summarized in the table below. The results are based on statistics from the relevant websites and a survey to 9243 public transport users completed in September 2019. Data collected in 2019 refers to 10 months (January to October), and has been increased by 20% in order to be comparable to the baseline.

The usage of the system by developers (measured by the number of users of the new open data platform compared to the users of the old data platform) has increased by 4%.

The usage of the system by citizens (measured by the number of users of the official CRTM's app “Mi Transporte” has decreased by 9.3%. It is worth noticing that the 2019 survey identified a large number of transport *app* available in Madrid, and that “Mi Transporte” was found to be used by just 4.0% of the respondents. It can be concluded that the decrease in the use of “Mi Transporte” has been an indirect effect of the success of this ECCENTRIC measure in providing real-time information to the developers of competing applications.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
System usage (developers)	Users/yr	6638	2017	6638	2019	6923	2019	285	285
System usage (users)	Users/yr	278790	2017	278790	2019	252770	2019	-26020	-26020
Satisfaction (developers)	Score (1-5)	NA	2017	NA	2019	3.9	2019	NA	NA
Satisfaction (users)	Score (1-5)	3	2017	3	2019	3.8	2019	0.8	0.8
Number of data sources	Quantity	1	2017	1	2019	1	2019	0	0

Table 7: Measure's results

The ECCENTRIC measure team was able to gather direct data on the satisfaction of developers with the new open data platform only from a limited sample of 11 respondents. The low number of respondents can be due to the anonymity of the access and the lack of interest of the platform users to respond to voluntary on-line surveys. The average level of satisfaction was high (3.9 on a 1-5 scale) and is consistent with the fact that CRTM has received no complaints, and that the number of platform users has increased compared to the previous platform. Furthermore, the high number of mobility apps (more than 18) identified during the survey suggests that the open data platform has been effective in supporting developers to improve the information services they provide.

Public transport users' satisfaction was assessed in the survey conducted in 2019. Compared to the previous situation (which is assumed to get a score of 3.0), the satisfaction of users with public transport information has increased by 0.8 points.

The number of data sources for the information provided in the new platform has not changed compared to the previous one: all real-time information is being gathered by CRTM; in spite of efforts to provide real-time information from other mobility providers (taxis, car sharing, etc.), these providers have not agreed to share their information, mostly to avoid losing what they perceive as a commercial advantage.

C.3 Summary: achievement of objectives

The assessment of the achievement of the objectives initially established for this measure is summarized in the table below.

The project could not achieve its objective to increase the number of data providers, as a way to expand the mobility information available in the platform. The mobility providers that were approached by the measure team argued that real-time data information was commercially sensitive for them, as competitors could identify their commercial strategies (e.g. deployment of vehicles in certain places in the city). These concerns can be due to the fact that new mobility providers are still trying to consolidate their position in the mobility market, with limited

resources, and are keen to preserve their own identity, rather than getting integrated in the general mobility system.

No.	Objective and target	Rating	Comment
1	Number of data sources integrated in the platform (static and dynamic, by provider)	O	ECCENTRIC was unsuccessful in cooperating with mobility service providers outside the traditional PT system, due to commercial concerns.
2	Increase in the number of queries (visits) to the CRTM information sites.	O	The number of queries to the CRTM information sites (app <i>Mi Transporte</i> and web site) slightly decreased, as new <i>apps</i> entered the market providing services better tailored to different users' profiles.
3	Number of queries to the open data portal from its implementation to the end of the project	**	The number of queries significantly increased, reflecting the value of open data for the developers' community.
4	Number of open data licenses signed and new mobile applications developed with data from the portal.	*	Developers were not requested to sign licenses to use PT open data. The high number of <i>apps</i> available in Madrid suggest that a substantial number of them were developed or improved as a result of ECCENTRIC.
5	Increase the quality perceived by clients related to public transport information systems (surveys to users)	**	The survey provided evidence of a high level of satisfaction among <i>apps</i> ' users.
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded			

Table 8: Assessment of measure's objectives

It was initially expected that the development of the open data platform would serve to expand and improve the information services provided by the CRTM's own app and website. In fact, this has not occurred: Due to the lack of interest of new mobility providers to join the platform, the CRTM's information services remain providing the same information as before ECCENTRIC started; on the other hand, the availability of real-time information has empowered other app providers (public and private) to offer their own services, reducing the market share of CRTM as an information provider. In fact, this effect could have been anticipated at the beginning of the project, as new app developers have probably been able to identify different users' profiles and to tailor the information providers to their particular needs.

The increase in the number of queries to the new open data portal (with substantial improvement in terms of real-time information) compared to the old one has increased by 11% in a little more than 2 years. ECCENTRIC has been successful in mobilising the developers' community and in supporting the development or improvement of more than 18 mobile apps and 9 websites providing information on the mobility system in Madrid.

The quality of the information has been positively assessed by public transport users, with an average score of 3.8, and by a small sample of app developers, with an average score of 3.9. Websites and apps are being used to estimate of waiting times ("always" by 46.9% "and sometimes" by 18.3% of respondents, respectively), for trip planning ("always" by 32.9% "and sometimes" by 29.7% of respondents, respectively), and for on-route verification ("always" by 15.4% "and sometimes" by 19.1% of respondents, respectively).

C.4 Up-scaling

As the platform is already covering the whole region, there are no further plans for geographical up-scaling. The platform will remain operation after the termination of ECCENTRIC and CRTM will keep trying to attract additional mobility providers to join it, once their market position

strengthens and they may become less concerned about losing commercial independence and consider the advantages of getting their services known by a much broader community of potential users.

D. Process Evaluation findings

The main findings of the process evaluation are summarised in this section. More details are available in the **Process Evaluation Report** of this Measure.

D.1 Deviations from the original plan

The measure implementation only faced one deviation from the original plan. It reduced the initial scope and ambition of the open data platform.

D.1.1 Scope of the open data platform

ECCENTRIC was unsuccessful in engaging some stakeholders to participate in the measure, as they refused to share their data and make them publicly available in the open platform. This has resulted in a more flexible concept, in order to accommodate the various levels of detail in the information provided, with different levels of integration. When information is available in open data format, platform users are allowed to access and download the information for their own use (this is the case mainly for public transport data); in other cases, the platform provides access points to the operators' websites or to some specific documents.

In fact, during the project implementation a number of new “emerging” providers of mobility solutions have appeared in Madrid (on-street shared bikes and motorbikes, electric scooters...). The project has not developed any follow-up plans to contact again reticent stakeholders and try to integrate them in the platform.

D.2 Barriers

The barrier identified during the process evaluation is closely connected to the deviation mentioned in the previous section.

D.2.1 Involvement: lack of commitment of relevant agents.

The lack of involvement of key relevant agents, and particularly new mobility operators (sharing services, micro-mobility...) was mentioned by almost half of the project participants as a relevant barrier. The measure participants reacted by focusing their activities on technical issues, as a way to reach full technological development and implementation in spite of the lack of commitment of those agents. The platform remains open to integrate those agents in the future, although the project has not made any specific plans to gain their involvement.

D.3 Drivers

Three main drivers were identified in the process evaluation.

D.3.1 Cultural driver

The ICT sector in Madrid proved to be interested in the potential opportunities within the mobility sector. Building upon the networks established in previous FP7 projects, ECCENTRIC partners, ITC experts within public transport operators and app developers have been actively involved in the measure.

D.3.2 Planning driver

This measure benefitted from careful design by CRTM, based on the experience in previous ITC-related projects. The transition from planning to implementation was smooth, in spite of the difficulties associated to the lack of engagement of some potential data contributors.

D.3.3 Leadership driver

The leadership provided by CRTM was effective in helping to mobilise many stakeholders. As a metropolitan public transport authority, CRTM was in a unique position to integrate the various data providers and to serve as a one-stop source for app developers and for all those interested in mobility data.

D.4 Supporting activities

No supporting activities were undertaken within this measure.

D.5 Recommendations on the implementation process

The implementation process showed the difficulties to engage two key stakeholders: small (“disruptive”) mobility providers and app developers. The recommendations provided below refer to both groups.

D.5.1 Involvement of *disruptive* mobility providers

The emergence of new or *disruptive* mobility services is often mentioned as a challenge for integrated public transport systems. This particular ECCENTRIC measure was seen as a way to provide a mechanism for *soft* integration of new mobility providers within the metropolitan transport system, and a first step towards their collaboration with stakeholders in the public transport sector. As already mentioned, these expectations did not materialise, due to its conflict with the new mobility providers’ strategy.

This strategy seems to look for potential demand niches of trips poorly served by current services or customers willing to pay more for better tailored mobility services. It can be adequate in future actions to pay more attention to the characteristics of the services offered and the profile of the customers served by new mobility providers, and to initiate a co-creation process with them in order to establish a shared vision in which the providers’ strategies can be compatible with their partial integration within the public transport system. Such a shared vision could have provided the pre-conditions for these providers to be integrated in the open data platform.

D.5.2 Involvement of *app* developers

The project measure team did not report any specific measures to actively involved the app developer community in Madrid during the design or implementation stages of the project. The positive results in terms of platform usage suggests that the team was well-aware of the expectations of this community and provided a useful tool. However, it could be argued that a more participatory approach could have facilitated the deployment of the platform.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed with measure leaders, site coordinators and stakeholders. Based on this, the following evaluation conclusions are presented.

E.1 Validated direct impact

- The measure has successfully empowered app developers to provide enhanced information services through their applications. More than 18 app are currently available in Madrid providing real-time information on mobility services.
- Public transport users are very satisfied with the real-time information available in Madrid.
- The deployment of alternative apps has resulted in a slight decrease in the users of the CRTM app “Mi Transporte”.
- The measure has not achieved its initial ambition of including additional real time information from additional mobility services not integrated in the public transport system, such as taxis, car sharing or micromobility services.

E.2 Relevance of supporting activities

There were no supporting activities associated to this measure.

E.3 Interaction with other measures

This measure had no interactions with any other ECCENTRIC measures in Madrid.

E.4 Main lessons learned

- Open data platforms can be an excellent tool for app developers to get interested in urban mobility and develop innovative applications providing real-time information for users.
- Users appreciate the availability of a variety of mobility apps, as they can look for those better tailored to their particular expectations.
- Users are primarily interested in getting information on waiting times, trip planning and to a lesser extent, on-route confirmation of the itinerary.
- New mobility operators, providing services outside the traditional transport system such as car or bike sharing and micromobility are reluctant to share their information in such platforms. Efforts to do so are likely to require early involvement of these stakeholders and an adequate framework to gain their trust.

E.5 Long term impact

It can be expected that the platform will serve to consolidate the central role of CRTM, as the regional public transport authority, in integrating mobility services in Madrid, with a focus on public transport.

E.6 Potentials for up-scaling in the city

The platform is already covering the whole metropolitan region, and is expected to remain operational after the termination of the project. CRTM intends to keep working with reluctant mobility providers in order to integrate them in the platform.

F. Additional information

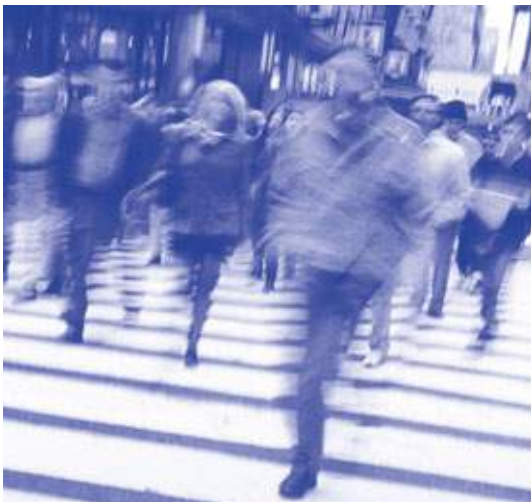
F.1 Appraisal of evaluation approach

The evaluation approach for this measure has been successful in providing accurate monitoring and reporting of the results achieved. The strong points include the convenience of the data collection process for those KPI related to the platform use, as they can be obtained from standard internet applications.

The main weak point in evaluation is the difficulty to obtain information from app developers. In spite of the CRTM's efforts (voluntary registration, on line surveys...) these stakeholders seem reluctant to collaborate. It can be considered that a specific regular communication channel (e.g. a focus group including at least some well-known developers) could have served to get them more engaged at the measure design and implementation stage, and could have resulted in direct feedback from them.

F.2 Future activities relating to the measure

No specific recommendations seem necessary for the future of this measure after the project lifetime.



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STO 3.5

Develop smart choice of mobility services

Measure Evaluation Report

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2020
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2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KTH
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
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	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
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19	Green City Projekt GmbH	Germany	GCP
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	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Joel Franklin	KTH Royal Institute of Technology
Helene Carlsson	City of Stockholm

Table of Contents

ABSTRACT.....	581
A. INTRODUCTION.....	582
A.1 EXPECTED RESULTS OF THE MEASURE	582
A.1.1 Quantifiable impacts.....	583
A.2 MEASURE DESCRIPTION	583
A.2.1 Measure outputs.....	583
A.2.2 Supporting activities	584
A.2.3 Interactions with other ECCENTRIC measures.....	584
A.2.4 Interactions outside ECCENTRIC	584
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	584
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS	584
A.5 IDENTIFIED RISKS	585
B. MEASURE IMPLEMENTATION	586
B.1 SITUATION BEFORE CIVITAS	586
B.2 INNOVATIVE ASPECTS.....	586
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	586
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	586
C. IMPACT EVALUATION FINDINGS	589
C.1 EVALUATION APPROACH.....	589
C.1.1 Expected impacts and indicators.....	589
C.1.2 Baseline.....	591
C.1.3 The business-as-usual (BaU) scenario	592
C.2 MEASURE RESULTS.....	592
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	594
C.4 UP-SCALING	595
D. PROCESS EVALUATION FINDINGS	596
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	596
D.2 BARRIERS	596
D.3 DRIVERS	598
D.4 SUPPORTING ACTIVITIES.....	598
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	598
E. EVALUATION CONCLUSIONS	599

E.1	VALIDATED DIRECT IMPACT	599
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	599
E.3	INTERACTION WITH OTHER MEASURES	599
E.4	MAIN LESSONS LEARNED	599
E.5	LONG TERM IMPACT	599
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	599
F.	ADDITIONAL INFORMATION	600
F.1	APPRAISAL OF EVALUATION APPROACH	600
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	600

List of Figures

Figure 1: Bookings on UbiGo. 593

List of Tables

Table 1: Quantifiable impacts.....	583
Table 2: Target groups or affected parties.....	584
Table 3: Measure stakeholders.....	585
Table 4: Risk assessment.....	585
Table 5: KPI Descriptions.....	590
Table 6: KPI Details.....	591
Table 7: KPI Results.....	594
Table 8: Summary of Objective Achievement.....	595
Table 9: Identified barriers and planned/taken actions.....	598
Table 10: Identified drivers and planned/taken actions.....	598

Project	City		
ECCENTRIC	Stockholm		
Measure code	Measure name		
3.5	Develop smart choice of mobility services		
Last update	Responsible	e-mail	telephone
	Helene Carlsson	helene.carlsson@stockholm.se	

Abstract

The City of Stockholm aims to improve mobility options for citizens, particularly to enable the use of more sustainable travel modes as an alternative to energy- and emissions-intensive private automobile use. In particular, this measure consists of the establishment and operation of a (beta) MaaS-Service, UbiGo, with the participation SnappCar, GoMore and the City of Stockholm in order to provide sustainable transport options as alternative to private car and to facilitate the development of services offering alternatives to the private car for the citizens in Stockholm. Outputs of this measure included establishment of the UbiGo integrated mobility subscription platform, allowing access to public transport, taxi, rental cars, shared cars, and other mobility services.

This measure implemented a set of Mobility-as-a-Service (MaaS) initiatives in the City of Stockholm: firstly, an integrated mobility service comprising public transport use, car rental and taxi bookings; and secondly, two separate peer-to-peer mobility services that pair automobile owners with travelers who wish to borrow a car for local trips. Awareness of MaaS-type services was gauged using a general web-based survey, satisfaction for the UbiGo service was measured by a targeted app-based survey, and usage was monitored using each MaaS provider's internal operations records.

The results showed that all three MaaS providers experienced very strong growth during the project: UbiGo, which started from zero, jumped to over 1800 bookings per month by December 2019. Customer satisfaction with UbiGo was high, with an average score of 3.8 out of 5. GoMore and SnappCar, reporting in percentage growth, increased by 261% and 623% respectively, between 2018 and 2019. Overall awareness of peer-to-peer mobility services such as GoMore and SnappCar increased during the project period from 49% to 67%.

The findings indicate that MaaS is experiencing a strong period of growth in the Stockholm market, both in terms of an integrated mobility platform in the form of UbiGo, and in terms of new business models for mobility service in the form of SnappCar and GoMore. Among the general population, an improved awareness and comprehension of these services was detected, indicating that even non-users have been aware of the growth in this sector.

A. Introduction

A.1 Expected results of the measure

Improved mobility options for citizens including new integrated and shared services. An increasing interest for car-light lifestyle among citizens. Improved conditions for an increasing number of citizens to shift to car-light lifestyles which in turn has a positive effect on congestion as well as emissions and life quality. Increased knowledge regarding how to – and maybe how not to – sell the service of integrated mobility and of P2P sharing services. Also increased experiences on how to build business models for mobility services that are sustainable.

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

The City of Stockholm aims to improve mobility options for citizens, particularly to enable the use of more sustainable travel modes as an alternative to energy- and emissions-intensive private automobile use.

(2) Strategic level:

The strategic objective of this measure is to work toward the City's goals by lowering barriers to the use of Mobility-as-a-Service (MaaS)²¹ and increasing awareness of alternatives to the use of private car.

(3) Measure level:

The measure's particular objectives are to increase the level of integration of different travel modes, including shared ones, to increase the use of these services by individual and businesses, to reduce the use of private vehicles as a consequence, and to increase the rate of entry of new mobility solutions into the market. In quantifiable terms, the measure seeks to:

- Attract 200 subscribers to the integrated MaaS service
- Reduce these households' travel by private car by 180 000 km

²¹ Mobility-as-a-Service is defined by the MaaS Alliance as "is the integration of various forms of transport services into a single mobility service accessible on demand" (ERTICO, 2020)

A.1.1 Quantifiable impacts

The quantifiable impacts are summarized in the table below.

Expected Impacts	Improved mobility options for citizens including new integrated and shared services. An increasing interest for car-light lifestyle among citizens. Improved conditions for an increasing number of citizens to shift to car-light lifestyles which in turn has a positive effect on congestion as well as emissions and life quality. Increased knowledge regarding how to – and maybe how not to – sell the service of integrated mobility and of P2P sharing services. Also increased experiences on how to build business models for mobility services that are sustainable	CIVITAS ECCENTRIC Objectives								
		Reduce:			Improve:					
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight
1	Satisfaction of the MaaS services				x	x	x	X	x	x
2	Awareness raising					x	x	X		
3	Usage				x		x		x	

Table 1: Quantifiable impacts.

A.2 Measure description

This measure consists of the establishment and operation of a (beta) MaaS-Service, UbiGo, with the participation SnappCar, GoMore and the City of Stockholm in order to provide sustainable transport options as alternative to private car and to facilitate the development of services offering alternatives to the private car for the citizens in Stockholm. For all of these services, the product is a platform on which sustainable travel can be organised – either as an interface to multimodal options, or as an exchange for private individuals to either lend or borrow the use of a car. The services were made available and marketed to residents of the Stockholm metropolitan region during the project, with the intention of it continuing indefinitely after the project's conclusion.

A.2.1 Measure outputs

The partners' contributions led to the following outputs of the measure:

- Establishment of the UbiGo integrated mobility subscription platform, allowing access to public transport (Stockholm Transport SL), taxi, rental cars, shared cars, city bikes and other mobility services.
- Deployment of the GoMore Mobility Platform in Stockholm for ridesharing, leasing, and peer-to-peer rental in Stockholm by establishing Swedish customer care, adding new features to the app, and increasing awareness in Stockholm.
- Enhancement of the SnappCar peer-to-peer car-sharing platform by improving the owner experience, increasing awareness of sharing-economy solutions.
- Integrated follow-up studies to measure Stockholmers' awareness and use of mobility services, as well as their ordinary mobility patterns.

A.2.2 Supporting activities

Except of the stakeholders meetings, no additional supporting activities were included in this measure.

A.2.3 Interactions with other ECCENTRIC measures

The measure interacted with Measures 6.6 Masterplan for EV charging, and 6.7 Promote EV-charging in multifamily houses, if electric vehicles are registered into the car-sharing systems to make mutual use of possibilities and requirements of charging facilities. Fruitful exchanges with Eccentric MaaS measures e.g. in Turku and Madrid are also taking place.

A.2.4 Interactions outside ECCENTRIC

Most of the work to build an integrated MaaS service has been based on interactions outside Eccentric. This comprises service providers (Taxi, Carsharing, Bikes, Stockholm Public Transport, Citybikes), joint ventures with industrial partners (platform, backend and app-provider), and consumer groups (housing companies and more), as well as national agencies, research community networks, and projects in the field of innovation new mobility, transport etc.

Additional evaluation, funded by Swedish innovation agency Vinnova collected detailed travel behaviour data from all adult household members from the households subscribed to the UbiGo service. This facilitated deeper insights about the impacts of the service beyond what is possible to finance as part of Eccentric. In addition, the Swedish research project Mistra SAMS were invited to compare the UbiGo subscribers with a control group using the same evaluation tools. Mistra SAMS also offered UbiGo the possibility of in/depth interviews and focus groups to further explore the drivers and motives for the households to try out UbiGo.

A.3 Target groups and/or affected part of the city or region

Table 2 lists the target groups affected in this measure.

Target group		Affected area	
Type	Description	Type	Description
9. General Public	Potential users of the service	Demonstration area	
10. Other	Companies participating in the measure	Stakeholders	

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

In the Table 3 stakeholders participating in this measure are listed, representing the city of Stockholm, research, and private sector.

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR- other	Level activity L-P-O	Role Links -
P02	Citizens of Stockholm	S	Other	O	
P03	Environmental Department of the city of Stockholm	P	C	L	
P07	UbiGo, SnappCar and GoMore	S	PR	P	
P10	KTH Royal Institute of Technology	P	KI	P	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Table 4 lists the risks identified prior to the implementation of this measure.

Identified risk	Category	Mitigation actions	Responsible
Delays (implementation, data collection, dependent tasks etc.)	Operational	Transfer of money among partners in the measure and if not accepted by project officer change of technological providers	UbiGo, City of Stockholm
Inefficiencies with stakeholders (competitiveness, conflicts, turnover, no support, disengaged)	5 Involvement, Communication	Unavoidable since the partners are competitors (SnappCar and GoMore) – Acceptance that full openness is not an option and reliance on the validity and truth of the provided data from the companies	-
Legal & regulatory issues	2 Institutional	Seeking for creative workarounds during the pilot.	UbiGo & project partners (within the Maas but not inside Eccentric)
Conflict/Lack of cooperation with similar projects/actions/pilots	7 Planning	Big efforts to cooperate with SL. Participating in national networks and other pilots/testbeds national and international etc.	UbiGo, City of Stockholm
Lack of data/data of low quality	Operational	Cooperation with researchers and other stakeholders in Sweden.	City of Stockholm
Technology components aren't fit for purpose	Operational	Seeking for creative workarounds for the pilot based on today's ticket system instead of on a mobile app solution.	UbiGo & project partners (within the Maas but not inside Eccentric)

Table 4: Risk assessment.

B. Measure implementation

B.1 Situation before CIVITAS

There is a lot “buzz” regarding MaaS and several smaller pilots in a conception phase in Sweden but no combined mobility service offering a variety of travelling options in operation in Stockholm or Sweden. The reluctance from all public transport companies to open up their systems for third parties to sell tickets is one problem to tackle. Established service providers like car rentals, taxi and 2-way carsharing companies experimenting with new service concepts. Moreover, car-leasing companies are experimenting with shared car-leasing and micro-car sharing. Several start-up service providers have announced they will enter the market with several innovative concepts to collaborative car use. However, the market does not develop as rapidly as visions and new concepts are pitched to media and spread in social feeds.

B.2 Innovative aspects

This measure is innovative in two key respects: first, that it provides a Level-3 Mobility-as-a-Service (MaaS) (that is, it integrates multiple mobility services), and secondly, that it engages whole households as customers, not simply individuals.

B.3 Research and Technology Development

The UbiGo integrated MaaS platform and app is developed as part of this measure. Moreover, the participating SnappCar and GoMore apps are also developed to provide increased features and functionality.

B.4 Actual implementation of the measure

Below is described the major activities during Civitas Eccentric. We begin with a summary of the partners’ status prior to the start of the project. Before CIVITAS ECCENTRIC, UbiGo gathered experiences as a MaaS operator by setting up a MaaS six-month pilot in Gothenburg (Sweden), and they were ambitious to set up a MaaS platform in Stockholm within CIVITAS ECCENTRIC. For UbiGo the activities aim to build up a MaaS service with all its components and to run a beta pilot in Stockholm.

SnappCar offers a platform for peer-to-peer³ car rental. They are based in the Netherlands and acquired the Swedish startup Flexidrive (in 2015) to launch their operations in Sweden. GoMore offers a platform for peer-to-peer car rental and peer-to-peer car-sharing. They are based in Denmark but started in Sweden in 2015. For Snappcar and for GoMore, the activities aim to improve their services and to increase their use in Stockholm.

After Year 1: Initiation and Integration

In the initial stage of the project, the partners aimed to integrate the two peer-to-peer services (SnappCar and GoMore) into the UbiGo MaaS platform. During the first year it was decided to put this idea on hold, due to the fact that peer-to-peer solutions require extra considerations regarding the contracts when included in a bundled MaaS-offer. Thus this measure now basically comprises three more or less individual actions, along with the City of Stockholm supporting in evaluation, communication and EU-administrative reporting and in sharing experiences with the city administration.

After Year 2: Mobilisation

During the first two years of the measure, numerous meetings were held to: establish cooperation and joint ventures, set up business agreements, find complementary financing, exchange experiences and for communication/marketing purposes (local, national and global networks, key stakeholders within city administration, etc.). It is worth mentioning that the company UbiGo, in particular, have extensively and generously shared their knowledge with almost all MaaS actors, including with potential competitors.

After Year 3: Development and Deployment

Through the remainder of the implementation period, the four partners carried out the following tasks leading up to the final impact evaluation.

UbiGo

- During the R&D phase, forms of subscription, payment methods, existing platforms, sources of funding, potential partners, user needs and service features were analysed and evaluated.
- UbiGo has established cooperation with technology platform provider Fluidtime and reached agreements with three service providers: Stockholm Transport (public transport), Cabonline (taxi service) Hertz (car rental), which were integrated in the UbiGo app. Negotiations regarding additional financing are ongoing and remain unsolved.
- Several versions of UbiGo Stockholm App were developed and the current version is available in AppStore and Google Play. Its features include, for example, trip planner, booking tickets, 'my pages with my booked tickets', account balance, and booking history. There is also a new website (ubigo.me), presenting the plans and the MaaS offer in Stockholm, including a form for applying to participate in the UbiGo Stockholm pilot. Initial prices, subscription models and terms of use have been set and contracts for end users formulated.
- The agreement with Stockholm Transport includes a special ticket format (day tickets to a 'subscription price'). This required a workaround in the form of a smart card until mobile tickets can be validated in the public transport system and are available for integration via API (application programming interfaces) in the platform. With Cabonline the customer books a taxi using the mobile application and the trip is billed afterwards on the monthly invoice. Hertz car rentals are booked in the app and car hours are withdrawn from the household account balance.
- The UbiGo service was deployed in October 2018, including public transport tickets and taxi bookings. Car rental was added one month later. Finally, electric vehicle car-share was made available at different locations starting in January and April 2019.

SnappCar

- The SnappCar App went through a total redesign and was launched as a native app in 2017 for iOS and 2018 for Android. First features included finding cars and booking followed by continuous improvements, updates and additional features. The latter are registration, verification, driver's license check system to improve security, rating of both car rentals companies and rental customers, bonus system (inviting a friend gets you credits), etc.

GoMore

- During the project GoMore established Swedish customer service (available by phone, email and chat) taking direct contact with new users and helping them familiarize with the platform and its services.

- A bonus system based on usage and referring new customers was developed with the aim to reactivate users, cross services and functionality (<https://gomore.se/points/how>). On Facebook there was targeted marketing in Stockholm.
- Discussions with the Swedish Tax Agency and other project partner were held to establish better tax explanation and communication.

City of Stockholm

- The City of Stockholm was responsible for background data collection and complementary data compilation used to identify potential pilot areas. A GIS (geographic information system) map was produced combining mobility data (availability of services, driver license density, ownership of cars, public transport-cards, etc.), with the aim of testing the usefulness of combining such data to reach potential users of MaaS services.
- Marketing and promotion: Communication and promotional activities included newsletters, web articles, press releases, articles (for example, debating shared economy and legal framework), partner cooperations.
- The City of Stockholm also monitored media exposure and to some extent also social media, and conducted awareness surveys during the implementation of the measure.
- Another major contribution for the project was networking and facilitating networking on different levels (project, city, national) to create awareness of upcoming services and trends, and to identify where and in which role the city should intervene, and how. Within the city administration, a informal working group was set up to ensure interdepartmental cooperation and information exchange on issues that may provide solutions for a car-light lifestyle, such as parking, traffic and spatial planning and housing.
- Letter of intent between SL, City of Stockholm and UbiGo that regulates on an overall level the cooperation and responsibilities in the MaaS pilot has been signed.
- Detailed planning of the evaluation of the MaaS pilot has started in cooperation between UbiGo, Stockholm Transport and the City of Stockholm.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Satisfaction

The deployment of the UbiGo platform in Stockholm was evaluated using an extensive opinion survey carried out on a test panel. The panel was recruited prior to deployment of the app by distributing information about the panel via the newly created UbiGo web site, project partners, news articles, and a small marketing campaign. As an incentive, participants were offered a low-level membership to the service for free, which included 6 hours car rental and 10 days of public transport. Initially 200 households were recruited, of which a third signed a contract. Many dropped out after the free month, leading the planned obligation to complete the survey to be relaxed and combined with a further incentive for those who did complete the survey. Surveyed participants included household members over 15 years in age.

The survey was carried out using a mobile travel survey app, *TravelVu*, published by consultancy Trivector. Two waves were conducted: the first wave was conducted during the initial deployment of the UbiGo service and focused on expectations and existing travel patterns; the second wave was conducted in August and September 2019, after extensive opportunity to use UbiGo, and this wave contained the question on overall satisfaction with UbiGo. In this second wave, 23 households with a total 25 individuals participated, a response rate of about 40% of remaining households at that point.

UbiGo System Bookings

The usage levels of the UbiGo platform were reported directly by the operator, UbiGo. The numbers reported include car rental bookings (commercial car-hire), public transport bookings, and taxi bookings, and here we report the sums of all three.

Peer-to-Peer System Fleets and Growth in Bookings

Due to competition between providers, the available statistics for these services are somewhat limited. The statistics shown are a consequence of negotiations between the measure leader and the two companies. For the size of the fleets, it was agreed to provide the figures to the City of Stockholm but that the number should be a total for the sector, not specified per provider. For bookings, it was agreed that each provider would report their annual growth in bookings but not the absolute number of bookings.

Awareness

Awareness was measured using web-based interviews of a randomly recruited respondents in Stockholm aged 18-79. The survey has been carried out annually, but for purposes of this assessment, we use 2016 data as the baseline and 2019 data for the impact measurement. Some aspects of the data collection have changed over these years, including a change in survey contractor and a shift from mixed paper/web to fully web-based. The survey in 2016 was carried out from 14th November 2016 to 9th January 2017 and included 373 respondents. The 2019 wave was carried out in January 2019 and included 445.

In all four waves, respondents were asked whether they were aware of peer-to-peer carsharing services. However, respondents were also asked to name such a service, and rather few

(around 10%) named a true peer-to-peer carsharing services, while many others named commercial ridesharing or ride-hailing services. Thus we should treat this data with caution.

The fourth wave, and final one available for Eccentric, was the first to include a question specifically asking about MaaS, namely whether respondents were aware of apps that integrated nearly all types of mobility. We should also treat this data with caution, as the most popular services named were Google and SL (the regional public transport company).

Impact	Satisfaction	Usage	Usage	Usage	Usage	Awareness Raising	Awareness Raising
Indicator name	Customer Satisfaction	UbiGo System Bookings	P2P Carshare System Fleets	GoMore System Bookings Growth	SnappCar System Bookings Growth	Awareness	Awareness
Type	KPI	KPI	KPI	KPI	KPI	KPI	KPI
Category	Society - People	Transport system	Transport system	Transport system	Transport system	Society – People	Society – People
Subcategory	Acceptance	General	General	General	General	Acceptance	Acceptance
Aspect	Fulfilment of expectations	Transport system utilization	Transport system utilization	Transport system utilization	Transport system utilization	Awareness Level	Awareness Level
Definition	Satisfaction among the users/ customers of the MaaS service	Level of activity and use of the various components of the service among subscribers	Total number of vehicles subscribed among	Year-on-year growth in number of bookings among traveling members of GoMore	Year-on-year growth in number of bookings among traveling members of SnappCar	The share of respondents that claim to be aware of peer-to-peer carsharing	The share of respondents that claim to be aware of integrated mobility services

Table 5: KPI Descriptions.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement
1	Customer Satisfaction	Score from 1 to 5	I (1)	S	UbiGo Users	Stockholm
2	UbiGo System Usage	Number of bookings	I (1)	DC	UbiGo (operator)	Stockholm
3	P2P Carshare System Fleets	Number of cars available	I (1)	DC	GoMore and SnappCar (operators)	Stockholm
4	GoMore System Usage	Year-on-year growth in number of bookings	I (1)	DC	GoMore (operator)	Stockholm
5	SnappCar System Usage	Year-on-year growth in number of bookings	I (3)	DC	SnappCar (operator)	Stockholm
6	Awareness of Peer-to-Peer Carsharing	%	I (4)	S	General public (users, residents, visitors)	Stockholm
7	Awareness of Integrated Mobility Services	%	I (4)	S	General public (users, residents, visitors)	Stockholm
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: KPI Details.

C.1.2 Baseline

Prior to Eccentric, there was no combined mobility service offering a variety of travelling options in operation in Stockholm or Sweden. A lot of “buzz” has emerged regarding MaaS and several smaller pilots in a conception phase in Sweden. However, public transport companies have been reluctant to open up their systems for third parties to sell tickets.

Established service providers like car rentals, car leasing, taxis and 2-way car sharing companies are also experimenting with new service concepts. Some companies are experimenting with shared car-leasing and micro car sharing. Several start-up service providers announce they will enter the market with several innovative concepts to collaborative car use. But the market, i.e. the use of the old and new services by Stockholmers, is not developing as rapidly as visions and new concepts are pitched to media and spread in social feeds.

Satisfaction with UbiGo

The UbiGo system did not exist in the base case, so there is no measure of satisfaction in that scenario.

UbiGo System Bookings

Since the UbiGo system did not exist in the base case, there were zero bookings at that time.

SnappCar and UbiGo Fleet Size

In January 2017, the total reported fleet size was 604. In other words, this many individuals had signed up their private vehicles as available for others to rent through one of the apps.

SnappCar and UbiGo Bookings Growth

At the beginning of the project, both GoMore and SnappCar were experiencing similar annual growth of 65%, providing a baseline for comparison.

Awareness

In the 2016 wave of the general survey, 49% reported being aware of peer-to-peer carsharing services. As mentioned earlier, the question about MaaS was not yet included in this wave.

C.1.3 The business-as-usual (BaU) scenario

The market for service-based mobility in Stockholm is highly volatile and currently almost only driven by private actors. For example, in recent years both Car2Go and DriveNow have entered the market and have left again, and Aimo has more recently started up in Stockholm. Meanwhile, among soft modes, Mobike dock-less bikes have also come and gone and EU-bike dock-less city bikes have arrived. Stockholm's own procurement of a new docked bikeshare system has been appealed in court and failed and now needs a restart.

In general, the City has only recently realized the need to have a strategy for how and when to encourage, or discourage, all these forms of new mobility options. Laws and regulations also don't fit to a possibly completely different selection of shared mobility services. All of this makes any prediction about future developments in the business-as-usual scenario extremely tenuous. Having said that, exposure to this variety of schemes is likely to at least increase awareness of subscription-based mobility solutions somewhat, as well as give insights about the acceptance among citizens.

More specific to Eccentric, the UbiGo service was introduced to Stockholm mainly as a consequence of this measure. The attention the measure has brought has put Stockholm among the top cities mentioned in association with MaaS.

In quantitative terms, the above conditions are not sufficient to suggest any significant deviation from the baseline conditions. Without Eccentric, we would expect the existing services to continue to grow at the same rate and for non-existent services to remain so. Awareness would likely remain constant.

C.2 Measure results

The measure KPIs were estimated as follows:

Satisfaction with UbiGo

According to the survey of UbiGo users, the average rating on a scale from 1 (not at all satisfied) to 5 (very satisfied) was 3.8. A separate question, not reported here as a KPI, asked whether respondents, after access to UbiGo, "can participate in the activities I'd like to", and "can go where I want without problem". These were formulated in such a way that they were not tied to the UbiGo service, so it was possible to compare to a control group. In general, the responses were slightly more positive for those using UbiGo than for the control group.

Bookings on UbiGo

In the case of UbiGo, absolute numbers were reported monthly, with the last reporting period in December 2019 seeing 1811 total bookings. Of these, the vast majority were for public transport (1742), while 63 bookings were for car rentals and only 6 were for taxi trips (see Figure below). Monthly public transport bookings increased dramatically over the six previous months, having been stable between 300 and 400 bookings per month until July 2019.



Figure 1: Bookings on UbiGo.

Total Fleet on P2P Carsharing

The total fleet size for both peer-to-peer carsharing services was 1167 in December 2019.

Growth in Bookings on GoMore and SnappCar

Both peer-to-peer carsharing services saw strong growth during the last reported year, with GoMore seeing 261% annual growth and SnappCar 623% annual growth.

Awareness

By the 2019 survey, the awareness of peer-to-peer carsharing service had risen to 67%. Awareness of MaaS, however, was only 26%.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Customer satisfaction	Average Score (1-5)	N/A	2016	N/A	2019	3.8	Spring 2019	N/A	N/A
UbiGo System usage	Num. bookings/month	0	2016	0	2019	1811	Dec. 2019	+1811	+1811
P2P Carshare System Fleets	Number of cars	604	Jan. 2017	874	Jan. 2020	1167	Dec. 2019	+824	+293
SnappCar System usage	Annual growth, %	65%	2018	65%	2019	623%	2019	+558 p.p.	+558 p.p.
GoMore System usage	Annual growth, %	65%	2018	65%	2018	261%	2019	+196 p.p.	+196 p.p.
Awareness of P2P Carsharing	%	49%	2016	49%	2019	67%	2019	+18 p.p.	+18 p.p.
Awareness of integrated mobility services	%	N/A	N/A	N/A	N/A	26%	2019	N/A	N/A

Table 7: KPI Results.

C.3 Summary: achievement of objectives

The KPI results suggest that all three of the measure's objectives were met, and in particular that usage, in terms of bookings, easily met the objectives of the measure. However, the selected KPIs were not able to determine what kinds of trips were replaced, or whether they were entirely new trips, so the broader sustainability effects remain unassessed.

No.	Objective and target	Rating	Comment
1	Satisfaction of the MaaS Services	★★	High satisfaction with UbiGo, confirmed by another question about accessibility with UbiGo compared to a control group.
2	Awareness Raising	*	Awareness of P2P carsharing increased during the demonstration from 49% to 67%, but awareness of MaaS was only 26%.
3	Usage	★★	Usage of all three services saw very strong growth.
NA = Not Assessed O = Not Achieved in full * = Substantially achieved (at least 50%) ** = Achieved *** = Exceeded			

Table 8: Summary of Objective Achievement.

C.4 Up-scaling

An up-scaling of this measure has not been carried out. In essence it is already a city-wide measure, and the opportunities to grow exist mainly in integrating more mobility services and in engaging more car-owners to offer their cars in the peer-to-peer sharing services.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the **Process Evaluation Report** of this Measure.

D.1 Deviations from the original plan

Bike-share service – The City's procurement of a new generation of the municipal bike-share system, CityBike, has been delayed; therefore this has not been integrated into the platform

Peer-to-peer car-sharing – UbiGo has decided to put the integration of this kind of service on hold, since the p2p business model has unresolved challenges for how to handle contracts

D.2 Barriers

The following barriers were recognized during implementation.

No.	Barrier field	Description	Action to overcome the barrier
1	Cultural	It is always tricky to estimate the need for an unknown and until now not existing concept.	Some investigations have shown interest among consumers, but real willingness to participate is still unknown.
2	Positional	The business models making it possible to operate a MaaS service on commercial basis also remain to be proven.	The trial itself will help overcome this uncertainty in future projects.
3	Institutional	The current market conditions for expansion of shared mobility and new mobility concepts are not sufficient without either substantial risk capital, or exceptions and incentives provided by the municipality; yet, these are not allowed by national law.	The city must act responsively to innovators who have access to substantial risk capital, so that these few tests have a good chance of success. Even without financial incentives, the city can act as a facilitator.
4	Positional	The partners in this measure do not comprehensively represent the necessary actors for a MaaS-service. The most important, the Public transport operator in Stockholm, is not a partner in the project, which was a major problem in the first year of the project.	The fact that UbiGo was partner in Eccentric together with City of Stockholm however partly helped to get agreements for a pilot in place between them and Stockholm Transport. One-year pilot agreements with Stockholm Transport seem too short term to motivate service providers and investors to join the different MaaS startups. This is now also a conclusion from Stockholm Transport getting the same feedback from other MaaS pilots.
5	Organizational	When joining the project draft in 2015, UbiGo calculated with joint ventures to be able to build the service. (e.g. for technical platform and car sharing). However these joint ventures "vanished" during the period between application and the first six month of Eccentric, leaving the company both having to find new business partners and additional capital.	UbiGo has since set up another joint venture, but this caused substantial delays.
6	Problem-related	The current situation on the "new mobility market" in Stockholm and in Sweden, as elsewhere, is highly volatile, rapidly changing,	It pays to be as flexible as possible in the project plan.

		and unstable. The coverage, variation and competition between different suppliers of individual new mobility services is at the same time both insufficient and too high.	
7	Problem-related	Most actors, including probably all car brands and most major car rentals are experimenting with own and various mobility and sharing concepts and are currently in a learning phase. Without having insight in the latest annual accounts it is realistic to assume that most of them still have red figures or at least very small margins. The willingness to let their own services be sold by a third party, the MaaS-operator, seems currently to be very weak, or non-existing. This also leaves the business models for local and independent MaaS-operators unproven.	Again, the city must be responsive when an innovator has enough resources on its own to experiment in Stockholm.
8	Institutional	The legal framework for what role a Public Transport Authority can and cannot do in the field of MaaS engagement is partly unclear and open for interpretations, and partly restrictive.	Ambiguities in the legal framework should be clarified, and its opacity should be addressed by providing complementary guidance to potential operators.
9	Organizational	Until now, none of the existing, nor any of the in Stockholm emerging new car sharing initiatives, have been willing to join UbiGo. The only carsharing actor committed for UbiGo, DriveNow free-floating carsharing, unfortunately closed their operation by October 2018 in Stockholm (following their competitor Car2Go who left Stockholm 2016).	While no operator is willing to participate, the project must focus on other kinds of mobility services.
10	Problem-related	The contract for the Citybike system contracted by City of Stockholm ended 2017 and due to legal problems with the new procurement there is still no new contract, and hence no future operator for UbiGo to negotiate with. Currently (nov 2018) there is no official city bike system in place in Stockholm. The until recently old operator has not been interested to discuss with UbiGo due to uncertainty about their future engagement in Stockholm.	As long as the future procurement is unclear, there is little opportunity to integrate the CityBikes scheme.
11	Organizational	Private free-floating bike sharing systems were introduced in Stockholm during 2017 and 2018, recently also e-scooters and e-mopeds, and a third free-floating fully electric carsharing scheme launched October 2018. This has happened without city engagement and until now the City administration have no clear strategy on how to interact with this type of services. This has also hampered UbiGo somewhat in establishing cooperation with these actors.	The city can be more proactive in working with these new actors, which is probably necessary anyway to ensure the smooth interaction with other street users in the long-run.
12	Organizational	UbiGo decided to put integration of P2P-carsharing in the UbiGo offer and platform on hold, leaving SnappCar and GoMore to find other partners to be integrated with, if any.	
13	Involvement, Communication	None of the private partners in this measure is based in Stockholm and the two P2P-actors are not even based in Sweden, neither did they	The participants based elsewhere have in some cases increased

		initially have local representatives based in Stockholm. This made day-to-day cooperation much more challenging. Local representatives might also have a tougher task to get priority to local projects and to development of features that would give direct improvements in Stockholm but maybe not as obvious in the home market.	their presence in Sweden and Stockholm.

Table 9: Identified barriers and planned/taken actions.

D.3 Drivers

The following drivers were recognized during implementation.

No.	Driver field	Description	Action to make use of the driver
1	Cultural	SnappCar Facebook campaign became the most successful car acquisition campaign in the Nordics.	The City needs to maintain evidence of this success to ensure that other actors, and even current actors, are aware of the potential effectiveness of social media campaigns.
2	Institutional	The green parking standards, where the minimum parking requirements for new developments may be replaced with allocations for new mobility concepts, has awakened interest from developers, which can help the market prospects for shared mobility services.	The City departments responsible for new development should remain coordinated with the Department for the Environment, to ensure that these opportunities are communicated to developers.
3	Cultural	Providers of shared mobility solutions have found Stockholm to be an attractive location to test their services, due to IT infrastructure, high interest from the population, high smartphone penetration etc.	Swedish IT companies should be made aware of this comparative advantage in Stockholm to ensure that the benefits are counted in planning future IT infrastructure development.
4	Strategic/Political	Parking supply is being strategically decreased by the City and parking fees have increased, which increases the attractiveness of shared mobility as an alternative to private vehicle ownership.	Access to MaaS services should be highlighted as a potential positive outcome of these changes in parking policies.

Table 10: Identified drivers and planned/taken actions.

D.4 Supporting activities

No supporting activities were included in this measure.

D.5 Recommendations on the implementation process

Recommendations are specified in the final Process Evaluation Report, which was still under preparation during the finalization of this Measure Evaluation Report.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- Use of all three services increased substantially during the project
- Awareness of MaaS increased during the project
- Satisfaction with the UbiGo integrated mobility platform was high

E.2 Relevance of supporting activities

No supporting activities were included.

E.3 Interaction with other measures

This measure did not substantially interact with other measures.

E.4 Main lessons learned

Some of the lessons learned are as follows:

- Few users can lead to uncertain results; for UbiGo, for example, the survey responses were small, and moreover, even fewer participated in multiple waves of the survey so the responses in each wave are largely from different users.
- Curiosity is a key driver for early-adopters of the services.

E.5 Long term impact

The long-term impact is still highly uncertain, where there are potential implications on long-term behaviours such as household auto ownership and household locations to areas with lower public transport access.

E.6 Potentials for up-scaling in the city

While the services are already in essence city-wide, there remain potentials to scale them up in terms of which kinds of mobility services are offered and the level of engagement from car-owning individuals in the peer-to-peer services.

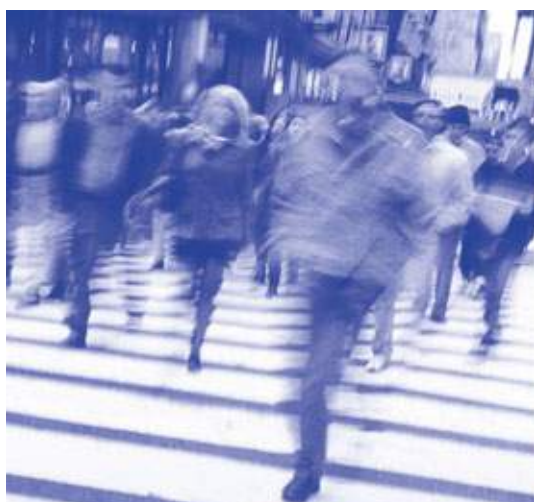
F. Additional information

F.1 Appraisal of evaluation approach

It is difficult to carry out a proper evaluation of a service that is still in the early stages of deployment. According to an evaluation report by Trivector, this is partly because it is difficult to implement a robust evaluation plan when the project is subject to delays and changes in the number of participants, recruiting methods, service characteristics, and incentives to participate.

F.2 Future activities relating to the measure

The UbiGo platform will continue to seek additional mobility services to integrate, and both SnappCar and GoMore will continue to grow into new regions and to increase the number of participants who offer their cars for rent.



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MUC 3.7

The App for the city lab Measure Evaluation Report

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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Christian Grundmann	

Table of Contents

ABSTRACT.....	608
A. INTRODUCTION.....	609
A.1 EXPECTED RESULTS OF THE MEASURE	609
A.1.1 Quantifiable impacts.....	609
A.2 MEASURE DESCRIPTION	609
A.2.1 Measure outputs.....	610
A.2.2 Supporting activities	610
A.2.3 Interactions with other ECCENTRIC measures.....	610
A.2.4 Interactions outside ECCENTRIC	610
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	610
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	611
A.5 IDENTIFIED RISKS	611
B. MEASURE IMPLEMENTATION	612
B.1 SITUATION BEFORE CIVITAS	612
B.2 INNOVATIVE ASPECTS.....	612
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	612
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	612
C. IMPACT EVALUATION FINDINGS	615
C.1 EVALUATION APPROACH.....	615
C.1.1 Expected impacts and indicators.....	615
C.1.2 Baseline.....	617
C.1.3 The business-as-usual scenario.....	623
C.2 MEASURE RESULTS.....	626
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	630
D. EVALUATION CONCLUSIONS	631
D.1 VALIDATED DIRECT IMPACT	631
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	631
D.3 INTERACTION WITH OTHER MEASURES.....	631
D.4 MAIN LESSONS LEARNED	631
D.5 LONG TERM IMPACT	632
D.6 POTENTIALS FOR UP-SCALING IN THE CITY	632
E. ADDITIONAL INFORMATION.....	633

E.1	APPRAISAL OF EVALUATION APPROACH	633
E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	633

List of Figures

Figure 1: Awareness of the app before the notification.....	617
Figure 2: Sources of information about the app <i>Luftlotse</i>	617
Figure 3: Willingness to download the app <i>Luftlotse</i>	618
Figure 4: Reasons for downloading the app <i>Luftlotse</i>	618
Figure 5: App functions of interest of the potential users	619
Figure 6: Willingness to change mobility behavior according to app suggestions	619
Figure 7: Number of cars per household, 2018.....	620
Figure 8: Modal Split of Living Lab residents, 2018	621
Figure 9: VKT by household (density plot), 2018	621
Figure 10: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)	622
Figure 11: Modal Split in Munich (2008+2017)	623
Figure 12: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)	625

List of Tables

Table 1: Quantifiable impacts.....	609
Table 2: Target groups or affected parties.....	610
Table 3: Measure stakeholders.....	611
Table 4: Risks.	611
Table 5: Emission Factors (HBEFA, 2017)	622
Table 6: Living Lab Emissions 2017	623
Table 7: Emission Factors (HBEFA, 2020)	624
Table 8: Living Lab Emissions 2020	625

Project	City		
ECCENTRIC	Munich		
Measure code	Measure name		
MUC 3.7	The App for the city lab		
Last update	Responsible	e-mail	telephone
30.10.2019	Christian Grundman	christian.grundmann@greencity.de	+49 (0)89 / 890 668-323

Abstract

The measure MUC 3.7 The App for the city lab aims to develop an app for the Living Lab which offers optimal routes with low degrees of air pollution for people walking or cycling. The app is called “Luftlotse - Der saubere Weg durch die Stadt” (- the clean way through the city) and integrates (among others) a routing function, information about the degree of air pollution in the direct surrounding and individual CO2 savings depending from the distance travelled by walking or cycling.

This Measure Evaluation Report shows the development of MUC 3.7 which was not always without problems due to several technical and content-wise adjustments which had to be done. A first version of the app was available on 30th September 2019. A first field test/evaluation took place in February 2020. About 11 people registered for the app but not many of them were willing to give feedback through the two online surveys which were conducted before and after the test launch.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measures' implementation and the ex-post data, which focuses on the impact of MUC 3.7.

Evaluation results for MUC 3.7 were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019), statistical data from the app's backend and a short online user survey which was conducted with the app users.

As there is an insufficient number of app users actually rating the system that there could not be a significant number of valid and representative results shown for the Baseline and After scenario. The backend data has been read out in 02/20 and showed a problem with delivering data for VKT and emissions.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- Promote sustainable, clean and efficient urban transport measures
- Testing new innovative measures in the Living Lab

(2) Strategic level:

- Enabling changes in the mobility behaviour of users by providing information about the current degree of air pollution as well as the impression of the user's individual carbon footprint

(3) Measure level:

- Create and implement an air quality monitoring system and a corresponding app that will:
 - o Reduce the individual car use by 10 percent at each user.
 - o Save over 30 tons of CO₂-emission (1.000 participants by a reduction of 10 percent from the German average 14.500 km p.a.)

A.1.1 Quantifiable impacts

Expected Impacts	The goal is to encourage users of the app (residents and employees in Domagkpark and Parkstadt Schwabing) to change their mobility behaviour by making them aware of their personal footprint and of air pollution. Expected effects are an increased (virtual) accessibility to mobility services, a modal shift towards more sustainable modes and a reduction in car use and car ownership. This might result in a reduction of transport-related emissions.	CIVITAS ECCENTRIC Objectives									
		Energy use, CO2 emissions	Reduce:				Improve:				
Air pollution	Road accidents		Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight	Local economy		
1	Awareness about the mobility services among app users										
2	Acceptance of the information provided by the app, and satisfaction with the services provided										
3	Mode shift towards more sustainable modes by app users										
4	Reduction of car ownership by app users										
5	Reduction of VKT by app users										
6	Reductions of CO2 emissions										
7	Reductions of NOx and PM emissions										

Table 1: Quantifiable impacts.

A.2 Measure description

There is a growing problem in several city centres regarding public health, which is air pollution.

This measure allows people to get around the city in a healthy and above all in a sustainable way. For this reason, an app has been developed; called: “*Luftlotse - Der saubere Weg durch die Stadt*” (- the clean way through the city).

The first version of the app has two main functions:

Firstly, users are able to check the air quality in their immediate surroundings. In order to make this possible a network of monitoring devices has been installed in the project area. Secondly, this information is integrated into the app's routing function, so that one may avoid areas with high degrees of pollution whilst cycling or walking. Yet, there are always offered two alternatives – the fastest and the cleanest.

In further steps, the advancement of the *Luftlotse* shall also include a more conventional mobility management tool for private users. Then, however, with an extended focus on sustainable local offers, such as the option of booking vehicles from different mobility stations, public transport, car-pooling and more.

The use of the app is expected to result in:

- The access to information about the current air quality.
- The ability to plan routes for cycling or walking with the lowest polluted air possible.
- A raised awareness amongst users about the relationship between one's own mobility behaviour and the environmental pollution/CO₂ emissions.
- An answer to the following question: Does knowledge about local air pollution and one's modal split/carbon footprint influence mobility behaviour?
- E.g. Do users choose the fastest and the cleanest route proposed?

A.2.1 Measure outputs

The output of the measure is a network of approx. 15 air quality measurement stations and a mobile app ("*Luftlotse*") for citizens, providing real-time information about air quality as well as routing for pedestrians and cyclists which takes the air quality into account.

A.2.2 Supporting activities

- Workshop to explore user needs in Domagkpark and Parkstadt Schwabing took place (05/2018).
- At least four information desks were held in the Living Lab (e.g. during the summer festivals in July 2017 and June 2018). The main aim was to make the *Luftlotse* known amongst inhabitants and find persons to host air quality monitors.
- During 2018, 3.000 postcards were distributed (in two waves) in the Living Lab. The aim was to make the "*Luftlotse-App*" known and find persons to host air quality monitors.

A.2.3 Interactions with other ECCENTRIC measures

Measure MUC 2.7 is hosting a website for the Living Lab and plays an important role in the procurement and implementation phase because they advertise the project. Thus, the website was also used to spread news about the *Luftlotse*.

Another interaction is with measure MUC 6.3 the ACM "electric-light-weight-vehicle", led by Green City Experience GmbH, a sister of Green City e.V. Events where the ACM vehicle is displayed and tested, the "*Luftlotse-App*" is advertised via posters and information material.

A.2.4 Interactions outside ECCENTRIC

The measure is cooperating with external companies and it is planned to work closer together with mobility service providers for integrating more mobility features into the app.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents	Living Lab	Domagkpark + Parkstadt Schwabing

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	Green City e.V.	P	NG	L	ML
2	Domagkpark eG	P	NG	O	Contacts to residents
3	Nachbarschaftstreff Parkstadt Schwabing	S	NG	O	Contacts to residents
4	MVG	P	PT	O	Interface to PT information
5	Netzinkubator Software GmbH	S	PR	L	App development
6	Hawa Dawa UG	S	PR	L	Measure devices
7	Residents with space for measure devices	S	Other	O	Volunteers for air quality measurement
8	Users	S	Other	O	App users
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Not enough app users	Involvement	The call for bids contains a section, where tenderers are challenged to depict additional functions (of gamification e.g.) which should be implemented, if there are not enough users.	ML
Obligate relevant providers of mobility services	Involvement	Fortunately, for every mobility service in Munich, there are at least two providers. So, parallel negotiations with different providers started, which offer the same service in order to have an alternative at hand.	ML

Table 4: Risks.

B. Measure implementation

B.1 Situation before CIVITAS

Residents of the Living Lab do neither have access to information about air quality in their neighbourhood, nor are they aware of their own contribution to air pollution and air quality. Information and digital incentives to encourage sustainable travel behaviour are not present. And there is also no app, that integrates all mobility offers that are relevant for inhabitants of the city lab.

B.2 Innovative aspects

New conceptual approach

In this measure, a new concept of a direct feedback between mobility behaviour and emissions (both global and local) in regard of its influence on mobility decisions is explored.

Use of new technology

Innovative air quality monitors are combined with a new smartphone application for the Living Lab. When the measure started, many different low-cost measuring devices were known, monitoring only one indicator concerning air quality (like particulate matter). On the other hand, there are really expensive and complex monitoring stations on the municipal side. The devices, used for the measure were a new compromise between costs and complexity of measuring system.

B.3 Research and Technology Development

Subcontractors are responsible for the deployment of air quality monitors to private households (facing outside) and app development.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning

Fundamental changes were made regarding the measurement during the planning phase. Initially the app concept was called "*CityLifta*" and was about "fly ridesharing". Which means that during a journey, drivers would get requests to pick up additional passengers with similar destinations.

A corresponding software solution was already used in 2016, near Frankfurt and Darmstadt. The intention of the project was to introduce this idea to CIVITAS ECCENTRIC's Living Lab in Munich and adjust it to a neighbourhood-orientated ride sharing app.

However, the company owning the software and that would have also been responsible to develop the adjusted version, dropped out due to essential changes in their business model in autumn of 2016.

As a result of the re-orientation of this measure, a new aim was drafted: How does knowledge about environmental parameters influence the behaviour of the Living Lab's inhabitants concerning mobility?

Or generally speaking, bringing together questions regarding air pollution and the planning of mobility. In order to resolve this inquiry, real-time air quality information should be made available for citizens to be a contributing factor in route planning for pedestrians and cyclists.

After all, new partners were found and the measure's concept was re-written almost entirely whilst the project was already running. The official amendment was approved in April 2017 and since then, a new concept has been developed:

- The start of a participation process with the Living Lab inhabitants to get to know their requirements for the app was in March 2017.
- Additionally, two network meetings occurred in Domagkpark and Parkstadt Schwabing. ML took part in a workshop of LHM München about establishing measuring grids for air quality. Also at Domagkpark's summer festival (summer 2017) an info booth was offered, where inhabitants could write down their proposals concerning the functions of the app.
- Meetings and negotiations with different potential partners were held to provide interfaces for the app (e.g. Munich's provider of public transport). There was a positive outcome.
- In September 2017, the subcontractors were selected:
 - o Hawa Dawa UG is responsible for the implementation of the measuring grid,
 - o Netzkubator Software GmbH is responsible for the software engineering.
- A kick-off workshop with all partners was held on the 5th of October in 2017.
- Corresponding contracts for subcontracting with all partners were signed in December 2017/January 2018.
- Therefore, the drop out of the initial partner and the discard of the first app idea led to a delay of at least one year.

Phase 2: Procurement & Implementation

- A detailed testing was held in 12/2017 in order to develop a good user interface for essential functions of the app, such as route planning
- The development of the corporate identity (logo, colour world, general design of interface) reached beta phase in 03/2018.
- An online call (via several newsletters of institutions in the Living Lab) was released on February 21st to attract residents to install one of the needed monitors to measure air quality:
 - o Inhabitants of the Living Lab are now able to register as a host for one of 15 air quality monitors. Fortunately, the feedback was quite high, there were already enough replies to distribute every device.
- However, the subcontractor wanted to await further confirmations in order to make a sophisticated choice for the best arrangement of the devices in the Living Lab, which is essential for a reliable display of the air quality in the app's heat map.
- The first air quality monitor was installed in the Living Lab on the 23rd of February 2018 and it has been working since.
- As of 11/2018, four monitors were installed in the Living Lab (8 are necessary for the heat map generation)
- The app is currently in a close-to-final beta phase with the following functions:
 - o Air quality monitoring and visualization
 - o Routing for pedestrian and cyclists
 - o Calculation of a CO2 footprint
- First internal testing has been completed in 09/2019
- Although many people showed interest in hosting an air quality monitor at first, the quota of people who really installed a device in the end was very low.
- Already throughout 2018, it was identified that only few people actually become hosts of a device in the end.

- As a reaction several actions were taken to acquire more interested parties:
 - o Three thousand postcards in purpose of acquisition were printed and distributed in the Living lab.
 - o Furthermore, posters were hung up in the Living Lab, as well as the implementation of several information stands at other CIVITAS Eccentric events or in front of supermarkets or close to the Tram-Station.
 - o Moreover, cooperating organisations (Domagkpark Association and Nachbarschaftstreff Schwabing) integrated the call to host a measuring device in their newsletter.
- There are two possible major reasons why the acquisition of hosts proved difficult:
 - o Primarily the people's interest in monitoring air quality was overestimated and
 - o secondly, the whole procedure from signalling interest in being a host to the final installation is too complex.
- Yet, possibilities to change this relevantly were not identified. For example, one of the sticking points was the signing of the contract that regulates the hosting, however it is an indispensable document as it handles issues of insurance etc.

Phase 3: Operation

- Contrasting the original plan to release the app in spring 2019, negotiations with the City's Department for Public Health and Environment ("HE") resulted in a preliminary stop of the app's rollout. Although, they were informed about the measure at least in 2018.
- The agency raised questions about the reliability of the interpolation between a low number of monitors and the extrapolation for the entire city.
- Even though HE has no formal power to block the rollout, ML decided to maintain a good cooperation and work together on a solution that works for all involved parties.
- Initially, the different air quality monitors were planned to be distributed within whole Munich. In order to increase the density of measurement points and the reliability of the resulting heat maps of air quality, the decision was made that further devices should only be installed inside the Living Lab.
- This compromise resulted in The City of Munich's support of measure MUC 3.7. Currently, representatives of the City's Department for Public Health and Environment even can imagine to support a roll-out citywide (even beyond the end of CIVITAS ECCENTRIC). Therefore, the City's HE department allows measuring devices to be installed in public spaces, not only on private property of Domagkpark residents. This is a very important perspective the ML wants to obtain.
- Currently they are looking for suitable locations to install the monitors in public space. Possible locations have to be reviewed by all relevant stakeholders. This process is still ongoing and will take time.
- Seven monitors are installed in private property of Living Lab residents.
- In 02/2020 the app was launched conditionally with regard to the reliability of the data which is shown through the app. A first field test runs about two weeks from 04.02.20-18.02.20.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Awareness	Acceptance	Satisfaction	Mode shift	Car ownership
Type	KPI	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	SOCIETY-PEOPLE	SOCIETY-PEOPLE	TRANSPORT SYSTEM	SOCIETY-PEOPLE
Subcategory	Acceptance	Acceptance	Acceptance	General	Accessibility
Aspect	Awareness level	Acceptance level	Satisfaction	Modal split	Physical accessibility to transport services
Definition	Percentage of residents with knowledge of the App and its functions	Perception and acceptance of the App	User/provider/stakeholder average reported satisfaction with the service/performance of the App.	Percentage of users who permanently changed modes for the same trip (same origin and destination, time, and frequency). The main mode of a trip is that used for the longest stage of the trip by distance. For instances with stages of equal length, the mode of the last stage is used.	Cars owned per 1000 inhabitants of the populations aged 18 and over (with driver's license?)
Unit	Percentage	Percentage	Score (0-5)	Percentage (various values)	Cars to inhabitants ratio
Method of data collection	Survey of Domagkpark residents (baseline, follow-up) and focus groups	Survey of Domagkpark residents (baseline, follow-up) and focus groups	Two short surveys to be answered directly through the app (or link from the app) in order to evaluate satisfaction and to improve the app if necessary.	Survey of Domagkpark residents (baseline, follow-up) and focus groups	Survey of Domagkpark residents (baseline, follow-up) and focus groups
Target group	Living Lab residents	Living Lab residents	App users	App users	App users

Impact	6	7	8	9
Indicator	VKT	CO2 Emissions	NOx emissions	PM emissions
Category	KPI	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ENVIRONMENT	ENVIRONMENT	ENVIRONMENT
Subcategory	General	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance
Aspect	Total Travel	Emissions	Emissions	Emissions
Definition	Kilometers traveled by App users	Total CO2 emissions produced by App users	Total NOx emissions produced by App users	Total PM emissions produced by App users
Unit	Kilometers	Tons	Tons	Tons
Method of data collection	Baseline and followup surveys and processing of tracking data such as VKT by mode, trip length, travel time	Estimation based on VKT (or PKT) and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) and average emission factors for the different transport modes available in the area
Target group	App users	App users	App users	App users

Impact	INPUT	INPUT	INPUT
Indicator	System Usage	Investment Costs	Operating Costs
Category	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ECONOMY	ECONOMY
Subcategory	General	Costs	Costs
Aspect	Transport System utilization	Investment costs	Operating Costs
Definition	App users per hour, day, week, month and year.	Total capital costs for purchase of equipment related to running the App. Preparation and design cost is defined as total costs expended setting up the measure covering a time period from the initiation of the measure preparation until the start of the measure implementation.	Personnel and maintenance costs for running the App per time period
Unit	(-)	Euro	Euro / (time or usage unit)
Method of data collection	Processing of system statistics: number of users, app server requests, mobility services used, successful car-pooling matches.	Data from financial reports, controlling	Data from financial reports, controlling
Target group	App users		

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	I – A	S	Living Lab population	Living Lab
2	Acceptance	%	I – A	S	Living lab population	Living Lab
3	Satisfaction	Score (0-5)	I – A	S	Users	Living Lab
4	Mode Shift	%	B – A	S	Users/ Living Lab population	Living Lab
5	Car Ownership	Cars-to-inhabitants ratio	B – A	S	Users/ Living Lab population	Living Lab
6	VKT	Km	B – A	S	Users/ Living Lab population	Global
7	CO2 Emissions	Tons	B – A	E	Users/ Living Lab population	Global
8	NOx Emissions	Tons	B – A	E	Users/ Living Lab population	Global
9	PM Emissions	Tons	B – A	E	Users/ Living Lab population	Global
	System Usage	App users/time	I	DC	Users	Living Lab
	Investment Costs	€	A	DC	Measure	Measure
	Operating Costs	€	A	DC	Measure	Measure
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

C.1.2 Baseline

The baseline was conducted as a household survey which was addressed to all 3.100 households within the Living Lab (Domagkpark and Parkstadt Schwabing). The survey took place from 04/2018-05/2018. The participation rate was 27%, what means that 935 people from 572 households answered the online survey or participated via telephone.

Additional Baseline data was collected by the ML at the subcontractor who is developing and monitoring the actual app. The app's backend promised to deliver information about system usage, VKT and saved CO2 emissions. The backend data has been read out in 02/20 and showed a problem with delivering data for VKT and emissions.

Another source of data was provided by a short user survey which was conducted with the potential app users as an online survey. The link of the online survey was spread via different channels: the news section on the community portal www.domagkpark.de, the ML's institutions website and various social media channels. The baseline survey took place for two weeks in 02/20. 17 potential app users answered the survey.

Addressing Indicators "1 – Awareness", "2 – Acceptance", and "3 – Satisfaction"

Among the participants of the smaller user survey of the app *Luftlotse*, the **Awareness** was even before the notification of the app release relatively high (see [Figure](#)).

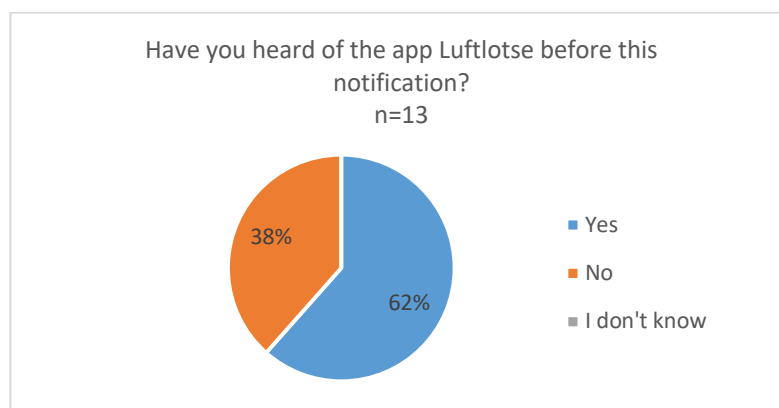


Figure 1: Awareness of the app before the notification

About two-third of the participants answered to have known of the app *Luftlotse* in advance. According to [Figure](#) , the sources of this prior information have been different.

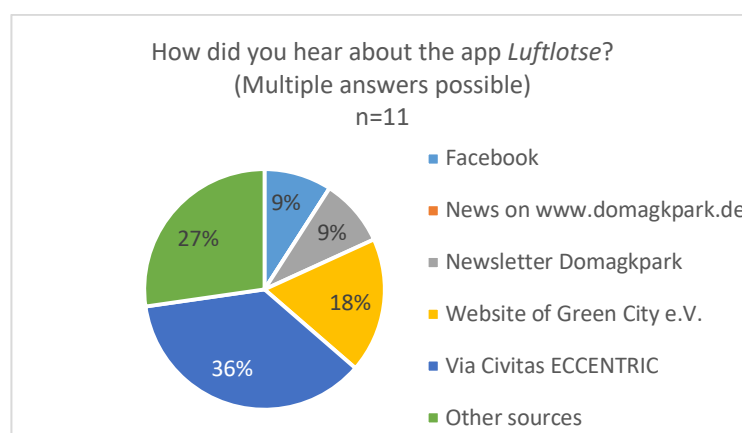


Figure 2: Sources of information about the app *Luftlotse*

Most of the participants answered to have heard about the app *Luftlotse* via the project Civitas ECCENTRIC (36%) and other unspecified sources (27%). It is to assume that among these other sources can be found the Instagram channel of Green City e.V. and their newsletter. 18% answered to have heard about the app via the executing institution of this measure, Green City e.V. Having heard about the app via Facebook or the Domagkpark newsletter, responded 9% in each case.

The **Acceptance** of the measure is shown by the Willingness to download the app, as a first step (see [Figure](#)).

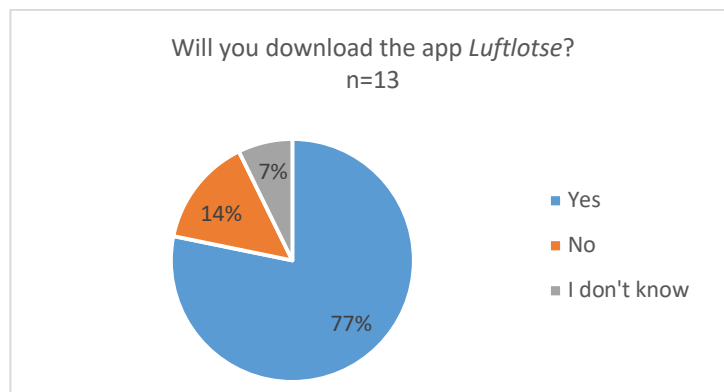


Figure 3: Willingness to download the app *Luftlotse*

The huge majority (77%) of the survey participants answered to be willing to download the app. Only a minority of 2 participants (14%) answered not to plan to download the app. One person (7%) had still not decided on that question.

The reasons why the participants want to download the app and thus, what they expect from the app are given in [Figure](#) .

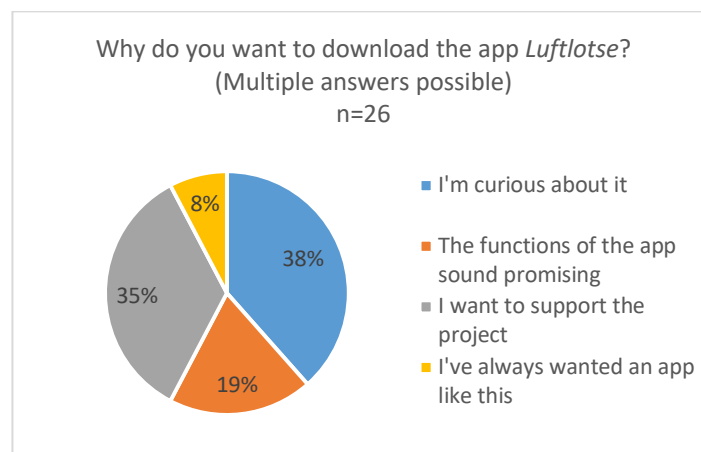


Figure 4: Reasons for downloading the app *Luftlotse*

Most participants (38% of responses) chose the answer, to be curious about the app, as reason for downloading it. Also, often chosen (35%) was the answer to want to support the project behind the app. 19% of the answers referred to the functions, which sound promising to the users. Only a smaller share of the chosen answers (8%) shows the wish of the participants to always have wanted such an app.

Only four participants assigned a reason for not downloading the app, each of the possibilities no time, no interest, no android phone and other reasons were chosen by exactly one person.

The functions and information of the app, participants would like to use, are shown in [Figure 5](#).

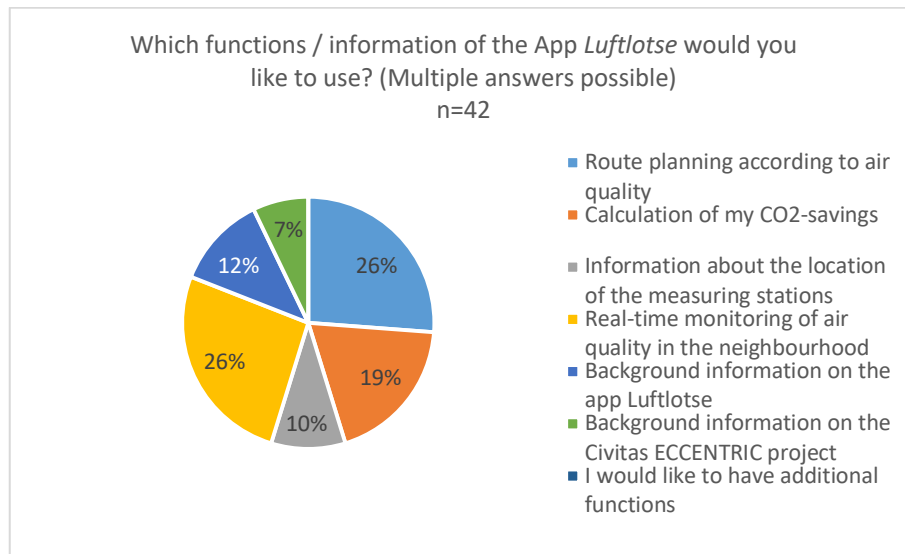


Figure 5: App functions of interest of the potential users

The participants state to be highly interested in the function for route planning according to air quality and the function for monitoring the air quality in the neighborhood (each 26% of responses). Another popular function is the calculation of the own CO₂-savings (19%). Less interest is stated regarding the background information of the app (12%) and of the Civitas ECCENTRIC project (7%), which does not surprise since many other options exist to observe this information. 10% of the responses show the interest in the location of the air quality measuring stations. Need for further functions (0%) is not given according to the participants.

The final goal of the app *Luftlotse* would be, to show the users a path with good air quality and thus protect their health while walking or cycling in the Living Lab. Therefore, also the willingness of the users to change the daily ways according to the suggestions of such a virtual consultant is required. According to [Figure 6](#), this willingness is existent in general.

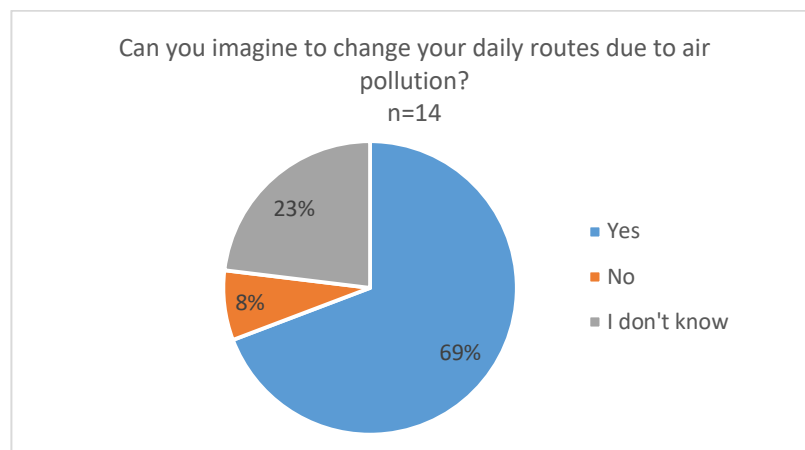


Figure 6: Willingness to change mobility behavior according to app suggestions

69% of the participants are willing to change their daily ways according to suggestions of the app. Only 8% exclude this possibility. 23% did not want to decide on this question, yet.

The KPI **Satisfaction** with the measure cannot be assessed before the measure is put into practice.

Mobility behavior of the target population

Addressing indicators "4 - Mode Shift", "5 - Car Ownership", and "6 - VKT"

Car ownership in the Living Lab was obtained with the first household survey in 05/2018. With 0.92 cars per household the car ownership rate is equal to the city-wide average of 0.9 (cf. infas, 2010).

In detail, around 25% of the 572 answering households are car-free, 60% do have one car and only few have 2 or more (Figure 7). This data is retrieved from the first household survey in 05/2018).

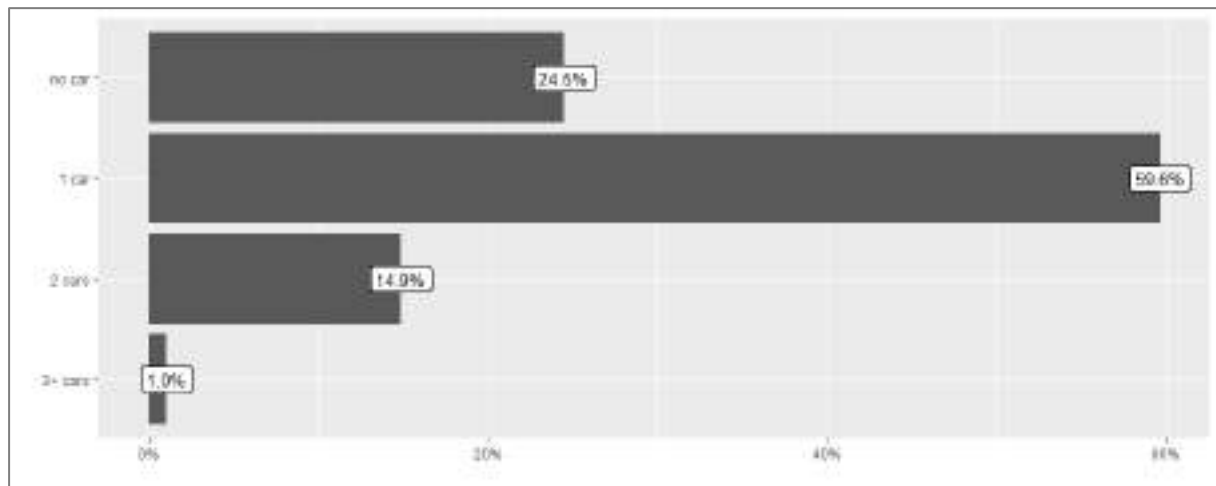


Figure 7: Number of cars per household, 2018

The Living Lab population is with 4.24 trips per day and person on average more mobile than the German average of 3.1 (infas, 2018).

The **modal split** (trip-based) of this group is visualized in Figure 8, based on the answers of 935 persons who reported about 3967 trips in April/May 2018 as part of the ECCENTRIC household survey.

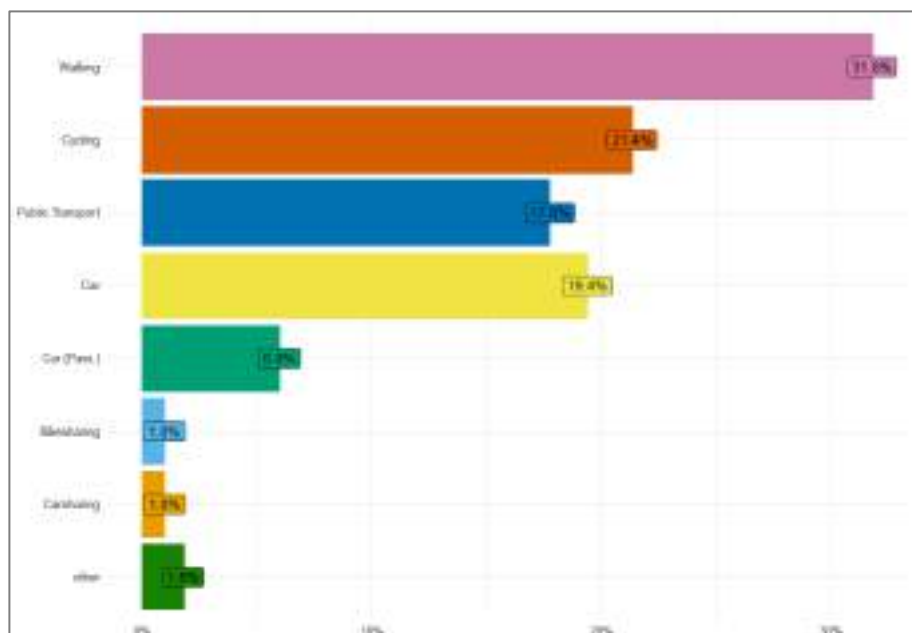


Figure 8: Modal Split of Living Lab residents, 2018

The average **VKT** per household (including also those without a car) is at 9.809 km per year (see [Figure](#) for the distribution), summing up to a total VKT in the Living Lab (3.100 households) of approx. 30.4 million VKT per year. This data was obtained with the household survey in 05/2018.

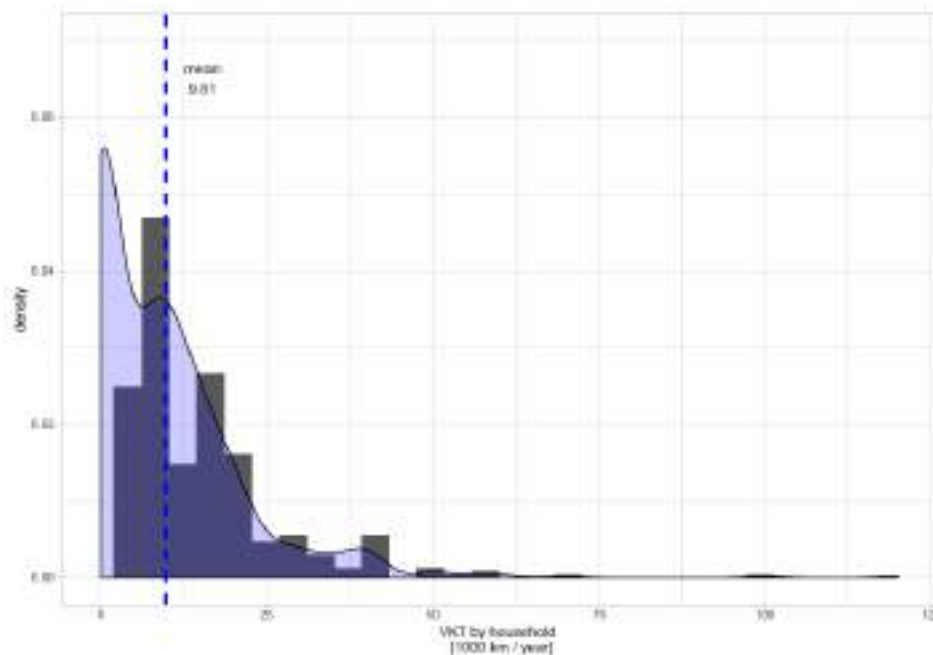


Figure 9: VKT by household (density plot), 2018

Transport-related emissions

Addressing indicators "7 - CO₂ Emissions", "8 - NO_x emissions", and "9 - PM emissions"

Emissions are calculated based on emission factors from the standard database "HBEFA" (*Handbook Emission Factors for Road Transport*) and information about both VKT and the vehicles in the Living Lab. See [Table](#) for the used factors, based on the German fleet average.

The number of hybrid/electric cars is too low to be considered as a separate category.

In 2017 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

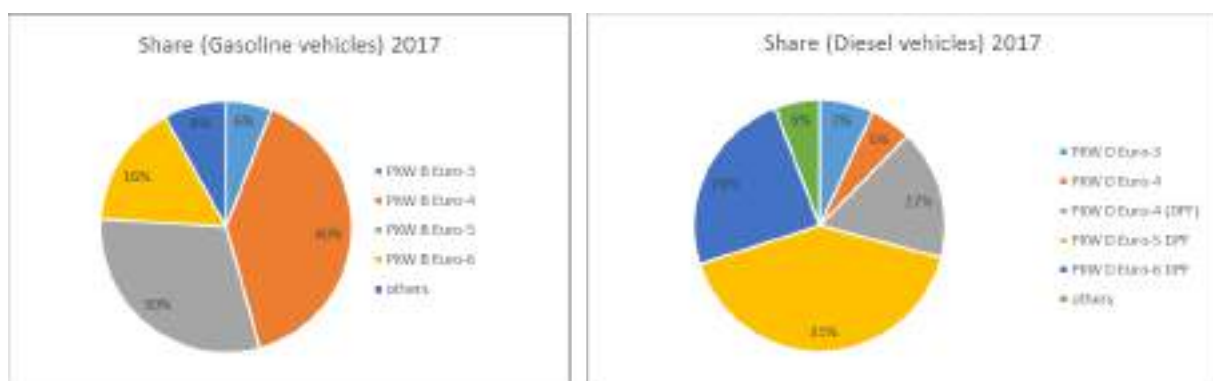


Figure 10: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)

The highest share among Gasoline vehicles consists of Euro 4 (40%) and Euro 5 (30%), followed by Euro 6 (16%). Regarding the Diesel vehicle share, there are 41% Euro 5 and 24% Euro 6. Euro 4 has a smaller share of 17%.

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	127,837 g/km
NO _x	Gasoline	0,060 g/km
PM	Gasoline	0,00102 g/km
CO ₂	Diesel	118,911 g/km
NO _x	Diesel	0,589 g/km
PM	Diesel	0,00675 g/km

Table 5: Emission Factors (HBEFA, 2017)

The following calculations are based on the HBEFA factors of 2017 and the annual VKT kilometres, differentiated by car type (first or second car) and fuel type (gasoline or diesel). The number of kilometres is then multiplied with the HBEFA factors and number of cars mentioned in the household survey (conducted in 05/2018).

Thus, the total annual emissions (based on VKT) for all 3.100 households in the Living Lab sum up to the following totals:

Pollutant	Emissions (2017)	Emissions/ household Living Lab (2017)
CO ₂	3.864 t	2.415 kg
NO _x	10,22 t	6,39 kg
PM	122,25 kg	76,41 g

Table 6: Living Lab Emissions 2017

Data on **investment and operational cost** was obtained for the ex-post evaluation when the implementation phase was completed.

C.1.3 The business-as-usual scenario

For **Awareness, Acceptance, and Satisfaction**, measurement is only possible when the measure is implemented.

Car Ownership does not show big changes on the nationwide level (2002-2008-2017), while the ratio cars per inhabitants in the relevant part of the city ("between middle ring road and city boundary") has been decreasing slightly over the last 10 years, from approx. 430 cars per 1000 inhabitants in 2005 to 412 in 2015 (-1%). However, for the reporting period until 2020 stable conditions are expected.

Mode Shift & VKT

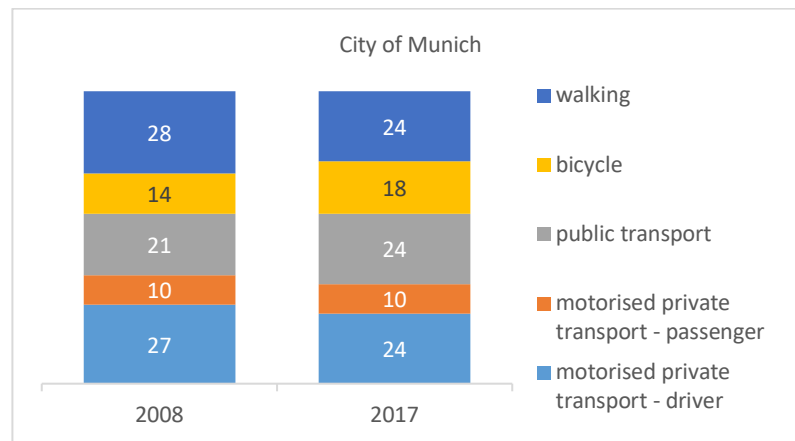


Image: City of Munich, Data: infas edited (2018)

Figure 11: Modal Split in Munich (2008+2017)

The nationwide mobility survey "Mobilität in Deutschland" acts as a reference to determine trends and future mobility behaviour in Munich.

In general, the Munich population drives less and walks less, while PT and cycling increase over time (see [Figure](#) : change 2008-2017: car -3%, PT +3%, cycling +4%, walking -4%). Extrapolating this trend from 2008 to 2020, the following mode shifts in the BaU Scenario for 2020 can be assumed:

Car: -1%; PT: +1%; Bike: +1%; Walking: -1%

These changes are reflected in VKT as well, so that the VKT is expected to decrease by 1% as well, being cautious because nationwide, the km per vehicle are slightly decreasing (2017: -0,7%, Kraftfahrtbundesamt (2018)).

Note: A recent study by the Center Automotive Research (CAR) of the University of Duisburg-Essen published in 12/2019 that the number of cars is constantly increasing within the last ten years in Germany's larger cities. Comparing the number of cars from 2009 until 2019, there is an increase of 18,5% in car ownership measured in Munich (cf. CAR, 2019). This resembles a different trend than expected above in the BaU scenario assumptions of 2018.

Emissions

In order to estimate BaU-emissions, the HBEFA projected emission factors for 2020 as well as the by 1% increased VKT, that was assumed in the section "Mode Shift & VKT", are used.

Thus, the following factors are used:

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	117,785 g/km
NO _x	Gasoline	0,049 g/km
PM	Gasoline	0,00108 g/km
CO ₂	Diesel	110,410 g/km
NO _x	Diesel	0,484 g/km
PM	Diesel	0,0045 g/km

Table 7: Emission Factors (HBEFA, 2020)

In 2020 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

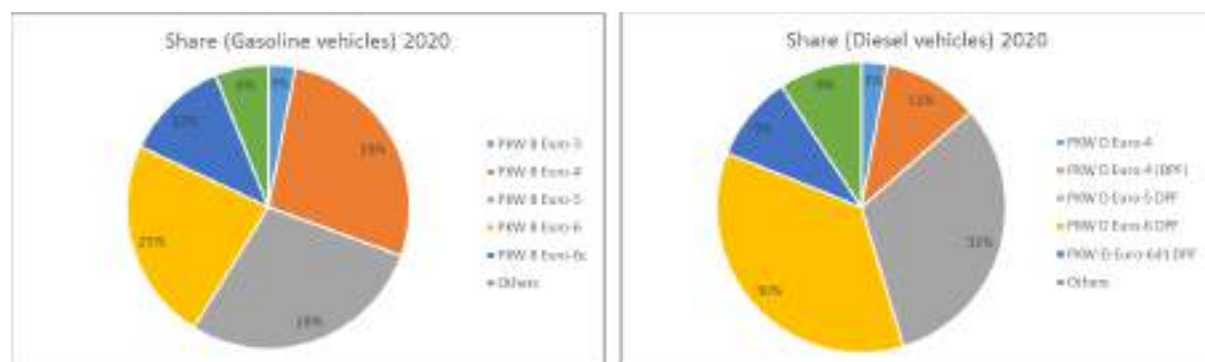


Figure 12: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)

Regarding the Gasoline Euro classes in 2020, there are about two-thirds of all Gasoline vehicles to be found with Euro 4 (28%), Euro 5 (28%) or Euro 6 (23%). The share of Diesel vehicles is similar but compared to HBEFA 2017 assumptions, Euro 6 has the biggest share in 2020 (36%, 24% in 2017).

Note: These emission factors assume technological progress and a renewal of the average fleet in Germany until 2020. In the light of "*Dieselgate*" and great uncertainties in the accuracy of emission information by the car manufacturers, the HBEFA assumptions have to be verified. New HBEFA assumptions are to be published in the end of 2019 (after MER2).

This results in the following emissions for 2020:

Pollutant	Emissions (2020)	% change to 2017
CO ₂	3,610 t	-7%
NO _x	8,49 t	-17%
PM	88,76 kg	-27%

Table 8: Living Lab Emissions 2020

C.2 Measure results

The following table shows the measure results of MUC 3.7. In some cases, the Business as Usual scenario is valued as not assessed (NA) because there would not be any other developments without the implementation of this measure. The After scenario is valued as not representative as there were too less answers of the app users regarding the KPIs.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	62%	02/2020	NA	-	Not representative	02/2020	NA	NA
Acceptance	%	77%	02/2020	NA	-	Not representative	02/2020	NA	NA
Satisfaction	Score (0-5)	NA	-	NA	-	Not representative	02/2020	NA	NA
Modal Split/ Mode Shift	%	Modal split: Walking: 31,8 Cycling: 21,4 PT: 17,8 Car (Driver): 19,4 Car (Passenger): 6,0 Bikesharing: 1,0 Carsharing: 1,0 other: 1,8	05/2018	Modal split Munich: Walking 23% Cycling 19% PT 25% Car: 33%	2020	NA	-	NA	NA
Car Ownership	%	No car: 24,5 1 car: 59,6 2 cars: 14,9 3+ cars: 1,0 →0,92 cars/household	05/2018	Overall: -1%: No car: 28,2 1 car: 58,4 2 cars: 9,7 3+ cars: <0,7	2020	NA	-	NA	NA
VKT	km/ year	9.810 km/year/ HH 4,89 million km/ year/ Living Lab	05/18	-1%	2020	NA	-	NA	NA
CO2-Emissions	tons	3.864	2017	3.610	2020	NA	-	NA	NA

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After–BaU
NOx-Emissions	tons	10,22	2017	8,49	2020	NA	-	NA	NA
PM-Emissions	kg	122,252	2017	88,755	2020	NA	-	NA	NA
System Usage	#app-users/ time	0	02/2020	NA	-	11/two weeks	02/2020	+11/ two weeks	NA
Investment Costs	Costs related to people and their time period:					Costs of equipment:			
	trainers (workshops)	4073,69 01/2016-09/2019				infrastructure	470,82 team software for the year 2018		
	program and web developers	97.398 01/2018-09/2019				material	584,37 01/2016-09/2019		
	design/UX/UI	12.872,80 12/2017-09/2019				marketing campaigns	split over trainers and material		
	roll-out , measure grid	16.946 01/2016-09/2019				legal support	17953,72 01/2016-05/2019		
Operating Costs	software maintenance cost	790€/month (on hold, as app is currently not running regularly)							
	marketing campaigns	1.000€/year							

The following ex-post data was obtained from the following data source:

- Short user survey conducted after two weeks of testing the app (02/2020). 2 of 11 users participated which sums up a participation rate of 18%. Those 11 persons were the ones which left their e-mail address for the second after-survey. Due to the very low response rate of only two survey participants (where only one participant answered all the questions), the following results are not at all representative and therefore there are no graphs or diagrams to show the distributions.
- Interviews with the ML

Addressing Indicators "1 – Awareness", "2 – Acceptance", and "3 – Satisfaction"

The **awareness** and **acceptance** level of the app is quite low when looking at the number of users who registered for the app. There were in total 11 people registered for the app within the two weeks. This number is retrieved from the backend through the app developer (02/2020).

The score for the KPI **satisfaction** cannot be evaluated because there were too less people answering the questions in the after survey. There was only one person who rated the app, this does not give a representative picture to rely on.

Addressing indicators "4 - Mode Shift", "5 - Car Ownership", and "6 - VKT"

Indicators could not be assessed in the after-scenario due to several delays of the app launch and communicative difficulties with the subcontractor which did not deliver the backend data which was promised beforehand.

Addressing indicators "7 - CO2 Emissions", "8 - NOx emissions", and "9 - PM emissions"

Indicators could not be assessed in the after-scenario due to several delays of the app launch and communicative difficulties with the subcontractor which did not deliver the backend data which was promised beforehand.

Addressing indicators "System usage"

The system usage is very low with only 11 registrations within two weeks after the launch. One major reason for this can be found in the fact that the app is only available for Android users and not for the iOS. Some other potential app users stated that they had difficulties with the registration process itself and did not receive a confirmation link via e-mail.

Addressing Indicators "Investment costs" and "Operational costs".

As measure MUC 3.7 contains an app development from scratch, the biggest share of costs occurred as **investment costs**. Program and web developers (97.400 Euro) as well as the roll-out and measure grid (16.950 Euro) were two of the biggest parts regarding the costs. The topics design and user experience took another 12.870 Euro. The named costs listing refers to a period from 2016/2017 until 02/2020. Due to the fact that there is a new app developed, there was additional legal support needed which accompanied the project from the beginning, especially having an eye on general regulations regarding apps and data protection topics. As a foreseen subcontractor dropped out in the beginning, a new tendering process had to be carried out. The whole work process with the subcontractor responsible for software development turned out to be quite complex, which made it necessary to create an additional

contract and having more legal support than expected. These are the reasons, why the costs for legal support are quite high (17.954 Euro). Once the app development is finished the **operating costs** are on a relatively low level. There are 790 Euro per month software maintenance costs and marketing costs about 1.000 Euro per year planned.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Promote sustainable, clean and efficient urban transport measures.	★	In general, the app does contribute to these objectives. It offers an app which focuses on a clean and efficient urban transport and promotes modes like walking and cycling.
2	Testing new innovative measures in the Living Lab.	★	The app is a new innovative measure in the Living Lab which underwent a first field testing in 02/2020. There have been many delays due to several adjustments which had to be done during the project lifetime.
3	Enabling changes in the mobility behaviour of users by providing information about the current degree of air pollution as well as the impression of the user's individual carbon footprint.	★	The app potentially enables changes in the mobility behavior with the help of showing the air pollution degree of a route within the Living Lab.
4	Reduce the individual car use by 10 percent at each user.	NA/ O	In fact, it is to assume that no changes occurred because there were too less people using the app and there was not too much time to test the app. In addition to that, mobility behavior is something which does not change within such short period.
5	Save over 30 tons of CO ₂ -emission (1.000 participants by a reduction of 10 percent from the German average 14.500 km p.a.).	NA/ O	This saving of CO ₂ emissions cannot be calculated for this specific case of MUC 3.7. In general, the app is able to show the individual CO ₂ savings according to the distance traveled. In the end there were too less people using the app that there could be emissions savings to be observed.
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded			

D. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

- First of all, the measure managed to provide a downloadable and usable app.
- No validated impact on most of the KPIs like satisfaction, mode shift or car ownership as number of users and duration of field test was too low/short.
- Due to several marketing activities awareness for sustainable mobility and air pollution was risen.

D.2 Relevance of supporting activities

- A workshop to explore the user's needs concerning functions of the app was very relevant and helpful to see where to place the focus in software development.
- The efforts in marketing activities to acquiesce hosts of air quality monitors was very high (at least four info desks, newsletter dispatch, and distribution of 3.000 postcards) only led to 29 interested persons and 7, who finally installed a device).

D.3 Interaction with other measures

- Relevant steps during project lifetime were communicated on the website for the Living Lab (MUC 2.7). However, the impact was quite low, e.g. no testers for the app was derived from the corresponding article on the website (see [Figure](#) , p.617).
- The interaction with measure MUC 6.3 was quite fruitful. As the “electric-light-weight-vehicle” was shown at events, the *Luftlotse* was presented as well via posters and information material. Here a higher interested was noticeable. Direct acquisition of hosts for air quality monitors happened. A possible explanation is, that already the main event attracted people, interested in sustainable mobility. So maybe marketing actions of several, closer related measures should be bundled.

D.4 Main lessons learned

- The major lesson learned was, that the intended citizen participation did not work well. For example, the process to host an air quality monitor was too complex. Many potential private hosts dropped out, when a contract had to be signed. However, this was unavoidable. It is one example among others, that a quite elaborate process like the setup of a measure grid across a whole district should not be tackled depending on private households. An institution from the municipal side should be partner from the beginning to provide infrastructure and suitable spots in public space to install measuring devices. Only a quite low engagement amongst the inhabitants of the Living Lab in general was perceived. E.g. only five persons took part in the workshop about the app's functions. In future projects one should be aware, that an easy process of participation cannot be taken for granted. Sufficient resources in time and money should be provided for that.
- Agile project management (concerning development of new software) can be quite challenging. In particular, if it is done via subcontracting. The controlling must be really strict.

And the specifications for each new sprint/step must be as detailed as possible. If this is not the case, misunderstandings are very likely to happen. If it is already clear on beforehand, that the software development will be quite complex and demanding, a well-known company might be the better choice than small start-up with resources difficult to judge.

D.5 Long term impact

- Awareness about air pollution raises in the Living Lab.
- Changes in mode shift are possible (because digital incentives about CO₂-savings work).
- Profound feedback from more users after a longer runtime can lead to further development of the app and higher degree of acceptance and satisfaction.
- Continuous improvement of the product might also attract new stakeholders.

D.6 Potentials for up-scaling in the city

- The City's Department for Health and Environment has offered help to expand the measure grid in the Living Lab to meet their standards about measuring air quality (concerning number of monitors and density of the measure grid/measuring points).
- If a larger-scaled field test of the app working on the basis of an extended measure grid shows promising results (in terms of user acceptance and technical aspects), the City of Munich considers it to be possible to bring the *Luftlotse* also to other districts.

E. Additional information

E.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

Evaluation work was strongly dependant from several delays which occurred during the measure development and implementation process. The subcontracted agile software development was very challenging and led to many delays. The actual field test took place just some weeks before this deliverable 8.4 was due, in 02/2020. There were several last-minute barriers in the collaboration between the ML and the app developer. The app developer promised to deliver backend data regarding CO2 savings and VKT which they did not do in time. So it was not possible to take corresponding data into account for evaluation.

There were two specific online questionnaires developed in cooperation between ML and LEM. This online survey was focused on the KPIs which had to be answered. The channels of distributing the survey link were chosen well and spread in different directions. So, the potential of gaining a significant number of app users was relatively high. In the end there was only a very low number of app users. There were no valid and representative results conducted which could have been used for this MER MUC 3.7.

If the launch of the “*Luftlotse-App*” would have been in an earlier stage of the ECCENTRIC project lifetime users would have had more time to test the app. Another reason of the very low usage rate of the app can be found in the fact that it was tested during winter season. As this app is providing a service for people walking or cycling they are highly weather-dependant and might not make use of the measure during bad weather conditions.

Due to the many barriers which occurred during the project development and implementation, a detailed Process Evaluation Report could have showed better and more helpful insights into MUC 3.7. Interviews with the app developers, the cooperating Department for Health and Environment, the people which installed the air quality monitors and (potential) app users could have given more helpful information regarding barriers and drivers and actions to overcome or make use of those.

E.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime. The app currently does not work to full satisfaction. In the remaining time of the project, some more bug fixing and fine-tuning has to be done. A version shall be provided, which can convince potential partners. This is not too far-fetched, as big German companies, Siemens and Deutsche Telekom, already showed interest during the project lifetime. But this refined version shall be brought to the City's Department for Public Health and Environment in the first place to come back to and to intensify the offered cooperation. It would be a milestone, if the City of Munich joins the measure by giving infrastructure and budget to improve the measure grid. However, ML does not expect this process to be finished before the end of project.

If testing, usage and refinement of the app under cooperation with the Department shows good results, a further step might be to think about a business model. Because, as mentioned above, several companies had shown interest in the *Luftlotse* (or at least in parts of the developed

algorithm). Currently, the *Luftlotse* is not on a development level to enter such negotiations. Concerning all this, several strategic decisions on the ML's side have to be taken, e.g. whether commercial opportunities shall be taken into consideration and if enough resources for the possible steps mentioned are available. If a market introduction really happens, external consultancy has to be engaged.

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ECCENTRIC



MAD 4.1

Innovative and participative approach to traffic safety at the neighbourhood level

Measure Evaluation Report

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4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
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28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Luis Fernández Heredia	
Ana Rosa Llorente	

Table of Contents

ABSTRACT.....	643
A. INTRODUCTION.....	645
A.1 EXPECTED RESULTS OF THE MEASURE	645
A.1.1 Quantifiable impacts.....	645
A.2 MEASURE DESCRIPTION	645
A.2.1 Measure outputs.....	646
A.2.2 Supporting activities	647
A.2.3 Interactions with other ECCENTRIC measures.....	647
A.2.4 Interactions outside ECCENTRIC	647
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	647
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	648
A.5 IDENTIFIED RISKS	648
B. MEASURE IMPLEMENTATION	649
B.1 SITUATION BEFORE CIVITAS	649
B.2 INNOVATIVE ASPECTS.....	649
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	649
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	649
C. IMPACT EVALUATION FINDINGS	651
C.1 EVALUATION APPROACH.....	651
C.1.1 Expected impacts and indicators.....	651
C.1.2 Baseline.....	652
C.1.3 The business-as-usual scenario.....	653
C.2 MEASURE RESULTS.....	653
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	654
C.4 UP-SCALING	655
D. PROCESS EVALUATION FINDINGS	656
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	656
D.1.1 The measure's approach to public participation.....	656
D.1.2 The geographical scope of the measure	656
D.2 BARRIERS	656
D.2.1 Public's involvement.....	656
D.2.2 Positional barrier.....	656

D.2.3	<i>Organisational barrier</i>	657
D.3	DRIVERS	657
D.3.1	<i>Political</i>	657
D.4	SUPPORTING ACTIVITIES.....	657
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	657
D.5.1	<i>Address the complexity of the public's involvement in road safety</i>	657
D.5.2	<i>The need of adequate indicators, to properly isolate the impact of the measure</i>	658
E.	EVALUATION CONCLUSIONS	659
E.1	VALIDATED DIRECT IMPACT	659
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	659
E.3	INTERACTION WITH OTHER MEASURES	659
E.4	MAIN LESSONS LEARNED	659
E.5	LONG TERM IMPACT	659
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	660
F.	ADDITIONAL INFORMATION	661
F.1	APPRAISAL OF EVALUATION APPROACH	661
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	661

List of Figures

Figure 1: On-street presentation of the measure in the living lab (February 2019).....	649

List of Tables

Table 1: Quantifiable impacts.....	645
Table 2: Target groups or affected parties.....	647
Table 3: Measure stakeholders.....	648
Table 4: Risks identified by the Measure Leader.....	648
Table 5: Description of key performance indicators (KPI).....	652
Table 6: Measure's indicators	652
Table 7: Baseline: Road accidents in 2016.....	652
Table 8: Summary of KPI values.....	653
Table 9: Achievement of objectives	654

Project	City		
ECCENTRIC	Madrid		
Measure code	Measure name		
4.1	Innovative and participative approach to traffic safety at the neighbourhood level		
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30/12/2019	Luis Fernández Heredia	fernandezsgl@madrid.es	

Abstract

This measure has conducted a comprehensive road safety study in the demonstration area, the districts of Puente de Vallecas and Villa de Vallecas, complemented by the development of a GIS-based application to map road safety incidents, categorized by type (e.g. with cyclist involved, pedestrians, etc.), as well as high risk locations (either real or perceived). The GIS-based tool has been used in more than 70 studies and 300 proposals developed by the technical services of the municipality.

The measure also intended to involve citizens and key stakeholders to deliver a proper policy and planning approach, gain population support and trigger new mobility behaviour. This involvement was finally implemented through a social media analysis tool, screening messages in social networks (Twitter) related to traffic accidents.

Overall, the measure substantially achieved its initial objectives. Although the number of accidents increased by 12.4% in 2018, the number of persons seriously injured decreased by 16.9%. In accordance with the messages analysed in social media, the perception of safety levels in the city has increased, from 2.0 in December 2018 to 2.3 in September 2019. However, there are two considerations to make related to these values: for the former, it is worth to highlight that the measure was implemented only at the end of 2018, and its impact in the 2018 accident figures is therefore very low, if significant at all ; for the latter, the number of social media messages identified within the category “accidents” was too low (just 7 in December 2018, 11 in September 2019 and a peak of 25 in February 2019) to provide a reliable picture of the public’s perception.

This ECCENTRIC measure provided three main lessons:

- Although relatively resource-intensive to integrate accident data reports, the development of a GIS-based tool has proved effective in facilitating the analysis of accident statistics in the city and to support the technical practice of the municipal services: The municipality has reported to have undertaken 70 studies and 300 proposals during the demonstration period, in which the new tool has been used.
- Monitoring the impact of accident-related measures is difficult, as the number of casualties and accidents can be influenced by many other variables and policy actions.
- The potential contribution of social media message analysis to accident monitoring and assessment is limited, due to the low number of messages related to accidents that can be identified, and the inability to identify the parts of the city or the transport

mode they referred to. Direct engagement with the public and improved participatory channels remain necessary to effectively integrate the views and knowledge of the public in road safety policies in cities.

A. Introduction

A.1 Expected results of the measure

This measure is expected to have impacts on the areas of society (safety and perception of safety) and transport system. Its objectives are:

Long term objectives

- Promote non-motorized mobility by providing a safer and more comfortable environment

Short term objectives

- Reducing the number of fatal accidents and serious injuries
- Reducing the perceived accident risk by all means of transport (particularly non-motorized).

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	Reducing the number of accidents and seriously injured			X							
2	Improved perceived safety levels (perceived accident risk, particularly for non-motorised users)					X					

Table 1: Quantifiable impacts.

A.2 Measure description

The main goal of the Traffic Safety Plan (2012-2020) adopted by the city of Madrid is to reduce the number of traffic deaths by 50% in 2020 compared to 2010 (33 deaths, of which 20 pedestrians). Following the new mobility culture guidelines, within which the traditional ‘traffic-vehicle’ approach to traffic safety is complemented with wider mobility issues (such as street design and urban layouts, mixed uses and shared spaces, traffic calming and shared speeds, etc.), it recognizes that the promotion of a sustainable mobility model is aligned with increased safety of the transport system. Following this approach, the Sustainable Urban Mobility Plan (SUMP) approved in 2013 by the City Council of Madrid, includes traffic safety as one of the four strategic goals for the Plan.

Within this measure, the Municipality of Madrid has conducted a comprehensive road safety study in the demonstration area, the districts of *Puente de Vallecas* and *Villa de Vallecas*, complemented by the development of a GIS-based application to map road safety incidents, categorized by type (e.g. with cyclist involved, pedestrians, etc.), as well as high risk locations (either real or perceived).

The road safety study was completed between February and April 2018, and consists of:

- Definition of traffic safety indicators.
- Collection and systematization of data linked to street safety through an application developed and based on GIS.
- Calculation of traffic safety indicators in sections of the street with homogeneous characteristics.
- Identification of points / sections of accident concentration.
- Identification of points / sections with traffic safety level (real and perceived) compromised.
- Identification of environments likely to perform actions to improve traffic safety.
- Definition of prioritization criteria and type of actions to be carried out.

The GIS-based tool has allowed to improve the quality check of accident data gathered by the local police and has empowered the officials working in the area of road safety to undertake in-depth analysis of traffic accidents, and to design actions (e.g. in terms of signalisation, traffic management and public space design) tailored to each particular context. The tool has also facilitated the implementation of some of the most relevant traffic safety measures included in the 2013 SUMP, and has served as a valuable support to the preparation of the new SUMP, expected to be adopted in 2020. Initially, the measure was expected to make use of new technologies to further promote traffic safety conditions by introducing tools such as intelligent speed humps, smart signage or blind spot alerts, but these actions did not materialise during the implementation stage as their actual contribution to road safety was assessed as uncertain.

In addition, public participation is highlighted as a determining success factor in the framework of the new mobility culture. Involvement of citizens and key stakeholders is needed to deliver a proper policy and planning approach, gain population support and trigger new mobility behaviour. Aware of it, the Municipality of Madrid will make use of its public participation infrastructure in order to:

- Feed the GIS-based application, particularly as regards of the perceived risk locations
- Engage with citizens in the delivery of neighbourhood level road safety actions, within which the neighbours will count with technical assistance in order to address road safety issues in their own neighbourhoods.

The aim is to complement technological approaches with physical interventions to provide 'shared speed' environments leading to safer conditions to all users (particularly pedestrians and cyclists).

A.2.1 Measure outputs

The measure will provide several outputs:

- Identification of relevant indicators and development of guidelines and procedures for urban traffic safety analysis.
- Setting up a GIS platform on urban traffic safety with business-intelligence and data-mining tools for analysis, initially covering the two districts in the living lab and subsequently expanded to the whole municipality of Madrid.

- Identification of existing communication and participation channels for citizens' involvement in traffic safety issues (from official participatory channels to social media), and development of adequate tools to analyse these contributions.

These new tools for information collection and analysis will be made available to municipal experts and technicians, to support the design and implementation of safety-related actions by the municipality.

Therefore, the measure intends to improve the response of the technical services of the municipality to road safety challenges through the integration of the citizens' and residents' views through the new GIS platform. Citizens and residents are not directly participating in the measure. What is done is to make use of the information and views these agents already provide through social networks and existing municipal participatory channels. The GIS platform provides an instrument to consistently analyse all this information, and to integrate it in the technical activities of the municipal professionals dealing with road safety. As a result, those in the municipality designing and prioritising road safety actions are empowered with more accurate information, including the citizens' and residents' perspectives. Action is expected to be better targeted on the most conflictual road sections (objective safety perception) and also on those sections perceived as riskier by users (subjective safety perception), with an impact in terms of reduction in the number of accidents and improvement in the level of safety perceived by the users (satisfaction).

A.2.2 Supporting activities

There are no additional activities supporting this measure.

A.2.3 Interactions with other ECCENTRIC measures

There are no interactions with other ECCENTRIC measures.

A.2.4 Interactions outside ECCENTRIC

This measure interacts with the broader [Madrid Traffic Safety Plan](#) (2012-2020). Furthermore, traffic safety is one of the four strategic goals of Madrid SUMP (2014-2020). The strategic objective of the traffic safety plan is to achieve a 50% reduction in the number of annual fatalities compared to the 2010 baseline (33 deaths), i.e. a maximum of 17 road traffic deaths. This strategic objective is complemented with more specific targets:

- Reducing the number of road traffic fatalities per million inhabitants to 1.60 in 2020.
- Reducing the number of pedestrians killed in road traffic accidents to 15 in 2020.

The use of the new ECCENTRIC tools is expected to empower the municipality experts to better target the actions to be implemented, improving the results to be achieved by the Plan in 2020.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
0	All transport users in Madrid	0	Whole municipality

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
	District councillor-chair (PdV and VV ²²)	O	C	O	
	Environment and Mobility City Councillor	O	C	O	
	Director traffic management	O	C	L	
	Local Police	O	C	P	
	Local Forum PdV	O	Other	O	
	Local Forum VV	O	Other	O	
	Mesa de movilidad (Mobility Board)	O	Other	O	
	Neighbourhood associations (6)	O	NG	O	
	Stop Accidentes (NGO)	O	NG	O	
	AMPA (PTAs at 4 schools)	O	NG	O	
	A pie (NGO)	O	NG	O	
	Political parties at both districts (PdV and VV)	O	Other	O	
	Ayuntamiento de Madrid	P	C	L	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Problems with existing regulation and documentation, as current rules are focused mainly on road safety, and not on integrated safety in urban areas	7	To be addressed during the implementation stage	Measure Leader

Table 4: Risks identified by the Measure Leader.

²² PdV: *Puente de Vallecas*; VV: *Villa de Vallecas* (the two districts included in the living lab).

B. Measure implementation

B.1 Situation before CIVITAS

The Traffic Safety Plan 2012-20 is under implementation in Madrid, and it is aligned with the guidelines of the European Commission's Communication on road safety policy (COM(2010)389), including its target of halving the number of casualties by 2020, compared to 2010.

In the city of Madrid, the number of casualties and traffic deaths decreased between 2006 and 2010, during the implementation of the previous Traffic Safety Plan (PSV 2007-2010), but have remained stable from 2010 to 2012, or even increased slightly.

The municipality is lacking adequate technical tools to analyse safety, as a basis to develop better focused actions. A GIS-based tool for evaluation of safety conditions could fill this gap and improve the technical capacities of the municipal services in the future.

B.2 Innovative aspects

The measure will develop a new analysis tool, including innovative indicators and participation channels.

B.3 Research and Technology Development

No relevant RTD contributions are expected from this measure.

B.4 Actual implementation of the measure

The design phase took place between September 2016 and July 2017.



Figure 1: On-street presentation of the measure in the living lab (February 2019)

The implementation phase took place between August 2017 and November 2018. During this period, and with the support of different specialists, the municipality identified key indicators on urban mobility safety (including innovative ones such as “risk perception level” or “risk factor”). These activities served (as a project by-product) to produce guidelines on urban safety analysis that could be useful for other cities. The safety information available was integrated in a GIS system with a virtual desk component, providing reports on a variety of safety aspects. A tool for screening and analysis of social media networks was also developed, as a way to assess perceived (versus objective) mobility safety and satisfaction levels among social network users and citizens making use of conventional participatory channels in Madrid (although geolocation of this information is not always possible).

The operation phase began in December 2018 and was completed in September 2019, making use of these new tools to better identify and develop safety actions of the municipality in the living lab and in other areas of Madrid.

One relevant change is worth mentioning compared to the approach described in the initial project proposal: the measure team dismissed its initial intention to develop an APP for citizens to report on perceived mobility safety hazards. It was considered that the acceptability and use of such a tool was unlikely to become widespread enough to provide useful information to the technical services of the municipality and would not increase significantly the active involvement of citizens in safety policy. As an alternative, it was decided to screen existing social networks to identify contents on mobility safety in Madrid through a newly developed tool, and to combine this with a systematic analysis of safety-related input provided by citizens through the already existing participatory channels of the municipality.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

The table below provides a description of the indicators retained for this measure in the local evaluation plan.

Impact	1		2		
Indicator name	Number of fatalities and seriously injured	Number of incidents reported by citizens	Satisfaction	New safety actions	
Type	KPI		KPI		
Category	Transport	Transport	Society		
Subcategory	Safety	Safety	Acceptance		
Aspect	Transport safety	Transport safety	Acceptance	Governance	
Definition	Fatalities and seriously injured in traffic accidents within the city lab (annual)	Monthly number of traffic incidents (by category) reported by citizens and identified by the system	Users' (citizens') average satisfaction as reported by the system	Number of actions in the city lab developed through the new system (i.e. actions considered by the municipality)	
Unit	Persons/year	Incidents/month	Score (1-5)	Units	
Method of data collection	Official reports from the municipality	Information from the new GIS tool	Survey in city lab or survey to users of the new system	Reporting from the municipality (technical services developing actions)	
Target group	All transport users	All transport users	Users contributing to the GIS system	Technicians and decision makers in the municipality	
Domain	Demonstration area	Demonstration area	Demonstration area	Demonstration area	
Control sample	Rest of the city	No	No	No	

Related measures, activities, and interference sources	Measures MAD 4.6 and MAD 4.7 could increase total number of pedestrians, cyclists, and their safety conditions	No interferences identified	No interferences identified	No interferences identified	
References					

Table 5: Description of key performance indicators (KPI)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Number of fatalities and seriously injured	persons/year	B; I(annual); A	DC	All transport users	Demonstration area
	Number of incidents reported by citizens	Incidents/month	A	DC	All transport users	Demonstration area
2	Satisfaction	Score (1-5)	A	S	Users contributing to the GIS platform	Demonstration area
	Governance/ Pilot progress	Units	A	DC	Technicians and decision makers at the municipality	Demonstration area
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Measure's indicators

C.1.2 Baseline

The baseline is prepared using the statistical information of the city of Madrid. The statistical information is based on the reports prepared by the local police for all traffic accidents in which its presence has been required. Data for year 2016 has been considered, referring to (1) number of fatalities, (2) number of casualties. Although not initially included within the set of indicators for this measure, the number of accidents involving pedestrians and cyclists has also been included in the baseline. The information refers to the whole of the municipality and to the two districts in the living lab.

Indicator	City	PdV	VV	Living Lab
Population (1/1/2016)	3,182,175	227,195	102,140	329,335
Accidents	12,337	805	295	1,100
Fatalities	35	3	0	3
Casualties	12,693	861	316	1,177
Accidents with pedestrians	1,555	117	54	171
Accidents with cyclists	271	11	4	15

Table 7: Baseline: Road accidents in 2016

In terms of the gravity of the accidents (casualties per accident) both districts show values slightly higher than the city average (1.07 compared to 1.03). Compared to the population, however, the number of casualties per million inhabitants is lower in both districts (3,790 in PdV and 3,094 in VV compared to 3,989 as the city average).

The percentage of accidents involving pedestrians is higher in the living lab: 14.5% in PdV and 18.3% in VV compared to 12.6% in the city. As for the number of accidents with cyclists, its low percentage reflects not only a high degree of safety, but also the quite low use of this transport mode in the city and in the districts of the living lab.

C.1.3 The business-as-usual scenario

The 2016 values for the indicators reviewed in the previous section are similar to those of previous years. As a reference, the total number of accidents in 2011 (the baseline year for the current Traffic Safety Plan) was 11,970 for the city, 751 for *Puente de Vallecas* and 238 for *Villa de Vallecas*, and the number of casualties was, respectively, 11,981, 780 and 283. This suggests that the Traffic Safety Plan (which was backed by the SUMP in 2013 without changes) is not delivering the expected results in reducing the number of accidents in Madrid (and that is one of the reasons why the new tool for analysis and design provided by measure MAD 4.1 is tested by ECCENTRIC). During the 2012-2016 period, figures have fluctuated above and below the 2011 reference. Therefore, for the future, the business-as-usual scenario would assume that at the end of ECCENTRIC, approximately the same accident rates in the city and in the living lab could be expected, should the measure not be implemented.

C.2 Measure results

The measure's results are summarised in the table below. Measurements have been jeopardised by the lack of continuity of the statistical series. As a result of the implementation of the GIS tool, a number of problems were detected in the reporting and recording of road accident data within the municipality (double counting, some reports not introduced in the data base, etc.). The data collected in 2019 follow the new reporting and recording protocols, resulting in 4 deaths and 41 persons seriously injured. As a result of the revised protocols, the number of accidents included in the data base has substantially increased compared to previous years (from 1036 in 2017 to 2167 in 2019 in the two districts) including many with victims with slight injuries (which have jumped from 409 in 2017 to 1175 in 2019). Similar differences have been found at the city level.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Number of fatalities and seriously injured	persons/year	60	2017	60	2019	45	2019	-15	-15
Number of incidents reported by citizens	Incidents/month	0	2017	0	2019	14.6	2019	14.6	14.6
Satisfaction	Score (1-5)	2.8	2017	2.8	2019	2.2	2019	-0.5	-0.5
New safety actions	Units	0	2017	0	2019	300	2019	300	300

Table 8: Summary of KPI values

The number of fatalities and seriously injured decreased in the two districts between 2017 and 2019, by 25% (it increased by 39% at the city level). However, both figures must be taken cautiously, due to the problems in data quality mentioned above; at any rate, it is uncertain to what extent ECCENTRIC can have had an impact in this indicator, as the implementation of the measure was not completed until November 2018.

As a reasonable proxy to the number of incidents reported by citizens, the project has been considered the number of tweets identified by the social-media analysis system referring to accidents. During the operational stage of the measure (December 2018–September 2019) an average of 14.6 accidents have been reported per month in the whole city (it is not possible to identify the district), with a maximum of 25 in February 2019. This is a low figure compared to the actual number of accidents per month (more than 1000), and suggests that social media does not seem to provide a fair image of traffic safety in the city.

In terms of general satisfaction with mobility issues (not just accidents), the social media tool provides a downward trend in the social media comments, from 2.8 in December 2018 to 2.4 in September 2019, and a peak of 3.1 in May 2019, with an average of 94 comments identified per month. Comments received on the conventional municipal communication channels have been more positive (from 3.3 December 2018 to 3.1 in September 2019), although in average, the municipality received only 33 of such communications per month.

The municipality has reported to have undertaken 70 studies and 300 proposals during the demonstration period, in which the new tool has been used.

C.3 Summary: achievement of objectives

The achievement of objectives is summarised in the Table below. Although the number of accidents increased by 12.4% in 2018, the number of persons seriously injured decreased by 16.9%. It is worth to highlight that, the measure was implemented only at the end of 2018, and its impact in these figures is therefore very low, if significant at all²³. In accordance with the messages analysed in social media, the perception of safety levels in the city has increased, from 2.0 in December 2018 to 2.3 in September 2019; however, the number of messages identified within the category “accidents” is very low: just 7 in December 2018, 11 in September 2019 and a peak of 25 in February 2019, too low to provide reliable figures; furthermore, the social network analysis system was unable to discriminate the messages referring to non-motorised users or to the living lab.

No.	Objective and target	Rating	Comment
1	Reducing the number of accidents and seriously injured	★	1181 accidents in the living lab in 2018 compared to 1051 in 2017, with 972 compared to 1170 seriously injured or death
2	Improved perceived safety levels (perceived accident risk, particularly for non-motorised users)	★	Score of comments increased from 2.0 (from 7 comments) in December 2018 to 2.4 (from 11 comments) in September 2019 for the whole city
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★ = Exceeded			

Table 9: Achievement of objectives

²³ Road safety figures for year 2019 will be available by February 2019.

C.4 Up-scaling

The GIS-based accident analysis system and the social data analysis tool are already operational at the municipal level. The guidelines produced within this measure intend to encourage other Spanish cities to make use of these tools for the design and implementation of their road safety policies.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

Two main deviations from the original measure concept can be identified: the first refers to the approach to public participation; the second, to the geographical scope of the measure.

D.1.1 The measure's approach to public participation

The measure team abandoned its initial intention to develop an APP for citizens to report on perceived mobility safety hazards. It was considered that the acceptability and use of such a tool was unlikely to become widespread enough to provide useful information to the technical services of the municipality and would not increase significantly the active involvement of citizens in safety policy.

The alternative has been to screen existing social networks in order to identify contents on mobility safety in Madrid, and to combine this with a systematic analysis of safety-related input provided by citizens through the already existing participatory channels of the municipality. The main limitation of this tool has been the low number of twitter messages on road safety and mobility in general it has been able to identify.

D.1.2 The geographical scope of the measure

The measure has been deployed at the city level, without a specific focus on the living lab, as it was initially expected. Consequently, the specificities of the living lab (high-density peripheral neighbourhood with particular social equity challenges) were not addressed by the measure, as initially expected.

D.2 Barriers

Three main barriers were identified in the process evaluation report.

D.2.1 Public's involvement

The measure focused progressively on its technical aspects, somehow relegating its initial ambition to effectively involve the public in road safety at the neighbourhood level. There were no channels to facilitate the participation of social stakeholders during the design, and implementation stages. The measure team tried to mitigate this barrier at the operational stage with the provision of the tool for social media analysis developed within the project, but the small number of messages screened by this tool, and its inability to identify whether the messages referred to the living lab or to other neighbourhoods in the city proved that this tool was insufficient to assure effective public's involvement.

D.2.2 Positional barrier

This barrier referred to the relative isolation of the measure, with little relationships with the rest of the project. As a mitigation measure, the project team envisaged to increase communication between with measures MAD 4.6 and MAD 4.7; however, this communication

did not materialise, mainly due to the weak relationship of measure MAD 4.1 with the living lab.

D.2.3 Organisational barrier

This barrier stems from the insufficient arrangements made by the measure team to involve stakeholders in the living lab. This barrier was mitigated through presentations of this measure in the living lab to the relevant stakeholders (such as the city councillor, and the *Foro Local* platform), and with an on-street presentation.

D.3 Drivers

One driver was identified in the process evaluation report of this measure.

D.3.1 Political

This measure was very well aligned with the city's strategic vision and planning documents on mobility, as all these documents include a specific objective to dramatically reduce the number of accidents in the city, and to explore innovative approaches to achieve this. The measure team made use of this driver by mainstreaming the measure outputs (the SIG system and the social media analysis tool), integrating them in the daily practice in safety actions developed by the municipal traffic safety department in the whole city. This has resulted in a high number of proposals (more than 300) undertaken by the traffic safety department which made use of these tools.

D.4 Supporting activities

There have been no supporting activities for this measure.

D.5 Recommendations on the implementation process

As a result of the process evaluation, two recommendations can be highlighted on the implementation process of this measure.

D.5.1 Address the complexity of the public's involvement in road safety

The measure implementation could not cope with its initial ambition to attain substantial participation of the public, and particularly of people in the living lab. The project experience showed that, in the absence of a clear participatory strategy since the beginning of the design stage, innovative measures, at least in an area like road safety, perceived of a highly technical nature, there is a strong tendency to focus on technical aspects and to marginalise and even neglect the participatory aspects. Furthermore, a technical-dominated approach tends to provide tools of a general nature rather than contextualised instruments. Both trends clearly dominated the implementation process of this measure, and could have been counteracted through earlier participation of the public and a more contextualised analyses of road safety in the living lab.

D.5.2 The need of adequate indicators, to properly isolate the impact of the measure

Indicators on the number of accidents and casualties reflect the effects of the multiplicity of variables that interact on road safety. To properly assess the measure's effects, the indicator should have been derived from an econometric model including all these variables. However, the development of such model has not been included within the measure activities. This should be taken into account for future monitoring of individual road safety actions in cities.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed with Measure Leaders and Site Coordinators. Based on this, the evaluation conclusions have been formulated.

E.1 Validated direct impact

- The number of fatalities and seriously injured decreased in the two districts between 2017 and 2018, by 16.9%, whereas at the city level it decreased by 6.5%. However, it is uncertain that this decrease can be attributed to ECCENTRIC, as the implementation of the measure was not completed until November 2018; it will be necessary to wait until 2019 data becomes available to assess this impact.
- The analysis of social media messages has not been able to provide reliable conclusions, due to low number of messages related to accidents that could be identified, and the inability to identify the parts of the city or the transport mode they referred to. The number of messages identified between December 2018 and September 2019 within the category “accidents” was very low: just 7 in December 2018, 11 in September 2019 and a peak of 25 in February 2019. This is a tiny fraction of the more than 1000 accidents per month at the city level, and suggests that social media does not seem to provide a fair image of traffic safety in the city.
- The GIS tool has effectively been mainstreamed within the technical practice of municipal services: The municipality has reported to have undertaken 70 studies and 300 proposals during the demonstration period, in which the new tool has been used.
- The measure did not complement its technological approach with physical interventions, as initially envisaged in the project proposal: it did not implement particular actions in the living lab, such as to provide ‘shared speed’ environments leading to safer conditions to all users.

E.2 Relevance of supporting activities

There were no supporting activities associated to this measure.

E.3 Interaction with other measures

There has been no interaction with the other measures implemented by ECCENTRIC in Madrid.

E.4 Main lessons learned

- Although relatively resource-intensive to integrate accident data reports, the development of a GIS-based tool has proved effective in facilitating the analysis of accident statistics in the city and to support the technical practice of the municipal services: The municipality has reported to have undertaken 70 studies and 300 proposals during the demonstration period, in which the new tool has been used.
- Monitoring the impact of accident-related measures is difficult, as the number of casualties and accidents can be influenced by many other variables and policy actions.

- The potential contribution of social media message analysis to accident monitoring and assessment is limited, due to the low number of messages related to accidents that can be identified, and the inability to identify the parts of the city or the transport mode they referred to. Direct engagement with the public and improved participatory channels remain necessary to effectively integrate the views and knowledge of the public in road safety policies in cities.

E.5 Long term impact

The long-term impact of this measure is associated to the progressive adoption of a more sophisticated approach to accident analysis and to the design of accident-reduction measures by the municipality of Madrid and other cities. The figures provided by the municipality are encouraging, as they suggest that the GIS-based tool is being widely used and the measure contents and conclusions are being widely shared with other Spanish cities.

Long-term impacts in terms of improving the public's involvement in road safety policies are more uncertain; ECCENTRIC has shown the need to look for direct involvement, rather than to indirect procedures, to gain understanding in the public's perceptions for safe urban mobility, but effective alternatives will still have to be identified and tested.

E.6 Potentials for up-scaling in the city

The current revision of the Sustainable Urban Mobility Plan could provide an excellent framework for up-scaling, taking into consideration the high priority given by local authorities to road safety. However, the municipality has not developed specific up-scaling actions concerning this measure.

F. Additional information

F.1 Appraisal of evaluation approach

The evaluation approach for this measure has been only partially successful in providing accurate monitoring and reporting of the results achieved. Its main strong point refers to the relative simplicity of the data collection process, based on the use of reliable accident statistics already provided by the municipality following well-consolidated methods. However, these statistics do not provide a reliable picture of the isolated influence that the measure implementation may have had. ECCENTRIC had not the resources to deal with this problem, which would have required the development of alternative modelling forecasting on urban accidents in Madrid; it would be convenient to develop such a model in the future, as it would be a cornerstone for any detailed monitoring of road safety policies.

Taking into consideration the limited results obtained by the social media analysis tool, the evaluation of this measure would have benefited from alternatives to gather information on the public's views on road safety in the living lab, through surveys or focus groups.

F.2 Future activities relating to the measure

It is recommended that the municipality considers alternatives to integrated the public's views and knowledge in its road safety policy, once the limitations of the social media tool have become clear.



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MUC 4.2

Software-controlled safety management in the road network Measure Evaluation Report

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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
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13	Mobility Motors Sweden AB	Sweden	MM
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17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
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23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Matthias Mück	

Table of Contents

ABSTRACT.....	669
A. INTRODUCTION.....	671
A.1 EXPECTED RESULTS OF THE MEASURE	671
A.1.1 Quantifiable impacts.....	671
A.2 MEASURE DESCRIPTION	671
A.2.1 Measure outputs.....	673
A.2.2 Supporting activities	673
A.2.3 Interactions with other ECCENTRIC measures.....	673
A.2.4 Interactions outside ECCENTRIC	673
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	674
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	674
A.5 IDENTIFIED RISKS	674
B. MEASURE IMPLEMENTATION	675
B.1 SITUATION BEFORE CIVITAS	675
B.2 INNOVATIVE ASPECTS.....	675
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	675
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	675
C. IMPACT EVALUATION FINDINGS	678
C.1 EVALUATION APPROACH.....	678
C.1.1 Expected impacts and indicators.....	678
C.1.2 Baseline.....	680
C.1.3 The business-as-usual scenario.....	692
C.2 MEASURE RESULTS.....	694
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	707
D. EVALUATION CONCLUSIONS	708
D.1 VALIDATED DIRECT IMPACT	708
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	708
D.3 INTERACTION WITH OTHER MEASURES	708
D.4 MAIN LESSONS LEARNED	708
D.5 LONG TERM IMPACT	708
D.6 POTENTIALS FOR UP-SCALING IN THE CITY	709
E. ADDITIONAL INFORMATION.....	710

E.1	APPRAISAL OF EVALUATION APPROACH	710
E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	710

List of Figures

Figure 1: Accidents by type	681
Figure 2: Heatmap of all accidents with injuries	682
Figure 3: Heatmap of all damages (without injuries)	683
Figure 4: Accident risk and age group (1.0 = average risk based on volume; red: responsible, grey: other involved)	683
Figure 5: Accidents with pedestrians involved	684
Figure 6: Accidents with cyclists involved	685
Figure 7: Map of perceived road safety problems	686
Figure 8: Perceived (left) and actual (right) accident hotspots	686
Figure 9: Previous experiences about road safety by schoolchildren	687
Figure 10: Knowledge about Road Safety before the measure	688
Figure 11: Perception of own Safety on the way to school	688
Figure 12: Acceptance to learn more about the topic, before	689
Figure 13: Mode Split schoolchildren FAPS	689
Figure 14: Number of cars per household, 2018	690
Figure 15: Modal Split of Living Lab residents, 2018	691
Figure 16: Modal Split in Munich (2008+2017)	692
Figure 17: PING markings per category in the Living Lab	700
Figure 18: Additional functions of the "Bike-Citizen-App", map section: Living Lab	701
Figure 19: City cycling dashboard by bike citizens	702
Figure 20: Knowledge about Road Safety after the measure	702
Figure 21: Acceptance to learn more about the topic, after	703
Figure 22: Satisfaction with the measure	704
Figure 23: Satisfaction with the agenda of the event	704

List of Tables

Table 1: Quantifiable impacts.....671

Table 2: Target groups or affected parties.....674

Table 3: Measure stakeholders.....674

Table 4: Risks. 674

Project	City		
ECCENTRIC	Munich		
Measure code	Measure name		
MUC 4.2	Software-controlled safety management in the road network		
Last update	Responsible	e-mail	telephone
17.10.2019	Matthias Mück	matthias.mueck@muenchen.de	+49 (0)89 / 233-39935

Abstract

The measure MUC 4.2 Software-controlled safety management in the road network aims to reduce the amount and consequences of accidents, especially for the modes walking and cycling. Three different approaches are being tested to increase road safety in the road network of the Living Lab and beyond. This contributes strongly to the general road safety concept of the City of Munich, which is developed in parallel and based on the experiences of MUC 4.2. While one sub measure provides the basic foundation for further investigations with a comprehensive in-depth analysis of the road safety status quo, another sub measures is testing a new, preventive and innovative software-controlled safety management for cyclists, called PING. The third sub measure is targeting a preventive approach for school children and offering a workshop concept to increase the individual perception of potential dangers on the way to school.

Those three measures are tested to find out if they would be suitable to upscale them within the entire city and see if the outcome is satisfactory enough in terms of data quantity and quality. The ML's institution, the Department of Public Order, is highly interested to search and test measures which could possibly help to pursue the goal of the "Vision Zero" of 2018 – to prevent traffic death and fatal and severe crashes.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measures' implementation and the ex-post data, which focuses on the impact of MUC 4.2.

Evaluation results for MUC 4.2 were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019), data on road safety assessed by a subcontracted firm specialized in transport consulting, several workshops for the particular sub-measures were carried out and a paper-based survey was conducted at two different times with secondary school students regarding the FAPS program.

It comes out that the in-depth analysis done by local traffic experts gives very helpful and detailed information about the current accident hotspots within the Living Lab (about 5.000 accidents happened from 2010-2014). The tested innovative software-controlled safety management with the so called PING-button and an accompanying app is very well accepted by the users and the ML is satisfied with the data output this system generates. The developed

workshop concept to teach pupils of 7th to 9th grade about road safety, shows that there is an increase about the awareness and perception of this important topic among the school children. 85% of the students stated to be satisfied and very satisfied with the FAPS workshop concept and content. And 90% stated to accept the topic of road safety in their school schedule. Due to the teachers statement some adjustments could be done regarding the difficulty level of the workshop leaflet but in general this method seems to be successfully implemented.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- Reduce Road Accidents
- Improve social inclusion and equal opportunity
- Improve liveability

(2) Strategic level:

- Piloting an innovative software-controlled safety management in the road network of the Living Lab
- Setting the foundation for an overall road safety concept for the north of Munich

(3) Measure level:

- A scientific analysis of the road safety in the Living Lab based on expert knowledge (subcontract)
- An in-depth analysis of the road safety in the Living Lab in cooperation with local stakeholders, especially with local neighbourhood associations and local police representatives
- The actual subsequent implementation of measures and monitoring for road safety improvements in the Living Lab

A.1.1 Quantifiable impacts

Expected Impacts		Based on this analysis, preventative measures will be identified and exemplarily implemented in the laboratory area in order to reduce fatalities and accidents. The higher sense of safety should encourage road users to use more often active modes of transport such as walking and cycling, especially on way-to-school routes.	CIVITAS ECCENTRIC Objectives									
			Reduce:				Improve:					
ID	Quantifiable Impacts		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight	Local economy
1	Avoidance of accidents (forecast + preventive actions)				X			X				
2	Road users are aware and accept the safety measures				X			X	X			
3	Road users are satisfied with the safety measures				X				X			
4	Road users change their mobility behaviour towards more walking and cycling								X			
5	Integration of road safety approach into standardized urban planning processes							X				

Table 1: Quantifiable impacts.

A.2 Measure description

The City of Munich will develop a new road safety concept and exemplarily show the potential of a new and innovative software-controlled safety management in the road network of the ECCENTRIC Living Lab. The aim is to reduce the amount and consequences of accidents, especially for users of sustainable modes. Three different approaches are to be executed to increase road safety:

a) In-depth analysis of the road safety situation in the Living Lab from road safety experts

Subcontracting road safety experts to do a comprehensive road safety assessment with police accident data, network analysis and carry out workshops to categorise subjectively perceived safety risks of local residents. This is not an implementation of a concrete measure which will reduce accidents in the Living Lab during the project lifetime of ECCENTRIC, but it is a first step to evaluate the status quo as a comprehensive baseline research.

b) Testing a device to identify, quantify and geo-referencing perceived safety risks in everyday cycling: PING button

Following the Vision Zero strategy, which is already approved as the basis of the Munich road safety concept, the addressing of preventive approaches for the improvement of road safety is crucial. After an intensive research phase by the ML, the idea to test the PING-button technique came up. Other European cities (e.g. Brussels in 2017) implemented this tool before with the aim that citizens can start mapping the perceived problems or risks they encounter whilst cycling. Data is then collected via the Bike Citizens App and can be analysed. In a last step, a city receives recommendations where to increase road safety standards for cyclists.

The aim of the PING-button usage is to check if the whole process of registration, “PING-ing” and categorizing the dangers is user friendly and if the size and quality of the collected data is useful for the purpose to enhance road safety in the Living Lab and to upscale the approach for the entire City of Munich. Main idea for the PING-button implementation in Munich is not yet to translate the PING results into direct physical actions for more road safety, but more to test the procedure and the handling for the users and to look at the collected dataset and its quality.

The PING-button allows people to actively engage in the development of their city and help to create a picture of the current traffic situation for cyclists in the Living Lab. The PING-button can be attached to the handlebar or clothing. The button communicates with the *Bike Citizens app* through Bluetooth. Cyclists can categorise and comment on their PINGs straight away or afterwards in the app. Exemplary categories are: Conflicts on road without/with bike lane, like close overtaking or cutting by a car, obstacles on the cycle path or lack of cycling infrastructure.

The PING-button is mainly used by residents which live and cycle in the Living Lab. Other PING-participants are selected colleagues from the ML’s institution in order to test the button-technique and gain some knowledge about the usability and potential to upscale this to the entire city.

c) Education on road safety on the way to school in facilities for children: FAPS - "Fraunhofer Accident Prevention School"

The aim here is to raise awareness on road safety aspects among schoolchildren with offering project days (“Projekttage”) / workshops at secondary schools to teach children of the 7th and 8th grade on the topic of road safety. A subcontracted experienced institute working on transport and infrastructure systems and well-known within Germany’s research landscape is carrying out the workshops. They were awarded the German Mobility Prize in 2017 for its “Fraunhofer Accident Prevention School” (FAPS) programme. Background to the programme is that mobility behaviour changes considerably at the age of 15-16 and that those students are exposed to particularly high risks as cyclists and pedestrians, which is reflected in accident figures. Initial idea is to provide material and content to the school’s teaching staff, that they can execute the road safety workshops on their own.

In May 2019 all secondary schools of Munich were addressed with a formal invitation by the ML’s department. As of November 2019, five schools were selected to hold workshops about road safety and accident prevention. At the end, three secondary schools actually agreed to carry out those workshops within their school schedule. For the schools it is very trustworthy to take actions in accident prevention and to focus on road safety. Also the police and local school route security (usually voluntary people) were part of the road safety workshops to give

short inputs. Because of their general government order to secure road safety, they probably have a high interest in implementing the measure.

Main project outcomes and respective evaluation results from the CIVITAS ECCENTRIC project will be a crucial basis for the design of a city-wide road safety management, a coherent infrastructure for the detailed analysis of accident data and the design and conception of road safety campaigns

The FAPS is taking place outside the actual Living Lab because there is no school with children of the dedicated target group in this area.

A.2.1 Measure outputs

- An extensive analysis of road safety in the Living Lab with the help of an innovative software tool
- Concrete improvements on road safety for the road network in the Living Lab in 2019/20, potentially (co-) financed by the City of Munich (e.g. infrastructure measures)

A.2.2 Supporting activities

An early parallel process towards the implementation of the road safety concept for the entire City of Munich based on replicable outcomes of the measure. This was possible due to a supporting and accompanying political process, which is bundled under the title “Vision Zero”. In 2018, the City Council agreed on “Vision Zero” - the clear statement to not accept any death or seriously injured road user in Munich (cf. Die Grüne Fraktion, 2019; Ride of Silence Munich, 2019).

A.2.3 Interactions with other ECCENTRIC measures

The PING-button which was distributed among the residents of the Living Lab could be picked up in the concierge shop, MUC 7.5.

A.2.4 Interactions outside ECCENTRIC

The measure is closely related to the City Council's *Vision Zero* concept for the entire City of Munich. *Vision Zero* aims to prevent traffic death and fatal and severe crashes. Furthermore, handling human failing by better road safety education and looking at a holistic system approach for the whole city.

A new traffic flow concept for the southern part of the Munich Living Lab is currently under development by the Planning Department of the City of Munich. The road safety measure plan, developed in MUC 4.2 is considered as an underlying key document ensuring a high road safety level for the new traffic flow concept.

A new routing concept to enforce speed reduction has been developed for a main road in the Living Lab based on recommendations from this measure and will be implemented in the near future.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
Residents	Residents (+ other road users) in the Living Lab	Living lab	Concrete measures will be implemented in the Living Lab

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	Domagkpark Association	P	NG	O	Contact in the Living Lab
2	Residents (over neighbourhood associations)	S	NG	O	Participation in workshops re. measure planning
3	Schools	S	KI	O	Consulting on school routes
4	Political representatives	S	C	O	Consultation in case of necessary political coordination processes
5	Police	S	C	O	Data provision
6	City administration	P	C	L	ML, approval & implementation
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Long term implementation processes for actual measures	Problem-related	Evaluation of to-be implemented measures by cost-benefit ratio and realisation effort; Activating political support	ML
Lack of funds for measure implication	Financial	Inclusion of municipal funding for road safety improvements	ML
Not enough participation in workshops	Involvement	Inclusion of resident associations, advertisement via Newsletters/Website	ML

Table 4: Risks.

B. Measure implementation

B.1 Situation before CIVITAS

A new housing area and related public institutions (e.g. child care, schools, parks, etc.) have been developed in the Living Lab (Domagkpark and Parkstadt Schwabing) in the northern part of Munich in 2016. In order to better integrate the area in the city, a sustainable and innovative road safety concept is needed, especially considering new mobility services (e.g. e-mobility, bike sharing, etc.). Especially the access ways to schools are currently not comprehensively implemented in a sustainable and safe mode. In some areas children have to cross wide roads and therefore many parents prefer to bring their children by car.

B.2 Innovative aspects

New conceptual approach

The combination of a software-based analysis of accident data and workshops to analyse police accident data and to evaluate the perceived safety is an innovative, new approach.

New physical infrastructure solutions

When it comes to implementing road-safety improvements in the second phase of the measure, new physical solutions will be used. i.e. it is planned to introduce a gadget (PING-button) which will be attached to the handlebars of a bicycle and is connected to an app which is tracking the cycling route. This PING-button should be carried during daily bike rides and be pushed when a dangerous situation occurs.

B.3 Research and Technology Development

The innovative road-safety analysis tool was not developed within CIVITAS ECCENTRIC, but sub-contracted from a professional provider. Thus, no development took place within the project.

B.4 Actual implementation of the measure

Note: This measure aims to develop a representative road safety concept and has been concretizing three actual sub measures to be implemented in the Living Lab (see A.2 Measure description). Due to several barriers in the implementation process, not all three road safety measures can be evaluated regarding the Baseline and After scenario for MER-2. Depending on the MUC 4.2 timeframe and several delays, only the in-depth analysis of road safety can be analysed for Baseline purpose. The other two approaches were tested in late autumn 2019 and beginning of 2020 and can only be partially evaluated.

Phase 1: Research and measure planning

- Implementation of an intensive communication and planning process with all relevant stakeholders
- Development and implementation of an innovative road safety concept ('Vision Zero') for the entire City of Munich, based on replicable outcomes of the CIVITAS ECCENTRIC project
 - o Principle program and strategy was approved in April 2018
 - o First implementation program was approved in November 2018

- Preparation of the measure implementation and demonstration phase in 2019
 - o Primary focus on realizable and effective measures (based on in-house and political discussions)
 - o Identification of intersections with key objectives of the road safety concept for the entire City of Munich
- Extension of the initially scheduled planning phase due to the high political relevance and external effects of the measure
- An early parallel process towards the implementation of the road safety concept for the entire City of Munich based on replicable outcomes of the measure → this was possible due to a supporting and accompanying political process

a) In-depth analysis of security experts of the road safety situation in the Living Lab:

- Subcontracting of traffic security experts for the
 - o Inventory and in-depth analysis of the road safety situation in Munich North based on existing traffic accident data
 - o Development of specific objectives to improve the road safety situation in Munich North
 - o Development of a specific measure program for the implementation of defined objectives including resource planning and cost calculation
 - o Development of a monitoring program to control the development of the road safety situation in the laboratory area and the achievement of objectives
- Identification of first measure implementation hotspots based on a hands-on road safety analysis together with measure stakeholders, especially local neighbourhood associations
- Intensive discussions concerning the outcomes of the finalized expert inventory and in-depth analysis of the road safety situation in Munich North based on existing traffic accident data:
 - o Intersections between the scientific analysis of accident data and the 'felt dangers' of local inhabitants
 - o Implementation potential of possible road safety measures (political and technical feasibility, costs, effectiveness)
- The in-depth analysis was finalized in phase 1 and was not a continuous measure because it was subcontracted for a pre-defined period.

b) Testing a device to identify perceived risks in everyday cycling (PING button):

- Delayed to a later phase after in-depth analysis has been done.

c) Education for children about road safety on the way to schools:

- Delayed to a later phase after in-depth analysis has been done. This measure took some time to implement because the concept was not clear from the beginning and there is an external stakeholder involved who is delaying the implementation as well.

Phase 2: Procurement and implementation

- A stakeholder workshop to develop a common understanding of road safety hotspots and the required measure design was conducted in 07/2017 and 05/2018.
- The implementation of two measures in the field of cycling safety and safety on the way to school has been prepared:
 - o PING-button: Testing a device to identify hazards in everyday cycling
 - o Education for children and parents about safety on the way to schools

b) Testing a device to identify perceived risks in everyday cycling (PING button):

- The PING-campaign was set up in cooperation with the two subcontractors, namely Bike Citizens and Mobiel 21
- Residents of the Living Lab have been contacted with information about the PING-campaign
- An event took place in 08/2019 to inform potential PING-users about the idea and the process

c) Education for children about road safety on the way to schools:

- All secondary schools in Munich have been contacted in May 2019
- Five schools were identified in taking part of the road safety workshops
- Three schools actually scheduled workshops for 11/2019, which did not take place due to delays caused by the external subcontractor who developed the workshop material

Phase 3: Demonstration and monitoring**b) Testing a device to identify perceived risks in everyday cycling (PING button):**

- The PING button test-phase started in 09/2019
- During a CIVITAS ECCENTRIC event in the Living Lab (08/2019), the PING-button and the complementary app were explained and distributed among interested residents who are willing to track their daily cycling route
- There are about 100 PING-button users, 51 of them are actively using the device
- The testing period is about two months (09/2019 - 10/2019)
- A closing event took place in 11/2019 to evaluate the user experience with the cyclists who were taking part at the test phase.

c) Education for children about road safety on the way to schools:

- One out of five schools actually conducted a workshop in 02/2020
- There were in total four school classes of a secondary school conducting the workshops about road safety.
- A media-effective opening event took place on the first workshop day where a camera team accompanied the happening

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Number of accidents	Number of fatalities and seriously injured	Awareness	Acceptance	Satisfaction
Type	KPI	KPI	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	TRANSPORT SYSTEM	SOCIETY-PEOPLE	SOCIETY-PEOPLE	SOCIETY-PEOPLE
Subcategory	Safety	Safety	Acceptance	Acceptance	Acceptance
Aspect	Transport safety	Transport Safety	Awareness level	Acceptance level	Satisfaction
Definition	Number of recorded accidents (in the target areas) caused by any means of transport recorded by the police which affect user health, or vehicle usability / performance	number of recorded fatalities and casualties caused by any means of transport	Percentage of residents / road users with knowledge about the implemented safety measures	Perception and acceptance of the safety measures	Users' average reported satisfaction with the safety measures
Unit	Number	number	Percentage	Percentage	Score (0-5)
Method of data collection	Police records	Police and hospital records	Baseline survey, follow up survey, and focus groups of road users affected by the safety measures	Baseline survey, follow up survey, and focus groups of road users affected by the safety measures	"After" Survey and focus groups
Target group	Road users	Road users	Living Lab residents, employees in Parkstadt Schwabing, and affected road users	Living Lab residents, employees in Parkstadt Schwabing, and affected road users	Users of the roads/paths that are affected by the safety measures

Impact	6	7	8	INPUT	INPUT
Indicator	Mode Shift	Car Ownership	Contribution to policies, plans and programs	Investment Costs	Operating Costs
Category	KPI	KPI	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	SOCIETY-PEOPLE	SOCIETY-GOVERNANCE	ECONOMY	ECONOMY
Subcategory	General	Accessibility	Planning	Costs	Costs
Aspect	Modal split	Physical accessibility to transport services	Planning process	Investment costs	Operating Costs
Definition	Percentage of users who changed permanently of transportation mode for doing the same trip (same origin and destination, time, and frequency). The main mode of a trip is that used for the longest stage of the trip by distance. With stages of equal length the mode of the last stage is used.	Cars owned per 1000 inhabitants of the populations aged 18 and over (with driver's license?)	Qualitative measurement on the process to modify policies, plans and programs in a significant and definitive way.	Total capital costs for purchase of equipment related to implementing the software and the later safety improvements. Preparation and design cost is defined as total costs expended setting up the measure covering a time period from the initiation of the measure preparation until the start of the measure implementation.	Personnel and maintenance costs for running the measure per time period.
Unit	Percentage (various values)	Cars to inhabitants ratio	Score (0-5)	Euro	Euro / (time or usage unit)
Method of data collection	Baseline survey, follow up survey, and focus groups of road users affected by the safety measures	Baseline survey, follow up survey, and focus groups of road users affected by the safety measures	Surveys and interviews to decision makers and relevant stakeholders	Data from financial reports, controlling	Data from financial reports, controlling
Target group	Users of the roads/paths that are affected by the safety measures	Users of the roads/paths that are affected by the safety measures	Decision makers		

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Number of accidents	Number	B – (A)	DC - E	Road users	Munich North
2	Number of fatalities and seriously injured	Number	B – (A)	DC - E	Road users	Munich North
3	Awareness	%	B - A	S	Residents / Road users	Munich North
4	Acceptance	%	B - A	S	Residents / Road users	Munich North
5	Satisfaction	Score (0-5)	B - A	S	Residents / Road users	Munich North
6	Mode Shift	%	B - A	E / S	Residents / Road users	Munich North
7	Car Ownership	Cars/inh.	B - A	E / S	Residents / Road users	Munich North
8	Contribution to policies, plans and programs	Score (0-5)	A	E	City	Munich
9	Investment Costs	€	A	DC	Measure	local
10	Operating Costs	€/time or unit	A	DC	Measure	local
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

C.1.2 Baseline

Measure MUC 4.2 is aiming to develop a road safety concept and to reduce accidents within the Living Lab. The three approaches (a) in-depth analysis, b) PING-button and c) FAPS) cannot entirely be evaluated regarding their Baseline and After scenarios. One reason is the lack of data regarding some of the KPIs, mainly caused by the serious delays of sub measure b) and c).

Sub measure a) is doing comprehensive research on the status quo within the Living Lab and not regarding an after-scenario because it was set up as a one-time subcontract for conducting the research. The baseline data for sub measure **MUC 4.2a** was assessed by a subcontracted firm, specialized in transport consulting. They obtained the entire data from the police headquarters of Munich for a period of five years. Other information comes from the Research Society for Roads and Transportation (Forschungsgesellschaft für Straßen- und Verkehrswesen, FGSV). Moreover, there were two workshops carried out with local residents of the Living Lab to obtain some qualitative data.

Sub measure b) is mainly evaluated in a qualitative way and only for the After scenario because there was not any similar measure existing before. The evaluation results for indicators like mode shift or car ownership would not change because of the implementation of the PING-measure because the aim is solely to test the PING-button technique and handling as well as the data output and quality the PING-tracking is producing.

For **sub measure c)** several workshops have been carried out which have been evaluated for the baseline and the after scenario. Due to the reason that this sub measure is not implemented in the ECCENTRIC Living Lab, there are some indicators which cannot be assessed. The baseline scenario data for sub measure **MUC 4.2c** "Education for children about road safety on the way to schools - FAPS" was collected by a short survey just before the realization of the workshop (02/2020). As sample two classes with 29 school children in total were asked about their perception and attitude towards the topic road safety.

Other baseline data was conducted as a household survey which was addressed to all 2.100 households within the Living Lab (Domagkpark and Parkstadt Schwabing). The survey took place from 04/2018-05/2018. The participation rate was 27%, what means that 935 people from 572 households answered the online survey or participated via telephone. The survey answered most of the KPIs while other KPIs are estimated by interviews with the Measure Leader.

a) Software-based road safety analysis

Addressing indicators 1 – "Number of accidents" and 2 – "Number of fatalities and seriously injured"

For the initial road safety analysis, the following data was used/ analyzed by the sub-contractor and put in to maps to show the local distribution within the Living Lab:

- Road network from the City of Munich
- Road transport accident data for the entire City of Munich (2010-2014) + Munich North (2015-2016) with the following attributes (data source: police reports of Munich)
 - o Date/time
 - o Location (Coordinates, Road classification, Area classification)

- o Circumstances of the accident (local situation, special factors, road quality, visibility/light, traffic signals, ...)
- o Accident classification (7 types)
- o Severity (Number of fatalities, severely injured and injured persons)
- o General reason of the accident
- o Cost
- o Involved persons (number, age, injuries, ...)

In total, the dataset includes 228.418 accidents with personal injuries or only material damages (data: whole city, 2010-2014). Filtering for the Munich North, 4.939 road accidents were included for analysis. E.g. driving accidents, turning accidents, cruising accidents, accidents due to dormant traffic or minor accidents. The number of accidents in Munich North seems to be representative regarding the type of accidents which occurred. There were 66% minor accidents (3.270), only 13% involve injuries. That meets the statistics of the State of Bavaria, where 17% of all accidents (2018: 410.000) involve injured persons (source: Ministry of the Interior of Bavaria).

Results

Main result is a map of accident types:

- (4)
- (5)
- (6)
- (7)
- (8)
- (9)
- (10)
- (11)
- (12)
- (13)
- (14)
- (15)
- (16)
- (17)
- (18)
- (19)
- (20)
- (21)
- (22)
- (23)
- (24)
- (25)



Figure 1: Accidents by type

The overall average annual societal cost for the accidents (2010-2016) sums up to **7.4 million Euro**. Most road accidents (3.270) can be assigned to the category "minor accidents". Thirteen percent of all accidents involved injuries. However, these are responsible

for 44% of the overall cost. Compared to the citywide average, this share is slightly higher (12% of all accidents and 39% of the costs). These data come from the police records of Munich.

3.859 accidents happened on major roads and intersections, 942 were recorded by the police of Munich in access roads. Another 139 accidents were recorded at Domagkstraße, which is classified as a collector street (data: police Munich). In the area of access roads, mostly minor accidents were recorded, while severe accidents usually happen at the bigger roads.

The accident information was processed into the following heat maps:

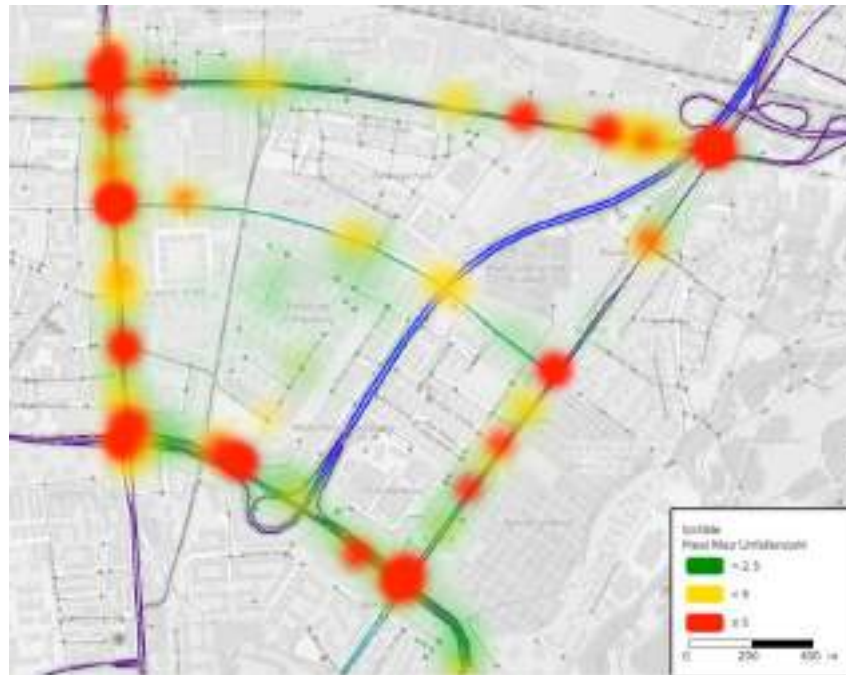


Figure 2: Heatmap of all accidents with injuries

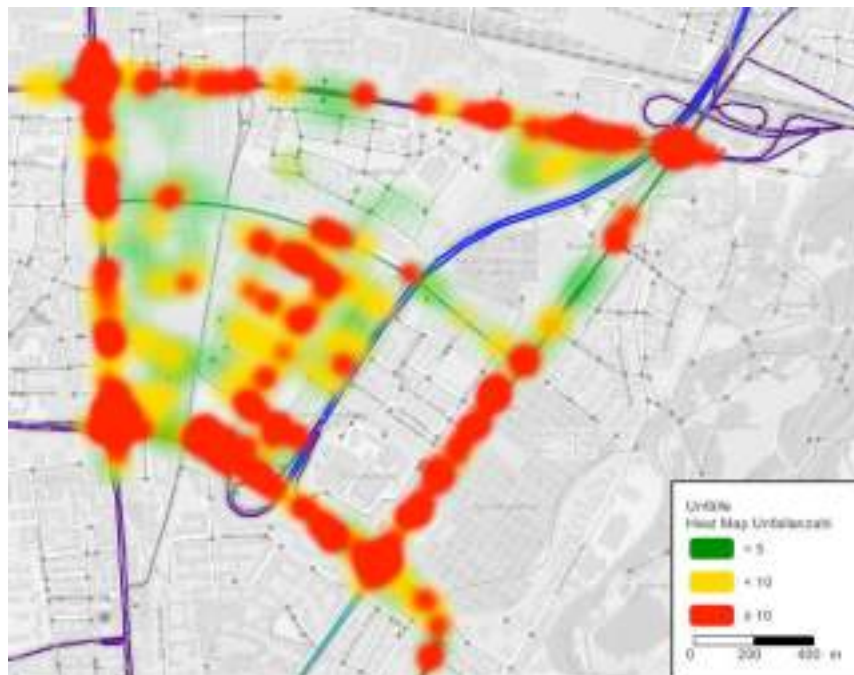


Figure 3: Heatmap of all damages (without injuries)

Among the accident types, collisions at intersections are more frequent than in the city-wide average, while the number of accidents with parked vehicles is lower. Especially the risk of collisions with turning cars and cyclists is high.

Regarding the ration between accidents and traffic volumes, younger demographics (18-29) have a remarkable high risk of being involved in an accident:

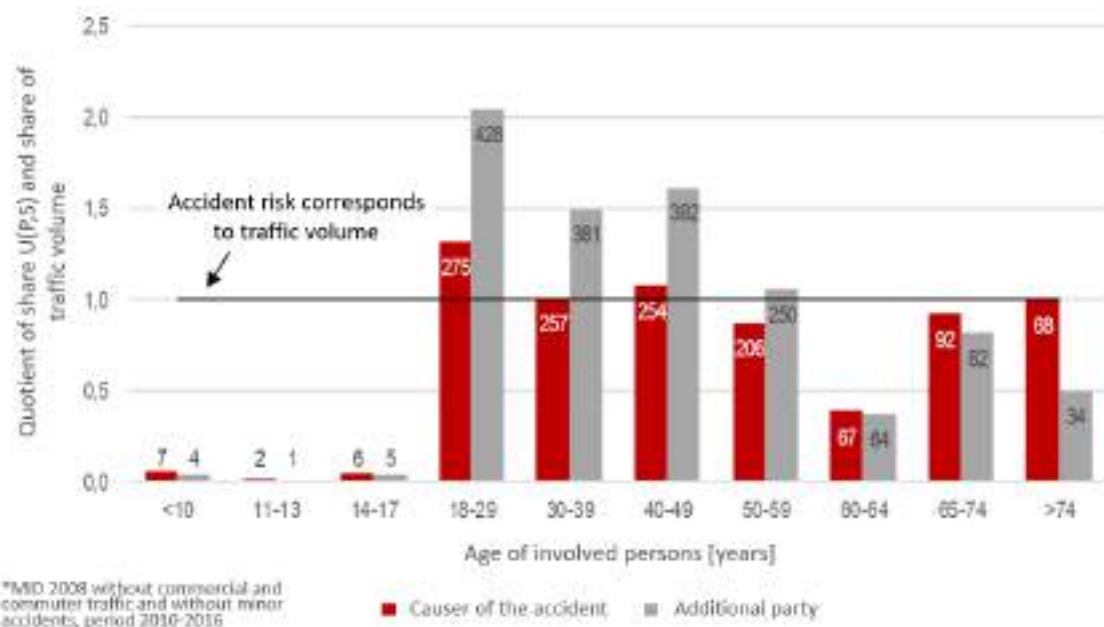


Figure 4: Accident risk and age group (1.0 = average risk based on volume; red: responsible, grey: other involved)

Regarding the reasons, the following causes are the most frequent in the study area:

- Mistakes at turns (15% of all accidents)
- Lack of safety distance (10%)

- Lane changes (10%)
- Direction changes / backward driving (8%).

A special focus of the analysis is the situation for cyclists and pedestrians, as the following two maps show:

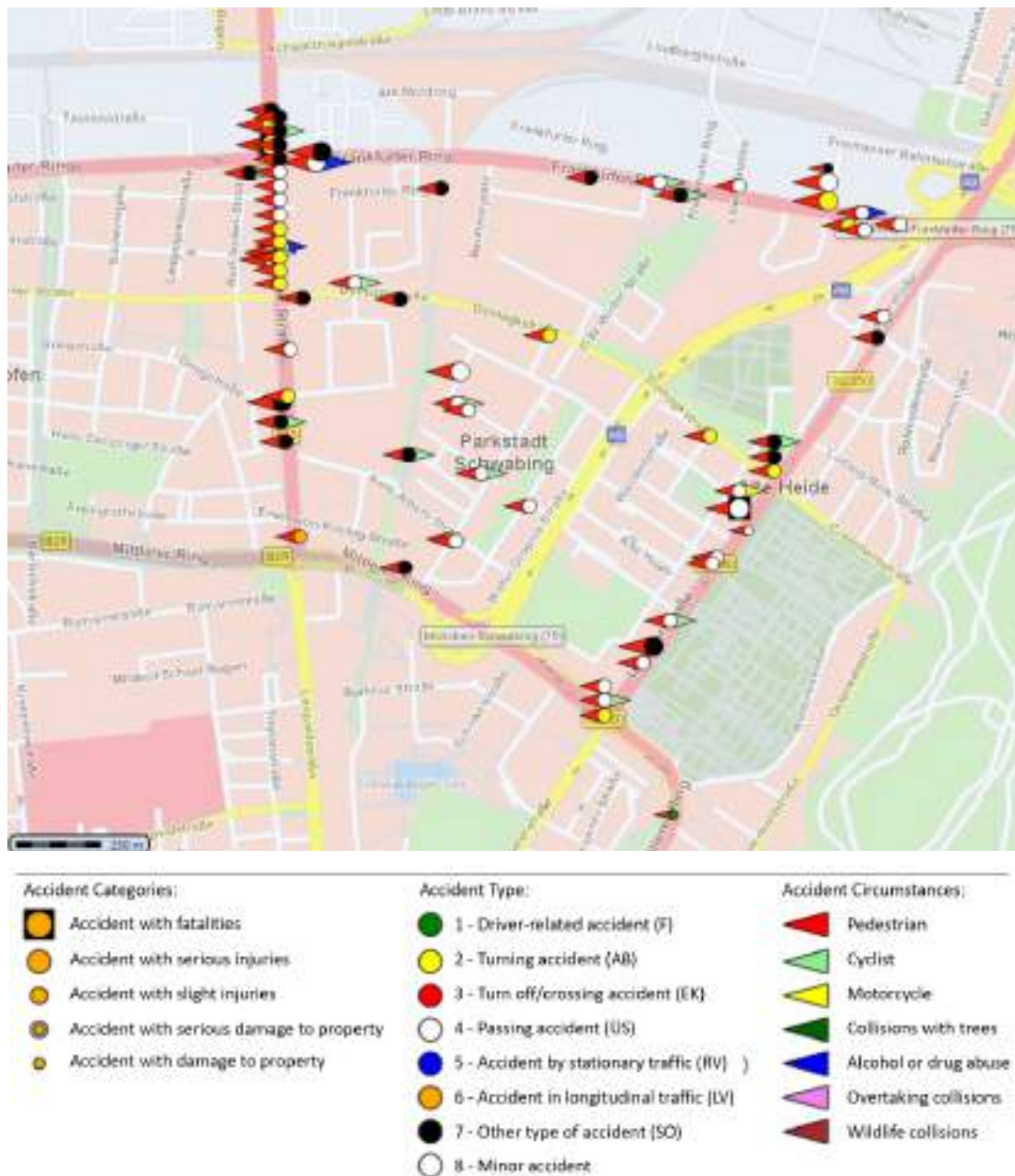


Figure 5: Accidents with pedestrians involved



Figure 6: Accidents with cyclists involved

Perceived road safety

Addressing indicator 3 – "Awareness" and 5 – "Satisfaction" of the current situation

Two workshops were organized to collect information about the perceived safety in the Living Lab. After the workshops with residents of the Living Lab, the ML stated that there is in general very little **awareness** about safety programs in the area or resources that could improve their safety.

In July 2017, a workshop was organized with the help of the residents' associations. The following map of perceived problematic areas was created:

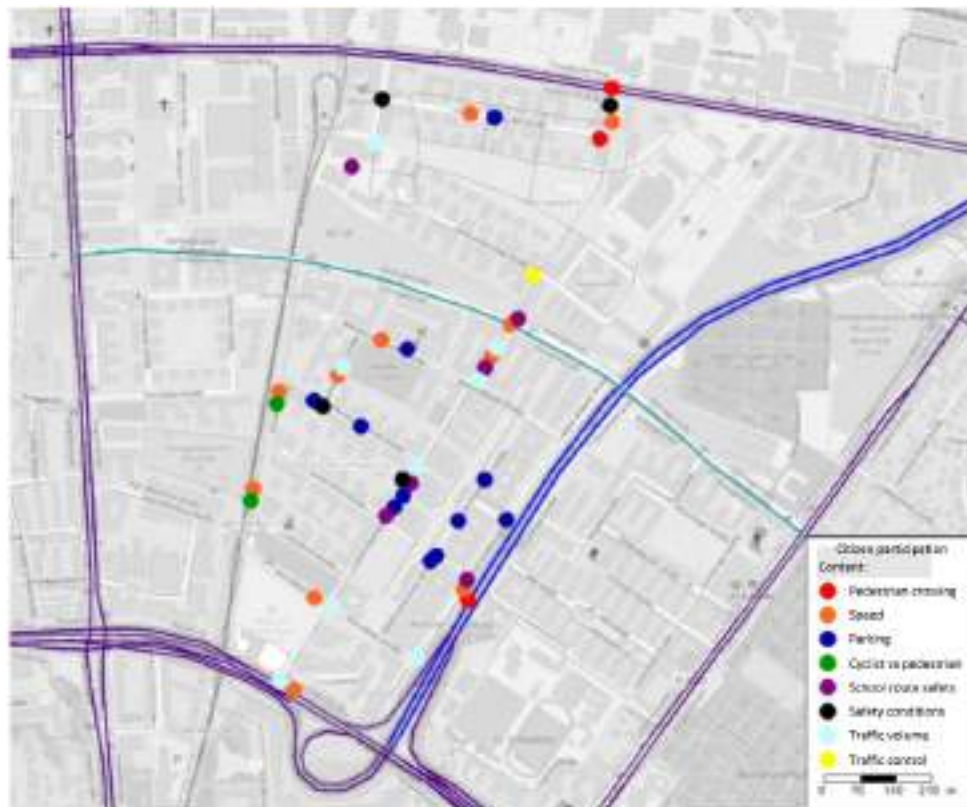


Figure 7: Map of perceived road safety problems

Comparing the actual hotspots from the analysis of police accident data with the perceived ones by the citizens, the following visualisation allows a comparison:

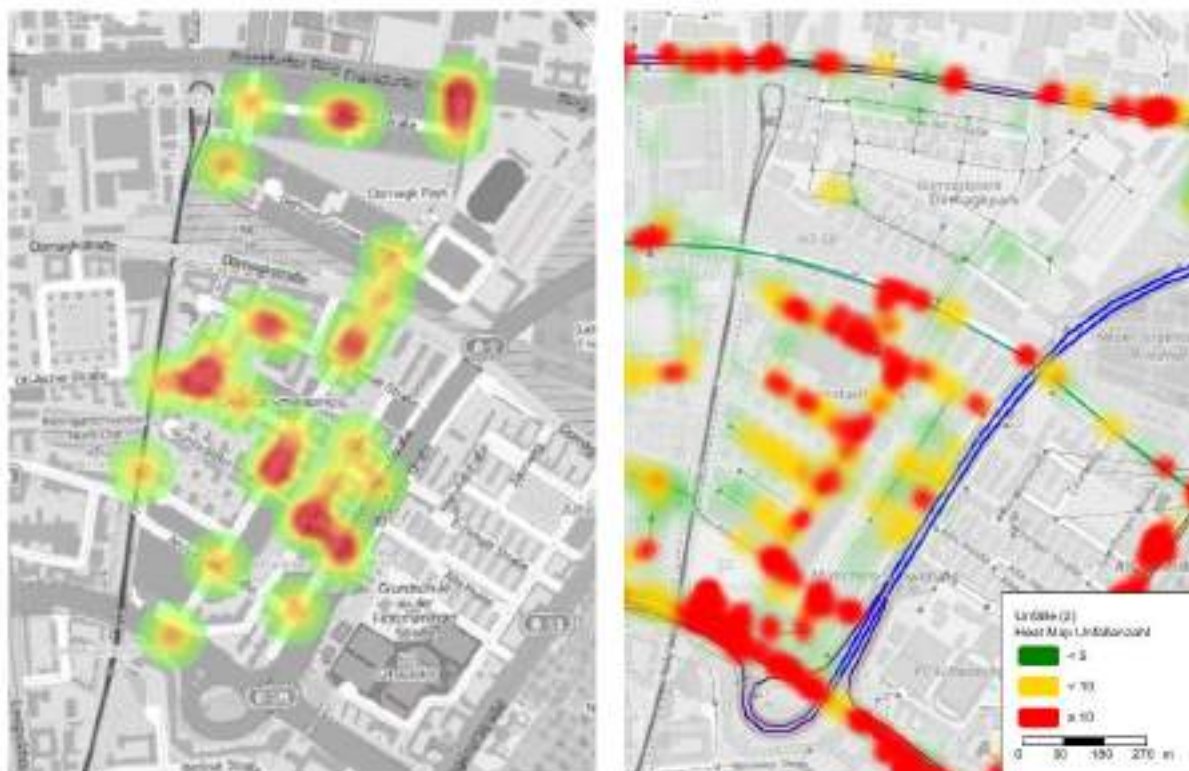


Figure 8: Perceived (left) and actual (right) accident hotspots

Some areas (partly Domagkpark, Hannes-Meyer-Street) were perceived as dangerous, but according to the data, they are not statistically significant accident hotspots.

In a second workshop in May 2018, the results were presented and residents could give feedback and name further problematic areas. The results will be included into the development of measures to improve the situation.

c) Education of children about road safety on the way to school (FAPS)

Addressing indicator 3 – "Awareness", 4 – "Acceptance" and 5 – "Satisfaction" 6 – "Mode Shift"

The education of school children took place at 1 secondary school, in four school classes from 7th to 9th grade. Two classes with 29 (before) respectively 30 school children (after) in total were chosen as sample and asked in a survey about their behaviour and perception regarding this topic before and after the workshop.

In terms of **Awareness**, the schoolchildren were asked about their background knowledge regarding road safety and in which situation they already dealt with this topic (see Figure 9).

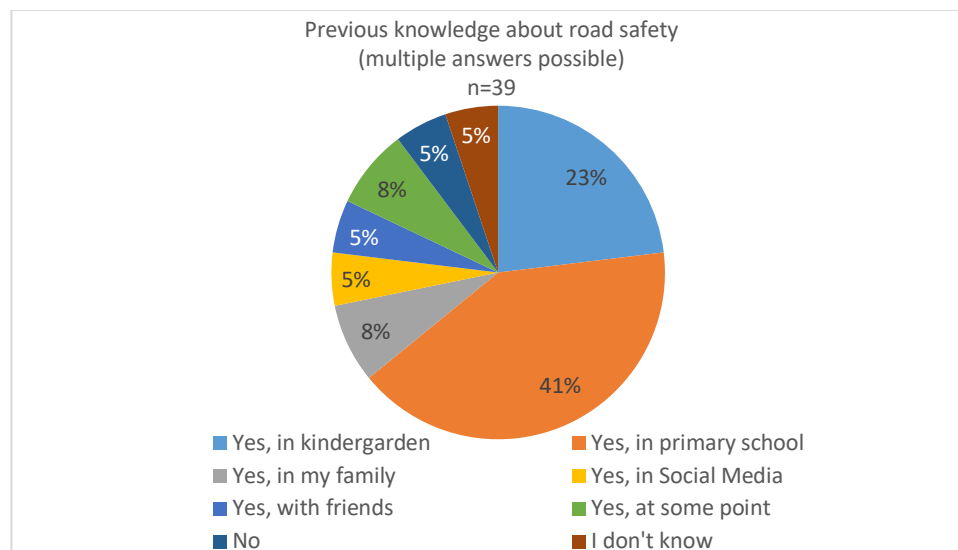


Figure 9: Previous experiences about road safety by schoolchildren

Except two, all of the schoolchildren were confronted with road safety once before. Most of them answered, to already have had some sort of education regarding this topic either in primary school (41% of responses) or in kindergarden (23%). The other answers are distributed relatively evenly among the remaining options: in the family (8%), in social media (5%), with friends (5%) and at some (undefined) point (5%).

The schoolchildren were also asked to rate their current knowledge regarding road safety on a scale from zero (no knowledge) to ten (very much knowledge) (see Figure).

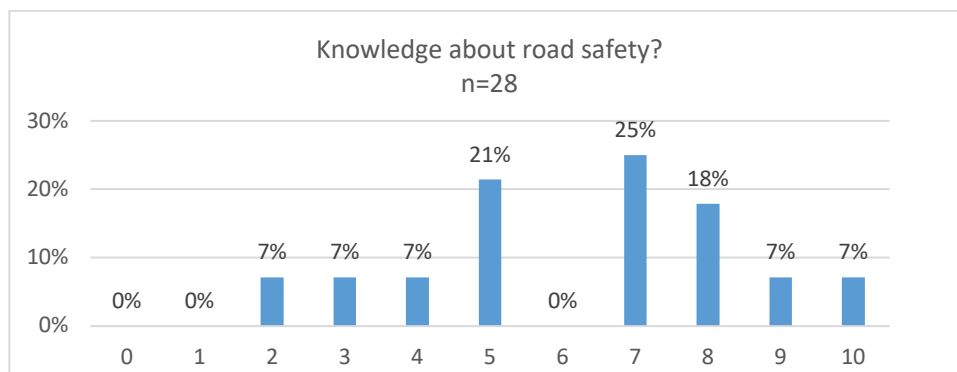


Figure 10: Knowledge about Road Safety before the measure

The evaluation of the knowledge resembles approximately a normal distribution. On average the schoolchildren rated their previous knowledge about road safety with 6,25 out of 10 and thus slightly above medium.

To estimate the **Acceptance** of the measure, the schoolchildren were also asked about their perception of their own feeling of safety on their way to school (see [Figure](#)).

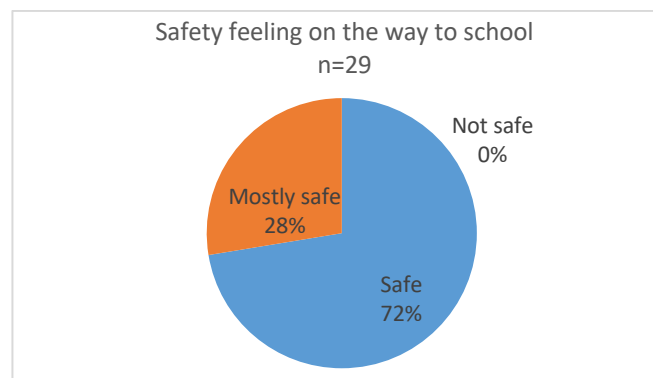


Figure 11: Perception of own Safety on the way to school

All children answered to feel “safe” (72%) or “mostly safe” (28%) on their way to school, no one answered to feel “not safe”.

A further question regarding the situations, in which the schoolchildren feel unsafe, gives specific information about critical situations on the school way from the perspective of the children. Three out of four respondents answered to feel unsafe because of cars driving too fast, respectively too close to them. One other respondent answered to be afraid of trucks probably missing him. In general, there were not many answers regarding this question which shows that the road safety perception is quiet positive.

Furthermore, the schoolchildren were asked if they would like to know more about the topic road safety which shows the acceptance towards measure MUC 4.2c (see [Figure](#)).



Figure 12: Acceptance to learn more about the topic, before

The majority (52%) of the schoolchildren answered to have no willingness to learn more about the topic of road safety. 21% responded neutrally “I don’t know” and 27% answered they want to learn more about it. There is a medium acceptance among the schoolchildren to learn more about road safety.

The mobility behaviour of the schoolchildren in form of the **modal split** is shown in [Figure 13](#).

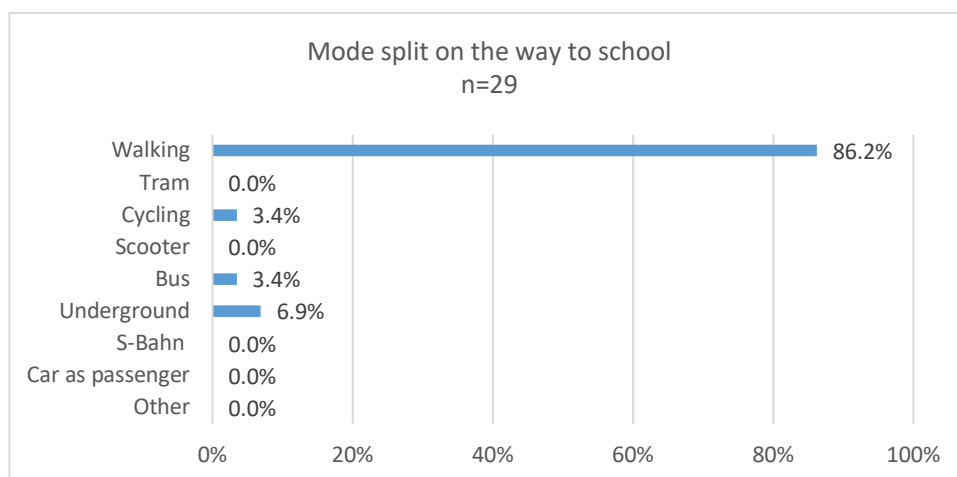


Figure 13: Mode Split schoolchildren FAPS

By far the majority (86%) of the schoolchildren walks to school. In a qualitative interview the teacher stated that most of the children live nearby in walking distance, so the big share of school children walking is no surprise. Only a minor part (10%) goes to school by public means of transport as underground (7%) and bus (3%). Also, a small share of children goes to school by bike (3%). None of the participating schoolchildren answered to have used tram, S-Bahn, scooter or car as passenger to go to school.

The KPI **satisfaction** cannot be assessed because there was no such measure or similar workshop concept before ECCENTRIC.

The KPIs **emissions** and **car ownership** cannot be assessed for sub measure MUC 4.2c because it is focusing on a target group below 18 years.

General Data of the Living Lab

Sub measures **MUC 4.2a and b** are taking place within the Living Lab. The following indicators are considered for the Baseline scenario but keep in mind that there is no reasonable After scenario to be observed for measure MUC 4.2a because its aim was not to change the circumstances within the Living Lab but to show the status quo and to test an instrument for measuring road safety perception.

Addressing indicators "6 - Mode Shift", "7 - Car Ownership"

Car ownership in the Living Lab was obtained with the first household survey in 05/2018. With 0.92 cars per household the car ownership rate is equal to the city-wide average of 0.9 (cf. infas, 2010).

In detail, around 25% of the 572 questioned households are car-free, 60% do have one car and only few have 2 or more ([Figure](#)).

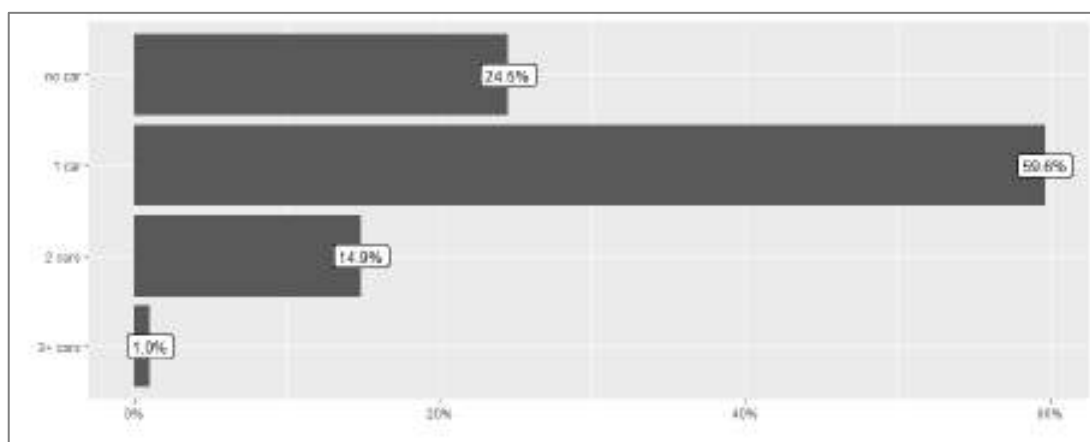


Figure 14: Number of cars per household, 2018

The Living Lab population is with 4.24 trips per day and person on average more mobile than the German average of 3.1 (infas, 2018).

The **modal split** (trip-based) of this group is visualized in [Figure](#), based on the answers of 935 persons who reported about 3967 trips in April/May 2018 as part of the ECCENTRIC household survey.

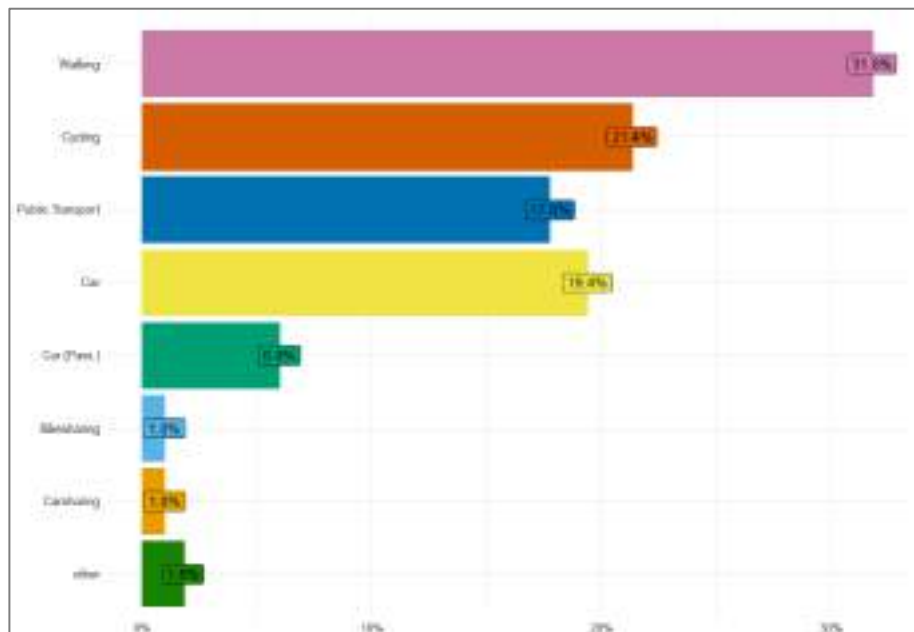


Figure 15: Modal Split of Living Lab residents, 2018

Addressing indicator “8 - Contribution to plans and policies”

The whole measure MUC 4.2 is **contributing** in several ways to **policy, plans and programs** within the city of Munich. The political development is highlighting aspects regarding road safety and many parties are pushing those decisions (e.g. Die Grünen, SPD, CSU, ÖDP). Furthermore, there are involved associations like the Allgemeiner Deutscher Fahrrad-Club (ADFC) Landesverband Bayern (General German Bicycle Club, Regional association of Bavaria) or public petitions like the Radentscheid München (“Munich bike decision”).

Munich has a road safety concept which has been approved by the City Council in 04/2018. The “Vision Zero” is the key element and basic strategy in this road safety concept. Vision Zero aims to prevent road death and fatal and severe crashes (see section A 2.2 and A 2.4). Two subsequent city council approvals in 2018 and 2019 addressed the implementation strategy for the Munich road safety concept. Those plans and policies have a major impact on the realisation of this measure MUC 4.2 because it’s in the political interest right at the time, especially before the local elections which take place in 03/2020. Due to this a score of 4 out of 5 can be given.

Data on **investment and operational cost** was obtained for the ex-post evaluation when the implementation phase was completed.

C.1.3 The business-as-usual scenario

According to the residents and experts, car **traffic volumes** are expected to increase over the next years due to the following factors:

- Completed construction works in the Living Lab.
- Further developments in the Munich North (Bayernkaserne, BMW FIZ, ...).
- General city-wide increase due to growth and increasing car use.

Due to difficulties implementing the sub-measures, there is no quantification within the scope of this measure possible. There can no targeted information and quantitative numbers about the actual changes/improvements be made in the area.

In general, the **number of traffic accidents** is increasing between 2011 (350.000) and 2018 (410.252) (data to be found in the Bavarian traffic accident statistics of 2018). But the **number of injured persons** remains constant about 68.000 to 71.000 (2011-2018).

For **Awareness, Acceptance, and Satisfaction**, no significant changes are expected in the BaU-scenario. There might be in general a better awareness due to the fact that the city of Munich is promoting their Vision Zero concept. On the other hand, the satisfaction rate might also increase because some changes regarding new and safer bike lanes etc. are being planned and implemented by the city.

Car Ownership does not show big changes on the nationwide level (2002-2008-2017), while the ratio cars per inhabitants in the relevant part of the city ("between middle ring road and city boundary") has been decreasing slightly over the last 10 years, from approx. 430 cars per 1000 inhabitants in 2005 to 412 in 2015 (-1%). However, for the reporting period until 2020 stable conditions are expected.

Mode Shift

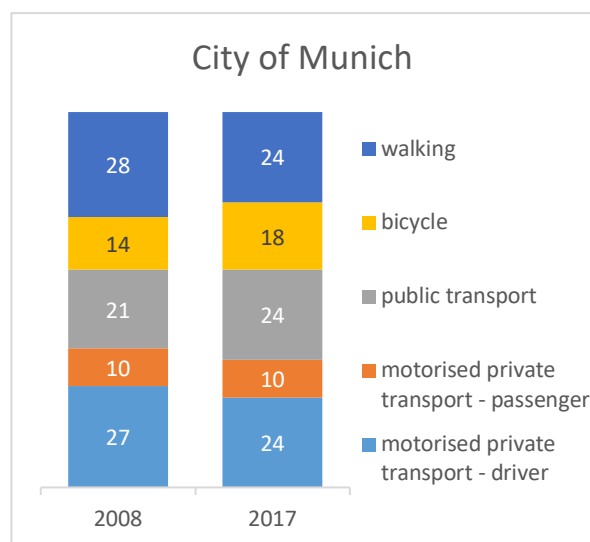


Image: City of Munich, Data: infas edited (2018)

Figure 16: Modal Split in Munich (2008+2017)

The nationwide mobility survey "Mobilität in Deutschland" acts as a reference to determine trends and future mobility behaviour in Munich.

In general, the Munich population drives less and walks less, while PT and cycling increase over time (see [Figure](#) : change 2008-2017: car -3%, PT +3%, cycling +4%, walking -4%). Extrapolating this trend from 2008 to 2020, the following mode shifts in the BaU Scenario for 2020 can be assumed: Car: -1%; PT: +1%; Bike: +1%; Walking: -1%

Note: A recent study by the Center Automotive Research (CAR) of the University of Duisburg-Essen published in 12/2019 that the number of cars is constantly increasing within the last ten years in Germany's larger cities. Comparing the number of cars from 2009 until 2019, there is an increase of 18,5% in car ownership measured in Munich (cf. CAR, 2019). This resembles a different trend then expected above in the BaU scenario assumptions of 2018.

C.2 Measure results

The following table shows the measure results of MUC 4.2 and its sub measure a), b) and c). In some cases, the Before, BaU or After scenario is valued as not assessed (NA) because there was not any direct measure implementation which would have an impact on the indicators.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After–BaU
Number of accidents	Number	228.418 City 4.939 Munich North	2010 - 2014	NA	-	NA	-	NA	NA
Number of fatalities and seriously injured	Number	642 Munich North	2010 - 2014	NA	-	NA	-	NA	NA
Awareness	%	c) Education of schoolchildren: 90% “Yes” 5% “No” 5% “I don’t know” Average of Rating: 6,25	01/2020	NA	-	c) Education of schoolchildren: Average of Rating: 8,0	30.01.2020	Rating: + 1,75	NA
Acceptance	%	c) Education of schoolchildren: Willingness to learn more about the topic: 27% “Yes”	01/2020	NA	-	c) Education of schoolchildren: Acceptance of the topic: 90% “I liked it very much” and “I liked it”	01/2020	c) Acceptance of the topic: + 63%	NA

2020
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		→ 0,92 cars/ household		2 cars: 9,7 3+ cars: <0,7					
Contribution to policies, plans and programs	Score (0-5)	2	-	NA	-	4	02/2020	+2	NA
Investment Costs (net)	Costs related to people and their time (in €) period: Road safety expert (subcontract): 33.613,45				Costs of equipment (in €): None				
Operating Costs (net)	personnel costs (subcontract road safety awareness campaign/ PING)					42.016 € (ca. 4 months)			
	personnel costs (subcontract event management agency)					7.300 € (ca. 3 weeks)			
	personnel costs (subcontract awareness project - road safety on the way to school)					6.000 € (1 month)			

The following ex-post data was obtained from different data sources:

b) Device to identify hazards in everyday cycling: PING

- Results of the road safety prevention tool test (PING button) carried out from 09-10/2019 with 49 participants. A short online survey was conducted through the subcontractor Bike Citizens and Mobiel 21.
- A workshop was carried out within the ML's institution together with the subcontractors (in 12/2019). The aim was to practice the usage of an online browser-based dashboard which allows to zoom in specific streets of Munich and see spots which were defined, being less safe for cyclists. In general, the workshop showed the quantity and quality of data which the system generates.
- A closing workshop event where participants of the PING-button test were invited to share their user experience. There were 11 participants present, who used the PING-button on a regular basis during the test phase of two months (11/2019).

c) Education of children about road safety on the way to school (FAPS)

- The "FAPS" workshop for schoolchildren was assessed by a paper-based survey with two school classes which took part in the "road safety project days". The survey took place right after the workshop was finished (02/2020). 30 school children participated in the survey.
- Another qualitative interview about the acceptance and satisfaction with the workshop concept itself was conducted with the school's principal who was responsible for preparing and carrying out the trainings.

Note: Due to several delays, internal coordination processes within the ML's institution as well as the foreseen implementation of a new traffic flow concept for the southern part of the living lab, there has not been implemented any concrete measures to actually reduce the number of accidents and fatalities. Especially the foreseen traffic flow concept will cause substantial changes in the living lab and will consequently change risk hotspots. The extensive baseline analysis of road safety and identified measures to improve road safety will therefore most probable lose its validity for this part of the living lab and will make necessary an additional baseline study. Nevertheless, a comprehensive research on feasible methods for accident prevention was done and the sub measure MUC 4.2b on testing a prevention tool called PING already took place within the Living Lab. The ex-post evaluation of the implementation of the FAPS workshop can also be done.

Addressing indicators "1 - Number of accidents" and "2 - Number of fatalities and seriously injured"

These indicators have not been assessed for ex-post evaluation because there was actually no sub measure implemented in the Living Lab to see differences between the Baseline and After scenario. Same goes for the KPIs "6 - Mode Shift" and "7 - Car Ownership".

b) Device to identify hazards in everyday cycling: PING

Addressing indicators 3 – "Awareness", 4 – "Acceptance" and 5 – "Satisfaction"

The goal of this sub measure MUC 4.2b was not to improve road safety through behaviour change of the citizens or the implementation of local measures, but to test a method for detecting road safety issues with modern technology and citizen's participation.

The **Acceptance** of the measure was good, during the testing phase of eight weeks, over 100 citizens subscribed for the application and about half of them (51 persons) used it constantly for their daily routes. From these 51 constant users, 47 profiles could be obtained more accurately, due to their participation in the corresponding user survey. About 60% of the survey participants answered to be male, 32% to be female and 8% did not specify their gender. The average age of the participants was 41, while the youngest participant was 27 and the oldest 67 years. 15 (32%) of the 47 participants stated to work in the Living Lab, while 19 participants (40%) stated to live there. 3 participants (6%) answered to be in the area because of other reasons and 10 participants did not answer this question. Most of the participants use a standard bike (81%), very frequently (70% daily and 24% several times per week) and perceive Munich as a bike-friendly city (81% of the respondents rate the city, on a scale with 10 as maximum, as five or higher).

The score for the KPI **Satisfaction** is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI. In case of MUC 4.2 the score derives from two different views:

- The PING-users.
- The Department for Public Order (ML and ML's institution).

PING-user's satisfaction:

To get feedback, all PING-users were invited to a closing workshop event, to share their experiences, satisfaction and suggestions for further improvement. 11 motivated PING-users participated and gave the following insights:

According to the impressions of the closing workshop, the **satisfaction** with the measure was high, in general. While the participants had mixed feelings about the registration process, they were very satisfied with the technology and the offered PING-categories. Furthermore, the participants stated to have a good feeling using PING and thus confirmed the user-friendliness of the application.

Nevertheless, the participants also wished for some improvements: According to some users, there is a technical issue with the accuracy of the PING-markings. The GPS-positioning seems to have inaccuracies of 2 meters and the accuracy decreases with the length of the travelled distance. To overcome this issue, the users suggest an option to edit the position of the PING-marking afterwards by themselves. Further suggestions of improvement are the menu navigation and design of the app, adding an option for commenting on PINGs. In addition to that they wish for an option to PING for positive experiences and thus derive best-practice examples. The participants also stated, that it's often difficult to remember the individual situation which lead to a PING-marking in the review of long ways and that the energy consumption for using the app is relatively high due to the constant GPS-tracking. One participant mentioned it would be helpful to directly use the smartphone to PING instead of having the PING-button as additional device.

The participants, in general, are happy to be involved in the process of road safety detection and would like to get more information about the further proceedings of the project. The users are satisfied with the number of categories, but additional ones would be useful. All hope that the PING-method will soon be implemented within the entire city. Swarm intelligence could be considered to avoid fragmentation, stated one participant. It has to be taken into account that

these statements are individual opinions and do not necessarily show a common sense of all PING-users.

Due to these qualitative statements of the PING-users a score of 3 out of 5 can be given. There is plenty of positive feedback about the handling and procedure to use the app but the user rate of people using this device in their daily life is still very low. Besides that, there are still improvements to be made for an even simpler and better app usage.

ML's satisfaction:

Not only the users, but also the ML is satisfied with the sub measure, which generates new data about road safety for cyclists. The generated data is sufficient in size and quality to assess cycling quality and deduce measures of improvement. Due to this a score of 3 out of 5 can be given. Over the duration of the pilot phase, 1.863 ways have been tracked and 3.103 PINGS have been marked. About half of the marked PINGS (1.552) were further classified according to the predefined categories for critical situations. The top five selected categories are:

1. Pedestrian on cycle lane
2. Ghost driver on a one-way cycling lane
3. No dedicated cycling infrastructure
4. Close overtaking or cutting in by motorized vehicle
5. Poor quality of road surface

The PING-data is also located on a digital map (see [Figure](#)):



Figure 17: PING markings per category in the Living Lab

The ML receives not only the PING-data, but has also access to four additional functions which were automatically tracked via the Bike Citizen app (see [Figure](#)).



Figure 18: Additional functions of the "Bike-Citizen-App", map section: Living Lab

Beside the tracking of safety issues for cyclists, the Bike Citizen app also analyses and maps data for preferred and avoided ways, absolute velocities, traffic density and waiting time at crossroads and traffic lights.

Additionally, the behavioural data of all users of the Bike Citizen app within Munich is provided on a daily updated dashboard (see [Figure](#)). A roll-out of this sub measure could facilitate a daily summary with the help of this cycling dashboard. In total there are yet 2.726 active cyclists in Munich which use the Bike Citizens app (data from 05/2013-02/2020). This number of people could easily be introduced to the PING-idea, and help to create an almost complete picture of perceived lacks of road safety. With investing in a simple add-on for the app the City of Munich can closely monitor the citizen's road safety feeling and thinking one step further, respond to those dangerous spots with physical construction measures.



Figure 19: City cycling dashboard by bike citizens

c) Education of children about road safety on the way to school (FAPS)

Addressing indicators 3 – "Awareness", 4 – "Acceptance", 5 – "Satisfaction" and "Mode shift"

The education of school children took place at one schools, in four classes from 7th to 9th grade. For the After-scenario two classes with 30 pupils in total were chosen as sample and asked about their behaviour and perception regarding the road safety topic after the workshop.

In terms of **awareness**, the schoolchildren were asked to rate their knowledge about road safety right after the workshop on a scale from 0 to 10. [Figure](#) shows the distribution:

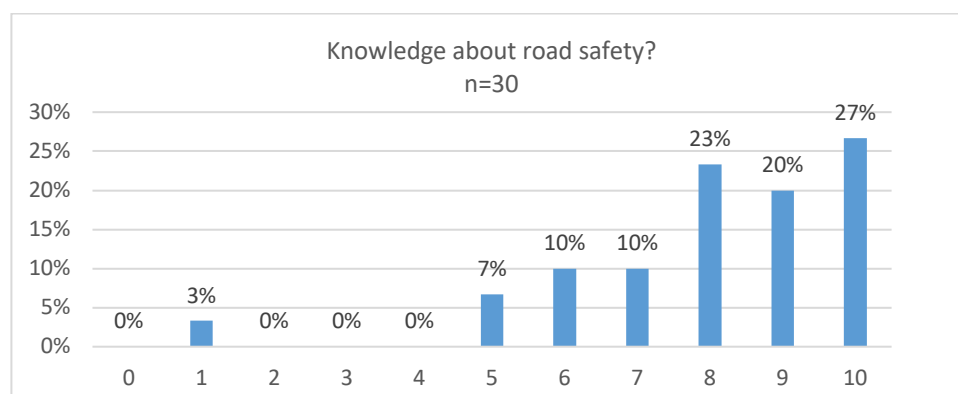


Figure 20: Knowledge about Road Safety after the measure

Except one, all of the schoolchildren rated their knowledge right after the workshop as five or higher. Thus, the rating average was with 8,0 after the measure on a relatively high level and about 1,75 points higher than before the road safety workshop. That means the awareness of the topic road safety increased through the implementation of sub measure MUC 4.2c.

The **acceptance** to learn more about the topic road safety which means the acceptance of the measure in general, has been rated higher after the workshops than before (compare [Figure](#) and [Figure](#)).

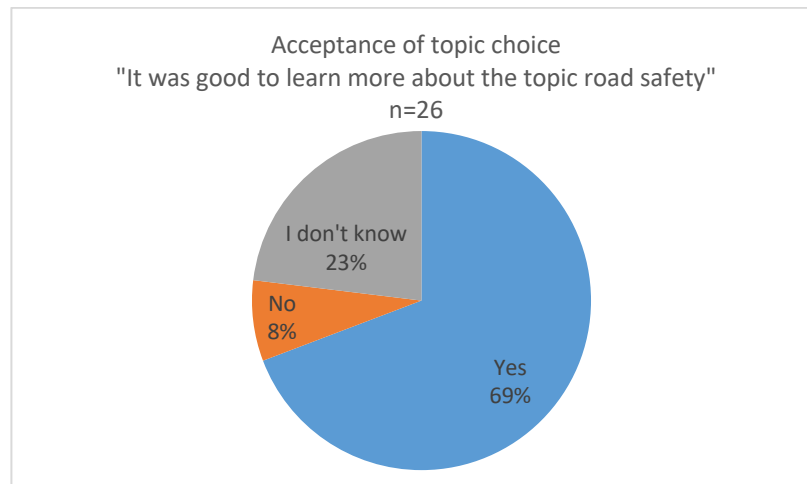


Figure 21: Acceptance to learn more about the topic, after

69% of the schoolchildren stated that it was good to have learned more about road safety. 23% responded neutrally "I don't know" and only 8% did not like to learn more about the topic. Compared to the willingness to learn more about the topic before the workshop (only 27% thought it was positive, see [Figure](#)) this means a huge increase in acceptance of the measure after the workshop took place.

In addition, when asking for the individual gains of the measure, 59% of the schoolchildren answered, to feel safer afterwards. This is a relatively high number regarding the safety perception before the workshop (see [Figure](#) , p.688) where already 72% stated to feel safe on their way to school.

The score for the KPI Satisfaction is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI.

The **satisfaction** with the measure was very high among the schoolchildren (see [Figure](#)).

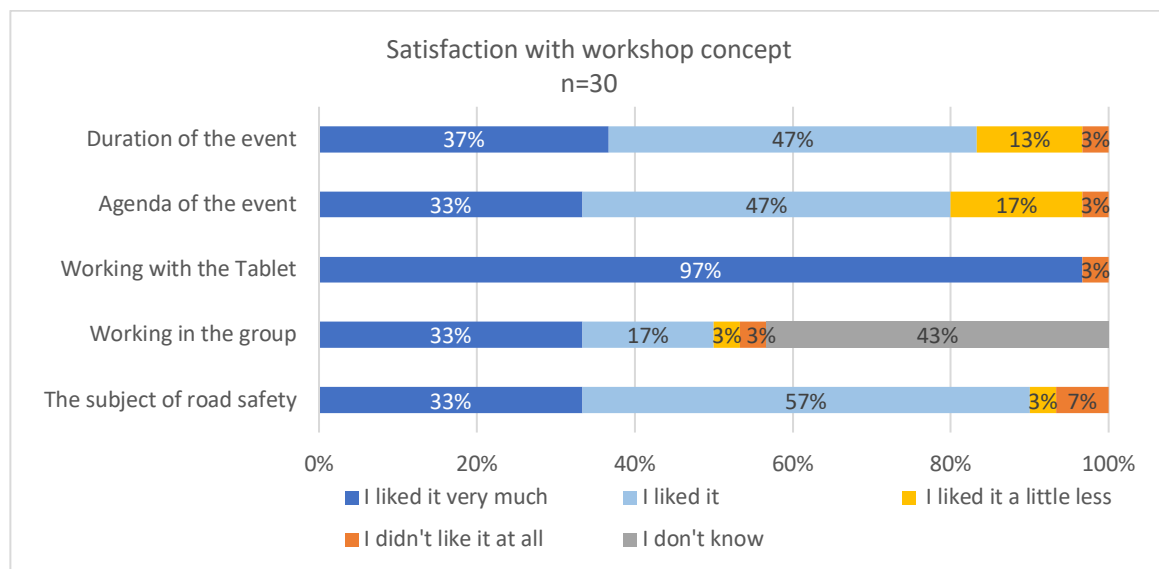


Figure 22: Satisfaction with the measure

In general, the children were very satisfied with all the aspects of the workshop. Especially working with a tablet was the highlight of the workshop (97% liked it very much). Even though the willingness to learn more about the subject road safety was low in advance, the subject was relatively popular afterwards (33% liked it very much and 57% liked it). Most of the pupils were also satisfied with the workshop duration (37% liked it very much and 47% liked it) and the agenda of the event (33% liked it very much and 47% liked it). The only aspect, rated with a smaller percentage of satisfaction was the group work, the majority, 43% answered here neutrally “I don’t know”. Due to the teacher’s comments from a qualitative interview, this is not surprising, considering that group work is somehow daily business for the pupils. Due to this a score of 5 out of 5 can be given for the pupil’s satisfaction.

Asking more into detail about the satisfaction with the individual agenda points, the following rating results (see Figure).

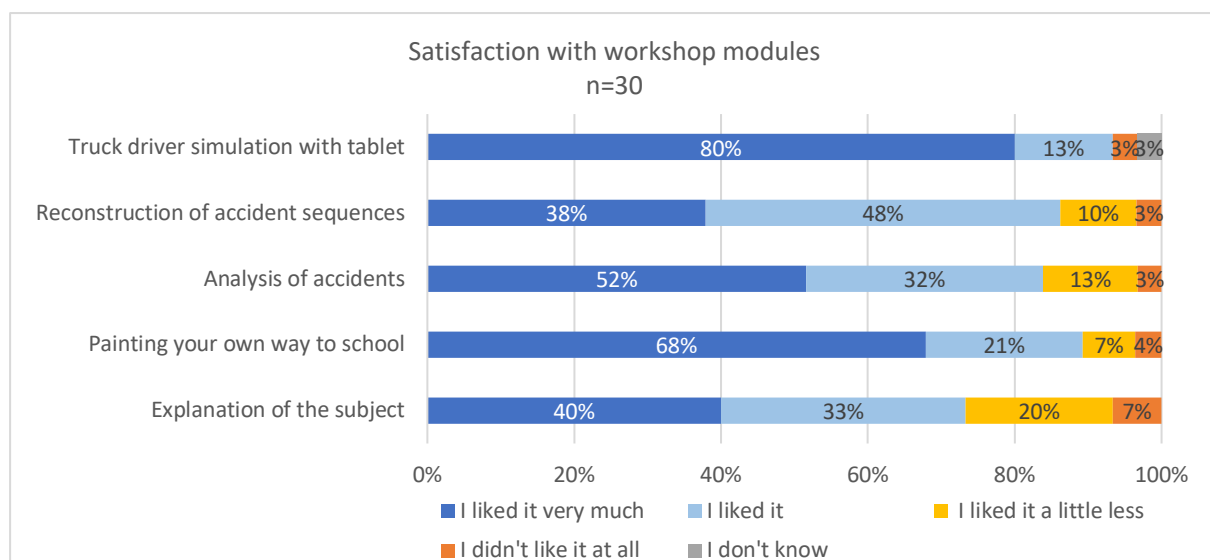


Figure 23: Satisfaction with the agenda of the event

In general, the children were very satisfied with all the agenda points of the workshop. The truck driver simulation with the tablet was their favourite part of the workshop (80% liked it very

much and 13% liked it). Also, Painting the own way to school (68% liked it very much and 21% liked it), the reconstruction of accident sequences (38% liked it very much and 48% liked it) and the analysis of accidents (52% liked it very much and 32% liked it) were rated very good. The lowest rated agenda point was the general explanation of the subject, even though this was a relatively dry point of the agenda, still 73% of the schoolchildren liked it.

To round off the opinion of the students about the workshop concept, qualitative statements of the school's principal can be added here:

- FAPS (Fraunhofer) offers good materials for teachers and students, but for the kind of school level (secondary school) it's a bit too extensive and detailed (especially the graphs and diagrams).
- Graphs and diagrams are partly difficult to explain or understand for pupils in grades 5-6.
- There were too many exercises and examples to go through.
- The workshop duration is well chosen with spending half a day on the topic.

The following recommendations have been given by the principal:

- Have individual scenarios developed for the tablet simulation, not just let the students "play around" with it.
- Integrate real field observations with the entire class, means common exploring the school surroundings and practising how to behave in real traffic situations.
- Reuse graphs and diagrams in other contexts/lessons and integrate the topic of road safety indirectly.
- Define the tasks in the workshop leaflet more in line with children of the targeted age group.

The MLs institution was also very satisfied with the measure as the positive results and feedback will in general allow a city-wide upscaling process. Slight limitations had been detected and already improved partly during the workshop series. The preconditions for the development of an adjusted and well-balanced implementation concept is seen as very high. Due to this a score of 4 out of 5 can be given from the MLs institution.

Addressing indicators "6 - Mode Shift"

The survey after the workshop asked for the future mobility behaviour of the pupils. One of 30 students stated to **shift** its **mode** due to the learning retrieved from the road safety workshop. This very low number can presumably be attributed to the general road safety perception which is not considered as high among children in the age group of 11-14 years than among adults.

Addressing indicator "7 - Car Ownership"

The indicator car ownership cannot be assessed because measure MUC 4.2a and b are not changing any mobility behavior within the Living Lab. MUC 4.2c is not taking place in Domagkpark or Parkstadt Schwabing and is targeting an age group younger than 18 years.

Addressing indicator "8 - Contribution to plans and policies"

Regarding the **contribution to policies and plans** within the city of Munich, there are still the same programs going on as obtained for the Baseline scenario. The city is actively implementing measures towards the implementation of the "Vision Zero" (see A.2.2, p.673). In 12/2019 a new prevention measure started to be implemented, it's the so called Trixi-mirror which prevents truck drivers from overlooking cyclists and pedestrians when turning left. Other mitigation of danger points was realised e.g. with expanding and marking bike lanes to secure road safety for cyclists. Note: These measures were not yet implemented within the Living Lab

but they are easy to transfer and replicate in the area of Domagkpark and Parkstadt Schwabing. Due to these increasing number of actions which is being implemented in the field of road safety, a score of 4 out of five can be given for the after-scenario. This measure highly contributes to these ongoing actions.

Addressing indicators “Investment cost” and “Operational cost”

The only expense (**investment costs**) during the measure planning phase was for sub measure MUC 4.2a, the contracted road safety experts who did the in-depth analysis of the status quo regarding the accidents and fatalities of people walking and cycling in the Living Lab. About 33.600 Euro (net) were spent for the research period of around 8 months.

The **operational costs** mainly consist of personnel costs which in case of each sub measure are limited to a contracted period of one to four months. The road safety awareness campaign with the Bike Citizens App and the PING-button cost about 42.000 Euro for four months. Another subcontracted event management agency cost about 7.300 Euro/three months. They helped to promote the sub measures within the Living Lab. The expenses for sub measure MUC 4.2c FAPS were about 6.000 Euro for one month.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Reduce road accidents.	O	Due to the fact that two out of three sub measures have not been directly implemented (especially no infrastructure) in the living lab, there is no short-term reduction in road accidents to be observed. The road safety workshop for school children has potential to reduce the number of accidents on a long-term, but it is not yet implemented within the Living Lab and can therefore not be measured.
2	Improve social inclusion and equal opportunity.	NA	Social inclusion and equal opportunity is not really given by measure MUC 4.2. The reason for that can be found in the fact that all three sub measures not necessarily aim to reach this objective which was defined before the sub measure was clearly identified and designed. On the other hand it can be said that sub measure MUC 4.2b and c addressed different target groups (all local residents of the Living Lab and pupils at the age of 11-14 years).
3	Improve liveability.	NA	Sub measures MUC 4.2b and c kind of improved indirectly the livability of these two target groups. The PING-users were able to contribute to the research and test phase of this device and school kids learned more about road safety and can use this knowledge in their everyday life.
4	Piloting an innovative software-controlled safety management in the road network of the Living Lab.	**	Sub measure MUC 4.2b tested the PING-button and the corresponding app of Bike Citizens with the help of Living Lab residents. The test phase was about two months and gave helpful information about the quality and quantity for the ML's institution of data which was assessed during the pilot.
5	Setting the foundation for an overall road safety concept for the north of Munich.	**	With testing three different measures focusing on the road safety of different age groups using modes like walking and cycling, a solid foundation for a comprehensive road safety concept for the north of Munich is set.
6	A scientific in-depth software-controlled analysis of the road safety in the Living Lab based on expert knowledge in cooperation with local stakeholders.	***	The road safety analysis was done in detail by subcontracted road safety experts which are locally known for their excellent and comprehensive work. Data, graphs and maps were done with data from local police and other reliable stakeholders.
7	The actual subsequent implementation of measures and monitoring for road safety improvements in the Living Lab.	*	All three sub measures of MUC 4.2 have been (indirectly) implemented in subsequent steps. The foundation was set with the in-depth road safety analysis of the Living Lab area (a), followed by the two other sub measures (b+c).
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded			

D. Evaluation conclusions

The observed impacts and pilots of the sub measures a), b) and c) have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

- There is no quantifiable validated direct impact within the Living Lab because the measures did not change the mobility behaviour of the local residents regarding a higher road safety.
- But it can be said that sub measures MUC 4.2b and c have been successfully tested among the two different target groups.

D.2 Relevance of supporting activities

- The parallel process of implementing a road safety concept for the city of Munich did facilitate the process due to a positive political attitude towards trying out new measures in this field.
- The *Vision Zero* also has a good influence on the pilots and comprehensive research which has been done within the measure.

D.3 Interaction with other measures

- There was one helpful interaction with another CIVITAS ECCENTRIC measure. The offered PING-buttons for the testing phase of sub measure MUC 4.2b were distributed in the Concierge shop of measure MUC 7.5. The shop is very central located within the Living Lab and therefore a good place to go for interested test users of the PING-campaign.

D.4 Main lessons learned

- The comprehensive in-depth analysis of the road safety within the Living Lab can be regarded as a good foundation for further actions in the field of road safety. The commission of this research was a good choice as experts delivered reliable results.
- Sub measures MUC 4.2b and c were well accepted by the respective target group.
- Feedback of PING-button users was very positive regarding the handling and procedure of the PING-ing.
- Students which took part in the FAPS workshop about road safety enjoyed the interactive and content-related concept. Most of the pupils stated to have gained knowledge about the road safety topic.
- The school's principal also gave positive feedback about the FAPS workshop concept. There were some recommendations named as well (see p. 704) but all in all the satisfaction rate is still high.

D.5 Long term impact

- Long term impacts are given by the implementation of the new traffic flow concept in the southern part of the Living Lab, including comprehensive safety aspects based on the extensive accident inventory work done in sub-measure a). This measure has substantially changed traffic flows, risk hotspots, traffic speeds and most probable also the accident development in this part.

D.6 Potentials for up-scaling in the city

- Sub measure MUC 4.2b (PING) has great potential to be up scaled in the city of Munich because there are already many active users registered which use the Bike Citizen app. The PING-button would be an easily fundable ad-on for the already existing and frequently used (high user rates) app so that a critical mass of cyclists joins the PING-ing of dangerous situations on their daily routes.
- Sub measure MUC 4.2c (FAPS) can also be easily and very cost effective up scaled in the city. As the workshop material is once developed and teachers are enabled by the FAPS-developers, every teacher can carry out this road safety workshop.

E. Additional information

E.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

The evaluation approaches of MUC 4.2 and its sub measure followed a multi-layered method approach. The approach includes the following methods to measure the status quo regarding road safety and user experience of the measure's target groups:

- Household online survey conducted for the Baseline data: 05/2018.
- User online survey conducted after the PING-pilot period: 10/2019.
- Two workshops after the PING-pilot period (users and ML's institution): 11/2019.
- Pre and post paper-based survey with students of the FAPS workshop: 02/2020
- Interview with the school's principal: 02/2020
- Interviews with the ML

The evaluation approach can be regarded as very diverse. There were multiple methods used suitable for the different sub measures of MUC 4.2.

The in-depth analysis which done for MUC 4.2a was an intensive research of secondary data that was collected and worked into helpful graphs and maps of the road safety status quo within the Living Lab.

Other primary data was conducted by the LEM with paper-based and online surveys as well as qualitative interviews and workshops with relevant stakeholders and users. This approach turned out to be very effective as especially the user experience could be investigated in a detail way with executing workshops and creating a motivating environment for constructive feedback.

Apart from the choice of methods itself the timing of the surveys and workshops could have been better. Due to several delays regarding measure MUC 4.2b and c, the possible period to collect data was quite short and very close to the submission deadline of MER-2. With more time and better planning with the LEM involved, there could have been other Baseline or After questionnaires been implemented.

E.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

The measure was designed to provide a learning and testing environment to improve road safety in line with the underlying approaches of the *Vision Zero* concept. The parallel political, designing and implementation process towards the Munich road safety concept was a very successful win-win-situation for both the measure and the city-wide concept. As explained in sections D.6, sub-measures b) and c) are already foreseen to be upscaled for the entire city. Based on the fruitful cooperation with the implemented stakeholder network, the CIVITAS ECCENTRIC Living Lab will be an ongoing focus area for the implementation of road safety measures in line with the Munich road safety concept. The detailed baseline analysis on police accident data, as well as the survey on perceived risks will further provide a good basis for

hotspot identification and mitigation strategies. An interesting development will be given by the new traffic flow concept in the southern part of the Living Lab. Outcomes like new hotspot developments, accident development and traffic speeds will be further observed and analysed.

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RUS 4.3

Providing Secure Pedestrian Crosswalks

Measure Evaluation Report

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Responsible Co-Author(s):	Zdravka Yakimova, Nikolay Simeonov, Pepa Rizova
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2020
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6	Ingeniería y Diseño S.L	Spain	AVIA
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15	GoMore ApS	Denmark	GOMORE
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	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
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23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Zdravka Yakimova	
Nikolay Simeonov	
Pepa Rizova	

Table of Contents

ABSTRACT.....	720
A. INTRODUCTION.....	726
A.1 EXPECTED RESULTS OF THE MEASURE	721
A.1.1 Quantifiable impacts.....	721
A.2 MEASURE DESCRIPTION	721
A.2.1 Measure outputs.....	723
A.2.2 Supporting activities	723
A.2.3 Interactions with other ECCENTRIC measures.....	724
A.2.4 Interactions outside ECCENTRIC	724
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	724
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS	725
A.5 IDENTIFIED RISKS	725
B. MEASURE IMPLEMENTATION	726
B.1 SITUATION BEFORE CIVITAS	726
B.2 INNOVATIVE ASPECTS.....	726
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	727
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	727
C. IMPACT EVALUATION FINDINGS	729
C.1 EVALUATION APPROACH.....	729
C.1.1 Expected impacts and indicators.....	729
C.1.2 Baseline.....	730
C.1.3 The business-as-usual scenario.....	732
C.2 MEASURE RESULTS.....	733
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	735
D. PROCESS EVALUATION FINDINGS	737
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	737
D.1.1 Deviation 1.....	737
D.2 BARRIERS	737
D.2.1 Barrier 1.....	737
D.2.2 Barrier 2.....	737
D.2.3 Barrier 3.....	737
D.3 DRIVERS	738

D.3.1	Driver 1	738
D.3.2	Driver 2	738
D.3.3	Driver 3	738
D.4	SUPPORTING ACTIVITIES	738
D.4.1	Supporting activity 1	738
D.4.2	Supporting activity 2	738
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	739
E.	EVALUATION CONCLUSIONS	740
E.1	VALIDATED DIRECT IMPACT	740
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	740
E.3	INTERACTION WITH OTHER MEASURES	740
E.4	MAIN LESSONS LEARNED	741
E.5	LONG TERM IMPACT	741
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	741
F.	ADDITIONAL INFORMATION	742
F.1	APPRAISAL OF EVALUATION APPROACH	742
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	742

List of Figures

Fig. 1 Depreciated crosswalk at the Druzhba entrance	722
Fig. 2 Old crosswalk in front of the school	723
Fig. 3 New crosswalk at the Druzhba entrance.....	728
Fig. 4 New crosswalk in front of the school.....	728
Fig. 5 Modal split Druzhba (2017)	730
Fig. 6 New crosswalks will improve safety and accessibility.....	731
Fig. 7 Modal split Druzhba (Jan. 2020)	733
Fig. 8 Chart accidents & dead.....	734

List of Tables

Table 1: Quantifiable impacts.....	721
Table 2 Supporting activities	724
Table 3: Target groups or affected parties	724
Table 4: Measure stakeholders.....	725
Table 5: Risks	725
Table 6 Innovative aspects	726
Table 7. Impacts and indicators	729
Table 8. Indicators and measurements.....	729
Table 9. Measure results.....	735
Table 10. Satisfaction, acceptance, awareness.....	736

Project	City		
ECCENTRIC	Ruse		
Measure code	Measure name		
RUS 4.3	Providing Secure Pedestrian Crosswalks		
Last update	Responsible	e-mail	telephone
02.05.2020	Lucia Ilieva	mail@csdcs.org	+359 888871208

Abstract

This measure deals with the infrastructure for pedestrians in the Ruse peripheral district Druzhba. It analyses the existing crosswalks and constructs new ones secured with LEDs, raised paths, etc. Additionally, cameras for video surveillance will be installed at junctions in the district.

The existing pedestrian crossings in Druzhba are not secure enough and present a high risk for accidents, leading to injuries and fatalities. Most people with disabilities and elderly people do not walk on the streets or travel by PT around the city due to the lack of convenient infrastructure.

So far, the key challenge for the implementation of this measure was to identify the most suitable locations for the new pedestrian crossings and to obtain the acceptance of the community for this. This has been achieved by carrying out an exhaustive analysis of the pedestrian infrastructure in Druzhba district and of the citizens' behaviour – their walking habits, preferred paths of movement around the district, points of interest, etc. Additionally, there were discussions with citizens in different formats – information events, round tables, interviews, questionnaires, social media, etc.

The measure contributed to achievement of the ambitious goals of the project – to reduce the number of road accidents involving pedestrians and to make walking a safer and more desirable way of moving in the district and in Ruse. The safe infrastructure for pedestrians, including people with disabilities will further increase the share of walking in the modal split in Druzhba, reduce the number of accidents with pedestrians and strengthen the use of public transport by disadvantaged groups living in the district.

The crosswalks' measure turns out to be a success and could be easily up-scaled because the municipality already owns its design and the necessary technical specifications. The Ruse decision-makers have plans to introduce it into the set of SUMP measures thus constructing such crosswalks in other parts of Druzhba and Ruse.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(4) City policy level in perspective of CIVITAS goals / longer term:

- Increase the share of walking in the modal split;
- Decrease the cases of accidents leading to injuries and fatalities;
- Increase the use of public transport from people with disabilities living in the district.

(5) Strategic level:

- Reduce road accidents with pedestrians.

(6) Measure level:

- Acceptance of the implemented measure in Ruse;
- Satisfaction with the implemented measure;
- Mode shift towards walking and cycling.

A.1.1 Quantifiable impacts

Expected Impacts	Decrease the number of road accidents involving pedestrians; Increase the share of walking and cycling in the modal split. Decrease the use of private cars and taxis in the region.	CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	10% decreased the number of road incidents with pedestrian in Druzhba			X				X			
2	10% increased share of walking in the modal split				X	X		X			
3	15% increased cycling in Druzhba		X			X		X			
4											
5											

Table 1. Quantifiable impacts

A.2 Measure description

The existing pedestrian crossings in Druzhba were not secure enough and presented a high risk for accidents, leading to injuries and fatalities. Most people with disabilities and elderly people did not walk on the streets or travel by PT around the city due to the lack of convenient infrastructure.

So far, the key challenge for the implementation of this measure was to identify the most suitable locations for the new pedestrian crossings and to obtain the acceptance of the community for this. This has been achieved by carrying out an exhaustive analysis of the pedestrian infrastructure in Druzhba district and of the citizens' behaviour – their walking habits, preferred paths of movement around the district, points of interest, etc.

Finally, two crossings were selected. The first was situated at one of the main stops on "Gotse Delchev" boulevard, at the main entrance in Druzhba. The second pilot crosswalk connected the shopping area at the central Druzhba square with the biggest secondary school in Ruse.



Fig. 1. Depreciated crosswalk at the Druzhba entrance



Fig. 2. Old crosswalk in front of the school

A.2.1 Measure outputs

- **Output 1** – Safe pilot infrastructure for pedestrians created in Druzhba at the two crossroads – at “Gotse Delchev” boulevard and at the main Druzhba square in front of the school “V. Levski”;
- **Output 2** – Access to PT facilitated for disabled and elderly people.

A.2.2 Supporting activities

	Type of supporting activity	Activity	Target group	Main objectives
1.	Promotion	Media and non-media campaign	Large public of 140 000 Ruse citizens via social media, municipal site), transport professionals (via the site of the National Coordinator on mobility and the SUMP focal point CSDCS, as well as via the SUMP BG network maintained by CSDCS)	• To raise the awareness about the safe walking infrastructure as a component of sustainable mobility • To support the use of the new crosswalks
2.	Promotion	Direct advertising (non-media campaign)	PT-commuters – Druzhba citizens, disabled people and school children (via dissemination of ECCENTRIC materials, direct meetings and discussions) – about 27 000 people.	• To raise the awareness about the safe walking infrastructure as a component of sustainable mobility • To support the use of the new crosswalks

3.	Training	Seminars and workshops	Druzhba citizens, school children, disabled people – auditory of about 200 participants	- To raise the awareness about the safe walking infrastructure as a component of sustainable mobility - To promote the road safety by using the new crosswalks

Table 2. Supporting activities**A.2.3 Interactions with other ECCENTRIC measures**

Being situated in Druzhba, the successful implementation of this measure has interactions with the following CIVITAS ECCENTRIC measures in Ruse:

- RUS 2.11 which aims at informing and promoting the new measure through training events and well targeted information campaign;
- RUS 4.4, which envisages the construction of safe pavements leading to the city centre thus facilitating the walking in Druzhba together with the new crosswalks;
- RUS 5.3: Achieving the goals of the new facility is also strongly reliant on the realisation of the measure 5.3 under which the public transport (bus and trolleybus) lines in Druzhba will be reorganised in order to better serve the needs of residents, commuters and visitors of the city. The new safe crosswalks will facilitate the access of the disadvantaged groups (disabled, elderly people, mothers with children) to the PT stops;
- RUS 5.4: The safe access to the new PT-night line servicing Druzhba will be provided by the new enlightened crosswalks.

A.2.4 Interactions outside ECCENTRIC

There will be an important interaction with the Ruse SUMP implemented in the moment outside of ECCENTRIC. The pilot crosswalks in Druzhba are a part of the new Ruse transport and mobility infrastructure having as a main goal to increase the road safety and the share of walking in the Ruse modal split, as well as to facilitate the access to PT.

A.3 Target groups and/or affected part of the city or region

Target groups			Affected area		
Type		comment	Type		comment
1	Druzhba citizens	28 000	0	Ruse citizens	140 000
10	School children (Druzhba secondary schools, Leonardo da Vinci School)	1 000	10	Schools in Ruse	5 000
5	Disabled people	5 000	5	Disabled and elderly persons	5000

Table 3. Target groups or affected parties

A.4 Stakeholders: ECCENTRIC project partners and other important actors

Main stakeholders are participants from the target group. In the following table, the stakeholders are summarized by function.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	Municipality of Ruse	P	C	L	Project partner
3	Druzhba citizens	S	other	P	Beneficiaries
4	Schools in Druzhba	S	other	P	Beneficiaries
Type: P:CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 4. Measure stakeholders

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Measure Progress Reports are not delivered on time	Process	Standardized forms should be filled in instead	Nikolay Simeonov (ML)
Delay in the construction due to the long process of public procurement	Process	The municipality makes efforts for speed up the process	Nikolay Simeonov (ML)
The quality of the enlightening elements is not good enough (easy to broke)	Process	The municipal Construction Control Unit asks the subcontractor to change the elements	Nikolay Simeonov (ML)

Table 5. Risks

B. Measure implementation

B.1 Situation before CIVITAS

The high traffic generated by the cars of commuters and guests in Druzhba uses to cause many negative externalities. The existing pedestrian crosswalks in the peripheral district of Druzhba were not secure enough and presented high risk for accidents leading to injuries and fatalities. Most people with disabilities and elderly people did not walk on the streets or travel around the city by PT due to the lack of convenient infrastructure. There was a high risk of road accidents involving children and people with disabilities.

The data for road accidents in Druzhba obtained by the Ministry of Internal Affairs/Ruse Road Police were:

- 2014 – 87 accidents, 3 dead;
- 2015 – 89 accidents, 3 dead;
- 2016 - 25 accidents, 1 dead;
- 2017 - 26 accidents, 1 dead;
- 2018 – 25 accidents, 1 dead;

The result from the survey in the schools has shown that 73% of children didn't feel safe when crossing the streets.

95% of the people with disabilities said that they didn't feel safe when crossing the streets for walking or going to the PT stops. The survey was conducted by CSDCS during the ECCENTRIC workshop in the office of the Union of Disabled People – Ruse branch.

B.2 Innovative aspects

Ranking	Innovative aspect	Description
1	New approach for pedestrian infrastructure	Introduction for the first time in Ruse of safe crosswalks with LED and cameras on the most dangerous crossings in Druzhba. The pedestrian safety system consists of the following essential elements: Light modules; Controller; Detection equipment; and Traffic signs. Three types of devices were used to activate the system: buttons, IR sensors and microwave sensors. At a certain distance before the crosswalk in both directions, road signs D17 "Pedestrian walkway" are installed and LEDs are added along the contour of the standard signs operating continuously in flashing mode.

Table 6. Innovative aspects

B.3 Research and Technology Development

The key challenge for the implementation of the measure was to identify the most suitable locations for the new pedestrian crossings and to receive the acceptance of the community for this. This has been overcome by carrying out an exhaustive analysis of the situation in the Druzhba district and analysis of the pedestrian flow – the citizens' walking habits, preferred paths of movement around the district, points of interest, etc. Additionally, there were discussions with citizens and collections of opinions in different formats – information events, round tables, interviews, questionnaires, social media, etc.

CSDCS used some secondary data about the mobility habits and needs in Ruse/Druzhba from some past projects' reports – TRANSDANUBE and BUMP.

The ToR for the public procurement procedure for selecting the subcontractor for designing and building the crosswalks was performed by a municipal team of architects and road specialists.

B.4 Actual implementation of the measure

The two pilot crosswalks were launched in October 2019 following the four project's stages of implementation. During the "Research and planning phase" (01.12.2016 – 28.02.2018) the following activities were implemented:

- Planning and research activities on innovative solutions for securing pedestrian crossings.
- Meetings with experts in the field.
- Analysis of the crossings available in the district and research into best practice for improved designs with safety and security in mind.
- Identifying the best locations for implementation of the new pedestrian crossings – close to focal points of pedestrian traffic – shopping areas, schools, main roads and streets leading to the city centre.
- Dissemination of the measure idea in order to appraise citizens' reaction.
- Development of technical specifications (ToR) for the public procurement.

During the 2nd phase "Procurement and implementation" (01.03.2018 – 30.09.2019) the procurement procedure was launched and the subcontractor was selected. The construction of the infrastructure was completed by the end of September 2019.

The third phase "Demonstration and monitoring" started in October 2019. In several days it became evident that the durability of the ground lamps was not sufficient and some of them

were broken by heavy vehicles. The subcontractor was asked to change the lighting with lamps of higher quality. It was performed in the night for not disturbing the usage of the crosswalks. The last Phase 4 “Conclusions and recommendations” was implemented by studying the impact of these safe crosswalks in Druzhba.



Fig. 3. New crosswalk at the Druzhba entrance



Fig. 4. New crosswalk in front of the school

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

	Impact category	Expected impacts	Aspect of this category	Indicators	No.
1.	Transport system	Safety of pedestrians and cyclists	Decrease # of accidents with 10%	Injuries and dead caused by accidents	11
2.	Society	Use of new crosswalks	Increase walking and cycling with 15%	Awareness and satisfaction	19
3.	Society	Use of PT by citizens with disabilities	Increased use of PT of disabled with 100%	Citizens' mobility	19

Table 7. Impacts and indicators

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
19	Road accidents	Units/year	B - A	DC	Road police data	Druzhba neighborhood
20	Road fatalities	Units/year	B - A	DC	Road police data	Druzhba neighborhood
11	Modal split	%	B - A	S	Druzhba citizens	Druzhba neighborhood
1	Awareness	%	B - A	S	Druzhba citizens	Druzhba neighborhood
2	Acceptance	%	B - A	S	Druzhba citizens	Druzhba neighborhood
3	Satisfaction	% (score 0-5)	B - A	S	Druzhba citizens	Druzhba neighborhood
7	Physical barriers (accessibility)	%	B - A	S	Disabled people	Druzhba neighborhood
5	System usage	%	B – A	E	Druzhba citizens	Druzhba neighborhood
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 8. Indicators and measurements

C.1.2 Baseline

As a baseline were used:

Modal split - For defining the baseline data, CSDCS used the data from the first research in May/June 2017 aiming to establish the initial modal split in Druzhba. First, CSDCS conducted a local citizens' survey. The methodology for the selection of respondents was quota-based, with a sample size of 215 people randomly selected and evenly distributed in the three parts of Druzhba district (Druzhba 1, Druzhba 2 and Druzhba 3), which guaranteed its representativeness. Subjects of the survey were individuals from all age groups of 15 and over, i.e. people who actually use public transport services and could give an objective assessment of both the advantages and disadvantages they face in their daily lives. For this purpose the following methods of registration of the information were used:

- direct group poll (participants in the citizens trainings) - 65 people;
- standard face-to-face interview - 150 people random selected in the three Druzhba neighbourhoods (respondents' panel);
- A supplementary group of 10 local leaders were interviewed orally by extended questionnaires (audio-registered conversations).

After processing the interviews' results, CSDCS established the mobility habits of Druzhba citizens and the modal split was as follows:

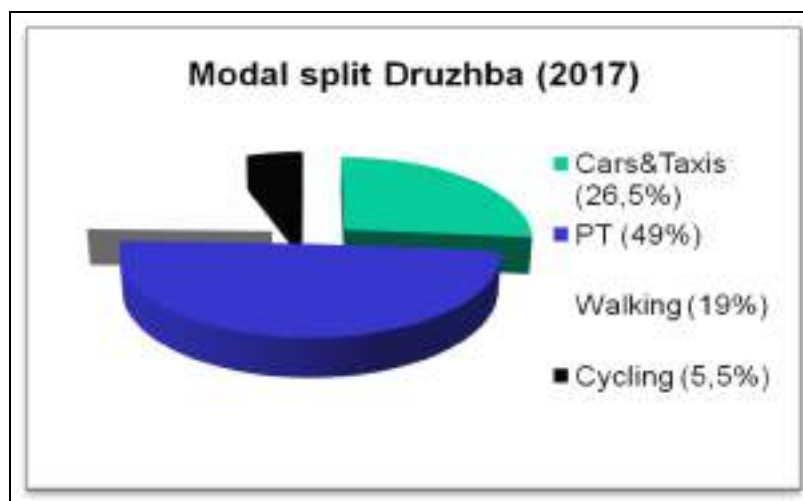


Fig. 5. Modal split Druzhba (2017)

During the study aiming at defining the baseline data, the awareness and acceptance about the pedestrian infrastructure were low, because people didn't know what kind of secure crosswalks exist. CSDCS concluded that a lot of training, information and promotional events would be necessary in order to introduce the sustainable mobility concept and to make people appreciating and using the new pedestrian infrastructure.

Awareness: Only 14% (mainly young people) were aware about the sustainable mobility, SUMP and the planned ECCENTRIC measures in Druzhba. In general, people were complaining of the quality of the infrastructure, didn't feel safe on the streets and estimated to be deprived of good pedestrian and transport connections to the city centre.

The acceptance of the new measure (safe crosswalks) was high from the very beginning. 75 % of the interviewed people accepted them thinking that the new crosswalks would improve their safety and accessibility.



Fig. 6. New crosswalks will improve safety and accessibility

The satisfaction with the existing crosswalks was very low (20%) according to the results from the initial survey made in May 2017. The survey made in Dec.2018 in the Ruse schools among 70 children aged 11-13 has shown the same results - 73% of school children didn't feel safe when crossing the streets.

The results of the direct interviews of 20 participants in the seminar for the Union of Disabled People conducted in May 2019 clearly demonstrated the problem of the disadvantaged groups with the bad pedestrian infrastructure - 95% of the respondents were not satisfied with the existing crosswalks and didn't feel safe when crossing the streets or reaching the stops of the public transport.

As a result, CSDCS calculated the average satisfaction with the existing crosswalks of only 22% (78% dissatisfied).

Road accidents and fatalities: The initial data for road accidents in Druzhba obtained by the Ministry of Internal Affairs – Ruse Road Police were:

- 2014 – 87 accidents, 3 dead;
- 2015 – 89 accidents, 3 dead;
- 2016 - 25 accidents, 1 dead;
- 2017 - 26 accidents, 1 dead

C.1.3 The business-as-usual scenario

The BAU scenario was discussed during the meeting with stakeholders held in the Ruse Municipality on 7th of May 2019. In the analysis of such a model, the results were discouraging. Transport demand would increase in line with population ageing, the internal migration from rural to urban areas, and greenhouse-gas (GHG) emissions could rise proportionally. City dwellers would travel in mostly the same ways as they do now, and private cars would continue to account for about 35 percent of passenger-kilometers.

This scenario permitted the CSDCS team to make several important conclusions and to forecast the further development. People were not satisfied with the condition of the crosswalks and found them dangerous or absent. The poor condition of the crosswalks in Druzhba used to create a high risk of road accidents involving pedestrians and cyclists as people often cross the streets when going towards the city centre or to PT stops. The existing crosswalks were extremely depreciated and not adapted to the needs of the most important target groups – school children, disabled and elderly people.

If the measure would not be implemented the existing crosswalks would become more and more depreciated and dangerous and the number of accidents would persist quite high. The presentations of the Ruse PM Mr. S. Karapchanski, the Dep. Mayor on Environment and the Chief-on-Architect of Ruse demonstrated that if the measure RUS 4.3 is never implemented and the concept of safe pedestrian infrastructure is not adopted in Ruse, the number of road accidents will remain high and will even increase.

In the BAU scenario, if nothing changes, people will continue to use taxis and personal cars, which create intense traffic from the peripheral district towards the city centre. This will lead to congestions, air pollution and noise. The construction of only two modern safe crosswalks will not change radically the situation for the pedestrians in Druzhba but will show the way for improvement and will enforce the municipality to implement similar measures in the entire district and in the whole city of Ruse.

C.2 Measure results

For evaluating the measure results, CSDCS processed the data collected in the period November 2019 – January 2020.

1. **Modal shift** – CSDCS evaluated the modal shift according to the data obtained by the survey made in the period 20.11.2019 - 20.12.2019 in Druzhiba with the established 150 panel respondents. They were contacted by the interviewers face-to-face or by phone and answered to similar questions as in the initial survey made in May 2017 concerning their travel mode, their opinion and use of the new measures, implemented in Ruse, etc. For obtaining the same number of 215 respondents as for the baseline study, CSDCS conducted oral interviews (registered by smart phones) with 30 school children from “V. Levski” school in Druzhiba, 20 pedestrians using the new crosswalks and 15 participants from Ruse during the 3rd ECCENTRIC Conference.

The results obtained from the 215 respondents showed that already 76% of the local population used for their every-day trips PT, walking or cycling. It meant that there was a shift to more sustainable way of moving. The initial percent of 73.5% increased with 2.5% and finally the sustainable commuters were 76%. The picture obtained was as follows:

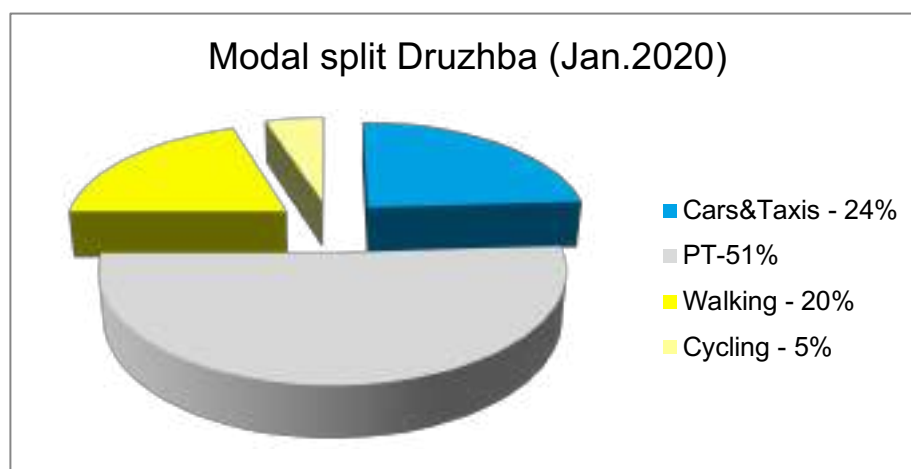


Fig. 7. Modal split Druzhiba (Jan. 2020)

The PT use increased the last two months also with 2% - from 49% to 51%. The walking increased with 1% from 19% to 20%. In general the trend was positive, although due to the late implementation of the technical measures in Ruse, they were in use only for a few months and couldn't influence much the travel behaviour of the citizens although they were well informed about them and persuaded that they would increase their safety when moving.

2. **Road accidents and fatalities:** For evaluating the road accidents and fatalities, CSDCS used data from the Ministry of Internal Affairs – Ruse Road Police:

- 2017 - 26 accidents, 1 dead;
- 2018 – 25 accidents, 1 dead;
- 2019 – 20 accidents, 0 dead

It is visible, that the trend is positive and it is due partly to the implementation of the new crosswalks in the district, and partly to the information and educational activities provided by CSDCS in the frames of ECCENTRIC. Below the trend is shown on a chart:

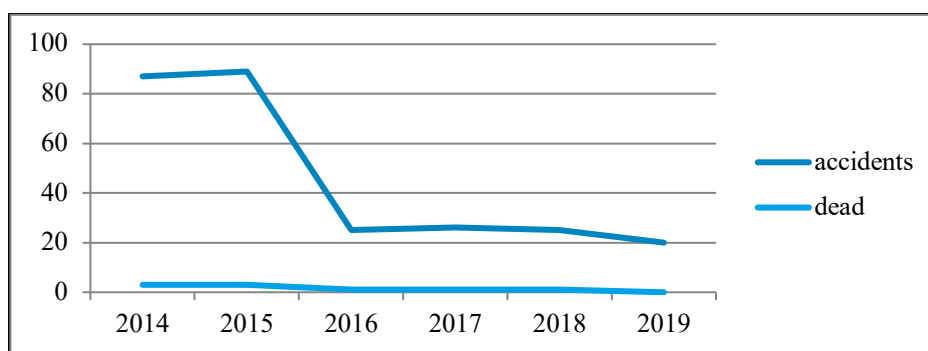


Fig. 8. Chart accidents & dead

3. For evaluating the **Awareness, Acceptance, and Satisfaction**, CSDCS processed the data obtained from the 215 respondents from the panel and the results of the direct oral interviews. The awareness about the mobility measures implemented under ECCENTRIC and in particular about the new crosswalks increased from 14% to 100%. The system usage was estimated to be 100% according to the observation of the usage of both new crosswalks (every pedestrian used them for crossing the streets). The acceptance was 95%, because 5% wanted to have more similar crosswalks in Druzhba and didn't accept to have only two. CSDCS obtained the same results for the level of satisfaction.
4. **Physical barriers:** the group of disabled people estimated that with the new crosswalks the physical barriers for them decreased from 95% to only 30% and for them it would be easier to move outside, to cross the streets and to reach the PT stops in the district. Of course, they expected to have such crosswalk all over the city and

clearly realised that the pilot crosswalks were only the first step to the improvement of the pedestrian infrastructure and much more measures were needed.

The measure results are summarized in the table below:

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Road accidents in Druzhba	Units/year	26	Jan. 2017	25	May 2019	20	Jan. 2020	-6	-5
Road fatalities in Druzhba	Units/year	1	Jan. 2017	1	May 2019	0	Jan. 2020	-1	-1
Change of modal split (shift to PT, cycling and walking)	%	73.5	June 2017	73.5	May 2019	76	Jan. 2020	2.5	2.5
Awareness about mobility	%	14	June 2017	14	May 2019	100	Jan. 2020	86	86
Acceptance	%	75	June 2017	75	May 2019	95	Jan. 2020	20	20
Satisfaction	% (0-5 scores)	22% (1.1)	Dec.2018; May 2019	22% (1.1)	May 2019	95% (4.8)	Jan. 2020	73% (3.7)	73% (3.7)
Physical barriers	%	95	May 2017; May 2019	95	May 2019	30	Jan. 2020	-65	-65
System usage	%	0	May 2017	0	May 2019	100	Jan. 2020	100	100

Table 9. Measure results

C.3 Summary: achievement of objectives

In summary, one can report that this measure contributed to the achievement of the planned results despite of the late implementation due to political and technical reasons in the municipality. Walking increased by 5% from the original value measured before the implementation. The number of road accidents decreased with 23%. New 2.5 % of the local

population adopted sustainable mode of transportation (increase by 3.4% from the original value).

The measure achieved 95% of satisfaction, 95% of acceptance and 100% of the citizens are aware about it and use it.

The results are shown in the table below:

No.	Objective and target	Rating	Comment
1	10% increase the share of walking in the modal split (shift to walking)	★	Walking increased from 19% to 20% in the modal split (increased by 5% from original value)
2	10% decrease the cases of accidents leading to injuries and fatalities	★★★	The number of road incidents decreased with 23%
3	Increase the use of public transport from people with disabilities living in the district	★	New 2.5 % adopted sustainable mode of transportation (increase by 3.4% from original value)
4	70% of satisfaction of citizens with new mobility measures	★★★	95% of satisfaction achieved
5	Acceptance of new measures	★★★	95% of acceptance achieved
6	Awareness and use of the system	★★★	100% of awareness achieved
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded			

Table 10. Satisfaction, acceptance, awareness

D. Process Evaluation findings

D.1 Deviations from the original plan

The measure was delayed due to the long process of the public procurement required by the Bulgarian legislation. Two public procurements were prepared and launched – the first for the design of the safe crosswalks and the second – for the construction of the two pilot crosswalks in Druzhba.

D.1.1 Deviation 1

The new crosswalks were opened for use in October 2019 instead of an year earlier because of the very slow public procurement procedures.

D.2 Barriers

There were three types of barriers to overcome: spatial, technologic and financial.

D.2.1 Barrier 1

The spatial barrier was related to finding the most convenient places in Druzhba for building the pilot crosswalks. It was overcome by involvement of infrastructure experts and local citizens in the discussions and the decision-making process. During the meetings with stakeholders many potential users participated - teachers, students, shoppers, civil society, disabled people, etc.

D.2.2 Barrier 2

The technologic barrier was related to the new technology for constructing safe crossings that has been never applied before in Ruse. The pedestrian safety system consisted of the following essential elements: Light modules; Controller; Detection equipment; and Traffic signs. Three types of devices were used to activate the system: buttons, IR sensors and microwave sensors. At a certain distance before the crosswalk in both directions, road signs D17 "Pedestrian walkway" are installed and LEDs are added along the contour of the standard signs operating continuously in flashing mode. The ground lamps that were installed on the road were not durable enough and some of them were broken by heavy vehicles. The subcontractor was asked to change the lighting with lamps of higher quality.

D.2.3 Barrier 3

The financial barrier was related to the project budget that was limited and could finance only 2 pilot crosswalks. The local population in Druzhba, as well as the citizens Ruse wanted to have such modern and safe crosswalks all over the city and the municipality decided to include this measure for up-scaling in the frames of the Ruse SUMP.

D.3 Drivers

The drivers detected were of planning, organizational and positional characters.

D.3.1 Driver 1

The technical planning of the measure was carried out meticulously and with strong stakeholder involvement. The crosswalks were designed using new technologies in order to increase the level of safety of pedestrians.

D.3.2 Driver 2

The key personnel involved in planning the measure were highly committed to achieving the measure objectives. The project team and the subcontractor prepared the design in a high professional way in order to keep the interest of the target groups and to provide best value for money.

D.3.3 Driver 3

The measure RUS4.3 is part of the mobility measures of Ruse in the frames of their SUMP. Local population became very sensitive to transport and mobility issues and required permanent accountability from the part of the municipality concerning the construction of the new pedestrian infrastructure.

D.4 Supporting activities

As supporting activities CSDCS qualifies the promotion of the new crosswalks and the monitoring of the measure.

D.4.1 Supporting activity 1

The information and promotional activities accompanying the introduction of the measure were very important moreover they were often combined with trainings on road safety.

D.4.2 Supporting activity 2

The monitoring of the measure is an important supporting activity allowing to discover the weak points of the system and to introduce the necessary corrections in-time.

D.5 Recommendations on the implementation process

CSDCS recommends on the further implementation of the safe crosswalks to use only materials and equipment of relevant quality in order to ensure the sustainability of the safe pedestrian system.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

This measure contributed to the achievement of the planned results despite of the late implementation due to political and technical reasons in the municipality. Walking increased by 5% from the original value measured before the implementation. The number of road accidents decreased with 23%. New 2.5 % of the local population adopted sustainable mode of transportation (increase by 3.4% from the original value).

The measure achieved 95% of satisfaction, 95% of acceptance and 100% of the citizens are aware about it and are using it actually.

E.2 Relevance of supporting activities

The supporting activities were relevant and contributed to:

- support the ECCENTRIC measures;
- raising the awareness about the safe crosswalks as a component of sustainable mobility.

E.3 Interaction with other measures

Being situated in Druzhba, the successful implementation of this measure has interactions with the following CIVITAS ECCENTRIC measures in Ruse:

- RUS 2.11 which aims at informing and promoting the new measure through training events and well targeted information campaign
- RUS 4.4, which envisages the construction of safe pavements leading to the city centre thus facilitating the walking in Druzhba together with the new crosswalks.
- RUS 5.3: Achieving the goals of the new facility is also strongly reliant on the realisation of the measure 5.3 under which the public transport (bus and trolleybus) lines in Druzhba will be reorganised in order to better serve the needs of residents, commuters and visitors of the city. The new safe crosswalks will facilitate the access of the disadvantaged groups (disabled, elderly people, mothers with children) to the PT stops

- RUS 5.4: The safe access to the new PT-night line servicing Druzhba will be provided by the new enlightened crosswalks.

E.4 Main lessons learned

The pilot crosswalks are only the first step to the transformation of the existing depreciated crosswalks into safe facilities allowing the enlargement of the share of walking and cycling in the modal split of Druzhba / Ruse. This measure is included in the Ruse SUMP and should be replicated all over the city.

E.5 Long term impact

- better safety for pedestrians and cyclists
- reducing the number of car users

E.6 Potentials for up-scaling in the city

The safe crosswalk's measure turns out to be a success and could be easily up-scaled because the municipality already owns its design and the necessary technical specifications. The Ruse decision-makers have plans to upscale it by introducing into the set of SUMP measures thus constructing such crosswalks in other parts of the city.

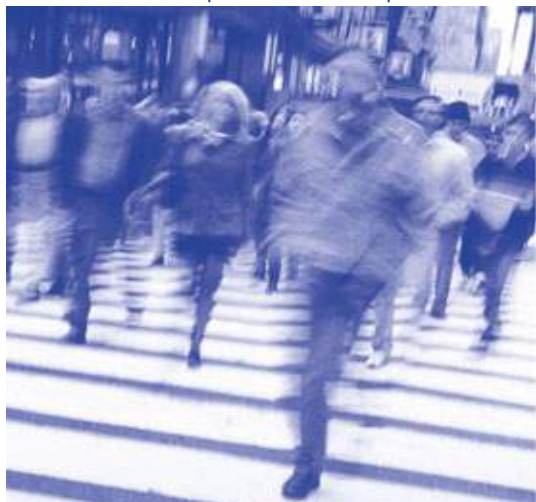
F. Additional information

F.1 Appraisal of evaluation approach

- The measure used relevant evaluation methods that could provide more reliable results in a long-term run.

F.2 Future activities relating to the measure

- Regular observation and maintenance of the crosswalks.



2020
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RUS 4.4

Safe Sidewalks with cycling facilities towards the city centre

Measure Evaluation Report

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List of Co-authors

Ivaylo Yakimov	
Nikolay Simeonov	

Table of Contents

ABSTRACT.....	750
A. INTRODUCTION.....	751
A.1 EXPECTED RESULTS OF THE MEASURE	751
A.1.1 Quantifiable impacts.....	751
A.2 MEASURE DESCRIPTION	751
A.2.1 Measure outputs.....	752
A.2.2 Supporting activities	752
A.2.3 Interactions with other ECCENTRIC measures.....	753
A.2.4 Interactions outside ECCENTRIC	753
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	753
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS	754
A.5 IDENTIFIED RISKS	754
B. MEASURE IMPLEMENTATION	755
B.1 SITUATION BEFORE CIVITAS	755
B.2 INNOVATIVE ASPECTS.....	756
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	756
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	757
C. IMPACT EVALUATION FINDINGS	759
C.1 EVALUATION APPROACH.....	759
C.1.1 Baseline.....	760
C.1.2 The business-as-usual scenario.....	762
C.2 MEASURE RESULTS.....	763
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	765
C.4 UP-SCALING	766
D. PROCESS EVALUATION FINDINGS	767
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	767
D.1.1 Deviation 1.....	767
D.2 BARRIERS	767
D.2.1 Barrier 1.....	767
D.2.2 Barrier 2.....	767
D.3 DRIVERS	767
D.3.1 Driver 1.....	767

D.3.2	Driver 2	767
D.3.3	Driver 3	768
D.4	SUPPORTING ACTIVITIES	768
D.4.1	Supporting activity 1	768
D.4.2	Supporting activity 2	768
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	768
E.	EVALUATION CONCLUSIONS	769
E.1	VALIDATED DIRECT IMPACT	ERROR! BOOKMARK NOT DEFINED.
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	769
E.3	INTERACTION WITH OTHER MEASURES	769
E.4	MAIN LESSONS LEARNED	770
E.5	LONG TERM IMPACT	770
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	770
F.	ADDITIONAL INFORMATION	ERROR! BOOKMARK NOT DEFINED.771
F.1	APPRAISAL OF EVALUATION APPROACH	771
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	771

List of Figures

Fig. 1. The boulevard “V.Levski” without sidewalks	756
Fig. 2. Design of the sidewalks in Druzhba	757
Fig. 3. The new sidewalk along “V.Levski” Boulevard.....	758
Fig. 4. Modal Split Druzhba	760
Fig. 5. New sidewalks improve safety and accessibility	761
Fig. 6. Modal split Druzhba (Jan.2020)	763
Fig. 7. Accidents and dead.....	764

List of Tables

Table 1. Quantifiable impacts.....	751
Table 2. Supporting activities	752
Table 3. Target groups or affected parties	753
Table 4. Measure stakeholders	754
Table 5. Risks	754
Table 6. Innovative aspects	756
Table 7. Impacts and indicators	759
Table 8. Indicators and measurements.....	759
Table 9. Measure results.....	765
Table 10. Achievement of objectives	766

Project	City		
ECCENTRIC	Ruse		
Measure code	Measure name		
RUS 4.4	Safe Sidewalks with cycling facilities towards the city centre		
Last update	Responsible	e-mail	telephone
02.05.2020	Lucia Ilieva	mail@csdcs.org	+359 888871208

Abstract

In this measure, a construction of safe sidewalks with cycling facilities towards the city centre was planned because the poor state of the existing pavements and cycling lanes in Druzhba district generated a high risk of road accidents involving pedestrians and cyclists. The footpaths on both sides of the main roads, connecting Druzhba with the central areas of the city, were either incomplete or in a very bad state of disrepair, and were unsafe for walking or cycling.

After a research of good practice and innovative solutions on design of safe pavements (shared with cyclists), the project team decided to implement the measure in the central part of Druzhba. Pavements were constructed along parts of the main roads only, as this was a pilot case. The design of the safe sidewalks envisaged the introduction of tactile paving between the walking paths and the cycling lanes of the sidewalks so that conflicts between pedestrians (including blind people) and cyclists were prevented.

The total length of the sidewalks that were designed under ECCENTRIC and were planned to be constructed in Druzhba was of 1500 m. The implementation has been separated into 4 stages shown on the picture below (Fig. 2). The first segment of 300 m was constructed in the frames of the ECCENTRIC project. The three remaining segments will be constructed in the frames of the Ruse SUMP.

The measure contributed to achievement of the ambitious goals of the project – to reduce the number of road accidents involving pedestrians and cyclists and to make walking and cycling a safer and more desirable way of moving in Druzhba. The sidewalks turn out to be a success and could be easily up-scaled because the municipality already owns its design and the necessary technical specifications. The Ruse decision-makers have plans to introduce it into the set of SUMP measures thus constructing such sidewalks in other parts of Ruse.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals / longer term:

- Increase the share of walking/cycling in the modal split;
- Promote and implement sustainable, clean and energy efficient transport measures.

(2) Strategic level:

- Reduce road accidents with pedestrians and cyclists.

(3) Measure level:

- Acceptance of the implemented measure;
- Satisfaction with the implemented measure;
- Mode shift towards walking and cycling.

A.1.1 Quantifiable impacts

Expected impacts	Increase the share of walking and cycling in the modal split; Decrease the number of accidents with pedestrians; Increase the use of PT by disabled people living in Druzhba	CIVITAS ECCENTRIC Objectives								
		Reduce:				Improve:				
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight
ID	Quantifiable impacts									
1	10% decreased the number of road incidents with pedestrian in Druzhba			X				X		
2	10% increased share of walking in the modal split				X	X		X		
3	15% increased cycling in Druzhba		X			X		X		
4	10% increase the use of PT by disabled people					X	X			

Table 1. Quantifiable impacts

A.2 Measure description

The poor state of the pavements (or footpaths) and cycling lanes in Ruse's Druzhba district generated a high risk of road accidents involving pedestrians and cyclists, as these often resulted in people opting for using roads when they headed towards the city centre. In the beginning of the project, the footpaths on both sides of the main roads, connecting Druzhba with the central areas of the city, were either incomplete or in a very bad state of disrepair, and were unsafe for walking or cycling.

After a research of good practice and innovative solutions on design of safe pavements (shared with cyclists), the project team decided to implement the measure in the central part of Druzhba. Pavements were constructed along parts of the main roads only, as this was a pilot case. The design of the safe sidewalks envisaged the introduction of tactile paving between the walking paths and the cycling lanes of the sidewalks so that conflicts between pedestrians (including blind people) and cyclists were prevented.

Special LED alley lighting was used along the pathway and the bicycle path of the new sidewalks. There is an intelligent system for monitoring and management of the lighting that allows the control of the intensity of the luminous flux during the different hours of the day. This energy efficient solution will decrease the electricity costs for the municipality and will ensure that all pedestrians and cyclists are clearly visible when walking/cycling on the sidewalks throughout the whole day.

A.2.1 Measure outputs

- **Output 1** – New sidewalks with facilities for disabled;
- **Output 2** – New cycling paths on the sidewalks strengthening the use of bicycles in Druzhba.

A.2.2 Supporting activities

	Type of supporting activity	Activity	Target group	Main objectives
1.	Promotion	Media and non-media campaign	Large public of 140 000 Ruse citizens (via social media and municipal site), transport professionals (via the site of the National Coordinator on mobility and the SUMP focal point CSDCS, as well as via the SUMP BG network maintained by CSDCS)	• To raise the awareness about the safe walking and cycling infrastructure as a component of sustainable mobility • To promote the cycling in Druzhba • To support the use of the new sidewalks
2.	Promotion	Direct advertising (non-media campaign)	PT-commuters – Druzhba citizens, disabled people and school children (via dissemination of ECCENTRIC materials, direct meetings and discussions) – about 28 000 people.	• To raise the awareness about the safe walking and cycling infrastructure as a component of sustainable mobility • To promote the cycling in Druzhba • To support the use of the new sidewalks
3.	Training	Seminars and workshops	Druzhba citizens, school children, disabled people – auditory of 150-200 participants	• To promote the road safety by using the new sidewalks • To raise the awareness about the safe walking and cycling infrastructure as a component of sustainable mobility

Table 2. Supporting activities

A.2.3 Interactions with other ECCENTRIC measures

Being situated in Druzhba, the successful implementation of this measure has interactions with the following CIVITAS ECCENTRIC measures Ruse:

- RUS 2.11 which aims at informing and promoting the new measure through training events and well targeted information campaign;
- RUS 4.3, which envisages the construction of safe crosswalks at the strategic crossing points in the district thus facilitating the walking and cycling in Druzhba;
- RUS 5.3: Achieving the goals of the new facility is also strongly reliant on the realisation of the measure 5.3 under which the public transport (bus and trolleybus) lines in Druzhba will be reorganised in order to better serve the needs of residents, commuters and visitors of the city. The new safe sidewalks will facilitate the access of the disadvantaged groups (disabled, elderly people, mothers with children) to the PT stops;
- RUS 5.4: The safe access to the new PT night line servicing Druzhba will be provided by the new enlightened sidewalks.

A.2.4 Interactions outside ECCENTRIC

There will be an important interaction with the Ruse SUMP implemented in the moment outside of ECCENTRIC. The pilot sidewalks in Druzhba are a part of the new Ruse transport and mobility infrastructure having as a main goal to increase the road safety and the share of walking and cycling in the Ruse modal split, as well as to facilitate the access to PT.

A.3 Target groups and/or affected part of the city or region

Target groups			Affected area		
Type		comment	Type		comment
1	Druzhba citizens	28 000	0	Ruse citizens	140 000
10	School children (Druzhba secondary schools, Leonardo da Vinci School)	1 000	10	Schools in Ruse	5 000
4	Cyclists	1500	4	Ruse cycling group	7000
5	Disabled people	5 000	5	Disabled and elderly persons	5000

Table 3. Target groups or affected parties

A.4 Stakeholders: ECCENTRIC project partners and other important actors

Main stakeholders are participants from the target group. In the following table, the stakeholders are summarized by function.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR- other	Level of activity L-P-O	Role - Links
1	Municipality of Ruse	P	C	L	Project partner
3	Druzhiba citizens	S	other	P	beneficiaries
4	Schools in Druzhiba	S	other	P	beneficiaries
10	Cyclists' NGO	S	NG	P	beneficiaries
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 4. Measure stakeholders

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Measure Progress Reports are not delivered on time	Process	Standardized forms should be filled in instead	Nikolay Simeonov (ML)
Delay in the construction due to the long public procurement process	Process	The municipality makes efforts for speed up the process	Nikolay Simeonov (ML)
The facility not used by all the stakeholders	Process	Close cooperation with the communication manager	Nikolay Simeonov (ML)

Table 5. Risks

B. Measure implementation

B.1 Situation before CIVITAS

The poor condition of the sidewalks and cycling facilities in the Druzhba district created a high risk of road accidents involving pedestrians and cyclists as people often walk on the roads when going towards the city centre. On some parts of the main boulevards in Druzhba (Vasil Levski Blvd. and Gotse Delchev Blvd.), connecting the district with the Ruse central part, there were no sidewalks or they were severely damaged. Most people preferred to use taxis and personal cars to go towards the centre thus creating intense traffic leading to congestions, air pollution and noise. The number of the road accidents was quite high. The data for road accidents in Druzhba obtained by the Ministry of Internal Affairs/Ruse Road Police is presented below:

- 2014 – 87 accidents, 3 dead;
- 2015 – 89 accidents, 3 dead;
- 2016 - 25 accidents, 1 dead;
- 2017 - 26 accidents, 1 dead;
- 2018 – 25 accidents, 1 dead;

The result from the survey in the schools has shown that 73% of children didn't feel safe when walking and cycling along the streets.

95% of the people with disabilities said that they didn't feel safe when walking on the streets or going to the PT stops. The survey was conducted during the ECCENTRIC workshop in the office of the Union of Disabled People – Ruse branch.



Fig. 1. The boulevard “Gotse Delchev” without sidewalks

B.2 Innovative aspects

Ranking	Innovative aspect	Description
1	New approach for pedestrian & cycling infrastructure	The new sidewalks will have cycling lanes and facilities for disabled people.
2	Special LED alley lighting	The innovative solution is in the design of the safe sidewalks with cycling facilities concerns the special alley lighting we introduced. Special LED alley lighting is used along the pathway and the bicycle path of the new sidewalks. There is an intelligent system for monitoring and management of the lighting that allows the control of the intensity of the luminous flux during the different hours of the day. This energy efficient solution will decrease the electricity costs for the municipality and will ensure that all pedestrians and cyclists are clearly visible when walking/cycling on the sidewalks throughout the whole day.
3	Tactile paving	The design of the safe sidewalks envisages the introduction of tactile paving between the walking paths and the cycling lanes of the sidewalks so that conflicts between pedestrians (including blind people) and cyclists are prevented.

Table 6. Innovative aspects

B.3 Research and Technology Development

The key challenge for the implementation of the measure was to identify the sections of pavements that would be first constructed as pilots in the district and to obtain community acceptance of them. This has been achieved by carrying out an exhaustive analysis of the infrastructure in Druzhba and of the pedestrian flow – the citizens' walking habits, preferred paths of movement around the district, points of interest, etc.

CSDCS has collected feedback from people living in Druzhba during meetings and through the social media channels. The information received was taken into consideration when choosing the sections of the main roads where the new pavements and cycling lanes would be built - close to focal points of pedestrian and cyclist traffic. Additionally, there were discussions with citizens in different formats – information events, round tables, interviews, questionnaires, etc.

CSDCS used secondary data about the mobility habits and needs in Druzhba from some past projects' reports – TRANSDANUBE and BUMP.

The ToR for the public procurement procedures for selecting the subcontractors for design and construction of the sidewalks was elaborated by a municipal team of architects and road specialists.

B.4 Actual implementation of the measure

The total length of the sidewalks that were designed under ECCENTRIC and were planned to be constructed in Druzhba was of 1500 m. The implementation has been separated into 4 stages shown on the picture below. The first segment of 300 m was constructed in the frames of the ECCENTRIC project. The three remaining segments will be constructed in the frames of the Ruse SUMP.



Fig. 2. Design of the sidewalks in Druzhba

The 300-meter pilot segment of the new sidewalk was opened in November 2019 following the four project's stages of implementation.

During the “Research and planning” phase (01.12.2016 – 28.02.2018) the following activities were implemented:

- Planning and research activities on innovative solutions for sidewalks with bike lanes.
- Meetings with experts in the field.
- Analysing the streets in the district for selecting the most convenient one leading from Druzhba to the city centre. Blvd. “V.Levski” was selected as the most convenient way used by the local population for reaching the city centre, the Druzhba commercial area and the secondary school “V.Levski” – the biggest in the country.
- Dissemination of the measure idea in order to appraise citizens’ reaction.
- Development of technical specifications (ToR) for the public procurement.

During the 2nd phase “Procurement and implementation” (01.03.2018 – 31.10.2019) the procurement procedures were launched and the subcontractors were selected. The construction of the infrastructure was completed by the end of October 2019.

The third phase “Demonstration and monitoring” started in November 2019.

In January 2020 CSDCS implemented the last Phase 4 “Conclusions and recommendations” by studying the impact of these sidewalks in Druzhba.



Fig. 3.The new sidewalk along “V.Levski” Boulevard

C. Impact Evaluation findings

C.1 Evaluation approach

Expected impacts and indicators

	Impact category	Expected impacts	Aspect of this category	Indicators	No.
1.	Transport system	Safety of pedestrians and cyclists	Decrease # of accidents with 10%	Injuries and dead caused by accidents	11
2.	Society	Use of new sidewalks	Increase walking and cycling with 15%	Awareness and satisfaction	19
3.	Society	Use of PT by citizens with disabilities	Increased use of PT of disabled with 100%	Citizens' mobility	19

Table 7. Impacts and indicators

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
19	Road accidents	Units/year	B - A	DC	Road police data	Druzhba neighborhood
20	Road fatalities	Units/year	B - A	DC	Road police data	Druzhba neighborhood
11	Modal split	%	B - A	S	Druzhba citizens	Druzhba neighborhood
1	Awareness	%	B - A	S	Druzhba citizens	Druzhba neighborhood
2	Acceptance	%	B - A	S	Druzhba citizens	Druzhba neighborhood
3	Satisfaction	%	B - A	S	Druzhba citizens	Druzhba neighborhood
7	Physical barriers (accessibility)	%	B - A	S	Disabled people	Druzhba neighborhood
5	System usage	%	B – A	E	Druzhba citizens	Druzhba neighborhood
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 8. Indicators and measurements

C.1.1 Baseline

As a baseline were used:

Modal split - For defining the baseline data, CSDCS used the data from the first research in May/June 2017 aiming to establish the initial modal split in Druzhba. First, CSDCS conducted a local citizens' survey. The methodology for the selection of respondents was quota-based, with a sample size of 215 people randomly selected and evenly distributed in the three parts of Druzhba district (Druzhba 1, Druzhba 2 and Druzhba 3), which guaranteed its representativeness. Subjects of the survey were individuals from all age groups of 15 and over, i.e. people who actually use public transport services and could give an objective assessment of both the advantages and disadvantages they face in their daily lives. For this purpose, the following methods of registration of the information were used:

- direct group poll (participants in the citizens trainings) - 65 people;
- standard face-to-face interview - 150 people random selected in the three Druzhba neighbourhoods (respondents' panel);
- A supplementary group of 10 local leaders were interviewed orally by extended questionnaires (audio-registered conversations).

After processing the interviews' results, CSDCS established the mobility habits of Druzhba citizens and the modal split was as follows:

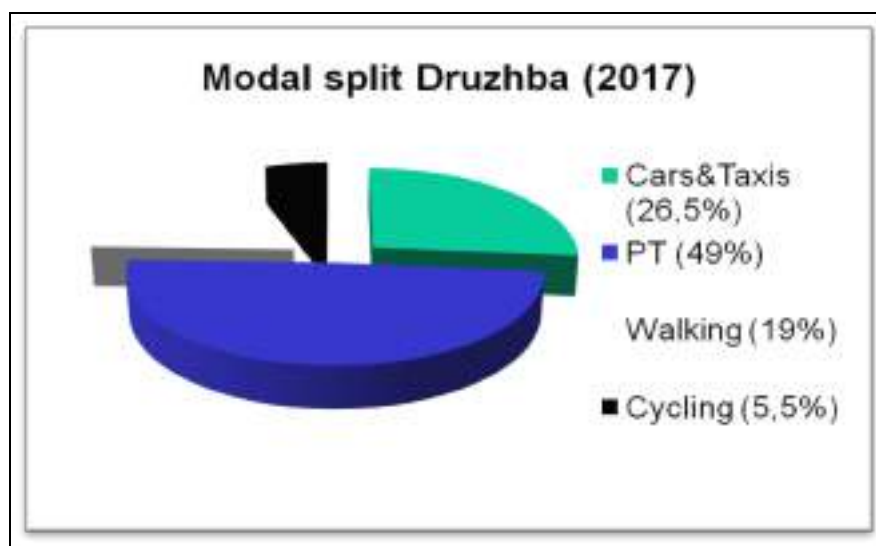


Fig. 4. Modal Split Druzhba

Awareness: Only 14% (mainly young people) were aware about the sustainable mobility, SUMP and the planned ECCENTRIC measures in Druzhba. In general, people were complaining of the quality of the infrastructure, didn't feel safe on the streets and estimated to be deprived of good transport connections to the city centre.

The acceptance of the new measure for sidewalks was very high from the beginning. 85 % of the interviewed people were estimating that their construction was compulsory and they would improve radically the safety and accessibility in Druzhba.

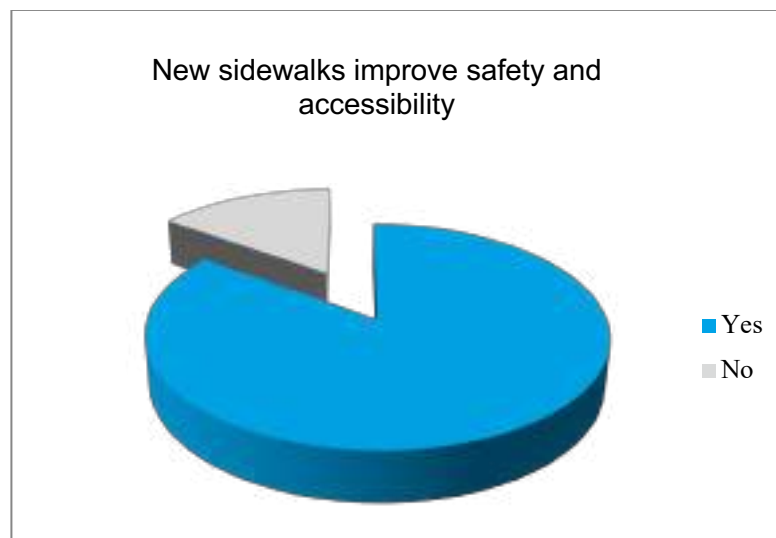


Fig. 5. New sidewalks improve safety and accessibility

The satisfaction with the existing sidewalks in Druzhba was very low (10%) according to the results from the initial survey made in May 2017. The survey made in Dec.2018 in the Ruse schools among 70 children aged 11-13 has shown the same results - 73% of school children didn't feel safe when cycling or walking along the streets.

The results of the direct interviews of 20 participants in the seminar for the Union of Disabled People conducted in May 2019 clearly demonstrated the problem of the disadvantaged groups with the bad pedestrian infrastructure - 95% of the respondents were not satisfied with the existing sidewalks and didn't feel safe when walking down the streets to reach the PT.

As a result, CSDCS calculated the average satisfaction with the existing sidewalks of only 14% (86% dissatisfied).

Road accidents and fatalities: The data for road accidents in Druzhba obtained by the Ministry of Internal Affairs – Ruse Road Police were as follows:

- 2014 – 87 accidents, 3 dead;
- 2015 – 89 accidents, 3 dead;
- 2016 - 25 accidents, 1 dead;
- 2017 - 26 accidents, 1 dead

C.1.2 The business-as-usual scenario

The BAU scenario was discussed during the meeting with stakeholders held in the Ruse Municipality on 7th of May 2019. In the analysis of such a model, the results were discouraging. Transport demand would increase in line with population ageing, the internal migration from rural to urban areas, and greenhouse-gas (GHG) emissions could rise proportionally. City dwellers would travel in mostly the same ways as they do now, and private cars would continue to account for about 35 percent of passenger-kilometers.

This scenario permitted the team to make several important conclusions and to forecast the further development. People were not satisfied with the sidewalks in Druzhba and estimated that their construction everywhere in the district was compulsory for the safety of the locals. The lack of sidewalks created a lot of problems for the citizens and especially for the disadvantaged groups. The poor condition of the few existing pavements presented a high risk of road accidents involving pedestrians and cyclists as people often walk on the roads when going towards the city centre. The sidewalks were not adapted to the needs of the most important target groups – school children, disabled and elderly people. They were not usable for cyclists because of the lack of bike lanes.

If the measure will not be implemented the lack of relevant sidewalks will provoke road accidents with pedestrians and cyclists and the use of cars will remain high. The presentations of the Ruse PM Mr. S. Karapchanski, the Dep. Mayor on Environment and the Chief-on-Architect of Ruse demonstrated that if the measure 4.4 was never implemented and the concept of safe pedestrian infrastructure was not adopted in Ruse, the number of road accidents will remain high and will even increase.

In the BAU scenario, if nothing changes, people will continue to use taxis and personal cars, which create intense traffic from the peripheral district towards the city centre. This will lead to congestions, air pollution and noise. The construction of the first 300 m segment of safe sidewalk (and even of 1500 m of pavements) will not change radically the situation for the pedestrians and cyclists in Druzhba. But the measure will show the way for improvement of the infrastructure for sustainable mobility and will enforce the municipality to implement similar measures in the entire district and in the whole city of Ruse.

C.2 Measure results

For evaluating the measure results, CSDCS processed the data collected in the period November 2019 – January 2020.

1. **Modal shift** – CSDCS evaluated the modal shift according to the data obtained by the survey made in the period 20.11.2019 - 20.12.2019 in Druzhiba with the established 150 panel respondents. They were contacted by the interviewers face-to-face or by phone and answered to similar questions as in the initial survey made in May 2017 concerning their travel mode, their opinion and use of the new measures, implemented in Ruse, etc. For obtaining the same number of 215 respondents as for the baseline study, CSDCS conducted oral interviews (registered by smart phones) with 30 school children from “V.Levski” school in Druzhiba, 20 pedestrians using the new sidewalks and 15 participants from Ruse during the 3rd ECCENTRIC Conference.

The results obtained from the 215 respondents showed that 76% of the local population used for their every-day trips PT, walking or cycling. It meant that there was a shift to more sustainable way of moving. The initial percent of 73.5% increased with 2.5% and the sustainable commuters achieved 76%. The picture obtained was as follows:

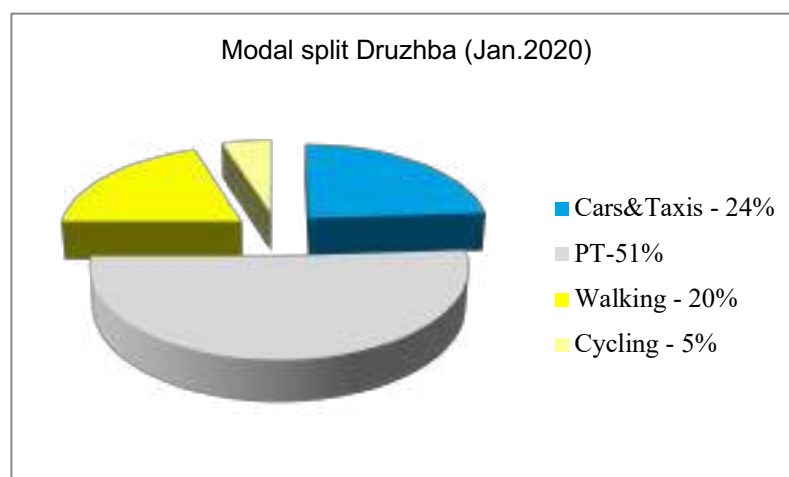


Fig. 6. Modal split Druzhiba (Jan.2020)

The PT use increased also with 2% - from 49% to 51%. The walking increased with 1% from 19% to 20%. In general the trend is positive, although due to the late implementation of the technical measures in Ruse, they were in use only for a few months and couldn't influence much the travel behaviour of the citizens although they were well informed about them and persuaded that they will increase their safety when moving.

2. **Road accidents and fatalities:** For evaluating the road accidents and fatalities, CSDCS used data from the Ministry of Internal Affairs – Ruse Road Police:

2017 – 26 accidents, 1 dead;

2018 – 25 accidents, 1 dead;

2019 – 20 accidents, 0 dead

It is visible, that the trend is positive and it is due partly to the implementation of the new sidewalks and crosswalks in the district, as well as to the information and education activities of CSDCS in the frames of ECCENTRIC. Below it is shown on a chart:

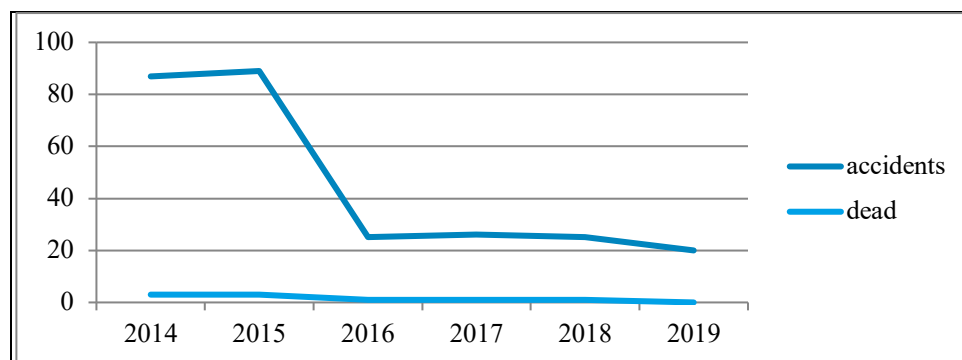


Fig. 7. Accidents and dead

3. For evaluating the **Awareness, Acceptance, and Satisfaction**, CSDCS processed the data obtained from the 215 respondents from the panel and the results of the direct oral interviews. The awareness about the mobility measures implemented under ECCENTRIC and in particular about the new sidewalks increased from 14% to 100%. People were interested and followed strictly how the municipality was implementing the measures. Often the Mayor received calls from citizens asking about the development of the implementation process and resources spent. The acceptance was 95%, because 5% wanted to have more similar sidewalks in Druzhba and didn't accept to have only 300 m. We obtained the same results for the level of satisfaction.
4. **Physical barriers:** the group of disabled people estimated that with the new sidewalks the physical barriers for them decreased from 95% to only 30% and for them it would be easier to move outside, to walk on the streets and to reach the PT stops in the district. Of course, they realised that the short sidewalk was only the first step to the improvement of the pedestrian infrastructure and much more measures were needed.
5. The **system usage** was estimated to be 50% according to the observation of its usage. Due to the winter season and the cold and windy weather in Ruse very few people were cycling using the new path. There were no foreign tourists coming by bikes as it was in

the summer. The pedestrians also were not so many and CSDCS estimated that the new facility was used at 50% of its capacity.

The measure results are summarized in the table below:

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Road accidents in Druzhba	Units/year	26	Jan. 2017	25	May 2019	20	Jan. 2020	-6	-5
Road fatalities in Druzhba	Units/year	1	Jan. 2017	1	May 2019	0	Jan. 2020	-1	-1
Change of modal split (shift to PT, cycling and walking)	%	73.5	June 2017	73.5	May 2019	76	Jan. 2020	2.5	2.5
Awareness about mobility	%	14	June 2017	14	May 2019	100	Jan. 2020	86	86
Acceptance	%	85	June 2017	85	May 2019	95	Jan. 2020	10	10
Satisfaction	% (0-5 scores)	14 (0.7)	Dec.2018; May 2019	14 (0.7)	May 2019	95 (4.8)	Jan. 2020	81 (4.0)	81 (4.0)
Physical barriers	%	95	May 2017; May 2019	95	May 2019	30	Jan. 2020	-65	-65
System usage	%	0	May 2017	0	May 2019	50	Jan. 2020	50	50

Table 9. Measure results

C.3 Summary: achievement of objectives

In summary, one can report that this measure contributed to the achievement of the planned results despite of the late implementation due to political and technical reasons in the municipality. Walking increased by 5% from the original value measured before the implementation. The number of road accidents decreased with 23%. New 2.5 % of the local population adopted sustainable mode of transportation (increase by 3.4% from the original value).

According to the answers of the questionnaires, cycling decreased from 5.5% to 5%, but CSDCS estimates that this is only a temporary result. Due to the cold and windy weather in Ruse very few people moved by bikes in the winter.

The measure achieved 95% of satisfaction, 95% of acceptance and 100% of the citizens were aware about it and used it.

The results are shown in the table below:

No.	Objective and target	Rating	Comment
1	10% increase the share of walking in the modal split (shift to walking)	★	Walking increased from 19% to 20% in the modal split (increased by 5% from original value)
2	15% increase the share of cycling in the modal split (shift to cycling)	○	Cycling decreased from 5.5% to 5% in the modal split (we estimate it is due to the winter time of survey and to the recent construction works in Druzhba)
3	10% decrease the cases of accidents leading to injuries and fatalities;	★★★	The number of road incidents decreased with 23%
4	Increase the use of public transport from people with disabilities living in the district.	★	New 2.5 % adopted sustainable mode of transportation (increase by 3.4% from original value)
5	70% of satisfaction of citizens with new mobility measures	★★★	95% of satisfaction achieved
6	Acceptance of new measures	★★★	95% of acceptance achieved
7	Awareness and use of the system	★★★	100% of awareness achieved
NA = Not Assessed ○ = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded			

Table 10. Achievement of objectives

C.4 Up-scaling

The modern sidewalk was only the first stage of the implementation (with the ECCENTRIC resources). The design was made for 4 segments with a total length of 1500 m., encompassing the two main boulevards in Druzhba and the three segments will be a replica to the implemented one. CSDCS estimates that the measure could be easily up-scaled all over Druzhba and the whole Ruse, because the municipality already owned its design and the necessary technical specifications.

The Ruse decision-makers have plans to upscale it by introducing into the set of SUMP measures thus constructing such sidewalks in other parts of the city moreover they could be included in the future Cycling strategy of the city.

D. Process Evaluation findings

D.1 Deviations from the original plan

The measure was delayed due to the long process of the public procurement required by the Bulgarian legislation. Two public procurements were prepared and launched – the first for the design of the sidewalks with bike lanes and the second – for the construction of the pilot segment in Druzhba.

D.1.1 Deviation 1

The new sidewalk was opened for use in November 2019 instead of October 2018.

D.2 Barriers

There were two types of barriers to overcome: spatial and financial.

D.2.1 Barrier 1

The spatial barrier was related to finding the most convenient places in Druzhba for building the pilot sidewalk. It was overcome by involvement of infrastructure experts and local citizens in the discussions and the decision-making process. During the meetings with stakeholders many potential users participated - teachers, students, shoppers, civil society, disabled people, etc.

D.2.2 Barrier 2

The financial barrier was related to the project budget that was limited and could finance only one segment of the new sidewalks. The local population in Druzhba, as well as the citizens of Ruse wanted to have such modern and safe sidewalks everywhere and the municipality decided to include this measure for up-scaling in the frames of the Ruse SUMP.

D.3 Drivers

The drivers detected were of planning, organizational and positional characters.

D.3.1 Driver 1

The technical planning of the measure was carried out meticulously and with strong stakeholder involvement. The sidewalks were designed using new technologies in order to increase the level of safety of pedestrians and cyclists and to contribute to the energy saving.

D.3.2 Driver 2

The key personnel involved in planning the measure were highly committed to achieving the measure objectives. The project team and the subcontractor prepared the design in a high

professional way in order to keep the interest of the target groups and to provide best value for money.

D.3.3 Driver 3

The measure 4.4 is part of the mobility measures of Ruse in the frames of their SUMP. Local population became very sensitive to transport and mobility issues and required permanent accountability from the part of the municipality concerning the construction of the new pedestrian infrastructure.

D.4 Supporting activities

As supporting activities, CSDCS qualifies the promotion of the new sidewalks and the monitoring of the measure.

D.4.1 Supporting activity 1

The information and promotional activities accompanying the introduction of the measure were very important moreover they were often combined with trainings on road safety.

D.4.2 Supporting activity 2

The monitoring of the measure was an important supporting activity allowing to discover the weak points of the system and to introduce the necessary corrections in-time.

D.5 Recommendations on the implementation process

CSDCS recommends on the further implementation of the safe sidewalks to combine them with the safe crosswalks, as well as to continue using the covering material and equipment for the lights of relevant quality in order to ensure the sustainability of the safe pedestrian system.

E. Evaluation conclusions

The observed impacts of the measure has been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

This measure contributed to the achievement of the planned results despite of the late implementation due to political and technical reasons in the municipality. Walking increased by 5% from the original value measured before the implementation. The number of road accidents decreased with 23%. New 2.5 % of the local population adopted sustainable mode of transportation (increase by 3.4% from the original value).

The measure achieved 95% of satisfaction, 95% of acceptance and 100% of the citizens are aware about it and are using it actually.

E.2 Relevance of supporting activities

The supporting activities were relevant and contributed to:

- support the ECCENTRIC measures;
- raising the awareness about the safe sidewalks and bike lanes as a component of sustainable mobility.

E.3 Interaction with other measures

Being situated in Druzhba, the successful implementation of this measure has interactions with the following CIVITAS ECCENTRIC measures in Ruse:

- RUS 2.11 which aims at informing and promoting the new measure through training events and well targeted information campaign
- RUS 4.3, which envisages the construction of safe crosswalks in Druzhba
- RUS 5.3: Achieving the goals of the new facility is also strongly reliant on the realisation of the measure 5.3 under which the public transport (bus and trolleybus) lines in Druzhba will be reorganised in order to better serve the needs of residents, commuters and visitors of the city. The new safe sidewalks will facilitate the access of the disadvantaged groups (disabled, elderly people, mothers with children) to the PT stops
- RUS 5.4: The safe access to the new PT-night line servicing Druzhba will be provided by the new sidewalks.

E.4 Main lessons learned

The pilot segment of the designed safe sidewalks in Druzhba is only the first step to the transformation of the existing depreciated pedestrian infrastructure into safe facilities allowing the enlargement of the share of walking and cycling in the modal split of Druzhba / Ruse. This measure is included in the Ruse SUMP and should be replicated all over the city.

E.5 Long term impact

- Better safety for pedestrians and cyclists
- Increase the share of walking/cycling in the modal split

E.6 Potentials for up-scaling in the city

The safe sidewalk's measure turns out to be a success and could be easily up-scaled because the municipality already owns its design and the necessary technical specifications. The Ruse decision-makers have plans to upscale it by introducing into the set of SUMP measures thus constructing such sidewalks with bike lanes in other parts of the city.

F.ADDITIONAL INFORMATION

F.1 Appraisal of evaluation approach

- The measure used relevant evaluation methods that could provide more reliable results in a long-term run.

F.2 Future activities relating to the measure

- Regular observation and maintenance of the sidewalks.
- Construction of the next three segments according to the design.



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STO 4.5

Policy for re-routing cyclist during construction works

Measure Evaluation Report

Deliverable No.:	8.5
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Workpackage/Measure No.:	4.5
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Responsible Author(s):	Joel Franklin
Responsible Co-Author(s):	Jessica Danielsson, Staffan Risberg
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Status:	MER-3 Submission
Dissemination level:	Confidential

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EUROPEAN UNION

Project Partners

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3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KTH
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12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
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List of Co-authors

Joel Franklin	KTH Royal Institute of Technology
Jessica Danielsson	City of Stockholm
Staffan Risberg	City of Stockholm

Table of Contents

ABSTRACT.....	778
A. INTRODUCTION.....	779
A.1 EXPECTED RESULTS OF THE MEASURE	779
A.1.1 Quantifiable impacts.....	779
A.2 MEASURE DESCRIPTION	780
A.2.1 Measure outputs.....	780
A.2.2 Supporting activities	780
A.2.3 Interactions with other ECCENTRIC measures.....	780
A.2.4 Interactions outside ECCENTRIC	780
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	780
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	781
A.5 IDENTIFIED RISKS	781
B. MEASURE IMPLEMENTATION	782
B.1 SITUATION BEFORE CIVITAS	782
B.2 INNOVATIVE ASPECTS.....	782
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	782
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	782
C. IMPACT EVALUATION FINDINGS	783
C.1 EVALUATION APPROACH.....	783
C.1.1 Expected impacts and indicators.....	783
C.1.2 Baseline.....	785
C.1.3 The business-as-usual scenario.....	785
C.2 MEASURE RESULTS.....	786
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	787
C.4 UP-SCALING	788
D. PROCESS EVALUATION FINDINGS	789
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	789
D.2 BARRIERS	789
D.3 DRIVERS	789
D.4 SUPPORTING ACTIVITIES.....	789
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	789
E. EVALUATION CONCLUSIONS	790

E.1	VALIDATED DIRECT IMPACT	790
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	790
E.3	INTERACTION WITH OTHER MEASURES	790
E.4	MAIN LESSONS LEARNED	790
E.5	LONG TERM IMPACT	790
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	791
F.	ADDITIONAL INFORMATION	792
F.1	APPRAISAL OF EVALUATION APPROACH	792
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	792

List of Tables

Table 1: Quantifiable impacts.....	779
Table 2: Target groups or affected parties.....	780
Table 3: Measure stakeholders.....	781
Table 4: Risk assessment.....	781
Table 5: KPI Descriptions.....	784
Table 6: KPI Details.....	784
Table 7: KPI Results.....	787
Table 8: Summary of Objective Achievement.....	788
Table 9: Identified barriers and planned/taken actions.....	789
Table 10: Identified drivers and planned/taken actions.....	789

Project	City		
ECCENTRIC	Stockholm		
Measure code	Measure name		
4.5	Policy for re-routing cyclist during construction works		
Last update	Responsible	e-mail	telephone
	Staffan Risberg	steffan.risberg@stockholm.se	

Abstract

Stockholm has a goal that it should have functional infrastructure for traveling that makes it easy and natural to live environmentally friendly. In particular, it aims to encourage a safer road environment for cyclists, making cycling a more attractive option for all types of trips. This measure focuses on the design and implementation of temporary traffic management measures at construction sites to facilitate the safe and efficient flow of bicycle traffic. In particular, new types of barriers and traffic control devices for construction work that have cyclists in focus were tested. These materials were assumed to create an enhanced degree of safety and a more continuous travel path for cyclists.

This measure develops and tests new potential standards for channeling bicyclists along construction sites in the City of Stockholm, through the use of alternate barrier materials that create a more rigid barrier between cyclists and motorized traffic, as well as between the construction site and the cycling path. The measure also contributed to a revision of the city standards for construction site traffic management that paid additional attention to the situation of vulnerable road users.

In the measurement of the impact, we compared the new standards for channeling bicyclists with the traditional channelization using the roadside survey method. The measure saw a reduction in bicycling traffic volumes, but far less than normal for a construction site, and a survey indicated that the approach was very favorable among cyclists. 85% of cyclists preferred the redesigned bicycle channelization and satisfaction rate improved.

In addition, as part of the measure, new guidelines were developed for both the overall design and for the choice of barriers for bicycle diversions around the construction site, and the recommendations in these guidelines were tested in a pilot study.

A. Introduction

A.1 Expected results of the measure

This measure aims to make cycling more attractive at road construction sites by providing better information, safety and accessibility for vulnerable road users.

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- Stockholm has a goal that it should have functional infrastructure for traveling that makes it easy and natural to live environmentally friendly.
- Stockholm is a city that is accessible to all.
- Stockholm will offer climate-smart transport
- Stockholm will be a safe and secure city

(2) Strategic level:

- To create consistent expectations for both cyclists and motorists for how to safely navigate construction zones without interfering with each other
- To encourage a safer road environment for cyclists, making cycling a more attractive option for all types of trips
- To give greater priority and accessibility to vulnerable modes

(3) Measure level:

- Increase awareness of vulnerable road users in construction zones
- Implement a measure that is accepted by affected stakeholders
- Increase cycling traffic volumes in construction zones
- Decrease collisions and near-collisions in construction zones

A.1.1 Quantifiable impacts

Expected Impacts	Make cycling more attractive at road construction sites by providing better information, safety and accessibility for vulnerable road users.	CIVITAS ECCENTRIC Objectives							
		Reduce:				Improve:			
ID	Quantifiable Impacts	Energy use, CO2	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and	Livability	Competitiveness
1	Awareness raising					x	x	x	
2	Acceptance of the new policy			x		x	x	x	
3	Transport volumes			x			x	x	
4	Safety			x					

Table 1: Quantifiable impacts.

A.2 Measure description

This measure focuses on the design and implementation of temporary traffic management measures at construction sites to facilitate the safe and efficient flow of bicycle traffic. As part of the measure, new guidelines for both the overall design and for the choice of barriers for bicycle diversions around the construction site, and the recommendations in these guidelines were tested in a pilot study.

A.2.1 Measure outputs

The key outputs of this measure are firstly a new set of guidelines that will be incorporated in the technical manual (the existing City of Stockholm 2015, “Teknisk handbok”) and other documents that may regulate how bicycle traffic diversion at construction sites should be designed and implemented. The guidelines include a checklist that it can be used at construction sites. The work that is being made with SIS (Swedish standard institute) will create a new standard for everyone to follow regarding what barrier types that are safe for cyclists. A second output from this measure is a pilot test of implementing the guidelines at an active construction site, along with the results of monitoring activities at the pilot test site.

A.2.2 Supporting activities

Supporting activities were meetings with the stakeholders.

A.2.3 Interactions with other ECCENTRIC measures

This measure did not interact with other ECCENTRIC measures.

A.2.4 Interactions outside ECCENTRIC

There is another project at the Traffic Administration Office *Jämställda TA-planer* (“Gender-equal traffic management plans”) that focuses on similar questions of bicycle accessibility in near construction sites. We also work with the Swedish Institute for Standards, who help to formulate standards and guidelines in a manner that is clear and transferable.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1 Residents		Demonstration area	Four demonstration areas, where at least three are located in Årsta
2 Motorists			
4 Cyclists			
7 Visitors			

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR- other	Level activity L-P-O	Role Links
P01	Residents of Årsta	S	Other	P	
P02	Citizens of Stockholm	S	Other	O	
P04	Traffic Administration of the City of Stockholm	P	C	L	
K07	Swedish Transport Administration	S	Other	O	
P15	Cyclists	S	Other		
	Dammarsberg enterprenad AB	S	PR	O	
	Atkins consultancy	S	PR	P	
	Ellevio	S	PR	O	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Lack of data/data of low quality	Operational	Being prepared to collect more data at several occasions if needed	City of Stockholm
Lack of knowledge/unfamiliar processes	7 Planning	Keep project administration to a minimum	City of Stockholm
Resource shortfalls (Inability to secure sufficient resources, overspending)	9 Financial	Keep project administration to a minimum in order to proceed with actual work and set aside time for project	City of Stockholm

Table 4: Risk assessment.

B. Measure implementation

B.1 Situation before CIVITAS

The City of Stockholm Traffic Department is today working based on overall goals and action plans stated in the city's Cycle Plan. The main focus is to facilitate commuting by bicycle for existing cyclists and to get more people to cycle. Cyclists' situation in connection with road construction sites is regulated in the city's Technical Manual. The handbook is rather thorough when it comes to handling motor vehicles, but lacking information on how to manage the situation for vulnerable road users (pedestrians and cyclists). Today the city is working with a project, 'Jämställda TA-planer', to work out renewed demands for materials and signage used at road construction sites, in order to provide better information, accessibility, safety and comfort to vulnerable road users.

B.2 Innovative aspects

The innovative aspects of this measure are that we are testing new types of barriers and traffic control devices for construction work that have cyclists in focus. These new materials are meant to create an enhanced degree of safety and a more continuous travel path for cyclists. The barrier types include concrete "Jersey" barriers, steel mesh enclosures, and moveable steel fence sections.

B.3 Research and Technology Development

The measure does not directly support technical development, but it is intended to incentivize private actors to develop new products for managing construction zones.

B.4 Actual implementation of the measure

A major part of the implementation of the measure is conducting tests with new innovative materials. Three tests were conducted at simulated work zones early in the project and a test at an actual work zone was carried out in summer 2019.

The participation with the collaboration with SIS (Swedish Standard Institute) to develop a new Swedish standard for bicycle diversion barriers used during construction work will continue. As we only are members in this work, we do not control the timeframe of this work.

Review our technical manual. This happened in multiple steps. We will first carried out a small review that incorporated more information and regulations about cyclists with what we have learned so far, and then we conducted a wider review after the pilot was concluded. The revised regulations are contained in *Teknisk Handbok: Del 5 – Trafikanordningar* (Technical Handbook: Part 5 – Traffic Regulations)²⁴

Implement a checklist for construction sites. A checklist was created that helps those that work at the construction site to think about the safety of cyclists.

²⁴ City of Stockholm, 2019, "Del 5 – Trafikanordningar", in: *Teknisk Handbok*, Stockholm: City of Stockholm, Department of Transport.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Awareness

Awareness was included in the original list of KPIs for this measure. We later judged that this KPI could not be efficiently measured for the kind of pilot that was feasible to conduct. Because of the short turnaround time between permit approval and construction start, an appropriate worksite for the pilot could only be identified at very short notice. On the other hand, awareness effects are slow to respond and would have required a more advance notice to implement both an adequate information campaign and an appropriately targeted baseline measurement. Measuring awareness afterward would also have required an extensive sample base, in contrast to the chosen roadside survey method used for Acceptance. Moreover, with a roadside survey method, awareness essentially is a foregone conclusion, since unaware cyclists would not have been captured in the survey.

Acceptance

We measure awareness using a survey conducted in conjunction with the pilot on a real construction site, held in September 2019. Cyclists were recruited at the roadside during commuting hours, 7:15—9:00 and 15:30—17:00, on 2nd September 2019, after construction of the protected cycle route around the worksite. The sample was effectively choice-based, hence there is certain to be bias toward greater acceptance, since those with lower acceptance are less likely to continue traveling along the cycle path. However, with such geographically localized target group, any other recruiting method would have been unacceptably inefficient.

System Usage

Usage of the worksite cycle path was measured using cable counters laid across the cycle path. Measurements were taken both during the pilot, a 7-day period in September 2019, and prior to the establishment of the worksite, a 14-day period in May 2019.

Number of Incidents

Traffic incidents are recorded using the *STRADA* database (Swedish Traffic Accident Data Acquisition), maintained by *Transportstyrelse*, the Swedish Transport Agency. Total incidents along the affected road were extracted for September 2018 and September 2019. However, the number of accidents is extremely low for such a short period of time and localized area, so comparisons are highly uncertain.

Investment Costs

Investment costs consisted of the one-time costs of implementing the measure, in this case primarily striping installation and removal.

Operating Costs

Operating costs consisted of the procurement of temporary materials for the barrier during the time of the trial.

Impact	Awareness raising	Acceptance	Satisfaction	Transport volumes	Safety	Exploitation	Exploitation
Indicator name	Awareness	Acceptance	Satisfaction	System usage	Number of incidents	Investment Cost	Operating Cost
Type	KPI	KPI	KPI	KPI	KPI	KPI	KPI
Category	Society - People	Society - People	Society – People	Transport system	Transport system	Economy	Economy
Subcategory	Acceptance	Acceptance	Acceptance	General	Safety	Costs	Costs
Aspect	Awareness level	Acceptance level	Satisfaction Level	Transport system utilization	Transport safety	Investment Cost	Operating Cost
Definition	Percentage of vulnerable road users awareness of policy/measure being implemented	The percentage of vulnerable road users approving/acceptance of policy/measure (in connection to pre-defined evaluation sites)	The average satisfaction score given by vulnerable road users	Measuring the number of system users prior, during and after road construction work on pre-defined evaluation sites	Sum up number of incidents reported to Trafikkontoret in connection to pre-defined evaluation sites	Fixed cost of installation and removal of the test site	Recurring costs of maintaining the test site

Table 5: KPI Descriptions.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	% + description	B – A	S	General public (residents, cyclists, drivers, companies related to cycling, politicians, visitors), operators	Demonstration area
2	Acceptance	% + description	A	S		Demonstration area
3	Satisfaction	Score (1-5)	B – A	S		Demonstration area
4	System usage	Number of cyclists	B – A	DC		System
5	Number of incidents	Number of incidents	B – A	DC		Demonstration area
6	Investment Cost	SEK	A	DC	Pilot implementation	Pilot worksite
7	Operating Cost	SEK	A	DC	Pilot implementation	Pilot worksite
Frequency: B: Before – I: Intermediate – I(x): Intermediate (frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: KPI Details.

C.1.2 Baseline

The evaluation makes two types of comparisons: first, comparing the full pilot to normal conditions with no worksite and no special bicycle channelization; and second, comparing the full pilot to a worksite with traditional bicycle channelization. To assist in making the distinction, we define the “Baseline” as the case with no worksite and no special channelization.

Acceptance

In quantitative terms, no baseline “acceptance” data was available since the roadside survey was carried out only after the worksite was established.

System Usage

In terms of system usage, for the identified worksite used cable counters were used to measure daily cyclist volumes per weekday and per day during a two-week period in May 2019. On a weekday basis there were 1213 cyclists per day and 985 per day.

Incidents

No incidents were recorded during the baseline time period.

Investment & Operating Costs

For costs, we take the Baseline scenario to indicate the case where no cycle path adaptation is implemented and there is no worksite, therefore the costs are zero.

C.1.3 The business-as-usual scenario

We define the Business-as-Usual case to be the case of a worksite with traditional channelization. To the extent possible we have used the early pilots as a business-as-usual case, since the data collected is at least useful and these three pilots used these more traditional bicycle channelization materials, for example so-called “jersey barriers”, i.e. 40-cm high concrete barriers to separate the cycle lane from general motor vehicle traffic.

Acceptance and Satisfaction

The survey posed a question with a somewhat different formulation than the measure’s own survey, in this case “Will you continue to bicycle along this road despite the worksite?”. Excluding invalid answers, 92% replied “yes”.

The survey also included a question on satisfaction using a 4-point scale. Converting to a more standard 5-point scale by inserting an unused “indifferent” option at 3, we find that the average response was 3.02.

System Usage

Based on a range of prior examples in Stockholm, bicycle traffic generally diminishes by about 40% in the presence of a worksite with special channelization for bicyclists. Applying a 40% reduction to the baseline results in 728 cyclists per weekday.

Number of Incidents

We assume the same number of incidents in the business-as-usual case as in the baseline, in this case zero.

Investment and Operating Costs

For Investment Costs, under Business-as-Usual we chose to report the expected cost of implementing a cycle path diversion using conventional methods. A typical investment cost

would be about 20000-30000 SEK, which we here take to be 25000 SEK to make comparison calculations. Operating costs are negligible for this kind of channelization, which we report as zero.

C.2 Measure results

Acceptance

The survey indicated that 85% of cyclists preferred the redesigned bicycle channelization. This is lower than the business-as-usual case, but it should be recalled that the question formulations are different. In the case of the measure impacts, the question was, “Do you prefer this kind of bicycle diversion channelization?” Hence, the two questions are asking respondents to make different kinds of assessments in whether they accept the approach or not, and this could explain the discrepancy.

It is worth noting that a significant share of cyclists was observed traveling on the mixed-use traffic lane instead of the diverted cycle lane. This could be considered a lack of acceptance, although we do not have sufficient data to confirm this definitively.

Satisfaction

Satisfaction, on the other hand, clearly improved, with the two surveys including similar questions and the measure showing a 1.1-point improvement, a clear increase in support.

System Usage

Usage, in the form of cyclist traffic per weekday, declined during the pilot but by only 5.2%, and this number represented a 58% improvement over what might have been expected using a more conventional method of channelizing cyclists.

Number of Incidents

As in the baseline, no incidents were reported during the trial. With both periods recording zero incidents, it is impossible to draw any conclusions about the measure’s effects on safety.

Investment and Operating Costs

The investment costs were somewhat more than in the business-as-usual case, but operating costs come on top of that with a rather significant weekly cost.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Acceptance	%	N/A	N/A	92%	N/A	87%	2 nd Sept. 2019	N/A	-5 ppts
Satisfaction	Score	N/A	N/A	3.02	2017	4.13	2 nd Sept. 2019	N/A	+1.11
System Usage	Cyclists per weekday	1213	11-25 May 2019	728	10-17 Sept 2019	1150	10-17 Sept 2019	-63	+422
Number of Incidents	Incidents per month	0	September 2018	0	September 2019	0	September 2019	0	0
Investment Cost	SEK	0	N/A	25000 SEK	N/A	30000 SEK	2019	+30000 SEK	+5000 SEK
Operating Cost	SEK/week	0	N/A	0 SEK	N/A	11600 SEK/week	2019	+11600 SEK/week	+11600 SEK/week

Table 7: KPI Results.

C.3 Summary: achievement of objectives

Most of the objectives were achieved in some part, although each with caveats. The KPI for awareness-raising could not be implemented, as discussed above, so no conclusion can be drawn here. The survey of cyclists indicated that acceptance was very high (86%), although this estimate is subject to self-selection bias since it was based on a roadside survey. Cyclist transport volumes clearly dipped, but far less than with an earlier experiment. However, the reduction did not quite reach the goal of only reducing by 5%. Finally, safety could only be assessed at a very coarse level since incidents are rare and the study area very localized. One incident each was recorded in the study period and the comparison period, so no differences could be detected. This does not, however, mean that the risk was unchanged.

No.	Objective and target	Rating	Comment
1	Awareness-Raising	N/A	The awareness KPI could not be implemented
2	Acceptance of the new policy	**	Acceptance levels were very high, though there may be self-selection bias
3	Transport volumes	**	Cyclist volumes decreased but far less than in previous trials
4	Safety	*	With no observed incidents, it is difficult to draw conclusions on safety
NA = Not Assessed O = Not Achieved in full * = Substantially achieved (at least 50%) ** = Achieved *** = Exceeded			

Table 8: Summary of Objective Achievement.

C.4 Up-scaling

The pilot will be naturally upscaled through the amendment of the technical handbook to incorporate the standards that were tested in this pilot.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the **Process Evaluation Report** of this Measure.

D.1 Deviations from the original plan

One deviation is most notable in the implementation of the measure:

Delay for new trials – the project went behind schedule in implementing a new trial, which is due to the technical manual not being finalized as early as planned.

D.2 Barriers

Below are some barriers that have been experienced, along with actions implemented to overcome them.

No.	Barrier field	Description	Action to overcome the barrier
1	Problem-related	It has proven difficult to find an appropriate trial site that facilitates testing the aspects we intend to test.	Establish contacts within the office and with the main utility companies to find a suitable test site.
2	Organizational	During the project we have had four different measure leaders, which has affected project progress	Staff turnover continues to be a challenge but overlapping handovers helped to smooth the transitions.

Table 9: Identified barriers and planned/taken actions.

D.3 Drivers

Below are some drivers that have been recognized as helping the measure's success, along with actions to help capitalize on them.

No.	Driver field	Description	Action to make use of the driver
1	Strategic	The city's stated goals to increase cycling and work with cycling have meant that the project is a priority.	No additional actions have been necessary.
2	Other	We see that the number of road works is increasing, and consequently, it is increasingly important to discuss how different traveler groups should be routed.	We have ensured that the measure is explicit about how it handles different traveller groups.

Table 10: Identified drivers and planned/taken actions.

D.4 Supporting activities

No supporting activities were included in this measure.

D.5 Recommendations on the implementation process

Recommendations are specified in the final Process Evaluation Report, which was still under preparation during the finalization of this Measure Evaluation Report.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

The pilot had the following validated impacts:

- Acceptance was high. Though it was not as high as acceptance for a test of traditional channelization, the question formulations were dissimilar enough that the difference could easily be explained by this.
- Average satisfaction was high, well above the earlier trial with traditional channelization.
- System usage, while diminished during the trial, maintained a much higher relative level than comparable worksites and bicycle diversion measures.
- No conclusions could be drawn on awareness due to lack of appropriate data collection, nor on incidents, with an absence of observed incidents during the baseline and trial periods.
- Costs were higher for the pilot than for traditional measures, they and could be significantly higher if the diversion were in place for a lengthy time period.

E.2 Relevance of supporting activities

No supporting activities were included in this measure.

E.3 Interaction with other measures

This measure had no significant interactions with other measures.

E.4 Main lessons learned

Two main lessons have been recognized:

- The early pilots tested the bike lane channelization materials on a street with no active construction site. This caused a high level of frustration among surveyed cyclists, as the diversion was seen as unnecessary, and this had obvious impacts on the level of acceptance and satisfaction. Hence it is worthwhile to conduct pilots in conjunction with real worksites.
- Even with an improved channelization, many cyclists will still prefer to divert to the general-purpose traffic lane rather than the diverted bicycle lane.

E.5 Long term impact

The results of these pilots will inform the City's regulations and guidance for future construction sites, particularly once the traffic standards are formally amended to take them into account. These impacts will be city-wide and felt as often as construction sites are installed.

E.6 Potentials for up-scaling in the city

The measure will essentially be upscaled in another form, once the City's standards are updated.

F. Additional information

F.1 Appraisal of evaluation approach

No comments have been documented so far. A more detailed appraisal is found in the Process Evaluation Report.

F.2 Future activities relating to the measure

As mentioned earlier, the technical handbook will be amended to include the new standards, once their specifications are finalized, and the City's routines for diversion of cyclists will be updated. More generally, the City has an intention to improve construction workers' knowledge of cyclists' circumstances around worksites.



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MAD 4.6

Pedestrian friendly public space
outside the city centre

Measure Evaluation Report

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EUROPEAN UNION

Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
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3	Consorcio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
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12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
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15	GoMore ApS	Denmark	GOMORE
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	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
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22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Carmen Hernanz	
Marisol Santos	
Isabela Velázquez	

Table of Contents

ABSTRACT.....	800
A. INTRODUCTION.....	802
A.1 EXPECTED RESULTS OF THE MEASURE	802
A.1.1 Quantifiable impacts.....	802
A.2 MEASURE DESCRIPTION	803
A.2.1 Measure outputs.....	803
A.2.2 Supporting activities	808
A.2.3 Interactions with other ECCENTRIC measures.....	808
A.2.4 Interactions outside ECCENTRIC	808
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	809
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	809
A.5 IDENTIFIED RISKS	810
B. MEASURE IMPLEMENTATION	811
B.1 SITUATION BEFORE CIVITAS	811
B.2 INNOVATIVE ASPECTS.....	811
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	811
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	811
C. IMPACT EVALUATION FINDINGS	814
C.1 EVALUATION APPROACH.....	814
C.1.1 Expected impacts and indicators.....	814
C.1.2 Baseline.....	816
C.1.3 The business-as-usual scenario.....	818
C.2 MEASURE RESULTS.....	819
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	820
C.4 UP-SCALING	820
D. PROCESS EVALUATION FINDINGS	821
HERE THE MAIN FINDINGS OF THE PROCESS EVALUATION ARE SUMMARISED. MORE DETAILS ARE AVAILABLE IN THE PROCESS EVALUATION REPORT OF THIS MEASURE.	821
D.1 DEVIATIONS FROM THE ORIGINAL PLAN.....	821
D.1.1 Change in the location and scope of the high-quality pedestrian corridor.....	821
D.1.2 Changes in the area selected for pedestrian-friendly transformation	821
D.1.3 Participation of residents and grassroots associations in Vallecas.....	821
D.2 BARRIERS	821

D.2.1	<i>Financial: Restrictions to the use of municipal budget in infrastructure improvements...</i>	821
D.2.2	<i>Institutional: Lack of commitment and support of key institutional stakeholders and decision-makers.....</i>	822
D.2.3	<i>Communication: Lack of involvement of social agents.....</i>	822
D.3	DRIVERS	822
D.3.1	<i>Political: Favourable strategies and mobility plans.....</i>	822
D.3.2	<i>Institutional: Strong commitment and support of some key decision-makers.....</i>	822
D.3.3	<i>Financial: Availability of resources provided by ECCENTRIC.....</i>	823
D.4	SUPPORTING ACTIVITIES.....	823
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	823
D.5.1	<i>Political support translated into bureaucratic priority.....</i>	823
D.5.2	<i>Formalising public participation</i>	823
E.	EVALUATION CONCLUSIONS	824
E.1	VALIDATED DIRECT IMPACT	824
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	824
E.3	INTERACTION WITH OTHER MEASURES.....	824
E.4	MAIN LESSONS LEARNED	824
E.5	LONG TERM IMPACT	825
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	825
F.	ADDITIONAL INFORMATION.....	826
F.1	APPRAISAL OF EVALUATION APPROACH	826
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	826

List of Figures

Figure 1: Transport infrastructure in Puente de Vallecas and Villa de Vallecas	803
Figure 2: Location and character of the main public facilities and urban activities	804
Figure 3: Pedestrian network (green) and high-quality pedestrian corridor (Itinerario Miradores)	805
Figure 4: E-mobility station.....	806
Figure 5: Improving the pedestrian network.....	807

List of Tables

Table 1: Quantifiable impacts.....	802
Table 2: Target groups or affected parties.....	809
Table 3: Measure stakeholders.....	809
Table 4: Identified risks.....	810
Table 5: Description of key performance indicators (KPI).....	814
Table 6: Description of key performance indicators (KPI) (Cont.).....	815
Table 7: Measures' indicators	816
Table 8: Share of walking trips in 2004.....	817
Table 9: Pedestrian and bicycle counts.....	817
Table 10: Traffic volumes in the streets targeted by ECCENTRIC.....	817
Table 11: Average emission factors per pedestrian trip replacing a car or bus trip	818
Table 12: Measure KPI results	819
Table 13: Measure objective's achievement	820

Project	City		
ECCENTRIC	Madrid		
Measure code	Measure name		
MAD 4.6	Pedestrian friendly public space outside the city centre		
Last update	Responsible	e-mail	telephone
20/04/2020	Carmen Hernanz (2016-2017) Marisol Santos (2018-2019)	hernanzcmc@madrid.es santoshms@madrid.es	915880920

Abstract

This measure has provided a vision for a future district-wide pedestrian network, and has implemented different pedestrian-friendly actions in the living lab, including the tactical action to improve the access to the University Campus with a temporary solution that will be consolidated in the future. Besides, this measure has delivered the detailed design of some ambitious actions that could not reach implementation during the project lifetime (pedestrian access to a hospital and an e-mobility station in *Sierra de Guadalupe*).

The final actions actually implemented within this measure included some sections within a future high-quality north-south pedestrian corridor (*Miradores Itinerary*), some improvements in the surroundings of the future e-mobility station and some improvements in the pedestrian core of Puente de Vallecas District (*Peña Gorbea Boulevard*). A pilot communication and awareness campaign on pedestrian mobility enhancement, highlighting the pedestrians' rights introduced by the new Municipal Ordinance in Madrid, was tested in the two ECCENTRIC areas of the living lab. The first urban signalisation pilot, focused on pedestrians and cyclists has been implemented in the area of the future e-mobility station.

Overall, the measure has been successful: the number of walking trips in the vicinity of the streets included in the measure has increased substantially (more than 9,000), far beyond the 1,000 target. The pedestrians' perception of the street conditions (which include safety as a key trait) has notably improved for 30% of them, which can be taken as a reasonable proxy to the consideration that safety perception among pedestrians has also improved. Finally, the reduction of CO₂ and other emissions can be considered as substantial, as it is equivalent to removing 100 cars from traffic in the area. It is however worth noticing that almost 8 of every 10 trips gained by walking are coming from public transport and only 2 from private cars.

The measure design and implementation stages showed the difficulties to introduce consistent participatory approaches when implementing innovative measures, particularly in the context of research and demonstration projects with tight schedules. To honour public participation commitments, demonstration projects may need to establish formalised participation plans at the beginning of the measure design identifying the local stakeholders to mobilize and the participation and decision-making procedures to be applied. In this case, the channelling of participation through an individual on-line consultation platform opened to all (www.participamadrid.org) has proved not to be appropriate for a quick and fair appraisal of the measure actions. Another lesson learned is that local bureaucracies can put

demonstrations at risk, even in the most committed cities. Cities undertaking demonstrations would benefit of establishing special approval and budgeting procedures for these actions.

The measure results suggest that pedestrian-friendly actions are likely to significantly increase the number of walking trips, but only a small fraction of them is likely to come from former car users. When cities are trying to curb car use, they should probably introduce additional measures, such as specific car restrictions, besides promoting sustainable modes. This should be also considered by policy-makers when establishing climate change mitigation policies, as pedestrian-friendly measures, in the absence of car restrictions, are unlikely to provide significant emission savings.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- To decarbonize mobility in the city of Madrid.
- To improve health and air quality, avoiding unnecessary car trips.

(2) Strategic level:

- To shift urban mobility the urban mobility patterns in the outskirts of the city towards active and sustainable modes.
- To increase safety and perception of security in outskirts areas of the cities.

(3) Measure level:

- To provide a solution (a new street or tunnel to cross the railway barrier) to a disconnected area of high intensity of use, including a large health facility (Hospital Infanta Leonor) and the UPM University Campus. This objective was subsequently modified, dropping the health facility access component (see D.1.1), as this access was included within a concerted action to be negotiated between the regional government and the municipality.
- To address the residents' short-distance mobility demands.
- To implement a part of the Regeneration Plan approved for Madrid in 2016, and to its follow-up action "Madrid Recupera 2018-2020".
- To re-shape a car-designed area as a safe, attractive walkable area.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
1	1000 more active travels per day in the area.					X					
2	15% increase in the perception of safety by pedestrians			X							
3	Reduce the number of traffic incidents with pedestrians involved			X							
4	Reduction of CO2 and other emissions	X									

Table 1: Quantifiable impacts.

A.2 Measure description

A.2.1 Measure outputs

The area consists of three different, isolated urban structures, and lacks a consistent pedestrian network linking them to each other, mainly due to infrastructure barriers such as railway lines and motorways and to piecemeal, car-focused urban design and development. This has a major impact on residents, as basic facilities (schools, University, hospital...) have been placed in the last ten years on the available public land close to these infrastructures, and they are difficult to reach by non-motorised transport modes.

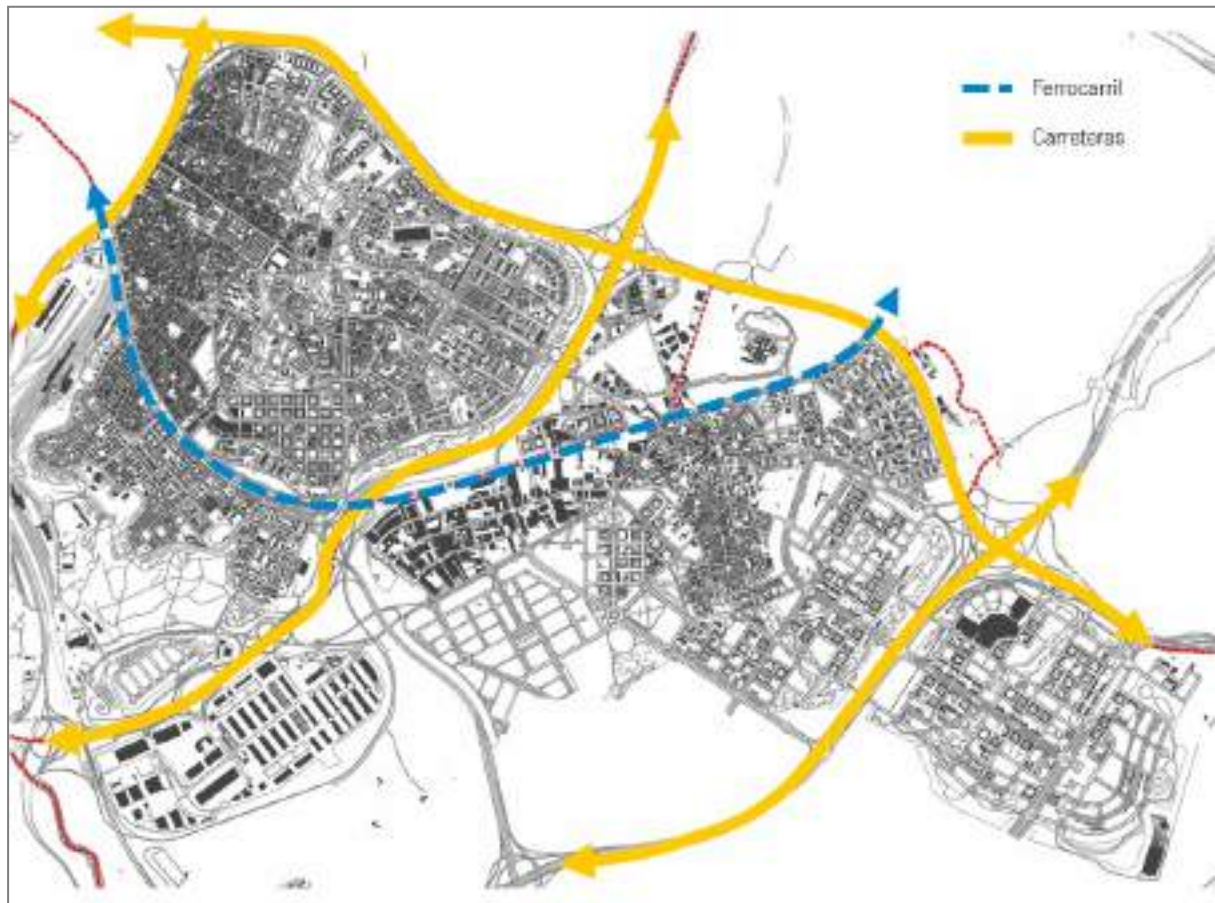


Figure 1: Transport infrastructure in Puente de Vallecas and Villa de Vallecas

Two pilot actions were initially envisaged to be implemented in the living lab. Both actions would be done in cooperation with residents and local stakeholders, following a participatory approach: (1) a high-quality pedestrian corridor and (2) the transformation of a disconnected and car-dominated area into a high quality public space devoted to pedestrian and social life. The location and scope of both actions has been reconsidered and refined, during the planning and design stages, as a result of the interaction between ECCENTRIC and the relevant stakeholders at the municipality and the living lab, as described below.

Additionally, the municipality has reviewed its city-wide Mobility Ordinance, establishing a 30 km/h maximum speed in 80% of the city streets, giving full priority to pedestrians on sidewalks, adopting clear rules for skaters and for micromobility vehicle users, as well as for cyclists, and leaving sidewalks for the sole use of pedestrians and requiring all other vehicles to use the

roadway. The Ordinance was adopted in October 2018 after a public participatory process including the main mobility associations.

The two main specific actions foreseen within this measure are the following:

1. High quality pedestrian corridor.

The initial action aimed at connecting the access to basic facilities (a hospital, a cultural centre and a sport facility) from three areas of the living lab (Santa Eugenia, UVA and the outskirts of the Old Village of Vallecas), crossing the railway line. The three areas of the living lab are the result of very different planning design logics. The high-quality pedestrian axis would make use of both, physical design measures and innovative tools (e.g. smart signage...). In particular, the plan would provide more convenient access to the hospital to local citizens, with a new crossing of the current barrier created by the railway. This project was abandoned during the first preparatory stages of the measure, as the competences for implementation were partially held by the regional government (responsible for this health facility), and the negotiation process between the local and the regional government was too long for this action to be completed within the lifespan of ECCENTRIC.

In addition, the pedestrian axis concept would include the redistribution of the cross-section, widening sidewalks, and rearranging the space dedicated to parking and circulation of vehicles, as well as the enhancement of environmental conditions with trees and urban furniture.

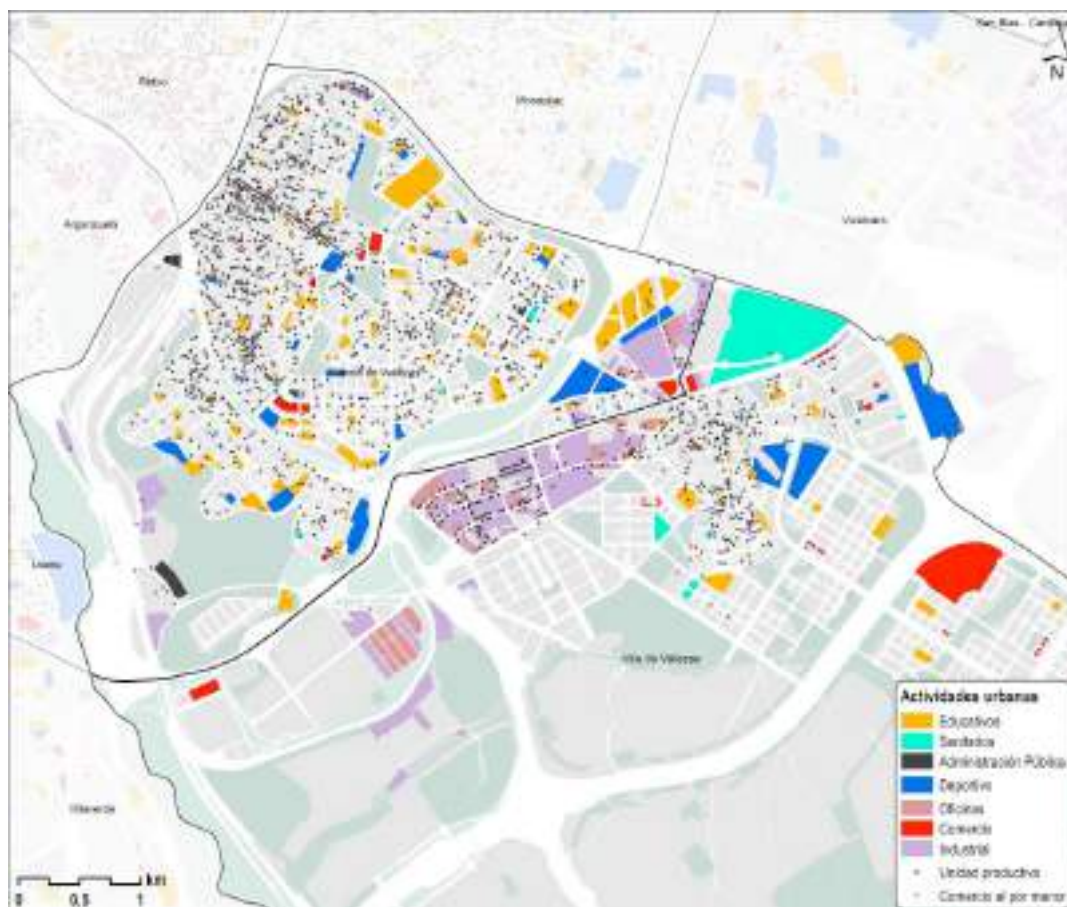


Figure 2: Location and character of the main public facilities and urban activities

The pedestrian network has been combined with the cyclist network, as both have to be merged in public space projects so that spatial justice/fairness is achieved in future through a balance distribution of future street space among users; therefore, the project team has addressed the actions included in ECCENTRIC measures MAD 4.6. and MAD 4.7 with a common approach.

After the ECCENTRIC design of the comprehensive pedestrian network, the so-called *Itinerario Miradores* was selected for the implementation of the pilot high-quality corridor (see red dotted line in the figure below). This route connects the major green areas in Puente de Vallecas, and improves north-south communication in the area for both, pedestrians and cyclists. Several sections of this corridor were completed in 2019 and others are being completed in 2020.



Figure 3: Pedestrian network (green) and high-quality pedestrian corridor (Itinerario Miradores)

2. Transformation of a disconnected and car-dominated area into a high quality public space devoted to pedestrian and social life.

The final location for this action was the area around the railway and metro station of Villa de Vallecas (*Sierra de Guadalupe*), where an e-mobility hub (following the experience of a similar measure in Munich and Turku, and also linked to measure 4.7) was designed.

The project for the new e-mobility hub was prepared with the technical support of a consultancy firm (Steer Davies Gleave, SDG) in 2018, combining some tactical urban actions and public

space improvements with the location of new mobility services in a place already well-served by public transport (railway, metro and buses). However, the complex negotiations among a diversity of public departments and private companies to include in this location a plurality of mobility services was unfruitful. One of the main hooks to attract other partners to this multimodal hub was the foreseen inclusion of facilities for car and bike-sharing services, serving the living lab. Regrettably, the companies in charge of these services finally decided not to expand them outside Madrid's central districts, for commercial reasons.



Figure 4: E-mobility station

A number of additional actions in the pedestrian network were also envisaged (along the yellow line in the figure below). These included the tactical urbanism component in calle Arboleda, focusing on pedestrians and cyclists, which was completed, in cooperation with the Technical University of Madrid (UPM), as this street provides the main access to its south campus.



Figure 5: Improving the pedestrian network



Figure 6: Pilot project during Mobility Week'18:
Arboleda St. Improvement

Additionally, some punctual works were expected to be completed during 2019 (including accessibility improvements, pedestrian crossings, and access to schools) in Puente de Vallecas (the other district included in the living lab): *Constitución Square*, *Peña Gorbea Boulevard* and *La Cañada Park*, as well as a pedestrian connection with Mendez Alvaro.

Furthermore, some additional measures are envisaged in the area, and works are likely to be undertaken in 2019 and 2020, such as the improvement of walkways in another section of the pedestrian network, *Av. de la Democracia*.

Finally, it is worth highlighting two particular contributions of the additional activities added to this measure during the design stages:

- The implementation in the place of the e-mobility station of the first pilot smart signage system, specifically addressed to pedestrians and cyclists. The signs and maps have been well received by the residents, in an area where vandalism has traditionally been an issue.



Figure 7: pilot smart signage focusing in pedestrians and cyclist

- The organisation of a wide communication campaign focused on pedestrian priority in the use of sidewalks, and explaining to residents the new framework defined by the Municipal Ordinance approved in October 2018. The campaign included many creative features and made use of a variety of advertising supports such as lampposts, underground and commercial centres, bus stops, as well as brochures and paper publicity items. The campaign was designed and tested with the support and feedback of a variety of local stakeholders, including participative workshops and street activities with residents and associations.

A.2.2 Supporting activities

No relevant activities are envisaged to support this ECCENTRIC measure.

A.2.3 Interactions with other ECCENTRIC measures

During the design process, interaction between measures MAD 4.6 and MAD 4.7 progressively became stronger. Both measures shared the key concept of an e-mobility centre in the public transport hub of Sierra de Guadalupe (currently providing commuter train, metro and bus services), providing improved information to users, and facilitating spaces for bike parking, as well as for car-sharing and bike sharing service providers. Interaction between the two measures refer to the design solutions retained for pedestrians and bicycles in the public transport hub and in the streets in which actions in support of both modes were envisaged, as action in these streets would require to combine both, cyclists' and pedestrians' needs. This interaction did not have an impact on the KPIs selected for each measure.

During implementation, the needs of pedestrians and cyclists have been included, as well as the adjustment of traffic and parking specifications to these needs

A.2.4 Interactions outside ECCENTRIC

A minimal interaction with MARES (MAdrid- Resilient urban Ecosystems for a Sustainable economy, <http://uia-initiative.eu/en/uia-cities/madrid> and <http://mares.es>) has taken place. MARES was another municipal project, focused on awareness-raising, capacity building and creation of "jobs and skills in the local economy" in four districts in the municipality, including Puente de Vallecas. MARES started in November 2016 and concluded in October 2019.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents in Vallecas		Living lab, with a focus on the area of influence of the north-south corridor in Puente de Vallecas, and the vicinity of the e-mobility hub and University's South Campus in Villa de Vallecas.
4	Pedestrians (and cyclists) in Vallecas		

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

The measure stakeholders are identified in the table below.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
	Head of planning, CRTM	S	PT	O	
	District councillor-chair (PdV & VV) ²⁵	S	C	P	
	City councillor for Environment and Mobility	S	C	P	
	Director General Urban Regeneration Strategy	S	C	P	
	Director General Public Space and Infrastructure	S	C	P	
	Director Traffic Management	S	C	P	
	Local Police	S	C	P	
	Foro Local Puente de Vallecas	S	NG	P	
	Foro Local Villa de Vallecas	S	NG	P	
	Neighbourhood Associations (6)	S	NG	P	
	Stop Accidentes	S	NG	O	
	Fundación ONCE	S	NG	O	
	A Pie	S	NG	O	
	Political parties in both districts	S	Other	O	
	Ayuntamiento de Madrid	P	C	L	
	GEA 21 SL	P	PR	L	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

²⁵ PdV: *Puente de Vallecas*; VV: *Villa de Vallecas* (the two districts included in the living lab).

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Remaining actions not included in the municipality's 2019 budget	Political	Projects prepared and approved by September 2018. Meetings with relevant actors within the city administration	ML
Insufficient involvement of local actors in the strategy and actions	Political	Two workshops already held during the inception stage. Two additional workshops held related to the new access to the University Campus and the e-mobility station. Change in the legal framework: new Mobility Ordinance. Workshops supporting the Ordinance communication campaign. The Ordinance communication campaign focuses on pedestrians' rights and mobility conditions in the Living Lab.	ML, GEA21

Table 4: Identified risks.

B. Measure implementation

B.1 Situation before CIVITAS

The area consists of three different, isolated urban structures, and lacks a consistent pedestrian network linking them to each other, due to barriers such as railway lines and motorways. It is a problem for the residents, particularly to reach some facilities- such as schools, the University Campus and one hospital recently built in the area-, isolated by these infrastructure barriers.

Additionally, the quality of the public space for non-motorized transport modes is low in some itineraries, particularly those following a north-south direction, or in the vicinity of key transport nodes such as *Sierra de Guadalupe* station.

B.2 Innovative aspects

The measure approach is innovative in Madrid, as it establishes a comprehensive strategy to improve the pedestrian quality within the living lab, especially considering that the living lab lies at the outskirts of the city. Several levels of innovation can be identified:

- At the strategic level: the definition of a pedestrian network addressing the main feasible challenges in the area.
- At the implementation level: the combination of actions of different scope that interact among them to provide a consistent improvement at the neighbourhood level.
- At the design level: the involvement of local stakeholders through design workshops to discuss the options.

B.3 Research and Technology Development

The main RTD contribution of this measure refers to the innovative design of the e-mobility hub. The e-mobility station at *Sierra de Guadalupe* is an ambitious project to convert a spot of public transport and pedestrian itineraries into an e-mobility node with tactic urban actions combined with the location of new mobility services.

The main innovative contribution is a way- finding signage pilot integrated into the municipal project "Reading Madrid", the new plan for the homogenisation and rationalisation of signage in Madrid, which serves to improve the pedestrian mobility. *Sierra de Guadalupe* is a pilot project to be applied within the project time.

B.4 Actual implementation of the measure

The design phase took place between September 2016 and April 2017. It was followed by a long implementation phase in which some of the initial design concepts had to be changed. The implementation phase was completed in September 2019.

The operational phase began in May 2018 for some of the actions included in the measure, and was completed in December 2019.

There have been some significant changes in the actions included in this measure, although respecting the general objectives, approach and targeted social groups and areas. The measure had to accommodate itself to the budgetary constraints of the municipal programmes (as the infrastructure investments are made by the municipality and have to meet rigid national regulations), and had also to adapt itself to the priorities identified by local stakeholders in the living lab. Although highly demanding in terms of time and resources, the planning and implementation stages have resulted in widely supported actions, some of them implemented in the second half of 2018 and others completed in 2019. The remaining actions have not been ruled out by the municipality, and could be implemented after the project life span.

The strategic itinerary linking various district parks, *Miradores* (Viewpoints) Itinerary, was defined in 2017 by the Directorate General of Strategic Planning of the municipality, and the preparation of the construction project was completed by the Works Department in January 2018. The Viewpoints Itinerary has been supported as a key project for Vallecas by the residents through the participatory budgeting process. It is a part of the Liveable Itineraries Programme, which will upscale this kind of interventions in other peripheral neighbourhoods, after its evaluation in this pilot project²⁶.

The request for proposals for the construction works of some sections were launched in 2018, and the works were carried out along 2019 and 2020. This has included some improvements in the footpaths and gardening of two parks (Cerro del Tío Pío and Payaso Fofó) making part of the Viewpoints Itinerary.

A tactic or pop-up urban action has been achieved in Arboleda Street to widen its sidewalks and to enhance cycling conditions. The action was completed during the European Mobility Week, in September 2018. This is a key connection for students in the Campus Sur of the Technical University of Madrid (UPM). Arboleda is also included in the pedestrian network identified at the beginning of the measure (linking several disconnected areas of the Living Lab, as described in the initial diagnosis documents during the measure planning stage). After the completion of the action, a request has been made to include in the municipal budget the completion of further works for the permanent consolidation of the new Arboleda Street, but this request has not succeeded in getting the additional works budgeted and implemented.

The integrated technical solution for an e-mobility station in Sierra Guadalupe has been studied by an international consultancy firm (SDG) along 2018. It included improvements in the main walking accesses in this area. The municipality could not implement this action, as the negotiations with the variety of Departments and private stakeholders involved (particularly those providing the commercial car sharing and bike sharing services) did not succeed. As a first step, a way-finding signage pilot integrated into the municipal project “Reading Madrid” was contracted and later implemented in the area of Sierra de Guadalupe during 2019.

Some other construction projects with a similar approach to the Viewpoints Itinerary (walkability plus accessibility, green quality, safety, identity and liveability of the street for walking and staying) were prepared in 2018 (*Peña Prieta* Boulevard, *Constitución* Square, and the park of *La Cañada* in *Puente de Vallecas*, and a pedestrian connection of the south of *Puente de*

²⁶ The project is available in the following interactive story map:
<http://madrid.maps.arcgis.com/apps/MapJournal/index.html?appid=faaa60fa83364618b7238aafd1d78145>

Vallecas (San Diego) with Mendez Alvaro Avenue). The intervention in *Peña Prieta* boulevard was completed in 2019.

Summarizing, the final actions implemented within this measure have been the following ones:

- Within Miradores Itinerary: actions in Cantalapiedra, Alcalá de Guadaira, M^a Teresa Robledo, Puerto de Costabona, as well as introduction of the new wayfinding system “*Leer Madrid*” (Legible Madrid) in some parts of the itinerary (in project).
- Surroundings of the future e-mobility station: Sierra Gorda, Arboleda, Avenida de la Democracia, Jesús del Pino. Pilot project implemented in the area of the future e-mobility hub, with the first street signage system oriented to pedestrians and cyclists.
- Improvements in the pedestrian core of Puente de Vallecas, focusing on Peña Gorbea Boulevard and Martínez de la Riva, as well as on some sections of the main axis of Villa de Vallecas.
- Campaign to promote pedestrian mobility, according to the new municipal Ordinance, where active modes are enhanced and protected.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1		3	2	4
Indicator name	Modal shift	System usage (pedestrian flow)	Nb. of death or seriously injured pedestrians	Satisfaction	CO2 Emissions
Type	KPI	KPI	KPI	KPI	KPI
Category	Transport system	Transport system	Transport	Society	Environment
Subcategory	General	General	Safety	Acceptance	Emissions and nuisance
Aspect	Modal split	System demand	Transport safety	Acceptance	Emissions
Definition	Number of pedestrians that have changed from another mode	Number of pedestrians within the new designed area	Number of pedestrians killed or seriously injured in the new designed area	Users' (pedestrians') average reported satisfaction with the new design	CO2 emissions saved by change of mode to walking
Unit	Number of trips	pedestrian/hour (daily average)	Pedestrians (quantity)	Score (1-5)	tons / year
Method of data collection	Survey to pedestrians.	Counts of pedestrians at key points	Official statistics; reports from GIS system (measure 4.1)	On-street survey to pedestrians	Estimates from survey results on modal shift
Target group	Pedestrians using the new designed area	Pedestrians using the new designed area	Pedestrians using the new designed area	Pedestrians using the new designed area	Pedestrians using the new designed area
Domain	Zone with new pedestrian-friendly design within the demonstration area	Zone with new pedestrian-friendly design within the demonstration area	Zone with new pedestrian-friendly design within the demonstration area	Zone with new pedestrian-friendly design within the demonstration area	Zone with new pedestrian-friendly design within the demonstration area
Control sample	No	No	No	No	No
Related measures, activities, and interference sources	No	No	Measure MAD4.1. Information from the same sources	No	No
References					

Table 5: Description of key performance indicators (KPI)

Impact	1		3	2	4
Indicator name	NOx Emissions	PM emissions			
Type	KPI	KPI			
Category	Environment	Environment			
Subcategory	Emissions and nuisance	Emissions and nuisance			
Aspect	Emissions	Emissions			
Definition	NOx emissions saved by change of mode to walking	PM emissions saved by change of mode to walking			
Unit	tons / year	tons / year			
Method of data collection	Estimates from survey results on modal shift	Estimates from survey results on modal shift			
Target group	Pedestrians using the new designed area	Pedestrians using the new designed area			
Domain	Zone with new pedestrian-friendly design within the demonstration area	Zone with new pedestrian-friendly design within the demonstration area			
Control sample	No	No			
Related measures, activities, and interference sources	No	No			
References					

Table 6: Description of key performance indicators (KPI) (Cont.)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
	Modal shift (number of trips changing mode to walking, classified by previous mode)	Quantity (trips)	A	S	Pedestrians using the new designed area	Transport system
	System usage: pedestrian flow (daily average)	Persons/hour	A	S	Id.	Transport system
	Number of casualties (including fatalities) involving pedestrians in the area	Quantity/month	A	DC	Id.	Transport system
	Satisfaction of pedestrians in the area with the new design	Score (1-5)	A	S	Id.	Society
	CO2 emissions avoided due to modal change	Tons/year	A	E	Id.	Environment
	NOx emissions avoided due to modal change	Tons/year	A	E	Id.	Environment
	PM emissions avoided due to modal change	Tons/year	A	E	Id.	Environment
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 7: Measures' indicators

C.1.2 Baseline

Modal change

The reference for modal split is the 2004 household survey (*Encuesta Domiciliaria de Movilidad*, EDM 2004). It shows a reasonable share for walking in the living lab (25.9% of all trips with origin or destination in the district), with a significant gender difference: 38.0 % for women and 19.7% for men.

The living lab includes 2 districts and 8 neighbourhoods²⁷. The neighbourhoods show significant differences in terms of the share of walking with origin or destination in the neighbourhood (see table below). This will be considered during the evaluation, in terms of selection of the samples in accordance with the areas where the ECCENTRIC actions have taken place within the living lab.

The information provided by the 2014 mobility survey is less accurate, due to the limited sample size. In this case, only the trips made by residents in the living lab are considered. The modal share of non-motorized trips (which can be assimilated to pedestrian trips, as the share of biking in 2004 and 2014 remains negligible) is 22.8%, compared to 20.4% in 2004. This modest growth may be consistent with the reduction in motorized trips due to the economic downturn.

²⁷ If fact, one of the neighbourhoods has been split into 2 in 2017, so that there are 9 of them now.

Comparing to the figures in [Table](#) , it would indicate that non-residents make a significant number of walking trips with origin or destination in the living lab.

Neighbourhood	Walking share Total	Walking share Women	Walking share Men
Entrevías	31,3%	38,0%	23,4%
San Diego	36,9%	41,5%	31,3%
Palomeras Bajas	31,7%	39,8%	20,7%
Palomeras Sureste	24,5%	29,0%	19,2%
Portazgo	29,7%	34,8%	23,2%
Numancia	27,0%	28,0%	25,9%
Casco histórico de Vallecas	19,2%	27,0%	14,1%
Santa Eugenia	23,5%	32,4%	14,0%
Living lab average	25,9%	38,0%	19,7%

Table 8: Share of walking trips in 2004.

System usage

Another useful reference regards the number of pedestrians in certain streets in the area. Counting of bicycle and pedestrian flows were made in May 2018, providing the following results (both walkways and both senses):

Place	Date	Average Hourly Flow Pedestrians (7-15 h)	Pedestrians Peak Hour Flow	Average Hourly Flow Bicycles (7-15 h)	Bicycles Peak Hour Flow
Albufera 11	9/6/2017	2103	2642 (13-14)	10	16
Martínez De La Riva	7/5/2018	537	837 (11-12)	3	7
Sierra Toledana	8/5/2018	220	282 (10-11)	3.5	5
Rafael Alberti	9/5/2018	646	819 (8-9)	0	0
Puerto de Canfranc	10/5/2018	352	524 (12-13)	1.2	3
Monte Igueldo	11/5/2018	979	1324 (11-12)	3.4	7

Table 9: Pedestrian and bicycle counts.

As *Avenida de la Albufera* is the main street in the corridor, pedestrian flows on this street could be taken as a reference for the indicator on system usage.

Finally, the measure team reviewed the traffic counts available in the municipality's database, as they could provide information on traffic volumes on the streets targeted by this measure. Unfortunately, only some of these streets were included in the database, and recent information (from 2016) was available only for one of them. This information is summarised in the table below.

Street	Station Number	Number of vehicles Daily Average .Working day		Number of vehicles Hourly peak	
		Westbound	Eastbound	Westbound	Eastbound
Jesús del Pino	180200517	2007	-	173	-
Sierra Gorda	NA	NA	NA	NA	NA
Pz. Antonio M ^a Segovia	NA	NA	NA	NA	NA
Av. Democracia / S. Guadalupe	4836	10931	12639	728	899
Arboleda	5234	NA	NA	NA	NA

Table 10: Traffic volumes in the streets targeted by ECCENTRIC.

Emissions

Due to the big size of the living lab in terms of surface and population, a simplified methodology has been developed to assess the impact of the measure in terms of modal change, and emission and energy savings. A survey was made in the second half of 2019 to a sample of pedestrians in the streets where the municipality had implemented actions to improve walking conditions and public space quality. The survey provides the percentage of pedestrians that have changed from other modes, and the characteristics (previous mode, distance and frequency) of their trips. The emissions (and energy) saved in each replaced trip will be estimated making use of the specific coefficients provided by COPERT 5.1²⁸. The coefficients change in accordance with the speed (20 km/h is assumed for cars and 15 km/h for buses) and vehicle characteristics. As an average, it will be considered that pedestrians which formerly made the trip by car used a medium-size 2016 Euro 6 vehicle (they will just be asked about the vehicle fuel and the number of persons in the car), taken as an average of the fleet. For pedestrians that previously used public transport buses, it is assumed that the service was provided by a Euro V bus with an average occupancy of 40 passengers. The coefficients in the table below will therefore be multiplied by trip distance and frequency (number of trips per year), and divided by occupancy for every respondent in the survey, and expanded to the whole number of pedestrians counted in the surveyed streets in order to obtain the annual emissions of the pollutants in tons. A similar methodology will be followed to estimate energy savings.

	CO ₂ (g/km)	NO _x (g/km)	NO ₂ (g/km)	PM ₁₀ (g/km)	PM _{2.5} (g/km)	ENERGY (MJ/km)
Car trip, gasoline	296.3583	0.069	0.0014	0.0231	0.013	4.1066
Car trip, diesel	222.5852	0.6827	0.2048	0.0246	0.0145	2.9964
Bus trip, Euro 5	1280,3214	10,14	1,014	0,1743	0,1254	17,2355

Table 11: Average emission factors per pedestrian trip replacing a car or bus trip

C.1.3 The business-as-usual scenario

Mobility data in 2004 and 2014 do not provide enough ground to conclude about significant changes in the modal share of non-motorized trips in Vallecas. Accordingly, the BAU scenario will consider that the 2004 modal share would remain constant in the absence of ECCENTRIC measures, as no additional measures outside ECCENTRIC have been implemented with an impact in the living lab²⁹.

Minor changes can be expected in the emissions, due to the reductions expected by technological progress after 2020. The changes are only significant in what refers to NO_x and NO₂ emissions, thanks to progress in diesel technology, and results in a reduction of NO_x emissions by 63% and a reduction of NO₂ emissions by 75%. Assuming that the current petrol

²⁸ COPERT (Calculation of Emissions from Road Transport) is a computer programme developed by EMISIA with the support of the European Environment Agency, currently used for the estimate of emissions in national inventories. <https://www.emisia.com/utilities/copert/>

²⁹ Concerning the MARES project, its Final Report does not identify to have achieved any mobility impact; therefore, there is no need to take this project into consideration for the assessment of ECCENTRIC.

to diesel ratio (50%) is maintained, savings per car trip would be of 31% and 37% respectively, but this would affect only to the part of the fleet renewed within the measure implementation period (which can be assumed to be less of 10% of the fleet); therefore, the effect of fleet renewal would be small, below 4% for NO_x and NO₂ at most, and will not be considered in the evaluation.

C.2 Measure results

Measure results are summarized in the table below. Final data on system usage will not be available until June 2020. This is due to the fact that the pedestrian counting campaign in Av. Albufera was made in June 2017, and this indicator has a strong seasonal bias; in June 2019, some of the measure actions had not been completed, and the campaign had to be postponed until June 2020³⁰.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Modal shift (number of trips changing mode to walking)	Trips/month	0	2016	0	2019	273,150	2019	273,150	273,150
System usage: pedestrian flow (daily in Av. Albufera)	Persons /hour	2,103	2017	2,103	2020	NA ³¹	2020	NA	NA
Number of pedestrian casualties in the area	Persons	171	2016	171	2019	365	2019	NA	NA
Satisfaction of pedestrians	1-5 Score	3	2016	3	2019	3.1	2019	0.1	0.1
CO2 emissions avoided due to modal change	t/year	0	2016	0	2019	386.5	2019	386.5	386.5
NOx emissions avoided due to modal change	t/year	0	2016	0	2019	1.5573	2019	1.5573	1.5573
PM emissions avoided due to modal change	t/year	0	2016	0	2019	0.0423	2019	0.0423	0.0423

Table 12: Measure KPI results

In accordance with the traffic policy, the sharp increase in 2019 in the number of pedestrians involved in accidents is mainly due to the change in the protocols to report and record accident information implemented at the end of 2018 (see evaluation report of measure MAD 4.1 for more details), which has resulted in a significant increase in the number of accidents for which information is now recorded.

The estimate of modal shift has been made considering as affected population that living within a 400-m band along the streets included in the measure. As many as 13.1% of them declared to have changed to walking, resulting in 273,150 trips per month or 9,105 trips per day.

Additionally, the survey to pedestrians also asked about the influence that the street improvements made have had in the respondent's choice for walking. This was considered as a reasonable proxy to assess the attainment of measure objective #2 (increase in the perception

³⁰ Due to the COVID-19 pandemic, it is unlikely that this campaign can be conducted in June 2020.

³¹ This information will not be available until the new pedestrian counting campaign can be completed, once mobility conditions are restored, after the COVID-19 pandemic.

of safety by pedestrians). 30.0% of the respondents answered that the improvements have had a total or substantial influence on their modal choice.

C.3 Summary: achievement of objectives

The achievement of objectives is summarised in the Table below. Overall, the measure has been successful: the number of walking trips in the vicinity of the streets included in the measure has increased substantially (more than 9,000), far beyond the 1,000 target. The pedestrians' perception of the street conditions (which include safety as a key trait) has notably improved for 30% of them, which can be taken as a reasonable proxy to the consideration that safety perception among pedestrians has also improved. It is worth noticing that, although the reduction of CO₂ and other emissions is substantial, almost 8 of every 10 trips gained by walking are coming from public transport and only 2 from private cars.

No.	Objective and target	Rating	Comment
1	1000 more active travels per day in the area	***	9,105 walking trips per day from other modes
2	15% increase in the perception of safety by pedestrians	**	Proxy: impact of perception of street conditions on modal choice
3	Reduce the number of traffic incidents with pedestrians involved	O	Changes in the accident data collection procedure prevent to undertake a sound comparison between 2019 and previous years.
4	Reduction of CO ₂ and other emissions	**	40% reduction due to change from public transport; 60% from private car
NA = Not Assessed O = Not Achieved in full * = Substantially achieved (at least 50%) ** = Achieved *** = Exceeded			

Table 13: Measure objective's achievement

C.4 Up-scaling

At this stage, the municipality has not made any decision to scale up the measures implemented (or proposed) within ECCENTRIC to other parts of the city. The decisions have been adopted to conclude *Miradores Itinerary*, but there are no decisions adopted to implement the e-mobility hub yet.

Additionally, the Municipality has adopted the necessary decisions regarding:

- The Way Finding signage system, which has been adopted for the city centre in future projects, especially focused on the most touristic areas.
- Completion of the access to the University Campus, once budget resources can be devoted to this project.
- Campaign on the pedestrians' use of streets, to be possibly replicated in other districts.
- The final implementation of the e-mobility station during the new local legislative mandate (2019-2023), as an action within the new local mobility strategy (Madrid 360°).

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the **Process Evaluation Report** of this Measure.

D.1 Deviations from the original plan

Deviations from the original plan have already been described in previous sections and are summarised below.

D.1.1 Change in the location and scope of the high-quality pedestrian corridor

The changes in the location of the pedestrian corridor were due to the delays in the decision-making process for the project initially identified, and the emergence of the “Viewpoint” concept within the municipality political leadership. These changes resulted in considerable delays and in the dedication of significant additional resources by some of the measure partners beyond the initial resource planning.

ECCENTRIC had to accommodate to the new context, and did so by actively participating in the design of the new pedestrian corridor.

D.1.2 Changes in the area selected for pedestrian-friendly transformation

Initially, it was thought to intervene in the streets providing access to Sierra de Guadalupe, as well as in the main east-west axis of the living lab. For a variety of reasons, this approach was replaced by the implementation of the e-mobility station in Sierra de Guadalupe, a more ambitious concept. The complex proposal subsequently developed by ECCENTRIC could not be implemented within the project lifespan without a strong political support from the city council. That support failed to materialise, although the project remains in the pipeline and is expected to be implemented in the next years.

D.1.3 Participation of residents and grassroots associations in Vallecas

Changes and delays in the location of the actions made it difficult to fully deploy the initially-envisaged co-creation processes for the implementation of these measures, and led to more conventional participatory initiatives to inform residents and associations about the actions envisaged.

This was complemented by a wide campaign to disseminate the contents of the new 2018 pedestrian-friendly mobility Ordinance among Vallecas residents.

D.2 Barriers

The following main barriers were identified during the process evaluation.

D.2.1 Financial: Restrictions to the use of municipal budget in infrastructure improvements

The financial barrier has had a strong influence in the measure final contents and outputs. Due to lavish infrastructure projects in the previous years (topped by the multibillion construction of motorway tunnels in the 2004-2008 legislature), the municipality was forced to comply with

strict expenditure and budgeting rules. These made it difficult to budget the ECCENTRIC actions within this measure, forcing the search for alternatives and leading to considerable delays and waste of project resources.

The measure team and site manager navigated these difficult waters through multiple meetings with key municipal stakeholders in charge of budgeting issues, search for less expensive alternatives with higher priority, and re-programming actions to 2019. At the end, the project could not meet its most ambitious targets, but it was successful in achieving outcomes similar to those initially identified.

D.2.2 Institutional: Lack of commitment and support of key institutional stakeholders and decision-makers

The ECCENTRIC measure team had strong difficulties to gain the support of key municipal directorates, in charge of project prioritisation and budget distribution, and in fact was unsuccessful in gaining their support to undertake the initially envisaged actions. Alternative contacts in the relevant municipal departments were established, which served to identify alternative actions that could be implemented within the project life span, so that the completion of this measure would not be compromised.

D.2.3 Communication: Lack of involvement of social agents

This barrier became significant as the initial actions were changed and delays in implementation occurred. Communication with social agents was difficult in a context in which the messages sent by the municipality were periodically changing without clear reason: it became obvious to social agents that the ECCENTRIC team had at best only limited control on the decision making process. On the other hand, it was difficult to the ECCENTRIC team to convene participatory activities when decision makers were not sure about the location and general scope of the actions to be implemented.

D.3 Drivers

The main drivers below were identified during process evaluation.

D.3.1 Political: Favourable strategies and mobility plans

This ECCENTRIC measure was very well-aligned with the general planning and policy framework in Madrid. Pedestrian-friendly actions were supported by the new Air Quality Plan and by the new mobility regulations, passed by the City Council in 2017 and 2018 respectively, as well as with the revision and update of the Urban Mobility Plan, started in 2018. The measure team justified and presented the proposed actions as adequately linked to these municipal strategies and plans, gaining the support of some decision makers to them.

D.3.2 Institutional: Strong commitment and support of some key decision-makers

Cooperation among the municipal departments in charge of Culture (environmental education) and Mobility (planning) was particularly fruitful. The support of political decision makers in Vallecas Districts and within the Mobility Area was instrumental in allowing this measure to provide tangible outputs, in spite of the institutional barriers mentioned above. It could be argued that this support should have been somehow formalised, as a way to more effectively remove the opposition raised from other municipal areas; however, it would probably have

been difficult-if not impossible- to further raise the political profile of this project within a large municipality such as Madrid.

D.3.3 Financial: Availability of resources provided by ECCENTRIC

H2020 financing played a game-changing role in this measure, allowing to rapidly undertake the necessary technical studies and actions at a time in which municipal resources were tight. In the absence of these financial resources, it is highly unlikely that pedestrian-friendly actions in Vallecas would have been undertaken.

D.4 Supporting activities

There were no relevant supporting activities for this measure.

D.5 Recommendations on the implementation process

Based on the experience of this measure in Madrid, two recommendations on the implementation process may be of relevance for other cities introducing pedestrian concepts in peripheral neighbourhoods.

D.5.1 Political support translated into bureaucratic priority

The alignment of the project actions with the city's general mobility policy is far from enough to guarantee their actual implementation. There is a need to translate the political support (in this case, it was obvious from the municipality's commitment with the ECCENTRIC project as coordinator) into clear instructions throughout the municipal services, so that the measures to be implemented are backed by the necessary budgetary decisions at the right time. In fact, some cities create special technical services to carry out innovative projects and actions, with their own procedures for project design, approval and budgeting. This is not the case in Madrid, and the experience show how difficult it can be to get actions completed when they include physical transformations in the city, no matter their size.

D.5.2 Formalising public participation

In the absence of formalised procedures, there is a risk for innovative actions to move forward based on the decisions of the usually enthusiastic technicians and professionals of the measure team, and to oversimplify participatory actions to avoid delays linked to the lengthy process of identifying and mobilizing the local stakeholders. Furthermore, it is not obvious that the project actions, chosen on the grounds of their innovative character, will fit with the local stakeholders' priorities; ironically, a highly participatory process could end up with the message to the project team that it would be wiser to spend the resources in other things, rather than in the sustainable mobility action foreseen in the project.

The challenges of public participation could be better addressed if a participation plan is prepared at the early stages of the measure design and is backed by the municipality in what refers to the decision-making procedures to be followed. Such plan would serve to identify the local stakeholders and to clarify the scope and milestones of the co-designing process.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

E.1 Validated direct impact

- The measure was successful in increasing the number of walking trips beyond the initial project expectations, as an effect of the improvement of walking conditions in certain streets.
- Modal change to walking was mainly due to former public transport users: 83% of the new walking trips were formerly travelled by public transport.
- For sure, CO₂ and emission savings should be taken into consideration, but they cannot provide the main justification for action: Although relevant (equivalent to taking 100 cars off the streets), CO₂ savings in this measure were limited to less than 400 tons per year (or less than €10,000 at current CO₂ market prices), a figure largely insufficient to justify on its own the investments needed for physical changes in the streets on their own. Pedestrian-friendly policies can primarily be justified on the grounds of their wide public support, and the health and social benefits it provides, as confirmed by the users that participated in the survey.

E.2 Relevance of supporting activities

There were no supporting activities associated to this measure.

E.3 Interaction with other measures

Although this measure was expected to interact with measure 4.7, this interaction was very weak, due to the changes in the location of the actions implemented in each measure, which took place largely in different parts of the living lab.

E.4 Main lessons learned

- It is difficult to introduce consistent participatory approaches when implementing innovative measures, particularly in the context of research and demonstration projects with tight schedules. To honour public participation commitments, demonstration projects may need to establish formalised participation plans at the beginning of the measure design identifying the local stakeholders to mobilize and the participation and decision-making procedures to be applied.
- Local bureaucracies can put demonstrations at risk, even in the most committed cities. Cities undertaking demonstrations would benefit of establishing special approval and budgeting procedures for these actions.
- Pedestrian-friendly actions are likely to significantly increase the number of walking trips, but only a small fraction of them is likely to come from former car users. When cities are trying to curb car use, they should probably introduce additional measures, such as specific car restrictions, besides promoting sustainable modes.

- This should be also considered by policy-makers when establishing climate change mitigation policies, as pedestrian-friendly measures, in the absence of car restrictions, are unlikely to provide significant emission savings.

E.5 Long term impact

Considering the good results achieved in terms of modal change, it can be expected that the pedestrian use of the streets included in the measure will continue growing, with potential spill-over effects to other areas in the city lab.

E.6 Potentials for up-scaling in the city

The undergoing revision of the Sustainable Urban Mobility Plan or the new Madrid 360° Strategy could provide an excellent framework for up-scaling, but thus far the municipality has not developed specific up-scaling actions concerning this measure. It is expected that up-scaling could primarily result in the completion of the e-Mobility station in Sierra Guadalupe, the extension of the Mobility Campaign to other districts and the implementation of the new signage system, focused on pedestrians and cyclists, in other parts of the city.

F. Additional information

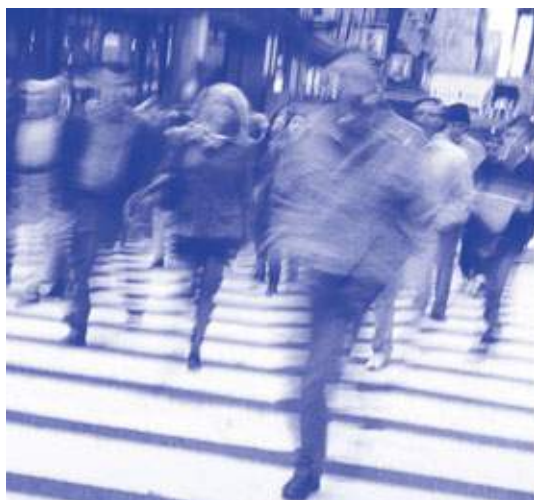
F.1 Appraisal of evaluation approach

The evaluation approach for this measure has been successful in providing accurate monitoring and reporting of the results achieved. The strong points include the relative simplicity of the data collection process, based on counting of pedestrian flows and one on-street survey.

The main weak point in the evaluation refers to the high seasonality of pedestrian flows; there are no references in Madrid referring to de-seasonalise pedestrian traffic flows (as there are for vehicle traffic), which makes it necessary to schedule counting campaigns in the same month to facilitate year-to-year comparison. This may not be possible in practice or can delay evaluation.

F.2 Future activities relating to the measure

It is recommended that the municipality considers the implementation of the actions that were developed within this measure but were not implemented; this is particularly relevant for the implementation of the e-mobility station in *Sierra de Guadalupe*.



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ECCENTRIC



MAD 4.7

Enabling cycling outside the city centre

Measure Evaluation Report

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2020
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EUROPEAN UNION

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Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consorcio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático SL	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
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12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
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	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
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24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Carlos Corral	
Carmen Hernanz	
Marisol Santos	
Isabela Velázquez	

Table of Contents

ABSTRACT.....	834
A. INTRODUCTION.....	835
A.1 EXPECTED RESULTS OF THE MEASURE	835
A.1.1 Quantifiable impacts.....	835
A.2 MEASURE DESCRIPTION	835
A.2.1 Measure outputs.....	835
A.2.2 Supporting activities	839
A.2.3 Interactions with other ECCENTRIC measures.....	840
A.2.4 Interactions outside ECCENTRIC	840
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	841
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	841
A.5 IDENTIFIED RISKS	841
B. MEASURE IMPLEMENTATION	842
B.1 SITUATION BEFORE CIVITAS	842
B.2 INNOVATIVE ASPECTS.....	842
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	842
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	842
C. IMPACT EVALUATION FINDINGS	844
C.1 EVALUATION APPROACH.....	844
C.1.1 Expected impacts and indicators.....	844
C.1.2 Baseline.....	846
C.1.3 The business-as-usual scenario.....	849
C.2 MEASURE RESULTS.....	849
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	850
C.4 UP-SCALING	851
D. PROCESS EVALUATION FINDINGS	852
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	852
D.1.1 High quality cycling corridor.....	852
D.1.2 Parking solutions for bikes.....	852
D.1.3 The potential of the existing cycling ring road	852
D.2 BARRIERS	853
D.2.1 Financial	853

D.2.2	<i>Political</i>	853
D.2.3	<i>Planning</i>	853
D.3	DRIVERS	853
D.3.1	<i>Positional</i>	853
D.3.2	<i>Institutional</i>	853
D.3.3	<i>Organisational</i>	854
D.4	SUPPORTING ACTIVITIES	854
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	854
D.5.1	<i>Formalisation of local cycling network schemes</i>	854
D.5.2	<i>Reaching out to potential users</i>	854
E.	EVALUATION CONCLUSIONS	855
E.1	VALIDATED DIRECT IMPACT	855
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	855
E.3	INTERACTION WITH OTHER MEASURES	855
E.4	MAIN LESSONS LEARNED	855
E.5	LONG TERM IMPACT	856
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	856
F.	ADDITIONAL INFORMATION	857
F.1	APPRAISAL OF EVALUATION APPROACH	857
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	857

List of Figures

Figure 1: Planned cycling network	836
Figure 2: 'Itinerario Miradores' Project- a cycle lane providing north-south connectivity	837
Figure 3: Cycle network in Puente Vallecas. Madrid.....	838
Figure 4: Cycle network in Villa Vallecas. Madrid	839

List of Tables

Table 1: Quantifiable impacts.....	835
Table 2: Target groups or affected parties.....	841
Table 3: Measure stakeholders.....	841
Table 4: Identified risks.....	841
Table 5: Description of key performance indicators (KPI).....	844
Table 6: Description of key performance indicators (KPI) (cont.).....	845
Table 7: Measure's indicators	846
Table 8: Share of biking trips in 2014.....	846
Table 9: Bicycle counts in 2014-2017 (one direction)	847
Table 10: Bicycle counts in 2018	847
Table 11: Traffic volumes in the streets targeted by ECCENTRIC.....	848
Table 12: Average emission factors per trip (g/km and passenger), for car and bus (Source: COPERT).....	848
Table 13: Summary of KPI values.....	850
Table 14: Achievement of objectives	851

Project	City		
ECCENTRIC	Madrid		
Measure code	Measure name		
MAD 4.7	Enabling cycling outside the city centre		
Last update	Responsible	e-mail	telephone
16/03/2020	Marisol Santos	santoshms@madrid.es	

Abstract

This measure has implemented different cycling-friendly actions in the living lab. Besides providing a vision for a future district-wide cycling network, it designed and implemented shared lanes for bikes and general traffic (*ciclocarriles*) along key north-south and east-west sections within the living lab. The design of mass-storage bike parking facility within the future e-mobility station in *Sierra de Guadalupe*, in cooperation with measure MAD 4.6 was not implemented.

Overall, the measure was successful in meeting or getting close to its initial targets: the number of new cycling trips in the living lab is estimated to have grown by 849 additional trips per day, not far from the 1,000 trip target. Data on the number of accidents will be available in February 2020; provisionally, it can be stated that the bikers' perception of the street conditions (which include safety as a key trait for bikers) has notably improved for 15.8% of them, which can be taken as a reasonable proxy to the consideration that safety perception among cyclists has improved. Finally, the reduction of CO₂ (and other) emissions has been close to the target: 35.2 tons/year instead of 50 tons/year; this modest attainment in terms of emissions is consistent with the fact that only 8.5% of the trips changing mode to cycling are coming from private cars, and 47.1% from much less polluting public transport.

The measure design and implementation stages showed the difficulties to introduce consistent participatory approaches when implementing innovative measures, particularly in the context of research and demonstration projects with tight schedules. In the case of this cycling measure the participatory approach was particularly difficult due to the low share of cycling in the living lab and in the whole of Madrid. To honour public participation commitments, demonstration projects may need to establish formalised participation plans at the beginning of the measure design identifying the local stakeholders to mobilize and the participation and decision-making procedures to be applied. Another lesson from this demonstration is that cycling actions need to be identified and implemented within duly formalised network concepts at the city and district levels. Without such formalisation, municipal technical services can risk to implement suboptimal actions without real impact in terms of attracting new bikers.

It is worth highlighting that only a small fraction of the cycling trips replaces car trips. When cities are trying to curb car use, they should introduce restriction measures, besides promoting sustainable modes: cycling-friendly measures provide modest CO₂ emission savings, and, to be effective, mitigation actions require the introduction of bold car restrictions.

B. Introduction

B.1 Expected results of the measure

The measure objectives are:

(4) City policy level in perspective of CIVITAS goals/ longer term:

- To decarbonize mobility in the city of Madrid.
- To improve health and air quality, avoiding unnecessary car trips.

(5) Strategic level:

- To achieve a modal share of 2% for bicycle trips in Madrid
- To reduce haphazard traffic with cyclists involved

(6) Measure level:

- To increase cycling levels in the targeted neighbourhoods.

B.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	1000 new bike travels per day (i.e. 2% modal share for bikes)		X								
2	No increase in traffic accidents involving cyclists			X							
3	50 t/year of savings in CO _{2eq} emissions	X									

Table 1: Quantifiable impacts.

B.2 Measure description

B.2.1 Measure outputs

In 2008, the Municipality of Madrid adopted its Bicycle Master Plan 2008-2016. The plan boosted the development of a cycling infrastructure network (with a length over 300 km in 2016) and led also to the implementation of BICIMAD, the electric bike-sharing system in 2014. Despite this, cycling levels remain very low, with a modal share below 1% of all trips. Cycling levels are particularly low in peripheral districts, and can be explained, among other factors, by a higher level of perceived risk for cycling.

With this ECCENTRIC measure, the municipality of Madrid was expected to update its Bicycle Master Plan in the living lab area (Vallecas) and implement some actions. The actions initially envisaged by the measure team included the development of a high quality cycling corridor, implementation of parking solution for mass storage of bikes, and a study on the potential of

the existing cycling ring road (a 64 km long facility which also serves the living lab) to boost cycling mobility in urban outskirts.

At the beginning of the project, the update of the Bicycle Master Plan in Vallecas led to the definition of the planned cycling network presented in Figure 1, which provides the structure of the cycling infrastructures in the living lab, connecting the main facilities, mobility nodes, public transport stations and key attractors (such as the UPM Southern Campus and the main commercial areas). The cyclist network is structured around two main corridors, following respectively Av. Albufera (east-west) and Pío Felipe- Av. Buenos Aires (north-south).

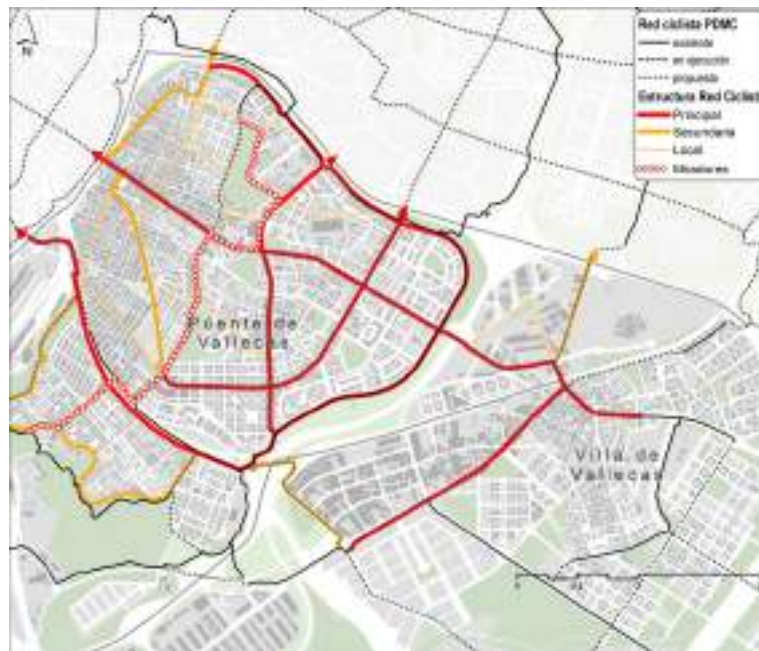


Figure 1: Planned cycling network

The *Miradores* corridor is incorporated into the cycling network as an additional element. *Miradores* is a pedestrian and bicycle itinerary that aims at structuring the sustainable mobility network of *Puente de Vallecas* district. This is a strategic action to transform mobility and the use of public space. It is conceived as a project that will trigger a larger scale transformation in the district, and will also serve as a reference for the city as a whole. The *Miradores* corridor will include a cycle lane similar to those planned in the city centre, and will cross the district from north to south, connecting various parks in the district with amazing vista points.

The Master Plan is focused on the construction of segregated cycle paths in the main axis. From a neighbourhood-centred approach, as addressed by ECCENTRIC, there is need of complementary shared lanes (*ciclocarriles*) for bicycles in secondary streets. This is backed by the regulatory changes set-up of the new Sustainable Mobility Ordinance in the fall 2018, reducing the speed limit to 30 km/h in many local streets (narrower streets without traffic relevance), and allowing the safe use of these streets by cyclists. With these regulatory changes, a completely new scenario for cycling has been set up in the whole city.

Two studies have been carried out to analyse the conditions of the road network in the districts and to create a network of routes specially designed for cycling, providing better conditions than other routes in terms of attractiveness, comfort, speed and safety. At the same time, the

network connects the main generators of travel, such as stations and public transport stops, facilities, economic activities, shops, leisure and restaurant centres, etc.

The network is adapted to the spatial distribution of urban activities and the location of facilities, with particular emphasis on educational centres and sport centres, as well as to topography (slopes) and the general traffic volumes on the roads. The analysis of the gradients and traffic shows that there are some network sections with steep slopes, which could reduce cycling demand.

Public transport is considered as an extension of bicycle travel. A major factor in the attractiveness of public transport for cyclists is the type of stop/station and the service offered at the stop/station.



Figure 2: 'Itinerario Miradores' Project- a cycle lane providing north-south connectivity

The measure has implemented some key elements of the cycling network in Vallecas. This includes some secondary north-south axes in Puente de Vallecas (western part of the living lab) and a shared lane on the main corridor of *avenida de la Albufera*. Additionally, a shared lane was provided within the tactical urbanism action in *calle Arboleda* (Villa de Vallecas district, central part of the living lab), together with some improvements for pedestrians; Arboleda street links the Southern Campus of the Technical University of Madrid with the rail and metro station *Sierra de Guadalupe*, where an e-mobility station was designed (but not implemented) within measure 4.6. The actions completed are the following:

- A shared lane for general traffic and bicycles on *Avenida de la Albufera* (completed in December 2017 between *Puente de Vallecas* metro station and the intersection with *Rafael Alberti* street).
- Arboleda: shared lane.

- Calle del Convenio: bike lane followed by a shared lane connecting the area known as *Pozo* with *Parque Tierno Galván*.
- Calle Martínez de la Riva: shared lane.
- Calle Monte Igueldo: shared lane.
- Calle Puerto Canfranc: shared lane.
- Calle Sierra Toledana: shared lane.
- Calle El Bosco: shared lane.
- Av. Rafael Alberti: shared lane
- Camino del Pozo del Tío Raimundo (shared lane still under consideration).
- *Itinerario Miradores* project: a cycle lane providing north-south connectivity.
- Development of high quality cycling corridors based on studies of district cycling networks which identify main routes and develop the priority ones.



Figure 3: Cycle network in Puente Vallecas. Madrid

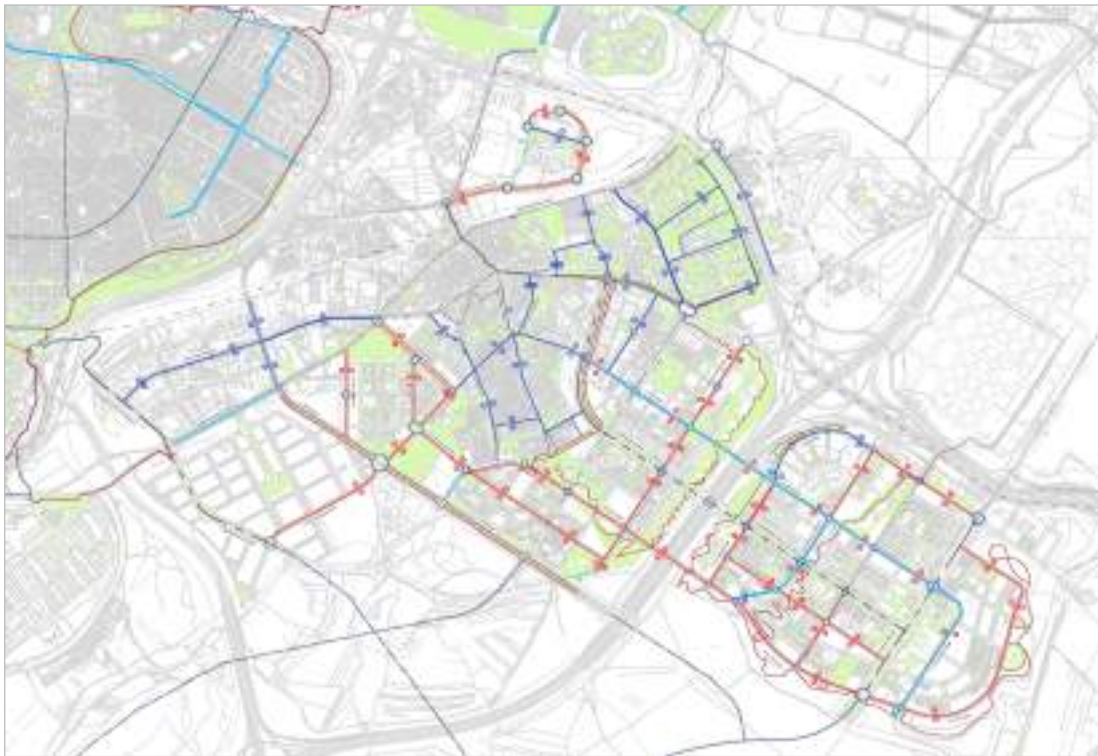


Figure 4: Cycle network in Villa Vallecas. Madrid

The measure had initially envisaged two additional actions, which could not be finally implemented:

- Mass-storage bike parking solutions, integrated within the development of the “e-mobility” node in Sierra de Guadalupe metro station, in coordination with measure MAD 4.6.
- Improvements in the Vallecas section of the existing 64-km long cycling ring road, with a potential to boost cycling mobility in the city-lab area, improving its connectivity with the surrounding neighbourhoods, and in the outskirts of Madrid at large. The biking network established for the living lab included the section of the ring road in this area. The comprehensive project for the rehabilitation and improvement of the cycling ring road was completed, and upgrading works started in July 2017 and were completed at the end of 2019. They included the improvement of the intersection of the cycling ring road with the shared lane on Av. Entrevías, as well as the replacement of equipment such as parking racks and benches. However, these actions took part outside the project measure and were not significant enough to have an impact in the living lab.

B.2.2 Supporting activities

There are no supporting activities in the living lab, which could have an impact on this measure’s KPIs. However, it is worth highlighting that the Cycling Network envisaged in the plan was greatly supported by two workshops with local stakeholders. The last one took place on 19 December 2017. The workshops were co-organized with “Universidad Social de Vallecas, USVK) and served to assess the residents’ and local stakeholders’ priorities

compared to ECCENTRIC measures. Measure MAD 4.7 (and MAD 4.6) received particular attention from participants.

B.2.3 Interactions with other ECCENTRIC measures

During the design process, interaction between measures MAD 4.6 and MAD 4.7 progressively became stronger. Both measures shared the key concept of an e-mobility centre in the public transport hub of Sierra de Guadalupe (currently providing commuter train, metro and bus services), providing improved information to users, and facilitating spaces for bike parking, as well as for car-sharing and bike sharing service providers. Interaction between the two measures refer to the design solutions retained for pedestrians and bicycles in the public transport hub and in the streets in which actions in support of both modes were envisaged, as action in these streets would require to combine both, cyclists' and pedestrians' needs. This interaction did not have an impact on the KPIs selected for each measure.

During implementation, the links between both measures weakened, as the e-mobility station was not implemented.

It is worth highlighting the pedestrian- cycling link in the *Itinerario Miradores* project. It provides a high-quality pedestrian and cyclist corridor in *Puente de Vallecas*, connecting the major green areas in this district, while improving north-south connectivity for pedestrians and cyclists in the area.

B.2.4 Interactions outside ECCENTRIC

MARES (MAadrid- Resilient urban Ecosystems for a Sustainable economy, <http://uia-initiative.eu/en/uia-cities/madrid> and <http://mares.es>) is one project of the municipality of Madrid and 8 private partners and NGOS. It is funded by the EU's European Regional Development Fund through its Urban Innovative Actions (UIA) initiative. Mares (mares.es). The project started in November 2016 and concluded in October 2019.

MARES addresses the UIA topic area "jobs and skills in the local economy" and benefits from a ERDF contribution of € 4,799,607.20. Four districts in the municipality are targeted, including Puente de Vallecas, and MARES in Puente de Vallecas is dedicated to mobility issues, offering significant synergies with ECCENTRIC measures MAD 4.6. and MAD 4.7. The purpose of MARES was to stimulate innovative and sustainable economic activities in Vallecas and other neighbourhoods. Initially, it was expected that some of MARES activities could provide mobility services (such as bike-based freight delivery or a micro-hub for logistics), which could have an impact in waking and cycling in Vallecas, to be considered within the evaluation of measures MAD 4.6 and MAD 4.7. However, the scope of MARES mostly remained at the awareness-raising and capacity-building level, without on-street impacts that could interact with ECCENTRIC.

B.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents in Vallecas		Living lab, with a focus on the north-south corridor in Puente de Vallecas, Av. Albufera and the vicinity of the e-mobility hub in Villa de Vallecas.
4	Cyclists in Vallecas		

Table 2: Target groups or affected parties.

B.4 Stakeholders: ECCENTRIC project partners and other important actors

The measure stakeholders are identified in the table below.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
	Head of planning, CRTM	S	PT	O	
	District councillor-chair (Puente de Vallecas & Villa)	S	C	P	
	City councillor for Environment and Mobility	S	C	P	
	Director General Urban Regeneration Strategy	S	C	P	
	Director General Public Space and Infrastructure	S	C	P	
	Director Traffic Management	S	C	P	
	Local Police	S	C	P	
	Foro Local Puente de Vallecas	S	NG	P	
	Foro Local Villa de Vallecas	S	NG	P	
	Neighbourhood Associations (6)	S	NG	P	
	Stop Accidentes	S	NG	O	
	Fundación ONCE	S	NG	O	
	Pedalibre, Madrid Ciclista	S	NG	O	
	Political parties in both districts	S	Other	O	
	Ayuntamiento de Madrid	P	C	L	
	GEA 21	P	PR	L	

Type: P: CIVITAS partner – S: other stakeholder
 Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company
 Level of activity: L: Leading role – P: Principle participant – O: Occasional participant

Table 3: Measure stakeholders.

B.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Remaining actions not contracted out in 2018 or not included in the municipality's 2019 budget	Political	Meetings with relevant actors within the city administration	ML
Insufficient involvement of local actors in the strategy and actions	Political	Two workshops already held. Further workshops envisaged during second half 2018	ML, GEA21

Table 4: Identified risks.

C. Measure implementation

C.1 Situation before CIVITAS

The living lab lacks a consistent cycling network, with dedicated infrastructure and parking for bicycles. The use of bikes remains marginal in the modal split. BICIMAD, the shared e-bike service introduced in 2014, has been deployed almost exclusively in the central districts of Madrid, and did not reach the living lab until September 2019, when the first station with a capacity for 24 e-bikes, was opened close to Puente de Vallecas metro station, in the western edge of the living lab.

The Cycling Master Plan presented by the city council in 2008 included some bike lanes in the living lab with a total length of 6,310 m as a part of the so-called “secondary network”. Most of these actions had not been implemented at the time ECCENTRIC started. The municipality undertook the revision of the 2008 plan, and published its conclusions in November 2016, suggesting a different approach, based on a vision of “inclusive cycling” open to all. A survey conducted in 2015 by *Conecta* and included in the technical document revising the 2008 Master Plan, showed stark differences among city districts in the propensity of their residents to change transport mode to bike: Puente de Vallecas was at the top, with 15% of residents interested in biking; Villa de Vallecas was at the bottom, with just 2%.

C.2 Innovative aspects

The main innovative aspects in the approach refer to the adoption of shared solutions (accommodating various transport means, besides bicycles) and the tailored approach in the access to the Southern Campus.

C.3 Research and Technology Development

There are no RTD contributions foreseen in this measure.

C.4 Actual implementation of the measure

The design phase took place between September 2016 and April 2017. The implementation phase began in May 2017 and was extended for some remaining actions until February 2019. The operational phase started for some actions in May 2018, and is expected to run until December 2019.

There have been significant changes in this measure compared to the initial concept: On the one hand, the development of the cycling network in the living lab had to be made consistent with some decisions and commitments already made by the municipality and with requests and priorities already stated by some social groups in the living lab. On the other hand, the initial action to provide parking racks for bikes in Puente de Vallecas was cancelled, as the inclusion of a biking component in the e-mobility station Sierra de Guadalupe (which belongs to the other district participating in ECCENTRIC, Villa de Vallecas), was considered as more ambitious and with a higher impact potential; however, the resources necessary for the

construction of the e-mobility station were not budgeted by the municipality, and the action could not be implemented within the project life span. The actions finally implemented within this measure are the following ones:

- A cyclist network in the two districts of the living lab has been defined, updating and expanding the Local Cycling Master Plan.
- A shared cycle lane has been implemented in *Avenida Albufera* (between Puente de Vallecas metro station and Rafael Alberti), in Puente de Vallecas District in 2017, providing a link with the city centre; in the future, the lane could expand further east, connecting with *Villa de Vallecas* district.
- A tactic pop-up urban action in *Calle Arboleda*, including a dedicated cycle lane and the widening of sidewalks, was implemented during the 2018 European Mobility Week. This is a low-cost transformation of the itinerary to the south campus of the Technical University of Madrid, that should have been consolidated in 2019; however, the municipality did not undertake such consolidation.
- Construction projects for several shared lanes, implemented along 2018 and in the first months of 2019 in the following streets: *Martínez De La Riva*; *Sierra Toledana*; *Rafael Alberti*; *Puerto de Canfranc*; *Monte Igueldo*, *Convenio*, *El Bosco*, and *Camino del Pozo del Tío Raimundo*. The prioritisation of these streets within the future cycling network was based on the level of support received by citizens in the Participative budgets process established every year by the municipality.

The implementation of a mass-storage bike parking solution was abandoned, due to lack of budget and the low modal share of cycling in the living lab. The parking solution for bikes was recovered in the design of the e-mobility station in Sierra de Guadalupe, but this action (included in measure 4.6) was not finally implemented.

The works for the improvement of the section of the “Bike Green Ring” in the area were completed in 2019 but, due to their modest scope and low connectivity with the rest of Vallecas, they were not expected to have an impact on bike use in the living lab.

D. Impact Evaluation findings

D.1 Evaluation approach

D.1.1 Expected impacts and indicators

Impact	1	2	3	
Indicator name	Modal shift	System usage	Number of accidents with bikes	Satisfaction
Type	KPI	KPI	KPI	KPI
Category	Transport system	Transport system	Transport	Society
Subcategory	General	General	Safety	Acceptance
Aspect	Modal split	Transport system utilisation	Transport safety	Acceptance
Definition	Number of bike users that have changed from another mode	Bicycle flows on the main axis of the new designed area	Number of accidents in the living lab involving bikes	Users' (bike users') average reported satisfaction with the new design
Unit	Number of trips	Average bikes per day (Peak hour)	Accidents (quantity)	Score (1-5)
Method of data collection	Survey to bike users	Counts of bicycles at key points	Official statistics; reports from GIS system (measure 4.1)	On-street survey to cyclists
Target group	Cyclists using the new designed area	Cyclists using the new designed area	Cyclists using the new designed area	Cyclists using the new designed area
Domain	Zone with new cycling-friendly design within the demonstration area	Zone with new cycling-friendly design within the demonstration area	Zone with new cycling-friendly design within the demonstration area	Zone with new cycling-friendly design within the demonstration area
Control sample	No	No	No	No
Related measures, activities, and interference sources	No	No	Measure 4.1. Information from the same sources	No
References				

Table 5: Description of key performance indicators (KPI)

Impact			
Indicator name	CO2 emissions	NOx emissions	PM emissions
Type	KPI	KPI	KPI
Category	Environment	Environment	Environment
Subcategory	Emissions and nuisance	Emissions and nuisance	Emissions and nuisance
Aspect	Emissions	Emissions	Emissions
Definition	Emissions (t per year of CO2) saved by change of mode to cycling	Emissions (t per year of NOX) saved by change of mode to cycling	Emissions (t per year of PM) saved by change of mode to cycling
Unit	tons / year	tons / year	tons / year
Method of data collection	Estimates from survey results on modal shift	Estimates from survey results on modal shift	Estimates from survey results on modal shift
Target group	Cyclists using the new designed area	Cyclists using the new designed area	Cyclists using the new designed area
Domain	Zone with new cycling-friendly design within the demonstration area	Zone with new cycling-friendly design within the demonstration area	Zone with new cycling-friendly design within the demonstration area
Control sample	No	No	No
Related measures, activities, and interference sources	No	No	No
References			

Table 6: Description of key performance indicators (KPI) (cont.)

No.	Indicator	Data units	Frequency B – I – A	Method DC-E-S-C	Observed group	Area of measurement
	Modal shift (number of trips changing mode to cycling, classified by previous mode)	Quantity (trips)	A	S	Cyclists using the new designed area	Transport system
	System usage: cyclists flow	Cyclists/m2	A	S	Id.	Transport system
	Number of accidents involving bikes in the area	Quantity/month	A	DC	Id.	Transport system
	Satisfaction of cyclists in the area with the new design	Score (1-5)	A	S	Id.	Society
	CO2 emissions avoided due to modal change	Tons/year	A	E	Id.	Environment
	NOx emissions avoided due to modal change	Tons/year	A	E	Id.	Environment
	PM emissions avoided due to modal change	Tons/year	A	E	Id.	Environment
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 7: Measure's indicators

D.1.2 Baseline

The reference for modal split is the 2004 household survey (EDM 2004). It shows virtually no cycling for residents in the living lab: only a few bike trips are identified in EDM 2004 in the neighbourhood of Portazgo (to reach the neighbourhood of Palomeras Bajas) and representing 1% of the trips with origin or destination in Portazgo.

In 2014, the Public Transport Authority (*Consortio Regional de Transportes de Madrid*) conducted a simplified phone and internet-based survey with a heavily reduced sample compared to EDM 2004: 84 instead of 1172 transport zones and just 60 persons surveyed in each zone (almost 5,000 surveys conducted for the whole metropolitan region). The 2014 survey (see table below) shows some increase in the number of cycling trips, and modal share for biking in the living lab higher than in the city. However, these figures should be taken cautiously, as the small sample used in this survey provides a high margin of error for modes with a small share.

DISTRICT	Biking share Total
Puente de Vallecas	0.9%
Villa de Vallecas	2.1%
Living lab average	1.2%
City average	0.6%

Table 8: Share of biking trips in 2014.

Another useful reference regards the traffic counting database of the municipality. It includes the number of bikes on certain streets in the area. The table below shows the last counts undertaken by the municipality, showing extremely low traffic volumes registered in 2014-2017:

Place	Date	Av. Hourly Sense 1 (15 h)	Av. Hourly Sense 2 (15 h)	Bicycles Peak hour
Albufera 11	9/6/2017	5	6	17
Arboleda	4/3/2015	1.3	0.9	10
Democracia	4/3/2015	0.5	0.3	4
Gran vía del Este	4/3/2015	0.9	0.3	8
Democracia (S de Guadalupe)	4/3/2015	0.3	1.7	10
Albufera	4/3/2015	1.1	1.0	7
Rafael Alberti (León Felipe)	24/2/2014	0	0	0
Albufera (Miguel Hernández)	24/2/2014	0.4	1.7	7
Rafael Alberti (Luis Buñuel)	24/2/2014	0	0	0
Albufera (Pablo Neruda)	24/2/2014	1.7	0.4	7
Sierra de Javalambre (Monte Oliveti)	7/6/2016	1.2	0	3
Albufera (Bustos)	7/6/2016	4.7	4.7	15
Cº Pozo del Tío Raimundo	26/5/2015	1.1	0.5	6
Ctra Villaverde a Vallecas (González Dávila)	26/5/2015	3.4	2.9	8
Ctra Villaverde a Vallecas (Mercamadrid)	26/5/2015	2.8	3.9	9
El Bosco (Ramón Pérez de Ayala)	23/4/2014	0.5	0.7	3
Pío Felipe (Arroyo Fontarrón)	23/4/2014	0.6	0.9	4
El Bosco (Pablo Neruda)	23/4/2014	0.9	0.6	4
Pío Felipe (Benjamín Palencia)	23/4/2014	0.7	0.5	4

Table 9: Bicycle counts in 2014-2017 (one direction)

The municipality has conducted additional traffic counts in May 2018. The measurements were done manually during one working day in each street, between 7 h and 15 h. The results are summarised in the Table below.

Place	Traffic Direction	Date	Av. Hourly Bicycles (15 h)	Bicycles Peak hour
Martínez De La Riva	One	5/2018	23	7
Sierra Toledana	Two	5/2018	28	9
Rafael Alberti	Two	5/2018	0	0
Puerto De Canfranc	One	5/2018	10	3
Monte Igueldo	One	5/2018	27	7

Table 10: Bicycle counts in 2018

Finally, the table below provides information on motorized traffic volumes on the streets in which actions in favour of bicycles are envisaged: *Convenio, Martínez de la Riva, Monte Igueldo, Puerto Canfranc, Sierra Toledana, El Bosco, Rafael Alberti*. It was intended to include also *Camino del Pozo del Tío Raimundo*, but this action could not be completed in 2019.

Street	Date	Station	Daily Av. Working day		Hourly peak	
			Westbound	Eastbound	Westbound	Eastbound
Convenio (Tramo 1)	18/02/2015	4834	7393	5065		
Convenio (Tramo 2)	12/10/2016	4835	3692	1698		
Martínez de la Riva (Tr.1)	26/02/2015	4896	4380			
Martínez de la Riva (Tr.2)	27/03/2014	7233	2347	2374	173	175
Martínez de la Riva (Tr.3)	26/02/2015	7234	2179	3026	180	229
Monte Igueldo (Tr.1)	21/03/2015	4914	9544			
Monte Igueldo (Tr. 2)	02/04/2015	4915	3065			
Puerto Canfranc	14/10/2016	7208	848	66		
Sierra Toledana	05/03/2018	2018-97	6877	701		
El Bosco (Tramo 1)	03/03/2015	4845	2384	5688		
El Bosco (Tramo 2)	18/07/2015	4846	2846	4009		
El Bosco (Tramo 3)	19/02/2015	4847	1561	2613		
Rafael Alberti	21/10/2015	4968	4093	3448	296	252
Camino del Pozo del Tío... (Tramo I)	06/03/2015 22/07/2015	5534	7989	7223	608	591
Camino del Pozo del Tío... (Tramo II)	21/10/2015	7230	7110	6072	513	452
Arboleda (1 day counts)	04/03/2015	Crossing	6472	2554	649	301

Table 11: Traffic volumes in the streets targeted by ECCENTRIC.

The table below provides average emission coefficients for the emission pollutants considered, in accordance with the COPERT³² software version 5.1 (considering an average speed 20 km/h, average car type 50% diesel and 50% petrol medium-size car, average bus occupancy, 40 persons, average car occupancy, 2 persons, Euro VI, up to 2016 technology). Emissions per bus trip compared to car trip are 4 times lower for CO₂, 14 times lower for NO_x, 38 times lower for NO₂, 4.7 lower for PM₁₀ and 5.2 times lower for PM_{2.5}. These ratios will be applied to the travel distances estimated from the surveys to be administered once the measure is implemented.

	CO ₂	NO _x	NO ₂	PM ₁₀	PM _{2.5}
Car trip, gasoline	296.3583	0.069	0.0014	0.0231	0.013
Car trip, diesel	222.5852	0.6827	0.2048	0.0246	0.0145
Car trip, average	259.4717	0.3759	0.1031	0.0239	0.0138
Bus trip, Euro 6	1305.8577	0.544	0.0544	0.102	0.0532

Table 12: Average emission factors per trip (g/km and passenger), for car and bus (Source: COPERT)

³² COPERT (Calculation of Emissions from Road Transport) is a computer programme developed by EMISIA with the support of the European Environment Agency, currently used for the estimate of emissions in national inventories. <https://www.emisia.com/utilities/copert/>

Based on these factors, KPI on emissions will be estimated through an on-street survey to cyclists making use of the new infrastructure in the living lab. Cyclists will be asked to report on their average cycling trips in a working day, trip distances, and their previous transport mode (and vehicle type) for such trips before the new infrastructure was implemented (one year ago). Cycling counts will also be completed. This information will provide the distances travelled formerly by car or bus, which are now done by cycling. The distances, multiplied by the average emission factors in the Table above, will provide the annual emissions savings.

D.1.3 The business-as-usual scenario

The BAU scenario will consider that the 2004 modal share would remain constant in the absence of ECCENTRIC measures, which means that the modal share of bikes would remain negligible on the targeted streets.

Minor changes can be expected in the emissions, due to the reductions expected by technological progress after 2020. The changes are only significant in what refers to NO_x and NO₂ emissions, thanks to progress in diesel technology, and results in a reduction of NO_x emissions by 63% and a reduction of NO₂ emissions by 75%. Assuming that the current petrol to diesel ratio (50%) is maintained, savings per car trip would be of 31% and 37% respectively.

D.2 Measure results

Measure results are summarised in the Table below. Final data on system usage will not be available until June 2020, due to the fact that the cycling counting campaign in Av Albufera was made in June 2017, and this indicator has a strong seasonal bias; in June 2019, some of the measure actions had not been completed, and the counting campaign had to be postponed until June 2020.

Information on the number of accidents including bikes has to be taken cautiously, as the reporting system was revised and improved in 2018, making it problematic to establish comparisons between 2019 and previous years.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Modal shift	Trips/month	0	2016	0	2019	25,459	2019	25,459	25,459
System usage: Cyclist flow, peak hour Albufera	Cyclists/hour	16	2017	16	2019	NA ³³	2020	NA	NA
Accidents including bikes	Acc./year	57	2016	57	2019	55	2019	- 2	- 2
Satisfaction of cyclists in the area with the new design	Score (1-5)	3	2016	3	2019	2.8	2019	-0.2	-0.2
CO2 emissions avoided due to modal change	Tons/year	0	2016	0	2019	35.2	2019	35.2	35.2
NOx emissions avoided due to modal change	Tons/year	0	2016	0	2019	0.1343	2019	0.1343	0.1343
PM emissions avoided due to modal change	Tons/year	0	2016	0	2019	0.0038	2019	0.0038	0.0038

Table 13: Summary of KPI values

The estimate of modal shift has been made considering the increase in bike use measured from the 2019 ECCENTRIC survey (estimated as a 22.7% growth in the number of bikers), and applying it to the population living in the neighbourhoods in which the new cycling lanes were implemented. This resulted in a total population of 3,193 estimated bikers, 25,459 trips changing mode to cycling per month or 849 trips per day.

Additionally, the survey to cyclists also asked about the influence street improvements implemented by ECCENTRIC had in the respondent's choice for cycling. This was considered as a reasonable proxy to assess the attainment of measure objective #2 (increase in the perception of safety by pedestrians). 15.8% of the respondents answered that the improvements have had a total or substantial influence on their modal choice.

D.3 Summary: achievement of objectives

The achievement of objectives is summarised in the Table below. Overall, the measure has been successful: the number of new cycling trips in the living lab is estimated to have grown by 849 additional trips per day, not far from the 1,000 trip target. The number of traffic accidents

³³ This information was expected to be collected in June 2020. The restrictions in place due to the COVID-19 pandemic make it impossible to collect this information.

involving cyclists has slightly decrease in the Living Lab (by 3.5%), although this figure has to be taken cautiously due to the changes made in 2018 in the reporting system. It can be stated that the bikers' perception of the street conditions (which include safety as a key trait for bikers) has notably improved for 15.8% of them, which can be taken as a reasonable proxy to the consideration that safety perception among cyclists has improved. Finally, the reduction of CO₂ (and other) emissions has been close to the target: 35.2 tons/year instead of 50 tons/year; the modest attainment in terms of emission is consistent with the fact that only 8.5% of the trips changing mode to cycling are coming from private cars, and 47.1% from much less polluting public transport.

No.	Objective and target	Rating	Comment
1	1000 new bike trips per day (i.e. 2% bike modal share)	★	849 cycling trips per day coming from other modes
2	No increase in traffic accidents involving cyclists	★★★ ³⁴	Proxy: impact of perception of street conditions on modal choice
3	50 t/year of savings in CO _{2eq} emissions	★	36.6% reduction due to change from public transport; 63.4% from private car
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★★ = Exceeded			

Table 14: Achievement of objectives

D.4 Up-scaling

The municipality continues its plans to keep expanding the cycling network in the living lab and in the city. This would include, in particular, the expansion of the shared cycling lane to the east of Av. Albufera and the completion of the cycling component of *Itinerario Miradores*.

The municipality will also continue the development of cycling corridors in other districts, based on district-level studies of cycling networks to identify the main routes and to establish priority to their development.

³⁴ This result is problematic, as comparisons between 2019 and previous years is problematic, due to changes in accident data collection procedures.

E. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

E.1 Deviations from the original plan

Deviations from the original plan have already been described in previous sections and are summarised below. high quality cycling corridor, implementation of parking solution for mass storage of bikes, and a study on the potential of the existing cycling ring road (a 64 km long facility which also serves the living lab)

E.1.1 High quality cycling corridor

Following the general municipality's approach to biking, the project did not implement any high-quality corridor for cyclists. Instead, the project implemented shared lanes (ciclocarriles) for bikes and general traffic (limiting the speed of motorised vehicles to 30 km/h) on the main east-west and north-south axes of the living lab; this approach is expected to be continued in the future. The municipality will continue its plans to keep expanding the cycling network in the living lab and in the city.

E.1.2 Parking solutions for bikes

The district of Puente de Vallecas, in the western part of the living lab, is characterised by its high population density and small low-quality apartments. The initial idea to install a mass-storage facility was justified on the grounds of the general lack of space at home of most residents, in case they decide to own a bike, and the lack of alternatives to safely park it. This idea was subsequently dismissed, due to the lack of space to install the pilot facility (envisaged to be located in the vicinity of the metro station, at Puente de Vallecas).

E.1.3 The potential of the existing cycling ring road

The integration of the existing cycling road with the local cycling network in the living lab was initially considered as a sound strategy to improve the functionality of the network with a high-capacity cycling infrastructure and to increase the use of the cycling ring-road, which is mostly used as a recreational facility.

In practice, the study and subsequent improvement works contracted by the municipality did not manage to include actions to improve the connectivity between the ring-road and the local cycling network; this is probably due to the initial design of the ring-road, largely segregated and with few connections with the local network; increasing its local connectivity would require expensive solutions, with uncertain impact in terms of improving biking conditions for local trips in the living lab.

E.2 Barriers

The following main barriers were identified during the process evaluation.

E.2.1 Financial

This barrier refers to the lack of availability of the private or public financial resources necessary to undertake the works necessary for the construction of the new biking infrastructure. This had a strong influence in the measure final contents and outputs. Due to lavish infrastructure projects in the previous years (topped by the multibillion construction of motorway tunnels in the 2004-2008 legislature), the municipality was forced to comply with strict expenditure and budgeting rules. These made it difficult to budget the ECCENTRIC actions within this measure, forcing the search for less ambitious alternatives such as the shared lanes (*ciclocarriles*).

The measure team and site manager were successful in getting a sufficient number of shared lanes included within the municipal budgets from 2017 to 2019. Although the project outputs were significantly less ambitious than initially envisaged, they proved to be able to reasonable attain the expected project's outcomes.

E.2.2 Political

This barrier refers to the insufficient support to this measure from local policy makers. The project successfully approached key decision-makers in the municipality to accelerate the implementation of the bike-supporting actions in the living lab, although it had to abandon the most innovative (and expensive) actions in favour of more conventional ones.

E.2.3 Planning

This barrier refers to the inadequate design of the measure and its execution. It can partially explain the project's failure in implementing the ambitious actions initially envisaged. Learning from failure, the project measure team was able to design and agree with key municipal stakeholders the alternative actions finally implemented.

E.3 Drivers

The main drivers below were identified during process evaluation.

E.3.1 Positional

The measure benefited from the support to biking already stated in the municipality's strategies and mobility plans. The measure team built upon the planning work already undertaken in Madrid (e.g. the revision of the Cycling Master Plan) to be able to implement the new cycling infrastructure (shared lanes) in a short time as well as the cyclists lanes built in other districts.

E.3.2 Institutional

ECCENTRIC found a favourable legal and institutional framework, and the measure team followed the existing legal and institutional framework and channels at the local level to get the project actions approved and implemented. The support of political decision makers in Vallecas Districts and within the Mobility Area was instrumental in allowing this measure to provide tangible outputs, in spite of the barriers mentioned above. It could be argued that this support should have been somehow formalised, as a way to more effectively remove the

opposition raised from other municipal areas; however, it would probably have been difficult-if not impossible- to further raise the political profile of this project within a large municipality such as Madrid.

E.3.3 Organisational

The measure benefited from adequate leadership and the effective involvement of all relevant stakeholders. The measure leaders made use of their long experience and knowledge of the municipal structures and decision-making processes to effectively get many actions implemented. Actual involvement of all affected in the measures implemented have largely taken place through already-existing local participatory channels, without specific contribution by ECCENTRIC.

E.4 Supporting activities

There were no relevant supporting activities for this measure.

E.5 Recommendations on the implementation process

Based on the experience of this measure in Madrid, two recommendations on the implementation process may be of relevance for other cities introducing cycling concepts in high-density, peripheral neighbourhoods.

E.5.1 Formalisation of local cycling network schemes

ECCENTRIC successfully delivered a cycling network for the living lab, in which the concrete actions would be framed. However, the status of the network proposal remained unclear: whereas the 2008 Cycling Master Plan and its 2016 Revision were officially backed by the municipality, there was not such recognition for the ECCENTRIC network: not only there are no deadlines or budgetary resources for its completion in the coming years, but it is even unclear whether the ECCENTRIC network remains as a reference document from the local technical services developing cycling infrastructure in the city.

To avoid such uncertainties, which can result in waste of resources and contradictory actions, it would have been convenient for ECCENTRIC to have tried to get some official backing to the proposed network, so that it could have been formalised. This approach would have served also to implement the same formalised approach to the deployment of the local cycling networks in other districts.

E.5.2 Reaching out to potential users

When the initial number of cyclists is very low, as was the case in Madrid, the design and implementation process of measures to encourage cycling need to take into consideration how to reach out to potential future users. In the case of Madrid, ECCENTRIC assumed that this effort would already be undertaken by the municipality at the city level within the implementation of the revision of the Cycling Master Plan, completed in November 2016, and the communication campaign on the new Mobility Regulations (*Ordenanza de Movilidad*), undertaken 2019. Even with these strong actions, the number of additional cycling trips resulted relatively low, suggesting the convenience to include bolder participatory and awareness-raising actions within cycling-related measures in cities with low cycling trips.

F. Evaluation conclusions

The observed impacts of the measure have been reviewed with Measure Leaders, Site Coordinators, and other stakeholders. Based on this, the evaluation conclusions have been formulated.

F.1 Validated direct impact

- The measure was reasonably successful in increasing the number of cycling trips almost reaching the initial project expectations, as an effect of the provision of shared lanes for cycling and general traffic (*ciclocarriles*) on certain streets.
- Modal change to cycling was mainly due to trips formerly done by pedestrians (54.8% of trips changing mode) and public transport users (36.6% of trips changing mode); only 8.5% of the cycling trips changing mode correspond to former car users.
- For sure, CO₂ and emission savings should be taken into consideration, but they cannot provide the main justification for cycling action. Although the measure almost achieved the expected CO₂ emission reduction target, its impact can hardly be considered as relevant: CO₂ savings in this measure were limited to 35 tons per year (or less than €900 at current CO₂ market prices), a figure largely insufficient to justify on its own the investments needed for physical changes in the streets on their own. Cycling-friendly policies can primarily be justified on the grounds of the health and social benefits it provides, and their potential for a more substantial modal change in the long-term, as confirmed by the users that participated in the survey, but not as a way to obtain short-term emission reductions, for which car restriction policies seem unavoidable.

F.2 Relevance of supporting activities

There were no supporting activities associated to this measure.

F.3 Interaction with other measures

Although this measure was expected to interact with measure 4.6, this interaction was very weak, due to the changes in the location of the actions implemented in each measure, which took place largely in different parts of the living lab.

As a result, this measure interacts with measure MAD 4.6 mainly in *Itinerario Miradores*, the high-quality pedestrian and cyclist corridor, connecting the major green areas in Puente de Vallecas, and improving north-south connectivity for pedestrians and cyclists in the area.

F.4 Main lessons learned

- It is difficult to introduce consistent participatory approaches when implementing innovative measures, particularly in the context of research and demonstration projects with tight schedules. In the case of this cycling measure the participatory approach was particularly difficult due to the low share of cycling in the living lab and in the whole of Madrid.

To honour public participation commitments, demonstration projects may need to establish formalised participation plans at the beginning of the measure design identifying the local stakeholders to mobilize and the participation and decision-making procedures to be applied.

- Cycling actions need to be identified and implemented within duly formalised network concepts at the city and district levels. Without such formalisation, municipal technical services can risk to implement suboptimal actions without real impact in terms of attracting new bikers.
- Only a small fraction of the cycling trips replaces car trips. When cities are trying to curb car use, they should introduce restriction measures, besides promoting sustainable modes.
- Cycling-friendly measures provide modest CO2 emission savings, which require the introduction of car restrictions.

F.5 Long term impact

The modest results achieved in terms of modal change are consistent with the initial project expectations and confirm that the promotion of cycling is a long-term objective requiring perseverance from the municipality and a consistent planning framework. This has been the approach in Madrid since the approval of the 2008 Cycling Master Plan, and it can be expected that the number of cyclists on the streets will continue growing, as the cyclist network continues being expanded.

F.6 Potentials for up-scaling in the city

The current revision of the Sustainable Urban Mobility Plan and of the cyclist network, updating and expanding the Cycling Master Plan and including cyclist networks at the district level, could provide an excellent framework for up-scaling the cycling concepts developed by ECCENTRIC in the living lab. However, thus far the municipality has not developed specific up-scaling actions concerning this measure.

G. Additional information

G.1 Appraisal of evaluation approach

The evaluation approach for this measure has been successful in providing accurate monitoring and reporting of the results achieved. The strong points include the relative simplicity of the data collection process, based on the on-street survey conducted close to the completion of the operational stage.

Due to the extremely low cycling flows on the streets, the statistical reliability of the counting campaign (just one day on each street) was low, and counting results were useless to provide evidence on cycling traffic growth. Another weak point in the evaluation refers to the high seasonality of these flows; there are no references in Madrid referring to deseasonalise cycling traffic flows (as there are for vehicle traffic), which makes it necessary to schedule counting campaigns in the same month to facilitate year-to-year comparison. This may not be possible in practice or can delay evaluation.

G.2 Future activities relating to the measure

It is recommended that the municipality considers the implementation of the actions that were initially foreseen within this measure but were not implemented; this is particularly relevant for the implementation of the parking facility within the e-mobility station in Sierra de Guadalupe, and the completion of a high-quality cycling corridors, providing better cycling conditions than the currently dominant shared lane concept (*ciclocarriles*). Additionally, the implementation of the cycling networks developed in other districts within the city could be facilitated by the lessons learned from this measure.



2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



TUR 4.8

Easy, safe and comfortable cycling and walking round the year

Measure Evaluation Report

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Responsible Co-Author(s):	Anette Korkiakangas, Juha Jokela, Stella Aaltonen
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2020
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ECCENTRIC



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1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
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3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
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21	City of Turku	Finland	TUR
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22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Anette Korkiakangas	Stella Aaltonen
Juha Jokela	

Table of Contents

ABSTRACT.....	865
A. INTRODUCTION.....	866
A.1 EXPECTED RESULTS OF THE MEASURE	866
A.1.1 Quantifiable impacts.....	866
A.2 MEASURE DESCRIPTION	866
A.2.1 Measure outputs.....	867
A.2.2 Supporting activities	867
No supporting activities were identified for this measure.	867
A.2.3 Interactions with other ECCENTRIC measures.....	867
A.2.4 Interactions outside ECCENTRIC	867
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	867
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS	867
A.5 IDENTIFIED RISKS	868
B. MEASURE IMPLEMENTATION	869
B.1 SITUATION BEFORE CIVITAS	869
B.2 INNOVATIVE ASPECTS.....	869
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	870
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	870
C. IMPACT EVALUATION FINDINGS	877
C.1 EVALUATION APPROACH.....	877
C.1.1 Expected impacts and indicators.....	877
Table 5: Description of key performance indicators (KPI)	877
C.1.2 Baseline.....	878
C.1.3 The business-as-usual scenario.....	883
C.2 MEASURE RESULTS.....	884
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	891
D. PROCESS EVALUATION FINDINGS	892
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	892
D.2 BARRIERS	892
D.2.1 Political/strategic.....	892
D.2.2 Planning.....	892
D.3 DRIVERS	892

D.3.1	<i>Planning</i>	892
D.3.2	<i>Organizational</i>	892
D.3.3	<i>Positional</i>	893
D.3.4	<i>Financial</i>	893
D.4	SUPPORTING ACTIVITIES.....	893
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	893
D.5.1	<i>Proper planning is key</i>	893
D.5.2	<i>Feedback on pilot quality is essential</i>	893
E.	EVALUATION CONCLUSIONS	894
E.1	VALIDATED DIRECT IMPACT	894
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	894
E.3	INTERACTION WITH OTHER MEASURES.....	894
E.4	MAIN LESSONS LEARNED	894
E.5	LONG TERM IMPACT	894
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	895
F.	ADDITIONAL INFORMATION	897
F.1	APPRAISAL OF EVALUATION APPROACH	897
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	897

List of Figures

Figure 1: Cycling frequency of regular cyclists.....	869
Figure 2. Support on cycling promotion	879
Figure 3. Satisfaction in the winter maintenance of cycling routes	880
Figure 4. Mode of travel / Winter months	881
Figure 6. Support on winter cycling promotion.....	886
Figure 7. Main mode of travel during the winter months	888
Figure 9. Fatalities in road traffic 1/1085 - 12/2019. Source: Statistics Finland.	889

List of Tables

Table 1: Quantifiable impacts.....	866
Table 2: Target groups or affected parties.....	867
Table 3: Measure stakeholders.....	868
Table 4: Identified risks.....	868
Table 5: Description of key performance indicators (KPI).....	877
Table 6: Measure's indicators	878
Table 7: Number of fatalities and seriously injured / baseline.....	882
Table 8: The main daily or almost daily wintertime mode of travel for Turku region 2017 + 2019	888
Table 9: Number of fatalities and seriously injured / follow-up.....	890

Project	City		
ECCENTRIC	Turku		
Measure code	Measure name		
TUR 4.8.	Easy, safe and comfortable cycling and walking around the year		
Last update	Responsible	e-mail	telephone
28.2.2020	Juha Jokela	juha.jokela@turku.fi	+359 40 838 9014

Abstract

During the winter months, cycling in Turku drops significantly. It only reaches about 20-25% of the cycling levels of the summer months. Increasing winter cycling rates through better maintenance of cycling routes and paths, combined with information campaigns, offered a good potential for improving the modal split. The objective of measure TUR 4.8. was thereby to increase the year-round traffic flows of cycling and walking by making the current infrastructure easier, safer and more comfortable to use. Especially the winter provided great potential for increasing cycling. Therefore, a study on available winter maintenance methods was to be performed. After the study, the winter method that showed the greatest potential, sweep salting, was to be piloted with a contract of 2+2 years. Feedback on the route was to be gathered meticulously and a cycling barometer performed to Turku residents twice during the project.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 4.8. was measured. Data was derived from the cycling barometer survey, the regional mobility barometer, secondary city statistics on insurance claims, secondary statistics from Statistics Finland, traffic calculators, city feedback channels, policy documents and the Measure Leader.

Overall, the measure achieved its objectives. A thorough review was made potential winter maintenance methods and a cycling barometer was performed twice to review the attitudes of the residents of Turku regarding the promotion of cycling the quality of cycling in Turku, providing valuable information for measure realization. The winter cycling maintenance pilot was implemented successfully and was in its third year of operation at the time of writing. A 39% increase in winter cyclist numbers was observed at the measurement point in central Turku. Although without further calculations strong conclusions on a permanent rise in winter cyclist numbers cannot be verified, the maintenance pilot was clearly well received and preliminary results on its potential impacts on wintertime modal shift are promising. The increased numbers of cyclists and walkers on the route also suggest that at least the perceived safety of the route is high, although due to lack of conclusive data no direct impact could be observed on incident or accident rates along the pilot route during the first two winters. The measure has also had a significant impact on cycling policy development in the city.

A. Introduction

A.1 Expected results of the measure

The measure objectives were:

(1) City policy level in perspective of CIVITAS goals/ longer term:

In long term, the goal of the measure was to promote cycling and walking as a lifestyle and thereby increase the modal split of sustainable travel modes. Improving the safety of walking and cycling in the wintertime was one of the main methods to increase the modal share of both modes of transport.

(2) Strategic level:

On the strategic level, the measure aimed to develop the city's winter maintenance methods and to use the funds available more cost-efficiently with prioritized network and efficient methods.

(3) Measure level:

The objective of this measure was to increase the year-round traffic flows of cycling and walking by making the current infrastructure easier, safer and more comfortable to use. The measure piloted an alternative winter maintenance method on a 12-kilometer pilot route during winters 2017/2018 and 2018/2019.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
1	The number of winter cyclist rises by 30% and full year cyclist amounts rise by 15% by 2020 compared to 2016	x			x	x					

Table 1: Quantifiable impacts.

A.2 Measure description

During the winter months, cycling in Turku drops significantly. It only reaches about 20-25% of the cycling levels during the summer months. Increasing winter cycling rates through better maintenance of cycling routes/paths, combined with information campaigns, was to offer good potential for improving the modal split.

The objective of this measure was to increase the year-round traffic flows of cycling and walking by making the current infrastructure easier, safer and more comfortable to use. Especially the winter provides great potential for increasing cycling. Therefore, a study on available winter maintenance methods was to be performed. After the study, the winter method(s) that show the greatest potential were to be piloted. Also, a study of the condition of

the main cycle network was to be performed, leading to a renewal plan and infrastructure improvements.

A.2.1 Measure outputs

During ECCENTRIC, a winter cycling pilot route testing an alternative winter maintenance method was to be realised.

A.2.2 Supporting activities

No supporting activities were identified for this measure.

A.2.3 Interactions with other ECCENTRIC measures

The measure was to entail a replication task of STO 4.5. “Policy for re-routing cyclists during construction work”, i.e. testing different safety measure in bicycle and pedestrian routes by construction sites. Measures TUR 2.2 “City District / Urban Corridor Case as a Pilot for Sustainable Urban Mobility” and TUR 5.5. “Bike-sharing and Car-sharing Schemes” both were to benefit from the information derived from the cycling barometer. The winter cycling pilot route was also to be promoted within the laboratory area in TUR 2.2.

A.2.4 Interactions outside ECCENTRIC

References from Best Practices were gathered from Helsinki, Stockholm and Linköping.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents		Turku city
4	Cycle / walking groups		Turku city
6	Commuters		Turku city
9	General public		Turku city

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type organisation of C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	City of Turku	P	C	L	Measure coordinator
2	Regional Council of Southwest Finland	P	Other	O	Partner
3	Tampere University of Technology	S	KI	O	Info provider
4	City of Helsinki	S	C	O	Advisory stakeholder
5	Swedish National Road and Transport Research Institute	S	KI	O	Info provider

6	WSP Finland	S	PR	O	Advisory stakeholder
7	Kuntec Ltd	S	PR	O	Developer
8	Kekkilä Ltd	S	PR	O	Manufacturer
9	Seab	S	PR	O	Manufacturer
10	City of Oulu	S	C	O	Advisory stakeholder
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Risks related to the technical realisation of automatic data calculators	Planning	The proper functioning of automatic traffic calculators should be verified via control calculations by hand.	ML
Data for number of incidents/fatalities/seriously injured may be subject to bias as not all incidents are reported.	Planning	The quality of data should be guaranteed via triangulation of methods to ensure reliability. Information will therefore be gathered from various sources.	ML/LEm

Table 4: Identified risks.

B. Measure implementation

B.1 Situation before CIVITAS

Winter cyclist amounts in Turku were approximately 20-25 % of summer's cyclist amounts, which was deemed rather low. There existed much potential to increase winter cyclist amounts through better winter maintenance and marketing. According to the 2016 cycling barometer, 88% out of the Turku residents who cycled regularly (at least once a week) cycled at least 2-3 times a week when there was no snow on the ground. However, out of these cyclists 64% stated that they stopped cycling during wintertime.

Cycling frequency (of regular cyclists)

% cyclists (cycles at least once a week when there is no snow on the ground) (n=630 / N=87 979)



Figure 1: Cycling frequency of regular cyclists

Winter maintenance of cycling routes is an essential part of winter cycling. Regular winter maintenance is comprised of removal of slush and snow, prevention of slipperiness, removal of packed snow, sanding and binding of dust. In Turku, the main roads have been divided into two maintenance categories since 2010. Winter maintenance of walking/cycling routes is mostly planned according to the maintenance class of the adjacent driveways.

B.2 Innovative aspects

The measure was to strive to search for a solution to consolidate cycling in Nordic countries round the year. The chosen method, sweep salting, was novel and innovative in the city of Turku.

B.3 Research and Technology Development

Investigation of best practice in winter maintenance methods to be tested.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning milestones (100 % completed)

Research and planning of the measure began in September 2016 and were completed in April 2017. The following activities were carried out:

- A Master of Science graduate was recruited to the project to study and contribute to the winter cycling conditions. A master's thesis was to be published in May 2018 concerning the winter cycling test route in Turku. M1-M2
- A cycling barometer study was planned, carried out and analyzed. The goal of the barometer was to review the attitudes of the residents of Turku regarding the promotion of cycling and the opinions of residents who cycle regarding winter cycling conditions and the quality of cycling in Turku. M1-M8
- Gathering of best practices took place by the thesis worker. This included meetings with relevant parties in the city, technical visits to other cities, interviews with experts and a literary review to investigate winter maintenance methods to be tested. Based on this process, sweep salting was chosen as the maintenance method for the winter cycling test route. Detailed planning, verifying the test route and preparing the tendering started. M3-M8
- Study tour to the city of Helsinki, VTI Linköping and the city of Stockholm took place. The purpose was to become acquainted with the cities' winter maintenance methods and hear about their important practical experiences and to get advice for the Turku pilot. M5

Phases 2: Procurement and implementation (100 % completed)

Procurement and implementation of the measure began in May 2017 and were completed in September 2017. It was decided that the pilot route maintenance would be tendered separately from the area-based business-as-usual street maintenance tenders. The method chosen for the pilot, sweep salting, is a method based on first brushing the snow off the route with special machinery and then salting the route to prevent slipperiness. The method prevents packed snow from forming to the surface, which is one of its greatest benefits as the softening, rutting and re-freezing of packed snow can lead to dangerous road conditions. Below is presented a picture of the pilot route maintained in the usual manner and after salt sweeping.



Picture 10. Itäinen Rantakatu street before and after sweep salting.

The following main activities were carried out during this phase:

- A tender was made for subcontracting the maintenance for a pilot in a 12 km cycle lane for 2 + 2 years. This process included market discussions with contractors, route check-ups and repairing, procurement documentations and tendering of the route. The agreement was concluded for 2 + 2 years and it applies to the test route that has been separated from the other contract areas. M9-M13
- Kuntec Ltd. was chosen as the contractor. Contract documents were prepared and plans for the implementation of the sweep salting were made with the contractor. M12
- Procurement of friction measurement for the winter route. M13
- Co-operation with the local cyclists' association TURPO was established for the purpose of gathering systematic feedback on the test route for the winter 2017/2018. The Turku city Cyclists' Association (Turun Polkupyöräilijät ry, TURPO) is an NGO whose main objective is to promote and support cycling and cycling culture in Turku and its surrounding areas. A contract was made with TURPO to provide regular and systematic feedback on the pilot route. As experts of Turku winter cycling conditions, TURPO members possess information on alternative road maintenance methods to make informed judgments on the feasibility of the selected pilot method. For the purpose of identifying the feedback to specific parts of the route, the route was divided into 17 parts. The quality of the route was to be estimated using a scale from 1 to 5. The assessment was to be based on the sense of security. The test group received a personalized link to the city feedback portal. Altogether 24 persons were recruited to give feedback. A guidance session was arranged for the TURPO members prior to the pilot phase.

Below is presented an example of the feedback given describing parts 6,7 and 16 of the route (grade 2 sense of security, soft slush making cycling difficult. In addition, some slipperiness in front of the theatre bridge).



Picture 11. Feedback form from the city's feedback portal.

- The pilot route was first sketched out even before the method was chosen. The 12km route was eventually chosen based on cyclist numbers, certain locations and densely populated areas along the route (e.g. the universities), its potential for the maintenance method and also the fact that it would reach the ECCENTRIC laboratory area in parts. It was discovered in the cycling barometer that Turku residents mostly cycle to work or study – hence the test route was to connect some of the main work or studying locations. The route condition was mapped prior to the pilot and some repairs made e.g. to the pavement surface in parts to allow for successful prevention of slipperiness. The route is presented below.



Picture 12. The winter maintenance pilot route (in red).



Picture 13. The winter maintenance pilot route

Phase 3: Demonstration and monitoring (100% completed)

The demonstration and monitoring phase started in October 2017 and ran until the end of May 2019. During this phase the winter maintenance pilot was repeated twice (winters 2017/2018 and 2018/2019). Regular communication took place between the contractor and the Turku city staff on the proceeding of the pilot. The following main activities were carried out during this phase:



Picture 14. Signpost for the test route.

- Planning the communication of the test route and implementation of the plans M14-M20
 - o Information campaign with sign posts on the streets (between 15.10.-15.5. on both test winters), news, media coverage and event on winter cycling (2.11.2017).
- Feedback process M14-M32
 - o Collection of experiences from the route both through specific feedback givers and through general city feedback. This included planning of the feedback collection, co-operation with TURPO and replies to the feedback.
 - o Examination and measuring cycle paths' condition through the pilot process. Friction measurements were carried out on the pilot route during the first test winter. A report was devised on the first year and second year experiences.
 - o Keeping track of the feedback given from the winter cycling test route and communicating with the contractor if changes needed to be done.

- Temporary traffic arrangement on pavements and cycle paths (replication of STO 4.5.) M16-M26
 - o Gathering of information on guiding pedestrians and cyclists during temporary construction works.
 - o Collection of best practices, documenting current usage, discussions with construction companies, gathering of the experiences from measure STO 4.5.
 - o Summarizing the best practices and methods regarding temporary traffic arrangements on pavements and cycle paths for the contractors, subscribers and supervisors. A bachelor's thesis summarizes the lessons learnt.
 - o A short test period with temporary light fences was carried out during Spring 2019. It was based on the idea that the construction site takes care of moving the fences to the new site. This turned out to be too time consuming and was not well taken by the providers.
- Plan for the improvement of the pedestrian and cyclists measurement points in Turku M20-M38
 - o Mapping the current situation, existing gaps, a plan for testing new measurement equipment, procurements.
 - o The focus was put on opening the data on the existing measuring points and improving the use of it. This led to the development of a holistic mobility data platform into which existing and new measurement points will be incorporated in the future.

Phases 4: Conclusions and recommendations (60% completed)

Conclusions and recommendations of this measure commenced in June 2019 and were to be completed in August 2020. At the time of writing the winter cycling pilot was in its third year of operation as the option for two extra years was realized. At this point, some preliminary conclusions could be made about measure learnings, divided into measure phases:

Research & planning:

- The costs of sweep salting and different de-icing chemicals are multiple compared with traditional winter maintenance methods. This naturally has an impact on decision making.
- The cycle paths' physical circumstances, such as the surfacing material and the condition of it, have an impact on the choice of the method and planning of the test route.
- With sweep salting, the first years are always a learning process as the planning is demanding and surprisingly many details need to be taken into account.
- Successful use of sweep salting requires good cooperation between many quarters. Fluent and frequent communication and a smooth flow of information within the team and with the city is important.

- The analysis of the current temporary traffic arrangement on pavements and cycle paths resulted in the conclusion that further work is needed for developing guidance during temporary construction works and events.
- The analysis of the pedestrian and cyclist data led to a larger process that will lead to an online data platform development.

Procurement & Implementation

- Fluent flow of the information is a key to the efficient working of a maintenance pilot.
- Enough time should be left for preparing between tendering and implementation.
- Enough room for development should be ensured in the contract, and the parties should be prepared to do so also during the contract period.
- Real-time data is needed on the route and the method used in the procurement, enabling route maintenance information to be shown for the users.

Demonstration & Monitoring

- The developed method works in practice in Turku.
- Exceptionally positive feedback was received from stakeholders, cyclists and pedestrians on the pilot.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact				
Indicator name	Awareness	Acceptance	Satisfaction	Physical barriers
Type	KPI	KPI	KPI	KPI
Category	Society	Society	Society	As in the framework
Subcategory	Acceptance	Acceptance	Acceptance	As in the framework
Aspect	Awareness	Acceptance	Acceptance	As in the framework
Definition	Awareness of winter cycling conditions	Acceptance of cycling promotion and improvement of cycling conditions	The satisfaction in the winter cycling maintenance methods	The accessibility to transport and transport services, as the average reported convenience of city transport for target groups.

Impact					
Indicator name	Contribution to policies, plans, and programs	Mode shift	Modal split	System usage	Number of fatalities and seriously injured
Type	KPI	KPI	KPI	KPI	KPI
Category		Transport system	Transport system	Transport system	Transport
Subcategory		General	General	General	Safety
Aspect	Governance	Modal split	Modal split	System demand	Transport safety
Definition	Qualitative measurement on the process to modify policies, plans, and programs (including SUMP) in a significant and definitive way.	Percentage of passengers which changed permanently of transportation mode for doing the same trip (same origin and destination, time, and frequency)	Number of all trips/deliveries made by each mode for all purposes.	Usage of the winter cycling pilot route.	The number of recorded fatalities and casualties caused by any means of transport.

Impact			
Indicator name	Number of incidents	Investment costs	Operational costs
Type	KPI	KPI	KPI
Category	Transport	Economy	Economy
Subcategory	Safety	Costs	Costs
Aspect	Transport safety	Costs	Operating costs
Definition	The number of recorded fatalities and casualties caused by any means of transport	Capital investment costs of the measure	Average operating costs of the measure

Table 5: Description of key performance indicators (KPI)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement

1	Awareness	%	A	S	Turku residents	City of Turku
2	Acceptance	%	B - A	S	Turku residents	City of Turku
3	Satisfaction	Score (0-5)	B - A	S	Turku residents and observer group	City of Turku
4	Contribution to Policies, Plans and Programs	Score (0-5)	B - A	DC	Decision makers	City of Turku
5	Physical barriers	%	B-A	S	Turku residents	City of Turku
6	Mode shift/Modal split	%	B - A	S	Cyclists and pedestrians	Turku region
7	System usage	Frequency (users/unit of time)	B – A	DC	Cyclists	City of Turku
8	Number of fatalities and seriously injured	Quantity	B – A	DC	Cyclists and pedestrians	City of Turku
9	Number of incidents	Quantity	B - A	DC	Cyclists and pedestrians	Pilot route
10	Investment costs	€	A	DC		
11	Operational costs	€	B - A	DC		
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Measure's indicators

C.1.2 Baseline

The cycling barometer formed the main baseline data collection method in measure 4.8. The purpose of the survey was to review the attitudes of the residents of Turku regarding the promotion of cycling, and the opinions of residents who cycle regarding winter cycling conditions and the quality of cycling in Turku. The baseline survey data was collected by means of telephone interviews in November–December 2016, and the sample represents Turku residents between the ages of 18 and 74. A total of 1012 interviews were conducted. As always with such a method, the flexibility of answers is small, and the awareness of being interviewed presents a source of error. The survey was conducted via a professional company and was carefully planned with the city of Turku, minimizing the error marginal.

The regional mobility barometer, conducted by the Regional Council of South-West Finland 20.10.-30.11.2019, provided data on modal split / mode shift. The main objective of the survey was to examine the views and attitudes of the residents in Turku core region concerning the objectives and measures of the Turku regional traffic system plan. The barometer was conducted as an online survey and received 3038 responses from the Turku region (the city of Turku and neighbouring municipalities Raisio, Kaarina, Lieto, Naantali).

Data linked to the number of incidents, fatalities and serious injuries was obtained from the city's insurance claims data and national statistics from Statistics Finland. Data may therefore inevitably vary in accuracy and scope. It should be noted that not all incidents are documented in official records unless they require medical attention, or if the person does not report the incident to the city feedback service herself. This issue needed to be taken into account when evaluating the impact of the measure.

Traffic calculations in chosen locations provided data for indicator system usage. The data was derived from a mechanical calculator on the bridge by the Turku cathedral.

Data on the operating costs of traditional winter maintenance methods in Turku was derived from the measure leader.

It should be noted that the domain of this measure covered the whole city as the activities have not been limited to the laboratory area alone. The winter cycling pilot route ran for a 12km stretch around Turku city centre and is presented in more detail in section B.4. above.

KPI 1: Awareness refers to awareness of the efforts to improve the winter cycling conditions in Turku. Unfortunately, there was no baseline data for this indicator due to the fact that the cycling barometer was conducted prior to the Turku evaluation framework had been set. Consequently, the LEMs did not get the opportunity to influence the barometer questions.

KPI 2: Acceptance refers to the support on the efforts to promote cycling and improve conditions for cycling. According to the cycling barometer, Turku's aim to promote cycling and improve cycling conditions was strongly supported by the city's residents. Almost all residents (96%) of Turku had a positive attitude towards the promotion of cycling.

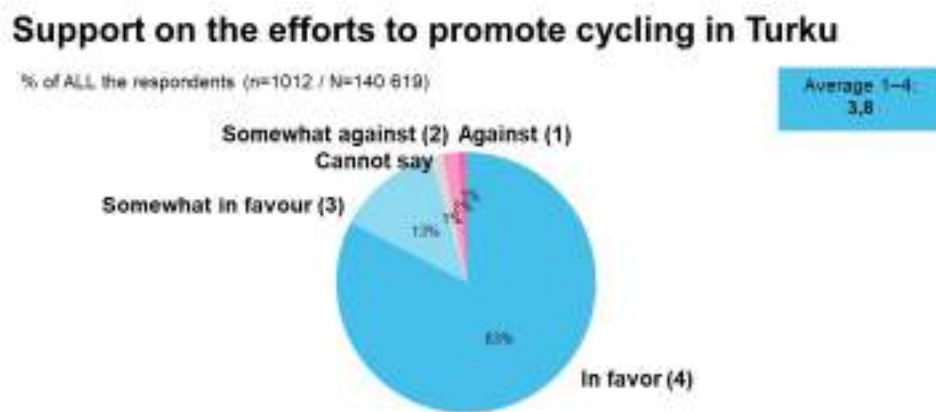


Figure 6. Support on cycling promotion

KPI 3: Satisfaction in this measure refers to the satisfaction in the winter maintenance of cycling routes around Turku. According to the 2016 cycling barometer, of those who cycle year round, 72% were either satisfied or quite satisfied with the winter maintenance of cycling routes in Turku. Score: Score: 3.6.

Satisfaction in the winter maintenance of cycling routes around Turku

% of year-round cyclists (n=207 / N=30 182)

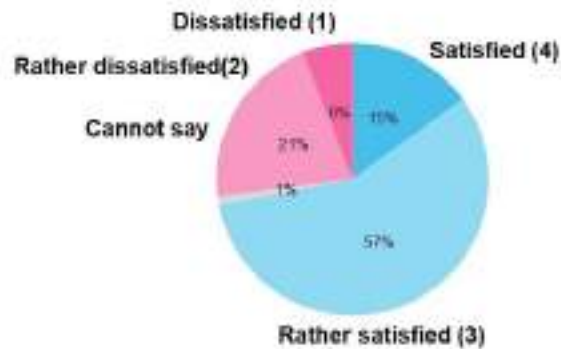


Figure 3. Satisfaction in the winter maintenance of cycling routes

KPI 4: Contribution to Policies, Plans and Programs relates to the impact the measure may have on policies or strategies to improve winter cycling conditions and increase the year-round traffic flows of cycling and walking by making the current infrastructure easier, safer and more comfortable to use. The state concludes agreements concerning land use, housing and transport (MAL) with the main city regions of Finland. These agreements enhance cooperation among the municipalities in the respective city regions and between the municipalities and the state in the steering of community infrastructure and coordination of land use, housing and transport. Although in the Turku region MAL agreement (2016-2019) improvement of cycling conditions is included, no specific mention is made of winter conditions in particular. The contract also mentions the traffic safety plan on a general level.

The Turku city cycling and walking strategy from 2010 recognizes the potential of winter cycling as a sustainable travel mode and the detrimental impact of poor traffic safety on it. It is stated that winter cycling can be increased by developing maintenance of cycling routes, among other things. Overall, it could thus be concluded that prior to the project, promotion of winter cycling was already visible on policy level along with the recognition of the importance of safety measures, however what was lacking was concrete actions or milestones for needed improvements. **Score: 3.5.**

KPI 5: Physical barriers in this measure describes the perceived safety of the cycling network in wintertime and the subsequent effect on mode choice. In the 2016 cycling barometer survey, 65% of the respondents (n=1012) stated that they would cycle more if cycling was safer in the city.

KPI 6: Modal split/Mode shift refers to the share of transport modes in Turku, focusing in this measure in the winter period. The most reliable data on travel modes could be derived from the National Travel survey from 2016. However, the survey in question was not to be repeated within the project duration, and does not differentiate between seasons. Hence it was decided that for this measure, data would be derived from the regional mobility barometer realised in spring 2017, allowing for better comparability as the same survey was to be repeated in 2019. The survey report contained the results and a summary of the Turku core regions traffic environment survey. The main objective of the survey was to examine the views and attitudes

of the residents in Turku core region concerning the objectives and measures of the Turku regional traffic system plan. The target group was residents over 15 year of age in the Turku region. Altogether 3530 replies were recorded. It should be noted that the results cannot be widely generalized and therefore the conclusions were considered to be only indicative.

In the 2017 regional mobility barometer, the respondents' mode of travel was inquired with the following question: *“Estimate how often you use the following modes of travel during the summer months (May-October) and, respectively, “Estimate how often you use the following modes of travel during the winter months (November-April).*

According to the barometer, the modal split in the Turku region was the following during the wintertime (n=3356).

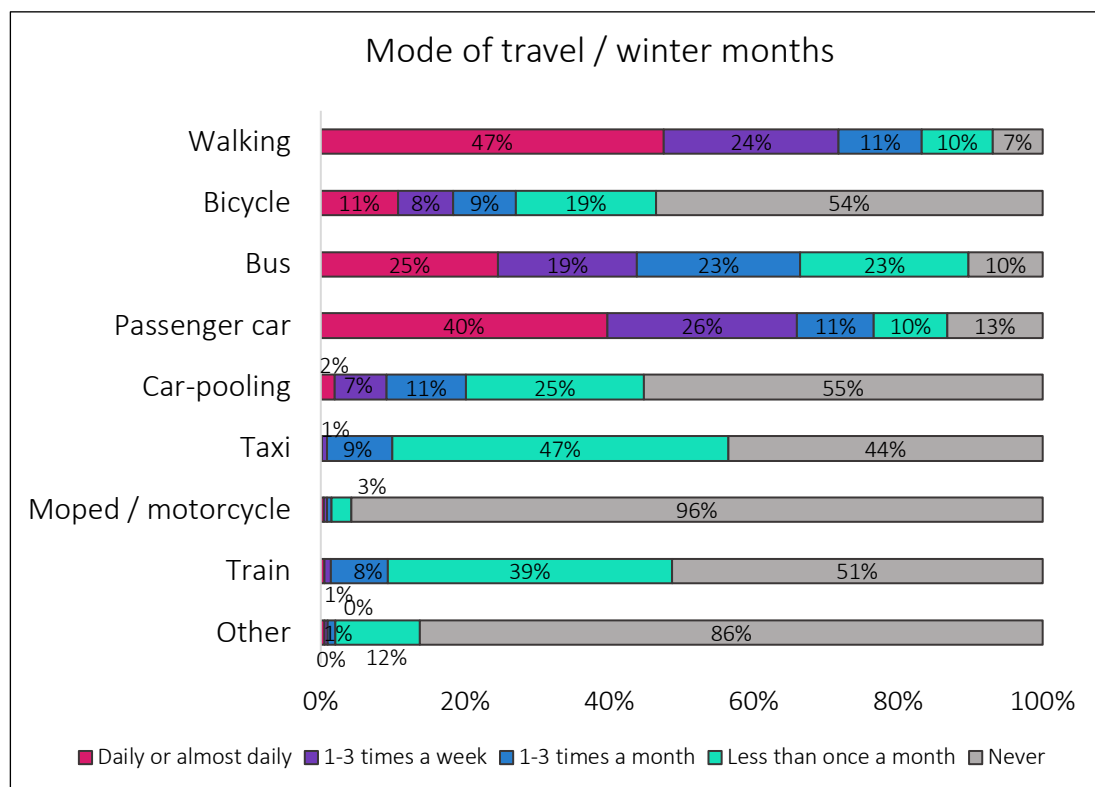


Figure 7. Mode of travel / Winter months

KPI 7: System usage in this measure refers to the numbers of winter cyclists at the only continuous automated measurement point on the bridge by the Turku Cathedral in central Turku. Before the winter maintenance pilot between 1.1.2016-29.2.2016 and 1.1.2017-28.2.2017, altogether 70 394 cyclists were calculated at the Turku Cathedral measurement point. Per month, this equaled an average number of 17 599 cyclists.

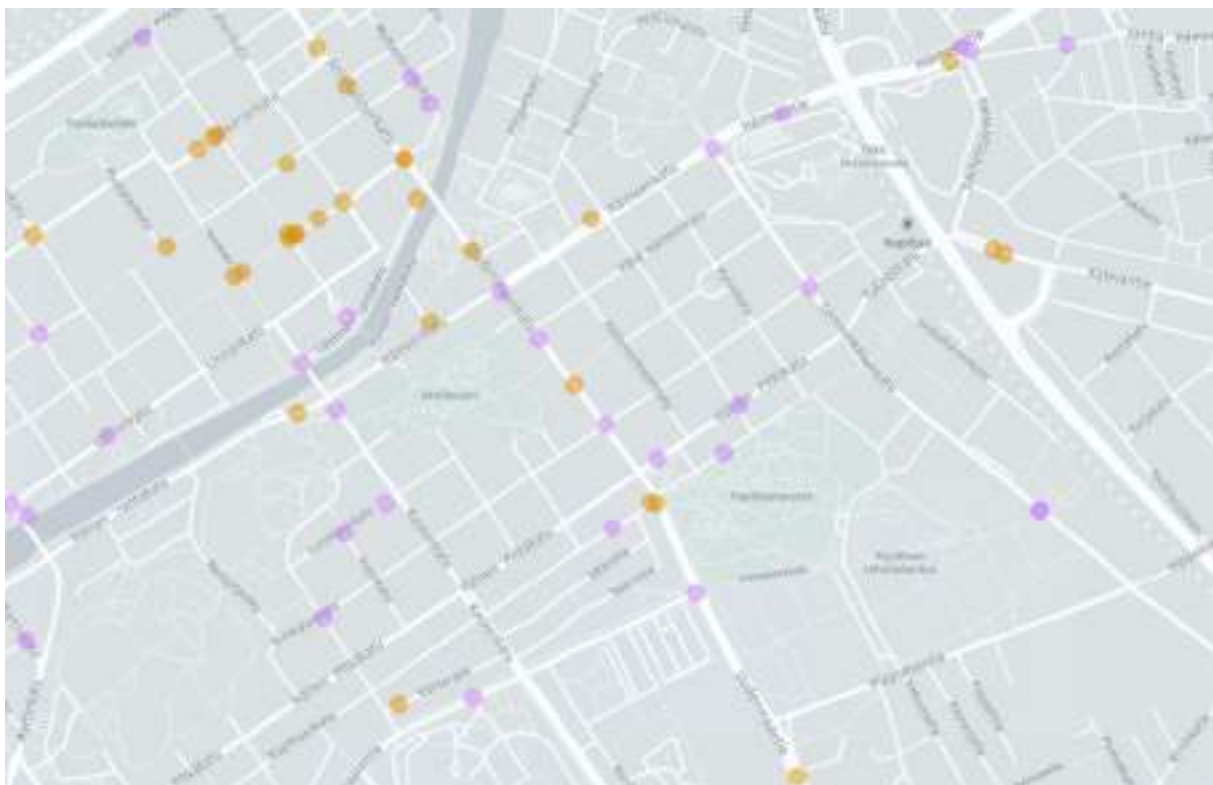
KPI 8: Number of fatalities and seriously injured refers to road transport related serious accidents leading to fatalities or serious injuries. These are reported to Statistics Finland on a regular basis by Finnish municipalities. Prior to the winter cycling pilot between 2014- 2016, two fatalities incurred among cyclists or pedestrians and the number of serious injuries was 22. This equaled on average of **0.67 fatalities and 7.3 serious injuries per year**. Statistics

on seriously injured have only been collected since 2014. The pedestrian fatality happened when a pedestrian was hit by a train in a suburban area.

Road user group	Fatalities			Seriously injured		
	2014	2015	2016	2014	2015	2016
Pedestrian	1	-	-	3	5	3
Cyclist	1	-	-	3	7	1

Table 7. Number of fatalities and seriously injured / baseline

KPI 9: Number of incidents in this measure refers to the number of incidents related to winter maintenance of cycling and walking paths. Cycling or walking related incidents that are reported to the police are further compiled to national statistics. According to data from Statistics Finland, there were 216 pedestrians or cyclists injured (not including seriously injured) in Turku between 2014-2016. The map below shows their locations in the city center (pedestrian incidents in orange, cyclist incidents in lilac). Data on the cause of the incident was available for each incident – however it was not specified in this data whether the incidents were road maintenance related.



Picture 15. Pedestrian and cyclist incidents within Turku city centre 2014-2016. Source www.mobilityanalytics.ramboll.com.

However, it should be noted that not all cycling or walking related incidents are reported to the police. Hence, nationally compiled data on incidents is bound to be incomplete. Also, in official statistics, as demonstrated above, information is not detailed enough to allow for an estimation

of the impact of specific road conditions. Therefore it was decided that the only possible source of data that would give at least some view on the cause of the incident would be the data from the city's insurance company claims.

According to insurance claims made to the city of Turku, there were altogether 31 winter maintenance related incidents in Turku in 2015. The incidents were either due to slipperiness, sanding sand, piles or lumps of snow, or ploughing damage. All these incidents had resulted either in personal damage and/or damage to a person's possessions. Car related incidents are not included here. These numbers were naturally only indicative and had to be interpreted with caution. A comparison was also made to previous years but data from 2014 was incomplete and could not be utilized. In 2013, there were 29 winter maintenance related incidents reported for insurance claims.

KPI 11: Operating costs in this measure refer to costs occurring from the traditional cycling/walking route maintenance. The operating costs of the customary winter maintenance method in Turku were 2300€/km/winter.

C.1.3 The business-as-usual scenario

Some winter maintenance improvements, especially regarding infrastructure, would probably have been undertaken in Turku despite the project. However, it could be assumed that these improvements would not have been as large-scale.

The added extra publicity brought by project communicational efforts should also not be underestimated in informing citizens about winter cycling and safety issues in general. Hence it was likely that without the project, BaU would have been the same as or very similar to baseline for most indicators.

Indicator	Unit	BaU	Date BaU
Awareness	%	It can be assumed that BaU is the same as or very similar to baseline.	12/2016
Acceptance	%	It can be assumed that BaU is the same as or very similar to baseline.	12/2016
Satisfaction	Score (1-5)	It can be assumed that BaU is the same as or very similar to baseline.	12/2016
Contribution to Policies, Plans and Programs	Score (1-5)	It can be assumed that BaU is the same as or very similar to baseline.	12/2016
Physical barriers	%	It can be assumed that BaU is the same as or very similar to baseline.	12/2016
System usage	Frequency (users/unit of time)	It can be assumed that BaU is the same as or very similar to baseline.	12/2016
Mode shift/Modal split	%	According to the National Transport Survey (2016), the modal split in Turku was the following: 23% walking and 8% cycling. The share has gone down from the previous survey: in 2008, the modal split for walking was 27% and for cycling 11%. It is a downward trend.	12/2016

Number of fatalities and seriously injured	Quantity	The five-year average number of fatalities among cyclists and pedestrians (2012-2016) based on Statistics Finland is 8, which equals an average 1.6 fatalities per year. Statistics on seriously injured have been collected only since 2014. Therefore a three-year average (2014-2016) is used here, which equals 7.3 injuries per year (same as baseline).	12/2016
Number of incidents	Quantity	Data was available on winter condition related incidents to persons from years 2013 (29), 2015(31) & 2016 (18). This makes for an average incident rate of 26 incidents per year.	12/2016
Operating costs	€/km	It can be assumed that BaU is the same as or very similar to baseline.	12/2016
Investment costs	€	No additional investment costs would have incurred without the measure. N/A	12/2016

C.2 Measure results

Values obtained for the selected KPIs are summarised in the table below, followed by a discussion on the results.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	N/A	12/2016	N/A	12/2016	34	12/2019	N/A	N/A
Acceptance	%	96	12/2016	96	12/2016	95	12/2019	-1	-1
Satisfaction	Score (0-5)	3.6	12/2016	3.6	12/2016	3.8	12/2019	0.2	0.2
Contribution to policies, plans, and programs	Score (0-5)	3.5	12/2016	3.5	12/2016	5	01/2020	1.5	1.5
Physical barriers	%	65	12/2016	65	12/2016	61	12/2019	-4	-4
System usage	Frequency (cyclists/month)	17 599	Jan-Feb 2016 & 2017	17 599	Jan-Feb 2018 & 2019	24 485		6 886	6 886
Mode shift/ Modal split	See for data below on page 28.								
Number of fatalities and seriously injured	Quantity	0,67 fatalities / 7.3 serious	12/2016	1.6 fatalities / 7.3 serious	12/2016	2.3 fatalities / 2.3 serious injuries /year	1/2020	1.63 / -5	0.7 / -5

		injuries /year		injuries /year					
Number of incidents	Quantity	31	2015	26	01/ 2017	38	2018	7	12
Investment costs	€	Repairs for the infrastructure along the pilot route before the measure was implemented: 80 000€							
Operating costs	€/km/ winter	2300	12/ 2016	2300	12/ 2016	6200	12/201 9	3900	3900

The ex-post data was derived from several sources:

- Similarly to the baseline, the cycling barometer formed one of the main sources of information for the follow-up assessment. Again, the purpose of the survey was to review the attitudes of the residents of Turku regarding the promotion of cycling and the opinions of residents who cycle regarding winter cycling conditions and the quality of cycling in Turku. Survey data was collected by means of randomized telephone interviews in November–December 2019, and the sample represented residents of Turku between the ages of 18 and 74. A total of 1001 interviews were conducted during weeks 48-50 in 2019. It should be noted that out of these respondents, 207 cycled year round. The survey provided information on KPIs Physical barriers, Awareness, Acceptance and Satisfaction in this measure. The margin of error in the survey was estimated at ± 3.2 % units at the most.
- Information on KPI Satisfaction was also derived from the city's official online feedback channel and a report from the local cyclists' association TURPO.
- System usage data was derived from automatic traffic calculators, provided by the ML.
- Secondary data analysis was performed on indicator Contribution to Policies, Plans and Programs.
- Secondary data on fatalities, seriously injured and incidents was derived from Statistics Finland and data on insurance claims from the City Of Turku department of infrastructure.
- Data on investment and operating costs was derived from the ML and Site Coordinator.

According to the cycling barometer, 34% (n=1001) of all the respondents were **aware** of the improvement of winter cycling conditions in Turku via the winter cycling pilot.

In general, the promotion of cycling and improvement of cycling conditions was **accepted** by Turku residents. Attitudes were favorable also among the population who didn't cycle at all. Out of all respondents, 95% had a positive attitude towards the promotion of cycling. There was a one percent drop from the baseline survey, which however fell within the margin of error (± 3.2 % units).

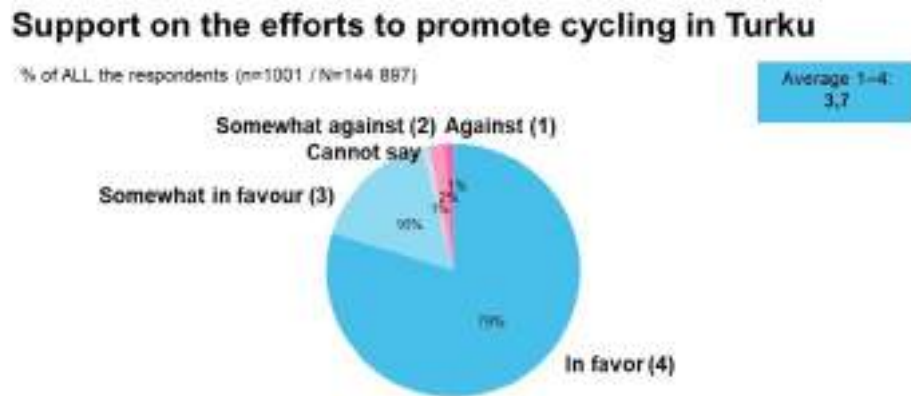


Figure 2. Support on winter cycling promotion

The **satisfaction** in the winter maintenance of cycling routes around Turku among those who cycle year-round increased slightly during the project. According to the 2019 cycling barometer, out of those who cycled year round, 79% were either satisfied or quite satisfied with the winter maintenance of cycling routes in Turku. The number of respondents who were unsatisfied with the winter maintenance had dropped 5%, from 6% in 2016 to 1% in 2019.

At the center of the measure was the winter cycling maintenance pilot. For the purpose of gathering feedback on the route, 24 active members of the local cyclist's association TURPO were recruited during the first pilot winter of 2017-2018. The first winter in Turku entailed some challenging weather conditions which put the maintenance method into test already in November. A variety of specific comments on the condition of the route were received throughout the winter as the volunteers were advised to give feedback both on their daily trips and particularly when there were changes in the weather conditions. Black ice was found particularly difficult to tell apart from the salted route and the route was found rather narrow in certain parts. The corrosive effects were found to be a negative side-effect by some – others, however, experienced no such effect. On the whole, each TURPO volunteer experienced the benefits of sweep salting to be much greater than the disadvantages.

In addition to the avid cyclists' feedback, citizens were able to give feedback online via the city's official feedback channel. The citizen feedback was mostly positive with 65% giving positive views on the pilot route and 31% negative. On the positive side, the route was found non-slippery and clean, with negative comments centered mainly on the width of the route, occasional piles of snow and the side effects of the salt, such as corrosion. The feedback was not limited to cyclists and a lot of the positive comments came from pedestrians and runners too.

The overall score for satisfaction was thus deduced from these three sources, giving the average score of 3.8 on a scale of 1-5.

The contribution of the measure to the development of **Policies, Plans and Programs** in the city of Turku is evident. The Turku city cycling development strategy for 2029 recognizes the fact that the potentials of winter cycling in the city are not fully harnessed. It is stated that winter maintenance on the main cycling and walking routes should reach the same quality as on the driveways. The improvement of winter maintenance was also presented as one of spearhead development measures promoted in the strategy. The experiences gathered in this measure

clearly contributed to strategy development, with CIVITAS ECCENTRIC mentioned specifically.

The goal to improve the conditions of winter cycling on selected corridors is even included in the MAL agreement draft for 2020-2023. In the Turku Climate Plan (SECAP) from 2018, it is also stated that “Cycling and walking conditions are significantly improved around the year and citizens are encouraged to actively engage in exercise in everyday life and free time”. The objective of “Improving cycling conditions and promoting cycling all year round” is listed in the SECAP climate action card “Quality routes for cycling within the main network”. Based on the above, it could be concluded that the impact of the measure on policy and strategy development was significant. **Score: 5.**

One indication of the existence of **physical barriers** was the experienced safety of the cycling network in the wintertime and the subsequent effect on mode choice. In the 2019 cycling barometer survey, 61% of the respondents (n=1001) stated that they would cycle more if cycling was safer in the city. There was a 4% decrease from the baseline results, which may have indicated a slight improvement in the perception of safety of the cycling infrastructure in the city.

The number of winter cyclists clearly increased during the project. At the continuous automated measurement point on the bridge by the Turku Cathedral in central Turku, 97 938 cyclists were calculated during the maintenance pilot between 1.1.2018-28.2.2018 and 1.1.2019-28.2.2019. Per month, this equaled an average number of 24 485 cyclists. This marked a 39% rise in **system usage** at the measurement point.

Mode shift and the subsequent resulting **Modal split** in this measure in this measure focused on the increase in winter cycling numbers. In the 2019 regional mobility barometer, the respondents' mode of travel was inquired with the following question: “*Estimate how often you use the following modes of travel during the summer months (May-October) and, respectively, “Estimate how often you use the following modes of travel during the winter months (November-April).*

According to the barometer, the modal split in the Turku region was the following during wintertime.

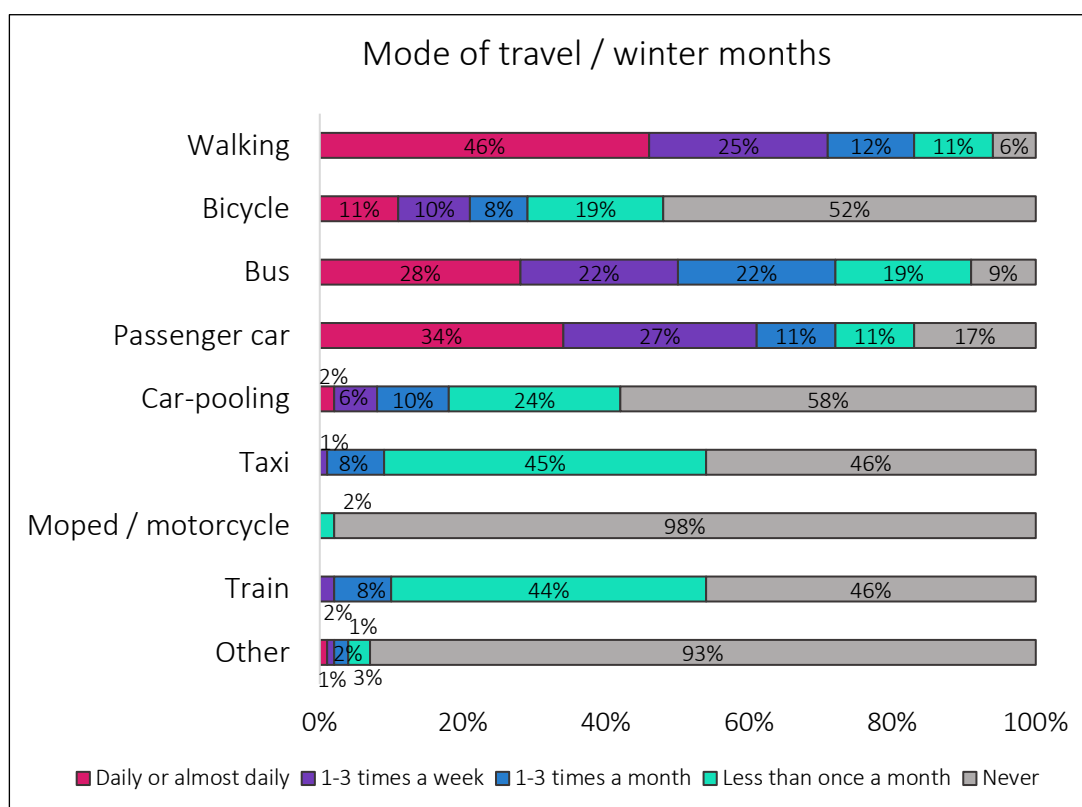


Figure 7. Main mode of travel during the winter months

The main **daily or almost daily mode of travel** in the wintertime for Turku region in 2019 was thereby the following:

2017	Winter months	2019	Winter months	Difference After – before
Walking	47%	Walking	46%	-1
Bicycle	11%	Bicycle	11%	0
Bus	25%	Bus	28%	3
Passenger car	40%	Passenger car	34%	-7
Car-pooling	2%	Car-pooling	2%	0
Taxi	<1%	Taxi	<1%	0
Moped/motorcycle	<1%	Moped/motorcycle	<1%	0
Train	<1%	Train	<1%	0
Other	1%	Other	1%	0

Table 8. The main daily or almost daily wintertime mode of travel for Turku region 2017 + 2019

Overall, it seems that the share of walking and cycling remained nearly the same in the Turku region during the project in the winter months. The use of public transport seemed to have grown slightly.

Making any valid conclusions on the impact of the measure on **traffic-related deaths, serious injuries or incidents** was very challenging. In Finland overall, traffic safety has been on a steady rise since the 1990s', as demonstrated by the data on fatalities from Statistics Finland.

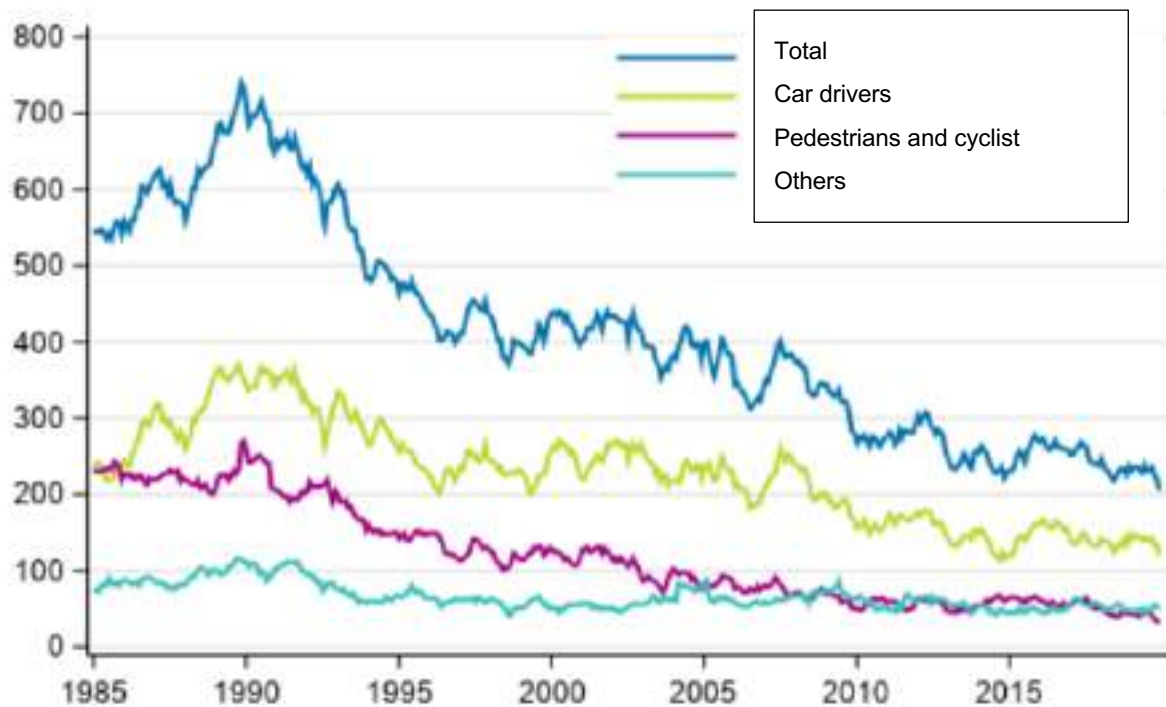
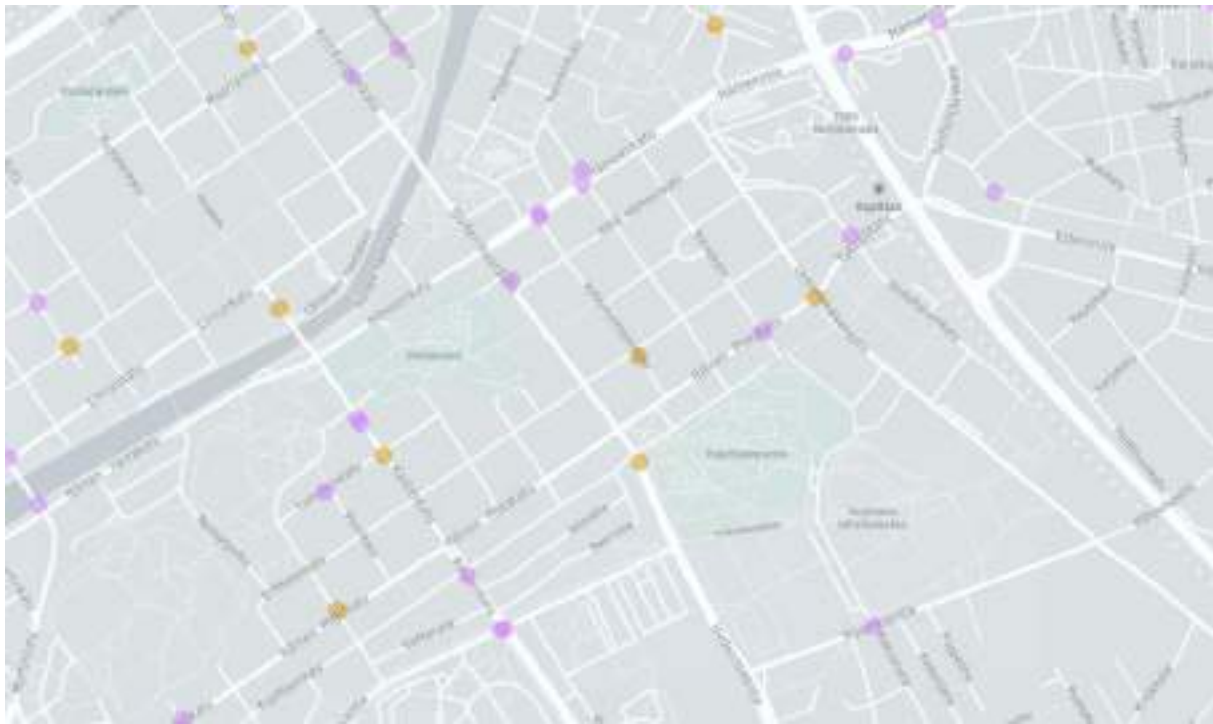


Figure 9. Fatalities in road traffic 1/1985 - 12/2019. Source: Statistics Finland.

According to data from Statistics Finland, there were 189 pedestrians or cyclists injured (not including seriously injured) in Turku between 2017-2019. The map below shows the locations of these incidents in 2017-2018 (2019 data was not available in this format yet) in the city center (pedestrian incidents in orange, cyclist incidents in lilac). Data on the cause of the incident was available for each accident – however it was not specified in this data whether the incidents were road maintenance related.



Picture 16. Pedestrian and cyclist incidents within Turku city centre 2017-2018. Source www.mobilityanalytics.ramboll.com.

According to insurance claims made to the city of Turku, there were altogether 38 winter maintenance related **incidents** in Turku in 2018. Out of these, two were located on the winter cycling pilot route. The incidents were either due to slipperiness, sanding sand, piles or lumps of snow, or ploughing damage. All these incidents had resulted in either personal damage and/or damage to a person's possessions. This was in comparison to the baseline of 2015 when there were 31 similar incidents in Turku. These numbers were naturally only indicative and thus needed to be interpreted with caution. Also it should especially be emphasized that the winter conditions in Turku vary greatly year by year. Hence no far-reaching conclusions can be made on data from a single year. It was thereby very difficult to attribute the direct effect of the measure on the incident numbers in such a short time span.

The number of fatalities among cyclists and pedestrians was higher during the project (2016-2019) than prior to it, with 7 fatalities incurred in total or on average 2.3 per year. On the other hand the number of **seriously injured** among cyclists and pedestrians had decreased, with a total of 7 serious injuries in the three years, 2.3 on average per year.

Road user group	Fatalities			Seriously injured		
	2017	2018	2019	2017	2018	2019
Pedestrian	2	3	1	3	-	-
Cyclist	1	-	-	1	3	-

Table 9. Number of fatalities and seriously injured / follow-up

Data was available only on the causes of the five fatalities in 2017 and 2018. None of the fatalities were linked to poor maintenance of road infrastructure.

Investment costs in this measure referred to repairs for the street infrastructure along the pilot route before the measure was implemented. When planning the route, locations in which the quality of the street was poor were mapped, in particular places where there might be a risk of slipperiness due to freezing puddles of water. 80 000€ was spent on these repairs.

As a maintenance method, sweep salting was clearly more costly than the traditional winter maintenance method (2300€/km/winter). **The operating costs** for sweep salting in Turku during the first winter were calculated to be 6200€/km/winter. The price was to be fixed according to the contract for the first two winters. After this, the contractor was allowed to present a maximum 3% raise in the unit cost.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	The number of winter cyclist rises by 30% and full year cyclist amounts rise by 15% by 2020 compared to 2016	***	A 39% increase was detected in winter cyclist numbers at the measurement point in central Turku. Although without further calculations strong conclusions on a permanent rise in numbers cannot be verified, the maintenance pilot was clearly well received and preliminary results on its potential impacts on wintertime modal shift were promising.
2	The develop the city's winter maintenance methods and use the funds more cost-efficiently with prioritized network and efficient methods	**	Prioritized winter maintenance will continue in Turku at least for the optional two winters (2019/2020 and 2020/2021). The impact of the measure on the cycling development strategy for 2029 was evident.
3	Decrease of cyclist and pedestrian individual injuries (slips, fallings etc.)	NA	Data on incidents was limited, hence no far-reaching conclusions could be made on incident rates.
4	Decrease of traffic accidents due to improved winter maintenance of cycling and walking pathways	NA	It was difficult to estimate direct impact as data was inconclusive on specific locations of traffic accidents.
5	Satisfaction in the winter maintenance pilot	***	Overall, the pilot was very well received by Turku residents.
NA = Not Assessed O = Not Achieved in full * = Substantially achieved (at least 50%) ** = Achieved *** = Exceeded			

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

No deviations were made from the original plan. The measure proceeded well on track.

D.2 Barriers

The following main barriers were identified during measure planning, implementation and demonstration

D.2.1 Political/strategic

Although the measure proceeded smoothly, the higher cost of the piloted winter maintenance method (2-3 times higher than the business-as-usual method) might entail the risk of discontinuation once the project funding ends. For the maintenance method to become a regular procedure, it would entail strong political will to gain the extra funding needed. Some funding has been already guaranteed for improved winter maintenance but not enough to expand the maintenance routes in the extent needed.

D.2.2 Planning

A planning-related barrier occurred when the demonstration phase started and some complaints were received on the corrosive effects of the chosen method for winter maintenance (sweep salting). The issue was discussed with the property owners along the pilot route who had expressed these concerns. The complaints were rather minor though and did not lead into further actions.

D.3 Drivers

The following main drivers were identified during measure planning, implementation and demonstration.

D.3.1 Planning

The fact that the technical planning of the measure was carried out meticulously and with strong stakeholder involvement cannot be underestimated as a driver for measure success. The local cyclists' association was involved in the planning of the winter cycling pilot and data gathering on its success. One person, a thesis-worker, was employed solely to plan and implement the pilot, which guaranteed that enough effort was placed on all facets of measure planning. The demonstration action was also monitored via sensors, giving valuable information on quality of maintenance in the pilot route.

D.3.2 Organizational

The key personnel in planning the measure were highly committed to achieving the measure objectives and the measure included some thorough preparations, such as a cycling barometer and very thorough study of possible options for the winter maintenance method in order to guide planning and get a good view of user needs. This organizational driver facilitated measure planning greatly.

D.3.3 Positional

The measure concerned was part of the cycling development programme of the city and there was a consensus on the need to develop cycling condition. This created a positive atmosphere towards cycling and walking improvements.

D.3.4 Financial

External project funding was decisive in bringing the pilot about, making it an essential financial driver. It is highly unlikely that the winter cycling pilot would have been realised without CIVITAS funding in the extent and timeframe it now was. Project funding thus provided an opportunity to test different methods and, by collecting and showcasing data on its success, to convince the decision makers on making future investments in improved winter maintenance.

D.4 Supporting activities

A spearhead project of the city of Turku started in 2018. This has enabled a larger development of a mobility data platform for the city of Turku.

D.5 Recommendations on the implementation process

Some recommendations on implementation can be suggested based on process evaluation of the measure so far.

D.5.1 Proper planning is key

In order to assure both quality of implementation and ease of process, thorough planning and benchmarking is essential.

D.5.2 Feedback on pilot quality is essential

To be able to adjust the chosen method for winter maintenance and assure its quality, feedback needs to be collected both from the users and via sensors.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- A thorough review was made potential winter maintenance methods.
- A cycling barometer was performed twice to review the attitudes of the residents of Turku regarding the promotion of cycling the quality of cycling in Turku, providing valuable information for measure realization.
- The winter cycling maintenance pilot was implemented successfully and is now in its third year of operation.
- The pilot was well received by system users.
- System usage grew 39% on the route.
- The measure has had a significant impact on cycling policy development in the city.

E.2 Relevance of supporting activities

No supporting activities were identified for this measure.

E.3 Interaction with other measures

The measure included a replication task from STO 4.5. “Policy for re-routing cyclists during construction works”. A thesis was made on temporary traffic arrangements on sidewalks and bike paths in the city of Turku. This resulted in a short test period with temporary light fences during spring 2019. However, the test turned out to be too time consuming and was not well taken by the providers.

E.4 Main lessons learned

- As the project defined a tight schedule for pilot realization, proper planning was essential for keeping with schedule. It was also vital that all the relevant parties within the city departments were involved already in the planning stage of the measure.
- Reviewing the citizens’ attitudes regarding the promotion of cycling and views on the quality of cycling in Turku served as a highly useful starting point for development actions in the measure.
- Combining an external process with the established processes of a city organisation could sometimes be challenging. In similar endeavours, added attention needs to be placed on a clear division of roles and responsibilities and, most importantly, on proper communication between different parties, e.g. the maintenance contractor and project staff.
- The maintenance method chosen was demanding in terms of e.g. drying, other traffic on the route and surface materials. The fact that the route ran its course in the city centre (and not in a quieter area, an approach chosen by many cities piloting alternative

maintenance methods) where there are plenty of external interfering factors for the maintenance made the process even more challenging. Placing the pilot route on streets where cycling and walking levels are high thus created an added need for supervision of the demonstration, allowing for quick reactions to any challenges encountered.

- Tendering for the pilot was made in a manner differing from traditional street maintenance tenders in Turku. As a maintenance method, sweep salting is rather varied and demanding, making it necessary to consider various aspects differing from usual maintenance methods in the tender. Preparation of the tendering thereby needs to be done thoroughly to allow for enough detail but at the same time leave room for improvement during the pilot period.
- Running a pilot applying a novel method such as sweep salting needs to be accompanied by both effective communicative measures and active gathering of feedback. Information on the prioritized cycling route was communicated to the public widely (both online information, media coverage and concrete signs on the route) along with the importance of giving feedback on user experiences via the city's official online feedback channel. The potential effect of the salt on the bicycle chains was one example of the issues that needed to be communicated to the public effectively. Active feedback also allowed for adjustments to be made on the method during the pilot.

E.5 Long term impact

Prioritized winter maintenance will continue in Turku at least for the optional two winters (2019/2020 and 2020/2021). Whether there will be continuance after this, with sweep salting or some other method, remains to be seen. The measure has, in any case, provided a valuable learning opportunity for improved winter maintenance in the varying Turku winters. As proved by the fact that winter cyclist numbers have increased along the route, based on data from the measuring points, it can safely be stated that the route has at least had an effect on winter cyclists' choice of route. Whether improved winter maintenance translates into actual changes in transport modes remains to be seen and needs more data collection to be verified. Also the impact on safety along the route and subsequent influence on decreased number of incidents/accidents is difficult to prove with the data available. The increased numbers of cyclists and walkers on the route suggest, however, that at least the perceived safety of the route is high. This was also reported by both the expert feedback group of avid cyclists and the general public.

In the end, in order to really have an impact on city-wide cycling numbers in the longer term, the maintenance route needs to be expanded.

E.6 Potentials for up-scaling in the city

The winter cycling maintenance pilot is currently in its third year of operation and feedback on the route has been largely positive. From the beginning it was acknowledged that realization of the test route would be one step on the path towards more widely prioritized and higher quality winter cycling in Turku. The pilot thus served as a valuable learning opportunity for future actions in improving winter cycling conditions in the city, whether it be realized with sweep salting or some other method.

This winter (2019-2020), an added stretch of street of app. 900 meters was added to the pilot in the Kupittaa laboratory area. The route has definitely proved the potential of sweep salting as an alternative, high-quality maintenance method for the Turku winters. The higher costs of the method naturally remain an issue that largely defines the expansion of prioritized winter maintenance. It should be borne in mind that providing highest-quality winter maintenance on all of the city's cycling routes has not been the goal to begin with – however, the primary streets and roads to the city centre are those that would reach a larger number of users if maintained better, with subsequently the best potential for increasing the numbers of cyclists year-round.

F. Additional information

F.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

- All in all, the importance of the thorough and meticulous work done by thesis worker Anette Korkiakangas cannot be emphasized enough. Most of the information on the pilot route and user experiences gathered were derived from her thesis, presentations and other reports. This facilitated the evaluation process greatly.
- Data for satisfaction was exceptionally ample, derived both from the expert group experiences, the general public via the city feedback portal, and Turku residents via the cycling barometer. This allowed for a thorough analysis of perceived satisfaction on the winter cycling pilot.
- The cycling barometer formed a good baseline for the measure and was repeated after two years, providing similarly useful ex-post data. The only shortcoming related to the barometer from the point of view of evaluation was the timing of the first round – the first barometer was realized already in November/December 2016 when the Turku evaluation framework was not yet set. Hence there was no possibility to influence the survey questions. Due to this, some baseline is lacking.
- Inadequate accident related data was a clear drawback for demonstrating measure success (or possible lack of thereof) in terms of improving traffic safety. In similar future endeavours, alternative measures should be searched to really be able to attribute the potential impact of the chosen maintenance method on numbers of accidents.

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

- The measure was well received by Turku cyclists, creating a fertile ground for possible future pilots. If similar pilots are realized, feedback should be gathered in a similar manner as in this measure in order to gain as much information on user experiences.
- The impact of improved winter maintenance on the number of incidents, serious injuries or fatalities is challenging to prove within project duration. Thereby careful investigation should be made into all possible data sources available yearly, now that it has been decided that prioritized winter maintenance will continue in Turku at least for the optional two winters (2019/2020 and 2020/2021).

Sources:

Anette Korkiakangas (2017). The Development of the Prioritized Winter Cycling Route – Case Winter Cycling Test Route in Turku (in Finnish). Master of Science Thesis, Tampere University of Technology.

<https://trepo.tuni.fi/bitstream/handle/123456789/25898/Korkiakangas.pdf?sequence=4>



2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



STO 4.9

Offering Test-Fleet with E-Bikes and E-Freight Bikes Measure Evaluation Report

Deliverable No.: 8.5

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Responsible Author(s):

Joel Franklin

Responsible Co-Author(s):

Helena Kalland

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28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Joel Franklin	KTH Royal Institute of Technology
Helena Kalland	Cykelkonsulterna

Table of Contents

ABSTRACT.....	905
A.INTRODUCTION	906
A.1. EXPECTED RESULTS OF THE MEASURE.....	906
A.1.1. <i>Quantifiable impacts</i>	906
A.2. MEASURE DESCRIPTION.....	906
A.2.1. <i>Measure outputs</i>	907
A.2.2. <i>Supporting activities</i>	907
A.2.3. <i>Interactions with other ECCENTRIC measures</i>	907
A.2.4. <i>Interactions outside ECCENTRIC</i>	907
A.3. TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION.....	908
A.4. STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	908
A.5. IDENTIFIED RISKS.....	908
B.MEASURE IMPLEMENTATION.....	910
B.1. SITUATION BEFORE CIVITAS.....	910
B.2. INNOVATIVE ASPECTS.....	910
B.3. RESEARCH AND TECHNOLOGY DEVELOPMENT.....	910
B.4. ACTUAL IMPLEMENTATION OF THE MEASURE.....	910
C.IMPACT EVALUATION FINDINGS.....	911
C.1. EVALUATION APPROACH.....	911
C.1.1. <i>Expected impacts and indicators</i>	911
C.1.2. <i>Baseline</i>	913
C.1.3. <i>The business-as-usual scenario</i>	914
C.2. MEASURE RESULTS.....	914
C.3. SUMMARY: ACHIEVEMENT OF OBJECTIVES.....	917
C.4. UP-SCALING.....	917
D.PROCESS EVALUATION FINDINGS.....	918
D.1. DEVIATIONS FROM THE ORIGINAL PLAN.....	918
D.2. BARRIERS.....	918
D.3. DRIVERS.....	918
D.4. SUPPORTING ACTIVITIES.....	919
D.5. RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS.....	919
E. EVALUATION CONCLUSIONS.....	920

E.1.	VALIDATED DIRECT IMPACT.....	920
E.2.	RELEVANCE OF SUPPORTING ACTIVITIES.....	920
E.3.	INTERACTION WITH OTHER MEASURES.....	920
E.4.	MAIN LESSONS LEARNED.....	920
E.5.	LONG TERM IMPACT.....	920
E.6.	POTENTIALS FOR UP-SCALING IN THE CITY.....	920
F.	ADDITIONAL INFORMATION.....	921
F.1.	APPRAISAL OF EVALUATION APPROACH.....	921
F.2.	FUTURE ACTIVITIES RELATING TO THE MEASURE.....	921

List of Tables

Table 1: Quantifiable impacts.....	906
Table 2: Target groups or affected parties.....	908
Table 3: Measure stakeholders.....	908
Table 4: Risk assessment.....	909
Table 5: KPI Descriptions.....	912
Table 6: KPI Details	913
Table 7: KPI Results	916
Table 8: Summary of Objective Achievement.....	917
Table 9: Identified barriers and planned/taken actions.	918
Table 10: Identified drivers and planned/taken actions.....	919

Project	City		
ECCENTRIC	Stockholm		
Measure code	Measure name		
4.9	Offering Test-Fleet with E-Bikes and E-Freight Bikes		
Last update	Responsible	e-mail	Telephone
	Helena Kalland	helena.kalland@cykelkonsulterna.se	

Abstract

The City of Stockholm aims to decrease transport emissions and free up road space by increasing the acceptance of e-bikes and e-cargo bikes as an alternative to private motor vehicles. These are despite the increasing sales, still infrequent in Stockholm.

This measure offered companies and residents in the two neighbourhoods in Stockholm the opportunity to test one of 25 pedelec e-bikes and e-freight bikes during a three-week period in order to find out whether, and to what extent, these vehicles provide a viable mobility option. This was with the obligation to complete a series of surveys and allow the bike's odometer to be used for evaluation. Evaluation was measuring acceptance, satisfaction, usage of the system, as well as the investment and operational costs.

The bikes were heavily used by participants, although this is more likely due to self-selection than due to the bicycles' electric assist. Comparing the statistics from the national household travel survey with the computed the average kilometres travelled, there was 126 km increase in the Sum of all kilometres travelled by the e-bikes over a period of three weeks. Based on the results of the survey, conducted with the users we found that the acceptance was very high (11%, 10 point growth), and while only a minority chose to purchase an e-bike at the end, this minority was significantly greater than the population-level interest in purchasing e-bikes.

A. Introduction

A.1 Expected results of the measure

Although the use of e-bikes and e-cargo bikes is common in some countries (e.g. the Netherlands and Denmark) and that the sales of e-bikes are rising by 70% in Sweden last year, the usage of e-bikes and e-freight bikes are fairly infrequent in Sweden.

The measure objectives are below:

(1) City policy level in perspective of CIVITAS goals/ longer term:

The long-term goal is to decrease transport emissions and free up road space by increasing the acceptance of e-bikes and e-cargo bikes as an alternative to private motor vehicles.

(2) Strategic level:

The long-term goal of this measure is to increase the usage of e-bikes and e-cargo bikes. After the European financing have reached its end, e-bikes will be more frequently occurring on the streets. If more people see the bikes, more people will buy them.

(3) Measure level:

The short-term goal is to deploy 25 e-bikes among 180 households on the streets of Stockholm during the test period to promote the attractiveness of cycling and encourage citizens to overcome barriers to adopting them as a daily mode of transport.

A.1.1. Quantifiable impacts

Expected Impacts	To increase the uptake of alternatives to the private car, thus replacing private leisure and shopping trips. This will reduce emissions (CO ₂ and local pollutants), free up space and may reduce mobility costs for households. Furthermore, the measure will reduce car trips for business and freight trips. The test-fleet is limited to 25 bikes. If 80 % of companies/residential apartments buy a bike after the trial, 20 new bikes would be sold. However, the marketing impact of the measure will be larger. The objective is that at least 300 bikes will be sold due to the measure in the future.	CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	Acceptance/Satisfaction of the testing of e-bikes				x	x	x	x			
2	Usage of the system										
3	Exploitation of the funding for implementation of the plan and giving opportunities to local economy								x		x

Table 1: Quantifiable impacts.

A.2 Measure description

This measure offered companies and residents in the Årsta and Hammarby Sjöstad neighbourhoods the opportunity to test one of 25 pedelec e-bikes and e-freight bikes during a three-week period in order to find out whether, and to what extent, these vehicles provide a viable mobility option. Households and companies were recruited from these two neighbourhoods by contacting housing cooperative boards, using existing interest-group email

lists, and contacting employers with workplaces in those neighbourhoods. With a normal maintenance turnaround time of one week between loans, the entire set of trials was completed from April 2017 to September 2018, an 18-month period. In total, 108 households participated.

After each trial period, the participants were offered the opportunity to purchase one of the e-bikes upon completion of the full trial. The idea was that they would want to purchase their own e-bike or e-freight bike after having tested it themselves. e-bikes and e-cargo bikes provide mobility options for work trips, movement of small amounts of freight trips and residents' leisure and shopping trips. The test bike campaign was principally directed to car users.

A.2.1 Measure outputs

The key outputs of the measure were the 25 e-bikes and e-freight bikes that were made available to households and employers during the trial period.

A.2.2 Supporting activities

The measure builds on participation from residents and companies in the area, therefore communication and information were of high importance both before, during and after the implementation of the test fleets. The communication activities conducted for this measure included:

- PR in traditional media.
- Project website and social media.
- Experiences from test persons in their own social networks.
- Stickers or colour on the bikes that make them visible.
- Marketing events in Årsta, preferably in connection to the big workplace districts.
- Events with retail shops and bike business to promote e-biking.

A.2.3 Interactions with other ECCENTRIC measures

There were no interactions with the other measures within ECCENTRIC.

A.2.4 Interactions outside ECCENTRIC

There were no interactions with projects outside of ECCENTRIC.

A.3 Target groups and/or affected part of the city or region

Table 2 lists the main target groups included in this measure.

Target group		Affected area	
Type	Description	Type	Description
Commercial	Bike companies	Neighbourhood	Årsta
Commercial	Logistics companies delivering small goods	Neighbourhood	Årsta
Commercial	Service businesses	Neighbourhood	Årsta
Commercial	Large companies willing to provide e-bikes to employees	Neighbourhood	Årsta
Commercial/ Non-profit organizations	Housing companies and cooperatives	Neighbourhood	Årsta
Private	Individuals/citizens	Neighbourhood	Årsta, Hammarby Sjöstad

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

Table 3 lists the main stakeholders included in this measure.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level activity L-P-O	of	Role - Links
P08	Cykelkonsulterna	P	PR	L		
P01	Residents of Årsta	S	Other	P		
P14	Companies offered e-bikes for trial	S	PR	P		
P15	Cyclists	S	Other	P		
S05	Companies and shops selling e-bikes	S	PR	O		
Type: P:CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant						

Table 3: Measure stakeholders.

A.5 Identified risks

Table 4 lists the risks identified before the implementation of the project and the mitigation actions.

Identified risk	Category	Mitigation actions	Responsible
Delays (implementation, data collection, dependent tasks etc.)	Operational	Need for manual on how and when to collect data	Cykel-konsulterna
Lack of knowledge/unfamiliar processes	7 Planning	Work manuals that is easy to understand	Cykel-konsulterna
Resource shortfalls (Inability to secure sufficient resources, overspending)	9 Financial	Always have on dedicated for delivery and data collection. Keep going on the already existing time schedule	Cykel-konsulterna
No interest of companies/individuals for participation in the trial	5 Involvement /Communication	Get out information about web page provacykel.se	Cykel-konsulterna
Limited participation to web-based questionnaires	5 Involvement /Communication	Promotion of the web page Provacykel.se	Cykel-konsulterna

Table 4: Risk assessment.

B. Measure implementation

B.1 Situation before CIVITAS

E-bikes and e-cargo bikes are common in a growing number of countries (e.g. the Netherlands and Denmark), and in Sweden they are being adopted at an increasing rate, with over 100 000 sold in Sweden in 2018. These vehicles are seen as providing a useful and attractive mobility alternative for many trips in Sweden.

Despite the sales of e-bikes rising by 70% in Sweden last year, it is unclear how much these e-bikes and e-freight bikes are actually used in Sweden since standard statistics do not distinguish between e-bikes and normal bikes.

B.2 Innovative aspects

By providing an easy way to lend an e-bike we can overcome obstacles and answers questions possible interested persons may have. We have had home delivery, service and pickup all for free. This makes the lending period easy and care-free.

B.3 Research and Technology Development

No research or development activities are conducted as part of this measure.

B.4 Actual implementation of the measure

Cykelkonsulterna manages all aspects of implementation:

- Planning and Project management
- Marketing and promotion
- IT system for booking
- Logistics of the bicycles
- Repair and services
- Finding a second use for the bicycles used

The implementation was organised into four actions:

- Action 1: Research and measure planning, September 2016 to April 2017. Identification of suitable workplaces and apartment buildings.
- Action 2: Procurement and implementation, April 2017 to September 2017. Procurement of bikes and implementation of the test fleet.
- Action 3: Demonstration and monitoring, October 2017 to September 2018.
- Action 4: Conclusions and recommendations, November 2018 to August 2019. Including the development of strategies for wider implementation of the concept.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

The subject area is the combination of the neighbourhoods of Årsta and Hammarby Sjöstad, just south of the central city area of Stockholm, but still within the Stockholm municipality. The test-fleet was limited to 25 bikes. Hence the maximum direct effect on long-term ownership would be those 25 bikes. However, the marketing impact of the measure could be larger, and the broader objective was that at least 300 bikes would be sold due to the measure in the future. Having said that, the measure's KPIs are focused on the outcomes for the observed participants, not for the wider population base influenced by this marketing exposure.

Satisfaction

The participants were given surveys at several stages relative to their use of an e-bike:

1. Prior to receiving the e-bike,
2. Two weeks into the three-week test period,
3. One month after the test period, and
4. Three months after the test period.

The exact dates of the surveys varied, based on when each household participated in the pilot. In waves 2 and 3, a question was posed asking whether participants were satisfied with their experience, yes or no.

Acceptance

Acceptance was measured primarily as the number of test e-bikes actually sold. This was complemented by a question in Wave 4 of the participant survey, which asked whether they had purchased an e-bike by that time, three months after their trial period. However, by this measure no households reported purchasing an e-bike. Hence, the record of actual purchases of the test bikes by participants proved to be the more reliable measure.

Usage of the system

Usage was measured using on-bike odometers. However, these were only implemented during the last phase of the implementation, so for each test e-bike, no more than three loans were observed for distance travelled. Moreover, inspection of the collected data has shown that the odometers suffered from reliability problems with several failing to produce data. At the same time, several reported no movement for the duration of a three-week loan, which could either mean that the participant did not use the bike in the end, or that the odometer failed to register movement, even if the e-bike was moving. Because of this high occurrence of zeros, we computed an average based only on participants with a non-zero distance, knowing that this only represents those with positive use of the test bike.

Investment cost and operations cost

For the final, financial measures, we report the purchase cost of the selected model of e-bike as well as the operating cost for preparing the bike for another loan after each completed loan. We have not accounted for salvage value of the test bikes, and in this case this represents a real value since about half of the bikes were, in the end, resold to former participants.

Impact	Acceptance	Acceptance	Usage of the system	Exploitation	Exploitation
Indicator name	Acceptance	Satisfaction	Vehicle-kilometre travelled	Investment cost	Operating cost
Type	KPI	KPI	KPI	KPI	KPI
Category	Society - People	Society - People	Transport System	Economy	Economy
Subcategory	Acceptance	Acceptance	General	Costs	Costs
Aspect	Acceptance level	Fulfilment of expectations	Total travel	Investment costs	Operating cost
Definition	The percentage of the population who participated in the trial and purchased a bike within a certain period after the trial.	E-bike users reported satisfaction with the service/performance of the measure	Sum of all kilometres travelled by the e-bikes	The total capital costs for the implementation of the measure per line (infrastructure, equipment and vehicles)	The cost of repairing/maintaining each E-bike between one loan and the next
Unit	Percent + Description	Percent + Description	km	SEK	SEK
Method of data collection	Questionnaire/Survey	Questionnaire/Survey . When bike is returned the system will generate an email with the questionnaire	Odometer	Monitoring tools of the project	Monitoring tools of the project
Target group	General public (residents, visitors), Companies related to E-bikes	General public (residents, visitors), Companies related to E-bikes	General public (residents, visitors), Companies related to E-bikes	Internal operations of the loan	Internal operations of the rental
Domain	Demonstration area/Target groups	Demonstration area/Target groups	Demonstration area/Target groups	The pool of loaned E-bikes	The pool of loaned E-bikes
Control sample	No	No	No	No	NO
Related measures, activities, and interference sources	Other projects related to e-bikes	Other projects related to e-bikes	Other projects related to e-bikes	Other projects related to e-bikes	Other projects related to e-bikes
References	WIKI	WIKI, CAPITAL	WIKI	WIKI	WIKI

Table 5: KPI Descriptions

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Acceptance	%	A	DC	Residents of Årsta area active in the project	Årsta
2	Satisfaction	%	I A	S	Residents of Årsta area active in the project	Årsta
3	Usage of the system	VKT	I	DC	Testbikes	Årsta
4	Investment Cost	SEK	I	E	Cykelkonsulterna	-
5	Operating Cost	SEK	I	DC	Cykelkonsulterna	-
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: KPI Details

C.1.2 Baseline

Acceptance

In the baseline case, there was no trial and we had not yet identified participants. However, we can use published statistics about bicycle sales as a comparison point. We used statistics from Cykelbranschen, an organisation representing the Swedish bicycle industry, to obtain the e-bike sales rates for a one-year period both in 2017 and 2018. Using 2017 as the baseline year, we find that only 0.7% of Swedish residents purchased a bicycle in that period, giving us a point of comparison for our test households. However, it should be noted that there is certainly some self-selection bias in our participant pool, as those who volunteered were probably already aware of and considering purchasing an e-bike. At least, they are likely to already be favourable to bicycle use in general, which is confirmed by the fact that fully 33% intended to use them on a trip where they currently use a non-electric bike. On the other hand, since our pool is households while the industry statistics use individuals as a base unit, we should consider the industry statistics to be a low estimate for household-level purchases.

Satisfaction

In the survey, participants were asked simple questions about their travel habits and willingness to pay for an e-bike but not about satisfaction with e-bikes, since they had not yet experienced one. We are also not aware of any study on the general population's satisfaction level with e-bikes.

Usage

In the baseline, before the study, participants did not yet have access to an e-bike, so average usage was zero. However, we can compare to statistics from the national household travel survey, in which the estimated annual kilometres travelled by any kind of bicycle plus as a pedestrian is 7121 km. In Sweden these two modes are grouped together, but in other countries we can estimate a split between them, such as using the UK statistic of 77% walk and 23% bike. Converting this to kilometres per week and multiplying by the three weeks of each trial period, this gives us 93 km. Note that this overestimates e-bike use since it includes all types of bicycles.

Investment and Operating Costs

The investment and operating costs were zero prior to the pilot.

C.1.3 The business-as-usual scenario

Acceptance

Using the same industry source as for the baseline scenario, we can obtain the purchase rate for 2018, finding that 1.0% of Swedish residents purchased an e-bike during that year. This is limited by the same caveats as the baseline measurement.

Satisfaction

Similar to the baseline, without this measure, people would still use some other mode of travel as usual. Consequently there would be no satisfaction to either have or not have for using e-bikes.

Usage

One year after the baseline, we use the same statistic as for the baseline, since we do not expect significant changes in overall cycling levels. Again, this is for all bicycle use, not exclusively e-bikes.

Investment and Operating Costs

Not acquiring an e-bike means avoiding the approximately €2000 purchase cost. For the operators of the measure, it is also noteworthy that the roughly €40 maintenance costs of turning around the e-bike between rentals would have been avoided.

C.2 Measure results

Acceptance

After the completed pilot, 12 of the 25 test e-bikes were purchased by one of the participants. This indicates a relatively high purchase rate of 11%, which we take to be over a one-year potential purchase period for comparison purposes. Another data source is the fourth wave of the survey, in which participants were asked if they had yet purchased an e-bike, three months after they returned their test e-bike. However, no respondents reported purchasing an E-bike. Perhaps some of these had not yet, because they intended to purchase one of the test E-bikes at the end of the trial, but in any case, given the self-evident purchases, this zero is a misleading figure. Moreover, in the second survey wave, respondents were asked if they were interested in purchasing an e-bike, and fully 75% replied “Yes”.

Satisfaction

Satisfaction was measured after the first two weeks of the three-week rental and again one month afterwards. The first observation was 82.5% and the second 80%, indicating a potential decline, but with only 31 and 21 respondents respectively (out of 108 participants), these cannot be considered to show any significant change. In either case, a large majority were satisfied.

Usage

Usage was measured using integrated odometers on the e-bikes. Unfortunately, these were only used for at most the last three loans of each e-bike, and even for these, much of the data was unusable. Moreover, of the usable data, fully 30% recorded zero kilometres travelled. While we would expect some participants to never use the bike, this is unexpectedly high and could as easily be attributed to a malfunctioning odometer that fails to record movement. Instead of using these, we computed the average kilometres travelled only for those with non-zero distances, giving an average of 219 km over three weeks. In comparison, if we included these zeroes then the average would have been 151 km over three weeks.

Investment and Operating Cost

The investment cost of each e-bike was approximately 20 000 SEK. Operating costs were taken to be the cost of regular maintenance between each three-week rental, to restore it to nearly new condition. Parts were only a negligible portion, so we report only labour costs, in this case approximately 400 SEK per rental.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Acceptance	%	0.7%	Pre-2017	1.0%	2018	11%	December 2018	+10.3 ppt	+10.0 ppt
Satisfaction	%	N/A	N/A	N/A	N/A	82.5% during, 80.6% after	After 1 week; after 1 month (dates vary)	N/A	N/A
Average Usage, given some usage	VKT	93 km	Pre-2017	93 km	2018	219 km	Over 3 weeks (dates vary)	+126 km	+126 km
Investment cost	SEK	0	Pre-2017	0	2018	20.000 SEK	2017	+20.000 SEK	+20.000 SEK
Operating cost	SEK	0	Pre-2017	0	2018	400 SEK/rental	April 2017 to Sept. 2018	+400 SEK/renter	+400 SEK/rental

Table 7: KPI Results

C.3 Summary: achievement of objectives

The table below summarizes the achievement of the measure's objectives.

No.	Objective and target	Rating	Comment
1	Acceptance/satisfaction of the testing of e-bikes	★★	High acceptance and satisfaction, particularly when comparing to national sales rates.
2	Usage of the system	★	Nearly a doubling of usage rates compared to national cycling statistics, but this required several assumptions.
3	Exploitation of the funding for implementation of the plan and giving opportunities to the local economy	★	The investment costs were as expected, though maintenance costs were high considering the short rental periods.
NA = Not Assessed O = Not Achieved full ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★ = Exceeded			

Table 8: Summary of Objective Achievement

C.4 Up-scaling

The project is not likely to be upscaled, but rather there is a naturally growing demand for electric bicycles and electric cargo bicycles.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the **Process Evaluation Report** of this Measure.

D.1 Deviations from the original plan

There were no noteworthy deviations from the project plan, although it should perhaps be noted that no companies volunteered as participants, so all participants were households.

D.2 Barriers

Several barriers have been identified for each of the two measures, with certain actions identified to help overcome them.

No.	Barrier field	Description	Action to overcome the barrier
1	Positional	The price of e-cycles is high according to many people, therefore they do not consider that option.	In marketing materials, we emphasized the long-run costs in comparison to other transport modes such as auto ownership.
2	Positional	Public transport access is generally so high that most people prefer it to e-cycling.	By highlighting the health benefits and by measuring time saved with taking the bike we could get people out of their comfort zone.
3	Other	The risk of theft discourages many from cycling.	We provided advice on properly securing e-bikes.
4	Positional	Companies in the study area have not shown interest in e-cycles	By pilot-testing and providing good examples (Cykelkonsulterna provides freight bicycles all over Stockholm) but also by reminding of all the positive effects of a company using e-cycles (cheaper than car, easier to find parking, lower investment cost, environmentally friendly, positive outward effects on social media, better health effects for employees).

Table 9: Identified barriers and planned/taken actions.

D.3 Drivers

Several drivers have been recognized as possibly helping to bring about the success of the two measures. In cases where it is possible to encourage and capitalize on these, we have identified actions to do this.

No.	Driver field	Description	Action to make use of the driver
1	Positional	Prior to the project, participants experienced considerable noise in dense traffic during trips.	Simply offering a trial helps individuals to experience an improvement in experienced noise.
2	Positional	Cyclists now avoid the problem of sweating, since e-cycles do not require as much physical effort as fully mechanical bicycles.	Undergoing a trial period also helped individuals experience lower physical effort levels.
3	Positional	Many participants were used to sitting stuck in vehicular traffic, whereas now they can bicycle quickly to work and feel physically better.	The City can ensure this benefit by providing safe and reliable bike paths and lanes that help cyclists avoid congested roads.

Table 10: Identified drivers and planned/taken actions.

D.4 Supporting activities

Supporting activities consisted of an integrated campaign of communication activities to help recruit participants. The campaign succeeded in recruiting households but was not successful in recruiting workplaces.

D.5 Recommendations on the implementation process

The management of the e-bikes and contacts with customers takes a significant amount of time and resources; these need to be well-staffed. Moreover, if sales to customers are involved, then the administrative burden of managing sales also needs to be anticipated, or perhaps preferably, outsourced to a proper reseller.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- The main impact is that the personal use of e-bikes in daily activity leads to a very positive impression of e-bikes.
- There are some indications that this leads to increased interest in purchasing one's own e-bike, but the findings here are not conclusive.

E.2 Relevance of supporting activities

The supporting activities helped recruit participants to the demonstration.

E.3 Interaction with other measures

There were no significant interactions with other measures.

E.4 Main lessons learned

Some of the key lessons were:

- It was much more laborious than expected, with extensive consumer contact and sometimes difficult customers, despite the fact that they were benefiting from the free use of an electric bicycle for several weeks.
- This was particularly difficult for the lead partner, Cykelkonsulterna, who is not really a reseller, to manage selling directly to customers. The administrative tasks took much more time than expected.

E.5 Long term impact

The long-term impact will result from the overall growth in e-bicycling in Stockholm, and not specifically from this demonstration, being at such a small scale as it was.

E.6 Potentials for up-scaling in the city

The project is not likely to be upscaled, but rather there is a naturally growing demand for electric bicycles and electric cargo bicycles.

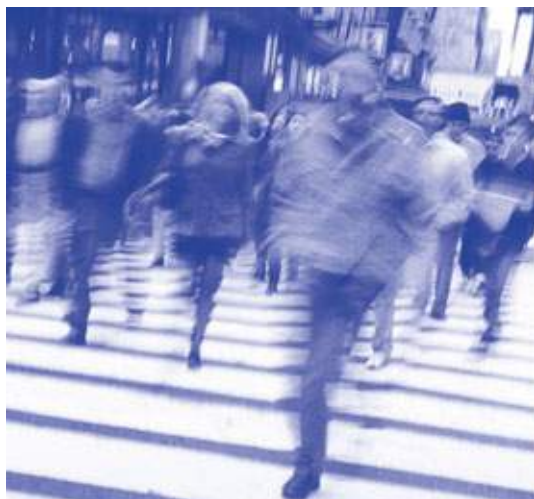
F. Additional information

F.1 Appraisal of evaluation approach

No comments have been noted at this time.

F.2 Future activities relating to the measure

There is no planned follow-up of this measure.



2020
CIVITAS
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ECCENTRIC



MAD 5.1

High level PT service corridors in peripheral districts

Measure Evaluation Report

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ECCENTRIC



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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid SA.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático SL	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures BV. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Laura Delgado	
Alicia Velasco	

Table of Contents

ABSTRACT.....	929
A. INTRODUCTION.....	931
A.1 EXPECTED RESULTS OF THE MEASURE	931
A.1.1 Quantifiable impacts.....	931
A.2 MEASURE DESCRIPTION	932
A.2.1 Measure outputs.....	933
A.2.2 Supporting activities	937
A.2.3 Interactions with other ECCENTRIC measures.....	937
A.2.4 Interactions outside ECCENTRIC	937
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	938
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	938
A.5 IDENTIFIED RISKS	939
B. MEASURE IMPLEMENTATION	940
B.1 SITUATION BEFORE CIVITAS	940
B.2 INNOVATIVE ASPECTS.....	943
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	943
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	943
C. IMPACT EVALUATION FINDINGS	944
C.1 EVALUATION APPROACH.....	944
C.1.1 Expected impacts and indicators.....	944
C.1.2 Baseline.....	946
C.1.3 The business-as-usual scenario.....	947
C.2 MEASURE RESULTS.....	948
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	949
C.4 UP-SCALING	950
D. PROCESS EVALUATION FINDINGS	951
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	951
D.1.1 Pilot section not constructed.....	951
D.1.2 Pilot section moved from the living lab to Moratalaz district.....	952
D.1.3 Innovative components not considered.....	952
D.2 BARRIERS	952
D.2.1 Political barrier.....	952

D.2.2	<i>Participation and involvement barrier</i>	953
D.3	DRIVERS	954
D.3.1	<i>Planning driver</i>	954
D.3.2	<i>Cultural driver</i>	954
D.3.3	<i>Institutional driver</i>	954
D.4	SUPPORTING ACTIVITIES	954
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	954
D.5.1	<i>Involvement of decision-makers</i>	954
D.5.2	<i>Assessing the public's actual support</i>	955
E.	EVALUATION CONCLUSIONS	956
E.1	VALIDATED DIRECT IMPACT	956
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	956
E.3	INTERACTION WITH OTHER MEASURES	956
E.4	MAIN LESSONS LEARNED	957
E.5	LONG TERM IMPACT	957
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	957
F.	ADDITIONAL INFORMATION	958
F.1	APPRAISAL OF EVALUATION APPROACH	958
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	958

List of Figures

Figure 1: Section of the corridor serving Vallecas.....	933
Figure 2: Section of the corridor serving Vallecas.....	934
Figure 3: Bus line 140 route	934
Figure 4: Bus line 142 route	935
Figure 5: Bus line 144 route	935
Figure 6: Bus line 100 route	936
Figure 7: Express bus line E4 route	936
Figure 8: Expansion of the bus lane system (Vision 2025)	937
Figure 9: Traffic counting spots in the corridor (September 2019).....	942

List of Tables

Table 1: Quantifiable impacts.....	932
Table 2: Target groups or affected parties.....	938
Table 3: Measure stakeholders and other relevant agents.....	938
Table 4: Identified risks.....	939
Table 5: Daily bus demand (passengers/day, September 2019).....	940
Table 6: Average bus speed on the corridor (km/h, September 2019).....	941
Table 7: Average general traffic speed on the corridor (km/h, September 2019).....	941
Table 8: Peak-hour traffic in the corridor (vehicles/hour, September 2019).....	942
Table 9: Description of key performance indicators (KPI).....	945
Table 10: Description of key performance indicators (KPI) (cont.).....	946
Table 11: Measure's indicators.....	946
Table 12: Reliability of bus services.....	947
Table 13: Measure's KPI results.....	948
Table 14: Achievement of measure's objectives.....	949

Project	City		
ECCENTRIC	Madrid		
Measure code	Measure name		
5.1	High level PT service corridors in peripheral districts		
Last update	Responsible	e-mail	telephone
10/01/2020	Alicia Velasco	alicia.velasco@madrid.org	

Abstract

This measure was expected to provide a first step towards the implementation of corridors served by buses with high level of service (BHLS) in Madrid. It should implement and operate a pilot construction project covering a 3.6-km section connecting the living lab with the districts of Moratalaz, San Blas-Canillejas and Ciudad Lineal, in the northeast periphery of Madrid. It was also expected to explore different options for segregation (physical/flexible/virtual), priority (using IT tools) and enforcement (IT tools/video cameras). The construction project was finished and delivered by the consultants in September 2018. It provided a complete redesign of the cross section of the corridor, including reserved bus lanes and bike lanes, and re-arranging on-street parking. However, the pilot section did not receive the financial resources from the city council to be built. Accordingly, the scope of the final demonstration stage of this measure changed. The ECCENTRIC measure team decided to dedicate the resources initially budgeted for the implementation stage to a detailed analysis of the corridor, including the users' and residents' practices and priorities; this detailed analysis provided a better understanding of the lack of priority given by the local decision makers to the implementation of the priority corridor, and served to identify some lessons for better considering these issues at the initial stages of project design of such corridors. The study was completed in December 2019.

Three main deviations from the original plan occurred during the design and implementation stages. The first and more relevant one was the decision of the municipality to not undertake the construction works for the pilot section. The second one was the decision to move the pilot section from the original location within the living lab to its current one, located mostly in the neighbouring district of Moratalaz. The third one referred to the lack of inclusion of some innovative components (for segregation and control of the bus lanes with ICT-related technologies) in the measure.

As the infrastructure has not been constructed and operated, the measure's objectives have not been achieved. However, it is still possible to take into consideration the new evidence provided by the survey completed in September 2019 and the technical study delivered by CRTM in December 2019; this information allowed to reasonably assess the measure's potential. The potential for modal shift from car use is estimated to be below the 4% measure objective. This is due to the low time savings achieved by the buses, and the lack of restrictive measures to car use (such as reduction in the number of general traffic lanes or in the number of parking places in the corridor). Bus commercial speed could increase substantially during

the peak hours, reaching a maximum value of 14.0 to 14.5 km/h depending of the trip direction; the relatively high number of bus stops in the 3.6 km section prevents to attain higher values. Public transport users' satisfaction would be likely to increase in a moderate way in case the project was built. The potential for emission reduction is low, compared to the investment mobilised, due to the modest number of trips changing from private car to buses.

The following lessons can be highlighted:

- The actual implementation of innovative measures requiring physical interventions in the public space with significant public investment require to build up in advance strong support among decision makers and potential beneficiaries.
- Such support seems more difficult to build up in the case of tangential corridors, like this one, in which in contrast with traditional radial corridors, there is a lack of a clear image and most users only travel on a short section of it.
- Tangential corridors also seem to offer less potential for modal change from private cars. Accordingly, the emissions saved by the implementation of such corridors are not significant, and cannot justify on their own the substantial resources required.
- Car restrictions on the corridor are likely to significantly improve the performance of such measures: on the one hand, encouraging more car users to look for sustainable mobility alternatives; on the other hand, by reducing the road space required in the corridor, and the investment resources to be mobilised.

A. Introduction

A.1 Expected results of the measure

The measure is included in the long-term vision of the public transport system envisaged in the regional Transport Plan (*Strategic Sustainable Mobility Plan of the Madrid Region, Vision 2025*), and is consistent with the municipality's plans on Air Quality and Sustainable Urban Mobility. These plans include the implementation of segregated bus lanes in the peripheral districts. Specifically, the development of a tangential, high level of service public transport (PT) corridor linking the southern and eastern peripheral districts of Madrid.

The measure is expected to provide a higher quality bus service in the peripheral demo area of Madrid, and will implement a pilot section at least 3.6 km long. The measure will be critical for the subsequent design and implementation of the whole corridor.

The measure's objectives can be summarised as follows:

(4) City policy level in perspective of CIVITAS goals/ longer term:

At the city policy level, the measure will develop some of the actions envisaged in the city's Air Quality Plan (2017) and Sustainable Urban Mobility Plan (2013) in what refers to the expansion of the bus network in peripheral districts.

The measure will therefore contribute to the city-level objective of increasing modal share for public transport (PT) and to the objectives of the Air Quality Plan to reduce emission levels and improve air quality.

(5) Strategic level:

At the strategic level, the measure will facilitate the identification of the best design and operational options to improve the efficiency of the bus service (by increasing commercial speed and bus regularity levels), to increase public transport patronage and reliability, to increase the environmental performance of the bus fleet and, overall, to implement a new and more attractive public transport service, more competitive with private car use.

(6) Measure level:

The measure is expected to increase bus patronage in the pilot section as a result of a gain in commercial speed (10%, reaching over 13 km/h), and regularity levels (by 9%, reaching an average level of 94%).

A.1.1 Quantifiable impacts

The measure is expected to achieve the following quantified impacts:

- An increase in bus patronage.
- An increase in commercial speed in the pilot section (by 10%, reaching over 13 km/h).
- An increase in reliability (regularity) levels (by 9%, reaching an average level of 94%).
- To contribute to the city level objective of increasing modal share for PT.

- To contribute to the Air Quality Plan objectives to reduce emission levels and improve air quality.

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	To increase bus patronage [no quantitative target]	X									
2	To increase commercial speed in the selected sections by 10%, reaching 13 km/h	X									
3	To increase regularity levels (by 9%, reaching an average of 94%)	X									
4	To contribute to the city level objective of increasing modal share for PT by 4%	X									
5	To contribute to the air quality plan objectives to reduce emission levels and improve air quality [30% reduction in energy consumption and emissions]		X								

Table 1: Quantifiable impacts.

A.2 Measure description

This measure provides a first step towards the implementation of corridors served by buses with high level of service (BHLS) in Madrid. The measure was expected to develop the theoretical concept and implement it in a pilot construction project covering a 3.6-km section connecting the living lab with the districts of Moratalaz, San Blas-Canillejas and Ciudad Lineal, in the northeast periphery. The new corridor includes connections to intermodal nodes, facilitating convenient modal transfer among public transport services, and would be further expanded in the future towards the north and south, in accordance with the Regional Sustainable Urban Mobility Plan (Vision 2025, see figure 3).

Initially, the measure was expected to explore different options for segregation (physical/flexible/virtual), priority (using IT tools) and enforcement (IT tools/video cameras). Once the conditions in the pilot section were analysed, the options were narrowed to different lane segregation solutions in the construction project, as well as bus stops able provide boarding times in line with the high level of service standards.

Several bus lines currently serve totally or partially the 3.6 km section targeted by this measure, but none of them covers the full corridor, as envisaged in Vision 2025. With the implementation of the pilot section, these lines were analysed, in order to decide whether to keep them following the same routes and schedules, or to replace at least some of the services on the pilot section by a new express line, covering the whole 3.6 km route.

The construction project was finished and delivered by the consultants in September 2018. It provides a complete redesign of the cross section of the corridor, including reserved bus lanes and bike lanes, and re-arranging on-street parking. However, the implementation of the pilot section as defined by the consultants within ECCENTRIC was considered as not feasible by the city council, as explained in more detail below. Accordingly, the scope of the final demonstration stage of this measure changed, refocusing on interaction with the residents and corridor users in order to better analyse their preferences concerning the corridor and the extent to which the concept developed by the consultant meets their needs and priorities. In

this way, ECCENTRIC will contribute to a more detailed review of the feasibility of implementation of the BHLS service in tangential corridors in Madrid.

A.2.1 Measure outputs

This measure initially expected to provide the following outputs:

- A preliminary study with different solutions for high-level-of-service bus corridors in the eastern periphery of Madrid (including the northern part of the project living lab).
- A construction project for the implementation of a pilot 3.6-km section. This first section could be the starting point of a future longer corridor.
- The construction and operation of the pilot section, based on the construction project (including rearrangement of cross-road; parking facilities; new signals; adapt bus stops; and connection with other intermodal PT facilities).
- Operation of bus lines on the new corridor.
- Monitoring of performance of the pilot section.

The construction of the pilot section in 2019 has been dismissed by the City Council, as it does not fit with its current priorities in the allocation of its budgetary resources. Therefore, the scope of the measure has been changed by the partners involved, and will now include the following output:

- A stated-preference survey of the design solutions provided by the construction project (the 3.6 km section was divided into 9 sections), addressed to both, residents and corridor users. This survey is expected to provide more robust evidence for the City Council to take a decision about the soundness of the concept and the subsequent allocation of resources for its completion.

The figures below show the pilot stretch and one of its cross-sections.



Figure 1: Section of the corridor serving Vallecas

Figure 1 provides the general layout of the 3.6-km section between the crossing of calle Pablo Neruda and Avenida de la Albufera in the south and Plaza de Alsacia in the north and the nine sub-sections considered.

Figure 2 provides the street cross-section of the corridor in one of the nine stretches. In this case, the new section would include for each direction, one bus lane, one lane for bikes and vehicles (maximum speed 30 km/h) and one standard lane (maximum speed, 50 km/h). In other stretches the design is modified, sometimes including segregated bike lanes, and sometimes including on-street parking.

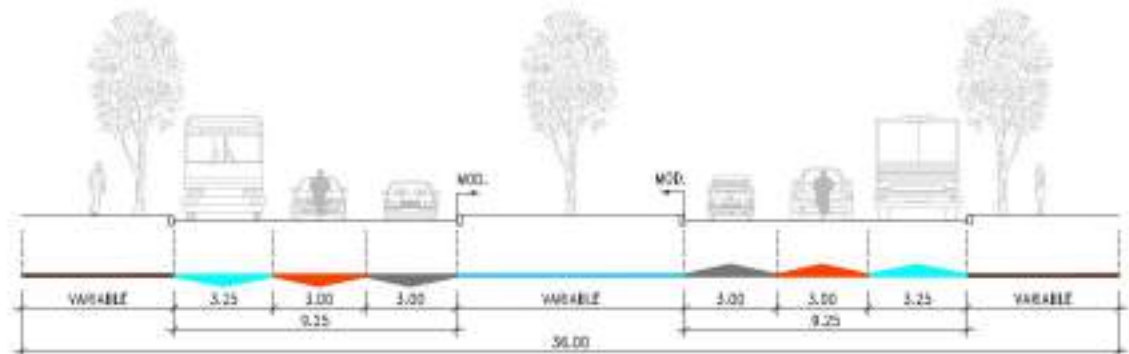


Figure 2: Section of the corridor serving Vallecas

The figures below provide the routes served by the bus lines (140, 142, 144, 100 and E4) that would make use of the corridor.

Bus line 100 includes the northern part of the pilot corridor until plaza Alsacia (crossing with *Avenida de la Institución Libre de Enseñanza*), and then continues further north until Canillejas.

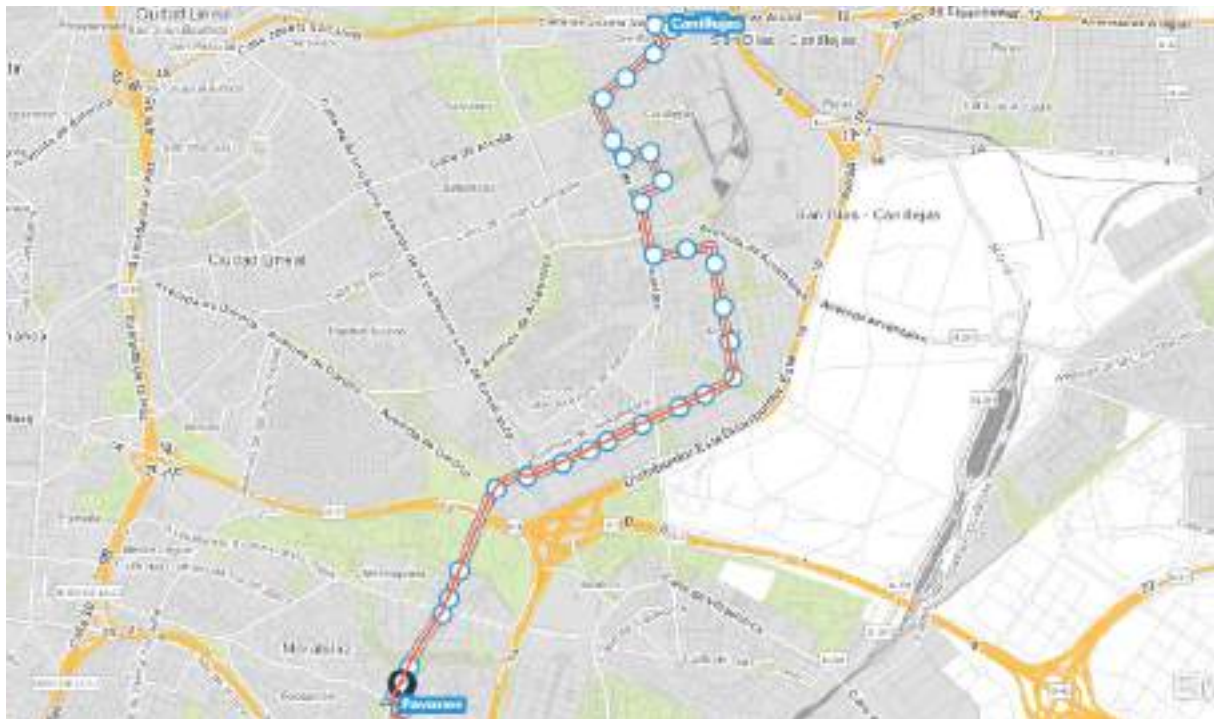


Figure 3: Bus line 140 route

Bus line 142 includes the southern section of the corridor, between *Pavones* and *Avenida de la Albufera*. It continues to the east of the living lab, reaching *Ensanche de Vallecas* metro station.

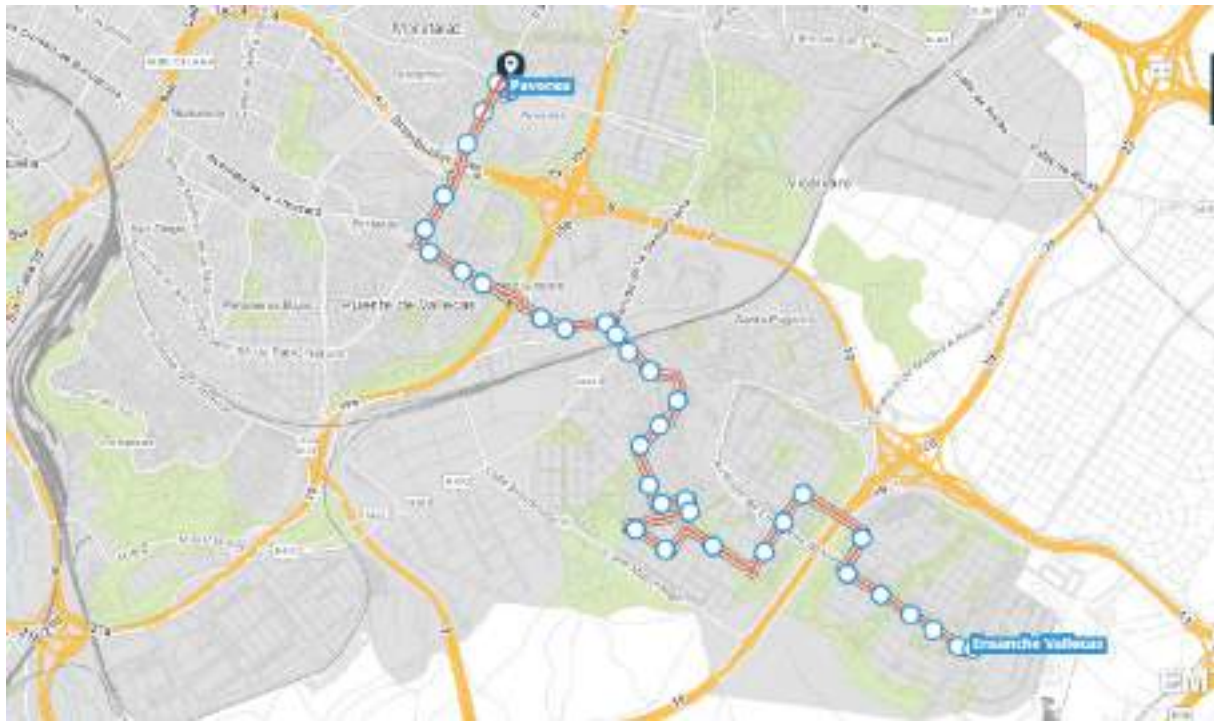


Figure 4: Bus line 142 route

Bus line 144 includes most of the southern section of the corridor also covered by line 142, and continues to the east of the living lab, to reach *Entrevías* railway station.

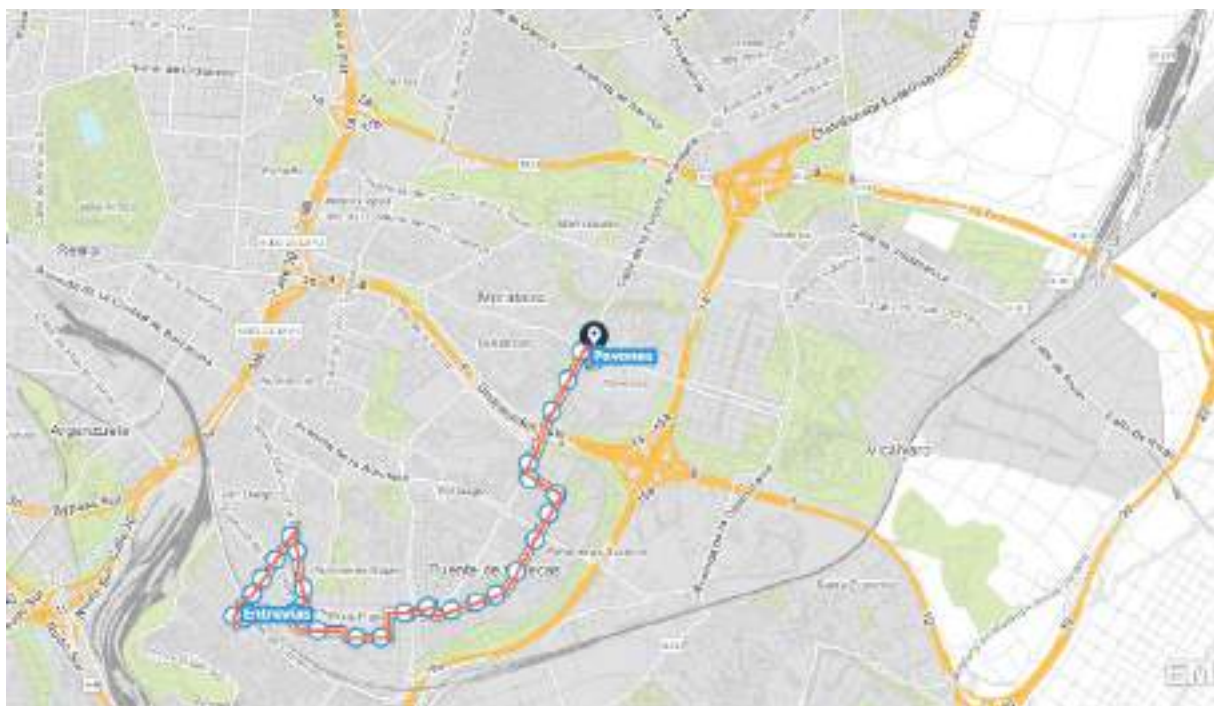


Figure 5: Bus line 144 route

Bus line 100 is a radial line within Moratalaz district, at the north of the living lab. It only makes use of a short section of the future corridor and does not properly provide tangential north-south connectivity.

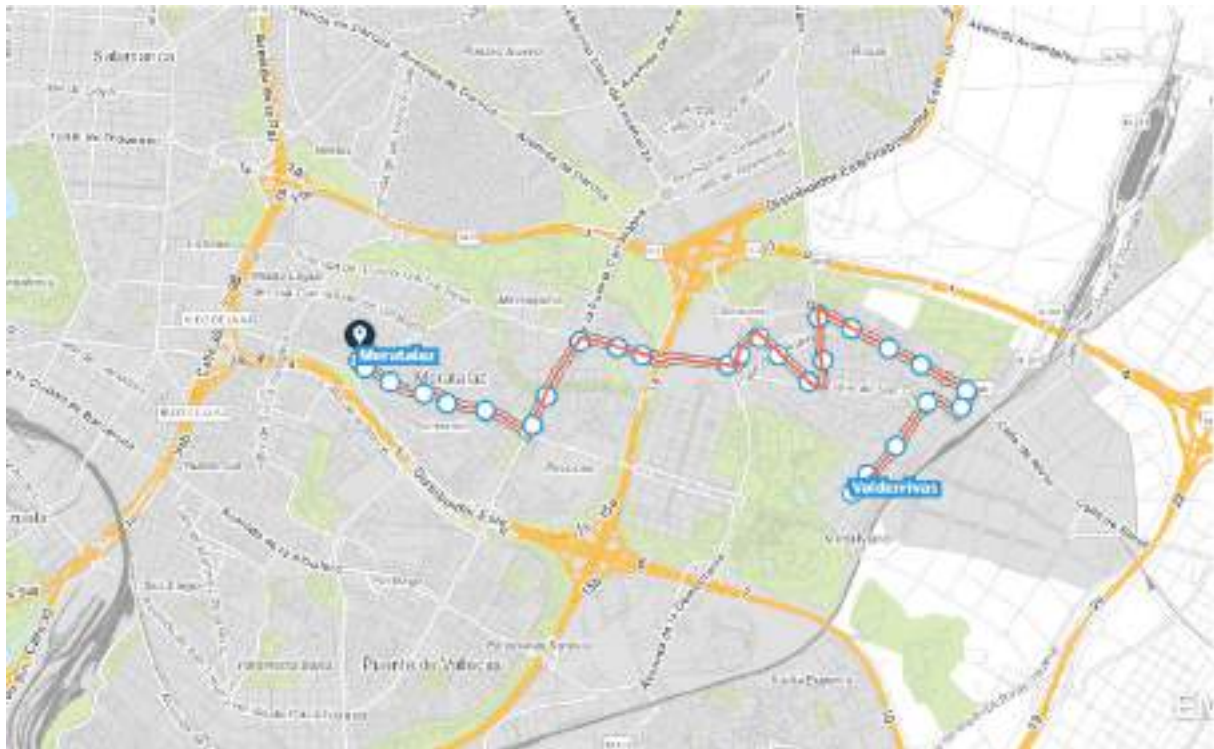


Figure 6: Bus line 100 route

Express bus line E4 is also a radial line, connecting Pavones with the central districts. It serves the northern part of the future corridor, although it does not reach its northern limit at *Plaza de Alsacia*. Express bus lines in Madrid only serve a few of the bus stops in their itinerary.

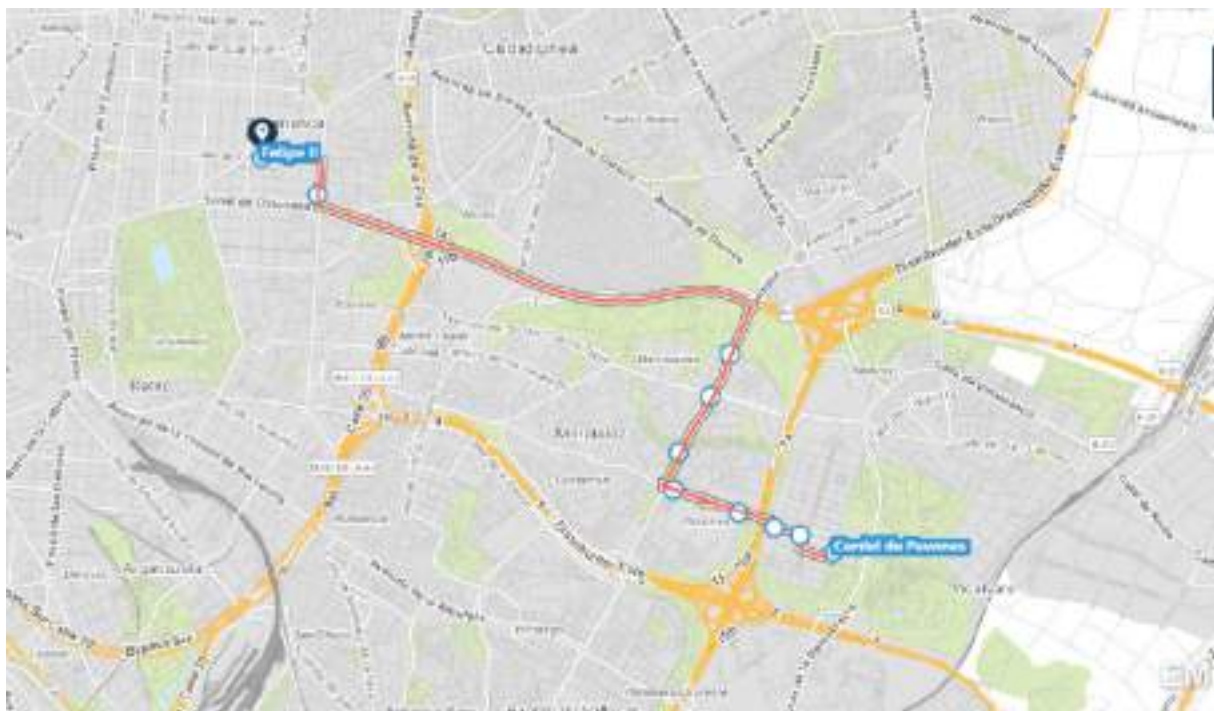


Figure 7: Express bus line E4 route

A.2.2 Supporting activities

No supporting activities outside ECCENTRIC have been identified for this measure.

A.2.3 Interactions with other ECCENTRIC measures

Initially, it was envisaged that the buses serving the measure MAD 5.1 corridor would include 6 hybrid buses from measure MAD 5.8. Once the decision to build the corridor was dismissed, measure MAD 5.8 was decided to carry out its demonstration in bus line 140, which follows a part of the pilot section.

A.2.4 Interactions outside ECCENTRIC

The *Strategic Sustainable Mobility Plan of the Madrid Region, Vision 2025* includes the expansion of the bus-lane network, implementing segregated bus lanes in the urban periphery. This measure is also included in the recent Air Quality Plan (2017) and in the Sustainable Urban Mobility Plan of the city (2013). The proposal is to implement transversal bus lines in order to connect peripheral districts among them. This proposal is likely to be revised in the context of the update of the SUMP the city launched in the fourth quarter of 2018 and expected to be published in 2020.

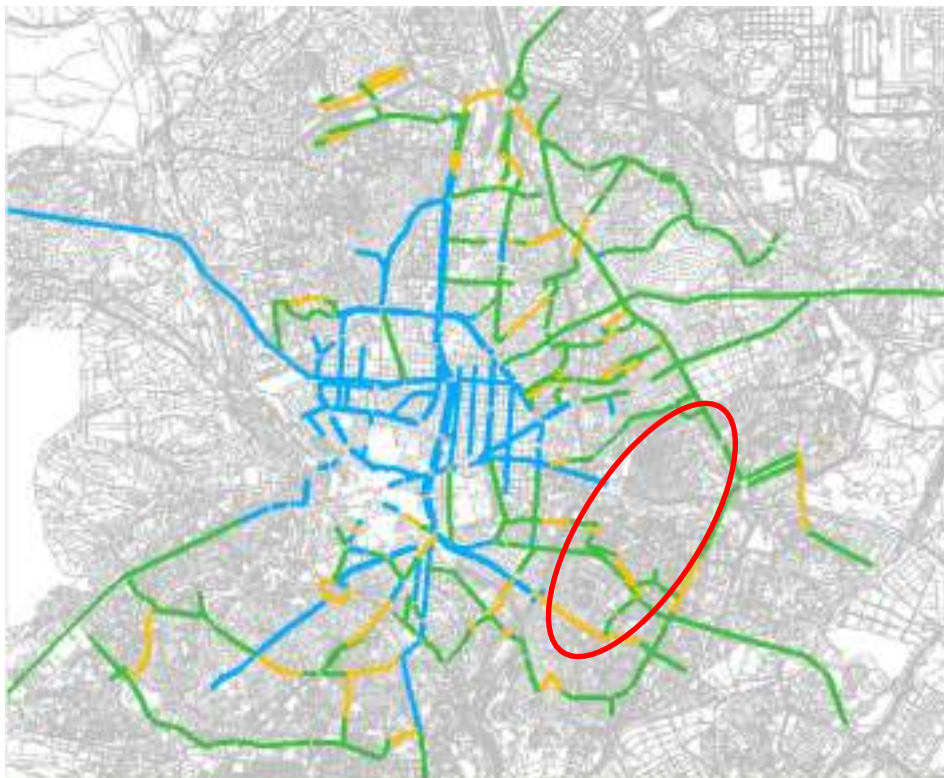


Figure 8: Expansion of the bus lane system (Vision 2025)

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents in Vallecas and Moratalaz districts		The corridor will connect the districts of Vallecas, San Blas Canillejas and Ciudad Lineal through the district of Moratalaz, all of them in the Eastern periphery of Madrid
2	Public transport users		

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PTA-PT-KI- NG-PR-other	Level of activity L-P-O	Role - Links
	CRTM. Director of strategic planning and operations	P	PTA	P	
	CRTM. Head of planning, studies and projects	P	PTA	P	
	CRTM. Development and strategy coordinator. Head of urban bus services	P	PTA	P	
	CRTM. External affairs department	P	PTA	P	
	City Councillor. Vallecas district	P	C	O	
	City Councillor. Environment and mobility	P	C	O	
	City Councillor. Sustainable urban development	P	C	O	
	City Council. Director General. Urban regeneration strategy	P	C	O	
	City Council. Director General. Traffic management	P	C	O	
	City Council. Deputy Director General. Mobility implementation and Transport	P	C	O	
	Local police	P	C	O	
	Foro local Puente de Vallecas	O	O	O	
	EMT. CEO	P	PT	O	
	EMT. Director of transport services	P	PT	P	
	EMT. Consultancy and communications department	P	PT	P	
	Neighbourhood association A.V. Puente de Vallecas	O	NG	O	
	Neighbourhood association A.V. Madrid Sur	O	NG	O	
	Fundación ONCE	O	NG	O	
	Political parties in the city-lab: PP	O	Other	O	
	Political parties in the city-lab: PSOE	O	Other	O	
	Political parties in the city-lab: C's	O	Other	O	
	CRTM. Measure leader	P	PTA	L	
	EMT. Measure partner	P	PT	P	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PTA Public Transport Authority - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders and other relevant agents

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Delays in delivery of the construction project	Organizational	Review CRTM internal procedures	CRTM
Delays in approval of construction works	Organizational	Review City internal procedures	Madrid City Council
Approval and operation of new bus line	Organizational	Exploitation with already existing lines	CRTM, EMT

Table 4: Identified risks.

B. Measure implementation

B.1 Situation before CIVITAS

Currently, standard PT bus services in the peripheral districts of Madrid run at speeds below the city average, due to traffic congestion and illegal parking. As the time a bus is stopped waiting for a green light is approximately 25% of its journey time, there is a significant potential to increase commercial speed through traffic light optimisation.

Most of the urban bus lines in the city's bus network provide radial connections to the city centre; the few tangential lines connecting peripheral areas among them are not provided with reserved bus lanes protecting them from traffic congestion; frequent stops at traffic lights in these districts also result in a decrease in commercial speeds.

In September 2019, detailed information was collected on bus demand in the corridor. The tables below provide information on bus demand and average travel speed on the corridor. Out of the 37,909 daily users, 79,.5% were women and only 20.5% men.

Bus line	Date	Demand (pass/day)
140	24-09-19	2,850
142	25-09-19	9,767
144	26-09-19	8,926
E4	27-09-19	9,098
100	30-09-19	7,268
Total		37,909

Table 5: Daily bus demand (passengers/day, September 2019)

Data on average bus speed showed low values even outside congested peak hours (below 14.5 km/h); this is due to the relatively high number of bus stops in the corridor, and limits the potential of speed improvements, even if a reserved bus infrastructure were implemented.

	Northbound		Southbound	
	Section I (North)	Section II (South)	Section I (North)	Section II (South)
6:00 - 7:00	10,36	12,90	11,57	11,56
7:00 - 8:00	10,27	13,15	11,33	12,45
8:00 - 9:00	10,28	11,89	9,26	13,29
9:00 - 10:00	12,82	11,98	12,95	11,66
10:00 - 11:00	13,30	11,51	11,84	11,20
11:00 - 12:00	10,87	11,60	11,77	11,66
12:00 - 13:00	14,14	13,11	11,44	13,32
13:00 - 14:00	10,09	12,90	11,56	10,86
14:00 - 15:00	12,91	12,85	13,48	12,83
15:00 - 16:00	11,83	12,84	13,54	12,69
16:00 - 17:00	11,92	12,49	13,14	12,29

17:00 - 18:00	13,22	13,42	13,41	11,94
18:00 - 19:00	11,05	13,01	13,18	11,51
19:00 - 20:00	10,47	13,25	10,91	12,37
20:00 - 21:00	11,48	14,46	10,68	10,52
21:00 - 22:00	13,77	13,18	11,31	13,13

Table 6: Average bus speed on the corridor (km/h, September 2019)

General traffic speed remains attractive, even at peak hours in the whole corridor, suggesting that a reduction in capacity to accommodate the new bus infrastructure could be undertaken without significantly impacting on general traffic, especially considering that most of it makes use of the corridor for a short section only, in their way to and from higher capacity roads.

	Northbound		Southbound	
	Section I (North)	Section II (South)	Section I (North)	Section II (South)
6:00 - 7:00	32,96	26,95	36,20	27,62
7:00 - 8:00	33,74	24,70	31,89	29,50
8:00 - 9:00	32,22	25,88	31,94	30,65
9:00 - 10:00	32,81	26,07	30,34	30,36
10:00 - 11:00	35,02	27,49	32,46	28,40
11:00 - 12:00	33,79	26,94	35,03	28,70
12:00 - 13:00	32,21	29,76	30,74	28,49
13:00 - 14:00	32,37	24,71	34,05	29,37
14:00 - 15:00	30,04	25,81	29,02	28,27
15:00 - 16:00	32,71	23,91	29,27	27,49
16:00 - 17:00	31,60	26,90	28,25	29,04
17:00 - 18:00	30,20	27,07	28,92	29,22
18:00 - 19:00	33,10	29,07	29,65	27,00
19:00 - 20:00	31,80	25,54	33,38	28,74
20:00 - 21:00	32,12	24,61	33,59	26,42
21:00 - 22:00	35,56	28,93	32,62	24,75

Table 7: Average general traffic speed on the corridor (km/h, September 2019)

Traffic counting was done at 8 spots within the corridor, as shown in the figure below. Traffic counts in all these spots showed a strong morning peak, between 8 and 9 am and a less-marked evening peak, between 18:00 and 19:00. Morning and evening peak values are presented in the table below.

Traffic counting spot #	Northbound		Southbound	
	8:00 – 9:00	18:00 – 19:00	8:00 – 9:00	18:00 – 19:00
1	739	502	561	886
2	1320	763	1090	1530
3	1195	521	695	814
4	1095	523	654	870

5	1258	607	569	997
6	2386	809	1180	1824
7	3071	1502	1353	2407
8	3247	1810	1407	2412

Table 8: Peak-hour traffic in the corridor (vehicles/hour, September 2019)

The traffic volumes decrease from the north to the south of the corridor. The morning peak is more relevant in northbound traffic, whereas the evening peak is more relevant in southbound traffic.



Figure 9: Traffic counting spots in the corridor (September 2019)

Traffic conditions were analysed with the support of a VISUM model. The analysis concluded that most of the vehicles driving on the corridor only use a section of it; this is to say that users prefer to access or exit the area served by the corridor using the motorways surrounding it (A-3, M-23 and M-40) as a more convenient way to reach their destinations in the districts of Moratalaz and Vallecas; only a negligible fraction of the traffic on the corridor makes use of its full length.

B.2 Innovative aspects

The innovative aspects in this measure initially referred to the solutions analysed for segregation, control and enforcement of the bus lanes. After the completion of the construction project, the scope of the measure changed: no innovative measures regarding segregation, control and enforcement were included in the final design retained in the construction project. The innovative aspects could have focused on the identification and assessment of the residents' and users' acceptance of the concept in the wider context of their preferences and expectations for the corridor; however, these aspects were considered as too difficult to be identified in detail with the resources available, and final data collection was limited to a traditional survey.

B.3 Research and Technology Development

There are no specific research and technology developments within this measure.

B.4 Actual implementation of the measure

The pilot section was selected at the start of the ECCENTRIC project based on pre-existing feasibility studies. The section would cover Fuente Carrantona and Pablo Neruda streets, from Alsacia Square (north) to the intersection of Pablo Neruda Street and Av. de la Albufera (south), with a total length of 3.6 km, within the Districts of Moratalaz and Puente de Vallecas.

The construction project was finished in September 2018. It included bus lanes, cycling lanes and the relocation of parking places in nearby areas, where necessary. CRTM, the measure leader, forwarded this project to the municipality for its final approval and inclusion in the annual budget, so that the municipality could contract out the construction works during 2019. However, the municipality was not convinced to give the necessary priority to this project, and decided to postpone its consideration until the SUMP had been revised (the revised SUMP is expected to be presented in 2020).

In accordance with these decisions, the ECCENTRIC measure team decide to dedicate the resources initially budgeted for the implementation stage to a detailed analysis of the corridor, including the users' and residents' practices and priorities; this detailed analysis was expected to provide a better understanding of the lack of priority given by the local decision makers to the implementation of the priority corridor, and to provide lessons for better considering these issues at the initial stages of project design of such corridors. The study was completed in December 2019.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	4	1	2,3		5
Name	Modal shift	System usage	Commercial speed	Satisfaction	CO ₂ Emissions
Type	KPI	KPI	KPI	KPI	KPI
Category	Transport system	Transport system	Transport	Society	Environment
Subcategory	General	General	Public transport	Acceptance	Pollution and nuisance
Aspect	Modal split	Transport system utilisation	Quality of service	Fulfilment of expectations	CO ₂ Emissions
Definition	Number of bus users that have changed from another mode	Number of bus users	Average journey speed within the section with new reserved lanes	Users' reported satisfaction with the improved service	Emissions saved by change of mode
Unit	Number of trips	Number of trips	km/h	Score (1-5)	tons / year
Method of data collection	Survey to bus users; demand studies	EMT system (ticket sales) or boarding/alighting counts	EMT bus tracking system	Survey to bus users; demand studies	Estimates from survey results on modal shift
Target group	Users of buses in the corridor	Users of bus lines making use of the corridor	Buses on the corridor section	PT users of city lab residents	PT users of city lab residents
Domain	Corridor with reserved bus lane	Bus corridor with reserved lane in the demo area	Bus corridor with reserved lane in the demo area	Bus corridor with reserved lane in the demo area	Bus corridor with reserved lane in the demo area
Control sample	No	A pool of reference bus lines in the city	No	Standard buses on the pilot section	Standard buses on the pilot section
Related measures,	None	Socio-economic changes	None	Measure MAD 5.8	Measure MAD 5.8

activities, and interference sources		affecting bus patronage in the city			

Table 9: Description of key performance indicators (KPI)

The expected impacts of the measure include:

- To improve the efficiency of public transport, by increasing commercial speed and the regularity (schedule compliance) of bus services.
- To increase the use of public transport usage and the reliability of public transport services in the pilot corridor.
- To increase the environmental performance of the bus fleet.
- To achieve a new more attractive offer of public transport services, in order to compete with private car use.

Impact	5	5		
Indicator name	NOx Emissions	PM Emissions	Investment costs	Operational costs
Type	KPI	KPI	KPI	KPI
Category	Environment	Environment	Economy	Economy
Subcategory	Pollution and nuisance	Pollution and nuisance	Costs	Costs
Aspect	Emissions	Emissions	Costs	Operating costs
Definition	Emissions (t per year of NOx) saved by change of mode to cycling	Emissions (t per year of PM) saved by change of mode to cycling	Total capital cost for implementation of the corridor	Average operating costs in the corridor
Unit	tons / year	tons / year	EUR	EUR/veh-km
Method of data collection	Estimates from survey results on modal shift	Estimates from survey results on modal shift	Reports from municipality, EMT, CRTM	Reports from municipality, EMT, CRTM
Target group	PT users of city lab residents	PT users of city lab residents	Bus lines making use of the corridor	Bus lines making use of the corridor
Domain	Bus corridor with reserved lane within the demonstration area	Bus corridor with reserved lane within the demonstration area	Pilot corridor section within demonstration area	Pilot corridor section within demonstration area
Control sample	Standard buses on the pilot section	Standard buses on the pilot section	No	Standard buses on the pilot section
Related measures, activities, and	Measure MAD 5.8	Measure MAD 5.8	None	Measure MAD 5.8

interference sources				
References				

Table 10: Description of key performance indicators (KPI) (cont.)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
4	Modal shift	Number of trips	A	S	Pilot section bus users	Pilot section
1	System usage	Number of trips	B – A	S	Pilot section bus users	Pilot section
2,3	Commercial speed	km/h	B - A	DC	Pilot section bus users	Pilot section
	Satisfaction	Score (1-5)	A	S	Pilot section bus users	Pilot section
5	Emissions CO2	tons / year	B – A	E	Pilot section bus users	Pilot section
5	Emissions NOx	tons / year	B – A	E	Pilot section bus users	Pilot section
5	Emissions PM	tons / year	B – A	E	Pilot section bus users	Pilot section
	Investment costs	EUR	A	DC		Pilot section
	Operational costs	EUR/veh-km	A	DC		Pilot section
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 11: Measure's indicators

C.1.2 Baseline

Currently, there are 9 bus lines partially serving some sections of the corridor:

- 140. Pavones – Canillejas.
- 142. Pavones – Ensanche de Vallecas.
- 144. Pavones – Entrevías.
- 100. Moratalaz – Valderrivas.
- E4. Avenida Felipe II – Valdebernardo.
- E2. Avenida Felipe II – Las Rosas.
- 54. Atocha Renfe – Congosto.
- 20. Puerta del Sol-Sevilla – Pavones.

Only the five lines at the top of this list serve a significant section of the corridor, as the others (E2, 20, 54) only follow the corridor for a few meters. A first approach to the expected corridor

demand can be estimated based on the demand of the bus lines mentioned above on a working day. Based on data obtained in September 2019³⁵ (see [Table](#)), the average number of passengers on a working day would be 37,909³⁶.

Current commercial speed, as an average of the commercial speeds of the five bus lines above along the future corridor is 12.0 km/h for southbound services (direction Alsacia-Albufera) and 12.1 km/h for northbound services (direction Albufera-Alsacia). As presented in [Table](#) , there are significant variations in commercial speed along the day, with minimum average values of 10.4 km/h for southbound services and 10.8 km/h for northbound services and maximum values of 13.2 km/h and 13.7 km/h, respectively. Commercial speeds are higher in the southern section of the corridor (Albufera- Doctor García Tapia, 1.3 km long) than in the northern section (Doctor García Tapia- Alsacia, 2.2 km long).

The reliability of bus services in Madrid is monitored through a reliability indicator, providing a weighted average of the number of bus services deviating from the planned schedule by a certain percentage (less than 20%, 20% to 50%, more than 50%). For the baseline, the reliability indicators have been calculated for each line on 23-26 October 2017, as presented in the table below.

Line	R.I. (%)
E4	73.48%
144	71.64%
142	48.24%
140	60.51%
100	84.34%

Table 12: Reliability of bus services

The modal split between private car and buses can be estimated based on the traffic counts and bus demand information collected in September 2019. Assuming an average car occupancy of 1.2 persons/car, the daily transport demand in a working day would be 58,253 car passengers in the corridor section with more traffic. Bus demand would be 37,909 passengers per day (see [Table](#)); private car would cover 42% of motorised trips on the corridor, and buses 58%.

C.1.3 The business-as-usual scenario

In the business-as-usual scenario, it is expected that patronage and service conditions will remain the same as those measured in September 2019.

³⁵ In accordance with CRTM and EMT, these data can be considered as representative for the whole year.

³⁶ Although this is the value to be retained for the baseline, it is worth noticing that this figure could overestimate the corridor demand, as it includes passengers using the 5 bus lines in sections outside the corridor.

C.2 Measure results

As the corridor has not been implemented, measure results can only provide an estimate of what would be expected to happen in the measure has taken place. These results are summarised in the table below.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Modal shift	Trips/day	0	2019	0	2019	1214	2019	1214	1214
System usage	Trips/day	37909	2019	37909	2019	39123	2019	1214	1214
Commercial speed	km/h	9.3	2019	9.3	2019	14.0	2019	4.7	4.7
Satisfaction	Score (1-5)	3.6	2019	3.6	2019	NA	2019	NA	NA
Emissions CO ₂	tons / year	11507.7	2019	11507.7	2019	11135.1	2019	-372.6	-372.6
Emissions NO _x	tons / year	26.38	2019	26.38	2019	26.15	2019	-0.2287	-0.2287
Emissions PM	tons / year	1.10	2019	1.10	2019	1.07	2019	-0.0328	-0.0328
Investment costs	M.EUR	0	2019	0.00	2019	4.25	2019	4.25	4.25
Operating costs	EUR/veh -km	NA	2019	NA	2019	NA	2019	NA	NA

Table 13: Measure's KPI results

As the project has not been implemented, the results presented are based in the study completed by CRTM in December 2019. The potential for modal shift from car use is only 3.2% of the initial bus demand; this is due to the low time savings achieved by the buses, and the lack of restrictive measures to car use (such as reduction in the number of general traffic lanes or in the number of parking places in the corridor). The low time savings achieved are due to the relatively short distances driven on the corridor by the different bus lines (2 km at most of the 3.6-km long infrastructure) and the virtual lack of demand for trips that would make use of the whole north-south connection that could be provided by a new bus line.

There is no difference between the number of trips changing modes from car to buses and the difference between the number of trips served by the various bus lines on the corridor. This is due to the inability of the corridor to induce additional demand, due again to the low number of trips with origins and destinations compatible with the use of the corridor in its full length. However, it has been considered that some induced demand could be generated if an express line, eliminating some of the intermediate stops were created. Based on experiences in radial corridors in Madrid providing such express bus services, it has been estimated that as many as 4,500 to 5,000 daily trips could be added to the corridor; however, as in this case the corridor

is not a radial one and the total travel demand is low, it is uncertain whether that estimate could materialise.

Commercial speed is estimated to increase substantially during the peak hours, reaching a maximum value of 14.0 to 14.5 km/h depending of the trip direction. The relatively high number of bus stops in the 3.6 km section prevents to attain higher commercial speeds.

The current satisfaction of users was measured in September 2019, and yielded a 3.6 average on a 1-5 scale. Obviously, not values can be provided on the “after” situation. A proxy to this indicator has been attempted based on the score bus users provide to the three main objectives of the construction project: increasing bus speed, improving traffic conditions, and improving cycling safety; the average scores provided were respectively: 3.6, 3.5 and 3.4; the support to the construction of a reserved bus lane was 4.3. These results suggest that an increase in satisfaction of 0.1 to 0.7 points could be expected in case the project were built.

The emission reduction expected is low, compared to the investment mobilised, due to the modest number of trips changing modes.

The estimated investment cost for the construction of the corridor is €4.25 million. Operational costs were not expected to change significantly, as the speed increase is not too significant and the additional demand does not require to introduce additional buses. Estimates for the introduction of an express line have not been provided.

C.3 Summary: achievement of objectives

As the infrastructure has not been constructed and operated, the measure’s objectives have not been achieved. However, it is still possible to discuss whether these objectives could have been achieved, taking into consideration the new evidence provided by the survey completed in September 2019 and the technical study delivered by CRTM in December 2019. These conclusions are summarised in the table below.

No.	Objective and target	Rating	Comment
1	To increase bus patronage [no quantitative target]	O	probably ★★ if implemented
2	To increase commercial speed in the selected sections by 10%, reaching 13 km/h	O	probably ★★★ if implemented
3	To increase regularity levels (by 9%, reaching an average of 94%)	O	probably ★ if implemented
4	To contribute to the city level objective of increasing modal share for PT by 4%	O	probably ★ if implemented
5	To contribute to the air quality plan objectives to reduce emission levels and improve air quality [30% reduction in energy consumption and emissions]	O	probably O if implemented
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded			

Table 14: Achievement of measure’s objectives

The first measure’s objective was to increase bus patronage. In accordance with the CRTM’s study, the implementation of the measure could add 1,214 additional bus trips per day in the corridor, from former car users. Furthermore, the study suggested that the total number of additional bus trips could increase to 6,000 or even 6,500 if an express line- with less intermediate stops than existing services- were implemented. However, the rationale for this last figure was not sufficiently justified in the study and, in fact, it is contradictory with other

information provided in the study, mainly the low number of trips making use of the whole future north-south corridor and of the pilot section.

The second objective was to increase commercial speed in the pilot section, reaching 13 km/h. The CRTM's study confirmed that commercial speed could reach at least 14 km/h if the project is implemented.

The third objective refers to the improvement of the regularity level (i.e. schedule compliance) for the bus lines making use of the pilot section. The CRTM's study does not provide a specific review of this issue. Although the measure would make it possible to achieve a homogeneous commercial speed in the pilot section, this section only covers a fraction (25% in the best case) of the whole length of the bus lines making use of the corridor. Moreover, peak hour traffic congestion is not limited to the pilot section, but also to other parts of those lines. For these reasons, it is considered that the implementation of the measure would have been able to increase regularity levels only partially, and not to the whole extent initially envisaged.

Concerning modal split, the 1214 daily trips changing from private car to bus in accordance with CRTM's study represent 3.2% of the daily motorised trips making use of the pilot section, close to the 4% target stated by the project for this objective.

The last measure's objective refers to the improvement of air quality. In accordance with the estimates made during the measure evaluation, the emission savings are far below the 30% target of the project of this objective.

C.4 Up-scaling

There are no concrete plans for scaling up this measure. On the one hand, there is no evidence that the municipality has changed its previous position concerning the implementation of this corridor. On the other hand, there have not been actions to push forward any of the other bus corridors identified in the 2013 local SUMP and regional SUMP.

The context could change once the current revision of the SUMP is completed, which is expected to happen in 2020.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

Three main deviations from the original plan occurred during the design and implementation stages. The first and more relevant one was the decision of the municipality to not undertake the construction works for the pilot section. The second one was the decision to move the pilot section from the original location within the living lab to its current one, located mostly in the neighbouring district of Moratalaz. The third one referred to the lack of inclusion of some innovative components (for segregation and control of the bus lanes with ICT-related technologies) in the measure.

D.1.1 Pilot section not constructed

At the time the City Council was preparing its 2019 budget (last quarter of 2018), the construction of the project was dismissed, to the benefit of other actions in the city considered as more relevant. The project had been given a low priority assessment by key local stakeholders compared to the many needs in the affected neighbourhoods. It is worth noticing the City Council was under budgetary pressure due to the restrictive investment regulations imposed on municipalities but the national government to comply with the European austerity policies.

Nevertheless, this measure remains relevant, as it is a section for the future public transport East Transversal Corridor envisaged in the regional (Vision 2025) and municipal SUMPs, both prepared in 2013. The municipal SUMP is currently under revision, and this revision- expected to be completed in 2020- could include this project within the review and update of the full network of bus corridors foreseen in 2013.

The design and implementation process have been considered as very useful to identify the weaknesses and strengths in the existing decision-making process. Among the lessons learnt, it is worth highlighting the following ones:

- As in many other public policy areas, it is necessary to take into consideration the complexity of the affected area. Whereas the bus corridor would have a positive effect on the mobility of residents, it seems that they have other priorities, and would prefer that the municipality's investments in their neighbourhoods be spent in actions outside the mobility realm.
- Whereas implementing a segregated platform without interfering with the general traffic is tempting, in terms of avoiding controversies and opposition, it results in significantly higher investments, which cannot be easily justified by the improvements achieved in bus operations. Furthermore, enjoying the same street space, car users are unlikely to consider to change their modal choice.
- It could be claimed that earlier involvement of local stakeholders (residents, district technicians, associations, politicians...) could have anticipated the limited support they

provided to the measure, cancelling it at an earlier stage. However, and based on past experience, it was decided that wider participation should be made only once a clear picture of the project could be provided. The measure reports for this measure state that the final agreement regarding the specific section of the corridor to be projected, based on the different options, was time-consuming, reducing the time available for drafting the construction project, compared to the initial work plan, in order to meet the ECCENTRIC project deadlines. That is the reason why the measure team could not carry out a broad participatory process, as it would have desired. In fact, the cost and efforts for preparing the construction project can be considered as limited (less than 2% of the anticipated construction costs) and the project has been useful for key local stakeholders to postpone its construction.

- On-street parking in the arteries and main streets of densely populated neighbourhoods is highly popular, and for many residents it contributes to their liveability. So one of the main requirements for drafting the construction project has been to avoid the loss of parking spaces, at least in the most critical sections. Therefore, options to provide a bus lane have considered how to make it compatible with on-street parking, projecting new parking lots in the area. This has increased the construction budget.

D.1.2 Pilot section moved from the living lab to Moratalaz district

This decision was taken at the initial design stage, based on the technical difficulties and high costs to complete the southern part of the corridor in the living lab (connection of Vallecas with the neighbouring district of Villaverde), and the higher number of buses making use of the new section.

D.1.3 Innovative components not considered

The initial measure description included the consideration and analysis of “different options for segregation (physical/flexible/virtual), priority (using IT tools) and enforcement (IT tools/video cameras). These elements were not subsequently included in the construction project developed by the measure team; based on the experience in Madrid with priority bus lanes and the perceived challenges in the corridor, the project team preferred to adopt a more conventional solution for the bus lane (physical segregation following the city standards and no IT tools for priority management and enforcement), and to dedicate its efforts to the inclusion of a cycling lane within the corridor.

D.2 Barriers

The following top barriers were identified in the process evaluation report.

D.2.1 Political barrier

This barrier refers to the lack of sufficient commitment and support from local and regional policy makers, and other key agents. In fact, this was a critical barrier ECCENTRIC could not cope with. It made clear that the bus corridor network concept developed by the regional and local SUMP in 2013 needed to be reconsidered, as it was not receiving the high support that had been assumed at that time.

The insufficient support this ECCENTRIC measure received reflects some mismatch between the transport planning process in 2013 and the stakeholders’ views five years later. Based on

the exchanges with the measure team, it could be suggested that there have been significant changes in Madrid since the time this action was included in the Local and Regional SUMP (in 2013) at three levels: transport planning priorities, availability of public funding, and the public's perception.

The transport infrastructure investment effort was very relevant in Madrid until the 2007 economic downturn, and at the time there was scarce criticism to public transport infrastructure improvements among political, economic, and social stakeholders. Possibly, the local and regional SUMP in 2013 still participated of that planning optimism, and the bus corridor (which is part of a whole network of bus corridors in the city) was included in the plan without sufficient verification of their pros and cons, and actual support among stakeholders. These stakeholders would have become more cautious about the virtues of such concepts since then.

The availability of public funding for transport infrastructure investments in Madrid was dramatically reduced since 2013, when new legislation was passed reducing the capacity of the city and the region to dedicate their resources to new investments until certain targets in the reduction of their debts were achieved. These measures have affected particularly the municipality, and has increased the internal scrutiny and debate about the projects to be funded. In this context, it seems that the new bus corridor did not gain sufficient support within the municipality structures.

D.2.2 Participation and involvement barrier

The measure team decided to follow the usual design and implementation procedure for transport infrastructure in the city. Assuming that the general concept had already been submitted to public participation in the context of the 2013 local SUMP approval process, it was decided that public participation would take place once the construction project documents had been completed. As the municipality did not move forward these documents for budget approval, the public participation stage never took place.

Subsequently, the measure team decided to undertake a survey that could provide insights on the preferences of residents and transport users. This survey was completed in September 2019, and its main conclusions have been presented in previous sections of this report.

Although the public's response to the measure concept is positive, in accordance with the survey, it did not receive the high scores that would correspond to a public action meeting urgent and widespread-perceived needs. This could be associated to the effects of the economic downturn, that may have changed the public's views and priorities. Whereas new public transport infrastructures had received wide popular support in the past, the deterioration of some key public services (education, health, public spaces...) have possibly changed the views of the public. The public may have experienced significant changes in terms of general priorities and of demand behaviour, making the bus corridor of secondary relevance for them.

D.3 Drivers

The three main drivers identified during the process evaluation of this measure are presented below.

D.3.1 Planning driver

The measure was building upon the bus network concepts included in the 2013 local and regional SUMP, and the technical feasibility studies already undertaken in the past by CRTM and EMT regarding the improvement of bus services through the implementation of dedicated infrastructure. As discussed in the barriers section, the ECCENTRIC project may not have assessed properly the relative obsolescence of those plans five years later, and the impact the economic downturn had had in public finances and in the perception of public priorities by decision-makers and the public.

D.3.2 Cultural driver

The measure benefited from the strong cultural know-how in CRTM and EMT. Indeed, the experience and commitment of the CRTM and EMT staff participating in the measure team was instrumental to complete the construction project documents within tight deadlines.

D.3.3 Institutional driver

The key transport institutions at the regional (CRTM) and local (EMT) levels provided a strong support to the bus corridor concept. However, this institutional support was insufficient to convince decision-makers at the municipality to provide the necessary resources for its construction. This suggests that an earlier interaction of ECCENTRIC with these decision-makers in charge of budgeting and project prioritisation would have been fruitful, either to detect that the bus corridor would not be implemented and dedicate the resources to an alternative bus-prioritisation measure, or to convince these decision-makers about the virtues of the project and to integrate their concerns (e.g. on the budget actually available for construction) within the design stage.

D.4 Supporting activities

No supporting activities have been undertaken during this reporting period.

D.5 Recommendations on the implementation process

Two main recommendations are worth being highlighted from the implementation process: the first one relates to the involvement of decision makers; the second one, to the public's involvement in the process.

D.5.1 Involvement of decision-makers

The involvement of decision-makers is particularly complex when the measure includes physical interventions with relatively high investments. Besides the decision-makers involved in local mobility policy, it is likely that decision-makers from the financial area and even from other areas unrelated to transport will have a say in the internal debate on the allocation of resources among competing policies and actions. For this reason, it seems that the early involvement of these decision-makers is necessary in order to get their views on the measure's

contents and potential impacts: this could facilitate the adaptation of the measure to the decision-makers' priorities, so that it can be financed, or to dismiss the measure if the technical team is unable to gain the necessary support, avoiding the waste of resources in further developing a project that has no chance to be financed.

Such involvement is associated with a broader view of the project, compared to other policies outside the transport sector that could be implemented in the targeted area. To facilitate such comparison, it seems necessary for transport professionals to gain a wider understanding of the general priorities at stake in the area, beyond mobility issues, and to provide adequate information to all decision-makers about the mobility proposal at stake. This is linked to the next recommendation below.

D.5.2 Assessing the public's actual support

The implementation of policy actions, particularly when they require significant public investment, is associated with the identification and strong support of a group of clear beneficiaries. If this group is identified at an early stage, the measure is more likely to gain a broader support afterwards, including those that will benefit only marginally from the project and those that, even without getting much benefit, consider the measure as fair and consistent with broader objectives (the environment, equitable access, liveability...).

In the absence of such network of support, the measure is less likely to receive approval from decision-makers. In ECCENTRIC, an early assessment of the public's support to this measure would have served to detect the low number of travellers along the whole corridor, and to identify and mobilise the groups of real beneficiaries (such as bikers or residents) and their concerns (safety, high traffic volumes, etc.), as a basis to undertake the design and implementation processes along different guidelines and objectives, and as a strategy to gain the necessary budget approval.

E. Evaluation conclusions

The estimated impacts of the measure have been reviewed with the measure team and site coordinator. Based on this, the evaluation conclusions have been formulated.

E.1 Validated direct impact

- The measure could not reach the demonstration stage and the expected direct impacts could not be verified. However, the information collected allowed to reasonably assess the measure's potential.
- The potential for modal shift from car use is estimated to be low, below 4%. This is due to the low time savings achieved by the buses, and the lack of restrictive measures to car use (such as reduction in the number of general traffic lanes or in the number of parking places in the corridor). The low time savings achieved are due to the relatively short distances driven on the corridor by the different bus lines (2 km at most of the 3.6-km long infrastructure) and the virtual lack of demand for trips that would make use of the whole north-south connection that could be provided by a new bus line.
- Commercial speed is estimated to increase substantially during the peak hours, reaching a maximum value of 14.0 to 14.5 km/h depending of the trip direction. The relatively high number of bus stops in the 3.6 km section prevents to attain higher commercial speeds.
- Public transport users' satisfaction would be likely to increase in a moderate way in case the project was built.
- The potential for emission reduction is low, compared to the investment mobilised, due to the modest number of trips changing from private car to buses.
- The estimated investment cost for the construction of the corridor is €4.25 million. Operational costs were not expected to change significantly, as the speed increase is not too significant and the additional demand does not require to introduce additional buses.

E.2 Relevance of supporting activities

No supporting activities have been implemented for this measure.

E.3 Interaction with other measures

This measure has not interacted with any other ECCENTRIC measure. If it had been implemented, it was expected that the new buses from measure MAD 5.8 (electric and hybrid buses) would have been introduced in the lines making use of the pilot corridor.

E.4 Main lessons learned

The following lessons can be highlighted:

- The actual implementation of innovative measures requiring physical interventions in the public space with significant public investment require to build up in advance strong support among decision makers and potential beneficiaries.
- Such support seems more difficult to build up in the case of tangential corridors, like this one, in which in contrast with traditional radial corridors, there is a lack of a clear image and most users only travel on a short section of it.
- Tangential corridors also seem to offer less potential for modal change from private cars. Accordingly, the emissions saved by the implementation of such corridors are not significant, and cannot justify on their own the substantial resources required.
- Car restrictions on the corridor are likely to significantly improve the performance of such measures: on the one hand, encouraging more car users to look for sustainable mobility alternatives; on the other hand, by reducing the road space required in the corridor, and the investment resources to be mobilised.

E.5 Long term impact

There are no concrete plans to implement this corridor or to revise the construction project developed by ECCENTRIC. However, it can be expected that the results of this measure will influence the approach of CRTM and EMT towards the design and implementation of bus corridors following the completion of the local SUMP revision in 2020.

E.6 Potentials for up-scaling in the city

The potential for upscaling the measure at the city level, analysing other tangential corridors is uncertain at this stage. The position of local decision-makers is unlikely to change at least until the revision of the local SUMP is completed.

F. Additional information

F.1 Appraisal of evaluation approach

In spite of the difficulties found by this measure, and its failure to achieve the demonstration stage, the evaluation activities have been successful in providing an adequate overview of the measure's potential, including the required KPIs.

Data collection has largely relied on an extensive survey, traffic counting and other activities conducted mostly in September 2019. The results obtained are consistent and valuable, due to the relatively lack of experience in the impact of tangential bus corridors in Madrid.

F.2 Future activities relating to the measure

There are no specific activities foreseen by CRTM and EMT related with this measure.



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STO 5.2

Speed up core bus routes

Measure Evaluation Report

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Responsible Co-Author(s):	Johanna Eriksson, Stina Airijoki, Tony Karlsson
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2020
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Cleaner and better transport in cities
ECCENTRIC



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Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consorcio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KTH
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12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
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15	GoMore ApS	Denmark	GOMORE
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17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
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21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Anastasios Koutoulas	KTH Royal Institute of Technology
Joel Franklin	KTH Royal Institute of Technology
Johanna Eriksson	City of Stockholm, Department of Transport
Stina Airijoki	City of Stockholm, Department of Transport
Tony Karlsson	Tyréns

Table of Contents

ABSTRACT.....	966
A. INTRODUCTION.....	967
A.1 EXPECTED RESULTS OF THE MEASURE	967
A.1.1 Quantifiable impacts.....	967
A.2 MEASURE DESCRIPTION	967
A.2.1 Measure outputs.....	968
A.2.2 Supporting activities	968
A.2.3 Interactions with other ECCENTRIC measures.....	968
A.2.4 Interactions outside ECCENTRIC	968
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	969
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	970
A.5 IDENTIFIED RISKS	971
B. MEASURE IMPLEMENTATION	972
B.1 SITUATION BEFORE CIVITAS	972
B.2 INNOVATIVE ASPECTS.....	972
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	973
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	973
C. IMPACT EVALUATION FINDINGS	975
C.1 EVALUATION APPROACH.....	975
C.1.1 Expected impacts and indicators.....	975
C.1.2 Baseline.....	976
C.1.3 The business-as-usual scenario.....	977
C.2 MEASURE RESULTS.....	979
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	979
C.4 UP-SCALING	980
D. PROCESS EVALUATION FINDINGS	981
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	981
D.2 BARRIERS	981
D.3 DRIVERS	981
D.4 SUPPORTING ACTIVITIES.....	982
D.4.1 Workshop	982
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	982

E.	EVALUATION CONCLUSIONS	983
E.1	VALIDATED DIRECT IMPACT	983
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	983
E.3	INTERACTION WITH OTHER MEASURES	983
E.4	MAIN LESSONS LEARNED	983
E.5	LONG TERM IMPACT	983
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	984
F.	ADDITIONAL INFORMATION	985
F.1	APPRAISAL OF EVALUATION APPROACH	985
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	985

List of Figures

Figure 1: Modal split in Stockholm (data presented in Polis Conference 2014).....	969

List of Tables

Table 1: Quantifiable impacts.....	967
Table 2: Target groups or affected parties	969
Table 3: Measure stakeholders.....	970
Table 4: Risk assessment	971
Table 5: KPI Descriptions.....	975
Table 6: KPI Descriptions.....	976
Table 7: Measured KPI results.....	978
Table 8: Objective achievement.....	979
Table 9: Identified barriers and planned/taken actions.	981
Table 10: Identified drivers and planned/taken actions.....	981

Project	City		
EECCENTRIC	Stockholm		
Measure code	Measure name		
5.2	Speed up core bus routes		
Last update	Responsible	e-mail	telephone
2020-02-28	Stina Airijoki	stina.airijoki@stockholm.se	08-508 26 063

Abstract

Stockholm is a growing city and in spite of a high public transport modal split of almost 80 % during the extreme peak, more people need to change to public transport to prevent rising congestion. To increase the speed and attractiveness of public transport, this measure tests the effectiveness of physical modifications to the roadway geometry, with a focus on corridors where fully segregated bus lanes are not feasible. The measure worked with two of the core buses in the outer urban area, focusing on increasing the speed and attractiveness of public transport, in terms of improved regularity, prioritisation of buses, reduced travel and dwell time etc.

In particular, geometric improvements were made along two trunk bus lines through the northern suburban districts of the City of Stockholm. Improvements included, for example, adding lengths of bus-only lanes, relocating and lengthening bus stop areas, and improving curbs for boarding and alighting. In the evaluation, we measured the following indicators: speed, regularity, dwell time, accuracy, and the investment costs for both bus lines. Monitoring made use of data collection systems already in place, namely the driving time data that is continuously collected for all bus routes, and the boarding count data collected on a rotating sample of buses; both data sources are reported to databases maintained by the Stockholm Region Public Transport Authority (SL).

Some of the results indicated a positive result, while others were ambiguous. Regularity in bus travel times improved on both study lines, by 5.7 and 4.1 percentage-points, respectively. Accuracy of timekeeping, measured on the one bus line where a comparison could be drawn, also improved, by 3.5 percentage-points. However, dwell times only decreased on one of the lines, by 0.4 seconds per passenger, while the other line saw no appreciable change. Moreover, overall commercial speed did not show any significant improvement, which we attribute to high variation in speeds by causes external to this experiment.

The main improvement was therefore the reliability of bus operations on these lines and the efficiency of boarding and alighting, but that when seen in the context of overall commercial speeds, these improvements are not noticeable. Having said that, travel time reliability has been shown to have outsized roles in passenger travel satisfaction, and shorter dwell time is a critical contributor to reliability, so these are encouraging results for improving passenger experiences.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- Promotion of collective transport for passengers

(2) Strategic level:

- Reduction of traffic congestion on road network and elimination of the travel time for users of public transport

(3) Measure level:

- Increase of transport efficiency in the two bus lines that there will be improvements in the frame of ECCENTRIC project
- Reduction of the operational costs as well as the costs for improving the bus lines

A.1.1 Quantifiable impacts

Expected Impacts	Reduction of passenger congestion on buses • Improvement of regularity (The travel time will be more predictable for travellers, the bus time and the waiting time) • Speeding up core bus routes (the hole line and between the bus stops, dwell time and driving time).	CIVITAS ECCENTRIC Objectives							
		Reduce:				Improve:			
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal	Livability	Competitiveness
ID	Quantifiable Impacts								
1	Exploitation of the funding for implementation of the plan							x	x
2	Transport efficiency			x	x		x	x	x

Table 1: Quantifiable impacts

A.2 Measure description

Stockholm is a growing city and in spite of a high public transport modal split of almost 80 % during the extreme peak, more people need to change to public transport to prevent rising congestion. Although inner city residents already use public transport (PT) or walk, most car users come from outside the inner city. To increase the speed and attractiveness of PT, this measure tests the effectiveness of physical modifications to the roadway geometry, with a focus on corridors where fully segregated bus lanes are not feasible.

An earlier pilot project has shown that it is possible to improve accessibility with minor measures at low costs if they are systematically implemented. The pilot project on one of the four core bus routes was carried out during 2014 and tested several measures to speed up

the buses. The result of the pilot have been developed and implemented on all inner city core bus routes.

The measure worked with two of the core buses in the outer urban area, bus lines 178: Mörby station–Jakobsbergs station and the line 179:Vällingby–Sollentuna station, focusing on increasing the speed and attractiveness of public transport, in terms of improved regularity, prioritisation of buses, reduced travel and dwell time etc.

A.2.1 Measure outputs

Some of the main action areas considered in this measure were the following:

- Improved regularity
- Improved monitoring of illegally parked vehicles
- Increased priority in the street space
- Bus priority at traffic signals
- Improved road interchange, short stop time
- Revise bus stop design and modes

The main objective of the measure was to increase of the attractiveness of buses as reflected in an increase of ridership. More specifically, the actions above were intended to achieve an increase of frequency and a reduction in congestion on buses; improvement of regularity in terms of predictability of trips (bus time, waiting time); generally higher operating speeds of these two core bus routes (for both the whole line and for segments between the bus stops, and for dwell time and driving time).

A.2.2 Supporting activities

On June 2017, a workshop was organized where a project group and network were formed. This project group/network consisted of a wide range of stakeholders namely representatives from the City of Stockholm, the public transport authority (SL), bus drivers, public transport users etc. Based on the discussion during the workshop focusing on the main problems, drawbacks, analysis of buses driving times, stop times etc. there was produced an action plan for the two under research bus lines. The findings of the workshop set the basis for the measures to be implemented.

A.2.3 Interactions with other ECCENTRIC measures

Although there is was direct interaction with the other measures in Stockholm in the frame of the project, a successful upscaling of Eccentric measures might improve speeds along these two bus lines. Specifically, a new parking fee and information system might free up space for bus-adapted road infrastructure, and an integrated MaaS system might improve access to public transport system as part of multimodal trips.

A.2.4 Interactions outside ECCENTRIC

As it can be seen in the Figure 1, public transport is a fundamental part of the city of Stockholm, where buses hold a dominant position.



Figure 1: Modal split in Stockholm (data presented in Polis Conference 2014)

Over 670 million individual journeys are made each year on a network with more than 1 900 buses on the road network. Responsible for the organization not only of the bus system but also for the whole public transportation in Stockholm is the Stockholm Regional Council (Region Stockholm) at a political level (planning, financial issues, subsidies etc.) and Storstockholms Lokaltrafik (SL) for the operation and maintenance of the public transport systems with the cooperation of several private operators. The bus lines are organized in three different categories, namely inner-city blue bus lines; suburban blue bus lines and service bus lines. As for the lines that are going to be analysed by this ECCENTRIC measure Arriva is the company that is responsible for the operational part.

The goals for sustainability and environmental efficiency set by the city of Stockholm and illustrated both in “Urban Mobility Strategy” and “Vision 2030” are in line with the objectives of the ECCENTRIC project.

In parallel, according to the general strategies of Stockholm like the accessibility strategy, the main network strategy and the action plan for the core buses 2017-21 for providing better public transport services to citizens, more efficient and more punctual in terms of waiting and dwell time, there is another project, similar to ECCENTRIC, focusing on bus line 178 and 179. Both projects had more or less the same goals.

A.3 Target groups and/or affected part of the city or region

The target groups are summarized in [Table 2](#).

Target group		Affected area	
Type	Description	Type	Description
Public transport users	The public transport passengers that use the two bus lines in an everyday basis for their transport in Stockholm region	Corridor	Ridership catchment area for bus line 178
Bus drivers	Drivers of the buses of that the measures are going to be implemented	Corridor	Ridership catchment area for bus line 179
Arriva	Company that operates the bus lines		
City of Stockholm	Planners, decision makers and people that organize public transportation		

Table 2: Target groups or affected parties

A.4 Stakeholders: ECCENTRIC project partners and other important actors

The relevant stakeholders are listed in [Table](#)

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG- PR-other	Level of activity L-P-O	Role - Links
P04	Traffic administration of the City of Stockholm	P	C	L	Organization, monitoring & management of the measure
P06	Stockholm Public Transport (AB Storstockholms lokaltrafik, SL)	S	PT	P	Managing overall public transport service operations
P10	KTH Royal Institute of Technology	P	KI	P	Supporting measure evaluation
P16	Public transport users of bus lines 178 & 179	S	Other	P	Experiencing changes and providing feedback
P12	Consultancy companies participating as subcontractors (Tyréns, Structor)	S	PR	P	Subcontractor for the implementation of the measure
K03	Public transport administration for Stockholm County (trafikförvaltningen)	S	PT	P	Planning, managing and regulating public transport supply
K07	Swedish Transport Administration (Trafikverket)	S	NG	L	Responsibility for road network - Monitoring
S06	Drivers of the bus lines 178 & 179 (Arriva, public transport operator)	S	PT	P	Public transport operations – monitoring and providing feedback
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders

A.5 Identified risks

At the outset of the project, risks were identified as those in [Table](#) .

Identified risk	Category	Mitigation actions	Responsible
Opposition of key actors based on political and/or strategic motives, lack of sustainable development agenda or vision, impacts of a local election, conflict between key (policy) stakeholders due to diverging beliefs in directions of solution	Political / strategic	Strong communication – cooperation among all key players in public transport in Stockholm. Identification and discussion on risks or potential deviations in order to avoid inefficiencies and misconceptions	All the stakeholders involved in public transport issues in Stockholm
Insufficient technical planning and analysis to determine requirements of measure implementation from the side of entrepreneurs	Planning	Detailed reporting and day to day monitoring of activities within the measure	Municipality of Stockholm
Delays (implementation, data collection, dependent tasks etc.)	Operational	Follow the time plan and act on time	City of Stockholm & subcontractor

Table 4: Risk assessment

B. Measure implementation

B.1 Situation before CIVITAS

Stockholm is among the most rapidly expanding cities in the world. The lack of space in the inner part of the city initiated the development of suburbs. But this exploitation of the suburban areas generated additional trips and needs for transport. Thus, the suburban core bus routes fill an important function in connecting places along orbital trajectories that are less well served by the metro and other rail networks.

These orbital core bus routes seldom benefit from on-street priority and are therefore affected by congestion caused by other motor vehicles. This means it is often more efficient to travel into central Stockholm and out again (increasing pressure on the radial rail networks and central metro stations), or travel by car. The City of Stockholm sees potential to improve these orbital core buses in the urban area to give better regularity, reduce travel times and have less crowding etc. This can in turn relieve pressure on the rail network and stations.

We chose the two lines, 178 and 179 because they are trunk-line buses with a large number of passengers. We have already worked extensively in the past with improving the core buses in the inner city of Stockholm, which is why we now focus on some outer regions in Stockholm in this project.

The area of core bus lines 178/179 is characterized as inner suburban in Stockholm County. These core buses travel perpendicularly between subway and commuter rail lines. In doing so, their routes pass through many different municipalities in Stockholm County, namely: Stockholm, Solna, Sundbyberg, Sollentuna, Danderyd, and Järfälla, and for many of these the routes pass through key suburban centres to which many jobs and services are moving. Hence the routes are important for commuters and citizens living in these areas. There is a wide range of land uses covered by these bus lines e.g. hospitals, schools, stadiums, shopping malls etc. highlighting the need for provision of better public transport services to citizens.

The buses on these routes are frequently caught in congestion along not only longer stretches but also at off-ramps and intersections. The transfer point Kista is judged to be underdimensioned. Certain bus stops are designed too short, which results in buses hindering each other from reaching the boarding/alighting area. These routes also pass through areas with social problems and segregation, which can produce deficiencies in experienced safety, as well as cause delays.

The key objective of the implemented measure is to provide more attractive services through these lines compared to the situation prior to Civitas Eccentric.

B.2 Innovative aspects

As already mentioned, in 2014 a pilot project was implemented in the city of Stockholm on one of the four core bus routes, bus line 4 Radiohuset–Gullmarsplan, testing several measures to speed up the buses. The result of the pilot have been developed and implemented on all inner city core bus routes.

The innovative character of this ECCENTRIC measure is that this idea for speeding up the bus lines will be tested in the outer urban area. The challenging part is that when it comes to suburban areas there is a totally different environment. The length of the whole routes is as

well as the distance between stops is much higher. The three main ring roads of Stockholm County, E4, E18 and E20, are in most cases congested especially in peak hours incommoding the regularity and the travel times of public transport.

What is also innovative in this measure is the process and the methodology used for the implementation. Instead of having predefined issues to be tackled by the project, the main problems/priorities were realized through a workshop organized in June 2017. A wide range of different stakeholders related to the selected bus lines were invited to discuss on buses driving times, stop times etc. Then an action plan was set up by the measure leader in each area of action.

B.3 Research and Technology Development

Not applicable in this measure.

B.4 Actual implementation of the measure

The implementation of the measure started directly after the Eccentric kick-off meeting in September 2016. The first step was the formation of the working team that would be involved. For this purpose, the City of Stockholm procured a subcontractor that would contribute in the technical parts of the implementation of the measure as well as the analysis and the evaluation. Thus, the first 9 months of the project included preparation of the procurement, selection of the consultant and identification of the additional needs for the project.

After the final selection of the team, the next step was the planning and organization of the activities to be taken in the frame of the project and setting up the action plan. The first step was the selection of the bus lines. The main criteria for such a selection were the demand and the volumes of passengers using the lines and the broadness of the area covered by the routes.

A milestone in the whole process was the identification of the situation before CIVITAS and mapping the key problems, issues and needs in the selected bus lines. In order to have robust data that presents depictive the reality, the project team organised a workshop with the participation of the City of Stockholm, the Stockholm Region public transport authority (SL), bus drivers, public transport users etc. Based on the discussion during the workshop focusing on the main problems, drawbacks, analysis of buses driving times, stop times etc., an action plan was produced for the two bus lines under examination. The findings of the workshop set the basis for the measures to be implemented.

Construction of the identified actions took place from June to August of 2018. After studying feasibility and considering the timeline of the Eccentric project, the following kinds of actions were in fact taken:

- Relocating bus stop shelters to improve comfort for waiting passengers
- Removing curb-side parking spaces to improve bus movements
- Relocating bus stops to improve boarding and alighting efficiency
- Creation of bus-only lanes
- Adjusting curbs and paving improve comfort for drivers and passengers
- Lengthening existing bus stops to improve boarding and alighting efficiency
- Traffic safety measure to reduce the risk of pedestrians on bus lanes
- Merging nearby bus stops to one
- Banning vehicle stopping along certain segments during peak hours
- Changing intersection control from yield-to-right to sign-posted yield
- Painting intersections as no-blocking zones

- Modifying an intersection to give priority to turning vehicles

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Monitoring made use of data collection systems already in place, namely the driving time data that is constantly collected for all bus routes and the boarding count data constantly collected on a rotating sample of buses; both data sources are reported to databases maintained by the Stockholm Region public transport authority (SL). The observation periods were determined to be the two periods of March to May in both 2018 (for baseline data) and 2019 (for impact data). Note that we have dropped Operating Costs as a KPI, as there were no measurable operating costs associated with the geometric modification measures implemented.

Impact	Transport efficiency	Transport efficiency	Transport Efficiency	Service Reliability	Exploitation
Indicator name	Commercial speed	Regularity	Dwell time	Accuracy of timekeeping	Investment cost
Type	KPI	KPI	KPI	KPI	KPI
Category	Transport system	Transport system	Transport system	Quality of service	Economy
Subcategory	Public Transport	Public Transport	Public Transport	Public Transport	Costs
Aspect	Quality of service	Service reliability	Service reliability	Service reliability	Investment costs
Definition	The average journey speed of a bus lines- the whole route, between specific bus stops and dwell time.	The regularity (time between the buses).	Dwell time is the time that the buses of the two under research lines spend at a scheduled stop without moving	The number and percentage of public transport that arrive within an acceptable interval around the planned times given by timetables.	The total capital costs for the implementation of the measure per line (infrastructure, equipment and vehicles). Preparation and design cost is defined as total costs expended in setting up the measure and cover a period from the initiative of the measure preparation until the start of the measure implementation

Table 5: KPI Descriptions

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E- S-C	Observed group	Area of measurement
1	Commercial speed on Line 178	km/h	B-A	DC	Buses	Area covered by Bus 178
2	Commercial speed on Line 179	km/h	B-A	DC	Buses	Area covered by Bus 179
3	Regularity on Line 178	% difference between 90%-ile and 10%-ile times	B-A	DC	Buses	Area covered by Bus 178
4	Regularity on Line 179	% difference between 90%-ile and 10%-ile times	B-A	DC	Buses	Area covered by Bus 179
5	Dwell time on Line 178	Seconds per boarding	B-A	DC	Buses	Area covered by Bus 178
6	Dwell time on Line 179	Seconds per boarding	B-A	DC	Buses	Area covered by Bus 179
7	Accuracy of time-keeping on Line 178	% of real headways within 10% to 90% of nominal headway	B-A	DC	Buses	Area covered by Bus 178
8	Accuracy of time-keeping on Line 179	% of real headways within 10% to 90% of nominal headway	B-A	DC	Buses	Area covered by Bus 179
9	Investment cost on Line 178	SEK (Swedish crowns)	A	C	Activities undertaken by the measure	Area covered by Bus 178
10	Investment cost on Line 179	SEK (Swedish crowns)	A	C	Activities undertaken by the measure	Area covered by Bus 179
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: KPI Descriptions

C.1.2 Baseline

The baseline values are shown in the first numeric column of Table .

Operating performance results are reported separately for bus lines 178 and 179. For the first KPI, operating speed, the average operating speed on Bus 178 was 27.1 km/hour, calculated as the average of the two directions of travel for the entirety of the route, which lies fully within the City of Stockholm. The corresponding KPI for Bus 179 was also 27.1 km/hour, calculated as the average of the two directions and over the morning (7-9 am) and afternoon (3-6pm) peak periods, but in this case only for the portion of the route within the City of Stockholm; other portions extend into suburban municipalities. The equal values for the two routes are entirely coincidental.

The second set of KPIs concerns regularity, or variability, of operating speeds. This is calculated as the percentage by which the 90th-percentile speed exceeds the 10th-percentile

speed. For Bus 178 the baseline value was 37.8%, whereas for Bus 179 the baseline value was 31.0%. Again, these values are averaged over the two directions of travel, the included segments, and the morning and afternoon peak periods.

The third set of KPIs measures a similar concept but with a different indicator: for Accuracy of Timekeeping, these KPIs indicate the reliability of the bus times in relation to the scheduled headway times. However, on Bus 179 a change in headway schedules meant that a proper comparison could not be made for this route, hence the KPI for this bus was dropped. For Bus 178, the percentage of real headways that fell within half of the scheduled headways was 52.0%. This value is averaged over partial indicators for the morning and afternoon peak periods as well as over the two directions of travel and over a subdivision into two segments of the studied route.

The final operating KPI, dwell time per boarding passenger, was calculated as the average overall over the included segments, then averaged over the morning and afternoon peak periods and the two directions of travel. Average dwell times on Bus 178 and Bus 179 were 4.6 and 5.3 seconds per boarding passenger, respectively, in the baseline scenario.

Investment costs in the baseline are zero, since nothing was implemented at that time.

C.1.3 The business-as-usual scenario

Forecast background developments, such as population growth and urban development, do not give a clear indication of how the baseline bus route performance measures would evolve over such a short period as the Eccentric project duration. Nor have any traffic modelling exercise been able to be conducted to obtain proper forecasts. Rather, to represent the business-as-usual scenario our best estimate must simply be a continuation of the same indicator values as in the baseline scenario. Hence we do not report any change in the operating indicators under the business-as-usual case as compared to the baseline.

However, we can qualitatively assess three indicators in terms of their potential development in the absence of Measure 5.2. Given the trajectory of background developments, we can speculate on whether these should be considered an upper bound or lower bound of business-of-usual outcomes.

- Commercial speed (the entire length of the line and intermediate stops in Stockholm city): our estimation is that average speeds on the trunk bus lines would be either the same as or lower than today's average speeds as background general purpose traffic increases.
- Regularity: similarly, our estimation is that regularity would remain the same as current conditions or gradually worsen as traffic increases.
- Dwell time: we estimate that dwell times along the corridor would be the same or gradually increase due to an overall increase demand for the bus services as population increases.

The investment cost indicator is also identical to the baseline – again, there are zero costs since there are no changes made.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Commercial speed on Bus 178	Km/h	27.1	March to May 2018	27.1	March to May 2019	27.9	March to May 2019	+0.8	+0.8
Commercial speed on Bus 179	Km/h	27.1	March to May 2018	27.1	March to May 2019	26.9	March to May 2019	-0.2	-0.2
Regularity on Bus 178	% difference between 90%-ile and 10%-ile times	38.7	March to May 2018	38.7	March to May 2019	33.0	March to May 2019	-5.7	-5.7
Regularity on Bus 179	% difference between 90%-ile and 10%-ile times	31.0	March to May 2018	31.0	March to May 2019	26.9	March to May 2019	-4.1	-4.1
Accuracy of time keeping on Bus 178	% of real headways within 10% to 90% of nominal headway	52.0	March to May 2018	52.0	March to May 2019	55.5	March to May 2019	+3.5	+3.5
Accuracy of time keeping on Bus 179	% of real headways within 10% to 90% of nominal headway	N/A	March to May 2018	N/A	March to May 2019	N/A	March to May 2019	N/A	N/A
Dwell time on Bus 178	Seconds/boarding	4.6	March to May 2018	4.6	March to May 2019	4.6	March to May 2019	0	0
Dwell time on Bus 179	Seconds/boarding	5.3	March to May 2018	5.3	March to May 2019	4.9	March to May 2019	-0.4	-0.4
Investment cost	million SEK	0		0		7.9		+7.9	+7.9

Table 7: Measured KPI results

C.2 Measure results

The measured results for all KPIs are shown in [Table](#) . Firstly, commercial speed gives ambiguous results, with an overall increase in speeds on line 178 from 27.1 to 27.9 km/hour, but an overall decrease on line 179, from 27.1 to 26.9 km/hour. Perhaps worth noting is that route 178 fully falls within the study area while 179 extends beyond the study area in both directions, including into municipalities other than Stockholm. The reported data here are obtained only from portions of the route within the City of Stockholm. Hence, there could have been other developments along the portions of Bus Route 179 outside the City of Stockholm that counteracted any overall improvements in speeds. However, a closer inspection of the underlying data demonstrates that fluctuations in average times are high: if we focus only on particular segments or stops, then we see a mix of increases and decreases in average speeds. Hence, it is difficult to attribute any increase or decrease in speed specifically to the geometric changes made by this measure.

The regularity improved on Bus 178 from a 38.7% to a 33.0% difference between the 10th and 90th percentile travel times, and on Bus 179 from a 31.0% to a 26.9% difference in these percentiles. It is notable that on Bus 178, a major portion of the improvements were only on one segment and in one direction. We have so far not identified the cause of this difference.

Accuracy of timekeeping could only be measured on Bus 178 since the scheduled headways on Bus 179 changed during the course of the project. On Bus 178, this indicator increased from 52.0 to 55.5, meaning that a greater share of observed headways remained within a range of half the scheduled headway time.

Dwell times on Bus 178 were essentially unchanged, at 4.6 seconds per passenger. On Bus 179, average total dwell times over the length of the studied route decreased by 0.4 seconds per boarding passenger, from 5.3 to 4.9. The decrease on Bus 179 could be due to a particular portion of the route where reserved bus lanes were added and bus stops were lengthened.

Investment costs with the measure, including contractor, signage and striping, inspection, and project management, totalled approximately 8.7 million Swedish crowns (mSEK).

C.3 Summary: achievement of objectives

All three of the measure's objectives have been substantially met, but none fully.

No.	Objective and target	Rating	Comment
1	Reduce travel times along the selected corridors	O	Travel speeds increased on one of the studies bus lines but not the other.
2	Reduce travel time variability along the selected corridors	★	Regularity improved on both routes, but not up to the goal of a 20% improvement for the routes overall.
3	Improve schedule reliability along the selected corridors	★	Reliability improved on one route but not up to the goal of 70%. Reliability could not be measured consistently on the other route due to a schedule change.
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★★★ = Exceeded			

Table 7: Objective achievement

C.4 Up-scaling

Effects can be upscaled by extending to the full lengths of the bus routes and by expanding to other bus routes that haven't yet been improved in this way. An extension to the full route might produce more-than-linear improvements in the effects, if our hypothesis is correct that the unimproved sections undermined the improved sections' effects to some extent. Expanding to other routes will have bring various degrees of improvements, but without examining their characteristics in detail, we can assume the improvements would be linear with the number of routes added.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the **Process Evaluation Report** of this Measure.

D.1 Deviations from the original plan

- **Location of bus routes** – the demonstration routes are located in the northern, near-suburban district rather than in the central city, as initially planned. This was because when the ECCENTRIC project started, a comprehensive set of circulation improvements had already been implemented for all core bus lines in the central city, so the focus of the new action plan going forward was on core lines in the outer city areas. Since this is a collaboration between the City of Stockholm Department of Transport, the Swedish National Transport Administration, and Stockholm Public Transport, the choice of route was made through discussions among all parties on which we would work with.

D.2 Barriers

Some of the main barriers identified in this initial phase of the measure are the following:

No.	Barrier field	Description	Action to overcome the barrier
1	Planning	It was found difficult to keep to schedule, particularly so that the changes would be implemented before winter.	Some flexibility in the overall project schedule has been necessary, and in particular, planning for construction if certain changes needed to be significantly delayed.
2	Organisational	When we planned to move a bus stop, it took considerable time for Stockholm Public Transport and the bus operator to clarify the division of responsibilities to realize this change.	Lessons learned from these discussions will help implementation of similar changes in the future.

Table 9: Identified barriers and planned/taken actions.

D.3 Drivers

Several drivers have been recognized as possibly helping to bring about the success of the two measures. In cases where it is possible to encourage and capitalize on these, we have identified actions to do this.

No.	Driver field	Description	Action to make use of the driver
1	Political/strategic	The project has political support and interest. Politicians behind both the City Department of Transport and Stockholm Public Transport are positive to the project.	Political support has helped to create an urgency to resolve inter-institutional ambiguities.
2	Planning	The project uses a proven method which has been already used applied for all five core bus lines in the inner-city area.	The lessons learned from those earlier applications have been capitalized now in this project.
3	Involvement/communication	A good collaboration between all partners (Stockholm Public Transport, Swedish National Transport Administration, Bus Operators, and neighbouring municipalities).	Collaborative networks are forming that could help facilitate cooperation in future projects as well.

Table 10: Identified drivers and planned/taken actions.

D.4 Supporting activities

Here we summarize the observations concerning the supporting activities:

D.4.1 Workshop

A fundamental supporting activity for the development of the action plan and organization of the implementation phase was the organization of a workshop. The workshop was held on June 2017 with the participation of City of Stockholm, the public transport authority (SL), bus drivers, public transport users etc. (around 30 people).

The scope of the workshop was to realize the main problems, drawbacks, analysis of buses driving times, stop times etc. that set the basis for the measure to be implemented.

As for the timing, it was the appropriate since the working team had already been established and the next step was setting up the action plan.

The workshop was held in a neighbourhood close to the two lines, which was inspiring. Apparently, several of the participants went there by using one of these bus lines which made them think about the project during this trip to the workshop. In addition, after the end of the workshop participants had the opportunity to have a tour with the buses and realize by themselves the main problems and issues. This activity initiated a new round of discussions that raised many ideas, thoughts and opinions, that in some cases it was difficult to keep record of all of them.

Regarding the number of participants, although there was quite a long list of participants in such a focused workshop, it was important to capture as many problems and suggestions as possible.

For the facilitation and better representation of the results, all the comments received by the participants were included in a map of the whole route of the bus lines where:

- The noted problems were marked with blue bubbles;
- Proposals for actions to be taken or improvements were marked with green bubbles.

This was assessed as a really easy and useful tool for better clarification of issues and presentation of the suggested modifications or interventions.

D.5 Recommendations on the implementation process

Recommendations will be included in the final process evaluation report.

E. Evaluation conclusions

The observed impacts of the measure has been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

The street modifications had several confirmed effects on bus route performance:

- Bus route regularity improved on both routes and accuracy of time-keeping improved on the one route for which a comparison could be drawn. These results indicate there were fewer disturbances to bus circulation along the routes.
- Dwell times improved on both routes, suggesting more efficient boarding and alighting.

E.2 Relevance of supporting activities

The 2017 workshop was useful in integrating a stakeholder perspective into the selection of sites and modifications to be made along the two selected routes.

E.3 Interaction with other measures

This measure had no significant interactions with other Eccentric measures.

E.4 Main lessons learned

- The project benefited from the use of a joint action plan, a joint working group of stakeholder representatives, and a joint steering group comprising stakeholder decision-makers, who could resolve questions where the joint action group could not agree.
- The bus lines in question operate partially outside the City of Stockholm in neighbouring municipalities, as well as on roads where the National Transport Authority is responsible. We learned that in order to succeed, all parties with some responsibility for either physical or regulatory aspects need to be represented in the working group, as well as contribute staff resources to participating.
- Police should also be involved and allocate resources to enforce new restrictions, to ensure the measures have their desired effects.
- In this case the neighbouring municipalities participated in problem scoping but not in implementation. This meant that measures were only deployed on partial routes, and we suspect that gains along the improved measures may have been undermined by the lack of similar measures elsewhere.
- Some of the potential gains for buses might have been undermined by increases in congestion for general traffic, which could have had detrimental effects for buses upstream and downstream of the measures. Also, a significant portion of drivers ignored the bus-only restrictions, undermining effectiveness.
- Some of the measures implemented were rather minor, and our data collection was not able to detect improvements in circulation attributable to these. However, these could still be motivated by other concerns such as improved comfort for passengers (and drivers) or simplifying boarding and alighting. Improvements' symbolic value should also be recognised.

E.5 Long term impact

The corridor improvements will continue to have some effect, but these are likely to be rather overshadowed by other, larger-scale changes in the road network.

E.6 Potentials for up-scaling in the city

As mentioned earlier, this measure can be scaled up to other suburban districts in the City of Stockholm as budget and circumstances allow. Earlier experiments with bus corridor improvements, particularly in the central city area of Stockholm, have been more successful, so the overall prognosis is rather good for these types of improvements.

F. Additional information

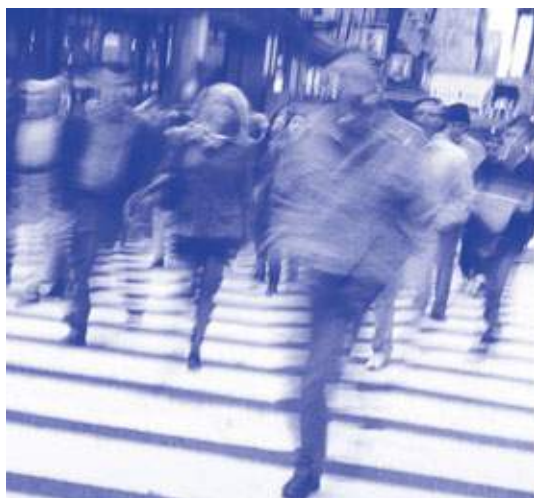
F.1 Appraisal of evaluation approach

The evaluation approach has been perceived as sporadic, with short deadlines when input is needed from measure leaders.

F.2 Future activities relating to the measure

This measure constitutes the first in a series of three work packages that the City is carrying out to improve circulation of trunk bus lines in the suburban districts. The subsequent packages are as follows:

- In Package 2, the suburban districts to the south are included. Similar measures have already been implemented and are currently being evaluated for their effects. In this case, neighbouring municipalities have been included in the implementation.
- In Package 3, currently in the start-up phase, the City currently carrying out an inventory of problems along trunk bus lines. This package encompasses suburban districts in the northern and western areas of the City of Stockholm that were not already covered in Package 1, along with some of the neighbouring municipalities.
- In parallel to these work packages, work is also ongoing to continuously evaluate the formulation of objectives and the measures, in general, that best meet these objectives. Together with the Stockholm Regional Council's Public Transport Authority and its contracted public transport operators, other means to improve public transport capacity are being examined, such as creating conditions for high-capacity public transport vehicles.



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RUS 5.4

Introduction of 'Good night' line to Druzhba

Measure Evaluation Report

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3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
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17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
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23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Nikolay Simeonov	
Ivaylo Yakimov	

Table of Contents

ABSTRACT.....	993
A. INTRODUCTION.....	994
A.1 EXPECTED RESULTS OF THE MEASURE	994
A.1.1 Quantifiable impacts.....	994
A.2 MEASURE DESCRIPTION	995
A.2.1 Measure outputs.....	997
A.2.2 Supporting activities	997
A.2.3 Interactions with other ECCENTRIC measures.....	999
A.2.4 Interactions outside ECCENTRIC	999
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	999
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS	1000
A.5 IDENTIFIED RISKS	1000
B. MEASURE IMPLEMENTATION	1001
B.1 SITUATION BEFORE CIVITAS	1001
B.2 INNOVATIVE ASPECTS.....	1001
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1001
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1002
B.5 EVALUATION APPROACH.....	1003
B.5.1 Expected impacts and indicators.....	1003
B.5.2 Baseline.....	1004
B.5.3 The business-as-usual scenario.....	1006
B.6 MEASURE RESULTS.....	1007
B.7 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1009
C. PROCESS EVALUATION FINDINGS	1011
D. EVALUATION CONCLUSIONS	1012
D.1 VALIDATED DIRECT IMPACT	1012
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	1012
D.3 INTERACTION WITH OTHER MEASURES.....	1012
D.4 MAIN LESSONS LEARNED	1012
D.5 LONG TERM IMPACT	1012
D.6 POTENTIALS FOR UP-SCALING IN THE CITY	1013
E. ADDITIONAL INFORMATION.....	1014

E.1	APPRAISAL OF EVALUATION APPROACH	1014
E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1014

List of Figures

Fig. 1. Itinerary of the night line.....	996
Fig. 2. Timetable of the nightline	996
Fig. 3. Information about the timetable and itinerary.....	998
Fig. 4. Information about the timetable and itinerary.....	998
Fig. 5. Ruse nightline	1003
Fig. 6. Modal split Druzhba	1005
Fig. 7. Modal split Druzhba (Jan.2020)	1007
Fig. 8. Level of emissions.....	1008

List of Tables

Table 1. Quantifiable impacts.....	994
Table 2. Supporting activities	997
Table 3. Target groups or affected parties	999
Table 4. Measure stakeholders.....	1000
Table 5. Risks	1000
Table 6. Innovative aspects	1001
Table 7. Impacts and indicators	1003
Table 8. Indicators and measurements.....	1004
Table 9. Level of emissions.....	1009
Table 10. Achievement of objectives	1010

Project	City		
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RUS 5.4	Introduction of 'Good night' line to Druzhba		
Last update	Responsible	e-mail	telephone
02.05.2020	Lucia Ilieva	mail@csdcs.org	+359 888871208

Abstract

This measure was planned for the first time in Ruse in order to provide demand-oriented, fast, regular and reliable public transport service during the night for the Druzhba citizens. For this purpose, a new PT line named 'Good night' was established in the frames of the ECCENTRIC project connecting the peripheral district with the city centre.

The main challenges faced while developing and implementing this measure so far have been to find the best solution for the vehicles to be used for operating the new line, and to identify an appropriate solution to award the operation of the service. As the municipality didn't have enough resources for purchasing e-vehicles during the project lifetime, we decided to use the existing trolleybuses. This decision has solved the problem with the operator – the service was assigned to the municipal trolleybus company.

Before launching the new service, a huge research took place aiming at establishing the most convenient itinerary of the new line served by a trolleybus. The route is from Druzhba district to Central Railway Station with 14 stops and passes through the main streets and boulevards connecting the peripheral area with the central part of Ruse.

A large promotional campaign was launched for informing citizens about this initiative and inviting them to use it with the aim to decrease the use of cars and taxis for moving during the night. On 10th of May 2019 the 'Good Night' line was launched and started operating.

The measure strongly contributed to the social inclusion and livability in Druzhba. 90% of the citizens accept it and estimate that it will improve their living conditions. 90% are satisfied with the "Good night" line because it gives them possibilities to move in the night and to have access to the Ruse evening attractions thus decreasing the social inequality and improving the quality of life in the peripheral district.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals / longer term:

- Increase the use of public transport. To encourage the different actors to embrace sustainable mobility habits leaving their cars on the peripheral parking and using PT;
- Decreased use of private cars. To create awareness of the need for and benefits of sustainable mobility in the City of Ruse and its importance for increasing the quality of life.

(2) Strategic level:

- Acceptance of the implemented measure in Ruse;
- Satisfaction with the implemented measure;
- Decrease emissions from cars/taxis.

(3) Measure level:

- Improved liveability in Druzhba (less feeling of social exclusion);
- Mode shift towards PT and away from private cars in the night.

A.1.1 Quantifiable impacts

Expected impacts	Increased use of PT Decreased use of private cars Decreased emissions and energy consumption by PT Decreased use of private cars and taxi services at night	CIVITAS ECCENTRIC Objectives								
		Reduce:				Improve:				
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight
ID	Quantifiable impacts									
1	20% decreased use of private cars in Druzhba	X								
2	20% increased use of PT in Druzhba	X					X	X		
3	10% decreased emissions from private cars and taxis		X							
4	20% decreased the use of private cars and taxis by night	X	X			X		X		

Table 1. Quantifiable impacts

A.2 Measure description

This measure was planned for the first time in Ruse in order to provide demand-oriented, fast, regular and reliable public transport service during the night for the Druzhba citizens. For this purpose, a new PT line named 'Good night' was established in the frames of the ECCENTRIC project connecting the peripheral district with the city centre. A large promotional campaign was launched for informing citizens about this initiative and inviting them to use it with the aim to decrease the use of cars and taxis for moving during the night.

Before launching the new service, a huge research took place aiming at establishing the most convenient itinerary of the new line served by a trolleybus. The route is from Druzhba district to Central Railway Station with 14 stops and passes through the main streets and boulevards connecting the peripheral area with the central part of Ruse: Dame Gruev Str., Vasil Levski Blvd., Hristo Botev Blvd., Tsar Osvoboditel Blvd., Gen. Skobelev Blvd. and Borisova Str. The movement of the trolleybus from/to the depot to the beginning of the main route of the night line passes along the following streets and boulevards - "Treti Mart" Blvd., "Nikolaevska" Str., "Gen. Skobelev Blvd., Tsar Osvoboditel Blvd., Hristo Botev Blvd., Vasil Levski Blvd., Dame Gruev Str. The distance between the stops is about 300 m.

On 10th of May 2019 the 'Good Night' line was launched and started operating. The night service runs from 0:30 h. to 3:10 h. The single-use ticket costs 1 BGN, as is the case with the other lines that run throughout the day. There is currently no provision for the introduction of separate monthly passes that apply only to the night line but citizens with travel passes for daily lines passing this route will be able to use them.

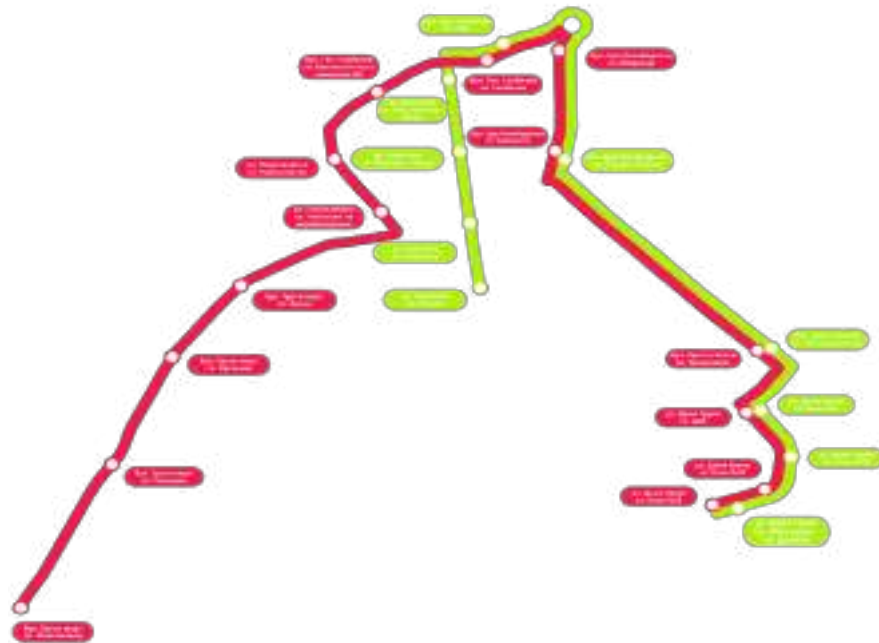


Fig. 1. Itinerary of the night line

РАЗПИСАНИЕ НА НОЩНАТА ЛИНИЯ

МАРШРУТ

ДРУЖБА 3 - ЦЕНТРАЛНА Ж.П. ГАРА

Дружба 3 - обръщало	01:00	01:50
Блок № 10	01:02	01:52
Блок № 6	01:03	01:54
Печатни платен	01:05	01:56
СУ "Йордан Йовков"	01:08	01:59
СБА	01:10	02:01
Мед. център - запад	01:12	02:03
Орхидея - запад	01:14	02:05
Некрасов	01:16	02:07
Космос	01:19	02:09

МАРШРУТ

ЦЕНТРАЛНА Ж.П. ГАРА - ДРУЖБА 3

Ж.П. Гара - ул. "Борисова"	01:25	02:16
Лермонтов	01:27	02:17
Орхидея - изток	01:29	02:19
Мед. център - изток	01:31	02:21
Скобелев	01:33	02:23
Оборище	01:35	02:25
Афродита	01:37	02:27
Технополис	01:40	02:30
ЦБА	01:42	02:32
Блок №33	01:44	02:34
Блок №28	01:46	02:36

МАРШРУТ

БОР - ДРУЖБА 3

Млекозавод	00:30
Пожарна	00:31
Организм	00:33
Фазан	00:34
Гимназия по корабостроене	00:36
Чайка - Изток	00:37
МГ "Баба Тонка" - юг	00:39
Скобелев	00:41
Оборище	00:43
Афродита	00:45
Технополис	00:46
ЦБА	00:50
Блок №33	00:52
Блок №28	00:54

МАРШРУТ

ДРУЖБА 3 - БОР

Дружба 3 - обръщало	02:40
Блок №10	02:42
Блок №6	02:44
Печатни платен	02:46
СУ "Йордан Йовков"	02:49
СБА	02:51
МГ "Баба Тонка" - север	02:53
Маршала Сени	02:56
Свет Уан	02:57
Жити	02:59
Юга	03:01
Виназавод	03:04
Бор	03:10

Проект "CIVITAS ECCENTRIC" - Иновативни решения за устойчива мобилност на хора в периферните градски квартали и товарна логистика без вредни емисии в градските центрове" се реализира в рамките на Програма "Хоризонт 2020" и цели да допринесе за подобряване на градската мобилност и качеството на градския транспорт в 5 европейски града - Мадрид, Виекни, Стокхолм, Турку и Рубо.

Fig. 2. Timetable of the nightline

A.2.1 Measure outputs

- **Output 1** – Public transport (PT) service during the night for the first time in Ruse (second in Bulgaria after the capital).
- **Output 2** – Improved livability in the peripheral district of Druzhba (people feel less isolated in their peripheral zone and equal to the citizens living in the centre)

A.2.2 Supporting activities

	Type of supporting activity	Activity	Target group	Main objectives
1.	Promotion	Media publications, Municipal site announcements, outdoor advertising (tables and posters in the PT vehicles)	Druzhba citizens, youth, visitors, people working in the Ruse suburbs	• To raise the awareness about the night line as a component of sustainable mobility • To support the use of the new PT night service • To decrease the use of cars/taxis in the night
2.	Promotion	Direct advertising (via dissemination of ECCENTRIC materials, direct meetings and discussions) – about 28 000 people.	PT-commuters – Druzhba citizens, youth, school students (aged 15-18)	• To persuade Druzhba citizens that they are not isolated and to popularize the MaaR (Mobility as a Right) concept among them; • To raise the awareness about the night line as a component of sustainable mobility • To support the use of the new PT night service • To decrease the use of cars/taxis in the night
3.	Training	Seminars, workshops, mobility conferences, festivals and other events	Druzhba citizens, school children, disabled people, academia – auditory of 350-400 participants	• To persuade Druzhba citizens that they are not isolated and to popularize the MaaR (Mobility as a Right) concept among them; • To raise the awareness about the night line as a component of sustainable mobility • To support the use of the new PT night service • To decrease the use of cars/taxis in the night
4.	Information	Media and non-media campaign (via social media, municipal site, the site of the National Coordinator on mobility and the SUMP focal point CSDCS, as well as via the Bulgarian SUMP network maintained by CSDCS	Large public of 140 000 Ruse citizens, transport professionals in Ruse and other cities, visitors of Ruse	• To raise the awareness about the night line as a component of sustainable mobility • To support the use of the new PT night service

Table 2. Supporting activities



Fig. 3. Information about the timetable and itinerary



Fig. 4. Information about the timetable and itinerary

A.2.3 Interactions with other ECCENTRIC measures

The successful implementation of this measure has interactions with the following CIVITAS ECCENTRIC measures Ruse:

- RUS 2.11 which aims at informing and promoting the new measure through training events and well targeted information campaign;
- RUS 2.6 because visitors could leave their cars at the P&R station and travel to the city centre using the night line;
- RUS 4.3 and RUS 4.4, which envisage the construction of safe pedestrian infrastructure in Druzhba (enlightened crosswalks and sidewalks) thus facilitating the access to the PT stops on the “V.Levski” Blvd.;
- RUS 5.3: Achieving the goals of the new facility is also strongly reliant on the realisation of the measure RUS 5.3 under which the public transport (bus and trolleybus) lines in Druzhba will be reorganised in order to better serve the needs of residents, commuters and visitors to the city. The new night line will be included in the whole transport scheme of Ruse and in the future its timetable and itinerary might be extended.

A.2.4 Interactions outside ECCENTRIC

There will be an important interaction with the Ruse SUMP implemented in the moment outside of ECCENTRIC. The night line is a part of the new Ruse transport scheme having as a main goal to better serve the Ruse citizens with PT for decreasing the use of cars for short trips, as well as to achieve better social equity and inclusion.

A.3 Target groups and/or affected part of the city or region

Target groups			Affected area		
Type		comment	Type		comment
1	Ruse (including Druzhba residents)	140 000 (28 000 in Druzhba)	1	Ruse (including Druzhba residents)	140 000 (28 000 in Druzhba)
7	Visitors	10 000	7	Visitors	10 000
3	PT users	55 000	3	PT users	55 000
10	Youth and students	10 000	10	School-children, youth and students	20 000

Table 3. Target groups or affected parties

A.4 Stakeholders: ECCENTRIC project partners and other important actors

Main stakeholders are participants from the target group. In the following table, the stakeholders are summarized by function.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR- other	Level of activity L-P-O	Role - Links
1	Municipality of Ruse	P	C	L	Project partner
2	Ruse PT Company	S	PT	P	PT provider
3	Ruse citizens	S	other	P	beneficiaries
4	Visitors of Ruse	S	other	P	beneficiaries
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 4. Measure stakeholders

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Measure Progress Reports are not delivered on time	Process	Standardized forms should be filled in instead	Nikolay Simeonov (ML)
Lack of interest to use the night line	Process	The municipality and CSDCS launch a large promotional campaign.	Nikolay Simeonov (ML)
People are not informed about the new transport links	Process	Close cooperation with the communication manager	Nikolay Simeonov (ML)

Table 5. Risks

B. Measure implementation

B.1 Situation before CIVITAS

In Druzhba neighbourhood lives about 20% of the Ruse population. There was no opportunity to use public transport to/from Druzhba neighbourhood in the city after 22 h. Most of citizens preferred to use their cars or taxis services instead of PT as they couldn't rely on it in the late hours of the day. As many people living in Druzhba couldn't afford to pay for taxi, they felt isolated and somehow discriminated in their peripheral district. The need of reorganizing PT and launching a night PT line was really urgent.

B.2 Innovative aspects

Ranking	Innovative aspect	Description
1	New approach for providing PT in the night	Introduction for the first time in Ruse

Table 6. Innovative aspects

B.3 Research and Technology Development

The main challenges faced while developing and implementing this measure so far have been to find the best solution for the vehicles to be used for operating the new line, and to identify an appropriate solution to award the operation of the service. As the municipality didn't have enough resources for purchasing of e-vehicles during the project lifetime, we decided to use the existing trolleybuses. This decision has solved the problem with the operator – the service was assigned to the municipal trolleybus company.

For establishing the most suitable itinerary, CSDCS used the data from the study of the mobility habits and needs in Druzhba (using secondary and primary sources - past project reports from TRANSDANUBE and BUMP; panel study, telephone interviews, e-questionnaires), as well as the data from the study made by the subcontractor "Mobilissimus" (HU) for the measure 5.3 "New PT scheme in Ruse".

B.4 Actual implementation of the measure

During the phase 1 “Research and planning” (01.12.2016 – 31.01.2018) the Municipality of Ruse received financing for implementing a SUMP. There was a high demand for a night PT service proved by the research done by CSDCS. Numerous letters from citizens have been received in the Municipality suggesting and asking to provide public transport during the night. The analysis of PT demand and the reorganization of the PT network in Druzhba district became part of this SUMP but performed in the frames of the ECCENTRIC project. After obtaining the results from the analysis, Ruse municipality established the night bus itinerary.

In February 2018 started the 2nd phase “Procurement and implementation phase”. Ruse Municipality finalised the procedure for choosing a contractor to update the whole transport scheme of the municipality, which also included the definition of the route of the Good night line, based on the PT demand of the citizens of Druzhba district and the results of the secondary sources. After the definition of the route, the operation of the service was subcontracted to the local public transport operator.

In April 2019 the new transport network was developed and approved by the City Council. The 3rd phase started next month, when the new ‘Good Night’ line was officially opened on 10th of May 2019. The operation of the new night line was accompanied with a large media and non-media promotion and information campaign held by CSDCS. The number of passengers increased and in September the City Council decided to extend the hours of services of the night line from 0:30 – 3:10 h to 21:30 – 3:30 h. By the end of 2019 the line registered 5 time more passengers than in the beginning.

Since November 2019 CSDCS was implementing the last Phase 4 “Conclusions and recommendations” by studying the impact of this new PT service.

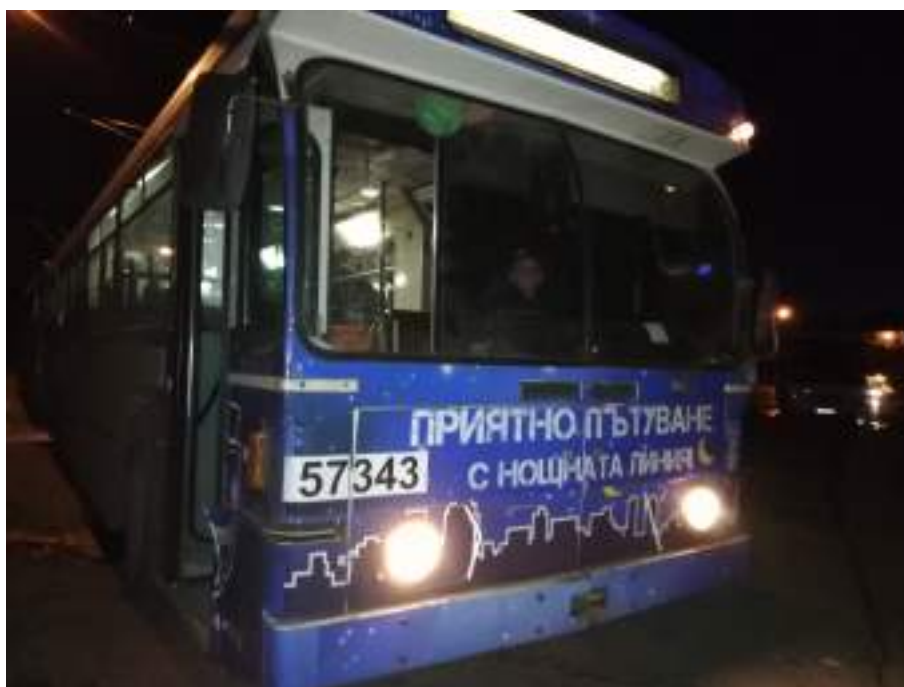


Fig. 5. Ruse nightline

B.5 Evaluation approach

B.5.1 Expected impacts and indicators

	Impact category	Expected impacts	Aspect of this category	Indicators	No.
1.	Environment	Emissions	Decrease of CO ₂ , NO _x and PM emissions	Pollutions	23
2.	Transport system	Decrease use of private cars and taxis	Increased use of PT with 20% (including by night)	Use of PT	1
3.	Society	Use of PT by local residents	Increased use of PT by residents with 20%	Mobility behavior	1

Table 7. Impacts and indicators

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement
23	CO ₂ emissions	Average monthly - mg/m ³	B - A	DC	Druzhba neighborhood	Druzhba neighborhood (measured by the mobile station Ruse)
24	NO _x emissions	µg/m ³	B - A	DC	Druzhba neighborhood	Druzhba neighborhood (measured by the mobile station Ruse)
25	PM emissions	µg/m ³	B - A	DC	Druzhba neighborhood	Druzhba neighborhood (measured by the mobile station Ruse)
23	CO ₂ saved	t/year	A	E	Druzhba neighborhood – city centre	Calculated
24	NO _x saved	t/year	A	E	Druzhba neighborhood 0 city centre	Calculated
25	CH ₄ saved	t/year	A	E	Druzhba neighborhood 0 city centre	Calculated
11	Modal split	%	B - A	S	Druzhba citizens	Druzhba neighborhood
1	Awareness	%	B - A	S	Druzhba citizens, visitors	Druzhba neighborhood
2	Acceptance	%	B - A	S	Druzhba citizens	Druzhba neighborhood
3	Satisfaction	%	B - A	S	Druzhba citizens	Druzhba neighborhood
29	Operational Costs	EUR/month	B - A	DC	Municipal budget	“Good night” PT line
28	Investment costs	EUR	B - A	DC	Municipal budget	“Good night” PT line
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 8. Indicators and measurements

B.5.2 Baseline

As a baseline were used:

1. **The level of CO₂, NO_x and PM emissions in Druzhba:** the data was obtained by the mobile station of the Regional Inspectorate of the Ministry of Environment and Waters (MOEW) in Ruse. They measure the emissions' level in Druzhba every day and publish the average daily data for each month. Although CSDCS thinks that the impact of only one PT-line running for several months will be insignificant over the district with 27 000 inhabitants, the team collected the data for the month before opening the “Good night” line (April 2019) and they were as follows:

- CO₂ - 10 mg/m³;
- NO_x – 106.4 µg/m³;

- PM – 52.3 µg/m³.

2. Modal shift - For defining the baseline data, CSDCS used the data from the first research in May/June 2017 aiming to establish the initial modal split in Druzhba. The estimations were that this PT-line will be used by local citizens living in Druzhba district. First, CSDCS conducted a local citizens' survey. The methodology for the selection of respondents was quota-based, with a sample size of 215 people randomly selected and evenly distributed in the three neighbourhoods of Druzhba district (Druzhba 1, Druzhba 2 and Druzhba 3), which guaranteed its representativeness. Subjects of the survey were individuals from all age groups of 15 and over, i.e. people who actually use public transport services and could give an objective assessment of both the advantages and disadvantages they face in their daily lives. For this purpose the following methods of registration of the information were used:

- direct group poll (participants in the citizens trainings) - 65 people;
- standardized face-to-face interview - 150 people random selected in the three Druzhba neighbourhoods;
- A supplementary group of 10 local leaders were interviewed orally by extended questionnaires (audio-registered conversations).

After processing the interviews' results, CSDCS established the mobility habits of Druzhba citizens and the modal split was as follows:

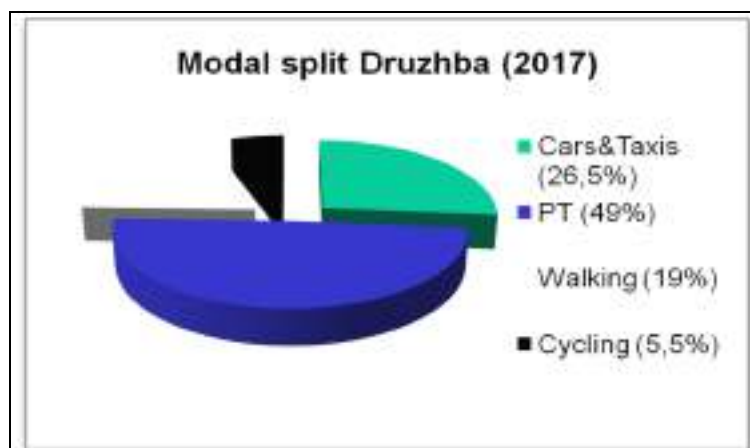


Fig. 7. Modal split Druzhba

3. Awareness and acceptance - During the study aiming at defining the baseline data, the awareness and acceptance were totally absent, because people didn't believe that a night PT could be launched in their district. In fact, such service was only provided in

the Bulgarian capital but because of low demand the night service was removed very fast.

CSDCS concluded that a lot of training, information and promotional events would be necessary in order to introduce the night PT service, to explain its profit for the citizens and to make people using it instead of their private cars or taxis for travelling in the night.

4. **Satisfaction** - According to the baseline analysis done by CSDCS, 90% the citizens of Druzhba district were not satisfied with the PT service after 21 h. estimating that they were deprived of transport links to the city centre. People felt isolated and excluded from the night life in the city, because all the Ruse attractions (restaurants, bars, cinemas, night clubs, etc.) were situated in the central part at 3 km from Druzhba.

B.5.3 The business-as-usual scenario

The BAU scenario was discussed during the meeting with stakeholders held in the Ruse Municipality on 7th of May 2019. In the analysis of such a model, the results were discouraging. Transport demand would increase in line with population ageing, the internal migration from rural to urban areas, and greenhouse-gas (GHG) emissions could rise proportionally. City dwellers would travel in mostly the same ways as they do now, and private cars would continue to account for about 35 percent of passenger-kilometers. Average travel times would increase by 15 percent because capacity would be strained.

This scenario permitted the project team to evaluate the current situation and to make several important conclusions. Without the night line Druzhba people estimate they are deprived with links to the city center and feel like a marginal group (90% of citizens). If the night line was not implemented this opinion would persist leading to social conflicts and even to some civil disobedience. With the rise of the price of fuel, people would not be able to pay taxis or to use their cars for night purposes which will lead to degradation of quality of life in Druzhba.

The presentations of the Ruse PM Mr. S. Karapchanski, the Dep. Mayor on Environment and the Chief-on-Architect of Ruse demonstrated that if the measure 5.4 is never implemented and the night PT service is not adopted in Ruse, the social exclusion in Ruse will go further provoking deeper dissatisfaction and the peripheral districts of Ruse will have low leaving standard.

It was mentioned that the night PT service will be introduced for the second time in Bulgaria after the failure in Sofia and many efforts are necessary for maintaining the demand and the

satisfaction of people high enough. Because of the lack of any experience, the audience needs a lot of information and promotional materials in order to start using the new service.

B.6 Measure results

For evaluating the measure results, CSDCS processed the data collected in the period November 2019 – January 2020.

6. **Modal shift** – CSDCS evaluated the modal shift according to the data obtained by the survey made in the period 20.11.2019 - 20.12.2019 in Druzhba with the established 150 panel respondents. They were contacted by the interviewers face-to-face or by phone and answered to similar questions as in the initial survey made in May 2017 concerning their travel mode, their opinion and use of the new measures, implemented in Ruse, etc. For obtaining the same number of 215 respondents as for the baseline study, CSDCS conducted oral interviews (registered by smart phones) with 30 school children from “V.Levski” school in Druzhba, 20 commuters using the night line and 15 participants from Ruse during the 3rd ECCENTRIC Conference.

The results obtained from the 215 respondents showed that 76% of the local population used for their every-day trips PT, walking or cycling. It meant that there was a shift to more sustainable way of moving. The initial percent of 73.5% increased with 2.5% and the sustainable commuters became 76%. The picture obtained was as follows:

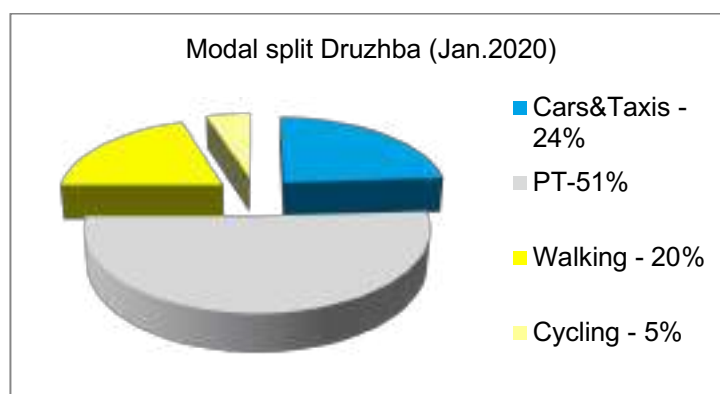


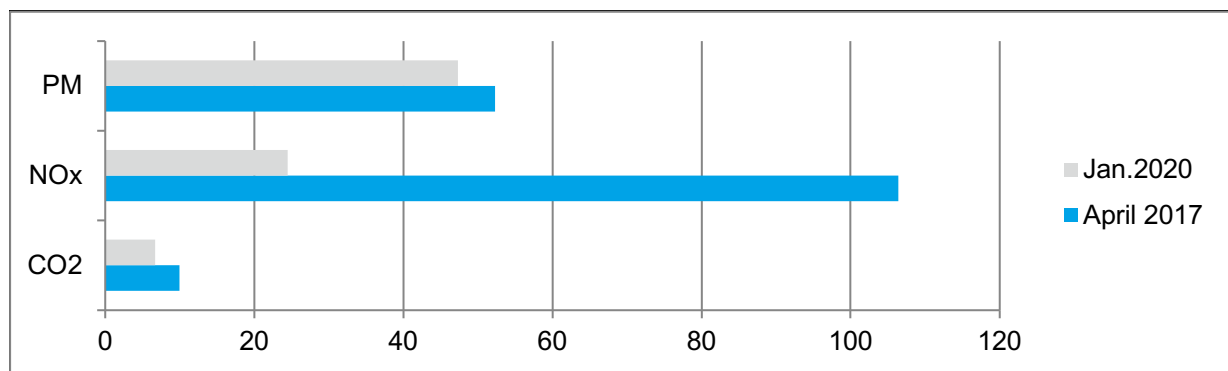
Fig. 7. Modal split Druzhba (Jan.2020)

The PT use increased also with 2% - from 49% to 51%. The walking increased with 1% from 19% to 20%. In general the trend is positive, although due to the late implementation of the technical measures in Ruse, they were in use only for a few months and couldn't influence much the travel behaviour of the citizens although they were well informed about them and persuaded that they will increase their safety when moving.

7. **The level of CO₂, NO_x and PM emissions in Druzhba**: the data was obtained by the end of December 2019 by the mobile station of the Regional Inspectorate of the Ministry of Environment and Waters (MOEW) in Ruse. They measure the emissions' level in Druzhba every day and publish the average daily data for each month. For January 2020 the data are:

- a. CO₂ – 6.7 mg/m³;
- b. NO_x – 24.5 µg/m³;
- c. PM – 47.3 µg/m³.

There is a slight improvement of the air quality partly due to the new measures. It is shown on the graph below:



(Data from <https://www.riosv-ruse.org/danni-punktove/>)

Fig. 8. Level of emissions

The emissions saved in t/year are calculated in the Annex 1.

8. For evaluating the **Awareness, Acceptance, and Satisfaction**, CSDCS processed the data obtained from the 215 respondents from the panel and the results of the direct oral interviews. The awareness about the mobility measures implemented under ECCENTRIC and in particular about the new “Good night” line increased from 70% to 90%. The acceptance was 90%, because about 10% wanted to have night PT service all over the city. We obtained the same results for the level of satisfaction.
9. **Investments and operational costs**: The investment in the new PT service is of € 99 000 and the operational costs for the past 8 months of exploitation are € 89 648 (€11206 / month).

The results are summarized in the table below:

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
23 – CO2 emissions	mg/m ³	10	April 2019	10	May 2019	6.7	Jan. 2020	3.3	3.3
24 – NOx emissions	µg/m ³	106.4	April 2019	106.4	May 2019	24.5	Jan. 2020	81.9	81.9
25 - PM emissions	µg/m ³	52.3	April 2019	52.3	May 2019	47.3	Jan. 2020	5	5
23-CO2 - saved	t/year	0	April 2019	0	May 2019	25344	Jan. 2020	25344	25344
24- NOx - saved	t/year	0	April 2019	0	May 2019	0.009	Jan. 2020	0.009	0.009
25 – CH4 saved	t/year	0	April 2019	0	May 2019	0.0043	Jan. 2020	0.0043	0.0043
11 - Modal split	%	49 -PT; 26.5 - car	June 2018	49 -PT; 26.5 - car	May 2019	51-PT 24 - cars	Jan. 2020	+2 PT -2.5 cars	+2 PT -2.5 cars
1 - Awareness	%	0	June 2018	70	May 2019	90	Jan. 2020	90	20
2 - Acceptance	%	0	June 2019	70	May 2019	90	Jan. 2020	90	20
Satisfaction	% (0-5 scores)	10% 0.5	May 2019	10% 0.5	May 2019	90% 4.5	Jan. 2020	80% 4.0	80% 4.0
Operational costs	EUR/month	0	May 2019	0	May 2019	89 648	Jan. 2020	89 648	89 648
Investment costs	EUR	0	May 2019	0	May 2019	85 262.5	Jan. 2020	85 262.5	85 262.5

Table 9. Level of emissions

B.7 Summary: achievement of objectives

Due to financial reasons this measure was implemented by the Ruse municipality later than planned. The new “Good night” line was officially opened on 10th of May 2019 and is successfully running for the first time in the Ruse.

The achievement of some objectives below was made at a reduced rate with the expectation that after a long run they will be achieved together with the other ECCENTRIC measures. CSDCS has planned too ambitious goals concerning the decrease of car use and increase of PT use (20% each) without taking into account that for a period of several months no new mobility measure is able to achieve such high positive results. People are accustomed to using their cars and do not trust public transport, which has not been at the desired level for years. In such conditions the positive trend in both car and PT use is a success. CSDCS registered

2.5 % less car usage thus providing a decrease by 10.4% comparing to the initial value, as well as 2 % more use of PT thus providing an increase by 4% comparing to the initial value.

The quality of the air was improved that is partly due to the combination of new mobility measures. CO2 emissions decreased with 33%. CSDCS registered 2.5 % less car usage thus providing a decrease by 10.4% comparing to the initial value. CSDCS also registered 2 % more use of PT thus providing an increase by 4% comparing to the initial value.

One can report that the measure strongly contributed to the social inclusion and livability in Druzhba. 90% of the citizens accept it and estimate that it will improve their living conditions. 90% are satisfied with the “Good night” line because it gives them possibilities to move in the night and to have access to the Ruse evening attractions thus decreasing the social inequality and improving the quality of life in the peripheral district.

No.	Objective and target	Rating	Comment
1	Decrease the CO2 emissions with 10%	★★	CO2 emissions decreased with 33%
2	Decrease the use of cars with 20%	★	We registered 2.5 % less car usage thus providing a decrease by 10.4% comparing to the initial value
3	Increase the use of PT with 20%	O	We registered 2 % more use of PT thus providing an increase by 4% comparing to the initial value
4	Improve social inclusion	★★★	90% are satisfied with the measure
5	Improve livability	★★★	90% acceptance of the measure
6	CO2 emissions saved (t/year)	★	25344 t/year saved
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★★ = Exceeded			

Table 10. Achievement of objectives

C. Process Evaluation findings

N/A

D. Evaluation conclusions

The observed impacts of the measure has been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

The night line runs only 9 months and this period is very small but already has some positive local impact, described in the C3 section.

D.2 Relevance of supporting activities

The supporting activities were relevant and contributed to:

- support the ECCENTRIC measures
- raise the awareness about the night line as a component of sustainable mobility

D.3 Interaction with other measures

- RUS 2.11 which aims at informing and promoting the new measure through training events and well targeted information campaign
- RUS 2.6 because visitors could leave their cars at the P&R station and travel to the city centre using the night line.
- RUS 4.3 and 4.4, which envisage the construction of safe pedestrian infrastructure in Druzhiba (enlightened crosswalks and sidewalks) thus facilitating the access to the PT stops on the “V.Levski” Blvd.
- RUS 5.3: Achieving the goals of the new facility is also strongly reliant on the realisation of the measure 5.3 under which the public transport (bus and trolleybus) lines in Druzhiba will be reorganised in order to better serve the needs of residents, commuters and visitors to the city. The new night line will be included in the whole transport scheme of Ruse and in the future its timetable and itinerary might be extended.

D.4 Main lessons learned

Although the number of passengers increased 5 times since the beginning of the service, their total number is small and is not sufficient to support the service after the end of the project.

D.5 Long term impact

- Reduction of cars flow in the night
- Social inclusion of disadvantaged groups

D.6 Potentials for up-scaling in the city

n/a

E. Additional information

E.1 Appraisal of evaluation approach

- The measure used relevant evaluation methods that could provide more reliable results in a long-term run.

E.2 Future activities relating to the measure

- Asking for funding in order to support the measure after the end of the project.

F. Annex 1

The Table 9 indicates the greenhouse gas pollution reported in the target region of Ruse according to the data from the Mobile station for measuring the **indicators of air quality**. The units of GHG are provided in and they show the difference in the air pollution before and after the measure, i.e. how the air pollution has decrease after the introduction of the measure RUS 2.6.

The required quantities **in tones/year** represent the **GHG emissions saved** as a result of the introduction of the measure RUS 2.6. They can be calculated theoretically on annual basis only after the introduction of the measure, so in the Table 9 there are no any data 'before' the measure.

The calculation of the saved greenhouse gas emissions as a result of the implemented measure RUS 2.6 has been made according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (<https://www.eea.europa.eu/themes/air/air-pollution-sources-1/emep-eea-air-pollutant-emission-inventory-guidebook>), using the general formula:

$$E_i = \frac{AD_i * EF_i}{10^6}$$

where:

E_i - greenhouse gas emissions in t;

AD_i - data on the total annual mileage of vehicles (in km);

EF_i - emission factor for the respective category (in g/km).

For the estimation of greenhouse gas (GHG) emissions, the following emission factors have been used, which were calculated as weighted average values on the basis of the data used for the preparation of the National Greenhouse Gas Inventory (<http://eea.government.bg/bg/dokladi/unfccc>):

CO₂ g/km – 220

CH₄ g/km – 0,037

N₂O g/km – 0,008

The total number of cars that used the buffer parking is 4 745 pcs. for a 6-month period, or an average of about 800 cars a month. The average annual number of cars in this trend of parking use is 9 600.

The distance from the parking lot to the center is 12 km in both directions / car / day. This is the average daily mileage that would drive a car from the parking lot to a central city area.

The annual average mileage (km) is:

$$9\,600\text{ pcs.} \times 12\text{ km mileage / car / day} = 115\,200\text{ km mileage}$$

Table 10

Number of vehicles reported by the system on a monthly basis (2019 data)

Month Reported data	July	August	September	October	November	December	Total
Number of cars registered	310	465	720	930	1085	1240	4750

Average car fuel consumption: 10lt / 100 km (urban);

Total Fuel Consumption: 11 520 lt (11,520 t)

The reduction of greenhouse gas emissions resulting from the built-in buffer car park is as follows:

$$115\,200\text{ km / year} \times 220\text{ CO}_2\text{ g/km} / 10^6 = \mathbf{25,344\text{ t/year of CO}_2\text{/year saved;}}$$

$$115\,200\text{ km / year} \times 0.037\text{ CH}_4\text{ g/km} / 10^6 = \mathbf{0.0042624\text{ t/year of CH}_4\text{/year saved;}}$$

$$115\,200\text{ km / year} \times 0.008\text{ N}_2\text{O g/km} / 10^6 = \mathbf{0.0009216\text{ t/year of N}_2\text{O /year saved.}}$$

These estimates show a high potential for annual savings. Indicative of this are lower levels of greenhouse gas pollution reported in the region (Table 9. Emissions level) during the period.



2020
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Cleaner and better transport in cities

ECCENTRIC



TUR 5.5

Bike-sharing and Car-sharing Schemes Measure Evaluation Report

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Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
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3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Stella Aaltonen	Katariina Salokannel

Table of Contents

ABSTRACT.....	1024
A. INTRODUCTION.....	1025
A.1 EXPECTED RESULTS OF THE MEASURE	1025
A.1.1 Quantifiable impacts.....	1025
A.2 MEASURE DESCRIPTION	1026
A.2.1 Measure outputs.....	1026
A.2.2 Supporting activities	1026
A.2.3 Interactions with other ECCENTRIC measures.....	1026
A.2.4 Interactions outside ECCENTRIC	1026
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1027
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1027
A.5 IDENTIFIED RISKS	1028
B. MEASURE IMPLEMENTATION	1029
B.1 SITUATION BEFORE CIVITAS	1029
B.2 INNOVATIVE ASPECTS.....	1029
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1029
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1029
C. IMPACT EVALUATION FINDINGS	1034
C.1 EVALUATION APPROACH.....	1034
C.1.1 Expected impacts and indicators.....	1034
C.1.2 Baseline.....	1035
C.1.3 The business-as-usual scenario.....	1039
C.2 MEASURE RESULTS.....	1040
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1049
D. PROCESS EVALUATION FINDINGS	1050
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1050
D.1.1 Deviation 1: number of bikes.....	1050
D.1.2 Deviation 2: Change in ML	1050
D.1.3 Deviation 3: Partial reallocation of focus	1050
D.2 BARRIERS	1050
D.2.1 Organisational	1050
D.2.2 Problem-related.....	1050

D.2.3	<i>Planning</i>	1050
D.2.4	<i>Institutional</i>	1050
D.2.5	<i>Political/strategic</i>	1051
D.2.6	<i>Technological</i>	1051
D.3	DRIVERS	1051
D.3.1	<i>Financial driver</i>	1051
D.3.2	<i>Political/strategic</i>	1051
D.3.3	<i>Political/strategic</i>	1051
D.3.4	<i>Planning</i>	1052
D.3.5	<i>Involvement/communication</i>	1052
D.4	SUPPORTING ACTIVITIES.....	1052
D.4.1	<i>Supporting activity 1</i>	1052
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	893
D.5.1	<i>It's all in the planning!</i>	893
D.5.2	<i>Political will and commitment is needed</i>	1052
E.	EVALUATION CONCLUSIONS	1053
E.1	VALIDATED DIRECT IMPACT	1053
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1053
E.3	INTERACTION WITH OTHER MEASURES	1053
E.4	MAIN LESSONS LEARNED	1053
E.5	LONG TERM IMPACT	1054
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1054
F.	ADDITIONAL INFORMATION	1055
F.1	APPRAISAL OF EVALUATION APPROACH	1055
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1055

List of Figures

Figure 1. Modal split according to the National Travel Survey 2008 / 2016.....	1036
Figure 2: Mode of travel / summer months	1037
Figure 3: Mode of travel / Winter months	1038
Figure 4. Bike share acceptance.....	1042
Figure 5. System satisfaction (customer survey).	1043
Figure 6. System satisfaction (cycling barometer).	1043
Figure 7. Reasons for not using the city bikes.	1044
Figure 8. Rides per month on the city bikes 2018/2019.....	1044
Figure 9. Vehicle-Km travelled May 2019 - January 2020.	1047
Figure 10. Vehicle-Km travelled May 2019 - January 2020.	1047

List of Tables

Table 1: Quantifiable impacts.....	1025
Table 2: Target groups or affected parties.....	1027
Table 3: Measure stakeholders.....	1028
Table 4: Risk assessment.....	1028
Table 5: Description of indicators.....	1050
Table 6: Measurements	1051
Table 7: The main daily or almost daily mode of travel for Turku region / 2017	1038

Project	City		
ECCENTRIC	Turku		
Measure code	Measure name		
TUR5.5	Bike-sharing and Car-sharing Schemes		
Last update	Responsible	e-mail	telephone
10.5.2020	Stella Aaltonen	stella.aaltonen@turku.fi	+358 44 9075983

Abstract

Bike share schemes offering affordable short-term rentals on a predefined geographical area have sprung up in many cities during the recent years. In Finland, Helsinki was the first city to implement a bike share system in 2016 and Turku followed with the system implemented in measure TUR 5.5. The system was to complement Turku's public transport services and to be integrated to the public transport Föli's IT-platform, providing a quick and easy way of getting around the city centre. The bikes were to be available all year round and in the wintertime they were to be equipped with winter tyres. The bike share system was to consist of bikes for public use and bike stations that serve as pick-up and drop-off points. The user could pick up and drop off a bike at any station. The station network expands from the Kupittaa laboratory area along the city centre up to the port of Turku. In addition to bike share system implementation, the measure aimed to encourage and enable car sharing systems to be offered in Turku.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data is gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 5.5. was measured. Data for the evaluation was derived from surveys, system usage logs, GPS logs, secondary sources from the city of Turku, policy documents and from the Measure Leader.

On the face of it, the measure achieved half of its main goals. The bike share system of 300 bikes and 37 stations is now in place. Car sharing companies are now offering their services in Turku, to be attributed to ECCENTRIC effect to a great extent. However, the city bikes have not become as attractive as was hoped and it remains inconclusive whether the system implementation has led to a growth in public transport. Mitigating factors and negative interference, both internal and external, have been recognized that could explain the lower system usage at least to some extent. Problems prevailing with the technical realization of the user interface, for example, are likely to have caused loss of users. Despite lower system usage than expected, the measure has however reached its main goals somewhat satisfactorily and, importantly, served as a valuable learning process for implementing a novel system with some unique characteristics.

A. Introduction

A.1 Expected results of the measure

The measure objectives were as follows:

(1) City policy level in perspective of CIVITAS goals/ longer term:

The measure aimed to promote car independent lifestyles and to implement integrated packages of technology in the city of Turku by complementing PT services by providing the first bike sharing system in Turku. Promoting car share was expected to decrease car ownership in the long run.

(2) Strategic level:

This measure was expected to increase the usage of public transportation in Turku by offering different alternatives suitable for various purposes. The measure was also to increase the popularity and attractiveness of cycling by introducing a bike share system. The bike share system was also expected to make cycling easier in both the city centre and the Kupittaa laboratory area. Renting or sharing a car was to become a more attractive alternative instead of car ownership via the introduction of car sharing schemes in the city area.

(3) Measure level:

The measure aimed to implement a bike share system of at least 100 bikes. The bike share system was to consist of at least two different key components:

- The city bikes
- Other bikes and vehicles available on the same platform (e.g. library and university bikes, bicycles from private rental companies, other types of electric vehicles)

The aim was that the system became so attractive that the amount of rentals would rise above the bike share system average, with the common average number of rentals per bike being one rent per day. There was to be a technical framework ready for car rental and first demos planned with car sharing providers or with existing car fleet owners, such as the city or the universities.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
1	The city bike system is in use	x			x			x	x		
2	Car sharing companies have tested their services in Turku				x			x	x		

Table 1: Quantifiable impacts.

A.2 Measure description

Bike share schemes offering affordable short-term rentals on a predefined geographical area have sprung up in many cities during the recent years. In Finland, Helsinki was the first city to implement a bike share system in 2016 and Turku was to follow suit with the system implemented in TUR 5.5. The system was to complement Turku's public transport services and be integrated to the IT-platform of the public transport office Föli, providing a quick and easy way of getting around the city centre. The bikes were to be available all year round and in the wintertime they were to be equipped with winter tyres.

The bike share system was to consist of bikes for public use and bike stations that would serve as pick-up and drop-off points. The user would be able to pick up and drop off a bike at any station. The station network was to extend from the Kupittaa laboratory area along the city centre to the port of Turku.

Another objective of the measure was to encourage and enable car sharing systems to be offered in Turku. Demos were to be planned with private car sharing providers or with existing car fleet owners like the city, the universities and other big car fleet owners.

A.2.1 Measure outputs

As a result of the measure, Turku aimed to have a bike sharing system of at least 100 bikes (the number was later increased to 300 bikes). In addition, car sharing companies were to have tested their services in Turku.

A.2.2 Supporting activities

Promotion of car share within the scope of the measure was connected with the development of parking policies in the city of Turku. There were ongoing processes to renew these policies which were hoped to better enable car share services.

A.2.3 Interactions with other ECCENTRIC measures

The measure was to interact with measure STO 3.5. "Develop smart choice mobility services" regarding car sharing company UBIGO. There had been discussions about the possible cooperation with UbiGo in Turku. The bike share system was to be year-round and therefore it had interactions with measure TUR 4.8., where year-round cycling is promoted. The measure was also to be promoted in measure TUR 2.2. "City District / Urban Corridor Case as a Pilot for Sustainable Urban Mobility". This measure was also to be directly linked with measure TUR 3.2. "Integrated Ticketing and Information System for Mobility", in which a new open data interface and platform were to be developed into which the ticketing system of the public transport system would be incorporated. This was to enable the integration of the bike share system to the PT.

A.2.4 Interactions outside ECCENTRIC

For the bike share procurement, several lessons learnt from other systems world-wide were gathered.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Bike share system users	Turku	The service targets all Turku residents
3	PT users as the bike share system is connected to the regional PT system	Turku region	Season ticket users of PT
7	Visitors to Turku	Turku	The bike share has a day ticket which is hoped to attract also short-term visitors
6	Commuters	Turku region	The bike share system may serve those commuting to Turku from the surrounding municipalities.

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	The City of Turku	P	C	L	Lead partner
2	Föli, Turku Region Traffic	S	PT	P	Provider of regional public transport services, partner
3	Helsinki Region Transport	S	PT	O	Provider of the Helsinki bike share system
4	Regional Council of Southwest Finland	S	Other	P	Partner, bike share promotion
5	Tampere University of Technology	S	KI	O	Diploma workers for the project will be recruited from TUT
6	City bike providers	S	PR	P	To be approached when tendering for the bike share system
7	Car-sharing providers	S	PR	P	Negotiations to be held in relation to car share demos in Turku
8	VR Group, State Railways	S	PT	O	The two railway stations in Turku are prime locations for bike share stations
9	Outdoor advertisement operators	S	PR	O	Different outdoor advertisement operators for the City bikes and illuminated advertisements have been identified for the implementation and operation of the measure
10	City of Helsinki	S	C	O	An important peer in measure as the first bike share system in Finland was established in Helsinki
11	Turku Cyclist's association TURPO	S	NG	O	The association is affiliated with the cycling development within ECCENTRIC, providing expertise on city bike sharing systems
12	Media	S	Other	O	Provides visibility for the bike share system
13	Shops located around the bike stations	S	PR	O	Targeted marketing for the shops.
Type: P:CIVITAS partner – S: other stakeholder					

Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company
 Level of activity: L: Leading role – P: Principle participant – O: Occasional participant

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Risks related to the technical realisation of city bike system, misuse of the system and subsequent effects on availability of user data	4	Flexibility of the budget, proper communication plan to launch and inform about the usage, positive examples	ML, SC
Lack of respondents to the targeted web-based survey questionnaire	4	Thorough marketing of the survey; possible “carrots” to survey respondents	ML
GPS data malfunction	3	Pre-testing and regular quality control	ML
The BSS is currently facing a rapid change with free floating BSS systems becoming a viable option in the market.	7	It was decided to procure a BSS that combines stations with the possibility to offer also free-floating bikes at the later stage. Also the it-platform is developed to incorporate other service providers in.	ML
Low nsystem usage for the bike share	5	In-depth analysis of reasons behind potential low system usage	ML

Table 4: Risk assessment.

B. Measure implementation

B.1 Situation before CIVITAS

There was no city bike system in Turku prior the project. Only a few bikes were available for short time rental in the library (or other similar places). There were no car-sharing companies operating in Turku. According to the cycling barometer of 2016, only 11% of Turku residents had used a bike share system in another city. Over 70% of the respondents stated, however, that they would be interested in using shared bikes if made available at suitable locations.

B.2 Innovative aspects

The planned procurement model for the city bike system was to be a novel way of doing the procurement – it was to include bikes, stations, operating and balancing but not the customer service, marketing or IT-side. The marketing side was to be tendered separately.

B.3 Research and Technology Development

No research or development activities were conducted as part of this measure.

B.4 Actual implementation of the measure

Some significant changes were made to the original measure plan along the inception time. The number of the bikes raised from 100 to 300 during the planning phase. The Turku city executive board accepted the proposal for the bike share system (henceforth BSS) procurement in April 2017. The procurement was to consist of 300 bikes and 37 stations (34 stations at fixed locations and three portable pop-up stations). These numbers were higher than originally planned in CIVITAS ECCENTRIC as it soon became apparent that the original number of bikes was too low. After approval from the executive board, the procurement phase began.

It should also be noted that the research, planning, procurement and implementation of the bike share system was a complex task that took more time than originally estimated and included some heavy-weight political arm wrestling especially on the issue of ensuring suitable locations for the bike share stations. As the measure proved rather overwhelming in terms of the amount of work required for planning and implementation of the bike share, car sharing received less attention to begin with.

The measure leader was changed as Jari Paasikivi left the project and Stella Aaltonen took over measure leadership in May 2017.

Phase 1: Research and measure planning (100% completed)

The research and planning of the BSS in Turku started officially in September 2016 and was finalized in February 2017. During this phase, the following activities were carried out:

- Internal dialogues with stakeholders and politicians, market dialogue with potential providers, operators and maintenance companies were conducted. M1-M6
- Benchmarking of existing bike sharing systems, literature and reports took place. M1-M6

- Marketing analyses of the car sharing companies in Turku area: the existing car sharing companies and their needs for market penetration in Turku were analysed. M3-M6
- Baseline data collection: gathering of baseline data from different sources and creation of starting maps for the bike sharing system, meetings with LEM and instructing with data collection activities regarding the baseline and BaU, instructing with the gathering of stakeholder feedback. M1-M6

Phase 2: Procurement and implementation (100% completed)

The procurement and implementation of this measure commenced in March 2017 and was completed in April 2018. The Turku city board accepted the proposal for the bike share procurement in April 2017. This was an arduous phase centred around the tendering for the bike share system and planning and setting of the station locations, as well as brand and marketing development. Based on the planning phase a proposal to the city board was made that included annual financing of 150,000 euros for the system of 300 bikes and 37 stations. This was accepted. The proposal also included an income plan from sponsoring and marketing. Based on this, the procurement for the marketing and sponsoring part was carried out separately from the actual BSS.

During this phase, the following activities were carried out:

- Preparations for the procurement of the BSS, planning of the income and cost model for the system, market discussions. M7-M9
- Tendering of the system and drawing up the contract with the chosen supplier. The tender was won by Nextbike Polska Ab for a contract of 3+3 years. M10-M13
- Tendering of the marketing and digital side of the bike sharing system: the physical marketing side of the bike sharing system was won by Clear Channel Suomi Oy, the digital side by Laulava Ovipumppu Oy. M13-M18
- Planning of the station locations (34 locations + three pop-up stations, app. 8-9 bikes per station). This included an internal process regarding the station plan and an external process regarding the other locations. After these processes, the locations were debated and decided by the politicians and all of the citizens living around the immediate location of a future bike sharing station were contacted by post. After the location places were decided, physical improvements of five station locations were made. M7-M18
- Creating a brand for the bike sharing system: creating the identity of the system with graphical elements, website plan, marketing plan, information materials, user videos, PR-videos, news, stakeholder involvement through local sparring group meetings. This phase also included pre-marketing for the companies located around the future bike sharing locations. The system was dubbed “Föli-fillarit” and it is brand protected. M13-M18
- Creating the pricing, ticketing system, registration system and IT-interphases in cooperation with the operator and the project partner Western Systems under measure 3.2. M17-M18
- Creating the bike sharing system from the operational side of the system together with Nextbike Polska Ab. Enabling the local maintenance to be in place. M14-M18
- Planning of the customer service and the process for informing faults in the bike system. Trainings for the customer service employees. M18-M20

- Planning process for the implementation of the physical marketing side of the BSS and the digital side of the system with the chosen operators. M15-M20
- A Masters of Science thesis was published called “The procurement of a mobility service – case bike sharing system of Turku” by Mikko Vallbacka. M20

The development of a BSS that is procured in a new way ended up causing more work than originally planned. Due to this, actions regarding the car-sharing were not prioritized before the launch of the bike share system. Therefore, this part of the measure did not proceed as quickly as was hoped.



Picture 17: The Föli-fillarit station sign and the bike share system launch event on May1st 2018.

Phase 3: Demonstration and monitoring (80% completed)

Demonstration and monitoring of this measure commenced in March 2018 and were to be completed in April 2020. The bike share system was launched on the 1st of May 2018. During this phase, adjustments have been made to the pricing of the system and some of the station locations. There have been various technical difficulties with the bikes. This has caused extra work to both the technical staff and the customer service.

During this phase, the following activities were carried out:

- Planning of the launch of the BSS together with third parties. Recruitment of the volunteers for the launch event. PR plans for the launch event. M19-M21
- Creating communication and marketing elements for the bike sharing system: FAQs, information tables, marketing brochures and campaigns, videos for the system, developing social media and print campaigns. M19-M38
- Stakeholder involvement and integration: involvement of different stakeholders into the bike sharing system, political discussions, integration of the topic into strategic documents. Group of key stakeholders meet regularly to develop different sides of the system. M19-M31
- Practical arrangements with the service providers: arrangements with service providers of the physical system, physical marketing and digital marketing, organizing the permissions, security issues, neighbourhood letters etc. M19-M44
- Constant meetings with the service providers to agree on the practical arrangements, contract details etc. M19-M44

- Implementation and evaluation of the system: further development of the system, collection and evaluation of customer feedback, service provider feedback and planning of the establishment of the system within the public transport operators services. Survey for users and its analysis. TUAS input on stakeholder feedback, instructions for other evaluation data collection. M20-M31
- Development of the ground for the car sharing companies to establish their operations in Turku: influencing the parking policies of the city, market discussions with operators, marketing of the operators to companies in connection with measure 2.1., sending the MaaS questionnaire (by TUR 3.1.) to car sharing operators. M19-M31



Picture 18. The bike share stations when the system was launched.

Phases 4: Conclusions and recommendations (75 % completed)

Conclusions and recommendations of this measure commenced in January 2019 and are to be completed in April 2020. The bike share system performance has been closely monitored throughout the period and adjustments have been made when needed. At this point, some preliminary conclusions can be made on measure success:

Time and resources required

- The procurement and implementation of the bike share system commenced in May 2017 and was completed in April 2018. In retrospect, the timeframe was very short for such an arduous undertaking. It is recommended that a minimum of 1.5 years be reserved to a similar effort.
- It should be ensured that there is enough time for piloting the bikes and the sharing system before the launch. In Turku, the operator was only able to deliver the stations

and bikes in Turku two weeks prior to the launch. This reduced the testing time significantly. Some of the technical problems associated with the system could possibly have been prevented with better testing.

- Launching a completely new system required more staff resources than expected, particularly as in the Turku case the system is maintained in three languages.
- Due to the time/resource/effort-consuming nature of implementing the bike share, the promotion of car share received far less attention than originally planned. Turku city did, however, carry out market discussions with several operators and invited them to show their offers in the mobility package presentation that is part of measure 2.2. Several car sharing companies have also presented their offers at events organised by the project. Currently one new company has established services in the Kupittaa area. In retrospect, it could be concluded that it would have been wiser to focus just on the bike share in this measure.

Marketing and brand management

- Integration with city public transport adds value to the system, especially in terms with co-operation with customer service, marketing and IT. This aspect needs a new way of thinking and efforts towards a common understanding should be highlighted.
- Creating a bigger vision for new mobility services and daring to set the ambition level higher than before is especially important when talking about actions with high visibility, such as city bikes, that will change the city in many ways.
- It is important to plan for the communication and media exposure in advance and involve celebrities in marketing actions. In Turku, launch videos were created in co-operation with the city theatre and local tv-celebrities. This created the base for good media exposure.

Risk taking

- There is always a risk entailed in launching a new system and the risk is multiplied when it is done differently from other systems in many ways. In the Turku case, the bike share is a year-round system, which even increases the risk as it creates an extra layer of issues to consider in addition to all the other new parts of the procurement. It is important that there is financial leeway and trust in the project manager of such a measure.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact					
Indicator name	Mode shift	System usage	Vehicle-Km travelled	Relative travel costs	Awareness
Type	KPI	KPI	KPI	KPI	KPI
Category	Transport system	Transport system	Transport system	Society	Society
Subcategory	General	General	General	People	0
Aspect	Modal split	System demand	Total travel	Accessibility	Awareness
Definition	Percentage of passengers which changed permanently of transportation mode for doing the same trip (same origin and destination, time, and frequency)	Average system usage (bookings, rentals, deliveries, users, passengers, etc.), in a given unit of time	Sum of all kilometres travelled by a fleet or a group of users.	The average travel cost (for the PT or other service) as a percentage of the average personal available income.	Awareness of bike and car share measures

Impact					
Indicator name	Acceptance	Satisfaction	Contribution to Policies, Plans and Programs	Investment costs	Operational costs
Type	KPI	KPI	KPI	KPI	KPI
Category	Society	Society		Economy	Economy
Subcategory	Acceptance	Acceptance		Costs	Costs
Aspect	Acceptance	Acceptance	Governance	Costs	Operating costs
Definition	Acceptance of bike and car share measures	Satisfaction in the bike and car share measures	Qualitative measurement on the process to modify policies, plans, and programs (including SUMP) in a significant and definitive way.	Capital investment costs of the measure	Average operating costs of the measure

Table 5: Description of indicators

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	B-A	S	Bike share system users	City of Turku
2	Acceptance	%	B-A	S	Bike share system users	City of Turku
3	Satisfaction	Score (0-5)	A	S	Bike share system users	City of Turku

4	Contribution to Policies, Plans and Programs	Score (0-5)	B-A	DC	Decision makers	City of Turku
5	Mode shift	%	A	S	Bike share system users	City of Turku
6	System usage	Frequency (users/unit of time)	A	DC	Bike share system users	City of Turku
7	Vehicle-km travelled	Kilometres	A	DC	Fleet	City of Turku
8	Relative travel cost	Percentage	A	DC	Bike share system users	City of Turku
9	Investment costs	€	A	DC	Fleet	-
10	Operating costs	€	A	DC	Fleet	-
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Measurements

C.1.2 Baseline

There was no city bike system in Turku prior the project. Only a few bikes were available for short time rental in the library (or other similar places). There were no car-sharing companies operating in Turku. The bike share systems was to cover the city from the Kupittaa laboratory area through the city centre and up to the commercial port. Therefore, the baseline was applicable on city-level, not the laboratory area specifically. The baseline describes the situation before implementation and has been derived from several sources in this measure, presented below.

The cycling barometer provided baseline data for indicators *awareness* and *acceptance*. The purpose of the survey was to review the attitudes of the residents of Turku regarding the promotion of cycling and the opinions of residents who cycle regarding winter cycling conditions and the quality of cycling in Turku, including the citizens' views on bike sharing systems. The baseline survey data was collected by means of telephone interviews in November–December 2016, and the sample represented residents of Turku between the ages of 18 and 74. A total of 1,012 interviews were conducted. As always with such a method, the flexibility of answers is small, and the awareness of being interviewed presents a source of error. The survey was conducted via a professional company and was carefully planned with the city of Turku, minimizing the error marginal. The margin of error for the survey was estimated $\pm 3.2\%$ at most.

The National Travel Survey from 2016 provides baseline statistics on indicator *Mode shift*. The National Travel Survey provides an overall picture of Finnish passenger mobility and its background as well as demographic, geographic and temporal variations in mobility. The 2016 survey was conducted by interviewing over 30 000 Finns by telephone, online form and mail survey throughout the year 2016. The research report was completed in March 2018. For Turku, the $n=3997$. The previous national travel survey dated back to 2008.

Since the measure was a new development in the city and some of the KPIs were connected to the bike share system performance, the baseline for some KPIs is not applicable (N/A).

KPI 1: Awareness in this measure describes the citizen's awareness of bike share systems. The baseline for awareness on the bike share systems was derived from the cycling barometer. According to the barometer, 59% of respondents (n=1012) were familiar with the concept of city bikes but had not tried any. 11 % of respondents had tried a city bike in another city.

KPI 2: Acceptance refers to the number of citizens willing to at least try a bike share system if one was available in Turku. The baseline for acceptance of the bike share systems was derived from the cycling barometer. According to the barometer, 74 % of respondents (n=1012) would be willing to use city bikes if such a system became available.

KPI 3: Satisfaction describes how satisfied citizens are in the bike share system. Baseline data was not available for this indicator.

KPI 4: Contribution to Policies, Plans and Programs relates to the impact the measure may have on policies or strategies to develop public participation in mobility planning processes. The state concludes agreements concerning land use, housing and transport (MAL) with the main city regions of Finland. These agreements enhance cooperation among the municipalities in the respective city regions and between the municipalities and the state in the steering of community infrastructure and coordination of land use, housing and transport. Although in the Turku region MAL agreement (2016-2019) improvement of cycling is included, no specific mention was made of bike or car-sharing systems. Overall it could be stated that prior to the project, promotion of bike or car share was not really visible on policy level. **Score: 2.**

KPI 5: Modal split/Mode shift refers to the share of transport modes in Turku. There was no prior bike share system in Turku. The most reliable data on Modal split was provided by the National Travel Survey (2016). According to the survey, the modal split in Turku region was the following:

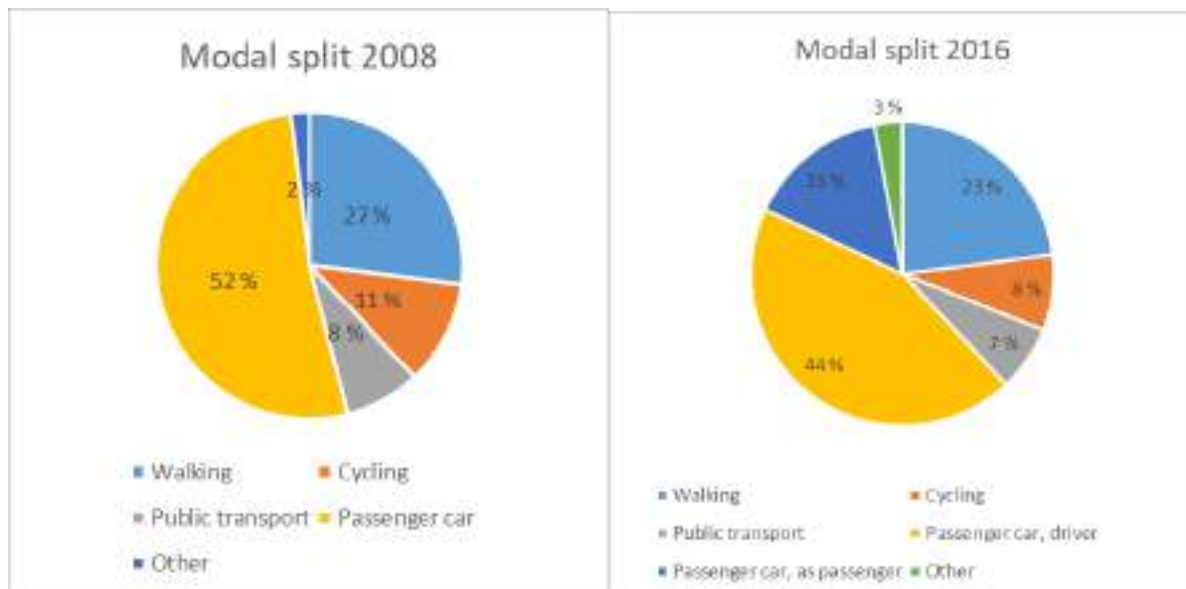


Figure 1. Modal split according to the National Travel Survey 2008 / 2016

The average share of sustainable travel modes was thus 38% in 2016, whereas in 2008 the share in the Turku region was 46%, demonstrating a decrease in the share of sustainable transport modes. It should be noted that the 2016 National Travel Survey was conducted using

a method different from the previous studies. Therefore, comparability to previous studies cannot be guaranteed.

For the ex-post evaluation on mode shift, data was to be derived from another source as the National Travel Survey is not repeated within the project duration. Hence it was decided that for this measure, ex-ante data would be derived from the regional mobility barometer realised in spring 2017, allowing for better comparability as the same survey was to be repeated in 2019. The survey report contained results and a summary of the Turku core regions traffic environment survey. The main objective of the survey was to examine the views and attitudes of the residents in Turku core region concerning the objectives and measures of the Turku regional traffic system plan. The target group was residents over 15 year of age in the Turku region. Altogether 3530 replies were recorded. It should be noted that the results cannot be widely generalized and therefore the conclusions were considered to be only indicative.

In the 2017 regional mobility barometer, the respondents' mode of travel was inquired with the following question: *“Estimate how often you use the following modes of travel during the summer months (May-October) and, respectively, “Estimate how often you use the following modes of travel during the winter months (November-April).*

According to the barometer, the modal split in the Turku region was the following during the summertime and wintertime (n=3356).

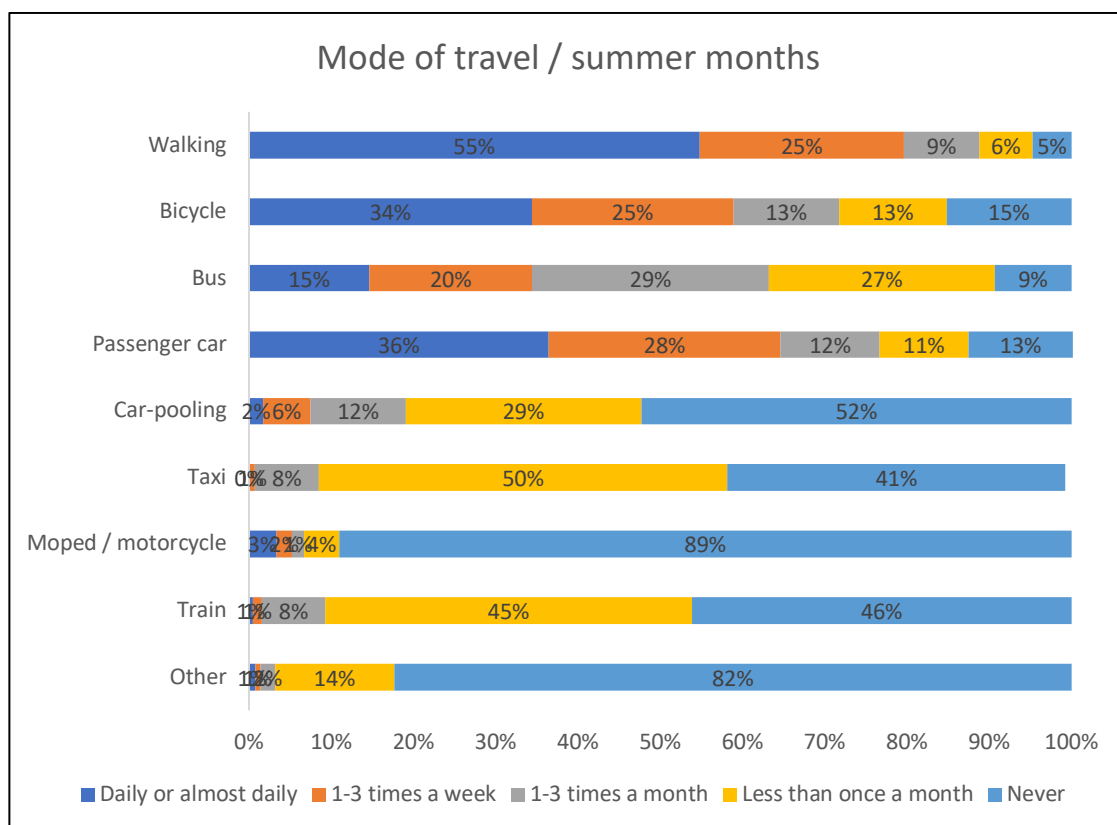
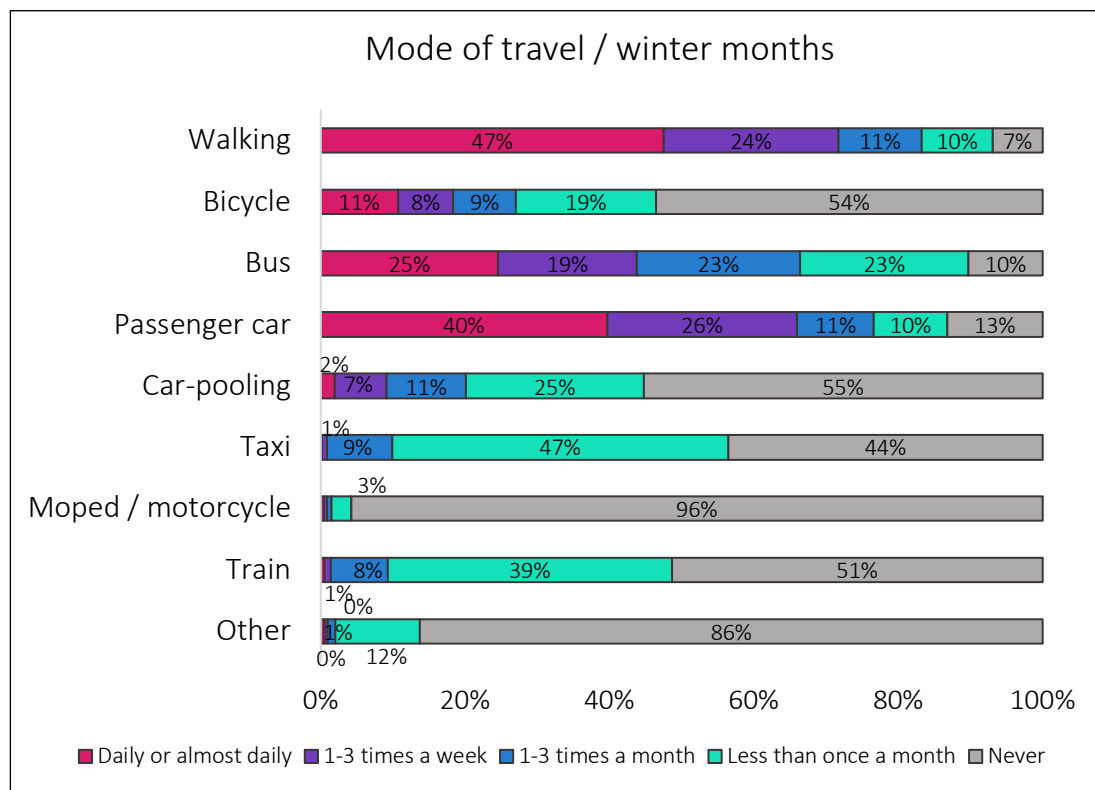


Figure 2: Mode of travel / summer months

**Figure 3: Mode of travel / Winter months**

The main daily or almost daily mode of travel for Turku region in 2017 was thereby the following:

	Summer months	Winter months
Walking	55%	47%
Bicycle	34%	11%
Bus	15%	25%
Passenger car	36%	40%
Car-pooling	2%	2%
Taxi	<1%	<1%
Moped/motorcycle	3%	<1%
Train	<1%	<1%
Other	<1%	<1%

Table 7: The main daily or almost daily mode of travel for Turku region / 2017

Data for **KPI 6: System Usage** was not available. Prior to the project, there were no city bikes available apart from a few bikes that could be rented out from the city main library and there was no data available on their usage.

KPI 7: Vehicle-km travelled could not be measured on baseline level as the system implemented is new with no proper bike share system available prior to the project. N/A.

KPI 8: Relative travel cost is defined as the average travel cost as a percentage of the average personal available income. Baseline for this indicator could not be measured as the system implemented was new with no proper bike share system available prior to the project, and subsequently no pricing scheme to compare with was available. N/A.

C.1.3 The business-as-usual scenario

It can be assumed that any developments related to bike or car share would have remained somewhat more modest without the extra push provided by the project. Thus, the bike share system would have been carried out within the coming years but most likely later, around 2025, as estimated by the Turku Site Coordinator. Developments related to the introduction of car-sharing operators into the city would probably have been more sporadic without project impact. In Finland in general, car share is a relatively new concept. The project has given a significant boost to car share awareness. Hence, it can be assumed that BaU would be similar to baseline for all the indicators within a time span of approximately five years.

Indicator	Unit	BaU	Date BaU
Awareness	%	It is assumed that the BaU is similar to baseline.	6/2018
Acceptance	%	It is assumed that the BaU is similar to baseline.	6/2018
Satisfaction	Score (1-5)	It is assumed that the BaU is similar to baseline.	6/2018
Contribution to Policies, Plans and Programs	Score (1-5)	Although ECCENTRIC has provided an extra push for the integration of bike and car sharing on the policy level, development of sustainable mobility is an ongoing process in Turku. BaU is therefore estimated to be slightly higher than baseline. Score: 3.	6/2018
Mode shift	%	It is assumed that the BaU is similar to baseline.	6/2018
System usage	Frequency (users/unit of time)	N/A within a five-year time span.	6/2018
Vehicle-km travelled	Km	N/A within a five-year time span.	6/2018
Relative travel cost	%	N/A within a five-year time span.	6/2018
Investment costs	€	N/A within a five-year time span.	6/2018
Operating costs	€	N/A within a five-year time span.	6/2018

C.2 Measure results

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	70	12/2016	70	12/2016	63	12/2019	-7	-7
Acceptance	%	74	12/2016	74	12/2016	34	12/2019	-40	-40
Satisfaction	Score (0-5)	N/A	12/2016	N/A	12/2016	4.2.	12/2019	N/A	N/A
Contribution to Policies, Plans and Programs	Score (0-5)	2	12/2016	3	12/2016	4.5		2.5	1.5
Mode shift	See for data below on page 35.								
System usage	Frequency (users /unit of time)	N/A		N/A		2.4	12/2019	N/A	N/A
Vehicle-km travelled	Km/y	N/A	12/2016	N/A	12/2016	125 859*	01/2020	N/A	N/A
Relative travel cost	%	N/A	12/2016	N/A	12/2016	Day ticket 5€, 0.002 % Week ticket 10€, 0.004% Period (one year) 40€, 0.017%	12/2019	N/A	N/A
Investment / Operating costs	Nextbike service for the city bike system: 695 562€ Customer service and coordination: 55 257€ Marketing: 32 698€ Maintenance: 5 866 Total: 789 473€ between 1.5.2018 – 30.4.2019								

*The data was derived May 2019 – January 2020.

The ex-post data was derived from several sources:

- The cycling barometer, which was conducted via phone interviews of randomly selected persons (18-74 years of age) during weeks 48-50 / 2019. n=1001. The survey provided data for indicators *awareness*, *acceptance* and *satisfaction*.
- A survey to bike share system users, conducted 1.-18.11.2018, provided additional data on indicator *satisfaction*. The survey was conducted online and advertised in the

social media by the public transport office and the city of Turku, and it was sent directly to the users who had authorized marketing when signing up to the system.

- The regional mobility barometer, conducted by the Regional Council of South-West Finland 20.10.-30.11.2019, provided ex-post data on *modal split / mode shift*. The main objective of the survey was to examine the views and attitudes of the residents in Turku core region concerning the objectives and measures of the Turku regional traffic system plan. The barometer was conducted as an online survey and received 3038 responses from the Turku region (the city of Turku and neighbouring municipalities Raisio, Kaarina, Lieto, Naantali).
- *System usage* data was provided by the ML.
- City bikes' GPS Data on *vehicle-km travelled* was provided by the ML.
- Secondary data on average annual income was derived from Turku city statistics for indicator *relative travel cost*.
- Secondary data analysis was performed on *Contribution to Policies, Plans and Programs*.
- Data on *investment and operating costs* was derived from the Site Coordinator.

Turku citizen's **awareness** of bike share systems in general was, surprisingly, a bit lower now, after the implementation of the system. Both the baseline and ex-post data for awareness on the bike share systems was derived from the cycling barometer. When in 2016, 70% of respondents (n=1012) were either familiar with the concept of city bikes or had even tried one, in 2019, 63% of the respondents (n=1001) were either familiar with the concept of city bikes or had tried one.

Acceptance of the Turku city bikes, according to the 2019 cycling barometer, was rather low although in the 2016 barometer 74 % of respondents (n=1012) stated they would be willing to use city bikes if such a system became available. In the 2019 barometer, the question was worded in the following manner: "Do you use or have you tried the Turku city bikes? 3% of the respondents used the bikes regularly and 9% had at least tested them. 21% were planning to test them. However, 50% stated that they were not willing to test the system and 16% did not know if they would test the bikes. Thereby overall acceptance was 33% (n=1001). Acceptance was greatest among young people (18-24 years) – 28% of men in this age group and 29% of women had at least tested the bikes.

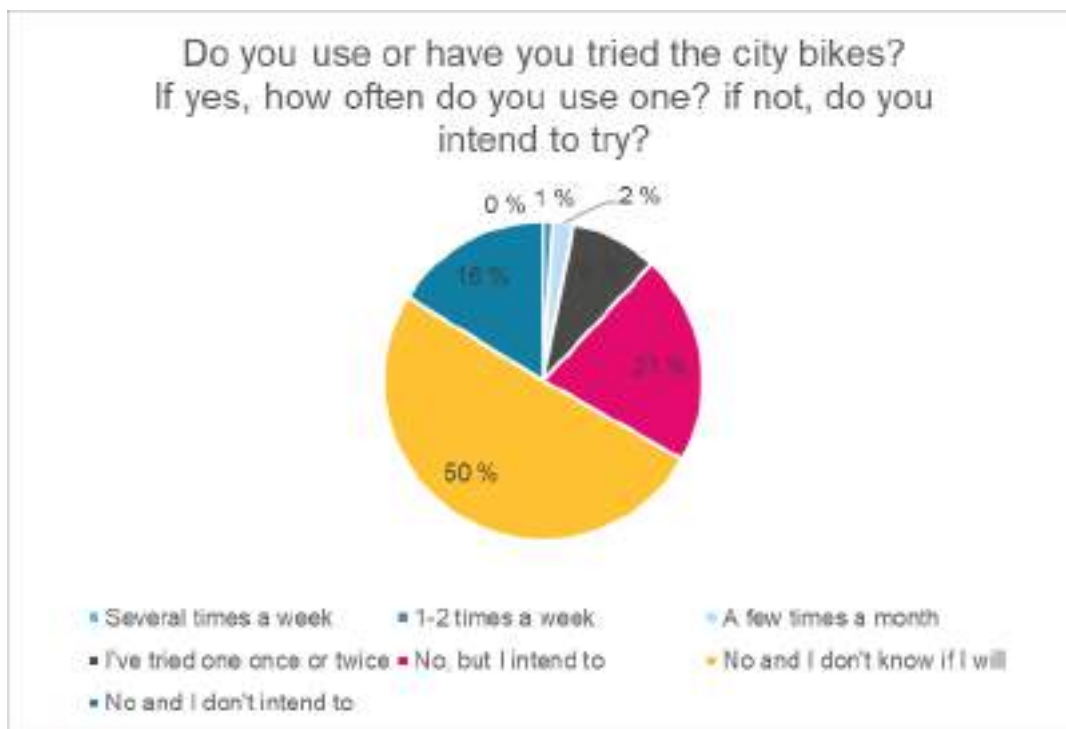


Figure 4. Bike share acceptance

Despite technical difficulties with the bikes, **satisfaction** in the bike share system was rather high according to both the cycling barometer and the bike share system user survey. Ex-post data covered both the cycling barometer results on satisfaction and the results from the customer satisfaction survey.

The average satisfaction level for the city bikes according to the user satisfaction survey was 3.9 on a scale of 1-5 (n=150). In other words, 79% of the respondents gave an average grade of “good” or “excellent” to the bikes. Respondents to the cycling barometer were even more positive in their assessment as 90% of those who had used the city bikes were either quite satisfied (44%) or satisfied (46%) with the service on a scale of 1-4 (n=121), with an average score of 3.4. An average score for satisfaction based on the two surveys was thus 4.2.

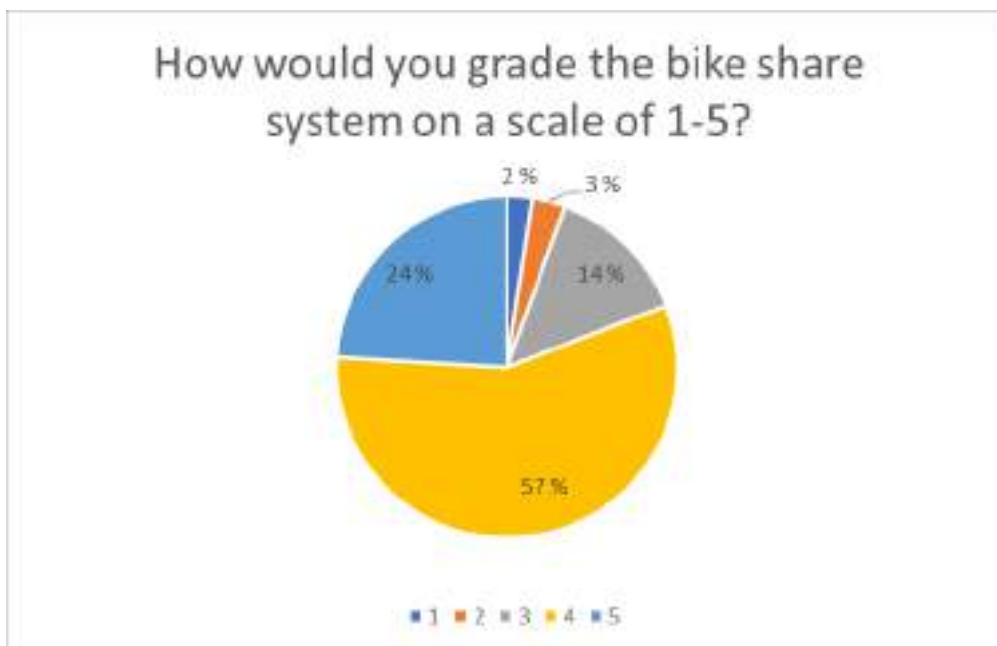


Figure 5. System satisfaction (customer survey).

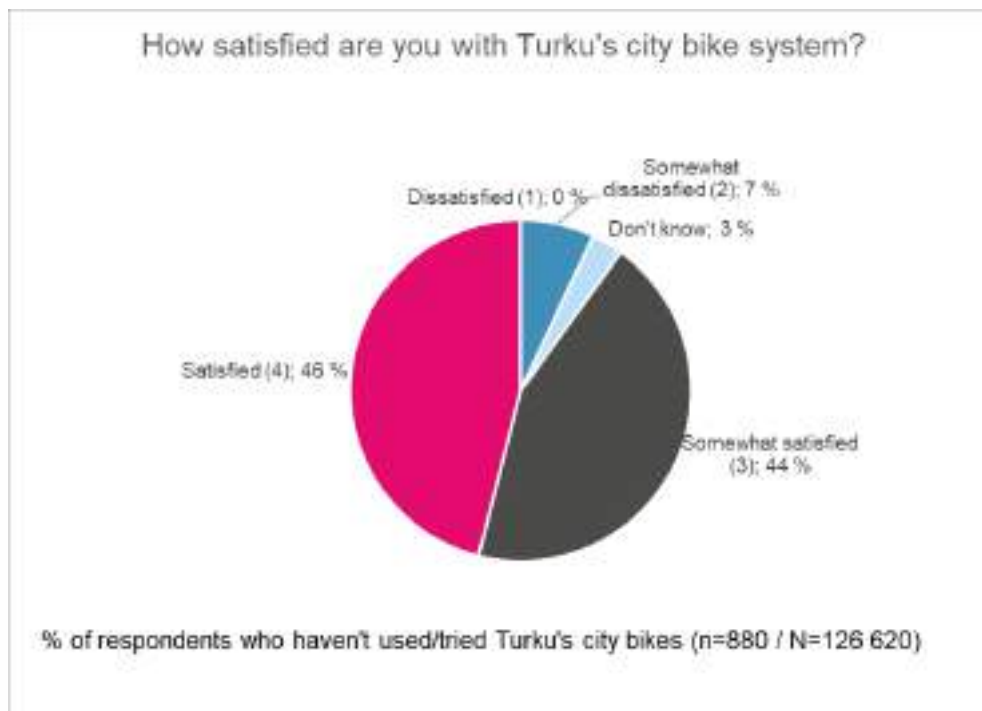


Figure 6. System satisfaction (cycling barometer).

It is interesting to contrast the user experiences with system usage and the reasons why people stated they had not used the city bikes. This was reviewed as part of the cycling barometer. The most stated reason (52% of respondents) for not using the city bikes was that there was no need as the person wanted to use their own bike (n=880), or used another mode of transport (29%). Only 4% stated that they were unwilling to use the bikes due to technical difficulties with using the bikes. This was in contrast to the fact that there have actually been quite a few problems with the bikes' technical interface. Based on the rather high levels of satisfaction, it was thus interesting that system usage has not been as high as was hoped.

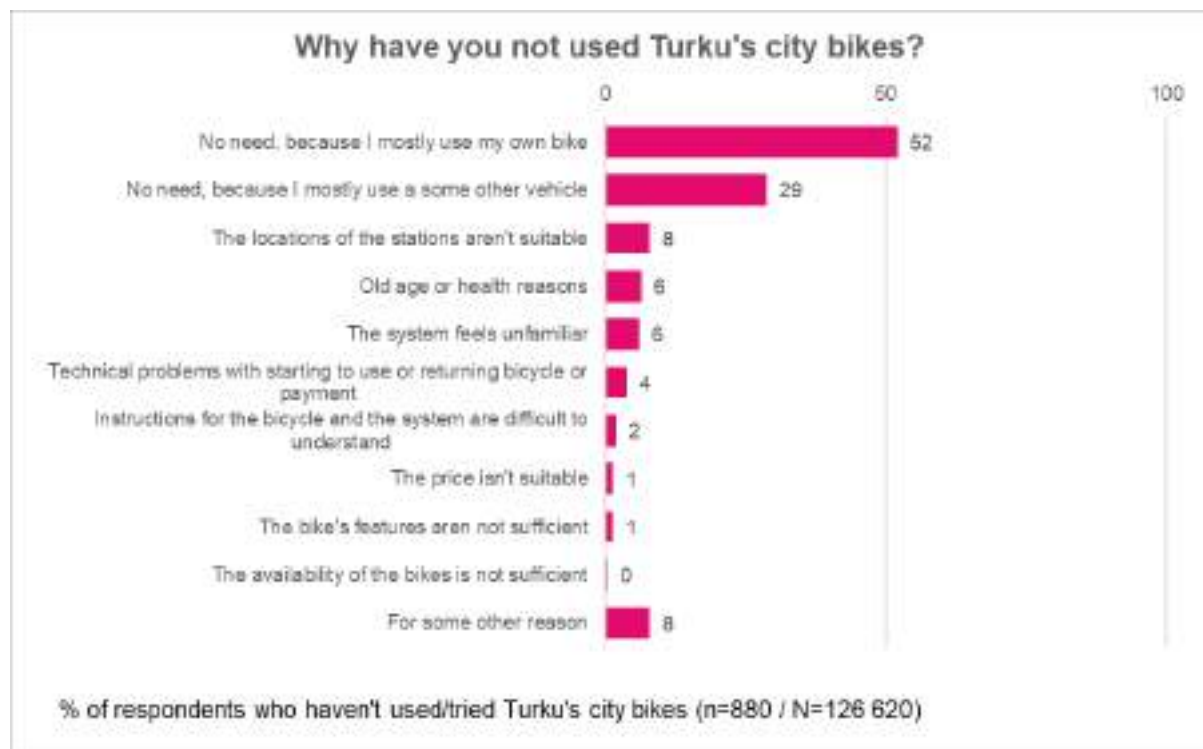


Figure 7. Reasons for not using the city bikes.

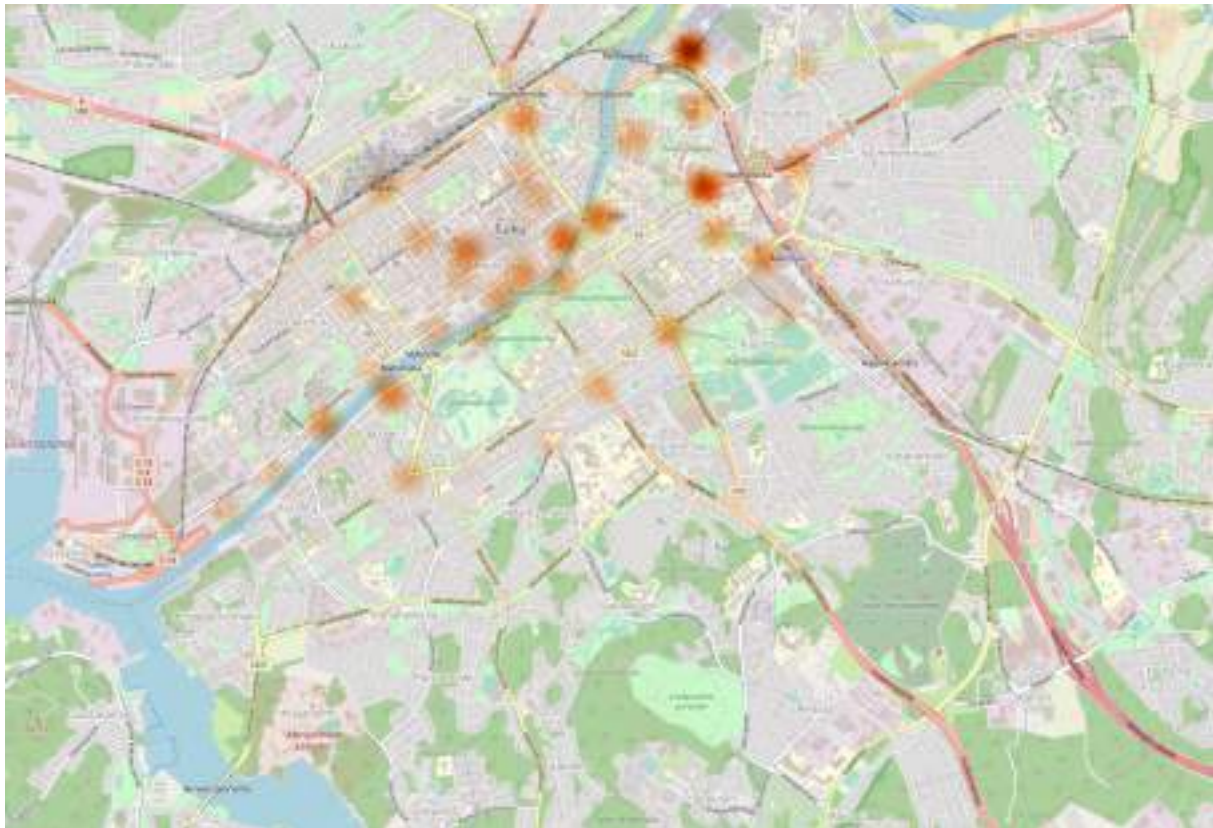
During its first year of operation (1.5.2018 – 30.4.2019), altogether 246 000 trips were made with the city bikes. This equaled approximately 820 trips per bike per year, 2.2 trips per bike per day. **System usage** was greatest during the first month of operation when 30 077 trips were made. During wintertime, there was a marked drop in system usage, with January being the slowest month. The Turku bike share system is unique in providing the service all-year-round, hence for the purpose of comparison with other city bike systems, an average usage of 2.4 trips per day was used in the measure results table below. This was the average number of trips per day per bike not including the winter months (November – March).



Figure 8. Rides per month on the city bikes 2018/2019

To provide some scope for system usage in Finland, the Helsinki city bike sharing system had an average of 7 trips per bike per day, the Espoo city BSS an average of 3 trips per bike/day, and the Kuopio city BSS an average 5-7 trips per bike/day. The Kuopio system differs from the other bike share systems in Finland as it has only e-bikes. All in all, the bike share system in Turku has not reached its goals in terms of usage and there has even been a slight decrease in usage since the first year of operation: between May – December 2019 altogether 147 500 trips were made with the city bikes, an average of 2.0 trips per bike per day.

A clear picture has been formed of the popularity of both the start and the end stations. Heatmaps on station use are presented below. The most popular start and end stations were located in the laboratory area (the student village, Hämeenkatu in the university area). Some adjustments to station locations have since been made based on customer feedback.



Picture 19. A heatmap on the most popular bike share start stations.



Picture 20. A heatmap on the most popular bike share end stations.

Although **Access to mobility services** was not a selected KPI for this measure, it is worth mentioning here that for the bike share system, the percentage of population living within walking distance (300m) of the 37 stations was 22%. This equaled 41 885 inhabitants. The calculation was based on the 2017 Turku population number of 189 669. (Sipponen 2019.)

The city bikes were equipped with a GPS tracking system from May 2019. **Vehicle-km travelled** from May 2019 to January 2020 was 125 859km. A marked drop in VKT could be observed in the winter months. In July, there was a system malfunction for which reason data for that month was unfortunately not complete.

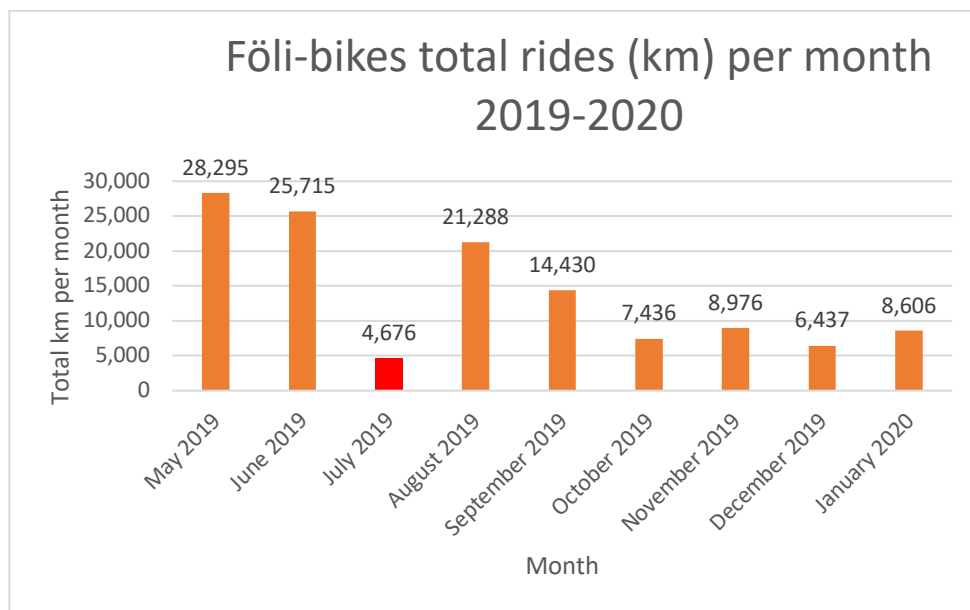


Figure 9. Vehicle-Km travelled May 2019 - January 2020.

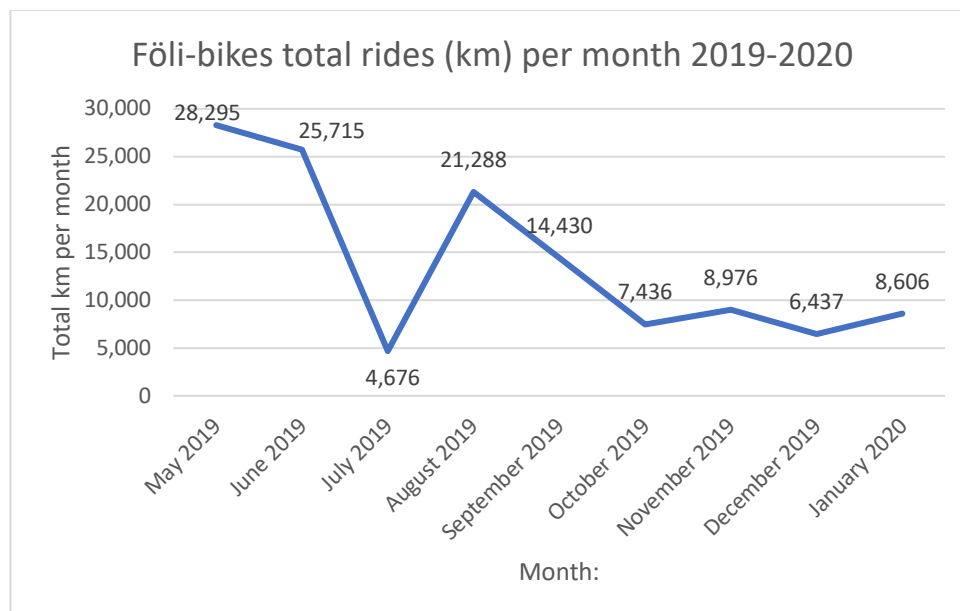


Figure 10. Vehicle-Km travelled May 2019 - January 2020.

When looking at the **Contribution to Policies, Plans and Program**, the impact brought about by the measure was evident. The draft version of the cycling development program in Turku was made already in October 2017, encompassing actions and goals for increasing cyclist numbers in the city region. The draft program included the continuation of the bike share system as one of the spearhead actions. In addition, both the city bikes and share use of cars are an integral part of Smart & Wise, one of the city's spearhead projects that combines the strategic goal of regional carbon neutrality in 2029 with the Smart City concept. Even in the MAL agreement draft for 2020-2023, the expansion of the bike share system in the city and regionally is clearly stated as one of the actions to be investigated in developing a livable and attractive walking and cycling city.

In the Turku Climate Plan (SECAP) from 2018, offering a year-round city bike system service that is conveniently linked to public transport is included in the list of climate action cards with medium level impact. The SECAP also states that the Turku city group is committed to sustainable mobility, including via “shared use vehicles and/or services offering them will be acquired for mobility in business affairs”: In terms of promoting car-sharing, development of city parking policies during the project has been essential. The measure has contributed to renewing these policies, including permit parking for shared cars. The Turku city parking policies were approved by the City Board on the 19th December 2019. Overall, it could be estimated that the measure policy level influence has been significant. **Score: 4.5.**

Changes in mobility behavior as manifested by **mode shift** were difficult to prove based on the data available. In Finland, the National Travel Survey is conducted every 8-10 years. As the latest survey dates back to 2016, no similar survey was to be made after measure implementation. For evaluation of mode shift, this meant that data needed to be derived from different sources than on baseline level, which would naturally influence comparability. Based on data from the customer satisfaction survey alone, it was inconclusive whether there had been a shift towards more sustainable modes of transport. When asked which mode of transport the system users were substituting (n=507), most city bike users actually stated that they substituted walking with the bikes (76% of respondents). The second most common mode being substituted was using a bus or other mode of public transport (55%), third came substituting one's own bike (36%) and only fourth came using the bikes instead of a passenger car (29%). However, as this data was not comparable with the baseline data, it was decided with the WPL that assessing the measure's impact on mode shift would be left out.

Relative travel cost was calculated from the average income of Turku citizens, derived from Turku city statistics (The city of Turku website). In 2017, the average earned yearly income per income earner was 28 107 €, or 2342.25€/month.

The city bike pricing varies according to type of ticket product. The use of the bikes is included in the seasonal ticket of public transport for 30 days or more without additional charge. In addition, one can purchase 24h, 7 days or a period ticket (one year). Below is presented the relative travel cost of each ticket type.

Ticket type	Price (€)	% of monthly average income
Day ticket	5	0,002 %
Week	10	0,004 %
Period (one year)	40	0,017 %

Data on **investment and operating costs** was derived from the measure leader and covered the investment and operating costs of the bike share system. All in all, running the city bike system cost 789 473€ during its first year of operation, 1.5.2018 – 30.4.2019. The bulk of the expenses during the implementation phase was caused by the Nextbike bike share service, covering the whole system (bikes, stations, maintenance), 695 562€. Some 55 257 were spent on customer service and coordination of the system, 32 698€ for marketing and 5 866 for maintenance.

C.3 Summary: achievement of objectives

On the face of it, the measure achieved half of its main goals. The bike share system was in place. Car sharing companies are now offering their services in Turku, to be attributed to ECCENTRIC impact to a great extent. However, the city bikes were not as attractive as was hoped and it was inconclusive whether the system implementation had led to a growth in public transport. There were mitigating factors and negative interference, both internal and external, that could explain the lower system usage at least to some extent. Public transport overall in Turku is a mess due to massive construction at the heart of the city, the market place. This may have shed negative light on other forms of public transport too apart from the buses. Problems with the user interface are quite likely to have caused loss of users as well. One should probably also not overlook the potential effect of the e-scooters (launched in Turku in April 2019) on bike share system usage, although information on potential mode shift towards the e-scooters was not available yet. To sum up, despite lower system usage than expected, the measure reached its goals somewhat satisfactorily and, importantly, served as a valuable learning process for implementing a novel system with some unique characteristics.

No.	Objective and target	Rating	Comment
1	The city bike system is in use (at least 100 bikes)	***	A system of 300 bikes was implemented.
2	Car sharing companies have tested their services in Turku	**	Several car share companies are offering their services for companies and housing companies. The city has implemented parking policies to facilitate this process.
3	The city bike system is attractive to citizens, leading to a growth in public transport	*	Problems prevailed with the technical realization of the bike share system, which quite likely had an effect on user satisfaction and subsequent impact on the number of users. The system has not attained as many users as was hoped, although those who have used the city bikes rated their satisfaction quite high, 3.9 on a scale of 1-5 (1=bad, 5=excellent).
4	The system is so attractive that the number of rental is better than on average city bike systems (<i>common average, amount of rents per bike: one rent per day</i>)	O	On average, each city bike was used 2.2. times a day on average during the first year of system operation. In comparison, in Helsinki the same number was 7.0. Although users have reported a high satisfaction level for the system, the system usage goals were not reached.
NA = Not Assessed O = Not Achieved in full * = Substantially achieved (at least 50%) ** = Achieved *** = Exceeded			

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

Some changes have been made along the inception time:

D.1.1 Deviation 1: Number of bikes

The number of the bikes raised from 100 to 300 during the planning phase. The Turku city executive board accepted the proposal for the BSS procurement in April 2017. The procurement was to consist of 300 bikes and 37 stations. This was a higher than originally planned in CIVITAS ECCENTRIC as it became evident that the original number planned was too low.

D.1.2 Deviation 2: Change in ML

The measure leader was change in May 2017 as Stella Aaltonen took over leadership from Jari Paasikivi.

D.1.3 Deviation 3: Partial reallocation of focus

Due to the time/resource/effort –consuming nature of setting up the bike share system, car-sharing received less attention than was originally intended.

D.2 Barriers

The following barriers were identified during measure planning, implementation and demonstration.

D.2.1 Organisational

Personnel changes at the beginning of the measure caused some delays to the preparation phase as Jari Paasikivi left his position. Stella Aaltonen took over measure leadership. The change caused only minor delay for this measure.

D.2.2 Problem-related

The measure proved rather overwhelming in contents. In retrospect, it would have been wise to just focus on bike sharing in this measure and to leave car sharing out altogether. The research, planning, procurement and implementation of a bike share system was an immense, complex undertaking that took more time than originally estimated. Due to this, promotion of car-sharing was emphasized with more effort later in the measure.

D.2.3 Planning

Originally the city bike system was planned for 100-150 bikes. This was soon found too small a number. The barrier was overcome as the ML convinced the city board of the need to grow this amount and it was decided that the system would be implemented with 300 bikes.

D.2.4 Institutional

As the bike share system was realized with project funding it did not have an administrative "home" in the start. Therefore, the system placement within the city departments has required some discussion. As the project nears its end, this barrier has been overcome and the bikes will be placed under the administration of the regional transport office Föli.

D.2.5 Political/strategic

The question of finding the locations for the bike share stations became increasingly political. There was a lot of opposition from e.g. landowners particularly when the placement of the stations would mean losing some parking spaces. The barrier was overcome as after lengthy discussions and several alternative proposals on placement of the bike share stations, the city board finally reached a decision on their number and placement.

D.2.6 Technological

The bike share system has been ridden with technical issues ever since system launch. To begin with, the system piloting period was far too short and some of the problems could have been alleviated by a longer testing period. The problems have mostly been related to the ambitious goal of creating a MaaS platform through the bike share system integration. This was a totally new way of development for the service operator and it turned out that their system was not ready for such an integration although they promised to be in the tender. This has caused huge delays on the IT-side and more work on all sides. This barrier has been partially overcome but issues still remain with the system.

D.3 Drivers

The following drivers were identified during measure planning, implementation and demonstration.

D.3.1 Financial driver

The fact that project funding was received for setting up the bike share system facilitated the process remarkably. Without external funding, it was estimated that the system would have been realised years later. The project funding thus assured that funding would be allocated to the bike share system in the city budget.

D.3.2 Political/strategic

Originally only 100 bikes were budgeted but when this number was found to be far too small extra funding had to be sought from the city. The additional funding from the city board was guaranteed rather easily in the end. The political support for the objective was thereby a clear driver.

D.3.3 Political/strategic

Placement of bike share stations faced quite a bit of opposition, with varying views and interests of stakeholders. Discussions with key stakeholders were conducted and various rounds of consultations held. In the end, there was courage to place the bikes even in such locations that were initially opposed by some parties and landowners. So, all in all, although the issue of station placement became highly political and sensitive, there was enough momentum and will as to push through the city bike station placements.

D.3.4 Planning

The measure relied on meticulous planning and benchmarking of existing bike share systems. There was a strong overall vision on its realization. Measure planning utilized the right kind of expertise needed at each particular phase of planning and implementation (e.g. on tendering and procurements). The cooperation with the Turku Region Public Transport office has been tight and there has been a strong will to break traditional operating models in setting up the bike share system.

D.3.5 Involvement/communication

Building the brand for the city bikes has succeeded well. The citizens seemed to “own” the city bikes very quickly and soon there were even nicknames for the bikes, “Föllärit”. The brand was utilised in marketing the system. The involvement of an expert group throughout the process has been significant. The group met actively during the 2 years and was composed of representatives of the local Student Union, the City Centre Association, the Chamber of Commerce, the local bicycle association TURPO and the University of Applied Sciences.

D.4 Supporting activities

D.4.1 Supporting activity 1

The development of parking policies in the city of Turku was necessary for proper promotion of car-sharing. The process to renew these policies is ongoing and political decisions will be made on e.g. permit parking for shared cars during spring 2020.

D.5 Recommendations on the implementation process

Some recommendations on implementation can be suggested based on process evaluation of the measure so far.

D.5.1 It's all in the planning!

In order to assure both quality of implementation and ease of process, attention must be paid to both technical testing of the system prior to launch and preparation of the tender. The contract with the service provider must entail proper sanctions.

D.5.2 Political will and commitment is essential

In order to implement a system such as bike share, political agreement and will is needed both for assuring the continuation of the system and some strategically important decisions, such as the placement of the stations. Station locations are vital for the usability of the system and often political leverage is needed to ensure that the best locations are secured.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- The bike sharing system is in place and running.
- Car sharing companies have tested their services in Turku: there are several operators offering these services e.g. at an apartment complex and at organisations in the laboratory area.
- Despite lower usage rates than expected, system satisfaction is rather high.

E.2 Relevance of supporting activities

The development of car share in the city was closely connected with the development of parking policies. A process to modify these policies took place during the project and has resulted in permit-based parking policies allowing a better operating environment for shared cars via more flexible parking possibilities. This development has been essential for the future of car sharing in the city.

E.3 Interaction with other measures

- TUR 2.2. was central in spreading information about bike share in the laboratory area.
- In TUR 3.2. a new open data interface and platform were developed into which the ticketing system of the public transport system (including the city bikes) were incorporated.
- Winter cycling promotion in TUR 4.8. served also promotional purposes of the city bikes as they are in year-round use.
- Some discussions were conducted with STO 3.5. about possible UbiGo cooperation in Turku.

E.4 Main lessons learned

The main lessons learned from the measure are summarized below:

- Setting up a bike sharing system is a huge undertaking that needs to be properly resourced both in terms of personnel, time and money. At least a minimum of 1.5 years should be reserved to a similar effort.
- Proper testing of the system is crucial in order to avoid (technical) problems in the first months of system launch.
- It was unfortunate but necessary due to the massive amount of resources needed for implementation of the bike share that car sharing received less attention in this

measure. In retrospect, it could be concluded that it would have been wiser to focus just on the bike share in this measure.

- It should be properly acknowledged that there are risks entailed in launching a system with some unique characteristics and that dealing with this risk needs some financial leeway and trust in the project manager. In the Turku case, the bike share is a year-round system – the first of its kind – which even increases the risk as it creates an extra layer of issues to consider. Also integration of the system to the PT ticketing system was something that has not been done everywhere and was not without its problems – however it was necessary to enable concurrent MaaS development.
- It is a must to have bike share system as an all-year system as this gives a strong impulse for users on the potentiality of biking.
- It is advisable to carry out studies in regards to the measures. The bike share system has resulted in two Master studies: tendering process and enlargement potential.

E.5 Long term impact

The long term impact of the measure remains to be seen. In order to be able to properly affect choice of travel mode, the station network needs to be widened and some system elements altered. According to the ML, discussions are under way currently on the future of the system and there is a preliminary decision not to continue with the current bike share system provider but to put out the tender again, with a set maximum budget per year. The measure has, in any case, served as a valuable model for other cities in their efforts to set up a bike sharing system (e.g. Tartu in Estonia, Joensuu, Kuopio and Tampere in Finland).

E.6 Potentials for up-scaling in the city

Up-scaling plans have been devised on city-level, with a suggested extension plan. Already in the spring 2020, a pilot with electric city bikes will take place with additional ECCENTRIC funding. Plans on the bike share system extension are, however, currently pending political approval (02/2019). Due to the financial pressure caused by a recently declined share of PT users, there is pressure to save on public transport. It remains to be seen whether this will have an effect on political will to extend the bike sharing system.

F. Additional information

F.1 Appraisal of evaluation approach

Overall, the evaluation approach in this measure has been successful. The following points, indicating weak and strong points and giving recommendations for similar evaluation work in the future, can be highlighted based on assessment of the evaluation approach.

- Lack of baseline data due to the novelty of the system meant that only a few comparisons could be made.
- Estimating mode shift was challenging due to question formatting of the surveys used – it was inconclusive whether the respondents classified the city bikes in the “bicycle” or “other” category. No far-reaching conclusions could thereby be made on the city bikes’ impact on travel mode. In retrospect, the surveys realised in the scope of ECCENTRIC should have taken this aspect better into account.
- The measure included meticulous collection of technical data on bike share system functioning, as well as usage data, which facilitated the evaluation process.

F.2 Future activities relating to the measure

Despite lower than expected usage rates, it looks like the system will be continued, although with a new tendering process. It naturally remains to be seen whether the system chosen will be better than the current one. Nevertheless, it is advisable to continue with regular surveys on system acceptance and satisfaction to get a better view of system functioning, and the system’s impact on modal change.

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2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



TUR 5.7

Introduction of Electric Public Transport Measure Evaluation Report

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2020
CIVITAS
Cleaner and better transport in cities
ECCENTRIC



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3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
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21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Stella Aaltonen	

Table of Contents

ABSTRACT.....	1064
A. INTRODUCTION.....	1065
A.1 EXPECTED RESULTS OF THE MEASURE	1065
A.1.1 Quantifiable impacts.....	1065
A.2 MEASURE DESCRIPTION	1065
A.2.1 Measure outputs.....	1067
A.2.2 Supporting activities	1067
A.2.3 Interactions with other ECCENTRIC measures.....	1068
A.2.4 Interactions outside ECCENTRIC	1068
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1068
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1068
A.5 IDENTIFIED RISKS	1069
B. MEASURE IMPLEMENTATION	1070
B.1 SITUATION BEFORE CIVITAS	1070
B.2 INNOVATIVE ASPECTS.....	1070
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1070
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1070
C. IMPACT EVALUATION FINDINGS	1072
C.1 EVALUATION APPROACH.....	1072
C.1.1 Expected impacts and indicators.....	1072
C.1.2 Baseline.....	1073
C.1.3 The business-as-usual scenario.....	1077
C.2 MEASURE RESULTS.....	1078
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1082
D. PROCESS EVALUATION FINDINGS	1083
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1083
D.2 BARRIERS	1083
D.2.1 Organizational	1083
D.2.2 Financial	1083
D.3 DRIVERS	1083
D.3.1 Political / strategic.....	1083
D.3.2 Technological	1083

D.3.3	<i>Planning</i>	1083
D.3.4	<i>Organizational</i>	1084
D.4	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1084
D.4.1	<i>Planning is of essence</i>	1084
D.4.2	<i>Political will and commitment is needed to implement electrified PT systems</i>	1084
E.	EVALUATION CONCLUSIONS	1085
E.1	VALIDATED DIRECT IMPACT	1085
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1085
E.3	INTERACTION WITH OTHER MEASURES	1085
E.4	MAIN LESSONS LEARNED	1085
E.5	LONG TERM IMPACT	1086
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1086
F.	ADDITIONAL INFORMATION	1087
F.1	APPRAISAL OF EVALUATION APPROACH	1087
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1087

List of Figures

Figure 1. TCO analysis of an e-bus system compared to various types of diesel buses... 1080

List of Tables

Table 1: Quantifiable impacts.....	1065
Table 2: Target groups or affected parties.....	1068
Table 3: Measure stakeholders.....	1069
Table 4: Risk assessment.....	1069
Table 5: Description of indicators.....	1073
Table 6: Measurements	1073
Table 7. Customer satisfaction.....	1079
Table 8. The planned e-bus rotation schemes for route 1.	1080

Project	City		
ECCENTRIC	Turku		
Measure code	Measure name		
TUR 5.7.	Introduction of Electric Public Transport		
Last update	Responsible	e-mail	telephone
11/5/2020	Stella Aaltonen	stella.aaltonen@turku.fi	+35844 907 5983

Abstract

In measure TUR 5.7, new electric buses were introduced in the PT fleet of the city of Turku. The goal of the measure was to have six electric buses operating on bus line no. 1 between the Turku airport and the ferry terminal, becoming the first Finnish city to use electric vehicles on an entire line of public transport. The main actions to be taken were to be piloting the first electric bus line, planning for extension of electric bus lines, development of charging solutions, analyses of the use as well as marketing and communication, including campaigns. As a result of the measure, the noise level of bus traffic was expected to decline on the route operated with e-buses. Customer satisfaction was expected to increase on line 1 due to more comfortable rides and better service quality. Driver satisfaction was to increase due to a more comfortable driving environment (less vibration, lower noise level). The cost efficiency of bus traffic was to increase due to lower operation costs (energy + maintenance).

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation if the bus line were driven with regular diesel-fueled buses, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 5.7. was measured. Data for evaluation was derived from the concurrent research project eFöli and from surveys carried out by the regional PT office.

As a result of the measure, six electric buses were on traffic, partly funded by ECCENTRIC. Bus line no. 1 was almost fully electrified, with the e-buses covering 88.9% of the service needs on that route. Customer satisfaction was rather high for the line, slightly higher than average PT satisfaction in Turku. During the first operative years, the reliability of the system, however, failed to reach a satisfactory level. Due to various interruptions in the service, the e-buses were constantly supplemented by diesel buses. Overall reliability still needs to improve greatly. Also in terms of realized driving output, the vehicles were yet to reach their planned yearly goals. Turku winter conditions also presented some challenges for the operation, which was to be expected. The expected long-term impacts of the measure relate to improved knowledge on PT electrification gained throughout the project and the integration of these learnings on policy level. The measure particularly contributed to proving that PT electrification can be a viable option of organizing public transport towards carbon neutrality.

A. Introduction

A.1 Expected results of the measure

The measure objectives were:

City policy level in perspective of CIVITAS goals/ longer term:

- To promote and implement sustainable, clean and (energy) efficient urban transport measures by electrifying most of the city bus lines in the city of Turku

Strategic level:

- To have PT electrification extension plans ready
- To have more cost-efficient and standardized charging solutions available
- To have created more customers and citizen demand for e-buses
- To have the political board give permission to tender the next bus lines based on e-bus operations
- Operator being satisfied with e-buses (reliability and total cost of ownership)

Measure level:

- To have bus line no. 1 fully electrified (the buses that run between Turku airport and the ferry terminal)
- To have gained customer satisfaction with electric buses

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	At least 6 e-buses are on traffic	x	x						x		

Table 1: Quantifiable impacts.

A.2 Measure description

Measure TUR 5.7 was to introduce new electric buses in the PT fleet of the city of Turku. The goal of the measure was to have six electric buses operating between the Turku airport and the ferry terminal, becoming the first Finnish city to use electric vehicles on an entire line of public transport. The main actions taken were to be:

- 1) piloting the first electric bus line
- 2) planning for extension of electric bus lines

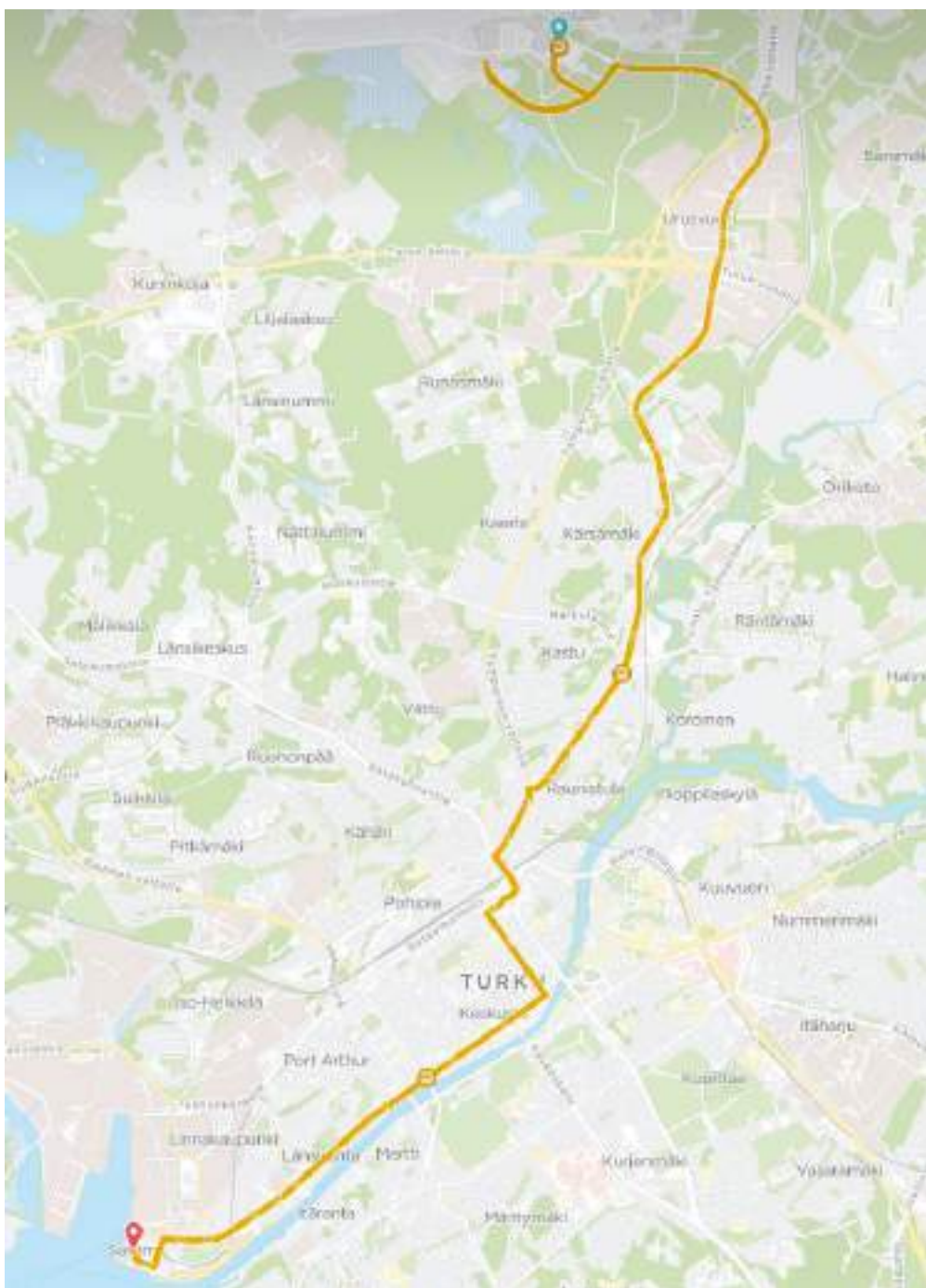
- 3) development of charging solutions and analyses of use
- 4) marketing and communication including campaigns

As a result of the measure, the noise level of bus traffic was expected to decline on the route that operated with e-buses. Customer satisfaction was expected to increase on line 1 due to more comfortable rides and better service quality. Driver satisfaction was to increase due to more comfortable driving environment (less vibration, lower noise level). Also the cost efficiency of bus traffic was to increase due to lower operation costs (energy and maintenance). Citizens would hopefully be more satisfied with public transportation as a result of more environmentally friendly solutions (less emissions and noise).

Below is presented the bus line nr. 1 route, Harbour–Market Square–Airport, 12,6km in total length. The topography of the line is mostly flat, covering both a stretch of highway from the airport towards the city, some suburban areas (Urusvuori, Käsämäki, Kastu, Raunistula), running past the main bus station and through the city centre ending up at the commercial port, located approximately 3,5km from the market square. The average commercial speed on the line is 19km/h. Two fast charging stations are located at the end-of-line stops of the route, Turku harbour and Turku airport. In addition to fast charging, the buses are charged overnight at the depot. Only during the rush hours of the port is the transport schedule complemented with two low-emission diesel buses.



Picture 21. Linkker electric bus charging at the airport roof-mounted pantograph system.



Picture 22. The route of bus line no. 1

A.2.1 Measure outputs

Adding two electric buses to the Turku city bus fleet, making the total number of electric buses six.

A.2.2 Supporting activities

No supporting activities were identified for this measure.

A.2.3 Interactions with other ECCENTRIC measures

Synergy was expected with the impact evaluation results of MAD 5.8. which also aimed to add electric or hybrid buses to the city fleet.

A.2.4 Interactions outside ECCENTRIC

The measure was to support the electrification of the bus line 1 in Turku, started with the eFöli project. The eFöli project, funded by the City of Turku and TEKES (the Finnish Funding Agency for Innovation) in 2016-2019, was established to carry out a research project in conjunction with the procurements to transform the bus line number 1 of Turku region public transport to operate with electric vehicles. 778 000€ was awarded by TEKES for these purposes. The pilot line has provided research and empirical data in the operational environment of the City of Turku on how the number of electric buses should be increased in the future, which lines they are suitable for and what is the total and life cycle cost of these kind of traffic, stock and charging solutions.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Turku residents	Turku city	The bus line runs in the centre and the suburban area between the harbour, market place and the airport.
7	The route of bus line nr.1 runs from the airport to the harbour via the market place and is hence likely to be used by many visitors to the city.		

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	Turku Region Traffic Föli	S	PT	P	Main partner providing public transport services in the Turku region.
2	Regional Council of Southwest Finland	P	other	P	Regional authority providing e.g. regional promotion of PT
3	The City of Turku	P	C	L	Organization and management of the measure
4	Turku University of Applied Sciences	P	KI	P	Data monitoring and analysis, measure evaluation
5	Linkker Ltd	S	PR	P	Manufacturer of the electric buses procured
6	Turku Energia Ltd	S	other	P	Charging infrastructure provider
Type: P:CIVITAS partner – S: other stakeholder					

Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company
 Level of activity: L: Leading role – P: Principle participant – O: Occasional participant

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Risks related to the technical realisation of e-bus data collection and subsequent effects on availability of operational data	Technical	Good cooperation with e-bus provider, operator and the city of Turku	ML, City traffic Ltd
Problems with technical realisation of noise level measurements and subsequent lack of reliable data	Technical	Using certified noise level measurements	ML, City traffic Ltd
Operational and investment costs are not easily differentiated from other operation and investment costs of the sectoral structure of the city because the city council budget structure and difficult to analyse.	Problem related	profound information to those administrative and budget person who are responsible for budget and finance	ML, City traffic Ltd
The risk of not receiving truthful answers to the e-bus line user survey due to awareness of being surveyed	Communication	Posing the questions in a neutral manner, cross verification with several similar questions	ML, LEM

Table 4: Risk assessment.

B. Measure implementation

B.1 Situation before CIVITAS

On June 1st 2015, the Turku City Council approved the launch of an e-bus pilot project on route 1. This route – running between the city airport and the harbour – was considered a significant backbone of internal city traffic and was hence considered an attractive opportunity to display new technological developments in public transport. With the charging system, the total value of the procurement was approximately EUR 3.8 million. The Ministry of Employment and the Economy granted approximately EUR 1 million in investment aid for the implementation of the system.

Prior to the start of ECCENTRIC, there were only 4 e-buses operating in the route. Plans for further development were available. When ECCENTRIC started, this measure was thus already in procurement and implementation phase.

B.2 Innovative aspects

Electric buses are a somewhat new development in Finland. The measure provided valuable information particularly on the winter hardness of electric buses.

B.3 Research and Technology Development

Research and monitoring of e-bus performance in Turku was carried out under project eFöli as described above in section A2.4.

B.4 Actual implementation of the measure

This measure was ahead of schedule as the planning and research process started already in 2015, being realised as an ECCENTRIC early measure. During the years 2015-2017, the city of Turku procured a fleet of six fully electric Linkker 13 city buses along with two opportunity charging stations, as well as depot slow charging infrastructure. The length of the vehicles is 12.8 meters according to technical data from the manufacturer, similar to normal 2-axis diesel buses. The electric buses have 44 seats and 33 standing spots. Two of the buses were partly funded by ECCENTRIC. Due to being an early measure, phase 1 covered only two months in the beginning of the project to plan the starting points of the measure. Phase 2 thereby started in M1 as well. The measure leadership was transferred in May 2017 from Jari Paasikivi to Päivi Kynkäänniemi. In June 2018, Roope Virta took over the leadership of the measure. The changes in measure leadership were relevant for measure implementation.

Phase 1: Research and measure planning milestones (100% completed)

The actual research and planning phase was carried out in years 2014 – 2015 due to its magnitude and complexity – such an innovative procurement would not have been possible without a long process prior to the official project commencement. When the CIVITAS ECCENTRIC project started, this measure was already in the procurement and implementation phase.

The additional following activities related to research and planning of the measure were carried out during phase 1:

- Finalizing project planning with the supplier and other consortium partners. The consortium made formal agreements. M1-M2
- Planning of the driver trainings. M1-M2
- Collection of baseline data sets. M1-M2

Phases 2: Procurement and implementation (100% completed)

The procurement and implementation of the measure began in October 2016 and were completed in January 2018. The following activities were carried out:

- Delivery of two electric buses to complement the existing four. M1-M6
- Driver trainings on e-buses: altogether 94 of drivers were trained. M14-M16
- Compilation of studies on the system: 5 graduates wrote their theses on the busses. M1-M18
- Standardization of the technical parts of the system. M1-M18

Phase 3: Demonstration and monitoring (100% completed)

The demonstration and monitoring phase started in February 2017 and continued until the end of April 2019. The following activities were carried out during this phase:

- Collection of data on the usage of the busses and customer feedback.
- Customer survey was conducted by the regional PT office.
- Introducing the measure to interested cities.
- A plan for the extension of the electric bus lines was devised as part of the Turku city climate plan 2029.

Phases 4: Conclusions and recommendations

The conclusions and recommendations phase of this measure commenced in May 2019 and will be completed in August 2020.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

In this measure, the performance of electric buses was measured via the following key performance indicators. The data derived from different sources on electric buses was compared against data from diesel-operated buses in the Turku city fleet.

Impact					
Indicator name	Awareness	Satisfaction	Contribution to Policies, Plans and Programs	Investment costs	Operational costs
Type	KPI	KPI	KPI	KPI	KPI
Category	Society	Society		Economy	Economy
Subcategory		Acceptance		Costs	Costs
Aspect	Awareness	Acceptance	Governance	Costs	Operating costs
Definition	Awareness of the e-buses will be surveyed on the other hand via a targeted e-bus user survey as well as the mobility barometer aimed at the general public.	Satisfaction on the performance of e-buses	Qualitative measurement on the process to modify policies, plans and programs in a significant and definitive way.	Capital investment costs of the measure	Average operating costs of the measure

Impact					
Indicator name	Vehicle-Km travelled	Accuracy of time-keeping	CO2 Emissions	NOx emissions	PM emissions
Type	KPI	KPI	KPI	KPI	KPI
Category	Transport system	Transport	Environment	Environment	Environment
Subcategory	General	Quality of service	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance
Aspect	Total travel	Service reliability	Emissions	Emissions	Emissions
Definition	Sum of all kilometres travelled by a fleet or a group of users.	The real (not the perceived) reliability of arrival times of public transport services at PT stops and stations.	The total CO2 emissions by city residents / system users.	The total NOx emissions by city residents / system users	The total PM emissions by city residents / system users

Impact		
Indicator name	Energy efficiency	Noise level
Type	KPI	KPI
Category	Environment	Environment
Subcategory	Pollution and nuisance	

Aspect	Emissions	Noise
Definition	The energy consumption of e-buses and the corresponding vehicle-km and passenger-km will be collected from service operators, by recording fuel used and passenger-km or vehicle-km completed during the given periods.	Noise level measured on-site in the area or corridor under study.

Table 5: Description of indicators

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	Percentage	B – A	S	PT users	Line no. 1
2	Satisfaction	Score (0-5)	B	S	PT users	Line no. 1
3	Contribution to Policies, Plans and Programs	Score (0-5)	B	DC	Decision makers	Line no. 1
4	Investment costs	Euro	B	DC	Fleet	Line no. 1
5	Operational costs	Euro	B	DC	Fleet	Line no. 1
6	Vehicle-Km travelled	Kilometres	B	DC	Fleet	Line no. 1
7	Accuracy of time-keeping	Percentage	B	DC	Fleet	Line no. 1
8	CO2 Emissions	Tons of CO2	B	E	Fleet	Line no. 1
9	NOx emissions	Tons of NOx	B	E	Fleet	Line no. 1
10	PM emissions	Tons of PM	B	E	Fleet	Line no. 1
11	Energy efficiency	MJ/km	B	E	Fleet	Line no. 1
12	Noise level	dB(A)	B	S	Fleet	Line no. 1
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Measurements

C.1.2 Baseline

The baseline in this measure was based on the performance of diesel-operated buses in the Turku fleet. Data collection methods for this measure covered mainly secondary quantitative data analysis from data acquired within the scope of the eFöli research project (as mentioned in section A2.4.). In addition, a satisfaction survey was conducted within the scope of the project eFöli. General satisfaction on the PT fleet in Turku was surveyed by the regional public transport office Föli. Noise level on the route was measured by Turku University of Applied Sciences.

KPI 1: **Awareness** was left out due to unavailability of data.

KPI 2: **Satisfaction** describes how satisfied PT users have been in the operation of the diesel operated bus fleet. The overall satisfaction in public transport in Turku was surveyed between 23.7.-13.8.2018 via a survey that was available both online and in paper form at regional public

transport service offices. Overall satisfaction for public transport was 3,9 on a scale of 1 to 5 when N = 1482. During rush hours, two diesel-powered buses do operate alongside the electric buses, as well as during possible interruption periods of the e-buses. However, as the line is mainly operated by e-buses, it was not possible to gain data on satisfaction on diesel operated buses on that specific line alone.

KPI 3: Contribution to Policies, Plans and Programs relates to the impact the measure may have on policies or strategies to promote PT electrification. The state concludes agreements concerning land use, housing and transport (MAL) with the main city regions of Finland. These agreements enhance cooperation among the municipalities in the respective city regions and between the municipalities and the state in the steering of community infrastructure and coordination of land use, housing and transport. In the Turku MAL agreement (2016-2019) it is mentioned that new powertrain and automation solutions were to be piloted. It is also stated that the aim is that bus line no. 1 will be run totally with e-buses. **Score: 4.**

KPI 4: Investment costs refers to the purchasing costs of the EURO 6 model bus (Scania omnibus 3200), which was 225 000€ for the 2-axis bus in 2016. The renewal time of conventional buses was estimated at a 14-year straight-line depreciation, or a million kilometers. This information was derived from Juha Parkkonen, the Managing Director at Turku City traffic Ltd.

KPI 5: Operating costs of the conventional, EURO 6 model diesel-operated 2-axis buses in the Turku fleet were estimated at 0.8€/km. This covered costs for urea (0,01€/km), fuel (0.37€/km), maintenance and repair costs (0.20€/km), and vehicle costs (0.22€/km).

KPI 6: Vehicle-Km travelled on bus line 1 were compiled by Turku city traffic planner Jouko Tervonen in January 2020. In 2019, the sum of all kilometers travelled on line 1 was 695767.6km, out of which 618667.85km were driven with the six electric buses and 77099.75km with diesel buses. The six electric buses were thereby able to cover 88,9% of the service needs in 2019.

KPI 7. In this measure, **accuracy of timekeeping** was compared between diesel buses and e-buses operating on bus line no. 1 in Turku. For diesel buses, the average travel time reliability was -36 seconds. The arrival times of buses on the route were measured on a six-month period between 1.9.2017 – 28.2.2018. The information was derived from an eFöli-commissioned thesis by Juho Taavetinkangas (2018).

KPI 8: CO2 Emissions

The calculated local diesel bus tank-to-wheel CO2 emissions according to VTT (VTT Technical Research Centre of Finland Ltd, 2017) on a EURO VI model Linkker bus were 979.5g/km on a 50% payload. In 2019, in total 695767.6km were driven on bus line 1. If the line was operated solely with diesel buses, CO2 emissions would amount to 605.99t/year locally. Full heater emissions were omitted.

	g/km
EURO VI (full)	1201
EURO VI (empty)	758
EURO VI (50% payload)	979,5

KPI 9: **NO_x emissions**

The calculated local diesel bus tank-to-wheel NO_x emissions according to VTT (VTT Technical Research Centre of Finland Ltd, 2017) on a EURO VI model Linkker bus were 0.7g/km on a 50% payload. In 2019, 695767.6km in total were driven on bus line 1. If the line was operated solely with diesel buses, NO_x emissions would amount to 0.49t/year. Full heater emissions were omitted.

	g/km
EURO VI (full)	0.8
EURO VI (empty)	0.6
EURO VI (50% payload)	0.7

KPI 10: **PM emissions**

The calculated local diesel bus tank-to-wheel PM emissions according to VTT (VTT Technical Research Centre of Finland Ltd, 2017) on a EURO VI model Linkker bus were 0.0135g/km on a 50% payload. In 2019, in 695767.6km in total were driven on bus line 1. If the line was operated solely with diesel buses, PM emissions would amount to 0.0093t/year. Full heater emissions were omitted.

	g/km
EURO VI (full)	0.014
EURO VI (empty)	0.013
EURO VI (50% payload)	0.0135

KPI 11: Energy efficiency

The energy efficiency of diesel buses was calculated from the EURO VI Linkker diesel buses' energy consumption, divided with km's driven (VTT 2017). On a 50% payload, the energy efficiency of the bus is 3.9kWh/km or 14.04MJ/km.

Km's driven: 695767,6 km

	MWh
EURO VI (full)	3367
EURO VI (empty)	2124
EURO VI (50% payload)	2745,5

KPI 12: **Noise level** was measured by Turku University of Applied Sciences engineering students with the supervision of professor Markku Ikonen on bus line no. 1 (airport – harbor) on a Scania OmniExpress 320LE diesel bus. The measurements were made from an approximate distance of 7,5m from the passing vehicle. A Rion NL-52 sound level meter was applied in the measurements (range 0-130 dB). The meter was equipped with a foamed plastic windscreen to reduce wind noise and was propped to the ground with a tripod at 1,5m height during the measurements. The measurements were made at noon on the road by the airport with not much other traffic at that time of the day to minimize other sources of noise. The temperature at the time of measurement was +5 °C.

Level of noise at an even speed:

Driving speed	Measuring point 1	Measuring point 2
20km/h	72.1dB	70.7dB
30km/h	72.8dB	70.7dB
40km/h	75.9dB	73.3dB
50km/h	77.6dB	77.1db
60km/h	79.7dB	77.6dB

Level of noise at acceleration:

Driving speed	Measurement 1	Measurement 2
0-20km/h	75.7dB	76.7dB
20-40km/h	78.2dB	76.9dB
40-60km/h	79.6dB	78.9dB

Since the average driving speed in the bus line no.1 is 50 km/h in those areas where there is housing and commercial activities (the city center and the suburban area), the value chosen for comparison was the average of measuring points 1 and 2 at 50km/h: **77,4dB**.

C.1.3 The business-as-usual scenario

Electrification of public transport is part of Turku city's strategy for carbon neutrality. Therefore PT electrification would have taken place without the measure. However, fewer buses would have been operating on the bus line no. 1 without project impact. In the business-as-usual scenario it is assumed that the bus line no. 1 would be running with four electric buses instead of the six, with BaU values calculated accordingly. The total amount of kilometers driven on line 1 in 2019 was 695767.6km, out of which 618667.85km were driven with the six electric buses and 77099.75km with diesel buses. The average yearly amount of km per each e-bus was 10311,3km. In a scenario with four e-buses, the total VKT would be the following: 412445,2km with e-buses and 283322,4km with diesel buses (59,3% and 40,7%, respectively). Full heater emissions were omitted.

In some of the indicators BaU was similar to After-scenario as electrification of the bus fleet in Turku would have taken place in any case, albeit with less electric buses.

Satisfaction	BaU is similar to After-scenario.
Contribution to Policies, Plans and Programs	BaU is similar to After-scenario.
Investment costs	BaU is similar to After-scenario.
Operating costs	BaU is similar to After-scenario.
Vehicle-Km travelled	The total amount of kilometres on bus line 1 is used here, 695767,6km.
Accuracy of time-keeping	BaU is similar to After-scenario.
CO2 Emissions	With an estimated yearly amount of VKTs both with e-buses and diesel buses, the CO2 emissions would amount to 277.514t/year.
NOx emissions	With an estimated yearly amount of VKTs both with e-buses and diesel buses, the NOx emissions would amount to 0.2t/year.
PM emissions	With an estimated yearly amount of VKTs both with e-buses and diesel buses, the PM emissions would amount to 0.0038t/year.
Energy efficiency	BaU is similar to After-scenario.
Noise level	BaU is similar to After-scenario.

C.2 Measure results

Values obtained for the selected KPIs were summarised in the table below. Data for KPI 1, awareness, was not available and the indicator was hence left out.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Satisfaction	Score (1-5)	3.9	2016	4.1	2016	4.1	2016	0.2	0.2
Contribution to Policies, Plans and Programs	Score (1-5)	4	2016	5	2019	5	2018	1	0
Investment costs	€	225000	2016	525000	2015	525000	2015	300000	300000
Operating costs	€/km	0.8	2017	0.85	2017	0.85	2017	-0.05	-0.05
Vehicle-Km travelled	Km	695767.6	2019	695767.6	2019	695767.6	2019	0	0
Accuracy of time-keeping	s	-36	2018	-54	2018	-54	2018	-18	0
CO2 Emissions	tons/yr	605.99	2019	277.54	2019	75,5	2019	-530.49	-202.04
NOx emissions	tons/yr	0.49	2019	0.2	2019	0,054	2019	-0.44	-0.15
PM emissions	tons/yr	0.0093	2019	0.0038	2019	0,001	2019	-0.0083	-0.0028
Energy efficiency	MJ/km	14.04	2019	3.24	2019	3.24	2019	-10.8	-10.8
Noise level	dB	77.4	11/2016	71.6	11/2016	71.6	11/2016	-5.8	-5.8

PT users' **satisfaction** in the Turku city buses was surveyed in 2019 on all the bus lines via paper forms to be filled in the buses, at the public transport office service points, or online. Data was acquired for line no. 1 and as a control sample for line 18, another high capacity diesel-operated bus line that runs a route of approximately 16km between the southern suburbs of Turku via the city center to northern suburbs. The average weighted score on a scale of 1-5 for satisfaction for line no. 1 was 4.1, when for line no. 18 it was 4.0, making passenger satisfaction slightly higher for the e-buses. It should be noted, however, that some diesel buses still operate on line no. 1, especially during the rush hours, which possibly interfered with the results. Also the number of reviews for line 1. (n=31) was significantly lower than for line 18 (n=166), which naturally affected making any valid conclusions.

Customer satisfaction, line 1			Customer satisfaction, line 18		
	%	Weight %		%	Weight %
Driver service	3.97	40	Driver service	41.5	40
Driving style	3.9	20	Driving style	4.12	20
Bus indoor appearance	4.32	25	Bus indoor appearance	3.83	25
Bus outside condition	4.03	15	Bus outside condition	3.68	15
Weighted average	4.1		Weighted average	4.0	

Table 7. Customer satisfaction

It is clear that the electrification of public transport is strongly embedded to **city policies, plans and programs**. In addition to the MAL agreement, steering community infrastructure and coordination of land use, housing and transport, the City of Turku Sustainable Energy and Climate Action Plan 2029 (2018) heavily promotes PT electrification. The plan has been prepared in accordance with the common model of the European Union (SECAP, Sustainable Energy and Climate Action Plan) and it includes climate policies and milestones for years 2021, 2025 and 2029. According to the plan, public transport in Turku will be turned into a carbon neutral service by 2029. Electrification of bus lines proceeds in the pace enabled by technical development and competitive tendering and electrification will be complemented with biofuel solutions. A more detailed plan for electrification is currently being devised and will be subjected to city council approval in the spring of 2020. Based on the above, it could be concluded that the impact of the measure on policy and strategy development was significant.

Score: 5.

The **investment costs** of electric buses were derived from the tender by Linkker Ltd. The cost of 525 000€ per bus was 57 % higher than that of a 2-axis EURO 6 model bus. When calculating the total costs of PT electrification in Turku one should naturally also include the building and infrastructure costs of the charging system. The total costs of ownership were analyzed by Janne Lankila (2017) from Tuku University of Applied Sciences, the results of which can be seen below. This model was however left out from the measure results above as the objective of the measure was to procure two electric buses to add the four already procured.

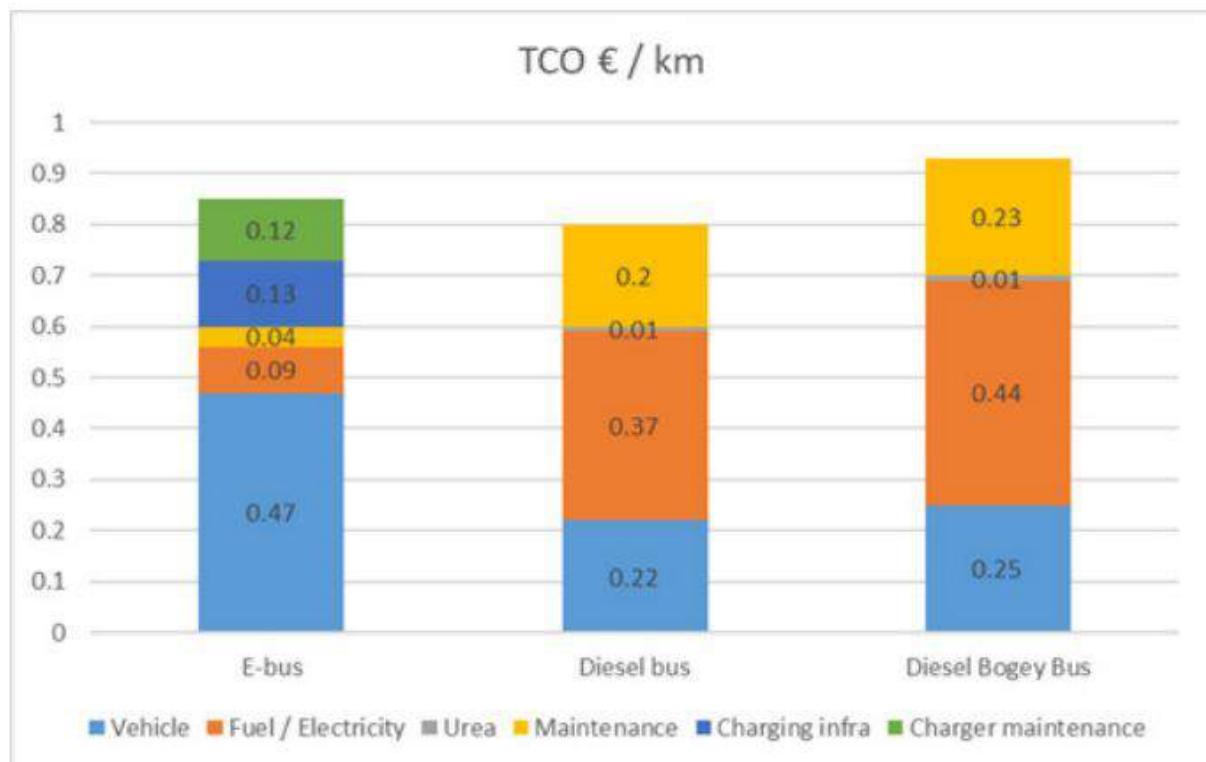


Figure 1. TCO analysis of an e-bus system compared to various types of diesel buses

The operating costs of the Turku electric buses were estimated at 0.85€/km. This covered costs for the charging infrastructure upkeep (0.12€/km), the charging infrastructure itself (0.13€/km), power (0.09€/km), maintenance and repair costs (0.04€/km) and vehicle costs (0.47€/km). According to this scenario, the costs of operating an electric bus were slightly higher than the costs of operating a new diesel bus of the same size.

Vehicle-Km travelled in this measure refers to the sum of kilometers travelled by the Turku e-buses. Overall, it should be stated that the Turku e-buses were yet to reach their planned yearly km-output (Aho 2019, 24). The annual km-goal for each e-bus was dependent on the rotation scheme the vehicle had been assigned to. The planned rotation schemes can be seen below (minimum and maximum daily planned kilometres are highlighted in red) – rotation schemes 1-6 were planned for working days (Mon-Sat) and schemes 7-9 for Sundays and midweek holidays. Due to the fact that the actual scheme being driven by a particular vehicle could change from day to day, an exact long-term mileage goal could not be stated for a single vehicle.

Rotation scheme #	1	2	3	4	5	6	7	8	9
Weekday	Mon - Sat						Sun		
Begin time	5:15	5:30	5:15	5:15	6:15	5:45	6:00	6:15	5:15
Stop time	1:05	22:42	0:22	22:20	0:35	22:07	1:05	0:35	0:22
Hours on route	19:50	17:12	19:07	17:05	18:20	16:22	19:05	18:20	19:07
Km's on route	341.7	296.5	327.2	294.6	314.6	280.2	325.3	312.7	325.4

Table 8. The planned e-bus rotation schemes for route 1.

During 2019, the third year of operation, total number of kilometers travelled on line 1 was 695767.6km, out of which 618667.85km were driven with the six electric buses and 77099.75km with diesel buses. The six electric buses hence covered 88.9% of the service needs in 2019 on line 1. To calculate emissions, these yearly VKTs were applied.

The accuracy of time-keeping reflects the reliability of the service, having thus an impact on customer satisfaction. The average travel time reliability e-buses operating on bus line no. 1 was -54 seconds. The arrival times of the electric buses on the route were measured on a six-month period between 1.9.2017 – 28.2.2018. When compared with the diesel buses operating on the same line, the difference amounted to -18 seconds.

The emissions reduced in line no. 1 were naturally substantial, despite the occasional replacement of some of the electric buses with conventional diesel buses (mostly with the EURO VI model). In 2019, the sum of all kilometers travelled on line 1 was 695767.6km, out of which 618667.85km were driven with electric buses and 77099.75km with diesel buses. The six electric buses were thus able to cover 88,9% of the service needs in 2019. Then, as 11.1% of all kilometers travelled on the line were driven with diesel buses, are the local CO₂/Pm/NO_x values presented according to this number of kilometers in measure results. The heating in the e-buses is diesel-based, however the full heater emissions were omitted here. The need for heating naturally varies a lot depending on the weather conditions – the Turku winters tend to fluctuate in this respect greatly.

The average energy efficiency of a Linkker 13 electric bus was 0.89kwh/km as calculated by Lankila (2017), or 3.24MJ/km. From an energy efficiency point of view it could be stated that the Turku e-buses have proven competitive compared to traditional diesel buses, even the more energy efficient EURO VI models.

Noise level was measured by Turku University of Applied Sciences on bus line no. 1 (airport – harbor) on a Linkker 13 electric bus. The measurements were made from an approximate distance of 7,5m from the passing vehicle. A Rion NL-52 sound level meter was applied in the measurements (range 0-130 dB). The meter was equipped with a foamed plastic windscreen to reduce wind noise and was propped to the ground with a tripod at 1,5m during the measurements. The measurements were made at noon on the road by the airport with not much other traffic at that time of the day to minimize other sources of noise. The temperature at the time of measurement was +5 °C.

Level of noise at an even speed:

Driving speed	Measuring point 1	Measuring point 2
20km/h	63.6dB	64.4dB
30km/h	66.6dB	67.5dB
40km/h	68.9dB	70.2dB
50km/h	70.5dB	72.7db

Level of noise at acceleration:

Driving speed	Measurement 1	Measurement 2
0-20km/h	63.8dB	64.5dB

20-40km/h	65.8B	66.8dB
40-60km/h	75.5dB	70.7dB

Since the average driving speed in the bus line no.1 is 50 km/h in those areas where there are housing and commercial activities (the city center and the suburban area), the value chosen for comparison was the average of measuring points 1 and 2 at 50km/h: **71.6dB**.

It could be inferred from the measurements that noise reduction can somewhat be achieved with electric buses in urban areas. At a speed of 20km/h, the noise generated by an e-bus can be up to approximately 9dB lower than those of a diesel bus. However, differences in noise as compared to diesel operated buses decrease when speed increases.

C.3 Summary: achievement of objectives

From a technological point of view, the components of the system have performed satisfactorily. In terms of energy efficiency, the system has proven competitive when compared to traditional diesel-fueled buses. Some problems still prevail with the most critical auxiliary services, such as the HVAC system – critical for system satisfaction in northern climates.

No.	Objective and target	Rating	Comment
1	At least 6 e-buses are on traffic	★★	Six e-buses were operating bus line no.1, leading to improved energy efficiency, decreased CO2 emissions and reduced levels of noise.
2	Line 1 is fully electrified	★★	The six electric buses covered 88,9% of the service needs in 2019 on bus line no. 1
3	Customers are satisfied with the e-buses	★★	Customers scored an average satisfaction of 4.1 to the bus line no. 1, which was a slightly higher score than for the overall satisfaction in PT in Turku (3.9) and the satisfaction on a control bus line (4.0).
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★ = Exceeded			

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

The only deviation from the original plan was that the ML was changed as first Päivi Kynkäänniemi and then Stella Aaltonen took over measure leadership from Jari Paasikivi.

D.2 Barriers

The following barriers were identified during measure planning, implementation and demonstration.

D.2.1 Organizational

Key personnel in the measure has been subject to changes. However as the measure was ahead of schedule when ECCENTRIC started and plans were made and validated early on, the personnel changes did not have a significant effect on measure results.

D.2.2 Financial

An e-bus is an expensive investment, which might hinder further procurements. This might also thwart the long term objectives of the measure to promote and implement sustainable, clean and (energy) efficient urban transport measures by electrifying most of the city bus lines in the city of Turku.

D.3 Drivers

The following drivers were identified during measure planning, implementation and demonstration

D.3.1 Political / strategic

Commitment of key actors to promote electrification of public transport in Turku has been a major driver for this measure. The goal to electrify bus line no.1 was largely supported politically and larger scale electrification of public transport is part of the city's climate objectives. The measure and its results have contributed to the vision for Turku to become carbon neutral by 2029.

D.3.2 Technological

Although there have been technical issues in the measure related to e-bus performance, e-bus reliability has steadily grown throughout the project. The technology used is mostly appropriate for Finnish weather conditions. Solving the technical issues has been facilitated by the fact that several similar pilots have been running in Finnish cities over the last years. These have been benchmarked both in the planning phase and during implementation if needed.

D.3.3 Planning

Planning-wise, the timing of the measure was just right. The measure was pre-planned to a good extent before the measure officially started, which meant that procurement and

implementation could get started already in November 2016. A procurement of this size could not be carried out within a project time-scale, hence the success of the pre-planning was essential for measure objective realisation.

D.3.4 Organizational

The strong role of Turku City Traffic Ltd. and the commitment of the company's senior management to PT electrification has been an essential driver in the electrification process. Turku City Traffic has successfully promoted PT electrification on political and strategic level.

D.4 Recommendations on the implementation process

Some recommendations can be highlighted based on process evaluation.

D.4.1 Planning is of essence

In order to facilitate the process of e-bus procurement and implementation, the importance of planning cannot be underestimated. It is relevant both in terms of technology and procurement (contract) details, both having a critical impact on subsequent system cost-efficiency.

D.4.2 Political will and commitment is needed to implement electrified PT systems

Implementing a system based on novel technology is bound to have some setbacks and failures, possibly leading to apparent inefficiency of the system at times and higher upfront costs. Therefore political commitment of key actors to promote electrification of public transport is of essence for attaining trust in the longer-term functioning of the system despite initial setbacks.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- 6 electric buses are on traffic, partly funded by ECCENTRIC.
- Bus line no. 1 is almost fully electrified, with the e-buses covering 88.9% of the service needs on that route.
- Customer satisfaction is rather high for the line, slightly higher than average PT satisfaction in Turku.

E.2 Relevance of supporting activities

No supporting activities were identified for this measure.

E.3 Interaction with other measures

No interactions were realized with other ECCENTRIC measures.

E.4 Main lessons learned

The main lessons learned are summarized by Aho in the eFöli publication “Procurement and commissioning of electric buses in Turku” (2019).

- In measures that involve new technology, delays and setbacks are naturally to be expected. During the first operative years, the reliability of the system has, however, failed to reach a satisfactory level. Due to various interruptions in the service, the e-buses have been constantly supplemented by diesel buses. Overall reliability still needs to improve greatly.
- In terms of realized driving output, the vehicles are yet to reach their planned yearly goals. In general, however, the output increased per each vehicle during the first years of operation. There are still recurring reasons why the traffic is periodically halted, e.g. bus auxiliary malfunction, charging infrastructure malfunction, planned maintenance and service or operative reasons. There is a general upward trend for improved mileage but it remains inconclusive whether the target level of operation has been reached permanently.
- Winter has presented some challenges for operation, which was to be expected. There was a distinct decline in the number of successful days particularly in winter 2017-2018, mainly due to problems with the integrated auxiliary heater. It remains to be seen whether these problems have been resolved and whether the good general performance level achieved can be sustained also during the cold period in the future.
- There is an image and PR risk associated with poor reliability of service – both in the eyes of the public and public transport professionals. This may affect future

development within the field. It is thus of great importance that in the future tendering processes for e-buses, attention is paid on all the details of achieving a fully functioning bus system.

E.5 Long term impact

The expected long-term impacts of the measure relate to improved knowledge on PT electrification gained throughout the project. Continuing PT electrification is a long-term goal in the city as expressed in the Turku Climate Plan. The measure has contributed to proving that PT electrification can be a very viable option for organizing public transport towards carbon neutrality.

E.6 Potentials for up-scaling in the city

There is great potential for up-scaling of this measure on city level. Plans are already in place for further PT electrification as part of the Turku Climate Plan, for which the measure has provided valuable information. In January, it was actually published that a tender by the regional PT office Föli, aiming to cover transport on lines 6, 7 and 7A (between Turku and the neighbouring municipalities Lieto, Kaarina, Raisio and Naantali), was won by Nobina Ltd with the intention of covering the required service needs with 12 new electric buses and 13 diesel buses. The contract will be made for eight years as of 2021. The lines in question carry approximately 3M passengers per year. This is a significant development, showing that market-based expansion is feasible when it comes to electrifying public transport – the price of the tender won by Nobina Ltd. was estimated 5.3M€, which is 14.2% lower than the current price for those same bus lines.

F. Additional information

F.1 Appraisal of evaluation approach

Overall, the evaluation approach in this measure has been successful. The following points, indicating weak and strong points and giving recommendations for similar evaluation work in the future, can be highlighted based on assessment of the evaluation approach.

- The research project eFöli with its various studies monitoring the Turku e-bus system performance was of utmost importance for carrying out the evaluation. Availability of data and further recommendations were mostly based on the activities done within the scope of eFöli. It would not have been possible to carry out similar research within the scope of ECCENTRIC alone.
- Collection of data for customer satisfaction should have been more attuned to the specific qualities of the electric buses. As it is, the bus line no. 1 was surveyed with the same questions as the other bus lines, which meant that it was not possible to differentiate the qualities often associated with electric transport (e.g. lower levels of noise).

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

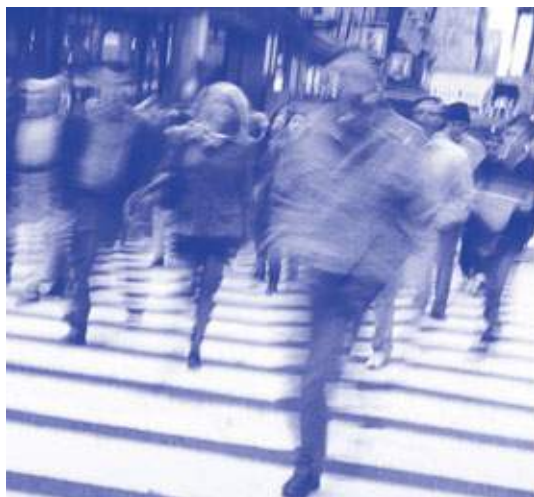
- The measure findings should be carefully taken into account when planning for the next actions related to PT electrification in Turku. The data available proves that from a technological point of view, the core components of the system functioned satisfactorily. This should be communicated on the political level to achieve political agreement on further PT electrification.
- The field of PT electrification is in constant flux. It is therefore recommended that emphasis be based on research projects mapping out possible alternatives for PT in the future too.

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2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



MAD 5.8

Electric and hybrid buses for public transport

Measure Evaluation Report

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2020
CIVITAS
Cleaner and better transport in cities
ECCENTRIC



THE CIVITAS INITIATIVE
IS CO-FINANCED BY THE
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28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Sergio Fernández	

Table of Contents

ABSTRACT.....	1096
A. INTRODUCTION.....	1097
A.1 EXPECTED RESULTS OF THE MEASURE	1097
A.1.1 Quantifiable impacts.....	1097
A.2 MEASURE DESCRIPTION	1097
A.2.1 Measure outputs.....	1098
A.2.2 Supporting activities	1098
A.2.3 Interactions with other ECCENTRIC measures.....	1098
A.2.4 Interactions outside ECCENTRIC	1098
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1098
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1099
A.5 IDENTIFIED RISKS	1100
B. MEASURE IMPLEMENTATION	1101
B.1 SITUATION BEFORE CIVITAS	1101
B.2 INNOVATIVE ASPECTS.....	1101
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1101
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1101
C. IMPACT EVALUATION FINDINGS	1103
C.1 EVALUATION APPROACH.....	1103
C.1.1 Expected impacts and indicators.....	1103
C.1.2 Baseline.....	1105
C.1.3 The business-as-usual scenario.....	1107
C.2 MEASURE RESULTS.....	1108
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1109
C.4 UP-SCALING	1110
D. PROCESS EVALUATION FINDINGS	1111
HERE THE MAIN FINDINGS OF THE PROCESS EVALUATION ARE SUMMARISED. MORE DETAILS ARE AVAILABLE IN THE PROCESS EVALUATION REPORT OF THIS MEASURE.....	1111
D.1 DEVIATIONS FROM THE ORIGINAL PLAN.....	1111
D.1.1 Selection of pilot bus line.....	1111
D.1.2 Number of hybrid buses	1111
D.1.3 Service provision by conventional diesel buses	1111
D.2 BARRIERS	1111

D.2.1	Operational barrier.....	1111
D.3	DRIVERS	1112
D.3.1	Political barrier.....	1112
D.4	SUPPORTING ACTIVITIES.....	1112
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1112
D.5.1	Get the Operations Department fully involved since the design stage.....	1112
D.5.2	Compare a broader range of technologies, if possible	1112
E.	EVALUATION CONCLUSIONS	1113
E.1	VALIDATED DIRECT IMPACT	1113
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1113
E.3	INTERACTION WITH OTHER MEASURES.....	1113
E.4	MAIN LESSONS LEARNED	1113
E.5	LONG TERM IMPACT	1114
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1114
F.	ADDITIONAL INFORMATION	1115
F.1	APPRAISAL OF EVALUATION APPROACH	1115
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1115

List of Figures

Figure 1: Hybrid buses in measure MAD 5.8 (Source: EMT).....	1102
Figure 2: Route of bus line 140	1105

List of Tables

Table 1: Quantifiable impacts.....	1097
Table 2: Target groups or affected parties.....	1098
Table 3: Measure stakeholders.....	1099
Table 4: Identified risks.....	1100
Table 5: Description of key performance indicators (KPI).....	1103
Table 6: Description of key performance indicators (KPI) (cont.).....	1104
Table 7: Measure's indicators	1124
Table 8: Emission and energy factors for an urban EURO IV bus (Copert).....	1106
Table 9: Baseline emission and energy factors for an urban EURO IV bus (Copert)	1107
Table 10: Commercial speed on bus line 140 (km/h).....	1107
Table 11: Quantifiable impacts.....	1109

Project	City		
ECCENTRIC	Madrid		
Measure code	Measure name		
MAD 5.8	Electric and hybrid buses for public transport		
Last update	Responsible	e-mail	telephone
31/10/2019	Sergio Fernández	sergio.fernandez@emtmadrid.es	+34 91 4068831

Abstract

This measure aims at increasing the efficiency and environmental performance of the public transport fleet of EMT, the municipal company in charge of bus services in the city of Madrid. Within this measure, 9 new hybrid buses were added to the EMT fleet and monitored for one year while operating on EMT route 140, a tangential bus line close to the ECCENTRIC living lab in Madrid.

The measure is in line with the Air Quality Plan and the Sustainable Urban Mobility Plan actions of Madrid City and also with the recently launched Madrid360 Sustainability Strategy (presented in September 2019). It is also in line with EMT strategic plans regarding clean fleet uptake, started in 2016.

The new hybrid buses were presented to the press in December 2016 and received by EMT between that date and January 2017. They were included within a package of 200 new buses, of which 30 are hybrids (models MAN LION'S CITY HYBRID and IVECO URBANWAY HYBRID) and the rest CNG buses.

Overall, the achievement of the objectives has been satisfactory. Only the 30% reduction in energy consumption and CO₂ emissions has not been achieved in full considering the complete bus fleet (actual reduction has been 20.7%), due to the assignment of some conventional buses to L140 at peak-hour times and in particular circumstances, covering in total 23% of the annual km travelled; if these services had been covered with hybrid buses, the reduction would have achieved 27%, closer to the target.

It is worth noting that noise reduction was the improvement most noticed by L140 passengers (one third of them), so that this objective can be considered as fully achieved.

The replacement of the old Euro IV buses by the new hybrid buses had a stronger impact on NO_x and PM emissions than on CO₂ emissions, as the new hybrid buses combine the effect of fuel savings and a cleaner Euro VI engine replacing Euro IV buses. The impact on air quality is therefore higher than the effect on climate change mitigation, and is very well aligned with the objectives stated by the municipality in its last Air Quality Plan.

Two lessons can be highlighted for this measure: First, hybrid buses provide an effective alternative for the replacement of diesel buses, as they provide CO₂ emission and fuel savings of more than 20%, reduction in NO_x and PM emissions, and significant customers' satisfaction; noise reduction is the most valued improvement by users; second, hybrid buses are also economically efficient, as the additional costs can be recovered in less than 5 years, due to fuel and maintenance savings.

It can be expected that this measure will influence EMT's future bus procurement decisions.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

To increase the efficiency and environmental performance of the public transport bus fleet in Madrid

(2) Strategic level:

To provide a more attractive offer of PT to compete with private car use

(3) Measure level:

To help developing guidelines and recommendations for selecting major fleet renewal to be undertaken in the upcoming years

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
1	Energy consumption (and emissions) reduced by 30%	X									
2	Noise reduction, due to the use of alternative technologies							X			
3	Contribution to the air quality plan objectives		X								

Table 1: Quantifiable impacts

The noise reduction objective has not been quantified. Hybrid buses provide lower noise levels than diesel buses at bus stops (mainly during acceleration), but the project did not undertake noise measurements during the demonstration.

A.2 Measure description

This measure aims at increasing the efficiency and environmental performance of the public transport fleet of EMT, the municipal company in charge of bus services in the city of Madrid. It includes the following actions:

- Adding at least 6 new electric or hybrid buses to the EMT fleet (9 hybrid buses have been added).
- Monitoring the performance of these new buses under real conditions while operating within the demo area (Puente de Vallecas and Villa de Vallecas districts, ECCENTRIC living lab in Madrid).
- Assessing and comparing the different technologies (standard buses versus new ones) in order to provide guidance for future fleet renewal.

A.2.1 Measure outputs

As its main output, this measure will help developing recommendations for future fleet renewal, based on the operation of this type of vehicles and technology (EMT has more of 2,000 buses in its fleet).

A.2.2 Supporting activities

There have been no supporting activities for the implementation of this measure.

A.2.3 Interactions with other ECCENTRIC measures

No interactions are envisaged with other measures. Initially, this measure was expected to interact with measure MAD 5.1, as the buses would be assigned to the high level PT service corridor to be developed under that measure. This option was abandoned due to the changes made in measure MAD 5.1, and the demonstration is being made in one of the bus lines (#140) in the area of the living lab. A significant part of the route served by bus line 140 overlaps with a section of the high capacity corridor foreseen in measure MAD 5.1.

A.2.4 Interactions outside ECCENTRIC

No interactions foreseen outside ECCENTRIC.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents in the area of influence of the lines served by the hybrid buses	2	Until implementation of Measure 5.1, the hybrid buses will serve Line 140.
2	Users of the lines served by the hybrid buses		

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR- other	Level activity L-P-O	Role Links –
1	Director of planning and operations, CRTM	P	OTHER	O	(1)
2	Head of planning, CRTM	P	OTHER	O	(1)
3	Head of urban bus services, CRTM	P	OTHER	P	(1)
4	District councillor chair. Puente de Vallecas and Villa de Vallecas	P	C	O	(2)
5	City Councillor. Environment and Mobility	P	C	O	(2)
6	City Councillor. Sustainable Urban Development	P	C	O	(2)
7	City. Director traffic management.	P	C	O	(3)
8	Local police	P	C	O	(3)
9	Foro local Puente de Vallecas	S	O	O	(4)
10	EMT CEO (<i>Gerente</i>)	P	PT	O	(5)
11	EMT Director of transport services	P	PT	L	(5)
12	Asociación de vecinos Puente de Vallecas	S	NGO	O	(6)
13	Asociación de vecinos Madrid Sur	S	NGO	O	(6)
14	Fundación ONCE	S	NGO	O	(7)
15	PP. Puente de Vallecas	S	OTHER	O	(8)
16	PSOE. Puente de Vallecas	S	OTHER	O	(8)
17	C's. Puente de Vallecas	S	OTHER	O	(8)
18	CRTM. Measure partner	P	OTHER	P	
19	EMT. Measure leader	P	PT	L	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

Some clarifications on the stakeholders' roles and links are provided below:

- (1) Although not directly involved in this measure, these CRTM executives are influential in establishing guidelines on bus fleet renewal for bus companies providing public transport services in the region.
- (2) With a different degree of involvement, these city councillors have been influential in setting general guidelines to EMT on fleet renewal and on the allocation and deployment of the new buses to particular areas in the city.
- (3) It was considered that the deployment of new buses could be associated to challenges on traffic management and traffic enforcement. However, during the implementation process it became obvious that this was not the case. Therefore, these stakeholders did not participate in the measure.
- (4) This is the public participatory platform established by the municipality to ensure citizens participation in the decision-making process for the district where the new hybrid buses will operate.

- (5) Beyond the role of EMT as measure leader, these key EMT executives, not personally involved in ECCENTRIC, were influential in establishing the strategy for the company's fleet renewal and taking decision in the allocation of the new buses to particular lines.
- (6) NGOs active in the area of deployment of the new buses.
- (7) NGO active in universal accessibility in public transport. Finally, as the accessibility characteristics of the hybrid buses did not differ from the general accessibility rules followed by EMT, this stakeholder was not involved in the measure process.
- (8) District branches of the political parties with representation in the city council, which do not participate in the local government (opposition parties).

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Delay or lack of implementation of the complementary measure (measure 5.1. high PT service corridor in peripheral districts), as the intention is to use these buses on that corridor.	Other (Technical)	Contingency plan to be prepared: The new buses could be operated on an existing bus line within or close to the city lab (e.g. Line 140).	EMT
Users are not attracted by the new buses	Cultural	The new buses are being operated in other lines outside the city lab to identify potential barriers to users' satisfaction	EMT
Monitoring of performance not fully completed by the relevant EMT services	Planning	Checking that regular monitoring already gathers the necessary data for monitoring	EMT
Key stakeholders and users not aware/not interested in the new bus technology	Involvement	Ad hoc meetings for presenting the new buses and their potential	EMT

Table 4: Identified risks.

B. Measure implementation

B.1 Situation before CIVITAS

The measure is in line with the Air Quality Plan and the Sustainable Urban Mobility Plan actions of Madrid City, as well as with the most recently launched Madrid360 sustainability strategy. It is also in line with EMT strategic plans regarding clean fleet uptake, started in 2016, as a way to replace buses after the financial constraints that followed the 2007 economic downturn.

The new hybrid buses were presented to the press in December 2016 and received by EMT between that date and January 2017. They were included within a package of 200 new buses, of which 30 are hybrids (models MAN LION'S CITY HYBRID and IVECO URBANWAY HYBRID) and the rest CNG buses. Nine of them were used within the ECCENTRIC project.

Subsequently, EMT has continued purchasing CNG and electric buses. In July 2017, a contract for a package of 89 units was approved (15 of them electric, the Irizar i2e model previously tested on line 39); they were delivered at the beginning of 2018 and started operations in February 2018. Five e-buses with an induction charging system have been tested on line 76 since January 2018. In July 2018, a new investment for the procurement of 460 CNG buses was approved; these buses will be delivered in two stages in 2019 and 2020. With this, EMT will have renewed 70% of its fleet between 2016 and 2020.

B.2 Innovative aspects

New hybrid diesel buses are added to the EMT fleet for the first time.

B.3 Research and Technology Development

Research and technology developments of hybrid buses are well known. The models chosen from IVECO (Hybrid Urbanway) and from MAN (Lions City)- both 12 m long- have been available in the market for some time.

B.4 Actual implementation of the measure

Phase 1 (design): Relevant milestones accomplished: Planning and research phase is complete. As soon as the project was officially selected for funding EMT started this phase and the procurement one in order to speed up the process.

Phase 2 (implementation). Procurement was concluded in December 2016. Before operation within the city-lab, the buses are being operated in other peripheral lines, and EMT monitored its performance, as a way to optimise operation during the pilot in Vallecas, in the high PT service corridor or other lines.

Phase 3 (operation). Initially, it was planned that the buses would operate in the new line to be implemented within ECCENTRIC measure MAD 5.1. However, as this measure experienced delays, it was decided to operate the buses on line 140, which connects the city lab (Vallecas) with its neighbouring district of Moratalaz. The operations started on 1st October 2018, with 9 (instead of the 6 initially envisaged) hybrid buses, and all of them being monitored within this ECCENTRIC measure.

The hybrid bus model selected is MAN's A37 Lion's City Hybrid. It combines two 75 kW-electric engines and one 250 CV diesel engine (186 kW), with a capacity to 28 seated and 67 standing passengers.



Figure 1: Hybrid buses in measure MAD 5.8 (Source: EMT)

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact		2	1,3	1,3	1,3
Indicator name	Bus service	Satisfaction	Emissions	Emissions	Emissions
Type	KPI	KPI	KPI	KPI	KPI
Category	Transport system	Society	Environment	Environment	Environment
Subcategory	General	Acceptance	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance
Aspect	Transport system utilisation	Acceptance level	Emissions	Emissions	Emissions
Definition	Vehicle-km travelled by the new buses	User average reported satisfaction with the improved service	Emissions (t per year of CO ₂) saved by new buses compared to ICE models	Emissions (t per year of NO _x) saved by new buses compared to ICE models	Emissions (t per year of PM) saved by new buses compared to ICE models
Unit	km/year	Score (1-5)	tons/year	tons/year	tons/year
Method of data collection	EMT bus tracking system	Survey to bus users	Estimate based on VKM and energy consumption	Estimate based on VKM and energy consumption	Estimate based on VKM and energy consumption
Target group	New buses	Users of new buses	New buses	New buses	New buses
Domain	Line 140	Line 140	Line 140	Line 140	Line 140
Control sample	No	No	No	No	No
Related measures, activities, and interference sources					
References					

Table 5: Description of key performance indicators (KPI)

Impact			
Indicator name	Energy efficiency	Operating costs	Investment costs
Type	KPI	KPI	KPI
Category	Energy	Economy	Economy
Subcategory	Energy consumption	Costs	Costs
Aspect	Energy consumption	Operating costs	Costs
Definition	Specific energy (MJ/km) consumption	Average operating costs (maintenance costs) in the corridor	Total capital cost for implementation of the corridor
Unit	MJ/km	EUR/km	EUR
Method of data collection	Investment and operational costs provided by EMT	Investment and operational costs provided by EMT	Reports from municipality, EMT, CRTM
Target group	New buses	New buses	New buses
Domain	Line 140	Line 140	Line 140
Control sample	No	No	No
Related measures, activities, and interference sources			
References			

Table 6: Description of key performance indicators (KPI) (cont.)

No.	Indicator	Data units	Frequency B – I – A	Method DC-E-S-C	Observed group	Area of measurement
1	Bus service	km	B – I – A	DC	New buses	Line 140
2	Satisfaction	Score (1-5)	I – A	S	Users of new buses	Line 140
3	Emissions CO2	tons	B – I – A	DC	New buses	Line 140
4	Emissions NOx	tons	B – I – A	DC	New buses	Line 140
5	Emissions PM	tons	B – I – A	DC	New buses	Line 140
6	Energy efficiency	MJ/km	B – I – A	DC	New buses	Line 140
7	Operating costs	EUR/km	B – I – A	DC	New buses	Line 140
8	Investment costs	EUR	B	DC	New buses	
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 7: Measure's indicators

C.1.2 Baseline

The baseline considers the *ex-ante* operations on line 140 of the EMT bus network. This is the line where the hybrid buses will be operating, as the new bus corridor initially envisaged within measure MAD 5.1 will not be implemented. The monitoring period extended since October 2018 until April 2019. It could be extended until September 2019 or December 2019, if needed.

There are several reasons for choosing line 140: (1) it is a tangential line, connecting peripheral districts; tangential lines face different challenges in terms of operation compared to radial lines, which can have an influence on energy consumption and emissions; (2) it serves some sections of the future bus corridor to be developed within measure MAD 5.1; (3) the line serves a peripheral area close to the city lab (Vallecas), and (4) the line is served by one of the EMT bus depots which can manage hybrid buses. The route of line 140 is presented in the figure below.



Figure 2: Route of bus line 140

The total length of line 140 is 8.6 km (northbound) and 8.9 km (southbound), and serves 28 stops in each direction, plus two terminals. The service is provided between 6 am and 11 pm. The interval between buses is 11 minutes between 7 am and 8 pm, and the time of the cycle is 96 minutes. The line is served by 9 buses during the morning peak, 7 buses until 13 h, and 8 buses between 13 h and 20 h. These characteristics are not expected to change during the measure demonstration.

The total number of passengers served by line 140 in 2017 was 2,486,942.

For the definition of consumption and emission patterns, a review was made of the buses that served line 140 between 1/1/2017 and 30/7/2018. Due to the operational practice of EMT, where buses can be assigned to different routes in accordance with exploitation needs, the total number of buses that operated on the line in this period is quite high, 346 of seven different models, many of them with only a few kilometres. The baseline took as reference the average values of a sample of 12 diesel MAN NL273F buses. These buses joined the fleet in 2008, and had served at least 2000 km during the period analysed. Together with an older model

(MAN263F), they had provided most of the services on the selected route until the new hybrid buses were put in service in October 2018.

MAN NL273F is an EURO IV bus, 12 m long with a maximum capacity of 90 passengers (33 seated, 57 standing). COPERT v.5.1³⁷ provides emission (g/km) and energy consumption (MJ/km) factors for this bus model running in urban traffic conditions with an average speed of 15 km/h. Based on these factors (and the average energy content values for gasoil, 35.14 MJ/l), it is possible to calculate emission factors expressed in grams per litre of gasoil consumed. These factors are presented in the Table below.

Category	Unit	Specific Factor
NOx emissions	g/l gasoil	16.36
PM10 emissions	g/l gasoil	0.35
PM2.5 emissions	g/l gasoil	0.23
NO2 emissions	g/l gasoil	2.29
CO2 emissions	g/l gasoil	2628
Energy consumption	MJ/l gasoil	35,14

Table 8: Emission and energy factors for an urban EURO IV bus (Copert)

Based on the specific factors above, total emissions and energy consumption can be estimated based on the actual average fuel consumption reported for the 12 reference buses in the period January 2017 to June 2018.

The consumption of the 12 buses retained for the baseline varies between 53.3 and 59.1 litres gasoil/100 km, with an average consumption of 55.5 litres gasoil/100 km. The total number of km needed to service line 140 in 2017 was 476,070 km, including 25,334 km (5.3%) of off-line mileage (from the depot to the terminals). Based on these values, the total emissions and energy consumption figures are presented in the table below.

³⁷ COPERT (Calculation of Emissions from Road Transport) is a computer programme developed by EMISIA with the support of the European Environment Agency, currently used for the estimate of emissions in national inventories. <https://www.emisia.com/utilities/copert/>

Category	Unit	Value
NOx	tons/year	4.326
PM10	tons/year	0.092
PM2.5	tons/year	0.062
NO2	tons/year	0.606
CO2	tons/year	694.9
Energy consumption	MJ/km	19.515

Table 9: Baseline emission and energy factors for an urban EURO IV bus (Copert)

The capital costs of MAN NL273F is € 226,452 EUR (except for three of them, with a slightly higher cost of 2.8%, or €232,853). The vehicles were procured in 2008, and their annual maintenance cost is 66.67 €/100 km. These vehicles were not submitted to any extraordinary maintenance or upgrading operations (i.e. structural changes, a different engine...) since 2008. The bus purchase cost can be updated to 2019 values applying a 13.6% correction, in accordance with *Instituto Nacional de Estadística* (INE); this results in an updated purchase cost of € 264,521.

Commercial speeds in the second half of September 2018 (before the new vehicles started operations) are summarized in the table below. September is considered to be representative of the annual average, taking into account traffic conditions in the city. Commercial speeds are not expected to change as an effect of the replacement of the buses serving the line, and are monitored solely to verify whether speed changes are taking place for reasons independent of the measure, which could have an influence in passengers' satisfaction.

	Average Speed	Standard Dev.	Decile
Total	15.0	2.6	12.3
Weekdays	14.4	2.3	12.0
Weekends	17.2	2.5	14.3

Table 10: Commercial speed on bus line 140 (km/h)

C.1.3 The business-as-usual scenario

In the business-as-usual scenario, it is supposed that line 140 is served with the old EURO IV buses. No changes are expected in the BAU scenario on commercial speed and passenger demand, as a result of this measure.

C.2 Measure results

Values obtained for the selected KPIs are summarised in the Table below.

The total number of km travelled by the buses servicing line 140 (including off-line km) has slightly decreased during the demonstration, compared to the bus line: 476,440 km, of which 450,564 (94% of the total) in regular service, and the rest for off-route trips (mainly trips between the depot and the line terminals at the beginning and conclusion of each bus service). The nine hybrid buses assigned to the line during the demonstration have been able to cover 77.1% of the service needs, and the rest has been covered by conventional diesel buses; this has slightly reduced the measure potential in terms of emission reduction.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Bus service	km/yr	479,279	2017	476,440	2019	476,440	2019	-2,840	0
Satisfaction	Score (1-5)	3	2017	3	2019	4.2	2019	1.2	1.2
Emissions CO ₂	tons/yr	699.6	2017	695.5	2019	549.1	2019	-150.5	-146.4
Emissions NO _x	tons/yr	4,355	2017	4.329	2019	1.162	2019	-3.193	-3.167
Emissions PM	tons/yr	0.09266	2017	0.09211	2019	0,05598	2019	-0.03668	-0.03613
Energy efficiency	MJ/km	19.515	2017	19.515	2019	15,481	2019	-4.035	-4.035
Operating costs	EUR/km	66.67	2017	66.67	2019	32,37	2019	-34.30	-34.30
Investment costs	EUR	232,853	2008	264,521	2017	335,294	2019	102,441	70,773

The number of passengers during the measure operational period has been 2,594,404, of which 2,002,986 have used the hybrid buses. In the previous 12-month period before the measure was implemented (i.e. October 2017-Septembre 2018), the number of passengers had been slightly lower: 2,514,770 passengers. It is unclear to what extent the 3%

Passengers riding L140 expressed a high level of satisfaction with the new buses, with a 4.2 score over 5, compared to a 3 score to the old buses. Most of them (68.6%) were aware that the new buses were providing the service; 69% considered highly adequate to dedicate municipal funding to this (a score of 4.5 over 5).

The emissions reduced in line 140 have been substantial, in spite of continuing providing 23.3% of the service with the old diesel buses. CO₂ emissions (and energy consumption) has been reduced by 21%; emission savings have been even more substantial for NO_x (73%) and PM (39%), as hybrid buses include a Euro VI engine instead of the Euro IV engine of the old diesel buses.

Investment costs are 39% higher for hybrid buses compared to the Euro IV diesel buses they have replaced (the 2008 cost of the latter has been updated to 2019 values). The difference would have been lower (around just 10%) in case of considering the cost of a conventional Euro VI diesel bus. Taking into consideration the full mileage provided by the 9 hybrid buses and a service life of 10 years, the GHG emission abatement cost is €24/ton CO₂.

Operating costs have been cut by more than half (51.4% reduction), from €66.67(100 km to €34.30/100 km. This strong difference can be explained by the long service life (more of 10 years) of the buses that were replaced by the new ones.

The survey has detected some minor changes in transport mode. Out of the growth in the number of passengers measured during the demonstration (79,634 additional trips), it can be estimated that 3,578 were car trips (as a driver) and 2,050 were car trips (as a passenger). This merely represents 0.22% of the annual trips in L140, and result in a slight reduction in CO2 emissions (5.37 t CO2/year) and to negligible reductions in other pollutants.

Commercial speed has not changed as a result of this measure. Commercial speed on line 140 is primarily influenced by the number and location of stops, which were not modified. A slight deterioration of traffic conditions in a couple of crossing points during the morning and evening peak periods have resulted in a slight decrease (0.8 km/h) in commercial speed between September 2018 and September 2019.

C.3 Summary: achievement of objectives

The Table below summarizes the achievement of the measure's objectives compared to the initial expectations.

No.	Objective and target	Rating	Comment
1	Energy consumption (and emissions) reduced by 30%	*	Energy consumption and CO2 emission reduction above 20% on L140. They could have been higher if the hybrid buses had provided more km on this route, instead of diesel buses.
2	Noise reduction, due to the use of alternative technologies	**	33.8% of the L140 passengers considered that the new buses were less noisy than the previous ones. This was the difference noticed by a higher number of respondents, followed by “more comfort” (32%)
3	Contribution to the air quality plan objectives	***	NOx and emission reductions were higher than initially expected (72.7% and 38.9%), contributing substantially the objectives of Madrid’s Air Quality Plan
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved *** = Exceeded			

Table 11: Quantifiable impacts

Overall, the achievement of the objectives has been satisfactory. Only the 30% reduction in energy consumption and CO2 emissions has not been achieved in full considering the total fleet operating on the bus line (actual reduction has been 20.7%), due to the assignment of some conventional buses to L140 at peak-hour times and in particular circumstances, covering in total 23% of the annual km travelled; if these services had been covered with hybrid buses, the reduction would have achieved 27%, closer to the target.

It is worth noting that noise reduction was the improvement most noticed by L140 passengers (one third of them), so that this objective can be considered as fully achieved.

As already stated, the replacement of the old Euro IV buses by the new hybrid buses had a stronger impact on NOx and PM emissions than on CO2 emissions, as the new hybrid buses combine the effect of fuel savings and a cleaner Euro VI engine. The impact on air quality is

therefore higher than the effect on climate change mitigation, and is very well aligned with the objectives stated by the municipality in its last Air Quality Plan.

C.4 Up-scaling

The measure has contributed to establish the EMT fleet renewal plan during these years. The plan's objective is to have a 100% fleet with low or zero emissions vehicles.

It seems that the role of hybrid vehicles in this renewal plan has been reassessed, though, as the political changes at city level during these years are more favourable towards full electrification, and the market evolution seems to be more favourable to this fact. In total, during the life span of the project, EMT has procured 30 hybrid buses, 1050 GNC buses, and 70 electric buses, all of them 12-m long. On top of that, EMT has also purchased 18 electric minibuses and 54 articulated (18-m long) CNG buses.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the **Process Evaluation Report** of this measure.

D.1 Deviations from the original plan

Only minor deviations have been implemented compared to the original plan. They refer to the selected pilot line, to the number of hybrid buses included in the pilot and to the partial provision of services in the pilot line by conventional diesel buses.

D.1.1 Selection of pilot bus line

It was initially envisaged that the demonstration would take place within the living lab. However, due to technical and operational reasons, the hybrid buses were assigned to a depot that was not covering those neighbourhoods. The measure team selected an alternative bus route close to the living lab and providing tangential (i.e. inter connecting neighbourhoods in the periphery) accessibility, so that results could be comparable to those that would have been obtained in the living lab, with similar results in terms of promoting cleaner mobility in peripheral districts of the city.

D.1.2 Number of hybrid buses

The number of hybrid buses was increased from 6 to 9, in order to be able to provide all the daily services scheduled in line 140.

D.1.3 Service provision by conventional diesel buses

In spite of the provisions made for the demonstration, service provision on line 140 has occasionally deviated from the initial plans following the decisions of the depot managers, in order to cover service needs on other lines. This has had two effects: some hybrid buses occasionally being assigned to other lines and conventional diesel buses providing the service gaps on line 140. These changes have not been substantial enough to compromise the reliability of the results obtained on passengers' satisfaction, fuel consumption and emissions.

D.2 Barriers

Only one barrier was identified during the process evaluation.

D.2.1 Operational barrier

The main barrier during the implementation stage was related to the internal EMT procedures to assign the new hybrid buses to a specific line. It took some time until the adequate line serving the Living Lab was identified and the buses could be assigned to it. As the chosen line (line 140) is operated with 9 buses, it was decided to increase the number of hybrid buses of the project from 6 to 9.

D.3 Drivers

This measure was influenced by one political driver: the priority given by the City Council and the EMT Management Board to fleet renewal.

D.3.1 Political barrier

This measure benefited from the political priority given by the City Council and the EMT Management Board to fleet renewal. This priority was not in place at the time the ECCENTRIC proposal was prepared and submitted for funding, and was adopted early in 2016. It has resulted in a quick procurement of the new buses, as well as an impressive effort to renew a large part of the fleet with CNG buses and to start operations with a few different electric bus models.

D.4 Supporting activities

There have been no supporting activities for the implementation of this measure.

D.5 Recommendations on the implementation process

Two recommendations can be made, based on the implementation process experience for this measure.

D.5.1 Get the Operations Department fully involved since the design stage

The assignment of the buses to particular lines and services within the bus company is a complex task, with a certain rigidity (buses assigned to depots, serving different city districts each, depots specialized in particular technologies, drivers assigned to lines and to buses following clearly established rules...). All this makes it necessary to get the Operations Department actively engaged in the selection of the appropriate route for the pilot.

D.5.2 Compare a broader range of technologies, if possible

The scope of this ECCENTRIC measure was to test hybrid buses versus conventional diesel ones, and it has properly done so. Although EMT was procuring also CNG and electric buses during this period, it was too late to consider widening the scope of the measure to include a comparison among all these technologies, due to the rigidity of the project deadlines incompatible with the complexity of establishing a pilot combining different technologies. For this reason, it seems advisable to consider at the beginning of the measure design stage some options to be able to integrate additional technologies if they are purchased during the lifetime of the pilot.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed with the measure leader and other measure participants, the site coordinator and other stakeholders. Based on this, the following evaluation conclusions have been formulated.

E.1 Validated direct impact

- The measure has been successful in achieving significant reductions in the emissions of CO₂ and key pollutants (NO_x and PM), as well as in energy savings.
- Operating costs have decreased by 51.7%, due to the combined effect of reduced fuel consumption (-20.7%) and lower maintenance costs. No technical incidents have been reported during the demonstration period.
- Users' satisfaction has considerably increased, from a score of 3 to 4.2 after the introduction of the 9 hybrid buses.
- One third of users also valued the reduction in noise provided by these buses.
- The additional cost of a hybrid bus compared with the updated cost of the Euro IV diesel buses it replaces is recovered in less than 5 years, considering an average annual mileage of 50,000 km, due to fuel and maintenance savings.

E.2 Relevance of supporting activities

No supporting activities have been implemented for this measure.

E.3 Interaction with other measures

This measure has not interacted with any other ECCENTRIC measure. Initially, it was expected that it would interact with measure MAD 5.1 (priority public transport corridor), but this measure did not reach the demonstration stage.

E.4 Main lessons learned

The following lessons can be highlighted for this measure:

- Hybrid buses provide an effective alternative for the replacement of diesel buses, as they provide CO₂ emission and fuel savings of more than 20%, reduction in NO_x and PM emissions, and significant customers' satisfaction; noise reduction is the most valued improvement by users.
- Hybrid buses are also economically efficient, as the additional costs can be recovered in less than 5 years, due to fuel and maintenance savings.

E.5 Long term impact

It can be expected that this measure will influence EMT's future bus procurement decisions.

E.6 Potentials for up-scaling in the city

In spite of the positive results achieved by the project, the potential for scaling up this measure at the city level, increasing the number of hybrid buses in EMT fleet, is low. Hybrid buses are seen by EMT as a transition technology, probably surpassed already for the movement towards full electric vehicles, and are not likely to play a significant role in the future. Hybrid buses are not considered as a clean vehicle, as CNG and electric buses are, and do not count for achieving EMT's clean fleet targets. Within EMT, there were concerns about the future maintenance cost of hybrid buses, once the warranty period would be terminated and EMT had to take care of its complex double technology. At the time of closing this report, EMT has made no decisions to purchase additional hybrid buses in the near future.

F. Additional information

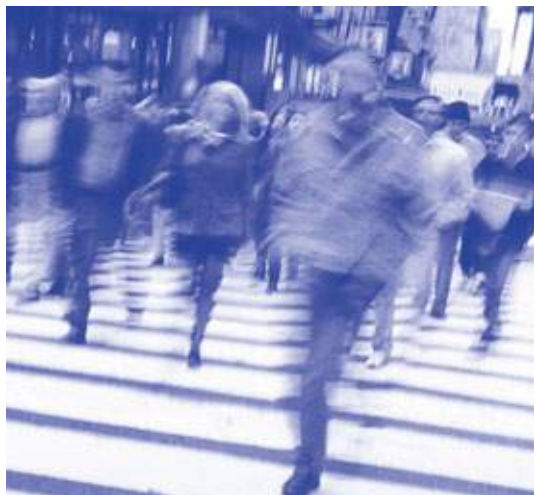
F.1 Appraisal of evaluation approach

The evaluation approach to this measure has been successful in providing an adequate overview of the measure, including the required KPIs. Monitoring vehicle performance was a relatively simple task, as most of the raw information was already provided by the EMT operations system.

The collection of data on users' awareness, satisfaction and previous mobility behaviour in the corridor was challenging and required significant resources. As an alternative to surveying mobility behaviour along the L140 route for all transport modes (which would have been extremely expensive in terms of time and resources) it was decided to conduct in-bus surveys and to estimate modal change based on the responses received about former trip choices for the same trip. The results obtained are consistent with general experience in the impact of bus renewal in keeping bus customers and gaining additional ones from alternative transport modes.

F.2 Future activities relating to the measure

The measure has shown the impact of bus renewal on customers' satisfaction and modal change. Following this approach, EMT could consider to undertake similar surveys in lines in which alternative technologies (full electric buses and GNC buses) are being used.



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MUC 5.9

Intermodal (E-)Mobility Stations Measure Evaluation Report

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2020
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Partner nº	Organization	Country	Abbrev.
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2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Stefan Synek	

Table of Contents

ABSTRACT.....	1124
A. INTRODUCTION.....	1125
A.1 EXPECTED RESULTS OF THE MEASURE	1125
A.1.1 Quantifiable impacts.....	1126
A.2 MEASURE DESCRIPTION	1126
A.2.1 Measure outputs.....	1127
A.2.2 Supporting activities	1128
A.2.3 Interactions with other ECCENTRIC measures.....	1128
A.2.4 Interactions outside ECCENTRIC	1129
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1129
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1129
A.5 IDENTIFIED RISKS	1129
B. MEASURE IMPLEMENTATION	1130
B.1 SITUATION BEFORE CIVITAS	1130
B.2 INNOVATIVE ASPECTS.....	1130
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1130
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1130
C. IMPACT EVALUATION FINDINGS	1132
C.1 EVALUATION APPROACH.....	1132
C.1.1 Expected impacts and indicators.....	1132
C.1.2 Baseline.....	1134
C.1.3 The business-as-usual scenario.....	1144
C.2 MEASURE RESULTS.....	1147
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1169
D. EVALUATION CONCLUSIONS	1170
D.1 VALIDATED DIRECT IMPACT	1170
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	1170
D.3 INTERACTION WITH OTHER MEASURES.....	1170
D.4 MAIN LESSONS LEARNED	1170
D.5 LONG TERM IMPACT	1170
D.6 POTENTIALS FOR UP-SCALING IN THE CITY	1171
E. ADDITIONAL INFORMATION.....	1172

E.1	APPRAISAL OF EVALUATION APPROACH	1172
E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1172

List of Figures

Figure 1: Mobility stations in the Living Lab	1127
Figure 2: Awareness of the mobility station FWS, 2018	1134
Figure 3: Acceptance of the mobility station FWS, 2018	1135
Figure 4: Satisfaction about the mobility station FWS.....	1135
Figure 5: Number of cars per household, 2018.....	1136
Figure 6: Modal Split of Living Lab residents, 2018	1137
Figure 7: VKT by household (density plot), 2018	1137
Figure 8: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)	1138
Figure 9: Accessibility improvements, 2018.....	1140
Figure 10: System usage MS Gertrud-Grunow-Straße, 2018.....	1142
Figure 11: System usage MS Marianne-Brandt-Straße, 2018	1143
Figure 12: Modal Split in Munich (2008+2017)	1144
Figure 13 Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)	1146
Figure 14: Awareness of mobility stations, 2019.....	1151
Figure 15: Awareness of the mobility stations, 2019.....	1152
Figure 16: Awareness through advertisement, 2019	1152
Figure 17: Awareness mobility stations, 2019.....	1153
Figure 18: Acceptance of mobility stations, 2019.....	1153
Figure 19: Satisfaction mobility stations, 2019.....	1154
Figure 20: Reasons for satisfaction about stations, 2019	1155
Figure 21: Reasons for not using the mobility stations, 2019	1156
Figure 22: Satisfaction mobility station facilities, 2019.....	1156
Figure 23: Satisfaction information at mobility station, 2019.....	1157
Figure 24: Satisfaction mobility station facility, 2019.....	1157
Figure 25: Modal Split of households using mobility stations, 2019.....	1158
Figure 26: Mode shift influence by advertisement, 2019.....	1158
Figure 27: Number of cars per household of MUC 5.9 users, 2019.....	1159
Figure 28: VKT by household (density plot) of MUC 5.9 users, 2019	1159
Figure 29: System usage MS Gertrud-Grunow-Straße.....	1161
Figure 30: System usage MS Marianne-Brandt-Straße	1162
Figure 31: Change in rentals between 07/18 and 07/19	1163

Figure 32: Average system usage over all three mobility stations, 2019	1164
Figure 33: System usage of the three mobility stations, 2019	1165
Figure 34: System usage mobility offers across all stations, 2019	1166
Figure 35: System usage purpose, 2019	1166
Figure 36: Accessibility improvements, 2018.....	1167

List of Tables

Table 1: Quantifiable impacts.....	1126
Table 2: Target groups or affected parties.....	1129
Table 3: Measure stakeholders.....	1129
Table 4: Risks.	1129
Table 5: Emission Factors (HBEFA, 2017)	1138
Table 6: Living Lab Emissions 2017	1139
Table 7: Travel offers of the different sharing options and providers, 2018	1141
Table 8: Rentals MS Gertrud-Grunow-Straße 06/18 - 12/18	1142
Table 9: Rentals MS Marianne-Brandt-Straße 06/18 - 12/18.....	1143
Table 10: Emission Factors (HBEFA, 2020)	1145
Table 11: Living Lab Emissions 2020	1146
Table 12: Emission comparison MUC 5.9, 2018.....	1160
Table 13: Living Lab emission comparison	1160
Table 14: Rentals MS Gertrud-Grunow-Straße 01/19 - 07/19	1161
Table 15: Rentals MS Marianne-Brandt-Straße 07/18 - 12/18.....	1162
Table 16: Travel offers of the different sharing options and providers, 2018	1168

Project	City		
ECCENTRIC	Munich		
Measure code	Measure name		
MUC 5.9	Intermodal (E-)Mobility Stations		
Last update	Responsible	e-mail	telephone
17.10.2019	Stefan Synek	stefan.synek@muenchen.de	+49-(0)89-233-39821

Abstract

The measure MUC 5.9 aims to implement a new multimodal mobility service for all citizens: mobility stations. These mobility stations are located within the Living Lab and combine and provide different sharing offers with charging infrastructure and general information about the different mobility options. They are easy accessible in close location to public transport offers and serve as an alternative to individual car ownership.

There are four mobility stations allocated in Domagkpark and Parkstadt Schwabing which address the individual mobility needs of residents and employees or customers who visit the Living Lab. As a transport related measure which promotes a mode shift and provides a sustainable alternative for motorized individual transport, MUC 5.9 is a central measure within Munich's ECCENTRIC landscape. Other ECCENTRIC measures are planned to be part of the mobility stations, e.g. the E-Trike (MUC 5.6 Conception and development of an integrated e-bike sharing scheme) or the electric light weight vehicle ACM (MUC 6.3 "Electric light-weight vehicles – one for all").

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measures' implementation and the ex-post data, which focuses on the impact of MUC 5.9.

Evaluation results for MUC 5.9 were retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019) and a workshop to investigate on the user experience and find out about the reasons for non-usage.

The evaluation of MUC 5.9 shows that about 76% of the residents which are making use of the mobility offers are satisfied with the mobility stations and the selection of vehicles as well as the services which are being provided. In general, the usage rate of mobility stations is quite low (depending on the station, between 3%-15%) and cannot promote a positive mode shift towards more sustainable transport options within the short project lifetime. Residents obviously need more time to change their mobility behavior. To raise the awareness of the mobility stations and make them more visible, residents wish to have a more striking color marking of the station and to integrate the service into Munich's mobility apps.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- Promote sustainable, clean and efficient urban transport measures
- Testing new innovative measures in the Living Lab

(2) Strategic level:

- Mobility stations become part of a new urban mobility lifestyle.
- Very integrated approach: car-free housing / lower car ownership rate / lower housing costs by innovative mobility concept / synergy effects by cooperation with neighbouring commercial zone
- Acceleration of the area, parking problems at the surface, attractive urban space, housing costs, life quality, legal and operational questions, participation
- Standardized planning and implementation process for new development and housing areas within Munich's urban planning
- Mobility stations as a proven concept for city wide up scaling in order to shift modal share towards more sustainable mobility

(3) Measure level:

- Increased awareness of residents about the multimodal variety of mobility services within the Living Lab but also in the entire city
- Positive acceptance and active usage of the mobility station services by inhabitants and customers at the project area
- Mobility stations as a new bundled supply of all modes of transport for all mobility needs
- Two different types of mobility stations at the same development area adapted to the local spatial and socioeconomic situation
- Provide different vehicles to use and share (i.e. (electric) car sharing, bikes, cargo bikes, etc.)
- Test of newly developed electric vehicles within a public mobility service concept
- Introduction courses and events for using new vehicles and ways of mobility

Directly observable and measurable goals:

- Overall goal: To provide many mobility services allowing residents to live a “private-car-free-life-style” or at least to have significant lower mobility costs.
- To reduce mobility costs
- To change mobility behaviour towards less car use
- To maintain current low levels of car ownership (reduce even further?)

A.1.1 Quantifiable impacts

Expected Impacts		Reduced car ownership, lower housing costs, increased awareness and acceptance of new (shared) mobility services, development of attractive urban space, public participation in planning process, foundation for legal and operation planning standards for Munich's urban planning. Sustainable mobility behaviour among residents.	CIVITAS ECCENTRIC Objectives									
			Reduce:				Improve:					
			Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts											
1	Awareness and acceptance of the mobility stations and the different mobility services						X	X	X			
2	Satisfaction with the mobility stations and mobility services among users						X	X				
3	Mode shift towards more sustainable modes by the users		X	X		X						
4	Reduction of car ownership by the users								X			
5	Reduction of VKT by app users		X	X								
6	Reductions of CO2 emissions		X									
7	Reductions of NOx and PM emissions		X									
8	Increased access to mobility services					X	X					
9	Increased social equity, affordability of mobility services					X	X	X				

Table 1: Quantifiable impacts.

- Facilitate a car ownership rate of less than city average (cars per household) within the project area, resulting in less parking demand and public space usage
- Increased social equity: low income households are able to use cars through sharing
- 50% of all potential users are users of the mobility stations and their services (Baseline: 4.000 Inhabitants live at the development area (3.000 Inhabitants (over 18) are potential users of the mobility stations and their services)
- Reduction of car kilometers of 1,96 million/year, modal shift to public transport and bicycle usage
- Reduction of CO2 emissions of 400 tons within the project lifetime
- Reduction of NOx and PM emissions

A.2 Measure description

In order to promote a more sustainable mode of mobility and to create a real alternative to private car ownership, the City of Munich has developed new multimodal mobility services for all citizens: mobility stations. Correlating to Munich's tremendous growth of population and traffic, the project area Domagkpark and Parkstadt Schwabing aimed to build less than (the normally obligatory) 1.0 parking lots per household as well as to prove the functionality of this approach through the integration of attractive alternatives for more sustainable mobility modes.

In order to achieve a well-working parking situation at the surface as well as an attractive mobility service offer within public space, new innovative concepts for public and individual mobility needs are essential. Consequently, easily accessible and user-friendly services for mobility have to be implemented as a real alternative to individual car ownership. Part of this approach was the development and implementation of mobility stations.

These mobility hubs combine and provide different types of mobility services and ensure that suitable means of transport are available for any purpose at any time in order to reduce private car ownership of residents and customers. The new and innovative aspect is to combine several sharing mobility technologies (car-sharing (stationary, free floating, electric), (e-) scooters, cargo- and normal bikes) in connection and complementation with the use of public transport like trams and buses. The provision of multimodal mobility service is allowing the residents to live a private-car-free-lifestyle or at least have significant lower mobility costs.

The selection of services provided at the different mobility stations follows the local spatial and socio-economic situation. But in general the following mobility services are planned to be available at each mobility station:

- 1 information pillar
- 1 MVG bikesharing station
- 2-3 E-Trikes³⁸ (Gertrud-Grunow-Straße)
- 2 charging stations
- Carsharing: stationary and free floating
- 1-2 cars e-carsharing
- 1-2 privileged e-parking spots
- E-scooters³⁹

A great challenge but essential backbone of the mobility station services is the provision of one common booking service where all sharing services are available. Consequently, the aim is to bundle all relevant stakeholders within an interactive service pillar at the station. Further, on the existing mobility app of MVG (Munich public mobility provider) all mobility services provided at the station were integrated and guaranteed an easy mode of booking from anywhere online.

A.2.1 Measure outputs

Four mobility stations were built in the Living Lab (see [Figure](#)):



Figure 1: Mobility stations in the Living Lab

- Gertrud-Grunow-Straße (operational since 07/2018):

³⁸ E-Trike is an electric driven tricycle with a cargo function. This is developed in ECCENTRIC measure MUC 5.6.

³⁹ E-scooters are electronic driven two wheelers for which a driver's licence (18+) is needed and not to be confused with e-kick-scooters by firms like Lime, Tier or Voi.

- o Carsharing: 5 reserved places for free floating carsharing (DriveNow, car2go, Oply, STATTAUTO and new providers),
 - 1 car of STATTAUTO above ground in public space
 - 2nd car of STATTAUTO (Nissan n-EV) since 03/2019 in public space
 - 2 cars of STATTAUTO in the underground car park of the private housing association in the Fritz-Winter-Straße
- o Bike sharing station of MVG Rad, with 10 bikes
- o e-scooter sharing of emmy (free floating)
- o 2 charging points for electric cars (by SWM), with one reserved parking place for charging cars
- Marianne-Brandt-Straße (operational since 07/2018):
 - o Carsharing: 10 reserved places for free floating carsharing (DriveNow, car2go, Oply, STATTAUTO and new providers),
 - 1 car of STATTAUTO above ground in public space
 - between 2 und 8 cars of STATTAUTO on private ground of a company (number is depending on the month)
 - o Bike sharing station of MVG Rad, with 10 bikes
 - o e-scooter sharing of emmy (free floating)
 - o 2 charging points for electric cars (by SWM) with two reserved parking places for charging cars
- Max-Bill-Straße (operational since 10/2019)
- Anni-Albers-Straße: planned for Q2/2020

In addition to the infrastructure, a marketing campaign was launched to promote the mobility stations among the residents and employees (MUC 2.9a).

A.2.2 Supporting activities

The launch of the mobility was accompanied by a marketing campaign to address all residents within the Domagkpark area (purely residential) but also companies and employees of neighbouring residential and business area Parkstadt Schwabing. The combination of an innovative direct and a dialogue marketing campaign for every household and as many companies as possible within the development area improved the measure's effectiveness. It offered information and guidance and thereby fortified the usage of the new offer (see ECCENTRIC measure MUC 2.9a).

The measure is also linked to parking management which has been implemented in the Domagkpark in March 2018 and is still discussed for the Parkstadt area. Even though a national carsharing law was approved in 2017, there is still no formal implementation of sanctions for illegal parking on reserved carsharing spots.

Media-effective opening event of the first two mobility stations in 07/2018. Local press, the major of the City of Munich, other local ECCENTRIC partners and the MSP were invited.

A.2.3 Interactions with other ECCENTRIC measures

For the first time two newly developed vehicles are planned to be part of a shared fleet: Electric light vehicle (see ECCENTRIC measure MUC 6.3a) and E-Trikes (see ECCENTRIC measure MUC 3.4). Also emmy, a scooter-sharing service (see ECCENTRIC measure MUC 6.3b), is now also part of the mobility offer at the stations. Awareness of mobility providers and their offers at the mobility stations was increased through a marketing campaign in the Living Lab area (MUC 2.9).

A.2.4 Interactions outside ECCENTRIC

None

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
1	Residents	Living Lab	Living Lab (Domagkpark and Parkstadt Schwabing)
2	All people able to use the mobility station offers	Living Lab	Everyone visiting the area is a potential user

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	City of Munich (KVR)	P	C	L	ML
2	City of Munich (other depts.)	S	C	P	Coordination, Construction, ...
3	SWM/MVG	P	PT	P	Construction and coordination of charging infrastructure and MVG Rad
4	Mobility service providers	S	PR	P	Integrating their services into the stations
5	District committee	S	C/NG	O	Cooperation, political communication and awareness rising
6	Housing Association	S	PR/NG	O	Mobility planning and housing development
7	Resident community (incl. businesses)	S	PR/NG	O	Target group and lobbying group
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e. g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
It may be difficult to achieve a good evaluation result, since there were some delay in construction of the mobility stations caused by the general construction works in the Living Lab area.	Problem related	Focus on the first stations if necessary (the ones already implemented)	ML/LEM
For the usage and acceptance of the new services, there may be the risk that the number of residents willing to use is not sufficient in the beginning.	Involvement	The marketing and dissemination activities would be extended within the Living Lab if this was the case.	ML

Table 4: Risks.

B. Measure implementation

B.1 Situation before CIVITAS

The northern area of Munich is growing twice as fast as the overall city. Several former barrack sites are currently under conversion into new housing areas in order to accommodate the tremendous increase in population. Due to rising population, pressure on public space and increasing number of road and mobility users the traffic networks is overburdened. This new area, called Domagkpark and Parkstadt Schwabing is consequently supposed to be pilot area in CIVITAS ECCENTRIC for sustainable mobility, not only within the area but also regarding the mobility behaviour of its residents in general. Currently there are only little alternatives to individual car use existing. With growing population in the area, also the offer of sustainable mobility modes needs to grow. According to an enquiry among the future citizens there is a great potential for shared (mobility) services as people are willing to give up private car ownership once alternative mobility options are well enough developed and available.

B.2 Innovative aspects

New physical infrastructure solutions

Mobility stations are a physical “hub” that combine various modes of (shared) transportation. The stations in this measure feature a new design and are a new means of providing access to these services in Munich. They are combined with new regulations that enable reserving parking space only for carsharing vehicles.

New organisational arrangement

The stations are provided by the City, who is offering a platform for all interested private mobility suppliers.

B.3 Research and Technology Development

The stations work with existing technology.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning

- Interdisciplinary working group for mobility stations are set up (stakeholders, city planners, living lab residents, district committee)
- Locations for four mobility stations identified and approved based on holistic spatial analysis
- Evaluation approach developed and embedded into Local Evaluation Plan
- Station equipment and service elements identified
- Detailed planning for four mobility stations initiated
- Procurement process for four elements initiated
- Construction process for three mobility stations completed
- Vehicles fully integrated in two mobility stations and partially in a third
- Charging infrastructure for e-vehicles at three mobility stations constructed

Phase 2: Implementation

- Opening of first two stations in July 2018:
 - o Gertrud-Grunow-Straße (operational since 07/2018):
 - Carsharing (car2go, DriveNow, MILES, Oply, SIXT share, STATTAUTO),

- Bike sharing (MVG Rad, Donkey Republic),
- e-scooter sharing (emmy),
- Two charging points for electric cars (by SWM),
- Extension of mobility station finalized in Q3/2019,
- Implementation of a parking management in the area around the mobility station in 2018,
- Dialogue marketing campaign launched in 2019.
- o Marianne-Brandt-Straße (operational since 07/2018):
 - Carsharing (car2go, DriveNow, MILES, Oply, SIXT share, STATTAUTO),
 - Bike sharing (MVG Rad),
 - e-scooter sharing (emmy),
 - Two charging points for electric cars (by SWM).
- Marketing concept developed and materials ordered
- Start marketing campaign in October 2018
- Introduction of trial offers for the involved mobility services
- Detailed planning for remaining stations finalized

Phase 3: Demonstration and further Implementation

- Opening of the third station Max-Bill-Straße in Q4/2019
- Opening of the fourth station Anni-Albers-Straße in Q2/2020
- Integration of further new mobility providers
- Intensify marketing and communication activities
- Usage data of evaluation available in Q1/2020
- Derivation of general conclusions and knowledge for further standardization
- Derivation of recommendations for scale up
- Integrate sharing mobility into the mobility planning of the city

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Awareness	Acceptance	Satisfaction	Mode shift	Car ownership
Type	KPI	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	SOCIETY-PEOPLE	SOCIETY-PEOPLE	TRANSPORT SYSTEM	SOCIETY-PEOPLE
Subcategory	Acceptance	Acceptance	Acceptance	General	Accessibility
Aspect	Acceptance level	Acceptance level	Satisfaction	Modal split	Physical accessibility to transport services
Definition	Percentage of residents with knowledge of the Mobility Stations and their functions	Perception and acceptance of the Mobility Stations	User/provider/stakeholder average reported satisfaction with the service/performance of the Mobility Stations	Percentage of users who permanently changed modes for the same trip (same origin and destination, time, and frequency). The main mode of a trip is that used for the longest stage of the trip by distance. For instances with stages of equal length, the mode of the last stage is used	Cars owned per 1000 inhabitants of the populations aged 16 and over
Unit	Percentage	Percentage	Score (0-5)	Percentage (various values)	Cars to inhabitants ratio
Method of data collection	Baseline survey of residents and businesses (Domagapark & Parkstadt Schwaning)	Baseline survey of residents and businesses (Domagapark & Parkstadt Schwaning)	Individual Mobility Station user surveys	Baseline survey and follow up survey to residents and businesses, and individual user surveys	Follow up survey to residents and businesses, and individual user surveys
Target group	Living Lab residents	Living Lab residents	Users of Mobility Stations (and services)	Users of Mobility Stations (and services)	Users of Mobility Stations (and services)

Impact	6	7	8	9	10
Indicator	VKT	CO2 Emissions	NOx emissions	PM emissions	Access to Mobility Services
Category	KPI	KPI	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ENVIRONMENT	ENVIRONMENT	ENVIRONMENT	SOCIETY-PEOPLE
Subcategory	General	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Accessibility
Aspect	Total Travel	Emissions	Emissions	Emissions	(physical) accessibility to transport services
Definition	Kilometers traveled by Mobility Station users	Total CO2 produced by Mobility Station users	Total NOx emissions produced by Mobility Station users	Total PM emissions produced by Mobility Station users	Percentage of population with access (physical) to Mobility Stations
Unit	Kilometers	Tons	Tons	Tons	Percentage
Method of data collection	Baseline survey and follow up survey to residents and businesses, and individual user surveys	Estimation based on VKT (or PKT) and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) and average emission factors for the different transport modes available in the area	Estimation based on VKT (or PKT) and average emission factors for the different transport modes available in the area	Follow up survey to residents and businesses, and individual user surveys
Target group	Users of Mobility Stations (and services)	Users of Mobility Stations (and services)	Users of Mobility Stations (and services)	Users of Mobility Stations (and services)	Living lab residents

Impact	11	INPUT	INPUT	INPUT
Indicator	Relative travel cost	System Usage	Investment Costs	Operating Costs
Category	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	TRANSPORT SYSTEM	ECONOMY	ECONOMY
Subcategory	Accessibility	General	Costs	Costs
Aspect	Economic accessibility	Transport System utilization	Investment costs	Operating Costs
Definition	Average travel cost of Mobility Station services as a percentage of the average personal available income. Average income is to be reported as well.	Number of registered users, usage of services (rentals per time period), etc.	Total capital costs for purchase of equipment related to the Mobility Stations and their services. Preparation and design cost is defined as total costs expended setting up the measure covering a time period from the initiation of the measure preparation until the start of the measure implementation.	Personnel and maintenance costs for running the Mobility Stations divided per time period
Unit	Ratio (travel cost/income)	(-)	Euro	Euro / (time or usage unit)
Method of data collection	Individual Mobility Station user surveys	Processing of system statistics; number of users, usage rate of the different services; trip length, travel time, temporal and spatial distribution of usage, etc.	Data from financial reports, controlling	Data from financial reports, controlling
Target group	Users of Mobility Stations (and services)	Users of Mobility Stations (and services)		

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	B – A	S	Living Lab Residents	Living Lab
2	Acceptance	%	B – A	S	Living Lab Residents	Living Lab
3	Satisfaction	Score (0-5)	I – A	S	Users	Living Lab
4	Mode Shift	%	B – A	S	Users	Living Lab
5	Car Ownership	Cars-to-inh. ratio	B – A	S	Users	Living Lab
6	VKT	Km	B – A	S	Users	Living Lab
7	CO2-Emissions	Tons	B – A	E	Users	Living Lab
8	NOx-Emissions	Tons	B – A	E	Users	Living Lab
9	PM-Emissions	Tons	B – A	E	Users	Living Lab
10	Access to Mobility Services	%	B – A	DC / S	Living Lab Residents	Living Lab
11	Relative Travel Cost	Ratio (travel cost/income)	I – A	DC	Users	Living Lab
	System Usage	# of rentals	I	DC	Users/ MSP	Living Lab
	Investment Costs	€	I – A	DC	-	-
	Operating Costs	€/time or usage	I - A	DC	-	-
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

C.1.2 Baseline

The baseline was conducted as a household survey which was addressed to all 2.100 households within the Living Lab (Domagkpark and Parkstadt Schwabing). The survey took place from 04/2018-05/2018. The participation rate was 27%, what means that 935 people from 572 households answered the online survey or participated via telephone. The survey answered most of the KPIs while other KPIs are estimated by interviews with the Measure Leader.

Additional Baseline data was collected by the ML at the different mobility service providers (MSP) which offer their services at the mobility stations. There are for example MVG, car2go, DriveNow, STATTAUTO, Oply, emmy and others.

Awareness, Acceptance, and Satisfaction among the target population

Addressing Indicators "1 – Awareness", "2 – Acceptance", and "3 – Satisfaction"

As the measure was not implemented yet when the first ECCENTRIC household survey took place, only information about the general **awareness** and **acceptance** of mobility stations can be obtained, as there is already a non-ECCENTRIC mobility station at Fritz-Winter-Straße⁴⁰ (FWS) which was included in the first survey. However, this station is not as prominently positioned as the new stations, so these results are likely to be different at the other mobility stations which are located in public space and with another appearance.

The household survey #2 which was obtained in Q4 2019 has refined these preliminary results.

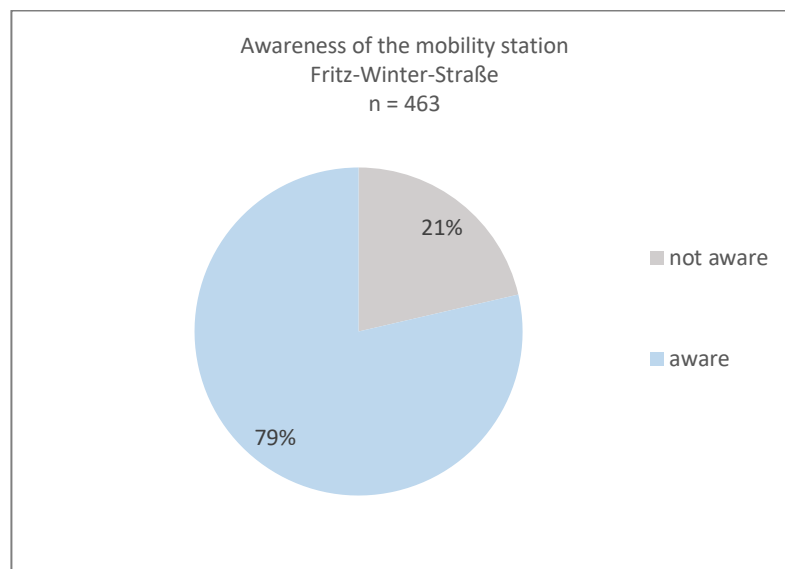


Figure 2: Awareness of the mobility station FWS, 2018

⁴⁰ The mobility station at Fritz-Winter-Straße is privately funded by a housing association and located on private ground.

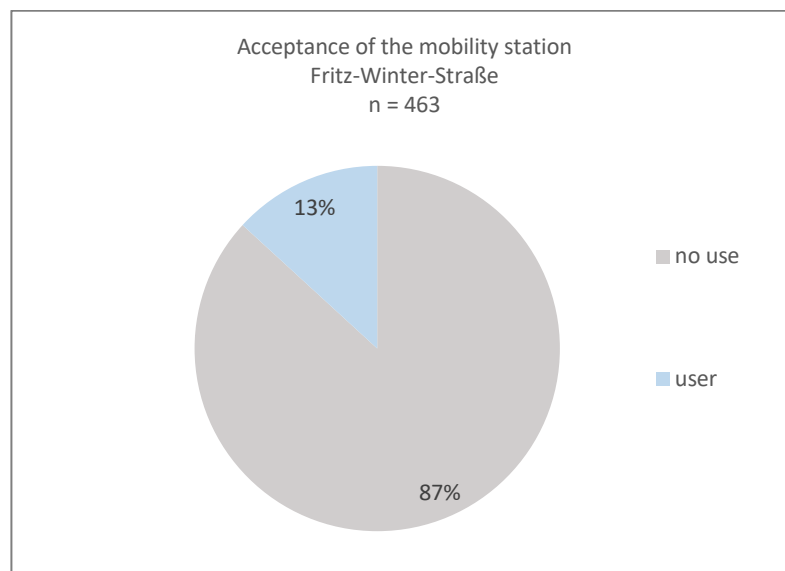


Figure 3: Acceptance of the mobility station FWS, 2018

The majority of residents is aware of the mobility station at Fritz-Winter-Straße (only 21% do not know it), but the actual share of users is with 13% lower (Figure). Thus, most residents (>60%) know that the station exists but do not use it. As stated earlier, this station is targeted at a specific building block in the Living Lab and financed by the local housing association, so the number of users is not intended to be higher.

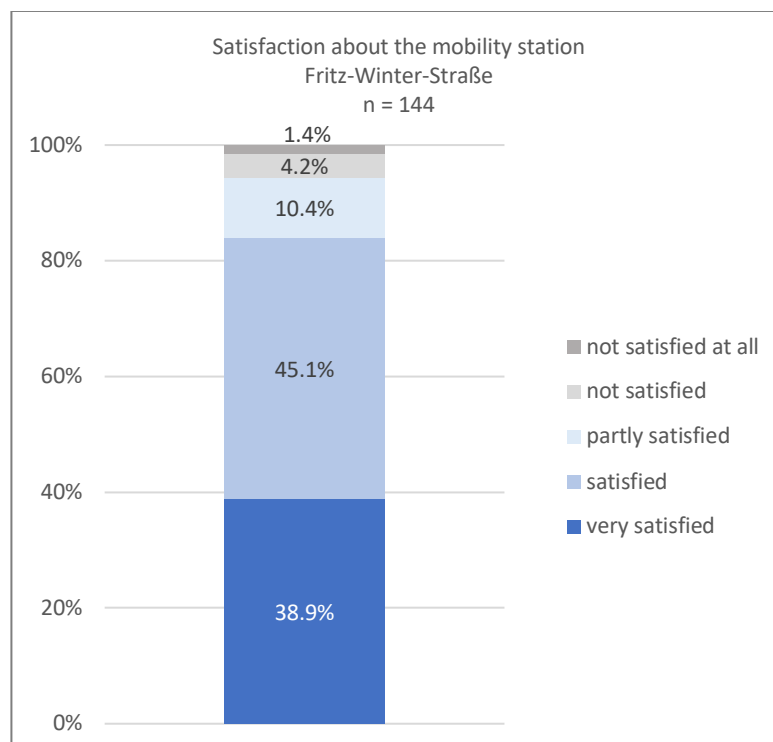


Figure 3: Satisfaction about the mobility station FWS

The score for the KPI **Satisfaction** is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI.

The **satisfaction** level of users is very high, 84% state that they are *satisfied* or *very satisfied* with the station (Figure 3). Another question in the household survey #1 asks for “Satisfaction with the availability of car sharing services in the immediate living environment (within a radius of 1km)”. 71,2% of the survey participants are “satisfied” or “very satisfied” with the availability. Both satisfaction questions resemble a score of 4 out of 5.

Mobility behavior of the target population

Addressing indicators "4 - Mode Shift", "5 - Car Ownership", and "6 - VKT"

Car ownership in the Living Lab was obtained with the first household survey in 05/2018. With 0.92 cars per household the car ownership rate is equal to the city-wide average of 0.9 (cf. infas, 2010).

In detail, around 25% of the 572 questioned households are car-free, 60% do have one car and only few have 2 or more (Figure).

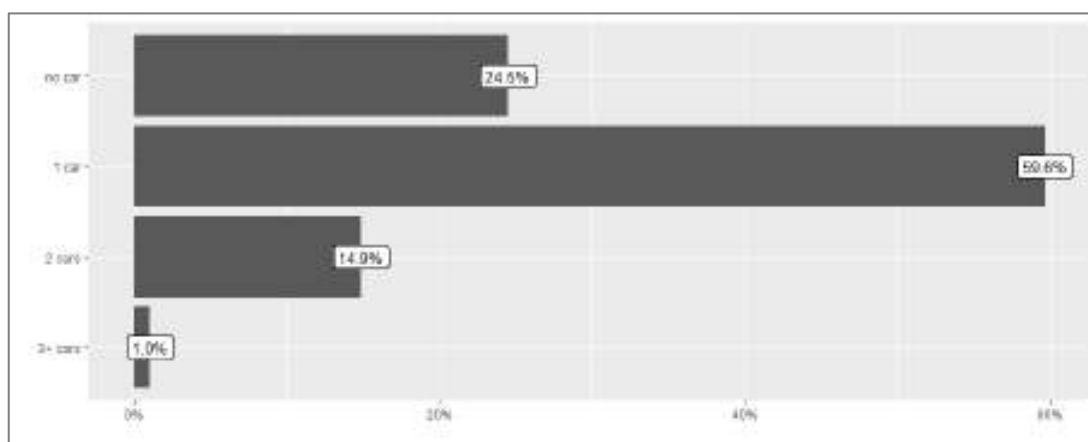


Figure 4: Number of cars per household, 2018

The Living Lab population is with 4.24 trips per day and person on average more mobile than the German average of 3.1 (infas, 2018).

The **modal split** (trip-based) of this group is visualized in Figure, based on the answers of 935 persons who reported about 3967 trips in April/May 2018 as part of the ECCENTRIC household survey.

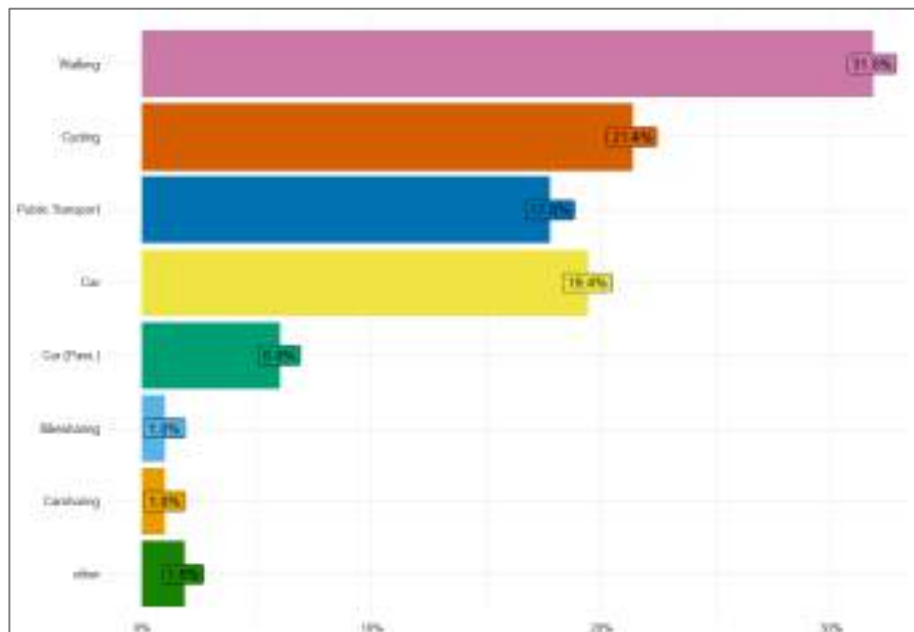


Figure 5: Modal Split of Living Lab residents, 2018

The average **VKT** per household (including also those without a car) is at 9.809 km per year (see [Figure](#) for the distribution), summing up to a total VKT in the Living Lab (3.100 households) of approx. 30.4 million VKT per year. This data was obtained with the household survey in 05/2018.

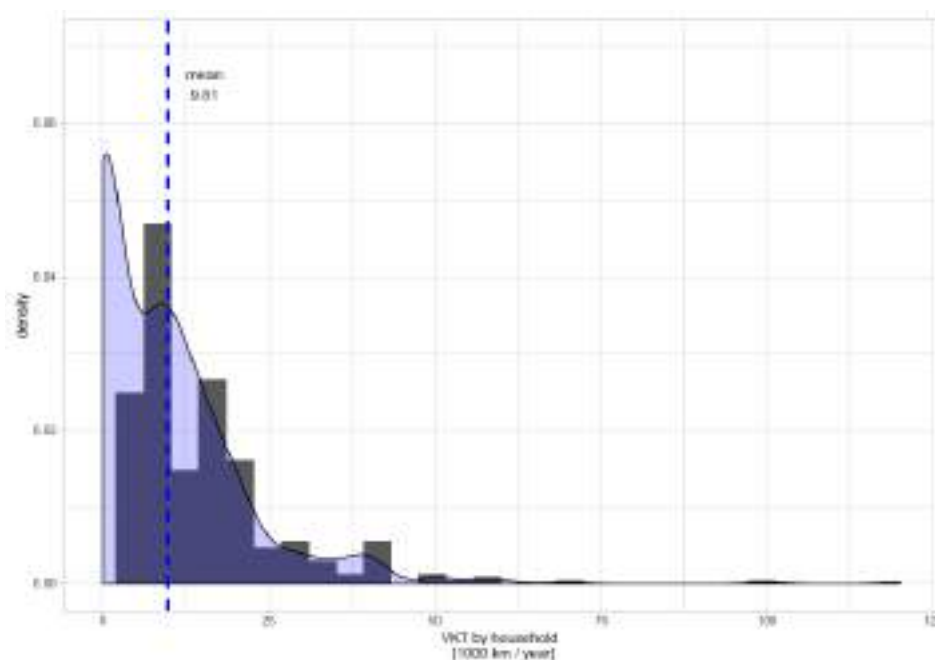


Figure 6: VKT by household (density plot), 2018

Transport-related emissions

Addressing indicators "7 - CO₂ Emissions", "8 - NO_x emissions", and "9 - PM emissions"

Emissions are calculated based on emission factors from the standard database "HBEFA" (*Handbook Emission Factors for Road Transport*) and information about both VKT and the vehicles in the Living Lab. See [Table](#) for the used factors, based on the German fleet average.

The number of hybrid/electric cars is too low to be considered as a separate category.

In 2017 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

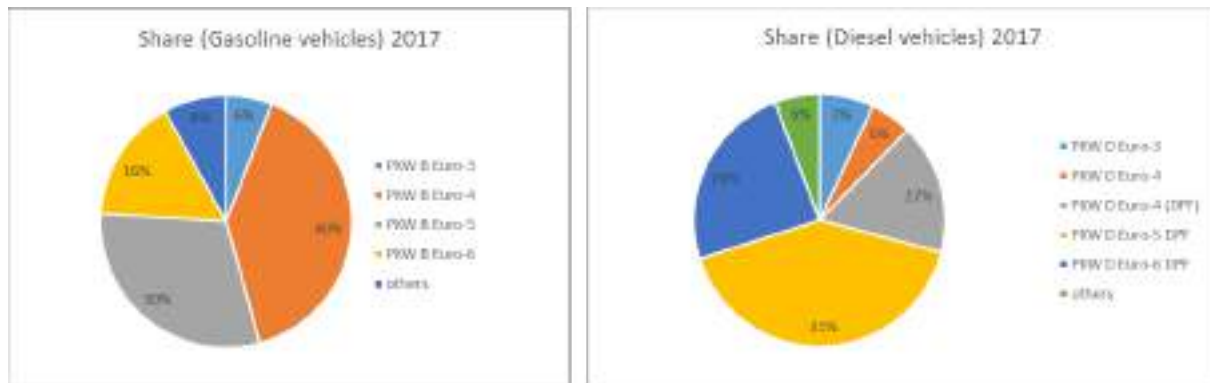


Figure 7: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)

The highest share among Gasoline vehicles consists of Euro 4 (40%) and Euro 5 (30%), followed by Euro 6 (16%). Regarding the Diesel vehicle share, there are 41% Euro 5 and 24% Euro 6. Euro 4 has a smaller share of 17%.

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	127,837 g/km
NO _x	Gasoline	0,060 g/km
PM	Gasoline	0,00102 g/km
CO ₂	Diesel	118,911 g/km
NO _x	Diesel	0,589 g/km
PM	Diesel	0,00675 g/km

Table 5: Emission Factors (HBEFA, 2017)

The following calculations are based on the HBEFA factors of 2017 and the annual VKT kilometres, differentiated by car type (first or second car) and fuel type (gasoline or diesel). The number of kilometres is then multiplied with the HBEFA factors and number of cars mentioned in the household survey (conducted in 05/2018).

Thus, the total annual emissions (based on VKT) for all 3.100 households in the Living Lab sum up to the following totals:

Pollutant	Emissions Living Lab (2017)	Emissions/ household Living Lab (2017)
CO ₂	3.864 t	2.415 kg
NO _x	10,22 t	6,39 kg
PM	122,25 kg	76,41 g

Table 5: Living Lab Emissions 2017**Accessibility improvements through the stations***Addressing Indicator "10 - Access to Mobility Services"*

Figure shows the general walking accessibility within a 5-minute radius around the mobility stations. The Living Lab is located in the business areas of the most important free floating carsharing and bikesharing companies in Munich:

- car2go
- DriveNow
- Oply (partly)
- MVG bike

Bikesharing stations (also MVG bike) are located at the tram stops "Schwabing Nord" and "Anni-Albers-Straße" – both locations are at the edge of the Living Lab and for most residents accessible.

Station-based carsharing (STATTAUTO) is (without the mobility stations) not present in Domagkpark, the closest station is at Ungererstraße, with a distance of >1.5km to the Living Lab. See map below for the 5-minute-catchment areas of the surrounding stations (grey) and the two first mobility stations in the Living Lab (blue). The assumed standard and maximum walking distance for potential mobility stations users is 5 minutes. The three mobility stations cover 77% of the Living Lab. This equals a land use of 1,19 km². The Living Lab is not yet in 2018 in the business area of the free-floating e-scooter service *emmy*.

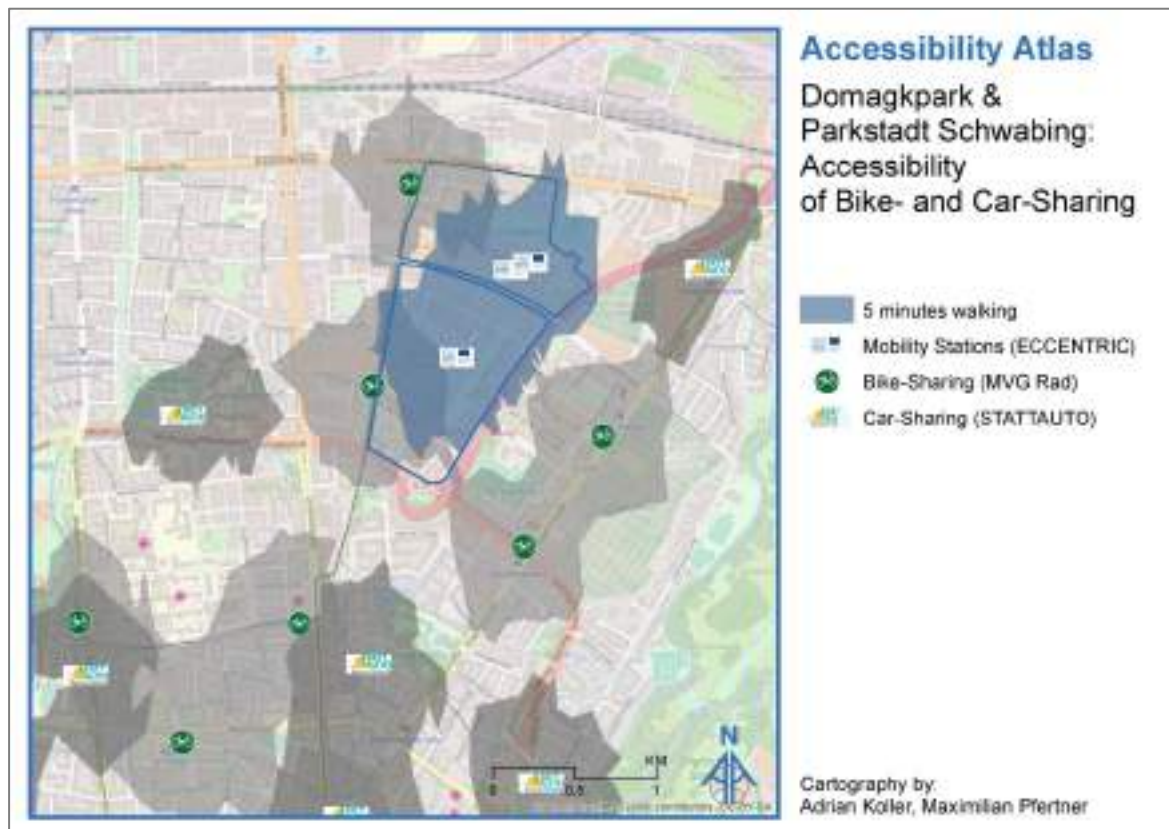


Figure 8: Accessibility improvements, 2018

Addressing indicator “11 – Relative travel cost”

Travel costs could be found at the websites of every single MSP who is offering mobility options at the stations. Unfortunately, the average income of the Living Lab residents was not obtained with the household survey due to the fear that too personal data is collected and survey participants might not continue the survey. However, sources from 2016 (cf. WSI, 2016) show an average disposable income of Munich’s residents of 29.685 Euro per year.

The following [Table](#) shows different costs (registration, daily, minute, hourly) for the three main sharing options being offered at the mobility stations:

	Carsharing				Bikesharing	E-scooter-sharing
	DriveNow	Car2go	Oply	STATTAUTO	MVG Rad	emmy
Registration fee	One-time 29€	One-time 9€ including 15€ travel credit	One-time 19€, currently free of charge	Standard: 55,60€, one-time + 7,79€/month + 500€ deposit Special offers for young (one-time 27,80€) and elderly people (three months free testing)	None	one-time 10€, including 50 min. travel credit
Time tariff	Starting from 0,33€/min. (depending on car type)	Starting from 0,19€/min. (depending on car type)	Starting from 6,00€/hour (150km inclusive)	Starting from 2,22€/hour + 0,22€/kilometer	Standard: 0,08€/min. Discount for owners of an MVG-Abo and students: 0,05€/min.	0,23€/min.
Daily prices	109€/day (depending on car type) with 200km inclusive	Starting from 79€/day (depending on car type) with 200km inclusive	Starting from 45€/day	Starting from 22,24€/day	12€/day	29€/day

Table 6: Travel offers of the different sharing options and providers, 2018

Note: This table does not contain all offers and prices of the providers but concentrates on a representation of the standard offers. Many providers have special packages for which the prices (per minute) can be reduced. A listing of all these packages, however, would lead too far and even make comparison more difficult.

Addressing indicator "System Usage"

The **system usage** of the mobility stations Marianne-Brandt-Straße and Gertrud-Grunow-Straße is shown in [Figure 9](#) and [Figure 10](#). The data displayed correspond to the loan processes of the mobility offers at the mobility stations, registered by the responsible providers and collected by the ML. The period considered for the base scenario starts 07/2018 and ends

12/2018. Since no data is available for 07/2018 from some providers, the observation period for these starts one month later.

Table and Table show the data in a comprehensive way, with minimum, mean and maximum of rentals per mobility station and transport provider during the observation period. In total there were 1.687 rentals at Gertrud-Grunow-Straße and 1.203 rentals at Marianne-Brand-Straße during the observed seven months in 2018.

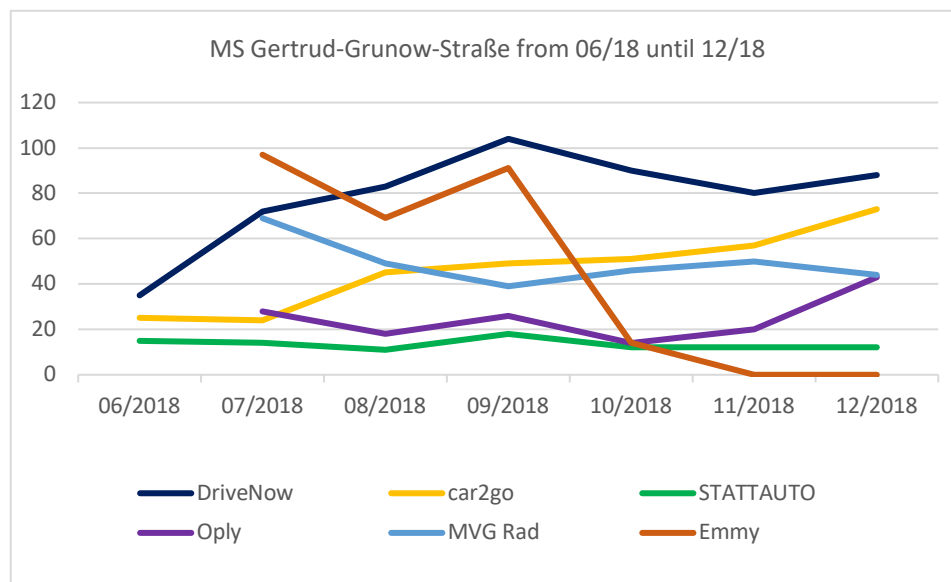


Figure 9: System usage MS Gertrud-Grunow-Straße, 2018

Provider	Min.	Av.	Max.
DriveNow	35	78,9	104
Car2go	24	46,3	73
STATTAUTO	11	13,4	18
Oply	14	24,8	43
MVG Rad	39	49,5	69
emmy	0	45,2	97

Table 8: Rentals MS Gertrud-Grunow-Straße 06/18 - 12/18

At the mobility station Gertrud-Grunow-Straße carsharing of DriveNow has on average the most rentals per month (78,9). The rentals of bikesharing by MVG Rad (on avg. 49,5 per month) and e-scooter sharing by emmy (on avg. 45,2 per month) are at both stations frequently used. In the winter month the demand for emmy's e-scooters is significantly decreasing: no rentals in November and December at both stations. The carsharing of car2go is also often

used (on avg. 46,3 rentals per month). The carsharing offers of Oply (on avg. 24,8 rentals per month) and STATTAUTO (on avg. 13,4 rentals per month) are less frequently used.

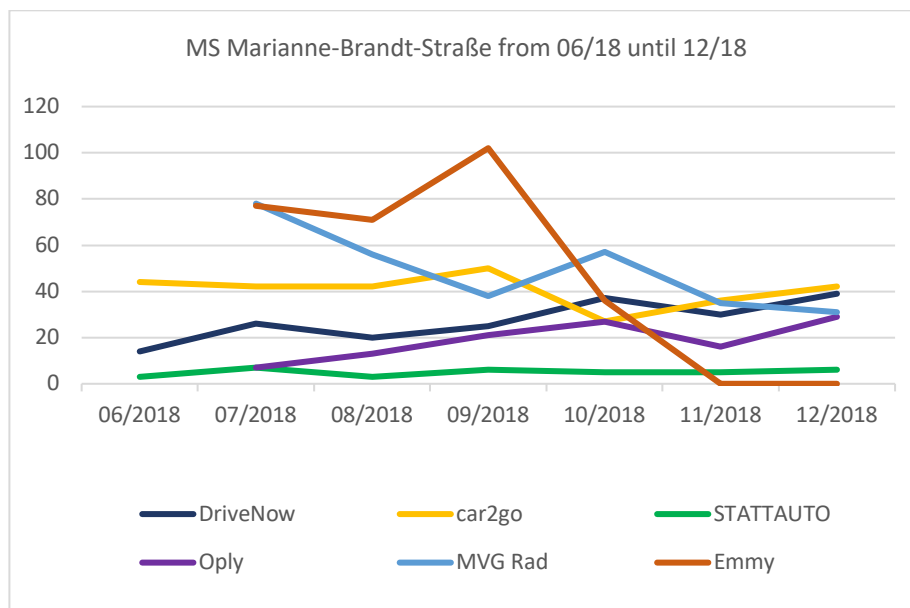


Figure 10: System usage MS Marianne-Brandt-Straße, 2018

Provider	Min.	Mean	Max.
DriveNow	14	27,3	39
car2go	27	40,4	50
STATTAUTO	3	5,0	7
Oply	7	18,8	29
MVG Rad	31	49,2	78
emmy	0	47,7	102

Table 9: Rentals MS Marianne-Brandt-Straße 06/18 - 12/18

At the mobility station Marianne-Brandt-Straße the bikesharing provider MVG Rad has on average the most rentals per month (49,2). The e-scooters of emmy are also frequently used (47,7 rents on average per month) and similar to MVG bike but even more depending on the season: with a minimum of 0 rentals in winter and a maximum of 102 rentals in summer. Car2go is the most frequently used car sharing service at Marianne-Brandt Straße with 40,4 rentals on average per month, followed by DriveNow with 27,3 rentals on average per month and Oply with 18,8 rentals on average per month. STATTAUTO is used relatively rarely with only 5,0 rentals on average per month.

Data on **investment and operational cost** was obtained at a later date for the after evaluation when the implementation phase was completed.

C.1.3 The business-as-usual scenario

For **Awareness, Acceptance**, even a higher rates of awareness and acceptance is expected, because the general trend of using sharing options is constantly increasing since the first sharing options have been implemented in 1999 in Germany (cf. bcs, 2019). The number of authorized drivers and the number of carsharing vehicles has more than doubled within four years. The number of people using carsharing and the size of the fleets is expected to raise until 2020. The Federal Carsharing Association (Bundesverband CarSharing e.V.) published that Munich has the second most carsharing vehicle-resident ratio in Germany. There are 2,13 cars per 1.000 inhabitants (cf. bcs, 2019).

For **satisfaction**, no serious BaU-estimation is possible but a study published in 12/2019 by the Center for Automotive Research shows that satisfaction about sharing options is not yet as high as expected after it has been introduced ten years ago in Germany (cf. CAR, 2019).

Car Ownership does not show big changes on the nationwide level (2002-2008-2017), while the ratio cars per inhabitants in the relevant part of the city ("between middle ring road and city boundary") has been decreasing slightly over the last 10 years, from approx. 0,43 cars per inhabitants in 2005 to 0,41 in 2015 (-1%). However, for the reporting period until 2020 stable conditions were expected.

Access to Mobility Services

Shared mobility is becoming more and more popular and the number of stations and the size of business areas is growing. The coverage with free floating services is already high in the Living Lab but the trend is to increase during the next years because more companies are providing free floating carsharing, e-scooter-sharing or bikesharing-concepts (e.g. Sixt, Miles, Uber). For station-based services, no new developments in the Living Lab are expected, as new services are much more likely to be added in the urban centers first. The percentage of people that are being projected for this BaU indicator is regarding all potential drivers being older than 18 years and owning a driver's license.

Mode Shift & VKT

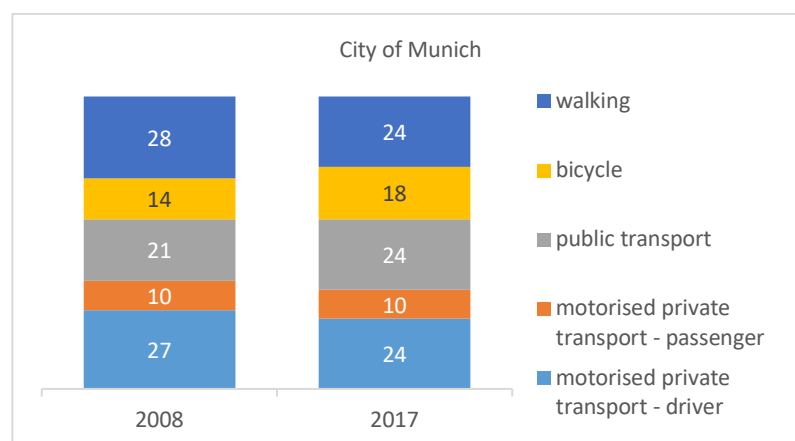


Image: City of Munich, Data: infas edited (2018)

Figure 11: Modal Split in Munich (2008+2017)

The nationwide mobility survey "Mobilität in Deutschland" acts as a reference to determine trends and future mobility behaviour in Munich.

In general, the Munich population drives less and walks less, while PT and cycling increase over time (see [Figure](#) : change 2008-2017: car -3%, PT +3%, cycling +4%, walking -4%). Extrapolating this trend from 2008 to 2020, the following mode shifts in the BaU Scenario for 2020 can be assumed:

Car: -1%; PT: +1%; Bike: +1%; Walking: -1%

These changes were reflected in VKT as well, so that VKT are expected to decrease by 1% as well, being cautious because nationwide, the km per vehicle are slightly decreasing (2017: -0,7%, Kraftfahrtbundesamt (2018)).

Note: A recent study by the Center Automotive Research (CAR) of the University of Duisburg-Essen published in 12/2019 that the number of cars is constantly increasing within the last ten years in Germany's larger cities. Comparing the number of cars from 2009 until 2019, there is an increase of 18,5% in car ownership measured in Munich (cf. CAR, 2019). This resembles a different trend then expected above in the BaU scenario assumptions of 2018.

Emissions

In order to estimate BaU-emissions, the HBEFA projected emission factors for 2020 as well as the by 1% increased VKT, which were mentioned in the section "Mode Shift & VKT", are assumed.

Thus, the following factors are used:

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	117,785 g/km
NO _x	Gasoline	0,049 g/km
PM	Gasoline	0,00108 g/km
CO ₂	Diesel	110,410 g/km
NO _x	Diesel	0,484 g/km
PM	Diesel	0,0045 g/km

Table 10: Emission Factors (HBEFA, 2020)

In 2020 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

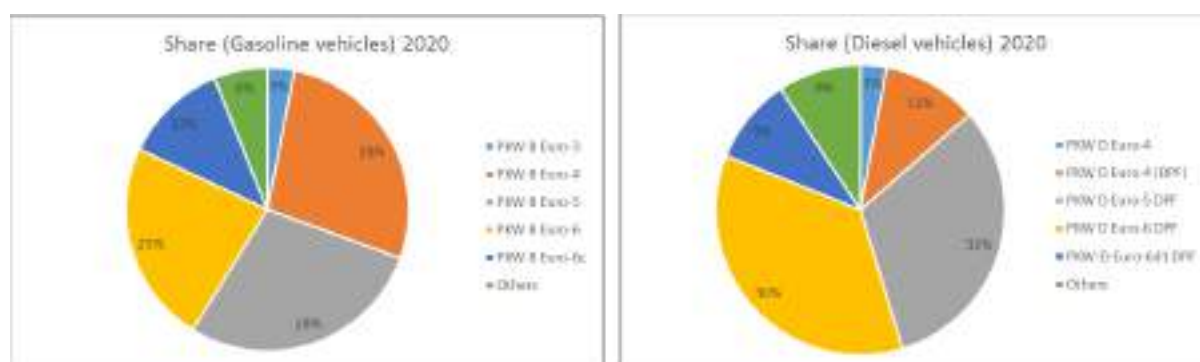


Figure 12 Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)

Regarding the Gasoline Euro classes in 2020, there are about two-thirds of all Gasoline vehicles to be found with Euro 4 (28%), Euro 5 (28%) or Euro 6 (23%). The share of Diesel vehicles is similar but compared to HBEFA 2017 assumptions, Euro 6 has the biggest share in 2020 (36%, 24% in 2017).

Note: These emission factors assume technological progress and a renewal of the average fleet in Germany until 2020. In the light of "*Dieselsgate*" and great uncertainties in the accuracy of emission information by the car manufacturers, the HBEFA assumptions have to be verified. New HBEFA assumptions are to be published in the end of 2019 (after MER2).

This results in the following emissions for 2020:

Pollutant	Emissions Living Lab (2020)	Emissions/ household Living Lab (2020)	% change to 2017
CO ₂	3,610 t	2.256 kg	-7%
NO _x	8,49 t	5,31 kg	-17%
PM	88,76 kg	55,47 g	-27%

Table 11: Living Lab Emissions 2020

C.2 Measure results

The following table shows the measure results of MUC 5.9. In some cases, the Business as Usual scenario is valued as not assessed (NA) because there would not be any other developments without the implementation of this measure.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	FWS: 79,0%	05/2018	NA	-	FWS: 69,6% GGS: 74,0% MBS: 37,4%	10/2019	FWS: -9,4%	NA
Acceptance	%	FWS: 13,0	05/2018	NA	-	FWS: 15,6 GGS: 13,4 MBS: 3,1	10/2019	FWS: +2,6%	NA
Satisfaction	Score (0-5)	FWS: 5 = 84,0%	05/2018	NA	-	FWS: 5 = 80% GGS: 4 = 73% MBS: 4 = 73% Average: 4 = 76,0%	10/2019	FWS: -4,0%	NA
Modal Split/ Mode Shift	%	Modal split Living Lab: Walking: 31,8 Cycling: 21,4 PT: 17,8 Car: 19,4 Bikesharing: 1,0 Carsharing: 1,0	05/2018	Modal split Munich: Walking 23% Cycling 19% PT 25% Car: 33%	2020	Modal split MUC 5.9 users: Walking: 31,4 Cycling: 32,2 PT: 18,6 Car: 11,2 Bikesharing: 0 Carsharing: 1,2	10/2019	Mode shift: Walking: -0,4 Cycling: +10,8 PT: +0,9 Car: -8,2 Bikesharing: -1,0 Carsharing: +0,2	Mode shift: Walking: + 8,4 Cycling: +13,2 PT: -6,4 Car: -21,8
Car Ownership	%	No car: 24,5 1 car: 59,6 2 cars: 14,9 3+ cars: 1,0 → 0,92 cars/ household	05/2018	Overall: -1%: No car: 28,2 1 car: 58,4 2 cars: 9,7 3+ cars: <0,7	2020	MUC 5.9 users: No car: 52,9 1 car: 39,2 2 cars: 7,8 3+ cars: 0 → 0,34 cars/household	10/2019	No car: +28,4 1 car: -20,4 2 cars: -7,1 3+ cars: -1,0 → -0,69 cars/ household	No car: +24,7 1 car: -19,2 2 cars: -1,9 3+ cars: -<0,7

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After–BaU
VKT	km/ year	9.810 km/year/ HH	05/2018	-1%	2020	VKT MUC 5.9 users: 4.760 km/year/ HH	10/2019	-5.050 km/year/ HH	NA
CO2-Emissions	kg/ house hold	2.415	2017	2.256	2020	186	10/2019	-92%	-92%
NOx-Emissions	kg/ house hold	6,39	2017	5,31	2020	0,40	10/2019	-94%	-92%
PM-Emissions	g/ house hold	76,41	2017	55,47	2020	4,28	10/2019	-94%	-92%
Access to Mobility Services	%	77 (1,19 km ²)	05/2018	NA	-	89 (1,39 km ²)	10/2019	+12%	-
Relative Travel Cost	Ratio (travel cost/ income)	NA	-	NA	-	NA	-	NA	NA
System Usage	#users Min Av Max	Provider: Min Av Max <u>GGS:</u> DriveNow: 35 78,9 104 car2go: 24 46,3 73 STATTAUTO: 11 13,4 18 Oply: 14 24,8 43 MVG Rad: 39 49,5 69 emmy: 0 45,2 97	2018	NA	-	Provider: Min Av Max <u>GGS:</u> DriveNow: 74 97,4 121 car2go: 42 66,1 106 STATTAUTO: 14 26,4 34 Oply: 11 31,4 45 MVG Rad: 46 89,0 122 emmy: 0 83,7 208 <u>MBS:</u>	2019	Provider: Min Av Max <u>GGS:</u> DriveNow: +39 +16,6 +17 car2go: +18 +19,9 +33 STATTAUTO: +3 +13,0 +16 Oply: -3 +6,6 +2 MVG Rad:	NA

		<u>MBS:</u> DriveNow: 14 27,3 39 car2go: 27 40,4 50 STATTAUTO: 3 5,0 7 Oply: 7 18,8 29 MVG Rad: 31 49,2 78 emmy: 0 47,7 102				DriveNow: 32 39,7 50 car2go: 19 32,0 42 STATTAUTO: 3 6,0 10 Oply: 15 30,0 44 MVG Rad: 31 124,4 194 emmy: 0 69,4 129		+7 +39,5 +53 emmy: +- 0 +38,5 +111 <u>MBS:</u> DriveNow: +18 +12,4 +11 car2go: -8 -8,4 -8 STATTAUTO: +- 0 +1,0 +3 Oply: +8 +11,2 +15 MVG Rad: +13 +75,3 +116 emmy: +-0 +21,8 +27	
Investment Costs	Costs related to people and their time period: None			Costs of equipment:					
				<u>Planning:</u>					
				Development of information pillar graphics 1.600 € (Cost of adapting the information pillar design to a new mobility station)					
				Icon development for mobility stations 4.300 €					
				Mobility stations Wortmarke 1.230 €					
				IHFEM- charging infrastructure (8 AC charging stations) 40.000 €					
				Rental bike system 7.500 €					
				<u>Infrastructure:</u>					
				IHFEM- charging infrastructure (8 AC charging stations) 200.000 €					
				Information pillar production 544 €					
				Information pillar shield bearer 450 €					
				Signage and marking per station 1.350 €					
				Rental bike system (2 MVG bike stations) 7.500 €					

		<u>Communication:</u> Planning and concept of communication campaign 5.000 € (Conception, Planning) 3 videos 9.000 € (Total costs incl. conception, production, postproduction) Flyers 900 € (Conception, drawing, image rights, printing, dispatch) Merchandise/Give aways 2.300 € (Concept, drawing, production, dispatch) Billboards 800 € Opening event 1.900 € (Catering, decoration, technical equipment, other equipment) Promotion Articles 3.650 € (Sweatshirts, T-shirts, Base-Caps, Outdoor-Jackets)
Operating Costs	Rental bike system per month 333,33 € Monthly rental or leasing cost per e-vehicle 527,78 € (Leasing contract for 48 months) Social Media Marketing Costs per month 500 € Film and picture material per month 525 €	

The following ex-post data was obtained from two different data sources:

- The second household survey which took place in the Living Lab in September and October 2019. 2.095 households were contacted and 328 households participated, this resembles a total number of 563 persons and a participation rate of 16% (27% in the first household survey, 05/2018).
- Statistical data on the number of rentals of the MSP collected by the ML in October and November 2019.

Addressing Indicators "1 – Awareness", "2 – Acceptance", and "3 – Satisfaction"

The survey of participants show that the **awareness** varies between the different mobility stations (Figure 13). While the majority of participants is aware of the E-mobility station Fritz-Winter-Straße (70%) and the mobility station Gertrud-Grunow-Straße (74%), only 37% are aware of the mobility station Marianne-Brandt-Straße. A reason for this could be the location of the station (see Figure) or the general attitude in the neighbourhood towards sharing options. The car ownership ratio in Parkstadt Schwabing, where Marianne-Brandt-Straße mobility station is located, is higher than in Domagkpark.

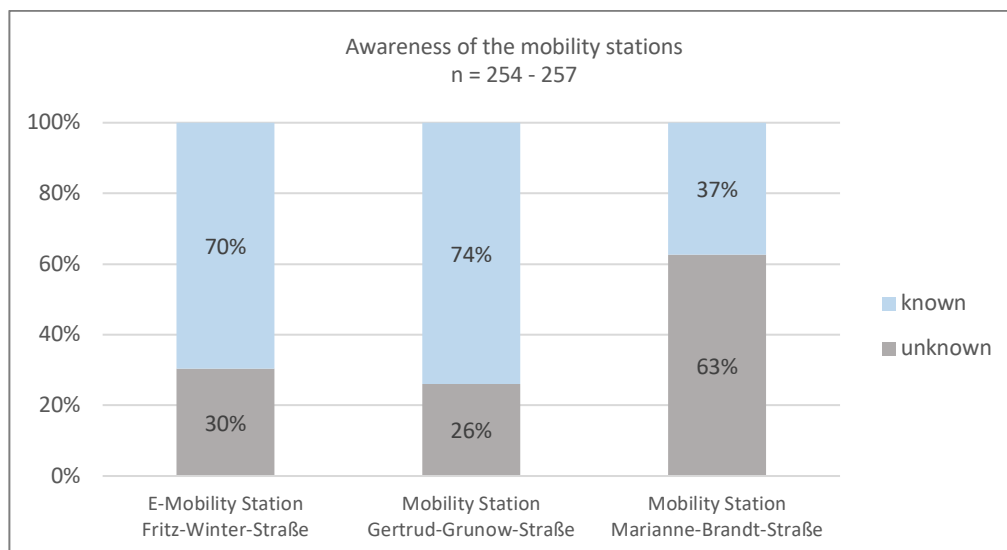


Figure 13: Awareness of mobility stations, 2019

Most of the participants know the mobility stations because they ran by it (46%). Only a small number answered that they were informed by internet advertisement (3%) or word-of-mouth (8%). Intended measures, such as advertising by the city of Munich and its partners (16%) and colour markings at the station (13%) were more successful in raising awareness.

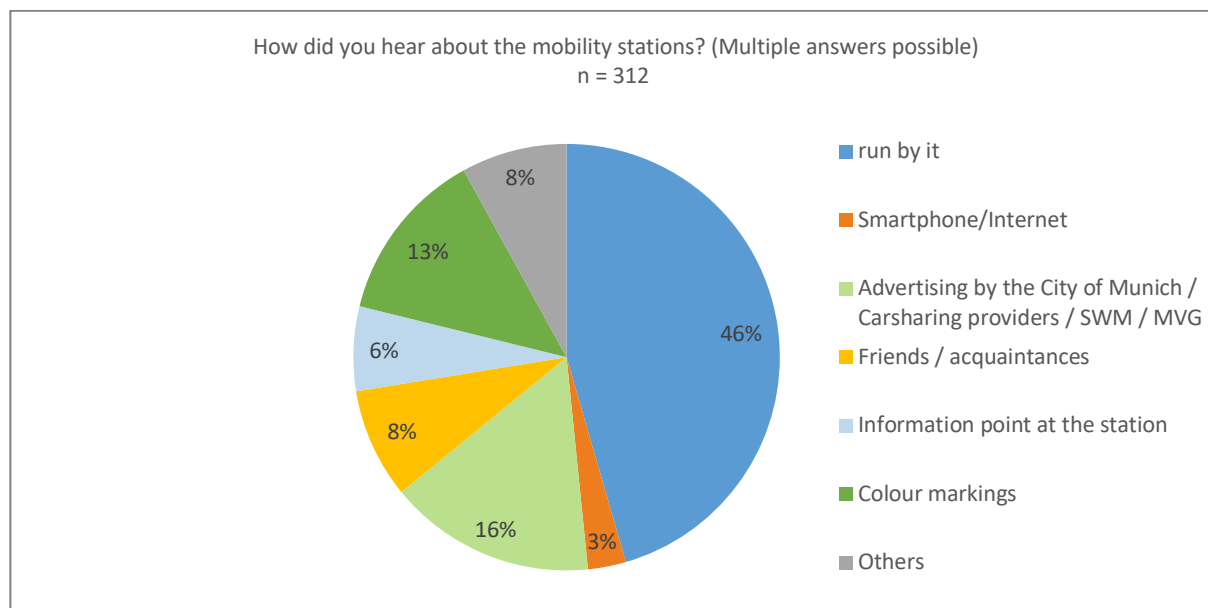


Figure 14: Awareness of the mobility stations, 2019

Accordingly, only a small percentage answered, that they noticed digital advertisement via the internet platforms Facebook (4%), YouTube (1%) or internet in general (9%). Conservative measures as advertisement in press (13%), at events (10%) word-of-mouth recommendation (18%) and in public spaces (19%) are still important in today's digital world. Even though a broad marketing campaign was started in October 2018, using all these different channels, 19% answered to not have noticed any advertisement.

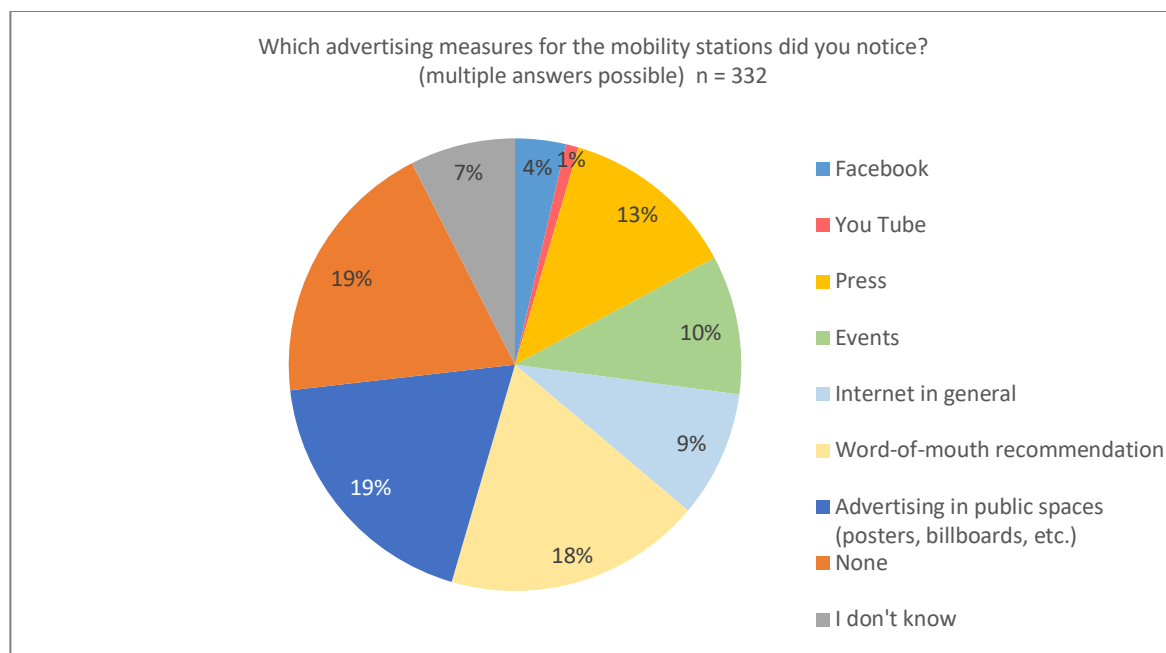


Figure 15: Awareness through advertisement, 2019

To further increase awareness in the population, participants recommend to use lighting (19%) and colour markings (29%) in order to attract more by-passing people to the mobility stations. Another option is to integrate the mobility stations in the apps of the corresponding municipality and apps of sharing partners, advice 26% respectively 23% of the participants.

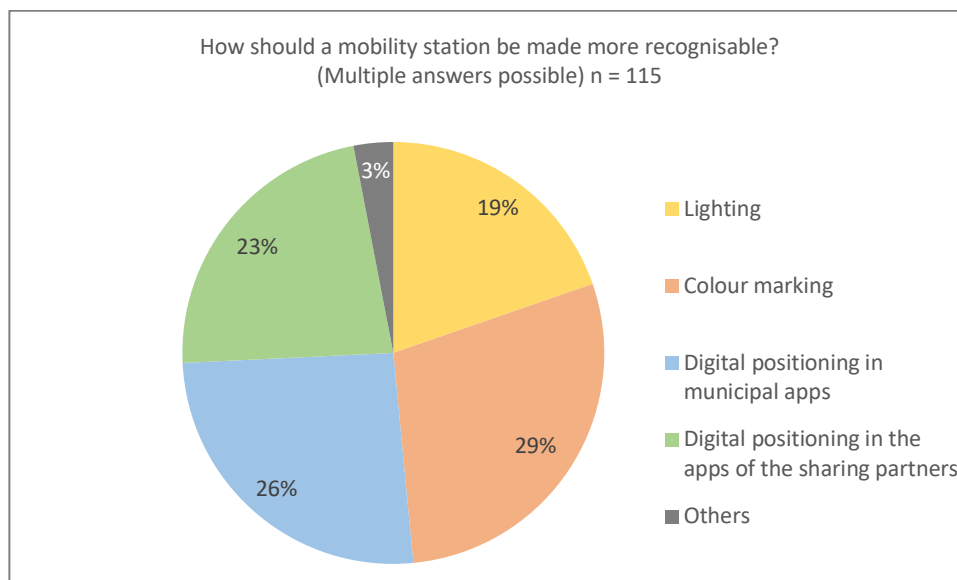


Figure 16: Awareness mobility stations, 2019

Even though the awareness of the mobility station is relatively high, the **acceptance** seems to be rather low (see Figure 17). According to the survey, Fritz-Winter-Straße is the most frequently used mobility station, 16% of participants stated to use it. The use of the mobility station in Gertrud-Grunow-Straße was reported by 13% of the participants. Only 3% of the participants said they would use the mobility station in Marianne-Brandt-Straße, which is not surprising, considering that it has the lowest awareness (see above). A direct comparison with the first household survey in 2018 is not possible because the stations Gertrud-Grunow-Straße and Marianne-Brandt-Straße did not exist back then. Note: mobility station Fritz-Winter-Straße is on private ground and not funded by ECCENTRIC but can be used for comparative considerations.

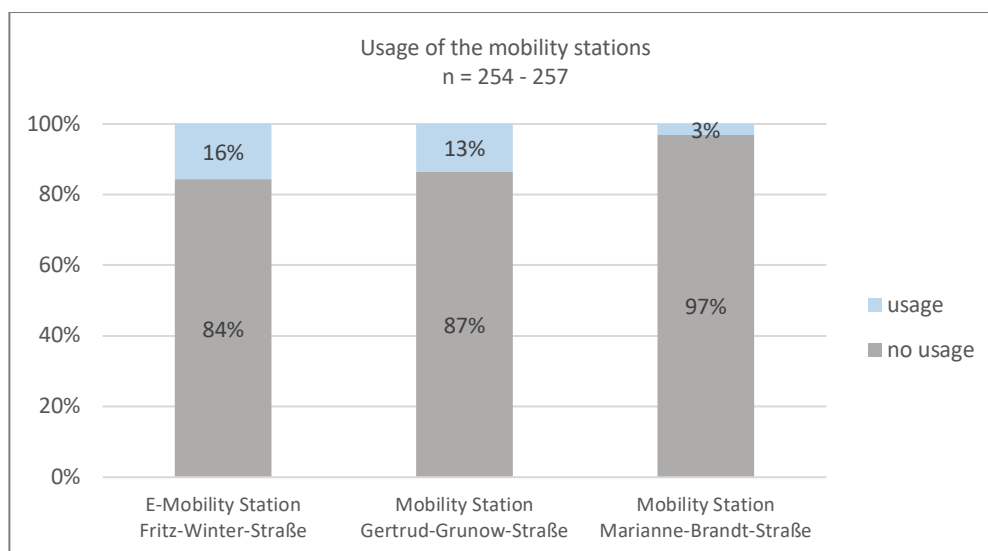


Figure 17: Acceptance of mobility stations, 2019

The score for the KPI **Satisfaction** is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI. A percentage value

of zero means as well that there are no other developments without the implementation of the measure.

A more general question in the household survey #2 asks for “Satisfaction with the availability of car sharing services in the immediate living environment (within a radius of 1km)”. 72,2% (household survey #1: 71,2%) of the survey participants are “satisfied” or “very satisfied” with the availability. Both satisfaction questions resemble a score of 4 out of 5.

The satisfaction about the different mobility stations is shown in [Figure 18](#). It can be seen, that the satisfaction is generally high for all three stations: for Fritz-Winter-Straße 80%, Gertrud-Grunow-Straße 74% and Marianne-Brandt-Straße 73% of the participants answered to be “satisfied” or “very satisfied”. Only a small percentage (on average 6%) answered to be unsatisfied. It is noticeable that the share of “very satisfied” participants is especially high for the E-mobility station Fritz-Winter-Straße (about double of the other two). The longer period in which people are already testing this mobility station might be a reason. Due to the high degree of satisfaction (73% - 80%) a score of 4 out of 5 can be given. A direct comparison with the first survey in 2018 is not possible because the stations Gertrud-Grunow-Straße and Marianne-Brandt-Straße did not exist back then.

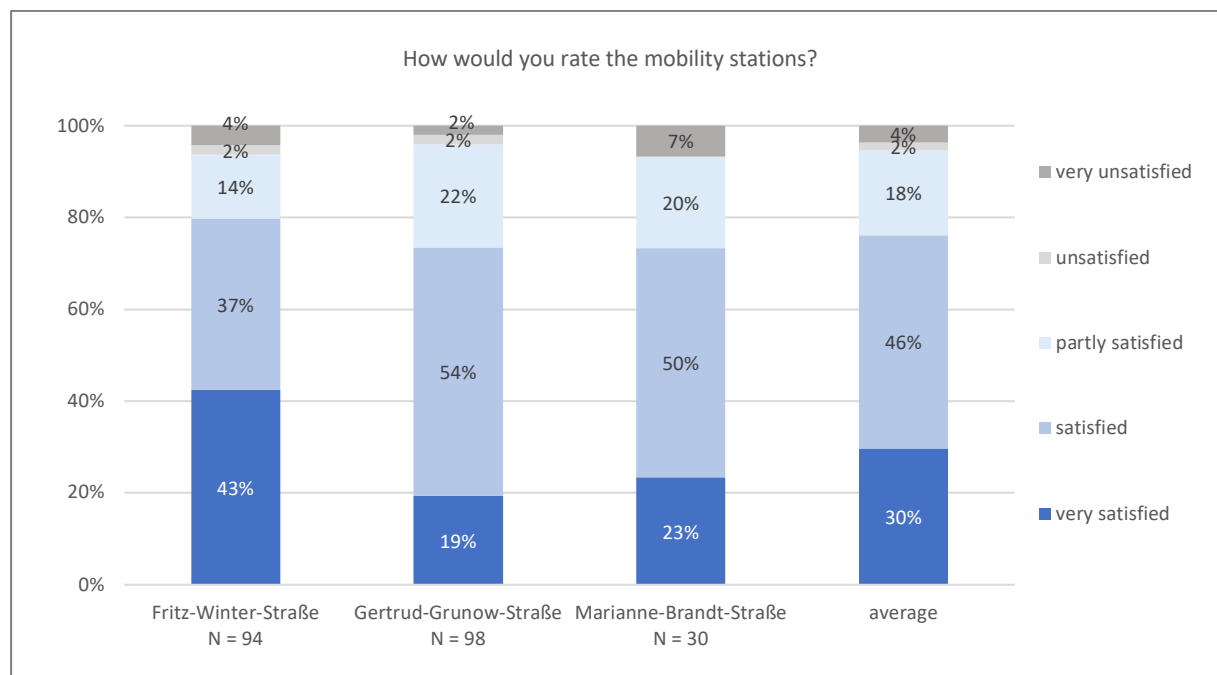


Figure 18: Satisfaction mobility stations, 2019

[Figure 19](#) shows which properties of the implemented mobility stations in Domagkpark and Parkstadt Schwabing are rated advantageous by the users. In this way, the reasons for their satisfaction are delivered. The proximity of the stations to the individual residence and/or working place are rated as major advantage (87% of the participant rated this as “advantageous” and “very advantageous”). Followed by the freedom of the users to have the choice between several modes of transport at the station (77% “advantageous” and “very advantageous”). Other reasons as the uncomplicated possibility to change between different means of transport (66% “advantageous” and “very advantageous”), and the safety, mobility station provide, regarding finding different means of transport (63% “advantageous” and “very advantageous”) as well as a parking space (67% “advantageous” and “very advantageous”) in situ are rated a bit lower but still as quite advantageous. Other reasons seem to play only a

minor role (only 49 answers in total). This second question for the KPI satisfaction can be rated with a score of 4 out of 5 as between 60%-80% of the users rated the MS very positively.

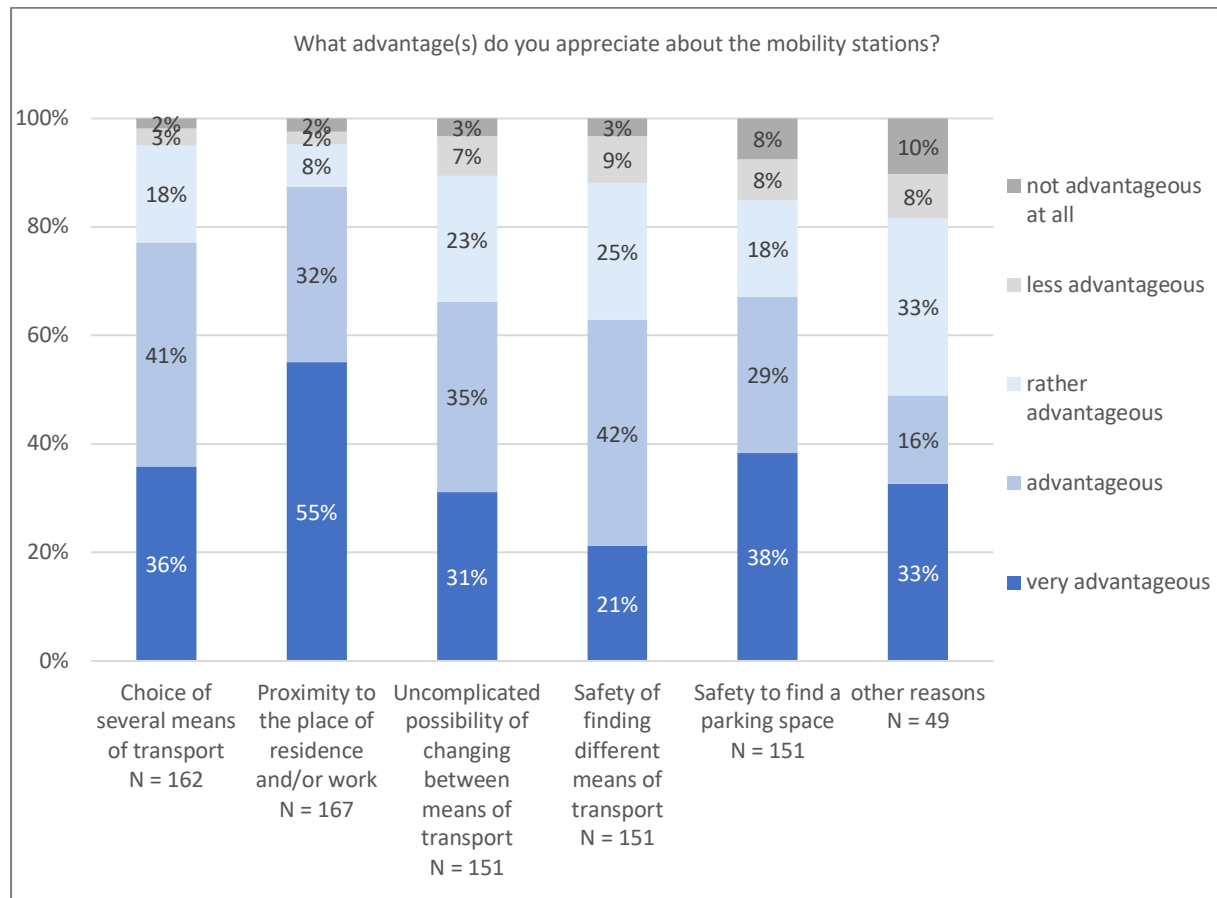


Figure 19: Reasons for satisfaction about stations, 2019

Reasons for dissatisfaction and thus potential for improvement of the service is shown in [Figure 20](#). The vehicle availability seems to be good at the stations, only 2% on average stated this as a reason for not using the mobility stations. The price of mobility services (8% on average) also seems to play only a minor role. The complexity of the renting systems (9% on avg.) is probably mainly for elderly people due to required technical skills a problem. By far the main aspect why people do not use the mobility stations is no need to do so (75% on avg.). The high percentage of car ownership (see [Figure](#), p. 381) in combination with a good public transport offer in the investigated area may serve as an explanation. This also shows how difficult it is to change one's mobility behaviour and habits despite a high willingness to do so.

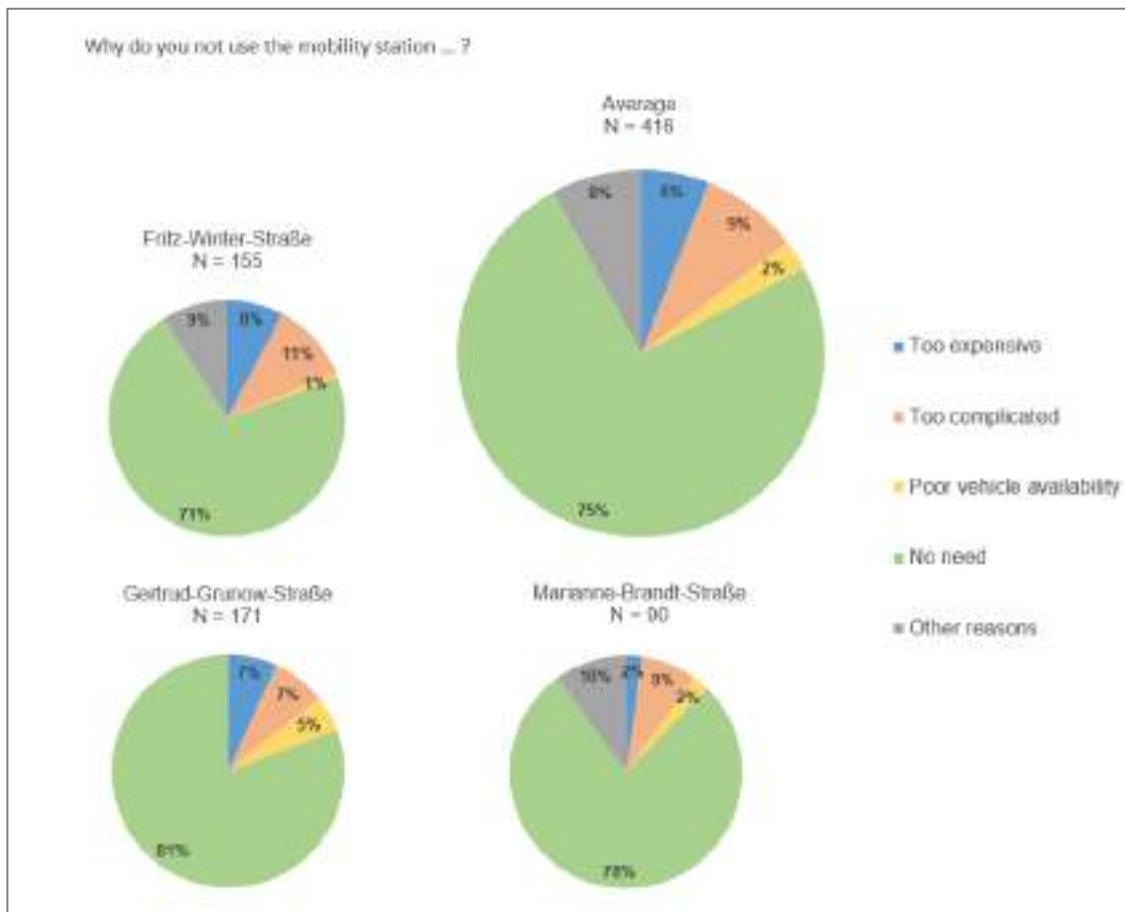


Figure 20: Reasons for not using the mobility stations, 2019

The information pillar and road markings as part of the mobility stations facilities are rated by most of the participants as easy to understand (44%). Only 10% rated them as misleading or not understandable. 26% stated to never have noticed them which could be an indicator, that they could be clearer.

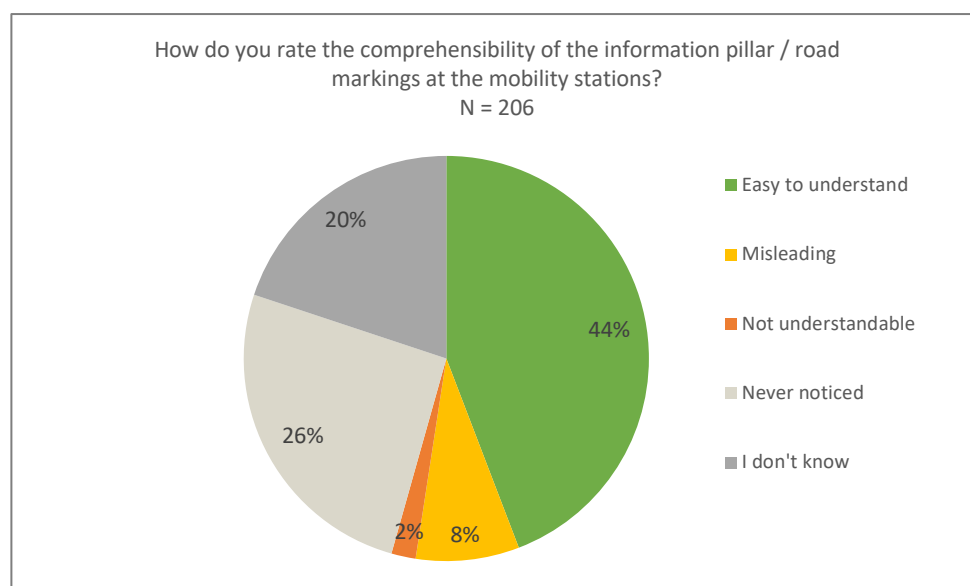


Figure 21: Satisfaction mobility station facilities, 2019

Figure 22 shows which features of the information pillar are important for the users. Main aspects are good visibility and providing information and booking options for the offered mobility services (both 29%). Followed by providing more general information as site maps (26%) and information on other offers and activities in the area (15%).

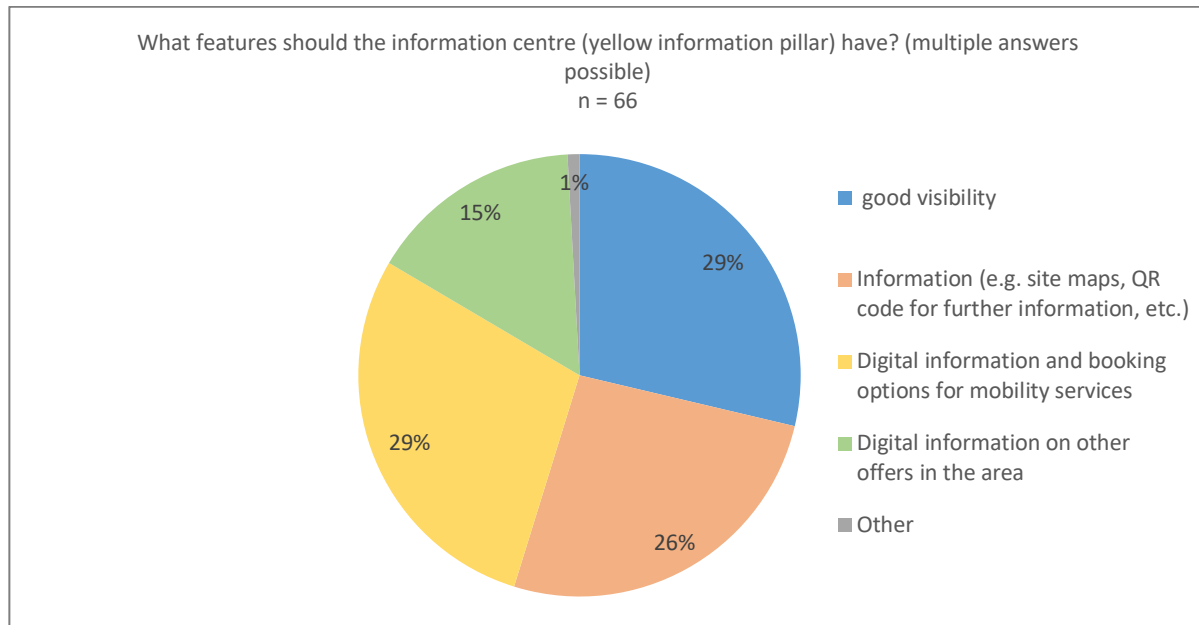


Figure 22: Satisfaction information at mobility station, 2019

When asking whether the mobility stations should be made more recognizable, significantly more participants answered with "No" (45%) than with "Yes" (15%). This suggests that the residents are generally satisfied with the marking.

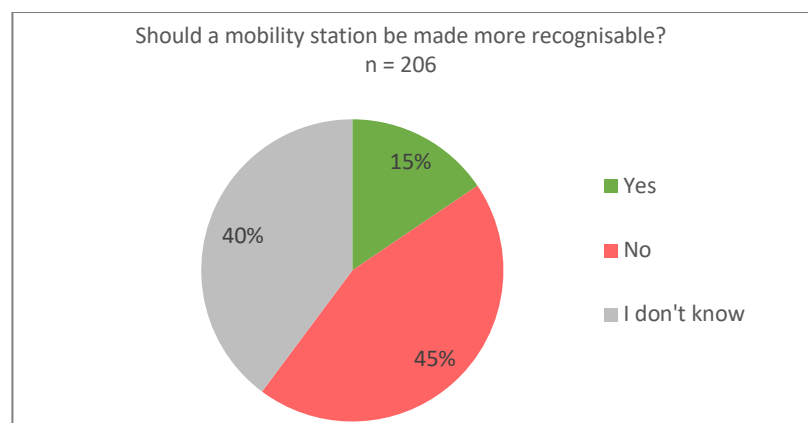


Figure 23: Satisfaction mobility station facility, 2019

Addressing indicators "4 - Mode Shift", "5 - Car Ownership", and "6 - VKT"

Regarding the following indicators, the group of households/ residents which stated to make use of the measure MUC 5.9 are extracted and compared to the Baseline scenario. There are in total 51 households and respectively 65 residents which use one of the three mobility stations.

To describe the **mode shift** from the first household survey (05/2018, n=935 Living Lab residents) to the second household survey (10/2019, n=65 Living Lab residents using measure MUC 5.9), the following mode split can be taken into account (see Figure 24):

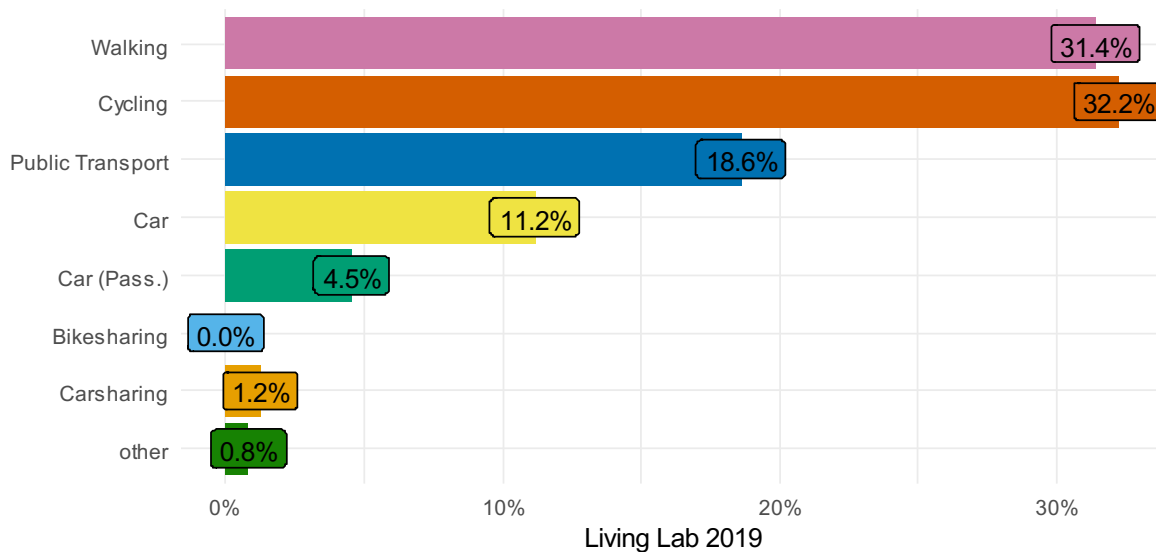


Figure 24: Modal Split of households using mobility stations, 2019

Whereas the survey in 2018 had a similar distribution of households in the Living Lab walking (-0,4%), there is a noticeable shift in 2019 towards modes like cycling (+10,8%). The use of an own car decreased (-8,2%) while 0,8% of the mobility stations users use PT. Contrary to expectations, the group of mobility stations users did not significantly often shift towards sharing options. As in 2018 the entire Living Lab had a share of 2,0% using sharing options, the group of MS users has a share of 1,2%.

A significant change in the modal split due to the marketing activities described above is not to be expected, only 12% of the participants said that they were influenced in their mobility behavior by corresponding advertising activities.

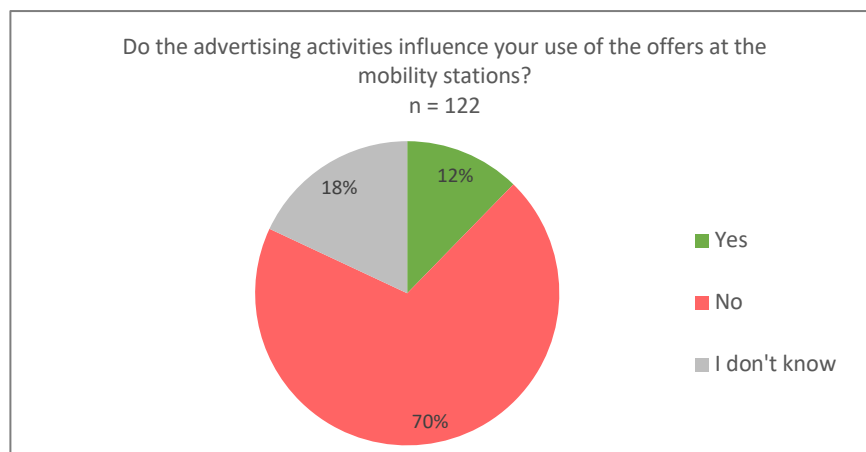


Figure 25: Mode shift influence by advertisement, 2019

The **car ownership** rate regarding the entire Living Lab from the observation period 05/18 until 10/2019 regarding only the group of residents which are using the mobility stations decreased rapidly. The ratio is about 0,34 cars/households in 2010. The change in car ownership is shown in detail as follows: about 53% of all mobility station users do not own a car, this is 28,4% less

than compared to the entire Living Lab in 05/2018 (see [Figure 26](#)). The number of households owning at least one car decreased from 59,4% to 39,2% (-20,4%). Also the percentage of households owning two cars has halved from 14,9% to 7,8%. There is no household which owns three or more cars.

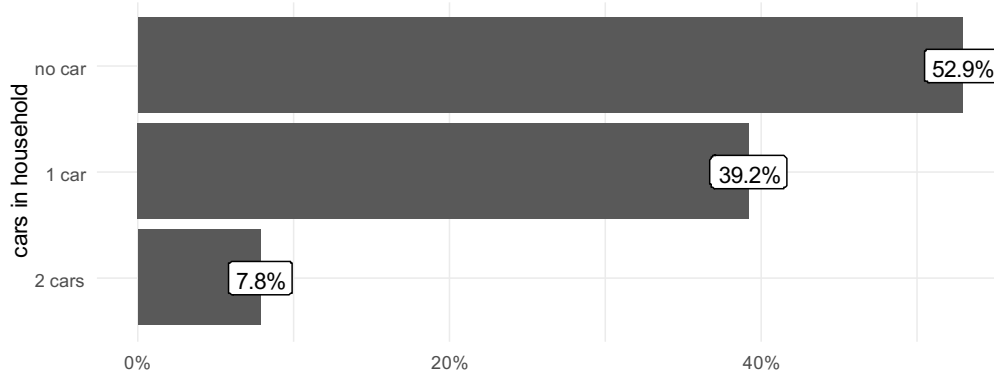


Figure 26: Number of cars per household of MUC 5.9 users, 2019

The **VKT** by household in 2019 among the mobility station users decreased to 4.760 km per year regarding the number in 2018 (9.121 km/year). [Figure 27](#) shows a density plot of the indicator vehicles kilometers traveled by household. The data was obtained during the household survey in 10/2019 and is referring to the users of all three mobility stations.

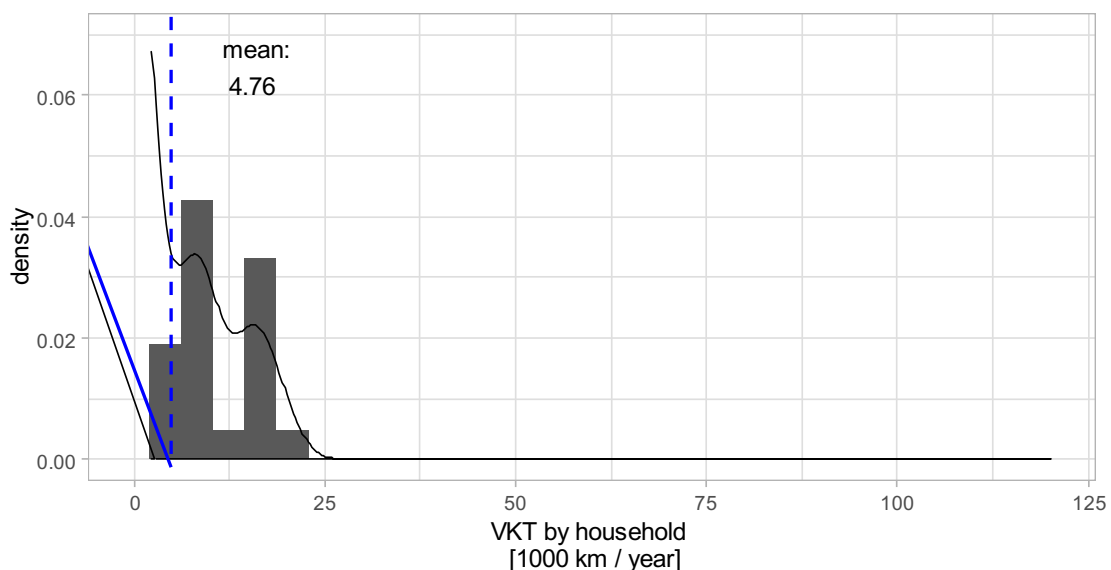


Figure 27: VKT by household (density plot) of MUC 5.9 users, 2019

Addressing indicators "7 - CO₂ Emissions", "8 - NO_x emissions", and "9 - PM emissions"

Similar to the indicators above, the emissions are calculated by looking at the group of households using the measure's output, the mobility stations. At this point it must be said that there are households which have interactions with other measures as well. But the number of households, which are making active use of all measure is assumed to be not representative enough. Therefore, the emissions are specifically calculated for the marketing material users. This is contrasted with the emissions of the non-users to see the difference between these two groups.

The emissions are obtained similar to the procedure described in section C.1.2 Baseline (p.1134). Based on the emission factors already used for the BAU scenario for 2020, emissions could be calculated analogue for the ex-post scenario, based on the VKT and car ownership numbers for Domagkpark residents. For emission factors see [Table](#) (p.251).

The following [Table](#) shows the emissions per household for three different groups: MUC 5.9-users, households not making use of the mobility stations and the entire Living Lab. This allows a comparison of the emission values of the Baseline scenario and the After scenario. This projection is calculated for the total of 3.100 households of the Living Lab because the marketing campaign is addressing all residents.

Pollutant	Emissions/ household MUC 5.9 users (2018)	Emissions/ household MUC 5.9 non- users (2018)	Emissions/household Living Lab (2018)
CO ₂	186 kg	2.699 kg	2.308 kg
NO _x	0,40 kg	6,05 kg	5,17 kg
PM	4,28 g	64,03 g	54,74 g

Table 12: Emission comparison MUC 5.9, 2018

It can be seen that the emissions regarding all three factors of the group which is making use of the mobility stations, are significantly lower than the households which are not using the mobility offer. This very low number mainly result from the mode shift which shows that the residents who are using the mobility stations have a very high share of cycling and walking (see [Figure 24](#)).

Regarding the actual change of the emissions from Baseline/ BAU to the After scenario, all three emission factors are decreasing rapidly (all factors about -90%) regarding the group of households which is using the mobility station offers. Very few of the households answering the household survey (10/2019) own a car. The biggest share is using more sustainable ways modes. See [Table](#) for details:

Pollutant	Emissions/ household MUC 5.9 users ex-post	% change to Baseline (2017)	% change to BAU (2020)
CO ₂	186 kg	-92%	-92%
NO _x	0,40 kg	-94%	-92%
PM	4,28 g	-94%	-92%

Table 13: Living Lab emission comparison

Addressing indicator “10-Access to Mobility Services” and “System usage”

As described above (under indicator Satisfaction) the proximity of the mobility stations to work and/or home is rated as major advantage by the users (87% rated this as “advantageous” and “very advantageous” see [Figure 19](#)). Since the distribution of this rating is very homogeneous across the area, it can be assumed that the **Access to Mobility Services** is good overall.

The **system usage** data collected by the ML, for the period from 06/2018 until 07/2019 is shown in [Figure 28](#) and [Figure 29](#) for mobility station Gertrud-Grunow-Straße and Marianne-Brandt-Straße. The data displayed correspond to the loan processes of the mobility offers at the mobility stations. The period considered for the after-scenario starts 01/2019 and ends 07/2019. The detailed characteristic values are given in [Table](#) and [Table](#) .

[Table](#) shows the data in a comprehensive way, with minimum, average and maximum of rentals per mobility station and transport provider during the observation period. In total there were 2759 rentals at Gertrud-Grunow-Straße and 2111 rentals at Marianne-Brand-Straße during the observed seven months in 2019.

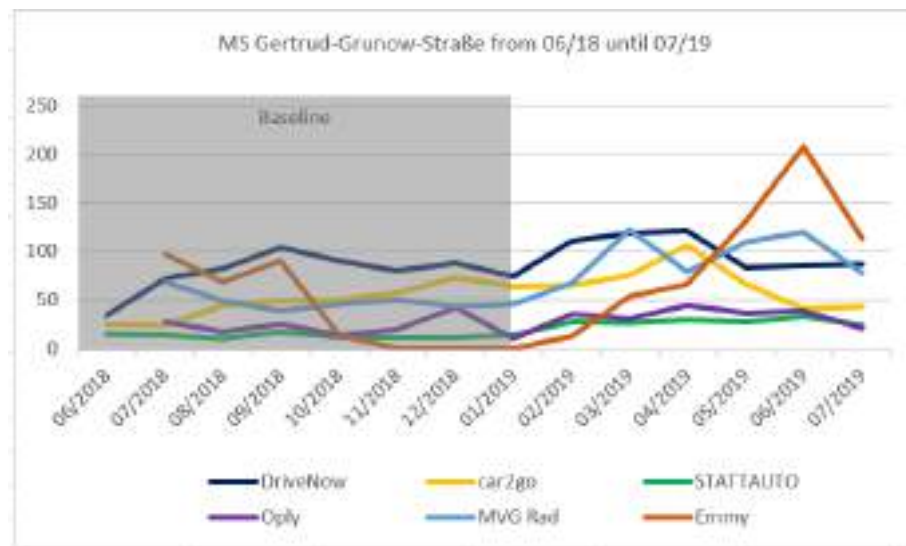


Figure 28: System usage MS Gertrud-Grunow-Straße

Provider	Min.	Mean	Max.
DriveNow	74	97,4	121
car2go	42	66,1	106
STATAUTO	14	26,4	34
Oply	11	31,4	45
MVG Rad	46	89,0	122
emmy	0	83,7	208

Table 14: Rentals MS Gertrud-Grunow-Straße 01/19 - 07/19

At the mobility station Gertrud-Grunow-Straße the carsharing provider DriveNow has on average the most rentals per month (97,4). The MVG bikes of MVG Rad are also frequently used (89,0 rentals on average per month) even though the demand is sensitive to the seasons. While the e-scooter sharing of emmy also has a high average usage rate per month (83,7), the seasonality plays here a major role: in winter months, as in not a single scooter is rented, while in summer up to 208 are rented per month. Overall, all services of the mobility station are used relatively frequently during the observed period: car2go (66,1), Oply (31,4) and STATTAUTO (26,4) also show a relatively high number of average loans per month.

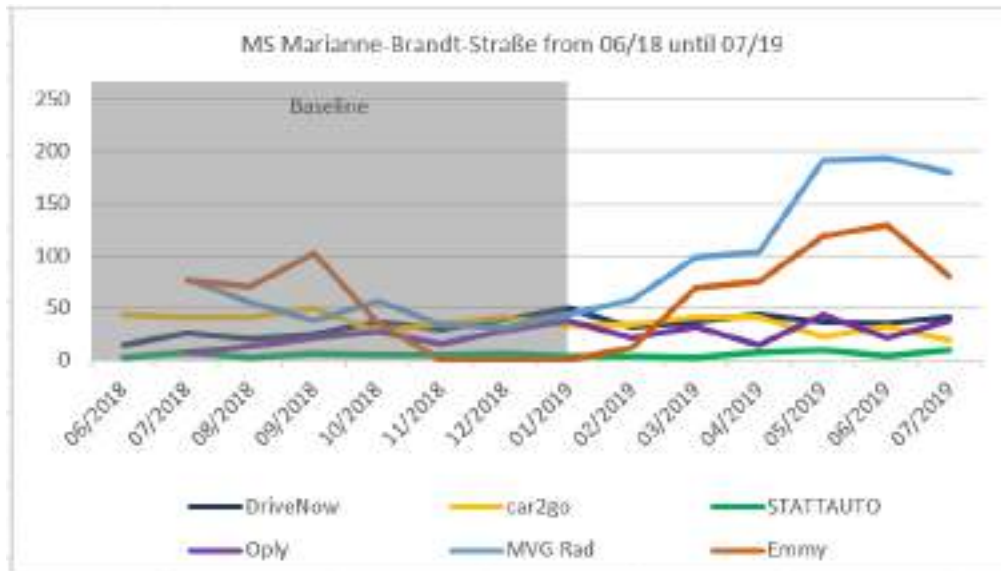


Figure 29: System usage MS Marianne-Brandt-Straße

Provider	Min.	Mean	Max.
DriveNow	32	39,7	50
car2go	19	32,0	42
STATTAUTO	3	6,0	10
Oply	15	30,0	44
MVG Rad	44	124,4	194
emmy	0	69,4	129

Table 15: Rentals MS Marianne-Brandt-Straße 07/18 - 12/18

At the mobility station Gertrud-Grunow-Straße MVG Rad has on average the most rentals per month (124,4). The e-scooters of emmy are the second most frequently used offer at the station over the time period, with 69,4 rentals on average per month. Similar to the mobility station in Gertrud-Grunow-Straße, the number of scooter rentals is highly fluctuating due to seasonality: In winter the minimum of 0 loans was reached, while in summer a maximum of 129 scooters were rented. The carsharing services are all used lesser than at the mobility

station in Gertrud-Grunow-Straße: DriveNow has on average 39,7 car2go 32,0 Oply 30,0 and STATTAUTO 6,0 rentals per month.

Due to the influence of the seasons, a direct comparison of the use of the mobility offers is only possible for the same time periods. Since the data is not available for the complete years 2018 and 2019, July is used as the only month for which all data are available for all providers and both years (see [Figure 30](#)).

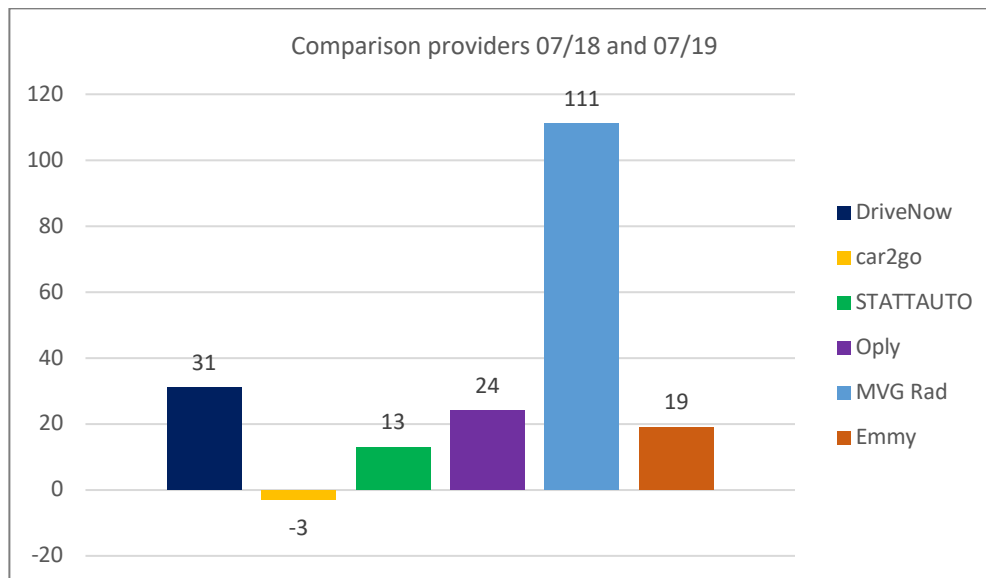


Figure 30: Change in rentals between 07/18 and 07/19

The usage of bikes of MVG Rad increased significantly, by 111 additional loan processes. The usage of the other offers, as carsharing (by DriveNow, STATTAUTO and Oply) and scooter sharing (emmy) increased also. The only exception is car2go, with a slight decline in rentals (-3).

[Figure 31](#) shows the share of users across the participants over all three mobility stations (Fritz-Winter-Straße, Gertrud-Grunow-Straße and Marianne-Brandt-Straße), while [Figure 32](#) shows the percentage of users for each mobility station in detail. The service with the most users is conventional carsharing with 25% of the participants. Carsharing with electric cars (14%) and the different bikesharing options: MVG-bikes (14%), E-bikes (12%) and electric cargo bikes (14%) are also used by several participants. Only 6% answered to use the charging infrastructure, which can be explained by the still low ownership of electric cars in Munich/ Germany. The e-scooters of emmy (5%) and the information pillar (3%) have a relatively low share of users across the participants. Compared to the participant's awareness of the variety of mobility options, the actual usage is relatively low. Only the information pillar is not well known across the participants yet, leading to a particularly low user rate. For the information pillar measures of increasing awareness could be improved. For the other offers user rates do not seem to be a question of awareness but probably of time: the survey shows, that the longest existing and thus most established services (as conventional carsharing) have the highest usage rates, compared to more recent offers (as electric scooter). That shows, that people need time for getting used to new mobility offers and integrating them into their mobility behaviour.

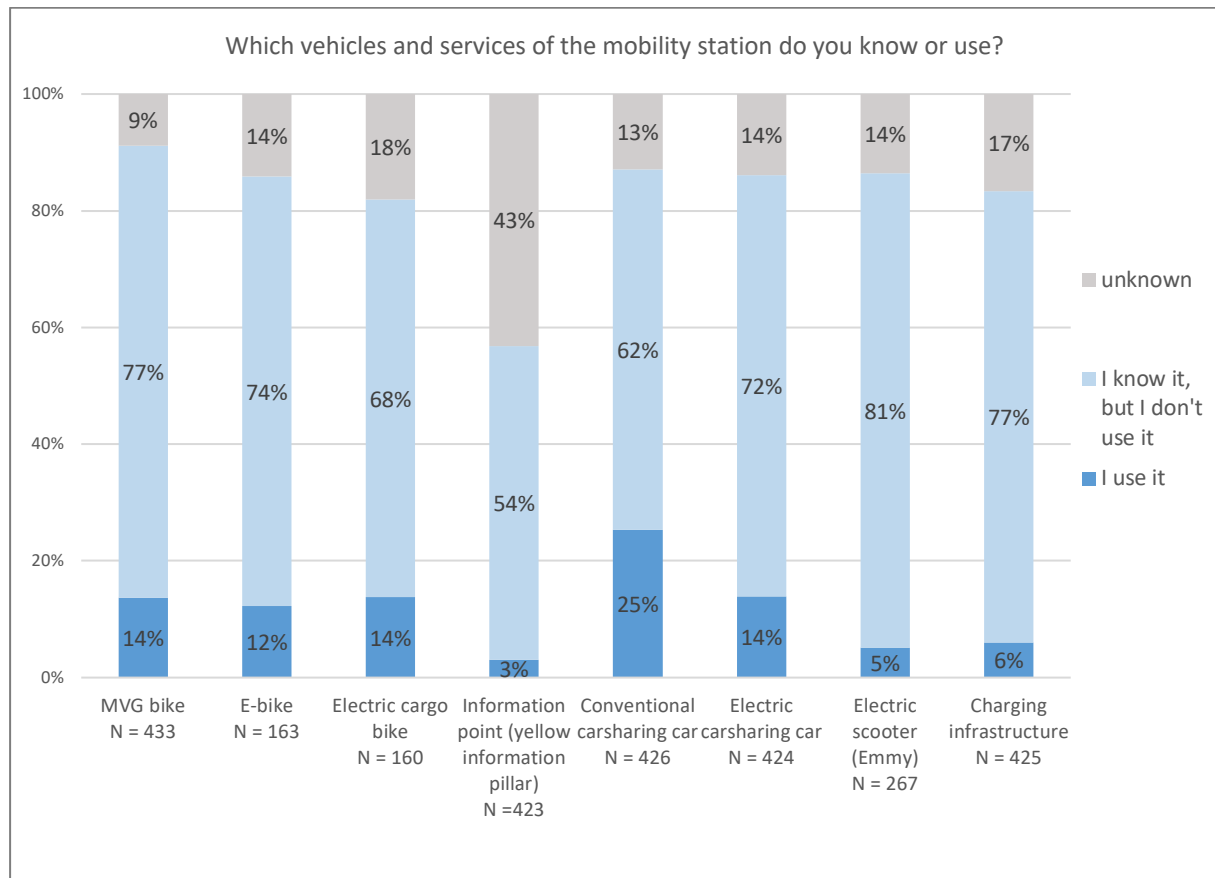


Figure 31: Average system usage over all three mobility stations, 2019



Figure 32: System usage of the three mobility stations, 2019

Figure 33 shows the usage frequency of the offers at the mobility stations. It can be seen, that most services are never or only occasionally used. Car sharing is the most commonly used offer, especially with conventional vehicles, it is used weekly by some participants: 2% answered to use it four to six days a week and 4% one to three days. 11% answered to use carsharing with conventional cars one to three days a month, for the other mobility offers, a maximum of 8% stated that they used them at least monthly. Again, it is car sharing and thus the longest existing mobility offer that has been best established in the mobility behaviour of participants.

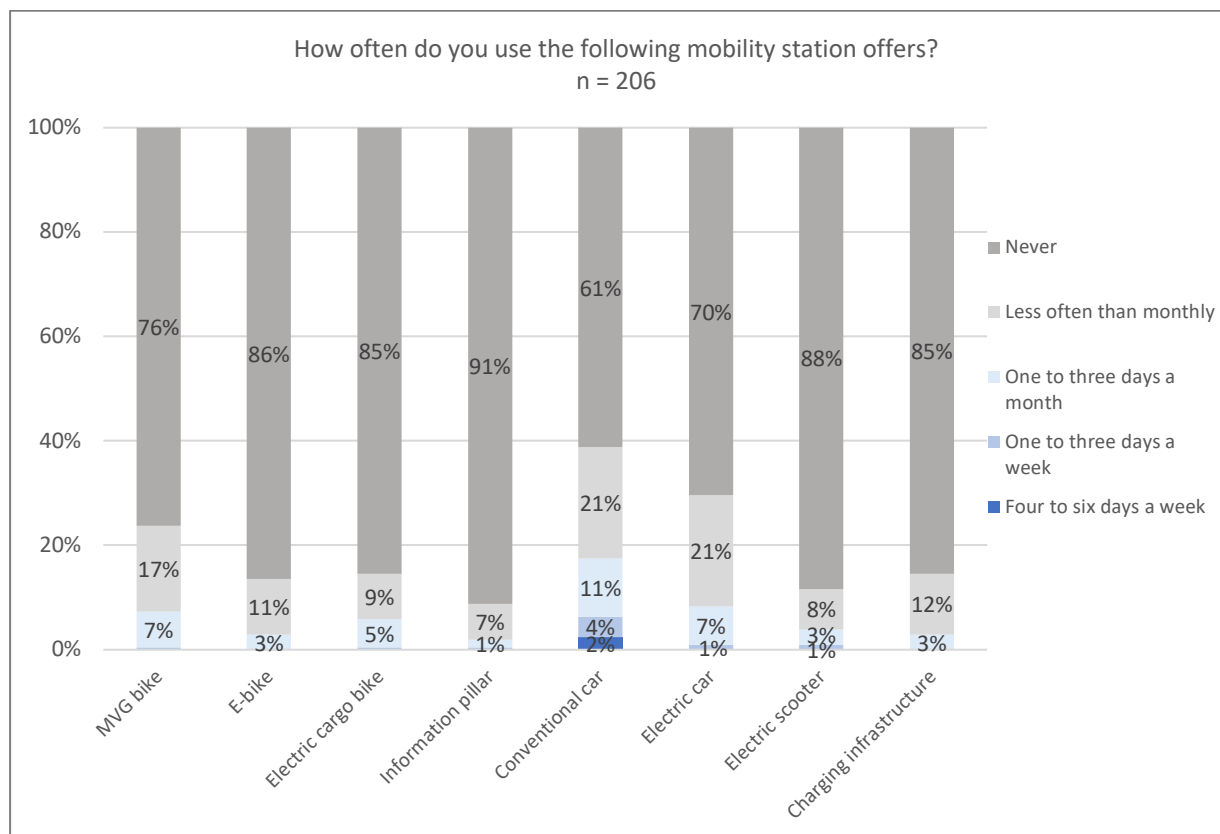


Figure 33: System usage mobility offers across all stations, 2019

Trips to work and school, for shopping and leisure activities are the reason for 60% of the use (see Figure 34). Leisure trips make up the largest share with 34%, 14% do trips for shopping and the lowest share with 12% use it for the way to work or school.

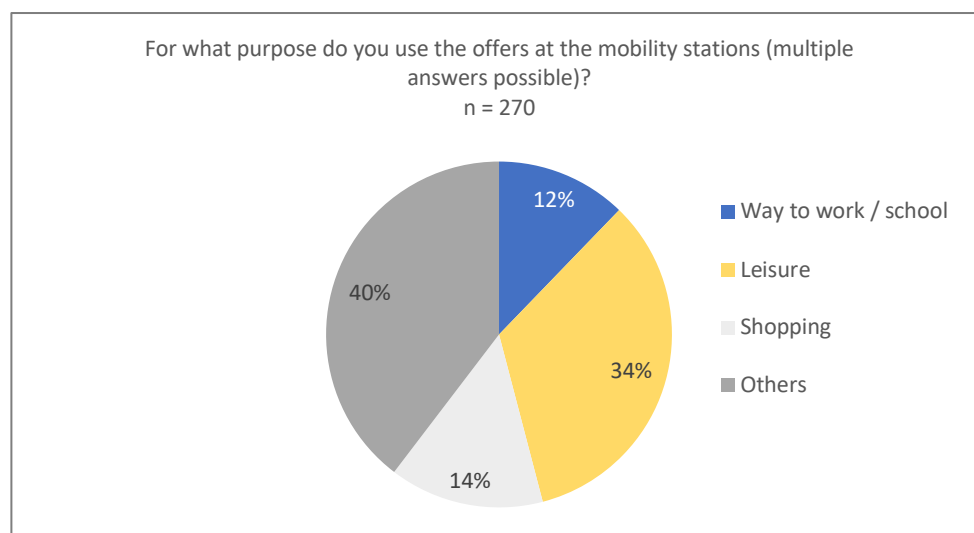


Figure 34: System usage purpose, 2019

Addressing Indicator "10 - Access to Mobility Services"

As in the Baseline-scenario the standard and maximum walking distance for potential mobility stations users is 5 minutes are assumed (see [Figure 35](#)). The three mobility stations cover 89% of the Living Lab. This equals a land use of 1,39 km². With the implementation of the fourth mobility station in the north of the Living Lab (Max-Bill-Straße), the coverage of residents which have a five-minute walk to the MS increased about 12%.

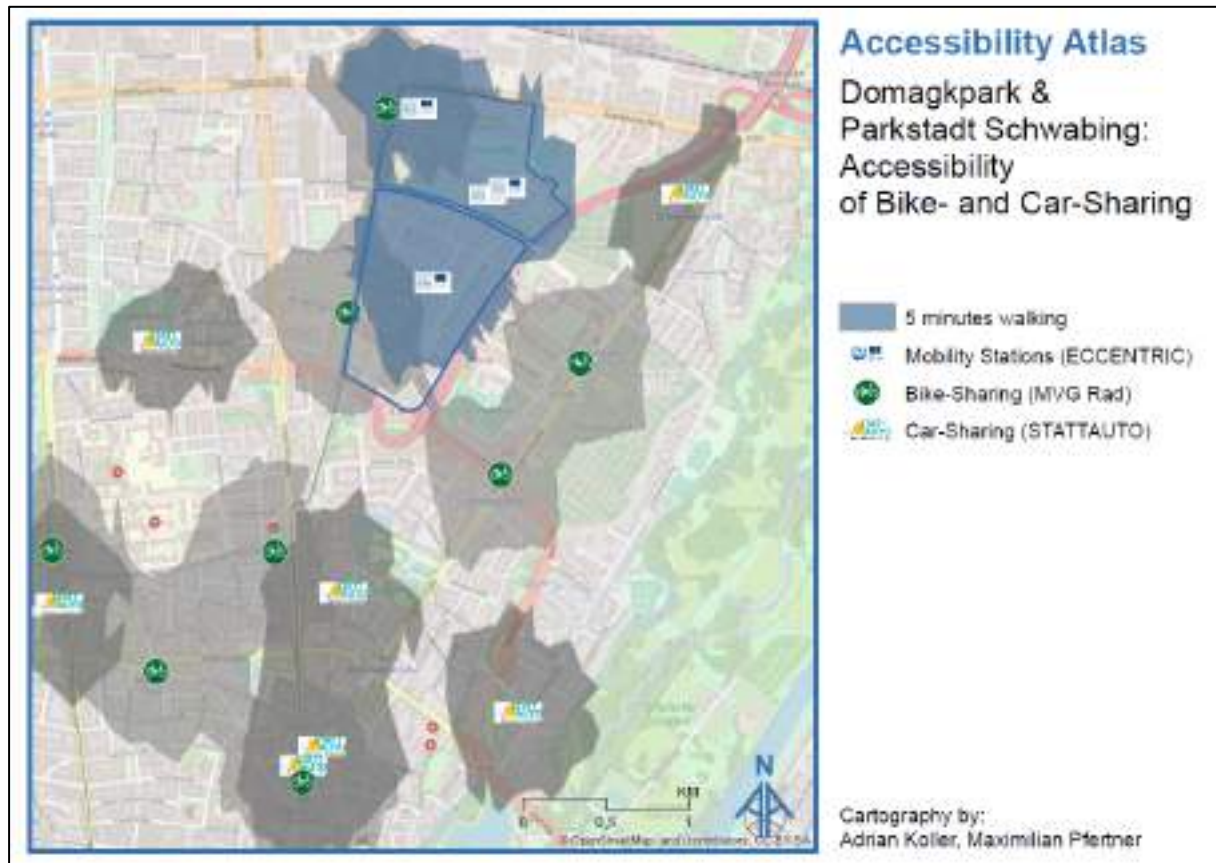


Figure 35: Accessibility improvements, 2018

Addressing indicator "11 – Relative travel cost"

Travel costs could be found at the websites of every single MSP who is offering mobility options at the stations. The average income of the Living Lab residents was not obtained with the household survey due to the fear that too personal data is collected and survey participants might not continue the survey.

For the ex-post evaluation there is no change in the prices but new sharing providers, as Sixt-Share and Jump (part of Uber) came up on the market which extends the mobility offer for the population. See [Table](#) :

	Carsharing	E-Bikesharing
	SIXT share	Jump (Uber)
Registration fee	29€, currently free	None
Time tariff	Starting from 0,09€/min. (depending on car type and demand) including 50km afterwards 0,34€/km	1€ reservation + starting from 0,20€/min. (depending on location and time of day)
Daily prices	59€/day (depending on car type and demand)	15€/day

Table 16: Travel offers of the different sharing options and providers, 2018

Addressing Indicators "Investment costs" and "Operational costs".

The KPI cost is divided into **investment cost** and **operating cost**. Those costs were obtained in 10/2019 when the measure was up and running for almost 2,5 years. The biggest investment costs came up due to the installation of the charging infrastructure. The planning for the eight AC charging stations (about 40.000 Euro) and the installation (about 200.000 Euro) account for a large part of the costs. Further infrastructure that had to be installed was the rental bike system consisting of two MVG bike stations (about 7.500 Euro). The development of the information pillar graphics (about 1.600 Euro) and the mobility stations icon (about 4.300 Euro) and the costs for the yellow information pillar at the mobility station (about 1.230 Euro) complete the planning costs. Production costs for an information pillar (about 544 Euro) and the corresponding shield bearer (about 450 Euro) as well as signing and marking the mobility stations (about 1.350 Euro) arise per station. The marketing campaign for the mobility stations, with concept, video production, events, promotion articles, etc. is another major cost component (in sum about 23.550 Euro). The operating costs per month consist of the costs for providing the mobility offers (rental bike system about 333 Euro and rental or leasing costs per e-vehicle about 528 Euro) and for the media marketing (for social media marketing about 500 Euro and for film and picture material about 525 Euro).

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Mobility stations as a new bundled supply of all modes of transport for all mobility needs become part of a new urban mobility lifestyle.	★★	Four mobility stations have been implemented within the Living Lab. All of them offer different mobility options like cars, bikes, scooters and other information shown at the mobility station-pillar.
2	Standardized planning and implementation process for new development and housing areas within Munich's urban planning	★	The planning and implementation process is getting more and more standardized as there are already several mobility stations finished.
3	Mobility stations as a proven concept for city wide up scaling in order to shift modal share towards more sustainable mobility	★★	The implementation of several mobility stations within the Living Lab showed that there is more routine regarding the setup and MSP with every new one. Up-scaling actions can easily be made due to the experience which was gathered during ECCENTRIC.
4	Increased awareness of residents about the multimodal variety of mobility services	★★	The awareness of residents increased over the project lifetime because there are several mobility stations visible in the public space and lots of advertising which also raises awareness.
5	Positive acceptance and active usage of the mobility station services	★	There is a positive acceptance to be observed, especially when looking at the usage of the single mobility options. Still, the usage could be more intense when looking at the numbers of evaluation. The trend of using sharing options is still lower than expected in the beginning.
6	Provide different vehicles (also e-vehicles) to use and share	★★	The offer of various mobility options is very broad. There is (e-)carsharing, bikesharing and e-scooter sharing.
7	Change mobility behaviour towards less car use (maintain low levels of car ownership)	★	There is a significant mode shift to be observed among the users of the mobility stations. The share of walking and cycling is very high compared to the rest of the Living Lab. The number of residents using sharing mobility options did not increase significantly, though.
8	Introduction courses and events for using new vehicles and ways of mobility	★	There were no courses being conducted but several events advertised the mobility stations, e.g. opening ceremonies for each mobility station and photo sessions for new providers at the mobility stations.
9	To reduce mobility costs	NA	Due to missing values about individual mobility costs, this objective could not be measured.
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★ = Exceeded			

D. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

- There are three mobility stations being installed in the Living Lab during the evaluation period and financed by ECCENTRIC: Gertrud-Grunow-Straße, Marianne-Brandt-Straße and Max-Bill-Straße.
- All mobility stations offer bikesharing, carsharing, e-scooter sharing, charging stations and an information pillar.
- 89% of the Living Lab are covered by mobility stations which are reachable within five minutes walking.
- The mobility stations which are implemented a longer time already are better known than the newer ones.
- Most of the residents got aware of the mobility stations because they ran by it, only 16% saw the advertisement.
- 76% of all users state that they are “satisfied” or “very satisfied” with the mobility stations.
- The system usage increased significantly after the first wave of the mobility marketing campaign took place in 06/2019 (see measure MUC 2.9a).
- Statistics by the MSP show that most users of the mobility station use classic carsharing, bikesharing and e-scooter-sharing options. The household survey shows that there is still a high percentage of people who know the vehicles and services a mobility station offers but do not use them. Conventional carsharing is still the most frequently used mobility option, pursued by e-carsharing, bikesharing or the e-cargo-bike sharing (this is only offered at the MS at FWS on private ground, not financed by ECCENTRIC).

D.2 Relevance of supporting activities

- Measure MUC 2.9a Direct and dialogue mobility marketing promoted the mobility stations with several information materials. Evaluation data shows that there is an increase of the system usage in 06/2019, when the marketing campaign started.
- A parking management was implemented in the Domagkpark area in March 2018 leading to less illegal parking on reserved carsharing spots compared to Parkstadt Schwabing area.

D.3 Interaction with other measures

- Measure MUC 2.7 is the website www.domagkpark.de which promoted the mobility stations when they were installed and when there have been any new mobility options being offered.
- The planned interaction with MUC 3.4 (E-Trikes) and 6.3a (ACM vehicle) did not work out due to several delays and other barriers regarding the process. Both mobility options could not be offered at the mobility stations.
- The marketing campaign of measure MUC 2.9 supported the awareness of mobility stations and their offers among the residents and employees in the area.

D.4 Main lessons learned

- Most of the residents got aware of the mobility stations because they ran by it, less because of advertisement.

- The type of advertisement which is most successful are posters or billboards and word-of-mouth recommendations.
- But in general 45% report that the mobility stations need to be made more recognisable by colour marking or digital positioning of the mobility stations in apps.
- Initial assumptions that the mobility stations are not used because of an unreliable availability of vehicles or lack of parking space did not turn out to be true. Most of the residents who do not use the mobility stations, state that they just do not need them.
- An evaluation period of 1-2 years is too short to see any shift towards a more sustainable mobility behaviour.
- Mobility stations are not used for regular trips, most of the questioned residents say that they never use the offers or less often than monthly. Only conventional carsharing is used more often.
- Ongoing construction works in new development areas hinder the implementation and completion of mobility stations.
- Early involvement of local stakeholders and planning community of the city is crucial for the planning process of mobility stations.
- Cooperation with MSP has to be practiced actively with marketing campaigns for their offers.

D.5 Long term impact

- There could be a long term impact regarding lowering emissions and promote a mode shift with the various sustainable mobility option which are being offered.
- Residents might become more familiar with the sharing concept and use the shared vehicles more often.

D.6 Potentials for up-scaling in the city

- The mobility stations are easy to up-scale because there are already four MS which have been implemented in the Living Lab.
- Investment and operational costs can be numbered quite precisely.

E. Additional information

E.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

Evaluation was mainly made by two different sources: First and second household survey and statistics provided by the MSP at two different times.

Unfortunately, there was only one mobility station in the Living Lab when the Baseline household survey took place: Fritz-Winter-Straße. This mobility station has a unique position because it is not financed by ECCENTRIC and is located on private ground of a housing association. But still, it serves at a good sample to compare the developments to the ones located in public space.

The second household survey gave very detailed information about the awareness, acceptance, satisfaction and usage of the mobility stations. Residents had for almost one year the chance to use the MS before answering household survey #2.

Collecting system usage data from the MSP proved to be more difficult because there was no standardizes form of tracking. Some MSP only gave monthly numbers and others daily and all of them delivered those statistics at different times. For similar evaluation work it can be recommended to set fixed dates when the MSP have to deliver their data and to determine the correct data format.

To address the KPI relative travel cost, the average income of the Living Lab residents would be of advantage. This was not assessed with the household survey.

E.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

The marketing campaign of measure MUC 2.9a will be continued in 2020 with the goal to promote mobility stations and their offers.

The planned interaction with the two other ECCENTRIC measures MUC 3.4 (E-Trike) and 6.3a (ACM vehicle) could be carried out in 2020, when the new prototype has been launched and the light weight vehicle is finally street legal.

New MSP will offer their mobility options at the mobility stations.

A fourth mobility station is planned for Q2 2020. This station should be very close to the public transport in the Parkstadt Schwabing (Tram-Station Anni-Albers-Straße) in order to reach a high usage. Due to new planning activities by the city of Munich for the area around the Anni-Albers-Straße in 2020 and the following years, original plans for a mobility station “Anni-Albers-Straße” as described above have to be rejected. Therefore, a new spot for the fourth mobility station has to be located and planned in Q1 2020, followed by the implementation in Q2 2020.

With regard to the upscaling potential of mobility stations beyond the project, a smaller sized and more decentralized concept of mobility stations seems favourable towards only a few large centralized mobility stations in a city. It is also important, that mobility stations are not viewed as a singular mobility measure, but rather are embedded in a city-wide mobility concept.

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2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



MUC 5.10

Sustainable mobility via E-scooter sharing

Measure Evaluation Report

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2020
CIVITAS
Cleaner and better transport in cities
ECCENTRIC



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1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
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11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
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21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

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Table of Contents

ABSTRACT.....	1181
A. INTRODUCTION.....	1183
A.1 EXPECTED RESULTS OF THE MEASURE	1183
A.1.1 Quantifiable impacts.....	1183
A.2 MEASURE DESCRIPTION	1184
A.2.1 Measure outputs.....	1185
A.2.2 Supporting activities	1185
A.2.3 Interactions with other ECCENTRIC measures.....	1185
A.2.4 Interactions outside ECCENTRIC	1185
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1185
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1186
A.5 IDENTIFIED RISKS	1186
B. MEASURE IMPLEMENTATION	1187
B.1 SITUATION BEFORE CIVITAS	1187
B.2 INNOVATIVE ASPECTS.....	1187
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1187
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1187
C. IMPACT EVALUATION FINDINGS	1190
C.1 EVALUATION APPROACH.....	1190
C.1.1 Expected impacts and indicators.....	1190
C.1.2 Baseline.....	1192
C.1.3 The business-as-usual scenario.....	1196
C.2 MEASURE RESULTS.....	1200
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1214
D. PROCESS EVALUATION FINDINGS	1215
E. EVALUATION CONCLUSIONS	1216
E.1 VALIDATED DIRECT IMPACT	1216
E.2 RELEVANCE OF SUPPORTING ACTIVITIES	1216
E.3 INTERACTION WITH OTHER MEASURES.....	1216
E.4 MAIN LESSONS LEARNED	1216
E.5 LONG TERM IMPACT	1217
E.6 POTENTIALS FOR UP-SCALING IN THE CITY	1217

F.	ADDITIONAL INFORMATION	1218
F.1	APPRAISAL OF EVALUATION APPROACH	1218
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1218

List of Figures

Figure 1: Modal Split of Living Lab residents, 2018 (cf. ECCENTRIC household survey 2018)	1193
Figure 2: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)	1194
Figure 3: Modal Split in Munich (2008+2017)	1196
Figure 4: Total km travelled in Germany/year (2010-2017), (Radke 2018: 217)	1197
Figure 5: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)	1198
Figure 6: Satisfaction with the ESS by RA related customers	1204
Figure 7: Mode Shift/RA related respondents, 2019	1205
Figure 8: Mode shifts 2019 - Comparison of mode shifts of RA related respondents to those in Munich in general	1206
Figure 9: Mode Shift related to the RA (by trip), 2019	1207
Figure 10: Mode Shift related to Munich (by trip), 2019	1207
Figure 11: Share of distances driven related to the research area, 2018/2019	1208
Figure 12: System usage per month 2018 and 2019	1209
Figure 13: System usage per weekday 2018 and 2019 (cf. ESS Usage dataset 2019)	1209
Figure 14: Temporal system usage patterns - start time of trips related to RA in 2018/2019 (cf. ESS Usage Dataset 2019)	1210
Figure 15: Temporal system usage patterns - start time of trip within all of Munich in 2018/2019 (cf. ESS Usage dataset 2019)	1211

List of Tables

Table 1: Quantifiable impacts.....	1183
Table 2: Target groups or affected parties	1185
Table 3: Measure stakeholders.....	1186
Table 4: Identified risks	1186
Table 5: ESS usage by research area residents, 2018.....	1194
Table 6: Emission Factors (HBEFA, 2017)	1195
Table 7: Living Lab Emissions 2017	1195
Table 8: Emission Factors (HBEFA, 2020)	1198
Table 9: Living Lab Emissions 2020	1199
Table 10: Awareness of ESS service, 2019.....	1203
Table 11: Estimation of emission reduction by ESS in research area and the total Munich business area.....	1212
Table 12: Customary market costs for the operation of ESS vehicles	1213

Project	City		
ECCENTRIC	Munich		
Measure code	Measure name		
MUC 5.10	Sustainable mobility via E-scooter sharing		
Last update	Responsible	e-mail	telephone
30.11.2019	Alexandra Bensler	alexandra.bensler@gre encity.de	0049 89 890 668 638

Abstract

The measure MUC 5.10 “Sustainable mobility via E-scooter sharing” aims to broaden and optimize clean and space efficient mobility offers in the Living Lab. In 07/2018, a local electric scooter sharing⁴¹ (ESS) business area was expanded to include the Living Lab (Domagkpark and Parkstadt Schwabing), thus granting residents and employees in the research area (RA) access to ECC services. The ESS service provides free-floating motor scooter sharing that can be booked via app. An ESS scooter can carry one to two people.

This measure focuses on introducing, understanding and optimizing the E-scooter sharing (ESS) service emmy in the Living Lab. The scooters are integrated into measure MUC 5.9. Intermodal (E-)Mobility Stations as well.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measure’s implementation and the ex-post data, which focuses on the impact and development of MUC 5.10.

Evaluation results for MUC 7.3 were mainly retrieved from different evaluation activities: two household surveys which addressed the entire Living Lab at two different times (05/2018 and 10/2019), ESS usage datasets for 2018 and 2019 supplied by the ESS data and an additional customer online survey (09/2019).

The measure evaluation shows how the introduction of ESS in the Living Lab has reached its intended effects: Ever since ESS was introduced in Domagkpark and Parkstadt Schwabing, the number of households using the services has increased by 5,19 %. Most emission-free ESS mode shifts have taken place from public transportation, followed by trips formerly taken by foot or by bicycle. This requires further research beyond the project as to whether ESS has contributed to making space for new public transportation users and furthering sustainable modes of transportation in the long run. In 2018 and 2019, trips related to the research area amounted to 24.029 km. The number of car drivers shifting to ESS trips leads to an emission

⁴¹ NB: In this context, E-scooters refer to moped-like L1e vehicles, not to the smaller E-scooters shared by companies such as Lime and Tier.

reduction of 0,899 t of CO₂ in 2018/2019 as well as to reductions of 2,2, kg of NO_x and 0,3 kg of particle matters.

Once the in-depth study of ESS usage and motivations is finalized, the final step of the measure will be implemented.⁴² It will aim at developing approaches to counterbalance ESS sustainability challenges such as unwanted ESS substitution effects. These approaches will be disseminated to ensure a successful scaling and replication of ESS implementations throughout suburban spaces in the European Union.

⁴² Due to the lengthy amendment process, the MUC 5.10 project schedule was delayed compared to the other ECCENTRIC measures (cf. chapter B4).

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/longer term:

- Cleaner and better transport in cities
- To promote and implement sustainable, clean and (energy) efficient urban transport measures
- To overcome barriers for implementing innovative and ambitious measures and policies through experimental testing and targeted research

(2) Strategic level:

- Broadening the offer of clean and shared mobility options in eccentric spaces
- Understanding usage patterns and motivations of said mobility options in order to develop demand management strategies to ensure sustainable mobility effects

(3) Measure level:

Short term objectives

- Introducing an electric scooter sharing (ESS) service in the research area
- Implementing an in-depth study to understand the usage, motivations and sustainability effects of ESS
- Developing managing solutions to ensure ESS sustainability (e. g. strengthening favorable substitution effects, counterbalancing others)

Long term objectives

- Contributing to the establishment of ESS in European eccentric spaces via the visibility of the local ESS as a best practice case
- Contributing to the scaling and replication of ESS services by communicating the developed ESS solutions

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	Awareness of ESS in Domagkpark	X	X		X	X					
2	Satisfaction of ESS in Domagkpark	X	X		X	X					
3	Developing/planning counterbalancing solutions to ensure ESS sustainability	X	X		X			X			
4	Mode shift among those using ESS	X	X		X			X			
5	ESS being used for a relevant no. of km by Domagkpark and Parkstadt Schwabing residents	X	X			X		X			
6	ESS system usage by Domagkpark residents	X	X		X	X		X			

Table 1: Quantifiable impacts.

A.2 Measure description

This measure focuses on introducing, understanding and optimizing the E-scooter sharing (ESS) service emmy in the research area in order to broaden the local sustainable mobility options (measure MUC 5.10). In this context, sustainable mobility is defined as an emission and space efficient mode of transportation. The goal of the sustainable optimization lies in identifying approaches to counterbalance possible surplus trips by ESS and substitution effects that can cause additional emissions and an increased road utilization.

- **INTRODUCING ESS:** The measure introduces an ESS service in the research area, which was not part of the ESS business area before ECCENTRIC. As the foundation of the measure, the ESS business area has been expanded to include two of the mobility stations in the research area, thus allowing ESS trips to start and end there.⁴³ The ESS service aims at periodically placing three scooters on the premises of the mobility stations in Gertrud-Grunow-Straße and Marianne-Brandt-Straße for ESS to be accessible for local customers. Besides, scooters are placed there by customers ending trips within the research area. Introducing ESS in the research area was accompanied by putting up street signs that allow ESS parking on the mobility station premises. The measure was introduced on 07/10/2018 and is currently scheduled to continue indefinitely.
- **UNDERSTANDING ESS:** An in-depth accompanying study ensures the ESS effects are sustainable by examining usage patterns and sustainability effects. As a groundwork, the study focuses on general ESS usage patterns such as system usage hubs and trip purposes as well as usage motivations. Then, it examines mode shifts to understand the substitution effects caused by the measure, since they affect emissions and road utilization rates. Finally, the study shows how ESS usage influences the users' image of and attitude towards electric mobility. Since attitude impacts behaviour according to the Theory of Planned Behaviour (cf. Ajzen 1991), this effect caused by ESS can optimize (sub-)urban transportation in the long run if it leads to trips being taken with EV instead of with ICE vehicles.
In general, the study compares the research area to the usage patterns and sustainability effects of the entire Munich ESS area to allow a result generalization, scaling and replication. The ESS sustainability challenges identified in the study will then lead to an applied governance process to find counterbalancing solutions.
- **OPTIMIZING ESS:** Based on the study results on usage motivations and substitution effects, the measure aims at developing approaches to counterbalance unwanted substitution effects. Inspired by current governance research, a focus group with decision makers from the ESS service can be a means to find sustainably effective and economically acceptable solutions.

⁴³ The emmy ESS concept is free-floating sharing. However, within the research area, the two ECCENTRIC mobility stations in Gertrud-Grunow-Straße and Marianne-Brandt-Straße were chosen to be included into the emmy business area. Therefore, ESS in the research area can be considered a hybrid between a station-based and a free-floating carsharing. Its starting and/or ending point in the research area are station-based, while other starting points/destinations outside the research area are free-floating.

A.2.1 Measure outputs

The measure generates the following output:

- The ESS business area includes parts of the research area, namely the mobility stations in Gertrud-Grunow-Straße and Marianne-Brandt-Straße as of 07/10/2018. Until further notice, the measure is planned to continue indefinitely.
- By extending the business area, residents and employees within the research area have access to a free-floating ESS service. The ESS company employs Govecs electric scooters, which are designed to resemble the popular ‘Schwalbe’ scooters. The scooters are shared via an app.
- At the beginning of the measure, three scooters are to be placed on the premises of each of the mobility stations periodically. In accordance with the Living Lab concept, the ESS company adapts their placing policy to best correspond to local demand during the course of the measure.
- The measure will produce study results on ESS sustainability effects.
- The measure will produce conceptual approaches to counterbalance unwanted ESS sustainability effects.

A.2.2 Supporting activities

No supporting activities have been identified.

A.2.3 Interactions with other ECCENTRIC measures

The measure MUC 5.9 (‘Mobility Stations’) can increase the use of ESS by contributing to a higher awareness of the ESS offer. Since the ESS parking areas within the Living Lab are part of the (E-)Mobility stations, potential customers using those stations can increase awareness of the ESS while using other mobility offers. This can enhance the potential usage group of ESS and contribute to obtaining a higher response rate.

A.2.4 Interactions outside ECCENTRIC

No external measures or influences interacting with the measure have been identified.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
Residents/employees of research area	Potential users of the ESS within the research area.	Research Area	The research area in Domagkpark and Parkstadt Schwabing features access to ESS via the mobility stations in Gertrud-Grunow- and Marianne-Brandt-Straße.
emmy customers	Indirectly supply usage data via usage tracking; those having agreed to be contacted for market research purposes belong to the potential sample for the user survey.	Munich	The comparison group for the ESS development in the research area is the entire business area (and the entire customer group) throughout Munich. The ESS business area currently involves spaces in the city center
Decision makers	Municipal and business (ESS) decision makers interested in optimizing ESS sustainability.	Munich	Municipal and business (ESS) decision makers interested in optimizing ESS sustainability.

Table 2: Target groups or affected parties

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role – Links
1	Green City Experience GmbH	P	PR	L	Measure leader
2	Emmy	S	PR	P	ESS operator expanding its operating area to the research area; supplies ESS usage data; enables access to survey participants
3	City of Munich/KVR	P	C	O	Responsible for Mobility Stations, supported the expansion of the ESS operating area to the research area, put up signs for ESS parking
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
ESS service is stopped because of lacking cost efficiency.	Organizational	[External business risk, however, it has not occurred within the implementation and the demonstration phase.]	emmy
Vehicles have technical problems and service is interrupted for a long time span/stopped.	Technical	Dialogue with ESS company shows their high motivation to fix potential problems and keep the business running, which they did when there were technical problems in the winter of 2018/2019.	ML/emmy
App has technical problems and service is interrupted for a long time span/stopped.	Technical	Dialogue with ESS company shows their high motivation to fix potential problems and keep the business running.	ML/emmy
Company does not provide usage data.	Organizational	[Company provided usage data.]	ML
Company does not allow access to customers for customer survey.	Organizational	[Company provided access to customers for customer survey.]	ML
Survey response rate is low.	Involvement	[Survey response rate amounts to +500 participants.]	ML
Total number of survey respondents is low within the laboratory area, since area is relatively small.	Positional	Survey has been extended to include all Munich users to be able to compare results and assess them on a larger scale.	ML
Company does not allow the research results to be published.	Organizational	[Conditions for publication of research results have been agreed upon with the ESS company.]	ML

Table 4: Identified risks

B. Measure implementation

B.1 Situation before CIVITAS

Free-floating E-scooter sharing (ESS) services have been establishing themselves in European cities especially since 2017. By offering a unique electric and shared mobility innovation, they broaden the potential user group for EV beyond the target groups examined within ECCENTRIC (e. g. target groups for electric lightweight vehicles). This furthers the use of clean vehicles in suburban spaces. However, little is known about the usage patterns and the sustainability effects of such motorized ESS services within (sub)urban spaces. (NB: In this context, E-scooters refer to moped-like L1e vehicles, not to the smaller E-scooters shared by companies such as Lime and Tier). Before ESS was introduced into the research area as part of the ECCENTRIC measure, there was no ESS offer in either Domagkpark or Parkstadt Schwabing. Since the area was not part of the ESS business area, vehicles were allowed to drive through it during a trip. However, it was not possible to begin or end trips within the research area.

B.2 Innovative aspects

New spatial approach

- Free-floating sharing mobility offers tend to be situated in city centres where the density of probable starting points and targets is high and attracts many potential users. Positioning ESS in an eccentric space enables a Living Lab approach to optimize the mobility offer to ensure sustainable mobility effects.

New understandings of usage patterns, motivations and sustainability effects

- While a first study on ESS usage patterns based on a relatively small ESS dataset (cf. Phase 1, Milestone 1) has been carried out, an in-depth understanding of usage patterns on a larger usage scale is still to be achieved. Moreover, quantitative effects of mode substitution, surplus trips (literal ‘joyrides’) and the influence of ESS on the user attitude towards EV in general are yet to be understood.

New planning objectives

- Developing ESS mobility management approaches in cooperation with political and business decision is a promising tool contributing to sustainable mobility. So far, German municipalities have few options to manage the introduction of free-floating vehicles in order to optimize sustainability effects.

B.3 Research and Technology Development

ESS market developments and existing scientific approaches to sustainably introducing ESS in (sub-)urban spaces were researched in the first project phase (cf. Phase 1, Milestone 1).

No new technology developments were necessary to implement the measure.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning milestones (M 20-22)

Relevant milestones accomplished:

- 1) Literature survey on ESS in cities shows that E-scooter sharing has mostly been examined from following points of view: business development, user experience of E-scooters and

E-motorcycles (hardly in sharing service contexts), customer analysis and historical and techno-sociological development of E-scooter-sharing services. To the knowledge of GCX, three studies on E-scooter sharing have focused on the following aspects:

- (1) Usage patterns in the context of ESS sharing within a short-term, laboratory-like test within informal sharing groups in a large German city in 2016 (cf. Hardt und Bogenberger 2019)
- (2) Usage patterns in the context of ESS sharing within a commercial ESS sharing service in a large German city in 2017 (approx. 53.00 trips/year) (cf. Degele et al. 2018)
- (3) Key factors explaining ESS use, including socio-demographic aspects (like age and level of education) and trip-specific characteristics in Spanish cities in 2018 (cf. Aguilera-García et al. 2019)

➔ Research gaps:

- ➔ Knowing and understanding usage patterns within well-established ESS businesses (+ 150.000 trips/year)
 - ➔ Understanding the impact that ESS can have on mobility patterns in (ec-)centric areas
 - ➔ Understanding sustainability effects of ESS business (concerning substitution effects and emission reduction as well as effects on space-efficient mobility)
 - ➔ Finding solutions to counterbalance unwanted substitution effects and other challenges to sustainability
- 2) Agreement to expand ESS service to the research area and to place E-scooters in the Mobility Stations: result of negotiations with the City of Munich as the responsible stakeholder for the Mobility Stations and the ESS business

Phase 2: Procurement and implementation (M 23-36)

Relevant milestones accomplished:

- 1) Introduction of the ESS service within the ECCENTRIC research area by an expansion of the emmy operating area
- 2) Collection and analysis of the first batch of usage data (2018), the development of the user survey and the first evaluation measures.
 - Accomplished, the ESS usage dataset for 2018 contains 145.066 trips.
- 3) Analysis of the 2018 usage data.
 - Overview of results communicated to the City of Munich and the ESS business.

Phase 3: Demonstration and monitoring (M 37-48)

Relevant milestones accomplished:

- 1) data collection of the second usage survey (2019)
 - Accomplished in M37, the ESS usage dataset for 2019 contains 268.384 trips.
- 2) data collection of the user survey (2019)
 - Accomplished in M37, the ESS user dataset for 2019 contains 553 users.
- 3) data analysis of the second usage survey (2019)
 - Accomplished in M42

- In the end of February 2020 it was decided to include the measure “emmy” into work package number 5 as MUC 5.10.

4) development of counterbalancing measures (2020)

- The developing/planning of counterbalancing measures (cf. MUC 5.10 – KPI 4) is crucial for scaling, replication and recommendations. Thus, corresponding with the ECCENTRIC time schedule, the KPI 4 was not achieved by the end of 12/2019. The developing/planning of counterbalancing measures could not be accelerated since it is based on the results of the data analysis, which are currently being produced.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Awareness	Satisfaction	Contribution to policies, plans, and programs	Mode Shift	Vehicle km travelled
Type	KPI	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	SOCIETY-PEOPLE	SOCIETY- GOVERNANCE	TRANSPORT SYSTEM	TRANSPORT SYSTEM
Subcategory	Acceptance	Acceptance	Planning	General	General
Aspect	Awareness level	Satisfaction	Planning Process	Modal Split	Total travel
Definition	Awareness: Percentage of those aware of the ESS offer in the laboratory area	Satisfaction: Percentage of usage frequency change between 2018 and 2019	Impact measurement of the leads developed with decision makers to ensure ESS sustainability on a municipal level	Percentage of survey participants (Munich and esp. Domagkpark residents/employees) using ESS instead of	Sum of all kilometers travelled by the target group
Unit	Percentage of those aware of the ESS offer in the laboratory area	Satisfaction: Score (0-5) based on the percentage of usage frequency	Score (0-5)	Percentage	km
Method of data collection	Awareness: household survey by ECCENTRIC project partners	Satisfaction: Usage data (supplied by ESS company)	Survey with decision makers (municipalities, businesses) after having developed leads to ensure ESS sustainability with	survey data (collected by GCX)	Usage data (supplied by ESS company)
Target group	Living Lab residents, employees and visitors	Living Lab residents, employees and visitors	Decision makers	Living Lab residents, employees and visitors	Living Lab residents, employees and visitors

Impact	6	7	8	INPUT	INPUT
Indicator	System usage	CO2 emissions	NOx emissions	PM emissions	Investment Costs
Category	KPI	KPI	KPI	KPI	KPI
Category	TRANSPORT SYSTEM	ENVIRONMENT	ENVIRONMENT	ENVIRONMENT	ECONOMY
Subcategory	General	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Costs
Aspect	Transport System Utilization	Emissions	Emissions	Emissions	Investment costs
Definition	Average usage time per trip, special focus on beginning time of system usage per weekday/time (to determine temporal	Sum of emissions reduced by emmy	Sum of emissions reduced by emmy	Sum of emissions reduced by emmy	Total capital costs for politically preparing the introduction of emmy in the laboratory area and developing the survey
Unit	Frequency (users/unit of time)	t [CO2]/year	t [NOx]/year	t [PM]/year	Euro
Method of data collection	Usage data (supplied by ESS company)	average emission factors from literature research and usage data	average emission factors from literature research and usage data	average emission factors from literature research and usage data	Data from financial reports, controlling
Target group	Living Lab residents, employees and visitors				

Impact	INPUT
Indicator	Operating Costs
Category	KPI
Category	ECONOMY
Subcategory	Costs
Aspect	Operating Costs
Definition	Personnel and maintenance costs for running the measure.
Unit	Euro / (time or usage unit)
Method of data collection	Data from financial reports, controlling
Target group	

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	%	I (1)	S	Households in research area	Participants
2	Satisfaction	Score (0-5)	I (1), A	DC	Total of ESS users	Participants
3	Contribution to policies, plans and programs	Score (0-5)	A	S	Decision makers	Participants
4	Mode Shift	%	I	S	ESS survey respondents	Participants
5	Vehicle km travelled	Km	I (1), A	DC	Total of ESS users	Participants
6	System usage	%	I (1), A	DC	Total of ESS users	Participants
7	CO2 emissions	t CO2/year [total]	I	DC + E	ESS survey respondents	Participants
8	NOx emissions	t NOx/year [total]	I	DC + E	ESS survey respondents	Participants
9	PM emissions	t PM/year [total]	I	DC + E	ESS survey respondents	Participants
	Investment costs	Euro	A	DC	ML	ML
	Operational costs	Euro	A	DC	ML	ML
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

C.1.2 Baseline

The baseline description is based on two main sources: the 2018 ESS usage dataset and the ECCENTRIC household survey from 05/2018, which was carried out before the measure implementation. The household survey took place from 04/2018-05/2018. The participation rate was 27%, which means that 935 people from 572 households answered the online survey or participated via telephone. The survey answered most of the KPIs while other KPIs are estimated by interviews with the Measure Leader.

Addressing indicator “1 – Awareness”

Since the ESS service was not available in the research area before the measure, the awareness for the neighborhood specific ESS is logically nil. **Awareness** for the ESS service throughout all of Munich by RA residents and employees was not measured before the measure was introduced.

Addressing indicator “3 – Planning Process”

German municipalities currently have little influence on the precise development of ESS in their cities. Since parking electric (LV1) scooters on the sidewalk legally is not permitted unless a designated sign allows it (cf. Weidner 2017), cities can support ESS by creating parking spaces for electric scooters or including them in mobility hubs such as in the Munich mobility stations. However, these management tools cannot be used to impact demand and usage, for instance to limit unwanted substitution effects. Thus, the **planning** and management scope referring to municipal decision makers could be considered a 2/5 (Scope 0-5). Including the actual ESS businesses into the planning process in order to identify solutions together can be a key to tackle this challenge.

Addressing indicator “4 – Mode Shift”

The **modal split** (trip-based) of this group is visualized in [Figure](#), based on the answers of 572 households who reported about 2.419 trips in April/May 2018 as part of the ECCENTRIC household survey (05/2018). About one third of all Living Lab inhabitants is walking and 21,4% cycling. 19,4% are using their own car and slightly less, 17,8%, are using PT. Only two percent are using sharing options like bikesharing or carsharing.

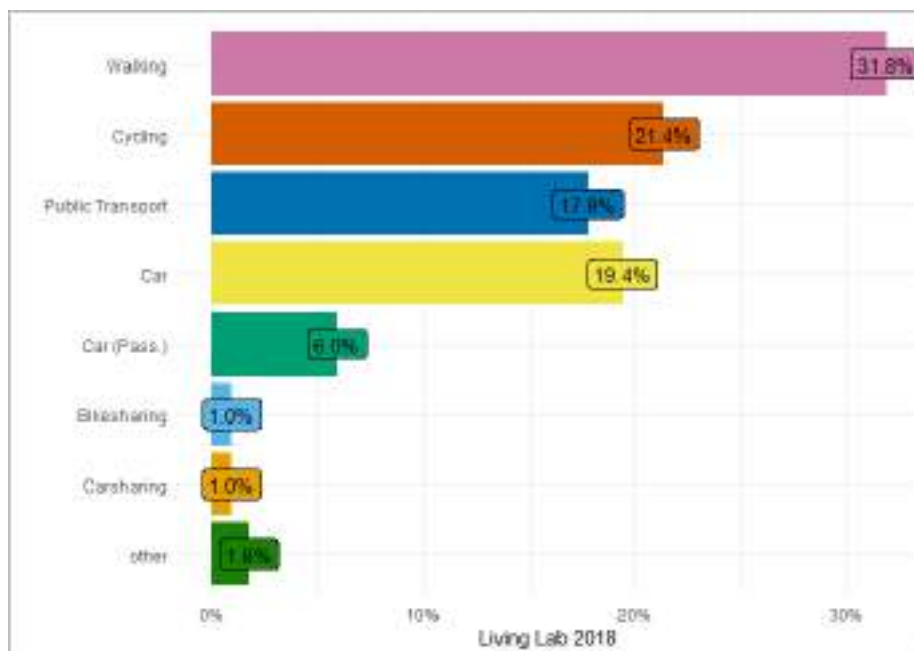


Figure 1: Modal Split of Living Lab residents, 2018 (cf. ECCENTRIC household survey 2018)

Addressing indicator “5 – Vehicle km travelled”

Assuming that it would be beneficial both in terms of emissions and space to replace trips taken by private (ICE) cars by ESS trips, the baseline household survey of 05/2018 covers the vehicle km travelled by car within the research area: On average, households within the research area travelled 9.810 km by car in 2018. The substitution potential for car trips can be determined in a more precise way by considering factors such as the position of trip targets (inside or outside the ESS business area), trip numbers differentiated by (winter) months and trip mobility purposes (e. g. shopping) in the calculation. The attitude of 41% of the households within the research area want to reduce car usage can be helpful to reducing the number of vehicle km travelled by car. Information concerning the vehicle km travelled by public transport was not collected before the beginning of the measure.

The actual vehicle km travelled by ESS that started and ended in the research area logically cannot be included in the baseline as the offer did not exist before the measure began.

Addressing indicator “6 – System usage”

ESS usage was extraordinarily low before the beginning of the measure: Only 0,32% of the respondent households were using ESS service during the data collection period for the 1st ECCENTRIC household survey of 2018 (May of 2018).

	Frequency	Percent
< once/ month	932	99,68%
1-3 times/ month	2	0,21%
≥ once a week	1	0,11%

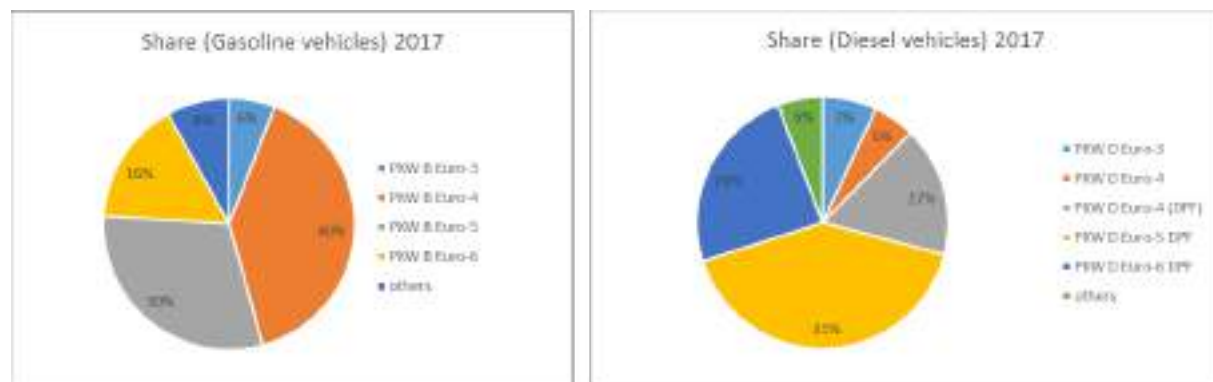
Total	935	100,00%

Table 5: ESS usage by research area residents, 2018*Addressing indicators “7-9 – CO₂; NO_x and PM emissions”*

Emissions are calculated based on emission factors from the standard database "HBEFA" (*Handbook Emission Factors for Road Transport*) and information about both VKT and the vehicles in the Living Lab. See [Table](#) for the used factors, based on the German fleet average.

The number of hybrid/electric cars is too low to be considered as a separate category.

In 2017 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

**Figure 2:** Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2017)

The highest share among Gasoline vehicles consists of Euro 4 (40%) and Euro 5 (30%), followed by Euro 6 (16%). Regarding the Diesel vehicle share, there are 41% Euro 5 and 24% Euro 6. Euro 4 has a smaller share of 17%.

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	127,837 g/km
NO _x	Gasoline	0,060 g/km
PM	Gasoline	0,00102 g/km
CO ₂	Diesel	118,911 g/km
NO _x	Diesel	0,589 g/km
PM	Diesel	0,00675 g/km

Table 6: Emission Factors (HBEFA, 2017)

The following calculations are based on the HBEFA factors of 2017 and the annual VKT kilometres, differentiated by car type (first or second car) and fuel type (gasoline or diesel). The amount of kilometres is then multiplied with the HBEFA factors and number of cars mentioned in the household survey (conducted in 05/2018).

Thus, the total annual emissions (based on VKT) for all 3.100 households in Domagkpark and Parkstadt Schwabing sum up to the following totals:

Pollutant	Emissions Living Lab (2017)
CO ₂	3.864 t
NO _x	10,22 t
PM	122,252 kg

Table 7: Living Lab Emissions 2017

The emission baseline for motor scooters which are the fourth most strongly shifted mode of transportation caused by the ESS service cannot be calculated due to the lack of data (e. g. the distance driven by private motor scooters in the research area).

Data on the KPI **satisfaction** and **investment and operational cost** were obtained for the ex-post evaluation when the implementation phase was completed.

C.1.3 The business-as-usual scenario

Addressing indicators “1-2 – Awareness level and Satisfaction”

According to a study by UnuMotors, the scooter market has been rapidly growing in 2019. Globally, ESS scooter numbers increased by 164% to 66.000 ESS scooters, while the number of registered customers rose by 166% to 4,8 mill. customers (cf. Unu Motors 2019: 5). In 2019, 17 Germany cities had ESS services. In Munich itself, the number of ESS vehicles to approx. 400 in 2019 (compared to 50 scooters in 2017, Werwitzke 2018). Within two years of entering the market, the local ESS in Munich service has gained 35.000 customers. Since ESS has become more widespread and thus more visible globally as well as locally, awareness would increase in a BaU-scenario, even though the service were not available in the research area.

The strong growth of both global and local users indirectly indicates a strong satisfaction with the service. Based on an analysis of app ratings, global satisfaction levels with ESS providers are highest towards established ESS businesses (cf. Unu Motors 2019: 30). This can therefore apply to the Munich ESS service in the BaU-scenario. However, if ESS had not been introduced in the research area, it would have likely been less used within the area than it currently is, since its availability would have been lower.

Addressing indicator “3 – Planning Process”

Planning processes and leads to optimize ESS sustainability have yet to be developed. Thus, this KPI does not impact the BaU-scenario.

Addressing indicators “4-6 – Mode Shift, Vehicle km travelled and system usage”

Mode Shift & VKT

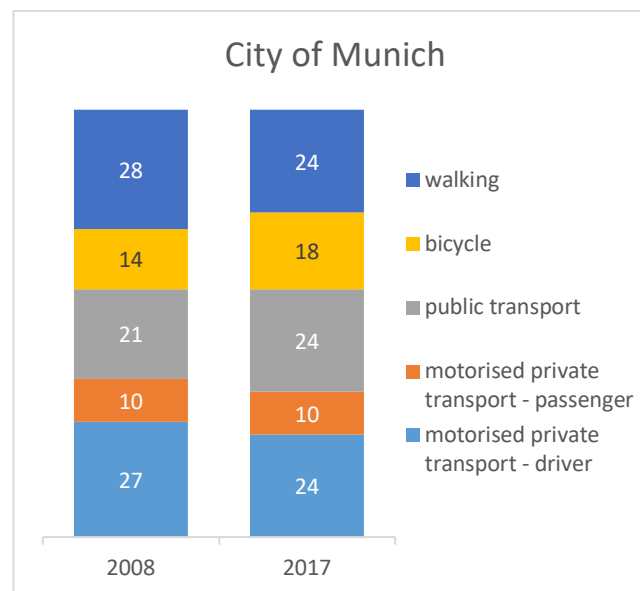


Image: City of Munich, Data: infas edited (2018)

Figure 3: Modal Split in Munich (2008+2017)

The nationwide mobility survey "Mobilität in Deutschland" acts as a reference to determine trends and future mobility behaviour in Munich.

In general, the Munich population drives less and walks less, while PT and cycling increase over time (see [Figure](#): change 2008-2017: car -3%, PT +3%, cycling +4%, walking -4%).

Extrapolating this trend from 2008 to 2020, we can assume the following mode shifts in the BaU Scenario for 2020:

Car: -1%; PT: +1%; Bike: +1%; Walking: -1%

These changes were reflected in VKT as well, so that we expected VKT to decrease by 1% as well, being cautious because nationwide, the km per vehicle were slightly decreasing (2017: - 0,7%, Kraftfahrtbundesamt (2018) and the emissions are as well decreasing regarding the data of HBEFA 2020 scenario.

Note: A recent study by the Center Automotive Research (CAR) of the University of Duisburg-Essen published in 12/2019 that the number of cars is constantly increasing within the last ten years with regard to Germany's larger cities. Comparing the number of cars from 2009 until 2019, there is an increase of 18,5% in car ownership measured in Munich (cf. CAR, 2019). This resembles a different trend then expected above in the BaU scenario assumptions of 2018.

Seeing the strong expansion of the local ESS provider by vehicle numbers as well as by expansion of its business area, it is likely that mode shifts would have occurred from different modes of transportation to ESS in the BaU-scenario. However, it is likely that ESS usage (and mode shift) in the research area would have been lower if the measure had not taken place (cf. BaU-scenario, KPI 2).

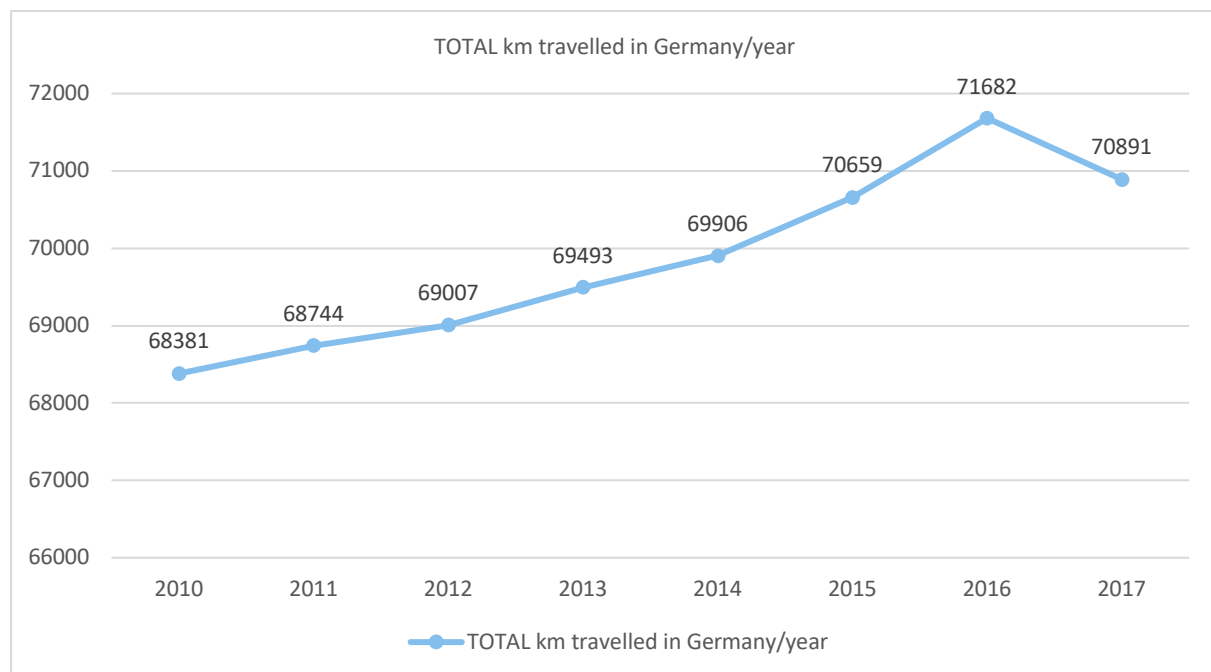


Figure 4: Total km travelled in Germany/year (2010-2017), (Radke 2018: 217)

Except for the year 2017 (which includes preliminary values), the total number of km travelled for passenger transportation throughout Germany has increased since 2010 (cf. Figure). Therefore, it is likely that the total of km travelled by ESS would increase not only because of mode shifts, but because of increased mobility in general. However, if the BaU were to be developed beyond 2020, it would have to take into account the possible trend shift of 2017 once complete data for the year(s) 2017 (onward) are available.

Addressing indicators “7-9 – CO₂; NO_x and PM emissions”

In order to estimate BaU-emissions, we use the HBEFA projected emission factors for 2020 as well as the by 1% increased VKT that we assume in the section " Mode Shift & VKT".

Thus, the following factors are used:

Pollutant	Fuel Type	Emissions per VKT
CO ₂	Gasoline	117,785 g/km
NO _x	Gasoline	0,049 g/km
PM	Gasoline	0,00108 g/km
CO ₂	Diesel	110,410 g/km
NO _x	Diesel	0,484 g/km
PM	Diesel	0,0045 g/km

Table 8: Emission Factors (HBEFA, 2020)

In 2020 HBEFA assumes the following shares of emission concepts, differentiated between Gasoline and Diesel:

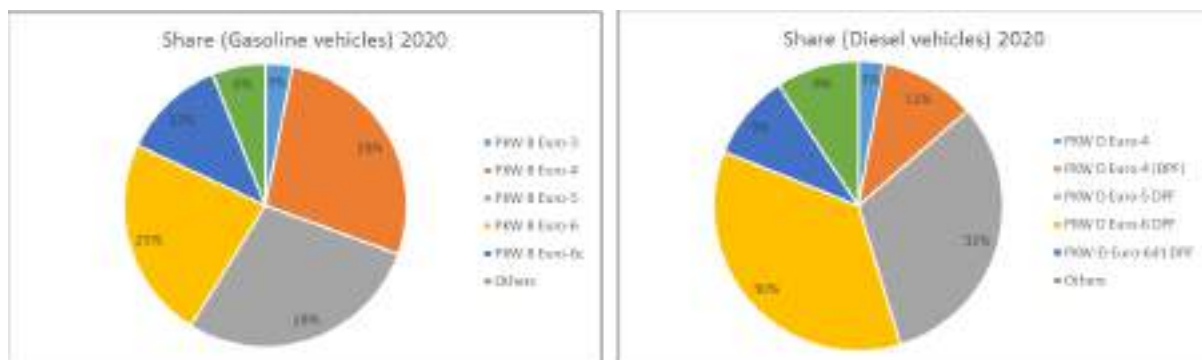


Figure 5: Shares of emission concepts in Germany, Gasoline and Diesel (HBEFA, 2020)

Regarding the Gasoline Euro classes in 2020, there are about two-thirds of all Gasoline vehicles to be found with Euro 4 (28%), Euro 5 (28%) or Euro 6 (23%). The share of Diesel vehicles is similar but compared to HBEFA 2017 assumptions, Euro 6 has the biggest share in 2020 (36%, 24% in 2017).

Note: These emission factors assume technological progress and a renewal of the average fleet in Germany until 2020. In the light of "Dieselgate" and great uncertainties in the accuracy of emission information by the car manufacturers, the HBEFA assumptions have to be verified. New HBEFA assumptions are to be published in the end of 2019 (after MER-2).

This results in the following emissions for 2020 (the calculation is analogue to the one in C.1.2):

Pollutant	Emissions Living Lab (2020)	% change to 2017
CO₂	3.610 t	-7%
NO_x	8,49 t	-17%
PM	88,76 kg	-27%

Table 9: Living Lab Emissions 2020

C.2 Measure results

The following table shows the measure results of MUC 5.10. Some indicators of the 'before' and the 'business as usual scenario' are not assessed based on a precise quantitative calculation when the necessary data is not available. In this case, comparable data from other studies is used to contextualize the measure results in an optimal way.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	%	Not quantifiably, NA	-	NA	-	92% in DP, 76% in PS	10/19	NA	NA
Acceptance	%	Not quantifiably, NA	05/18	NA	-	5,51% in DP+PS; 4% in DP, 4% in PS	10/19	5,19%	NA
Satisfaction	Score (0-5)	NA	-	NA	-	4	09/19	NA	NA
Contribution to policies, plans and programs	Score (0-5)	2	07/19	NA	-	NA	03/20	NA	NA
Mode Shift	%	<i>Modal Split (trip based, 2018)</i> Walking 31,8% Cycling 21,4% PT 17,8% Car 19,4% Car (Pass.) 6% Bikesharing 1% Carsharing 1% other 1,8%	-	NA	-	In DP+PS, values correspond to A. < 1x/ m. B. 1-3x/ m. C. ≥ 1x/w. <i>Car</i> A. 64,3% B. 28,6% C. 7,1% <i>Motorcycle</i> A. 95,24% B. 0,0% C. 4,76% <i>Motor scooter</i> A. 72,7% B. 4,5% C. 22,7% <i>Public transport</i> A. 33,3% B. 36,7% C. 30,0%	09/19	NA	NA

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Vehicle km travelled	Km	<i>VKT in RA by other modes of transportation</i> 9.810 km/ household by car <i>VKT travelled by ESS by trips starting/ending in the RA</i> 0 km	05/18	NA	-	2018/19 DP+PS: 24.029 km; Munich total: 1.815.349 km	09/19	NA	-
System usage	%	<i>System usage throughout Munich by households in RA (DP+PS):</i> 0,32% of RA households <i>ESS system usage for trips starting/ending in RA</i>	05/18	NA	-	<i>Share of households using ESS in RA</i> 5,51% in DP+PS; 4% in DP, 4% in PS <i>Strongest usage month July (2018+19):</i> DP/PS: 21,8% trips/year <i>Munich total:</i> 20,7% trips/year	09/19	<i>from 2018 to 2019</i> 5,19% of RA households	NA
CO2 emissions	t CO2/year [total]	3.864	2017	3.610	2019	2018+2019 DP+PS: 0,899 Munich total: 33,051	10/19	2018+2019 DP+PS: 0,899	NA
NOx emissions	t NOx/year [total]	10,22	2017	8,49	2019	2018+2019 DP+PS: 0,0022 Munich total: 0,0808	10/19	2018+2019 DP+PS: 0,0022	NA
PM emissions	kg PM/year [total]	122,3	2017	55,5	2019	2018+2019 DP+PS: 0,00003 Munich total: 0,00095	10/19	2018+2019 DP+PS: 0,00003	NA
Investment costs	Euro	costs related to people and their time: technicians or engineers 0 € maintenance personnel 0 € trainers 0 € program and web developers 100 € repair and maintenance cost 0 € drivers 0 € other 16.500 €							
Operational costs	Euro	measures related to transport (€/26 months, equals phases (2) implementation and (3) demonstration phase personnel costs 109.400 € fuel 0 €							

		electricity	0 €
		maintenance for vehicles	0 €
		other	2.760 €

The measure results are evaluated ex-post based on three main data sources:

- The 2nd ECCENTRIC household survey was implemented in 10/2019 via an online questionnaire that was distributed to all households in the research area. 16% of the households (n = 328) participated in the survey.
- The ESS usage datasets for 2018 and 2019 were supplied by the ESS company and consist of automatically tracked data. They comprise all trips and certain characteristics such as trip length, driven distance etc. taken by ESS customers in 2018 and 2019 (January to September). The usage datasets can be focused on the trips starting/ending in the research area.
- The ESS customer survey was implemented in September 2019. It was launched via the customer newsletter and led to n = 480 complete questionnaires, 33 of which were answered by customers that had at least once started or ended a trip in the research area. Among others, the survey comprised questions on customer mobility behavior, ESS usage patterns and motivations.

Addressing indicator “1 – Awareness”

The survey results show that the introduction of the ESS (electric scooter sharing) in the research area was accompanied by rising **awareness** for the ESS offer within the neighborhood. The ECCENTRIC household survey of 2018 did not include the ESS yet as it had not been introduced. The ECCENTRIC household survey of 2019 shows that awareness for the ESS exists in the context of the two mobility stations where the E-scooters can be found (see [Table](#)).

EMMY	Gertrud-Grunow-Straße		Marianne-Brandt-Straße	
	no.	Share/ column (%)	no.	Share/ column (%)
Unknown	13	7%	21	24%
Known, but not used	157	88%	64	72%
Used	8	4%	4	4%
TOTAL	178	100%	89	100%

Table 10: Awareness of ESS service, 2019

In both neighborhoods of the research area, the ESS service is known by most of the survey respondents: 92% of the households know and/or use the service in Domagkpark, while 76% are aware of it and/or use it in the Parkstadt Schwabing. Besides, 85% of the households claimed they were aware of and/or used the ESS within the third mobility station in the research area (Fritz-Winter-Str.). However, ESS vehicles are not positioned there since this third mobility station does not belong to the ESS business area. This implies that the great majority of the respondents are generally aware of the ESS offer within the research area but may lack precise information concerning the whereabouts of the vehicles as well as the exact usage procedure.

Addressing indicator “2 – Satisfaction”

Based on the RA customer survey (2019), respondents related to the research area (n = 35) are very satisfied with the ESS service (see [Figure](#)).

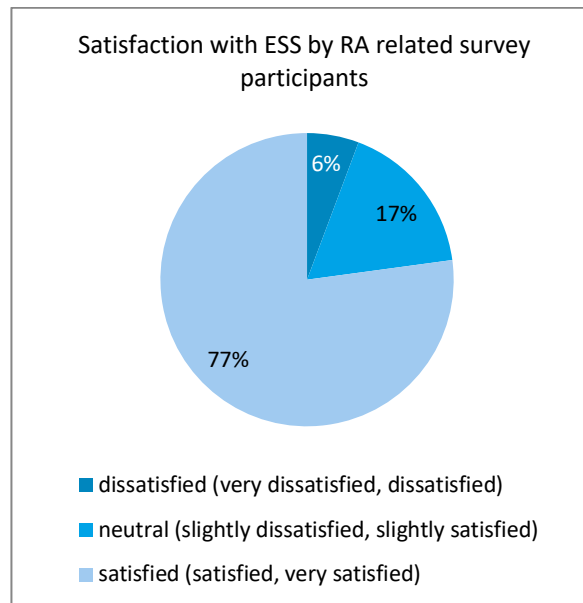


Figure 6: Satisfaction with the ESS by RA related customers

On a score from 0-5, satisfaction rates amount to 4 both in the research area (3,97/5) and in Munich in general (3,92/5).

Addressing indicator “3 – Planning Process”

As explained in chapter B.4, the developing/**planning** of counterbalancing measures is crucial for scaling, replication and recommendations. Thus, corresponding to ECCENTRIC schedule, GCX did not achieve the KPI 3 by the end of 12/2019. The developing of counterbalancing measures could not be accelerated since it was based on the results of the data analysis, which were still produced. Therefore, the KPI 3 could not be evaluated within this measure evaluation report.

Addressing indicator “4 – Mode Shift”

The indicator **Mode Shift** (by substitution frequency)⁴⁴ were addressed by first focusing on the survey respondents that claimed to have started or ended at least one ESS ride within the research area and who answered the mode shift question (abbrev. RA survey respondents; n = 21 to n = 33). Then, the results were compared to the Mode Shift throughout all of Munich (n = 480).

⁴⁴ The indicator refers to relatively steady mode shifts. Its data was collected by the question “How often do you use emmy for trips that you formally took with other means of transportation?”. The following mode options were listed: private car, motorcycle, motor scooter (‘Motorroller’ in German), public transportation, bicycle, pedal scooter, by foot, car sharing, bike sharing and other means of transportation.

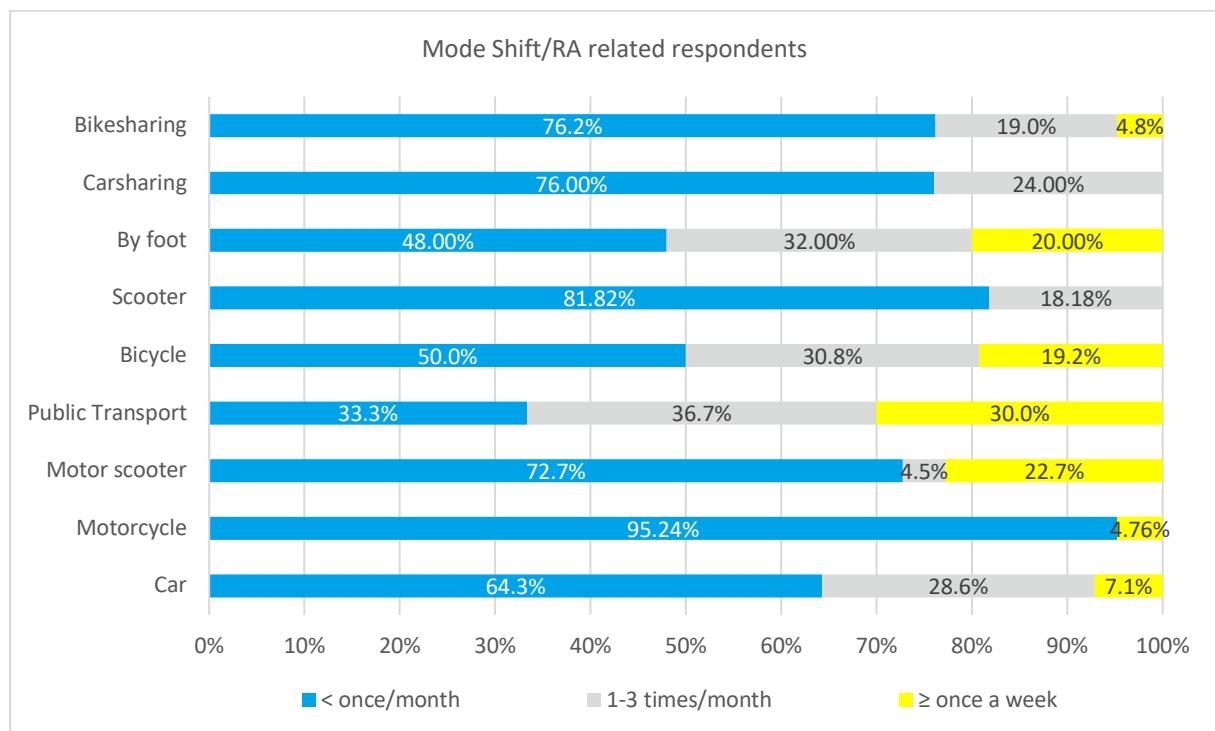


Figure 7: Mode Shift/RA related respondents, 2019

The sum of the mode shifts/mode by RA survey respondents⁴⁵ (cf. GCX user survey 2019) show that most shifts ($\geq$ once a month) come from public transportation followed by trips formerly taken by foot, by bicycle and by car. It becomes clear that actual mode shift does not correspond to the normative goal to mostly replace trips (or km travelled) formerly taken by private car (cf. Baseline, KPI 6). However, ESS replacing public transport trips can contribute to lowering the load factor of the latter in an emission-free way. At the same time, this mode shift makes space for more public transport users. This can indirectly strengthen sustainable mobility, if the 'new' public transport users shifted from trips formerly taken by ICE vehicles. The relevance and extent of this effect require further research beyond the project.

Focusing on regular shifts (1-3 times/month) by RA survey respondents (cf. GCX user survey 2019), most mode shifts take place from public transportation (36,7%), trips by foot (32,0%) and by bicycle (30,85). Concerning frequent trips ($\geq$ once a week) by RA survey respondents, the largest shift (30,0%) concerned ESS trips replacing public transport. It is followed by shifts from motor scooter (22,7%) and by foot (20,0%).

⁴⁵ In the following KPI about mode shifts in the research area, the term 'RA survey respondents' will refer to those respondents who claimed to have started or ended at least one ESS ride within the research area *and* who answered the different mode shift questions. The focus of the survey was designed this way since the RA is not only a residential area but a workplace (and a place to do business and to visit) to many. Therefore, from the point of view of urban development, it is important to see how ESS has connected the research area to other neighborhoods, which is also one of the main interests of Civitas ECCENTRIC. That is why the mode shift does not refer to the RA population, but to those accessing the neighborhood. Moreover, since only three participants of the GCX ESS survey claimed to be RA residents, the RA population data set would have been too small to analyze.

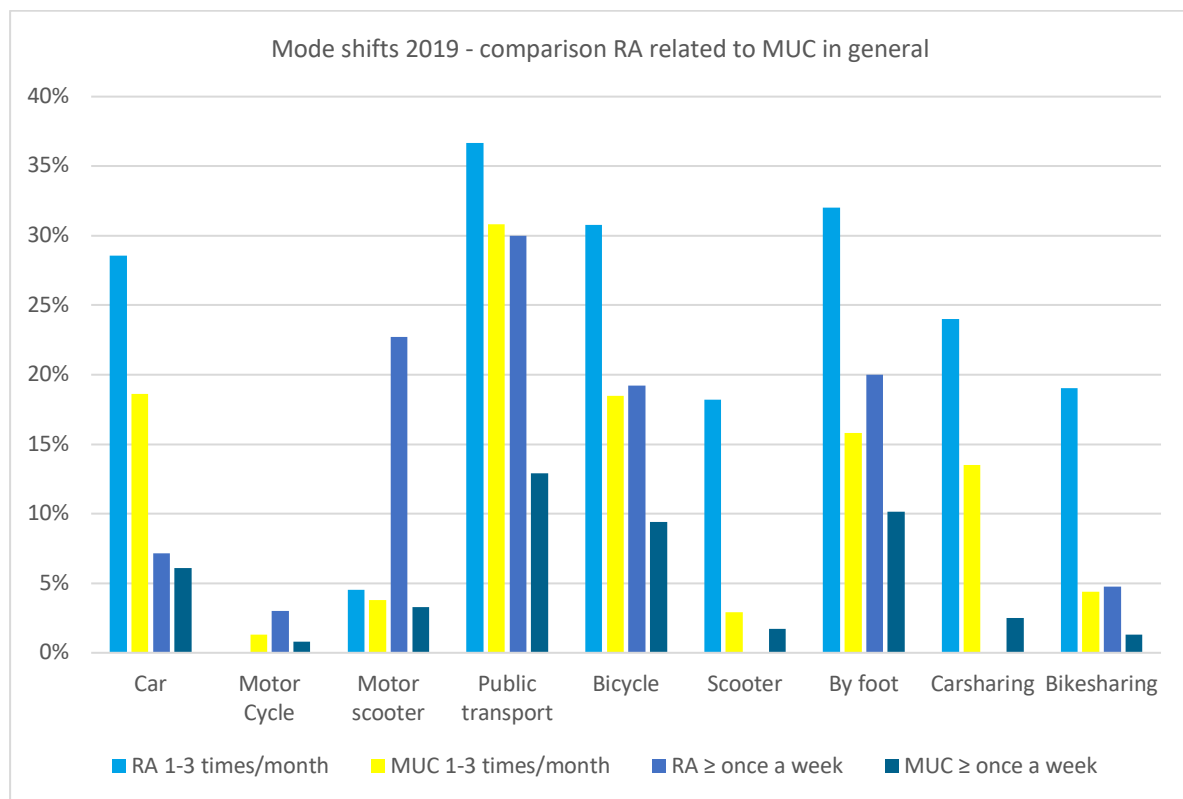


Figure 8: Mode shifts 2019 - Comparison of mode shifts of RA related respondents to those in Munich in general

Comparing the mode shifts between RA related respondents and those in all of Munich and specifically focusing on mode shifts taking place at least once a month, it becomes clear that mode shift rates tend to be higher for RA survey participants than for Munich survey participants in general: Except for mode shifts from motorcycle (1-3 times/month), motor scooters ($\geq$ once a week), kick-scooters ($\geq$ once a week) and carsharing ($\geq$ once a week) to ESS, regular mode shifts ($\geq$ once a month) are more frequent among RA related respondents than throughout all Munich respondents. Among others, this is because survey participants in Munich in total have a higher ratio of seldom mode shifts ($<$ once/month) for all means of transportation than within the research area.

The results of the mode shift KPI cannot be related to the base line since the latter refers to survey participants related to the RA (cf. footnote 45), while the modal split baseline refers to the RA population.

When looking at the mode shift by trips in the RA (cf. Figure), it becomes clear that most ESS trips are shifted from public transportation (28,98%, 610 trips), followed by trips formerly taken by foot (22,72%, 478 trips), by bicycle (19,53%, 411 trips) and by motor scooter (13,49%, 284 trips). ESS substituting car trips is the fifth most relevant mode shift category.⁴⁶

⁴⁶ The mode shift was calculated by setting off the total number of trips (March-September 2019) related to the RA (minus a ratio created by surplus trips) and the mode shift ratio for the means of transportation listed in Figure 1. The mode shifts can be considered relatively stable (cf. data collection mode in footnote *4). For the calculation of the mode shift ratio, it was assumed that trips less than once a month equaled 0 trips/month, whereas 1-3 trips/month equaled 2 trips/month, 1-3 trips/week equaled 2 trips/week and (almost) daily trips equaled 5 trips/week.

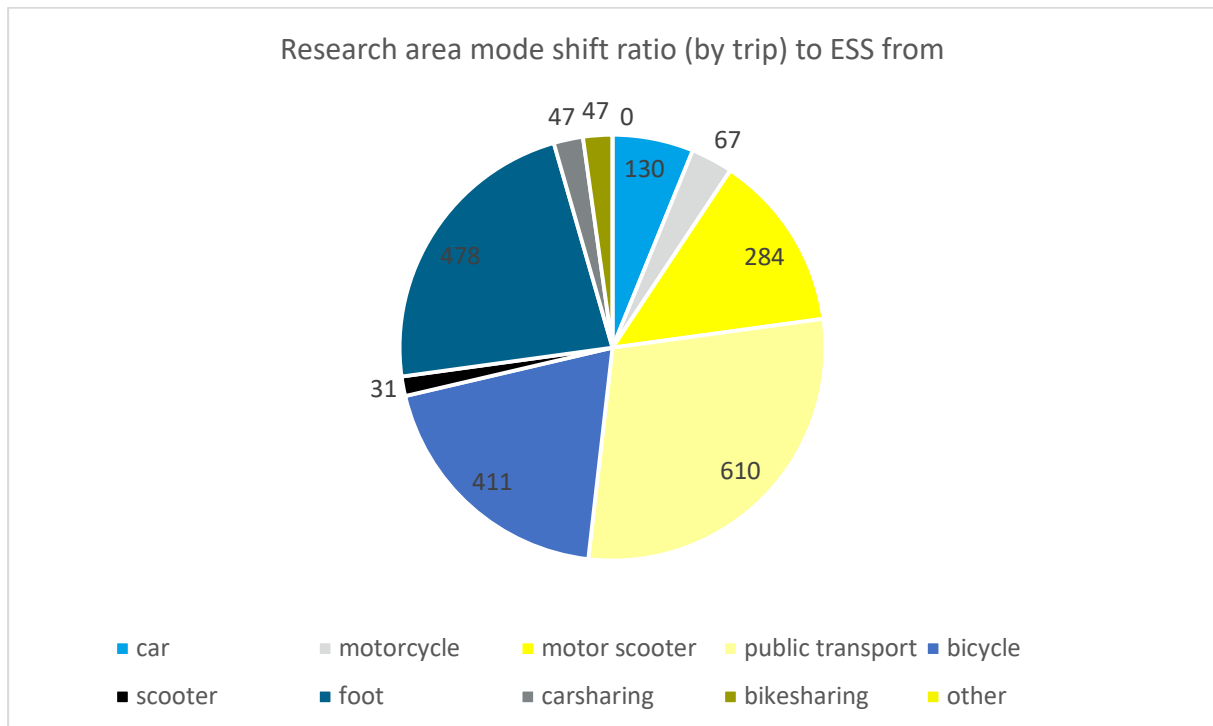


Figure 9: Mode Shift related to the RA (by trip), 2019

Compared to the Munich-wide mode shift (cf. [Figure 10](#)), substituting motor scooters is exceptionally important. In Munich as a whole, the most important substituted mode is public transportation as well (28,69%, 74.291 trips), followed by trips by bicycle (20,13%, 52.141 trips), by foot (18,39%, 47.626 trips) and by car (13,56%, 35.110 trips).

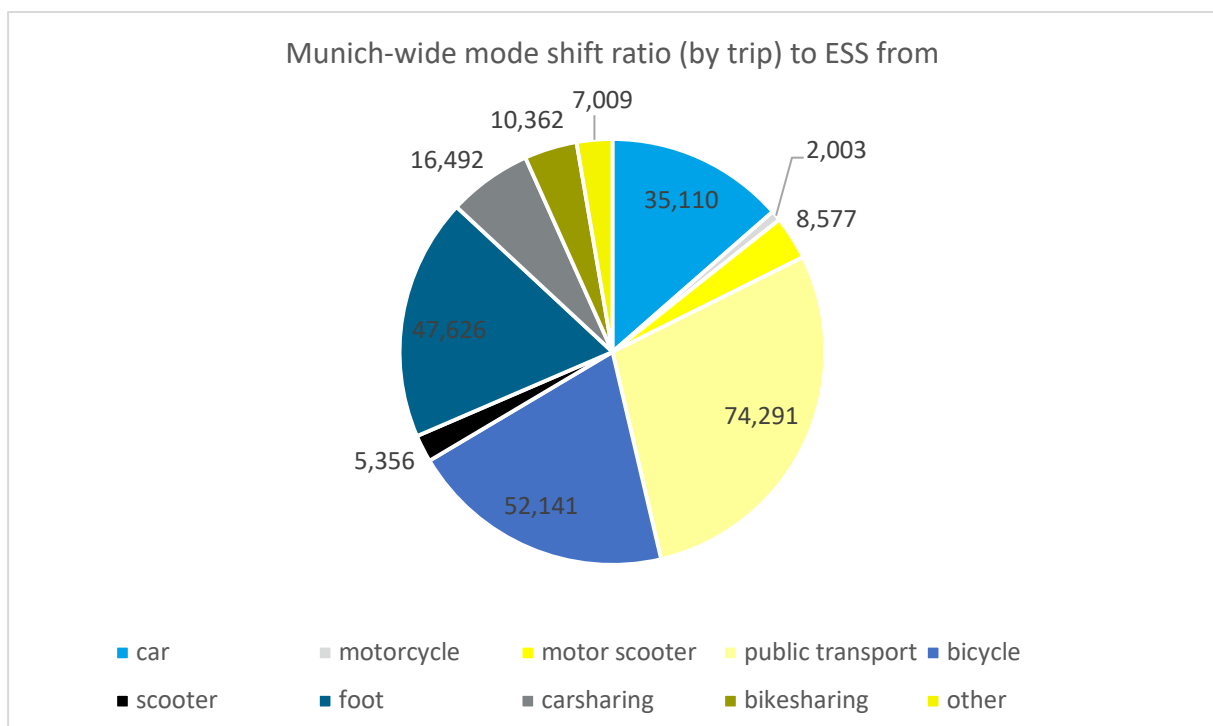


Figure 10: Mode Shift related to Munich (by trip), 2019

Addressing indicator “5 – Vehicle km travelled”

In 2018 and 2019, the distances driven related to the research area⁴⁷ totaled 24.029 km, while the sum of all trips taken outside the ECCENTRIC research area amounted to 1.791.320 km. Thus, the distances driven related to the research area account for 1,32% of the km travelled by the ESS fleet throughout all of Munich (cf. [Figure](#)).

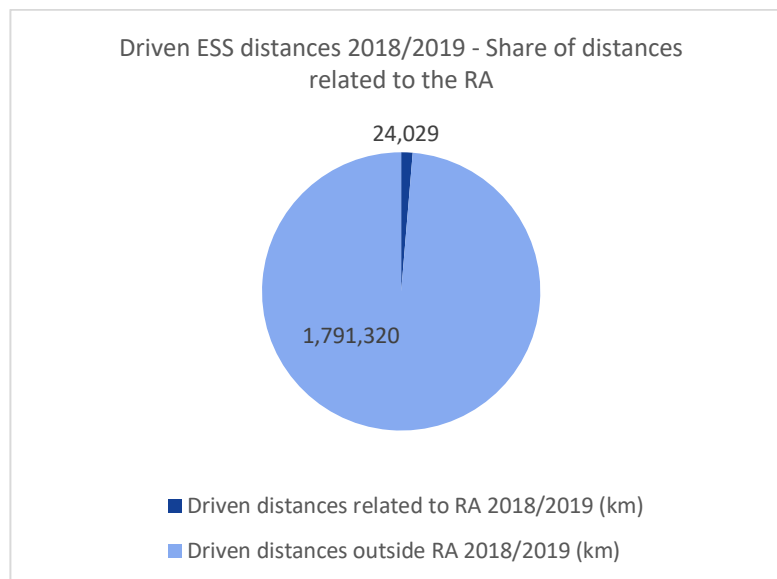


Figure 11: Share of distances driven related to the research area, 2018/2019

Addressing indicator “6 – System usage”

The usage of the ESS within the research area has increased since the beginning of the measure: The ECCENTRIC household survey of 10/2019 shows that since the beginning of the measure, 4% of the households have used the ESS offer starting and/or ending their trips from the research area at the mobility station in Domagkpark, the same percentage applies to those using ESS in Parkstadt Schwabing (cf. [Table](#)). A total of 5,51% used the ESS in the year 2019 (cf. ECCENTRIC household survey 2019).⁴⁸ The average number of trips related to the research area per months, in which the service has been functioning (status: 09/2019), amounted to 231 in 2018 and to 307 in 2019, and thus also rose.

System usage varies depending on the usage month, week day and hour.

⁴⁷ Distances driven related to the research area include the trips that started and/or ended there. Since the research area is not only a residential area but a workplace (and a place to do business and to visit) to many, it makes sense to not only look at the residential population from an urban development point of view. It is important to see how ESS has connected the research area to other neighborhoods, which is one of the main research interests of ECC. Therefore, the VKT refer to the lengths of all trips that started and/or ended in the research area.

⁴⁸ Because of relatively high number of respondents (n = 178) to the question, it is not necessary to compare the research area figures with those of Munich as a whole.

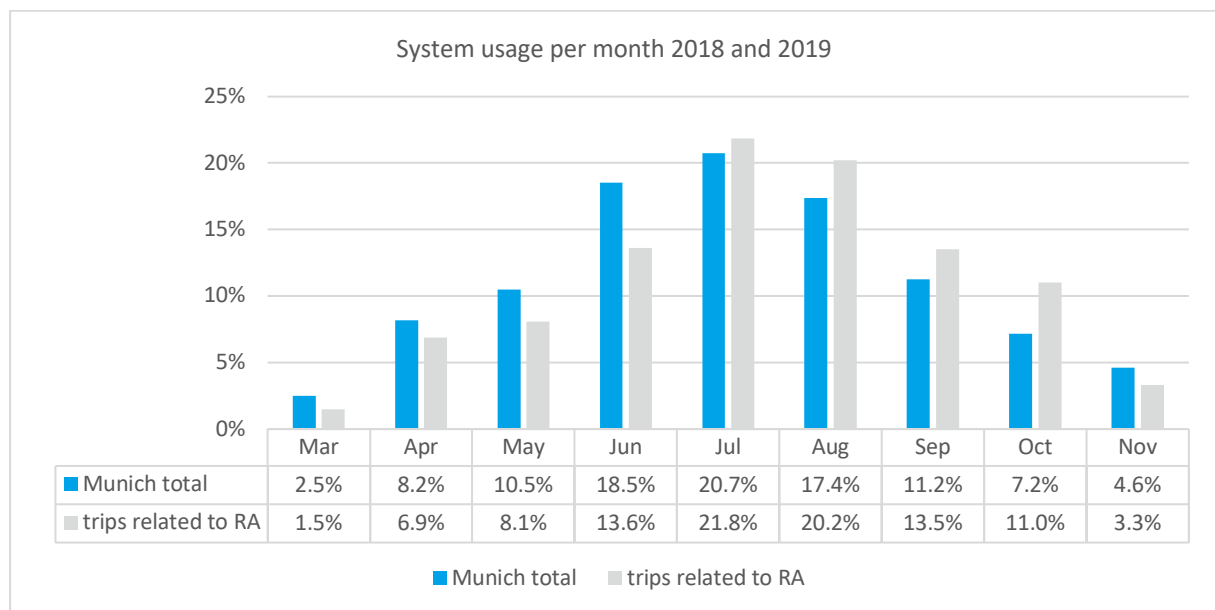


Figure 12: System usage per month 2018 and 2019

It is little surprising that the peak usage months of the ESS service are in summer, when the weather is presumably driest and warmest (cf. [Figure](#)). In the maximum usage month of July (aggregating 2018 and 2019), 723 trips related to the research area were registered.

When it comes to usage concentrations sorted by weekday (cf. [Figure](#)), it becomes clear that a higher percentage of trips related to the research area are taken from Monday to Friday than during the weekend, whereas the distribution between ‘workdays’ and weekend is less pronounced.

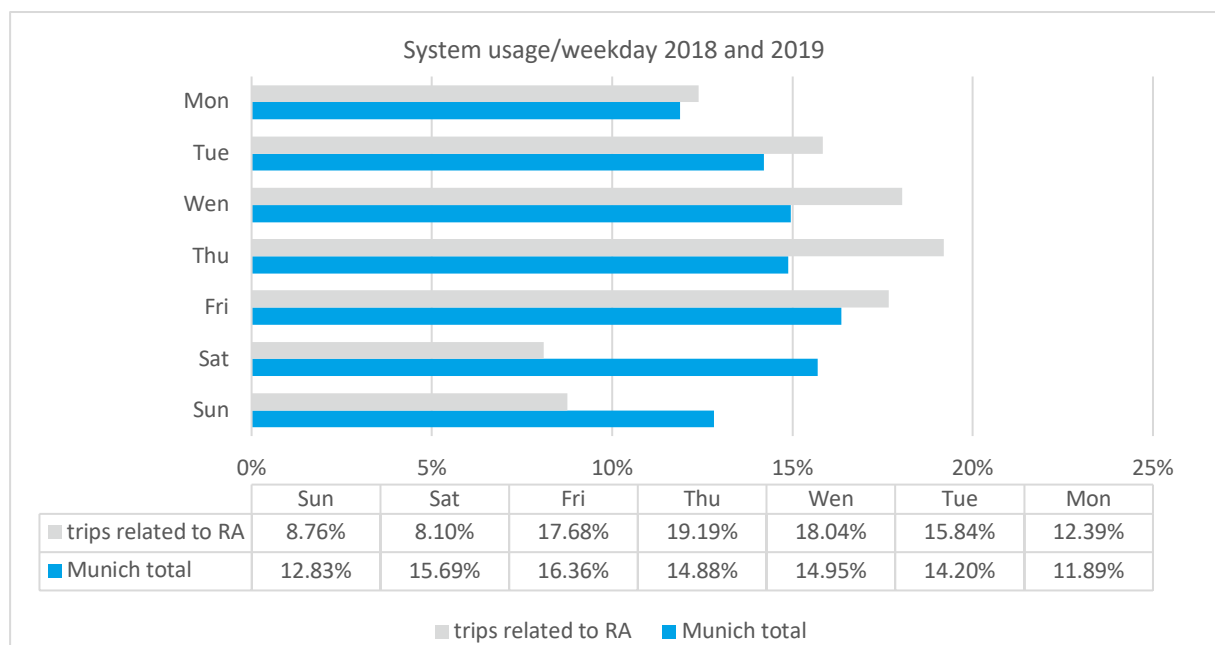


Figure 13: System usage per weekday 2018 and 2019 (cf. ESS Usage dataset 2019)

Concerning the trips related to the research area according to their start time, it becomes clear that there is a strong usage concentration of ESS during ‘rush hour’ (cf. [Figure](#)): There is a peak of trips between 5 and 9 a.m. as well as between 2 and 6 p.m. Between these two peaks, however, usage is less frequent.

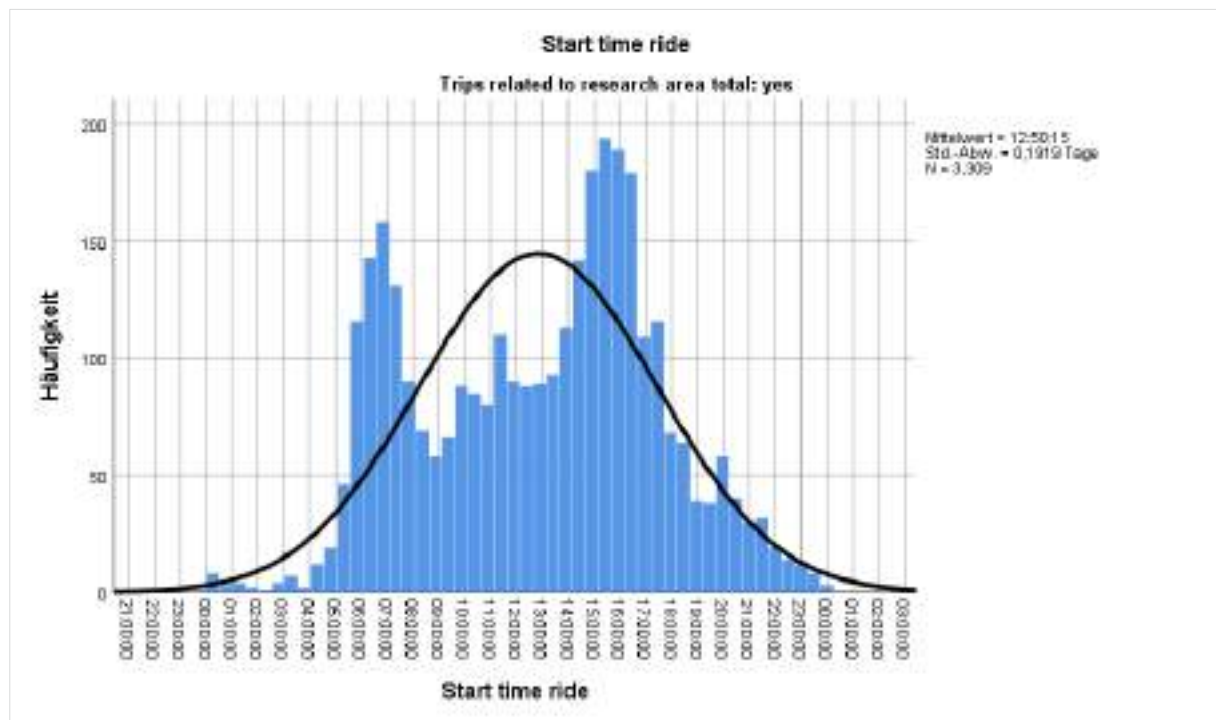


Figure 14: Temporal system usage patterns - start time of trips related to RA in 2018/2019 (cf. ESS Usage Dataset 2019)

Comparing the usage pattern of trips related to the research area to the total of trips in Munich (cf. Figure), it becomes clear that the research area peak during morning rush-hour is more developed (relatively) than throughout Munich as a whole. Moreover, the decrease of trip starting between the morning and the evening rush-hour as it can be seen in the trips related to the research area is less developed in the Munich-as-whole-trips. Instead, after a slight decrease between 8 and 9 p.m., there is a continuous trend of increasing trip starts until the evening rush-hour.

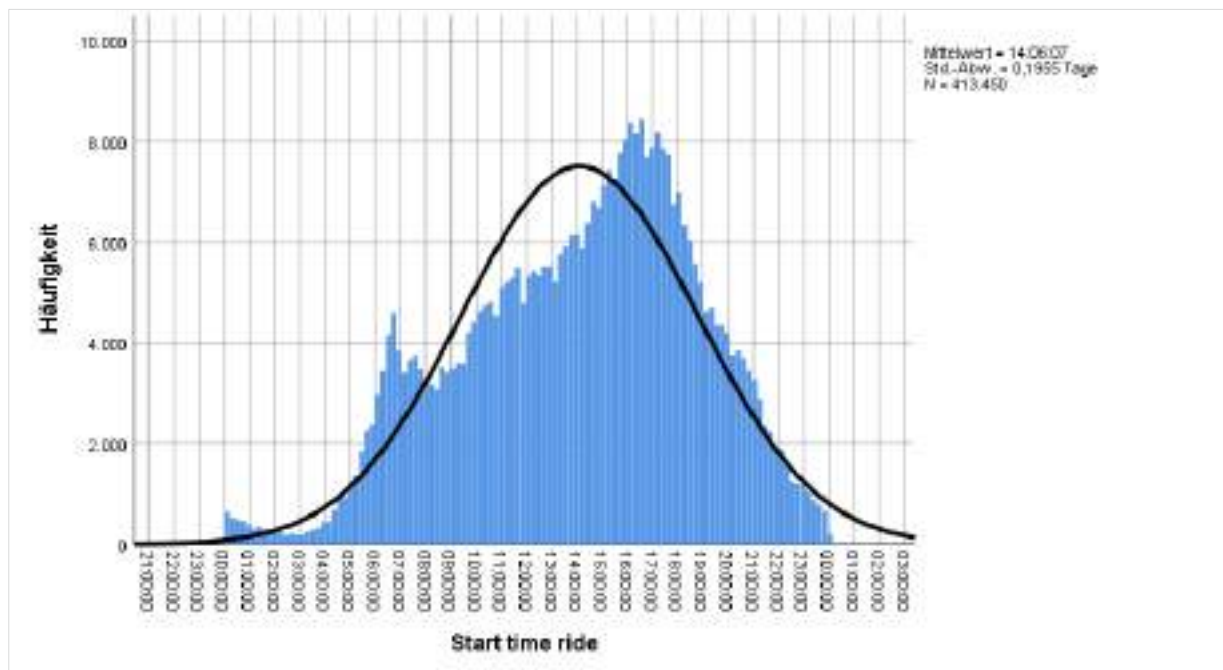


Figure 15: Temporal system usage patterns - start time of trip within all of Munich in 2018/2019 (cf. ESS Usage dataset 2019)

Possible explanations for these different curb developments should have become clear by considering the usage motivations of both the RA and the Munich respondents, for instance the relevance of trips from/to work that can influence rush-hour traffic.

Addressing indicators “7-9 – CO₂; NO_x and PM emissions”

Based on the tracked usage data for 2018 and 2019, the number of km that ESS was used for during those two years can be precisely determined. The ratio of trips formerly taken by different means of transportation can be calculated based on the ESS user survey (2019). By then combining it with the ESS fleet km, one obtains an approximatively driven distance by ESS to/from the RA replacing other means of transportation⁴⁹. The KPI focuses on local emissions⁵⁰ reduced by ESS mode shifts from car trips, which are the fifth most relevant mode shift. Other more pronounced mode shifts were disregarded for the following reasons:

- When looking at the (local) emissions reduced by a shift from **public transportation**, one has to consider that they do not equate a direct emission reduction, as the emission are then calculated based on the remaining passengers. However, by using ESS, the E-scooter drivers alleviate public transport running at maximum capacity⁵¹, thus creating space for

⁴⁹ To calculate the emission reductions, the VKT served as a basis that was then set off against the ratio of substituted trips formerly taken by car. The latter does not distinguish trips by ICE powered cars from EV. However, since the ratio of electric cars only amounts to 0,32% in Munich (cf. Vick 2019), the number of substituted electric car trips was deemed neglectable and all substituted car trips were considered as ICE car trips.

⁵⁰ The emission reduction factors refer to total emissions per means of transportation and were drawn from the HBEFA/TREMOT 5.82 study (cf. UBA 2019).

⁵¹ Ingo Wortmann, Head of both the Association of German Public Transportation Services (cf. VDV) and the Munich Transportation Services (MVG) has stated public transportation services have reached capacity, especially during rush hours and in large cities (cf. dpa 2019; Karowski 2020). This statement is reliable due to his expert standing although no corroborating figures were published.

new passengers.⁵² This could be considered a contribution to sustainable mobility structures. The relevance and extent of this effect require further research beyond the project. Therefore, the exact emission effects of shifts from public transportation remain inconclusive in this report.

- Mode shifts from trips formerly taken by **bicycle** and by **foot** do not have any local emission effects.
- Mode shifts from trips by **motor scooter** have to be disregarded due to a lack of data: Relevant data to calculate reliable emissions, for especially e-scooters stay unknown and cannot be obtained from the household surveys. The relevant average emission factor (based on the ratio of different types of motor scooter drives in Munich and their specific emissions) could potentially be retrieved from HBEFA but the driven kilometers per household are unknown.

ESS approximately reduces the following emissions (cf. Table 11)

		CO2 [t]/2018+2019	NOx [t]/ 2018+2019	PM [t]/ 2018+2019
2018+19	RA (by trips starting and/or ending in the RA)	0,89911	0,00220	0,00003
	Munich total	33,05108	0,08084	0,00095

Table 11: Estimation of emission reduction by ESS in research area and the total Munich business area.

Addressing indicators “Investment costs” and “Operational costs”

The **investment costs** of the Measure MUC 5.10 are relatively low and mostly consist of personnel costs (16.500 EUR).⁵³ They include negotiating with relevant stakeholders, namely the KVR/City of Munich responsible for the Mobility Stations within the research area and the ESS service operator emmy. The investment costs of associated project partners such the ESS operator are sensitive business data and are not publicly available. The operator’s investment (personnel and material costs) are neglected as they cannot be separated from their entire investment costs. No additional E-scooters were bought for the expansion of the ESS operating area to the research area. Had costs arisen in this context: A Govecs E-scooter model is currently obtainable for a market price of 5.600 Euro.⁵⁴

The preparation of the online survey caused minimum IT expenses (100 €). The **operating and demonstration costs** are higher (109.400,00 € personnel; 2.760 € travel costs and software fees): The operating costs include the collection and analysis of the first batch of usage data, the development of the user survey and the first evaluation measures. The

⁵² In order to model this effect, several figures would be needed including the load factor of public transportation and knowledge on how many new passengers were acquired for public transport due to the space vacated by now ESS users, and how many of these new users formerly travelled by ICE vehicles. Since the latter is not obtainable, forgoing an incomplete and therefore non-reliable model is suggested.

⁵³ The costs stated in section C.2 Measure results refer to the “introducing”, the “understanding” and the “optimizing ESS”. For the “understanding” phase, the ESS usage and user data is being analysed beyond what is needed for the MUC 5.10 MER.

⁵⁴ <https://tinyurl.com/r4kp5lo>; NB: It is safe to assume that prices differ for Govecs business purchases.

demonstrations costs on the other hand contain the data collection and analysis of the user survey, the data collection and analysis of the second usage survey as well the development of counterbalancing measures. The operating costs for the ESS company are sensitive business data that is not publicly available. However, ESS operating costs can be roughly estimated by the following customary market prices:

Monthly operating costs/ scooter		Minimum cost scenario per scooter for 14 months the project has been running (status: 9/2019)	Maximum cost scenario per scooter
Electric motor scooters	70 – 120 €	980,00 €	1.680,00 €
Battery change/maintenance	70 – 100 €	980,00 €	1.400,00 €
Insurance	30 – 60 €	420,00 €	840,00 €
Customer service	15 – 50 €	210,00 €	700,00 €
IT	20 – 50 €	280,00 €	700,00 €
Electricity	5 – 15 €	70,00 €	210,00 €
		2.940,00 €	5.530,00 €

Table 12: Customary market costs for the operation of ESS vehicles

Those estimated costs are based on knowledge from the ESS expert scene, in which GCX is active. The costs outlined in Table 12 are those approximately incurred by ESS service operators. They are not included in the calculation of the direct costs for MUC 5.10 but are an important factor when it comes to developing a sustainable E-Scooter sharing concept.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Reduce CO2 emissions	**	The introduction of ESS in the research area has reduced CO2-emissions (cf. KPI 8). Moreover, this effect is expected to increase once approaches are developed to manage unwanted substitution effects.
2	Air pollution	**	The introduction of ESS in the research area has reduced NOx and PM emissions (cf. KPI 9 and 10). Moreover, this effect is expected to increase once approaches are developed to manage unwanted substitution effects.
3	Road congestion	**	Since electric scooters are more space-efficient than cars to transport one or two people, the trips formerly driven by car substituted by ESS (by users related to the research area) have contributed to decreasing road congestion in an emission-free way. On the other hand, those substituting trips formerly taken by public transport slightly contribute to road congestion in an emission-free way. At the same time, they 'decongest' public transport.
4	Accessibility for all	*	The relevance the usage motivation "accessing poorly connected places" (cf. ESS survey) shows that ESS has contributed to increasing accessibility for all.
5	Livability	**	Cleaner air, less road congestion and a reduced noise pollution from ESS substituting cars contribute to an increased quality of public space, and, in the end to livability in cities.
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded			

D. Process Evaluation findings

A process evaluation did not take place as the amendment of measure MUC 5.10 – introducing, understanding and optimizing the E-scooter sharing (ESS) service emmy – is being decided well-advanced into the ECCENTRIC project (Q4/2019). While the project had been prepared beforehand, the official process evaluation did not include the measure until that point. Thus, it proves difficult to carry out an entire process evaluation for measure MUC 5.10. time wise. However, since by the end of Q4/2019, Green City Experience has introduced an ESS in in the living lab area and obtained all the necessary data to analyse its usage. Therefore, all risks mentioned in the Evaluation Plan are no longer relevant and/or have already been solved/mitigated.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- Key result 1 – The measure has enabled the ESS vehicle km travelled starting/ending in the research area to strongly increase seeing that its baseline of trips starting/ending in the research area was nil beforehand: 24.029 km were travelled to/from the research area in 2018/2019 after the introduction of the measure.
- Key result 2 – Most mode shifts ($\geq$ once a month) towards ESS come from public transportation followed by trips formerly taken by foot, by bicycle and by car.
- Key result 3 – The measure has enabled the ESS system usage starting/ending in the research area to increase seeing that its baseline of trips starting/ending in the research area was nil beforehand. The strongest annual usage per month to/from the research area in 2018/2019 was in July.
- Key result 4 – The introduction of ESS has directly reduced emissions. Knowing the total reductions within the entire Munich mobility system requires modelling the effects of the ESS modal shifts from public transport.⁵⁵

E.2 Relevance of supporting activities

No supporting activities were identified. Therefore, their relevance is nil.

E.3 Interaction with other measures

The relevance of measure MUC 5.9 for residents' and employees' awareness of ESS was not examined in the surveys. Therefore, its relevance cannot be corroborated.

E.4 Main lessons learned

- Key result 1 – Close cooperation and dialogue with both the responsible mobility company and the city in which the measure is implemented are key to a successful ESS introduction and study.
- Key result 2 – The measure has already contributed to decreasing the load factor in public transportation in an emission-free way. It can contribute to (further) sustainable mobility developments by enabling public transportation to transport new passengers that shifted from car usage.
- Further key results are expected as the measure, which started relatively late in the ECCENTRIC schedule (cf. Chapter D), is finalized.

⁵⁵ For instance, public transportation being less occupied due to ESS modal shifts can lead to new passengers being able to use it. Understanding the total emission reductions requires considering which modes of transportation the new public transportation passengers shifted from.

E.5 Long term impact

- Key expectation 1 - Effects such as a partial mode shift within the research area and a relevant number of driven kilometres can be expected to increase with the ESS service continuously establishing itself in the Munich mobility market throughout time.
- Key expectation 2 – Equally, the reduction of emissions is expected to increase depending on mode shift developments. The reduction of emissions can be strengthened by the counterbalancing approaches that were developed during the measure.
- Key expectation 3 – Whether the mode shift from public transportation to ESS leads to strengthening the former requires further research beyond the project. The suggested hypothesis is that by using ESS, the E-scooter drivers alleviate public transport running at maximum capacity, thus creating space for new passengers. If the ‘new’ public transport users shifted from trips formerly taken by cars, ESS can indirectly strengthen the mode share taken by space efficient means of transportation.

E.6 Potentials for up-scaling in the city

The measure is already continuously being up-scaled as ESS services are expanding their business areas as well as the number of scooters they are offering: Since the beginning of the ECCENTRIC measure, the ESS business area has been expanded to include relatively eccentric neighbourhoods such as Neuhausen-Nymphenburg, Bogenhausen and Sendling (cf. Green City AG 2018). At the same time, the number of scooters has been increased from 50 to 400 since the beginning of 2018 (cf. Werwitzke 2018). Globally, the scooter sharing market has been rapidly growing in 2019 according to a study by UnuMotors. ESS scooter numbers increased by 164% to 66.000 ESS scooters, while the number of registered customers rose by 166% to 4,8 mill. customers (cf. Unu Motors 2019: 5).

F. Additional information

F.1 Appraisal of evaluation approach

Potentially optimizable points:

- Ensuring that the units used for the baseline assessment and the measure results correspond would have facilitated quantifying the measure effects.
- Due to sensitive business data it was not always possible to retrieve information about KPIs like investment and especially operational costs. But because of an excellent network of experts, the ML was able to define some costs ranges regarding the operation of the services in the Living Lab.

Strong points:

- Since part of the measure consisted in a study of ESS usage, precise data was available for the MER process, especially concerning the KPI categories “society-people”, “transport system” and “environment”. Thus, the actual measure results could be easily measured.

Recommendations:

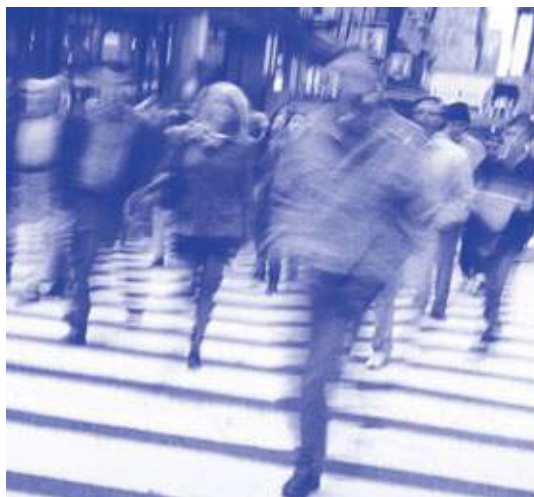
- It can be helpful to slightly adapt the KPI criteria in order to include the main insights of the measure in the measure evaluation.

F.2 Future activities relating to the measure

- To assure ESS accessibility for residents of employees of the research area, it is recommended to maintain the expanded ESS business area (to include the research area) after the measure ends. Until further notice, this is given since the measure is scheduled to continue indefinitely.
- Whether the mode shift from public transportation to ESS leads to strengthening the former requires further research beyond the project. The suggested hypothesis is that by using ESS, the E-scooter drivers alleviate public transport running at maximum capacity, thus creating space for new passengers. If the ‘new’ public transport users shifted from trips formerly taken by cars, ESS can indirectly strengthen the mode share taken by space efficient means of transportation.
- Integrating the counterbalancing approaches that are developed within the measure into the ESS service can contribute to strengthening the ESS sustainability effects.

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2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



STO 6.1

Offering EV-test fleets to selected target groups

Measure Evaluation Report

Deliverable No.:	8.5
Project Acronym:	CIVITAS ECCENTRIC
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2020
CIVITAS
Cleaner and better transport in cities
ECCENTRIC



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EUROPEAN UNION

Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KTH
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
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22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Joel Franklin	KTH Royal Institute of Technology
Maria-Angeliki Evliati	City of Stockholm

Table of Contents

ABSTRACT.....	1226
A. INTRODUCTION.....	1227
A.1 EXPECTED RESULTS OF THE MEASURE	1227
A.1.1 Quantifiable impacts.....	1227
A.2 MEASURE DESCRIPTION	1227
A.2.1 Measure outputs.....	1228
A.2.2 Supporting activities	1228
A.2.3 Interactions with other ECCENTRIC measures.....	1228
A.2.4 Interactions outside ECCENTRIC	1228
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1228
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1228
A.5 IDENTIFIED RISKS	1229
B. MEASURE IMPLEMENTATION	1231
B.1 SITUATION BEFORE CIVITAS	1231
B.2 INNOVATIVE ASPECTS.....	1231
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1231
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1231
C. IMPACT EVALUATION FINDINGS	1233
C.1 EVALUATION APPROACH.....	1233
C.1.1 Expected impacts and indicators.....	1233
C.1.2 Baseline.....	1235
C.1.3 The business-as-usual scenario.....	1236
C.2 MEASURE RESULTS.....	1237
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1238
C.4 UP-SCALING	1239
D. PROCESS EVALUATION FINDINGS	1240
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1240
D.2 BARRIERS	1240
D.3 DRIVERS	1241
D.4 SUPPORTING ACTIVITIES.....	1241
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1241
E. EVALUATION CONCLUSIONS	1242

E.1	VALIDATED DIRECT IMPACT	1242
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1242
E.3	INTERACTION WITH OTHER MEASURES	1242
E.4	MAIN LESSONS LEARNED	1242
E.5	LONG TERM IMPACT	1242
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1242
F.	ADDITIONAL INFORMATION	1243
F.1	APPRAISAL OF EVALUATION APPROACH	1243
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1243

List of Tables

Table 1: Quantifiable impacts.....	1227
Table 2: Target groups or affected parties.	1228
Table 3: Measure stakeholders.....	1229
Table 4: Risk assessment.	1230
Table 5: KPI Descriptions.....	1234
Table 6: KPI Details.	1235
Table 7: KPI Results.	1238
Table 8: Summary of Objective Achievement.	1239
Table 9: Identified barriers and planned/taken actions.	1241
Table 10: Identified drivers and planned/taken actions.....	1241

Project	City		
ECCENTRIC	Stockholm		
Measure code	Measure name		
6.1	Offering EV-test fleets to selected target groups		
Last update	Responsible	e-mail	telephone
	Maria-Angeliki Evliati	maria-angeliki.evliati@stockholm.se	

Abstract

The City of Stockholm aims to become fossil-free. Service and delivery sector is particularly relevant to explore as most often service and delivery cannot be replaced by public transport and is experiencing a heavy increase due to growing population and e-commerce.

Light commercial vehicles account for 20% of the traffic in the inner city, which is the next biggest category after personal cars. Documenting / Testing user satisfaction with the EV vans and examining their energy efficiency can support the City's objective to become one of the world's leading clean vehicle cities by 2030. This measure incentivized companies operating light-duty commercial vehicles in Stockholm to purchase or lease an electric-powered van at a reduced price, making it comparable in price to an equivalent diesel-powered van. Participants driving the 15 vans agreed to provide data about their use of the EV and to respond to surveys about their experiences. In the analysis of the impact of this measure, we measured user satisfaction, energy efficiency, travel time, emissions, and operational and investment costs based on a survey, logbook, secondary sources.

Compared to diesel-powered alternative, the EV had zero tailpipe emissions and were significantly more energy efficient. The results showed that participants were, on average, very satisfied (about 74% acceptance rate) and would recommend EVs to others in their respective sectors.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

Transports within the service sector, which most often cannot be replaced by public transports, need to be electric or bio energy driven in order to achieve the goal of a future fossil free fleet in Stockholm as well as in Sweden. In the growing Stockholm region, the energy efficient electric vehicles must have a great market share. As a long-term effect, more EVs at the cost of less fossil fuel driven cars means less noise pollution, more efficient use of energy and less emissions.

(2) Strategic level:

To achieve the city's policy-level goals, increased knowledge is needed both by those working in the service sector about the real-world characteristics of EVs when put to work, and by city officials to better understand what conditions are needed to ease a transition to EV use.

(3) Measure level:

This measure aims to address both knowledge gaps by exposing selected individuals from service industries and by gathering data on the performance of EVs in their work and how they respond to their use.

A.1.1 Quantifiable impacts

Expected Impacts	Transports within the service sector, which most often cannot be replaced by public transports, need to be electric or bio energy driven in order to achieve the goal of a future fossil free fleet in Stockholm as well as in Sweden. In the growing Stockholm region, the energy efficient electric vehicles must have a great market share. As a long-term effect, more EVs at the cost of less fossil fuel driven cars means less noise pollution, more efficient use of energy and less emissions.	CIVITAS ECCENTRIC Objectives							
		Reduce:				Improve:			
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal	Livability	Competitiveness
1	Acceptance/Satisfaction of the testing of EVs							x	x
2	Reduction of emissions	x						x	x
3	Exploitation of the funding for implementation of the plan and giving opportunities to local economy								x
4	Increase of energy efficiency	x						x	x
5	Increase of transport efficiency			x	x	x	x		

Table 1: Quantifiable impacts.

A.2 Measure description

With the objective to increase the share of EVs among business cars, the city of Stockholm, with the cooperation of the company Mobility Motors, has invited 15 business in the tradesman and delivery businesses to try EV-vans for the period of two years. These businesses were offered to lease an EV-van without any additional cost to an equivalent van powered by fossil

fuels. In turn, the participating businesses committed to answering three surveys and participate in lunch seminars to deliver the operational car data of the EV.

A.2.1 Measure outputs

The measure has made 15 electric-powered vans available for lease or purchase by local businesses.

A.2.2 Supporting activities

None.

A.2.3 Interactions with other ECCENTRIC measures

Measure 6.6 masterplan of charging infrastructure in Stockholm. Part of the evaluation survey seeks to understand how on-street charging infrastructure is used and perceived by the EV-drivers.

A.2.4 Interactions outside ECCENTRIC

None were anticipated.

A.3 Target groups and/or affected part of the city or region

In Table 2, we list the main two target groups within the service sector, that were included in this measure.

Target group		Affected area	
Type	Description	Type	Description
Service sector	Tradespersons	City of Stockholm and its surroundings	Driving through the city and in particular the living lab area in Årsta and the southern suburbs of Stockholm in order to deliver services to their customers
Service sector	Freight and courier companies	City of Stockholm and its surroundings	Driving through the entire city for parcel delivery

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

In Table 3 below we present the stakeholders included in this measure, which represent the main three groups included in the Eccentric project, such as the City representing the public sector, companies, representing the private sector, and research.

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR- other	Level activity L-P-O	Role Links
P03	Environmental Department of the City of Stockholm	P	C	L	
P09	Mobility Motors	P	PR	P	
P10	KTH Royal Institute of Technology	P	KI	P	
S12	Urban freight companies, courier companies, etc.	S	PR	P	
	Tradespersons	S	PR	P	
Type: P:CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Before the start of the project, the potential risks stated in the table below have been identified. At the end of the project, it was found, that not all of them became true.

Identified risk	Category	Mitigation actions	Responsible
Under communication	5 Involvement, Communication	Regular meetings were held between MM and STO. The limited size of the test fleet (only 15 cars or companies) is an advantage. MM was in contact with the companies and the drivers on a regular basis in order to solve any problems early and minimize their effects. One lunch seminar with the drivers and a final event where the participating companies shared experiences with other companies in Stockholm region (over 100 participants) was held. STO also had an early contact with the drivers, soon after the car has been delivered, in order to introduce their part of Eccentric, the expectations, and to try to create a commitment.	Mobility Motors (regular contacts) City of Stockholm (meetings)
Resource shortfalls (Inability to secure sufficient resources, overspending)	9 Financial	At the organisation of MM as well as at STO, two persons or more were involved in the Eccentric measure, for back up. At the participating/testing companies the agreement was signed by a person empowered to allocate resources to the project.	Mobility Motors & City of Stockholm
No sufficient attention and resources to evaluation tasks	7 Planning	City of Stockholm contacted the drivers and reminded them when it was time for the non-digital driver's log (which is 4 times 1 week per year). If some of the companies missed this, STO would immediately contact them again and they could fulfil their log book the next coming week. The outcome of the digital drivers' logs of all cars was to be roughly analysed within 3 months in order to see that they were functioning well, and also to estimate the workload, so that resources could be allocated for the evaluation work after year 1 and year 2.	City of Stockholm
Lack of data/data of low quality	Operational	The purchase agreement must have been clear on the responsibilities and expectations on the "testing company". STO was expected to remind the drivers when it was time to fill in their manual log book on charging and energy consumption (see cell above).	City of Stockholm
Technology components aren't fit for purpose	Operational	The driver's log programme is well known and installed by a serious and reliable company.	Mobility Motors

Table 4: Risk assessment.

B. Measure implementation

B.1 Situation before CIVITAS

The City of Stockholm has the ambition and objective of becoming one of the world's leading clean vehicle cities by 2030. For this reason, the City introduced a strategy for promotion of new electric vehicles onto the market in Stockholm. The strategy provided an assessment of relevant regulations and a comprehensive list of measures that needed to be implemented so that essential infrastructure could be installed in an efficient and optimal way. Although the share of EVs in Sweden and Stockholm is small, it is growing rapidly. Market share of brand-new E-vans in the city of Stockholm in 2015 was 1,1 %.

B.2 Innovative aspects

Testing electric vans with companies for which a vehicle is essential to carry out their work has not been done before. Data on driving distances, energy use and perceptions of the vehicle's functionality as well as availability of charging possibilities gives the City of Stockholm feedback on its strategy for on-street charging and can further inform policy making.

B.3 Research and Technology Development

Car manufacturers are working on battery improvement in order to provide drivers with better range. The same Nissan model e-NV200 as the one used in this test is now available with a 40kWh battery for better range. According to Nissan, the new battery gives the vehicle a 60% increase in range, up to approximately 301 km in urban driving and 200 km in mixed driving.

B.4 Actual implementation of the measure

Step 1: Selecting the test users

Soon after the project start Mobility Motors compiled an inventory of possible customers—test users. The target group was defined in collaboration with the City of Stockholm. The partners designed a competition and defined the criteria based on which the test users would be selected to receive the grant. Criteria aimed to include test users from various types of businesses and replace as many “fossil” miles as possible with electric. A test-fleet of 15 vehicles was finally decided instead of 20 initially planned due to cost reporting issues. (Deliverable 6.1). Selected companies were notified shortly after the competition ended. Designing and carrying out the competition and selecting test users took place between January 2017-August 2017. First delivery was made in October 2017 and the last one in February 2018. There is, in other words, a delay between selection of users and delivery of the vehicle.

Step 2: preparing for the evaluation activities

Preparation of the evaluation activities took place between January-October 2017. Mobility Motors has investigated the available technology for electronic logbooks tracking distance travelled. A manual logbook was developed along with instructions in order to record energy use four times during the year, taking into account seasonal variations. The City of Stockholm has also developed three surveys measuring acceptance and user satisfaction from driving an electric vehicle in five different business sectors. The first survey (wave 1) was distributed before or shortly after the company received the vehicle and started driving it, starting in November 2017. The second survey (wave 2) was distributed nearly one year later, starting in October 2018. A third survey (wave 3) was also conducted in October 2019.

Step 3: running the test fleet and measuring impact

Test-drivers have received three surveys about the driving experiences: one before the test period, one during the test (one year after) and one after the end of the testing period. They have also filled in logbooks on energy use in selected weeks throughout the year in order to capture temperature variations. The provider of the electronic logbook delivered distance travelled during each quarter of the calendar year. Data collection has been rather cumbersome and data inconsistencies have occurred as regards both energy use and distance travelled.

Research and planning phase for this measure was initially foreseen for the first three months of the project but has covered a longer period. Implementation started one year after the projects start (October 2017).

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Acceptance and Satisfaction

Acceptance and satisfaction were measured using a survey of participants, carried out in three waves. In the first wave, participants were asked about their expectations of EVs compared to an equivalent diesel vehicle with respect to 11 different characteristics, using a five-point scale from 1, “much worse”, to 5, “much better”. In the second and third waves, participants were similarly asked about their actual experiences with the same 11 criteria during the trial, and an eleventh criterion was added regarding in-vehicle heating.

Participants were also asked in these later waves how satisfied they were in general with the experience of driving the electric van, using a five-point scale from 1, “very dissatisfied”, to 5, “very satisfied”. However, since an equivalent question was not asked in the first wave, we instead chose to compute an aggregate of the criterion-specific questions, thus facilitating a comparison with the baseline case.

In the third wave, participants were asked whether they would recommend to others in their sector to purchase an electric vehicle, and we take these data to indicate acceptance.

CO2 and NOx emissions

Emissions were estimated using standardized emissions rates for the test vehicle and, as a comparison, for an equivalent diesel vehicle. These were then multiplied by total travel distance to obtain total estimated emissions. It was not possible, however, to directly compare before/after emissions for each vehicle because we could not describe the “before” scenario with sufficient specificity to directly estimate emissions.

The problem was essentially that for those companies who participated and used an electric vehicle, it was not possible to identify a specific vehicle, or even a specific regular portfolio of activities, that would be replaced by the new vehicle. No previous vehicle was fully taken out of service, as would be necessary to exactly replace it with an electric vehicle. Consequently, the new electric vehicle took up various tasks that the participant deemed appropriate for its characteristics.

Ideally, we would have tracked travel activity and estimated emissions for each participant’s full fleet of vehicles, so that the impact of this redistribution of activities could be accurately measured. However, this would be far more expensive than what we planned, and therefore prohibitive. Instead, we have compared to an imaginary scenario where the same tasks are taken up by the nearest-equivalent vehicle, which is the same make and model of van but with a diesel engine.

Operational and Investment Costs

Operating costs were estimated using standard energy efficiency rates for the test vehicle and an equivalent diesel vehicle, along with average costs for diesel and for electricity during 2018. These were multiplied by the average annual distance travel to estimate annual operating costs. These were then added to a typical service agreement for 36 months, converted to an annual basis. The investment cost was simply taken as the purchase price.

Energy Efficiency

The energy efficiency, in kWh per 100 km, is reported continuously on the vehicle dashboard. Participants were asked to complete a weekly logbook where the energy efficiency was written on each weekday on selected weeks throughout the test period. However, many logbooks were missing, incomplete or otherwise unusable. To produce an overall estimate without biasing against underreported participants, we computed successive averages: first, the average energy efficiency across each 5-day week, then the average of all reported weeks for each participant, and finally the average of across all participants. We also compared the estimated energy efficiency against the official statistics to confirm that they were in the same range.

Total Travel

Total travel was reported using the logbooks/onboard sensors as for energy efficiency. The data was cross-checked with manually collected distance data on that particular week (4 times a year). However, the two data sources proved to be highly inconsistent with each other, with the onboard sensors producing more realistic and consistent data. Therefore we chose to exclusively use the onboard sensors for usage statistics.

Impact	Acceptance	Acceptance	Reduction of emissions	Reduction of emissions	Exploitation	Exploitation	Energy Efficiency	Transport efficiency
Indicator name	Acceptance	Satisfaction	CO2 emissions	NOx emissions	Operational costs	Investment cost	Vehicle energy efficiency	Vehicle-kilometer travelled
Type	KPI	KPI	KPI	KPI	KPI	KPI	KPI	KPI
Category	Society - People	Society - People	Environment	Environment	Economy	Economy	Energy	Transport System
Subcategory	Acceptance	Acceptance	Pollution and nuisance	Pollution and nuisance	Costs	Costs	Energy Consumption	General
Aspect	Acceptance level	Fulfilment of expectations	Emissions	Emissions	Operating costs	Investment costs	Energy Consumption	Total travel
Definition	Attitude survey of acceptance of the measure of different stakeholders	Users average reported satisfaction with the performance of the vehicle after the implementation of the measure	CO2 emissions saved from the 20 vehicles compared to the diesel versions of the vans	NOx emissions saved from the 20 vehicles compared to the diesel versions of the vans	Service costs, energy costs etc.	The total capital costs for purchase of the vehicles, Depreciation included	The total energy used per vehicle-km (annual average)	Sum of all kilometers travelled by the test fleet

Table 5: KPI Descriptions.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement
1	Acceptance	%	B-I (1)	S	Companies participating in the implementation of the measure	Demonstration area
2	Satisfaction	Score	B-I (1)	S		
3	CO2 emissions	Tons	B	E		
4	NOx emissions	Tons	B	E		
5	Operational costs	SEK/year	B	DC		
6	Investment cost	SEK	B	DC		
7	Energy Efficiency	kWh/100km	B-I(1)	DC		Fleet
8	Vehicle- kilometers traveled	km	B-I(3)	DC		
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: KPI Details.

C.1.2 Baseline

Acceptance & Satisfaction

The participating companies did not previously own an electric vehicle, although the individual participants may have gained experiences elsewhere. A majority of those drivers who had experience of driving an EV had done so only in a private capacity. Knowledge about the functionality of an electric van for tradesmen, freight and courier companies therefore was very limited. There was also little understanding in this group of an EV's needs for charging infrastructure.

Expectations for EV characteristics compared to an equivalent diesel vehicle were measured in the first survey, and we take these to indicate expected satisfaction and use this as a baseline. To provide a simple summary, we took the average score across respondents and then across the 11 criteria, finding an overall average of 3.41. To be more specific, respondents expected the EV to be superior in terms of emissions, noise, and operating costs, as well as to a lesser extent in terms of comfort and ease-of-use. Expectations were worse in terms of range and speed, for example, 92% thought that the range of the EV compared to the equivalent fossil van is much worse (wave 1). On the other hand expectations were mixed on heating, safety, and reliability.

CO2 and NOx Emissions

Based on emissions rates of 138 g CO₂ per km and 140 mg NO_x per km, and based on the average of 13 481 annual kilometers traveled by the participants, an equivalent diesel vehicle would have produced 1.860 tons CO₂ and 0.001887 tons NO_x. However, since these are not directly observed, we do not report them in **Error! Reference source not found.**

Investment and Operating Costs

While the respondents indicated in the survey that there was no particular vehicle that the electric van replaced, we can in the long-run take as a replacement vehicle the diesel-powered Nissan NV200, which is nearly identical to the test van in its non-engine features. We obtained

the investment cost of this vehicle and computed operating costs based on average usage among the participants, the official fuel economy of the diesel NV200, and the prevailing price of diesel in 2017 for the baseline.

Energy Efficiency

The energy efficiency is difficult to compare across fuel sources since the production processes are vastly different, hence the cost and environmental implications per energy produced can be different. However, it is possible to convert diesel energy into equivalent kilowatt-hours units, and we have done so here assuming an energy density of 36 megajoules per litre diesel and using the conversion factor of 3.6 megajoules per kWh, by definition.

Usage

Participating companies drive 5 000—30 000 km (on average, 16 300 km) per year according to their estimations, based on the competition application form. However, we deemed these reported statistics to be unusable as a baseline firstly because it was unclear whether applicants were reporting their average distance traveled per vehicle, or total distance traveled for all vehicles, and secondly because it was unclear which part of this existing activity would be shifted to the electric vehicle.

C.1.3 The business-as-usual scenario

Acceptance and Satisfaction

The 15 companies of the test-fleet would have probably not chosen to buy an electric van due to the price difference (326 mSEK vs 169 mSEK), although an environmental profile is an important part of the company's business model (wave 1). Hence there might have been a low but not non-existent level of acceptance.

Compared to the baseline case, one might expect that increasing awareness of the characteristics of EVs might change the respondents' expectations of EVs compared to diesel. However, the responses to the characteristic-specific questions in wave 1 indicate an overall good understanding of the advantages and disadvantages of EVs, at least to the point that we cannot argue that expectations would have changed noticeably during the duration of the project.

CO₂ and NO_x emissions

The business-as-usual emissions levels would be different from the baseline emissions only in the sense that emissions rates and/or usage levels might have changed for reasons outside the influence of Eccentric. However, there is neither a data source detecting this change, nor a theoretical reason to believe that they would change. In general, there has been long-term trend of diminishing emissions for diesel vehicles in Europe; however, in the most recent years this trend has stabilized, or perhaps reversed, and the prognosis is very uncertain. Still, as with the baseline measurements, these are based on computed figures for an equivalent diesel vehicle and hence we do not directly observe them, and we do not report them in **Error! Reference source not found.**

Investment and Operating Costs

According to the Swedish Central Bureau of Statistics, the consumer price index for vehicle purchases sank by only a slight 0.05% from 2017 to 2018. We recalculated the investment cost of the diesel vehicle for 2018 using this slight difference. For operating costs, we recalculated the cost of fuel using 2018 prices.

Energy Efficiency

As with the baseline case, we have converted the energy efficiency in terms of litres of diesel into equivalent kilowatt-hours. All assumptions are the same so the business-as-usual case is equal to the baseline case.

Usage

Similar to the baseline case, we have no basis for the extent of use of the equivalent vehicle, since we cannot interpret whether the distances traveled reported on the application form are totals over all vehicles or averages per vehicle.

C.2 Measure results

Acceptance

The survey question for acceptance, asked only once at the end of each trial period, was formulated to focus on whether one would recommend to others in the sector to buy an electric vehicle, with the possible responses being “yes”, “no”, and “perhaps”. To compute an indicator we only took the percent replying “yes”, out of the total giving one of those three responses. The result was that 71.4% would recommend the electric vehicle, a very positive result.

Satisfaction

Experienced satisfaction was measured in survey waves 2 and 3, along with several questions about satisfaction with the same 11 aspects of using an electric vehicle as the expectations questions examined in wave 1. To facilitate comparison with wave 1, we computed the average score for each the criterion-specific questions, then took the average across these 11 criteria. The result in wave 2 was an average of 3.39 (a five-point scale from 1, “much worse”, to 5, “much better”, see page 14), a 0.02 decrease compared to the baseline, and the average response in wave 3 was a decrease of 0.16 compared to the baseline.

These results were surprising, in that they represented an overall reduction in satisfaction. Looking more closely at each characteristic, it transpired that for those where EVs were expected to perform more positively, expectations were not fully met – in particular noise, operating costs, and ease-of-use. Indeed, these remained on average positive compared to an equivalent diesel, just less so. At the same time, some characteristics where participants had lower expectations were shown to be less negative for EVs: heating, speed, and interestingly, range. Diesel retained an advantage over EVs on these criteria, but less so.

The change from wave 2 to wave 3 was greater, and saw a small rebound back toward initial expectations before the trial began, perhaps indicating a stabilisation of experiences. Overall across all criteria and both waves, the largest change in opinions was on noise levels: EVs were expected to be far superior but the experiences were mixed, with several experiencing noise as worse in the EV than an equivalent diesel.

CO₂ and NO_x emissions

For electric vehicles, the largest source of CO₂ emissions is associated with the production of the batteries, but this component is not always included in emissions estimates. Including the battery, as well as typical emissions from the typical power generation profile in Sweden, we estimate the rate to be 82.7 g/km including the battery, or 18.9 g/km without. For 13 481 annual kilometers traveled, this amounts to 1.115 tons per year including the battery, or 0.245 tons per year excluding the battery. Electric motors do not produce nitrous oxides.

If we are to believe the estimated emissions for an equivalent diesel vehicle, reported in the sections above, then these would represent a reduction of 0.745 tons of CO₂ and a reduction of 0.001887 tons of NO_x emissions compared to the baseline and business-as-usual scenarios. However, as mentioned earlier, we do not report these results in the table since they rely on a hypothetical baseline vehicle.

Investment and Operating Costs

The purchase cost of the electric Nissan NV20 was used as the investment cost. Operating costs included the annualized cost of a three-year service agreement plus the cost of charging over a year, given average usage for the participants and an electricity cost of 1 SEK per kWh.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Acceptance	%	N/A	N/A	N/A	N/A	72.4%	Oct.-Nov. 2019	N/A	N/A
Satisfaction compared to diesel	Points (1-5)	3.41	Dec. 2017 to June 2018	3.41	2019	3.39 and 3.25	Oct.-Nov. 2018 and Oct.-Nov. 2019	-0.02 and -0.16	-0.02 and -0.16
CO ₂ Emissions	Tons	N/A	N/A	N/A	N/A	1.115	2017-2019	N/A	N/A
NO _x Emissions	Tons	N/A	N/A	N/A	N/A	0	2017-2019	N/A	N/A
Investment Costs	SEK	168 816 kr	2017	169 738 kr	2018	326 806 kr	2017-2018	+157 990	+157 068
Operating Costs	SEK/year	7 580 kr	2017	8 039 kr	2018	2 882 kr	2017-2019	-4 690 kr	-5 156 kr
Energy Efficiency	kWh/100km	50 kWh/100 km	2017	50 kWh/100 km	2017	16.8 kWh/100 km	2017-2019	-33.2 kWh/100 km	-33.2 kWh/100 km
Usage	km/year	N/A	N/A	N/A	N/A	6 036 km/year	2017-2019	N/A	N/A

Table 7: KPI Results.

C.3 Summary: achievement of objectives

The strategic and measure level objectives set in the beginning of the project (see section A1, page 8) were successfully addressed through the implementation of this measure. In general, great amount of knowledge has been produced in this measure about the conditions that could

ease a transition to an EV use. Specifically, a deeper understanding about the particular sector, the service industry, has been gained. To some degree this has been measured through the indicators selected, including their social (measured acceptance and satisfaction), environmental (reduction of emissions), and economic (exploitation of the funding) nature, as the Table 8 below shows. However, the impacts go beyond these indicators, since already the implementation of the measure has brought the actors together and support the work towards the long term goal of a fossil free fleet in Stockholm.

No.	Objective and target	Rating	Comment
1	Acceptance/satisfaction of the testing of EVs	★	Overall satisfaction was very high, but experiences of EVs did not noticeably improve due to the trial.
2	Reduction in emissions	★★	The emissions reductions were as expected
3	Exploitation of the funding	★★	Investment and operating cost differences were in line with expectations
4	Increase in energy efficiency	★★	Energy efficiency substantially improved with the EVs
5	Increase in transport efficiency	○	Annual usage was on average well below the reported annual VKT
NA = Not Assessed ○ = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★ = Exceeded			

Table 8: Summary of Objective Achievement.

C.4 Up-scaling

The results here can be scaled up to a wider area by expanding the geographic scope and the range of businesses contacted. As it was, there was more interest in participating than there was capacity to include them.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the **Process Evaluation Report** of this Measure.

D.1 Deviations from the original plan

In general, the measure developed rather consistently with the plan and the general focus of the pilot, i.e. to explore the EV use within the service sector, remained intact. Small deviations around the practical implementation of the project did occur, these are elaborated below and concern the following three topics: 1) defining the target groups more specifically together with the Mobility Motors which produced a list of customers within the relevant service sector suitable for EV testing, 2) the timing of launching the vehicles, and 3) the number of test vehicles included in the measure.

Target groups – A competition was carried out to ensure a coverage of different sectors, aiming to have 1) real estate and cleaning services, 2) building and maintenance, including painting, electricity works, 3) courier/ delivery services 4) commerce and 5) other services. Taxi services are therefore not represented in the test-fleet.

Launch of the test-fleet operation – the test fleet was launched in October 2017 and cars were progressively put into service on a rolling basis. This was a combined result of the delayed start of the competition as of the uncertainties related to reporting formulas.

15 vehicles are delivered – 15 out of 20 vehicles were delivered by February 2018. Due to the cost reporting of the vehicle purchase, the test fleet comprised 15 vehicles instead of the 20 originally planned. This change did not have an impact on measure implementation as there was already a good coverage of various businesses to evaluate, which was the objective of this measure.

D.2 Barriers

Below are listed some of the barriers that have been reported and the actions that have either been taken, or that we learnt are important to consider for the implementation of the project, in order to overcome them. Barriers are elaborated more in detail in the process report.

No.	Barrier field	Description	Action to overcome the barrier
1	Financial	The investment cost is still too high compared to combustion engine vehicles.	Emphasize lower operating and maintenance costs for electric vehicles (at normal charging rates) compared to combustion engine vehicles.
2	Problem-related	Range limits are insufficient for companies that cannot plan their trips and have widely dispersed customers across the city.	Target companies that have a substantial share of trips and destination patterns that are compatible with range limits and can plan their trips, so that at least some of their activities could be conducted using electric vehicles. Alternatively, provide opportunity charging at strategic points.
3	Problem-related	Fast charging is as expensive as diesel for those who need to complement nightly home charging.	Encourage deployment of charging infrastructure at the workplace.
4	Problem-related	Heating in the cars works poorly and the driver compensates in other ways to avoid diminishing the range limit.	Monitor how users balance different demands on in-vehicle power in order to maintain range and use this to inform future users and selection of future car models, as well as the car industry.

Table 9: Identified barriers and planned/taken actions.

D.3 Drivers

Below are listed some of the drivers that have been recognized as helping the measure's success, and how these can be capitalized on.

No.	Driver field	Description	Action to make use of the driver
2	Problem-related	Utility vehicles cross the city during the daytime, and these trips cannot be shifted to public transport.	Promote electric vehicles as a complement to public transport, where certain non-transit-friendly trips would instead use electric vehicles.
3	Political/strategic	An increasing number of companies wish to give themselves an environmental profile	Provide reliable statistics that can be used as inputs to companies' environmental certification systems. Ensure that the electric vehicles are visibly identifiable as so to bystanders.

Table 10: Identified drivers and planned/taken actions.

D.4 Supporting activities

There were no supporting activities in this measure.

D.5 Recommendations on the implementation process

Recommendations are specified in the final Process Evaluation Report, which was still under preparation during the finalization of this Measure Evaluation Report.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

The measure produced the following validated impacts:

- Acceptance of, and satisfaction with, electric vehicles were clearly positive for participants overall, although some individual participants were less accepting or less satisfied.

E.2 Relevance of supporting activities

There were no supporting activities in this measure.

E.3 Interaction with other measures

The surveys did not identify significant effects from other Eccentric measures.

E.4 Main lessons learned

Several lessons learned were:

- It is essential to get people to personally test new vehicles and infrastructure themselves; a majority were satisfied and can recommend EVs to others, which gives a positive dissemination of this potential solution that the City would like to promote.
- It is important to identify and test with the target group that will lead to the greatest impact. Consider which group(s) contribute most to city traffic, are identifiable, and have circumstances that lend themselves to green vehicle technology (that is, if it is not possible to change to other modes of transport entirely).

E.5 Long term impact

We expect the long-term impact to be a faster dissemination of the benefits of electric vehicles, and faster counteracting of the negative preconceptions many hold against EVs, which both can lead to a faster transformation of the light-duty goods vehicle fleets in Stockholm.

E.6 Potentials for up-scaling in the city

Discussions are currently being held about expanding to more companies and to more diverse models of EVs.

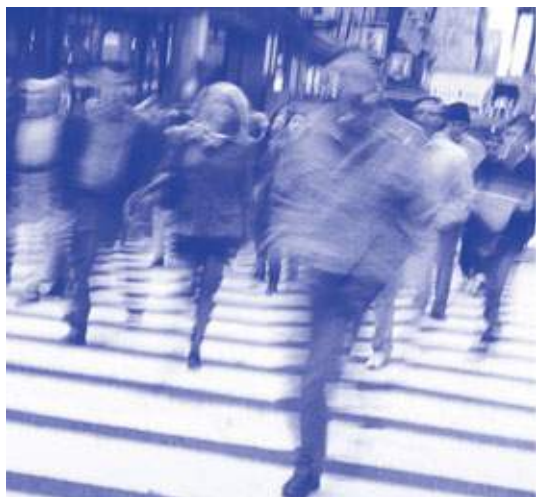
F. Additional information

F.1 Appraisal of evaluation approach

It was very difficult to collect user data, with many suspect data, making it difficult to draw firm conclusions.

F.2 Future activities relating to the measure

As stated earlier, there are plans to expand the trials to more companies and to more models of EVs.



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CIVITAS
Cleaner and better transport in cities

ECCENTRIC



MAD 6.2

Test fleets, policy incentives and campaigns for the uptake of electric vehicles

Measure Evaluation Report

Deliverable No.:	8.5
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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V.formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Enrique García Cuerdo	

Table of Contents

ABSTRACT.....	1251
A. INTRODUCTION.....	1253
A.1 EXPECTED RESULTS OF THE MEASURE	1253
A.1.1 Quantifiable impacts.....	1253
A.2 MEASURE DESCRIPTION	1253
A.2.1 Measure outputs.....	1254
A.2.2 Supporting activities	1254
A.2.3 Interactions with other ECCENTRIC measures.....	1254
A.2.4 Interactions outside ECCENTRIC	1254
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1255
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1255
A.5 IDENTIFIED RISKS	1255
B. MEASURE IMPLEMENTATION	1256
B.1 SITUATION BEFORE CIVITAS	1256
B.2 INNOVATIVE ASPECTS.....	1256
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1256
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1256
C. IMPACT EVALUATION FINDINGS	1259
C.1 EVALUATION APPROACH.....	1259
C.1.1 Expected impacts and indicators.....	1259
C.1.2 Baseline.....	1261
C.1.3 The business-as-usual scenario.....	1262
C.2 MEASURE RESULTS.....	1263
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1264
C.4 UP-SCALING	1264
D. PROCESS EVALUATION FINDINGS	1266
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1266
D.2 BARRIERS	1266
D.2.1 Technological barrier.....	1266
D.2.2 Financial	1266
D.2.3 Institutional	1267
D.3 DRIVERS	1267

D.3.1	<i>Political</i>	1267
D.3.2	<i>Cultural</i>	1267
D.3.3	<i>Institutional</i>	1267
D.4	SUPPORTING ACTIVITIES.....	1267
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1267
D.5.1	<i>Government's fleets: A bottom-up approach, mainstreaming the use of electric cars ..</i>	1268
D.5.2	<i>Adaptive management</i>	1268
D.5.3	<i>A long-term municipal strategy to encourage the electrification of private fleets</i>	1268
E.	EVALUATION CONCLUSIONS	1269
E.1	VALIDATED DIRECT IMPACT	1269
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1269
E.3	INTERACTION WITH OTHER MEASURES	1269
E.4	MAIN LESSONS LEARNED	1269
E.5	LONG TERM IMPACT	1270
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1271
F.	ADDITIONAL INFORMATION	1273
F.1	APPRAISAL OF EVALUATION APPROACH	1273
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1273

List of Figures

Figure 1: Presentation of the municipal EV fleet, February 2019.....	1257
Figure 2: ECCENTRIC at the Annual Electric Vehicle Exhibition.....	1258

List of Tables

Table 1: Quantifiable impacts.....	1253
Table 2: Target groups or affected parties.....	1255
Table 3: Measure stakeholders.....	1255
Table 4: Identified risks.....	1255
Table 5: Description of key performance indicators (KPI).....	1259
Table 6: Description of key performance indicators (KPI).....	1260
Table 7: Measure's indicators	1261
Table 8: Emission baseline values for the city's test fleet (19 cars).....	1262
Table 9: Emission BaU values for the city's test fleet (19 cars)	1262
Table 10: Measure results (summary of indicators)	1263
Table 11: Assessment of objectives.....	1264

Project	City		
ECCENTRIC	Madrid		
Measure code	Measure name		
MAD 6.2	Test fleets, policy incentives and campaigns for the uptake of electric vehicles		
Last update	Responsible	e-mail	telephone
31/10/2019	Enrique García Cuervo	garciaceda@madrid.es	+34 915884294

Abstract

This measure aimed at promoting the use of electric vehicles (EV) by the municipality of Madrid, private companies and individuals. It included activities for the integration of EVs in public and private fleets and to expand the public charging network in the city.

The initial measure expectations included to liaise with at least 5 key agents and companies (e.g. supermarket chains, shopping malls) in order to develop pilot projects concerning the use of electric vehicles, namely the launch of a “test fleet scheme”, including the potential implementation of electric charging facilities associated to their premises. In addition, strategies to promote the wide uptake of clean vehicles for freight delivery companies and private citizens will be designed and put in place.

Aiming to showcase EV benefits, as well as to play an exemplary role, the measure expected to introduce at least 20 electric vehicles in the municipal fleet.

The development of this measure was done in cooperation with EMT. EMT was expected to help the City Council in reaching out to different companies and stakeholders to involve them for a wider uptake of e-mobility, and to ease the access to its charging infrastructure, located at its public parking facilities, targeting specially car sharing services, taxi fleet and freight operators.

This measure has exceeded two of its three initial objectives, in both cases due to the commitment of the municipality: the number of electric cars added to the municipal fleet reached 130 units in January 2020, well above the initial objective of 20. The commitment of the municipal company EMT resulted in 5 fast-charging stations opened in different EMT-managed public parking facilities during 2018, to which it should be added 9 on-street fast-charging stations managed by the municipality as part of its own public charging network.

However, in spite of frequent contacts with different companies (and particularly with COOLTRA and Pascual), none of them engaged in the procurement of electric vehicles as a result of this measure.

The main conclusions on the measure integrating impact and process evaluation findings can be summarised as follows:

- E-cars provide substantial reductions in CO₂ and pollutant emissions as well as in energy use (83% to 100%), without any drawbacks in terms of reliability and performance of the fleet. In spite of energy cost savings, abatement costs remain high (EUR 250,71 per tCO₂ saved), but are expected to decrease as new e-car models enter the market.

- To achieve the expected emissions abatement results, a bottom-up approach is recommended, actively involving the vehicle users and those responsible for the municipal services to which the e-cars will be allocated. This will greatly facilitate the selection of the adequate e-car model for the envisaged service, as well as the active involvement of drivers and other personnel in making the most of the performance potential of e-cars.
- For municipal and other governmental fleets, operating lease (*“renting”*) schemes are a good alternative to circumvent bureaucratic barriers for procurement, and to relieve the reliability anxiety decision-makers and users may initially experience towards a new technology. Leasing schemes currently penalise e-cars versus ICE cars (additional cost of 45%), but this gap should decrease as leasing companies become more familiar with e-mobility and the availability and affordability of e-cars increase.
- The public fast-charging network can be substantially expanded in the short term, but it needs an adaptive management strategy to make the most of a rapidly evolving regulatory and demand framework. The combination of direct public action (by the municipality or through a public company like EMT in the case of Madrid) and cooperation with interested private companies is an effective way to achieve a strong deployment in a relatively short time (less than 2 years in Madrid).
- In the absence of such active policies, it is unlikely that the public fast-charging network will expand, due to a pervasive low demand explained not only by the low number of e-cars on the streets, but also but the convenience and lower costs of home charging.
- The ability of local governments to stimulate and support the electrification of private fleets is limited. This is due to the low priority that most corporate boards pay to fleet-related questions, to the fact that fleet-renewal decisions are taken only when the lifetime of the existing vehicles is close to termination, and to the still widely-perceived uncertainty regarding EV technology. Public action can be designed with a long-term strategy to raise awareness among corporate decision makers in the wider context of Corporate Social and Environmental Responsibility, rather than to spend public resources in incentives that are unlikely to change this conservative culture towards what is perceived as a marginal issue within many corporations.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

The measure is expected to have the following impacts:

- Improvement in the environmental performance of both, municipal and private fleets.
- Emission reduction from road traffic.
- Energy efficiency increased in road traffic.

(2) Strategic level:

- Reducing energy consumption and emissions coming from companies' fleets
- Promoting the uptake of clean vehicles
- Optimization of the city charging infrastructure.

(3) Measure level:

- An increase in the number of electric vehicles in the municipal fleet (minimum of 20)
- Deployment of the City Fast Charging Network: Increase of the number of fast charging stations (at least 3 new charging points)
- Increase of electric vehicles in private companies' fleet: Agreement with 5 companies to support the introduction of electric vehicles

A.1.1 Quantifiable impacts

Expected Impacts	ID	Quantifiable Impacts	CIVITAS ECCENTRIC Objectives								
			Reduce:				Improve:				
			Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight
	1	At least 20 electric vehicles in the municipality fleet (to be translated into energy, emission reduction)	x								
	2	Deployment of at least 3 new fast charging stations									
	3	Agreement with 5 companies to procure electric vehicles for their fleets	x								

Table 1: Quantifiable impacts.

A.2 Measure description

This measure aimed at promoting the use of electric vehicles (EV) by the municipality of Madrid, private companies and individuals. It included activities for the integration of EVs in public and private fleets and to expand the public charging network in the city.

The initial measure expectations included to liaise with at least 5 key agents and companies (e.g. supermarket chains, shopping malls) in order to develop pilot projects concerning the use

of electric vehicles, namely the launch of a “test fleet scheme”, including the potential implementation of electric charging facilities associated to their premises. In addition, strategies to promote the wide uptake of clean vehicles for freight delivery companies and private citizens will be designed and put in place.

Aiming to showcase EV benefits, as well as to play an exemplary role, the measure expected to introduce at least 20 electric vehicles in the municipal fleet.

The development of this measure was done in cooperation with EMT. EMT was expected to help the City Council in reaching out to different companies and stakeholders to involve them for a wider uptake of e-mobility, and to ease the access to its charging infrastructure, located at its public parking facilities, targeting specially car sharing services, taxi fleet and freight operators.

A.2.1 Measure outputs

Expected outputs at the planning and research stage:

- A City Electric Mobility Strategy, including (1) deployment of a (fast) charging network in Madrid for electric vehicles, (2) the renewal of the municipal fleet, including the replacement of conventional vehicles with electric vehicles as well as the identification of charging solutions for the municipal fleets, (3) the renewal of the city fleet, with a focus on professional users and key fleets (taxis, car sharing, urban freight, etc.).

Expected outputs and the procurement and implementation stages

- Procurement and operation of at least 20 electric vehicles for the municipal fleets, and at least 3 fast charging stations in the city.
- Identification of at least 5 private partners interested in the integration of electric vehicles within their fleets.
- Plan to engage stakeholders in the use of electric vehicles, including campaigns and incentives.

A.2.2 Supporting activities

No supporting activities have been identified at this stage.

A.2.3 Interactions with other ECCENTRIC measures

No interactions foreseen at this stage.

A.2.4 Interactions outside ECCENTRIC

Another actions outside ECCENTRIC may result in the procurement of additional electric vehicles for the municipal fleet or in further expansion of the number of fast charging stations.

In October 2018, the national government removed some existing regulatory barriers to the expansion of charging points. This could interact with ECCENTRIC, facilitating a quicker deployment of the public charging network envisaged in the municipality's strategy.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
10	Companies and institutions with car fleets		Vallecas and other Eastern districts
9	General public		City at large

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

The table below shows the main stakeholders involved in the measure. At this stage, the 5 private companies expected to participate in the measures have not confirmed their involvement yet.

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR- other	Level activity L-P-O	Role - Links
1	Director of Planning and Operations CRTM	P	Other (PTA)	O	
2	Head of Planning CRTM	P	Other (PTA)	O	
3	City councillor. Environment and Mobility	P	C	O	
4	City councillor. Sustainable urban development	P	C	O	
5	Director. Sustainability and Environmental control	P	C	O	
6	EMT CEO	P	PT	P	
7	EMT. Director of transport services	P	PT	P	
8	Ayuntamiento de Madrid. Measure leader	P	C	L	
9	EMT. Measure participant	P	PT	L	
10	Contacted companies (5 at least)	S	PR	O	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Difficulties in engaging private sector in the electric mobility uptake	9 (Financial)	Paying more attention to dissemination activities oriented to private companies. EMT strategy focused in creating a set of mobility services oriented to electric fleets	City EMT

Table 4: Identified risks.

B. Measure implementation

B.1 Situation before CIVITAS

Regarding air quality, the main problem of the city is related with NO₂ concentration levels. Road transport is responsible of the 50.4 % of the emissions of NO_x and the 34.9 % of CO₂ emissions within the city. The promotion of the use of Zero Emission vehicles, mainly for professional services, is considered as a key element in the promotion of a sustainable mobility in Madrid.

Electric Mobility is starting to grow. The city has an on-street charging network (24 spots) and a network of municipal parking facilities offering charging solutions. A fast charging infrastructure is starting to be developed. The first two fast charging points opened in September 2016.

Although several companies are starting to introduce electric vehicles in their fleets (taxi companies, private transport companies, car sharing companies) the electric mobility market needs to be boosted.

B.2 Innovative aspects

There are no innovative aspects to highlight in the implementation of this measure.

B.3 Research and Technology Development

There are no research and technology development dimensions to highlight in the implementation of this measure.

B.4 Actual implementation of the measure

Madrid has set its main goals on electric mobility under the frame of the PLAN A: AIR QUALITY AND CLIMATE CHANGE approved in September 2017. The city's Climate Change Department has drafted a roadmap to meet the electric mobility goals of PLAN A, consistent with the CIVITAS ECCENTRIC goals (Budget, Cooperation with EMT, Municipal Services, Stakeholders, etc.)

There have been some minor changes in the measure, mostly during the implementation stage. The main components of the measure are now the electrification of the municipal fleet (with a number of vehicles much higher than initially expected, thanks to the operating lease scheme and the decentralised management system put in place within the municipality), and the expansion of the fast-charging network in the city.

The design phase took place between September 2016 and July 2017. It built upon some initial experiences in leasing of electric cars conducted by the municipality, and included the key decision of decentralising the management of the leasing contracts. Leasing proved to be an effective mechanism to accelerate the inclusion of innovative technologies, such as electric cars, in the city fleet. The Waste Collection Service was selected for the pilot. The vehicles are dedicated to inspection of the services of garbage collection and street cleaning. Concerning the expansion of the public charging network, the planning stage included some pilot fast charging points installed by EMT in its public parking, Benavente in February 2017, and the necessary paperwork to get the official permit required to offer charging services to the public (electric charging manager license). In late 2018, the requirement of such official license was considered by the national government as a relevant barrier to the expansion of the charging network at the national level, and was abolished in October 2018.



Figure 1: Presentation of the municipal EV fleet, February 2019

The implementation phase took place between August 2017 and July 2018. It included the drafting of the first Request for Quotations (RfQ) for operating lease of 22 electric cars. An additional RfQ was launched subsequently, in 2018, for 32 additional electric cars. Concerning the charging network, in March 2018 EMT had charging points in operation at 4 public parking facilities (Colón, Benavente, Salamanca, Recuerdo), within the programme “Electro-EMT”. It also included the preparation of the RfQ by the municipality for 20 additional fast-charging points in the city, in private premises with public access; these fast-charging points should be operational in 2019. The involvement of private companies in the measure has been difficult. Thus far, two companies (COOLTRA, offering e-mobility services, and Pascual, a freight distributor) have agreed to explore the possibility of including electric vehicles in their fleets. Pascual is building upon their previous experience in the FP-7 “FREVIEW” project, and has recently decided (board decision in March 2018) to procure several plug-in hybrids, as an intermediate step before considering to include full electric vehicles in its fleet. COOLTRA’s mobility services are focusing on leasing of electric motorbikes, but the company is considering to expand its services to include a new last mile delivery service with electric vans in Madrid.

The operational phase is taking place since February 2018 and includes 19 electric cars. They are part of the new 70 (44 acquired by Environment Area and 26 belonging to Economy Area) electric cars that started regular operations in municipal services in April 2018. In addition, 136 electric cars (74 acquired Environment a mobility Area and 62 new electric vehicles acquired by the Municipality’s Economy Area) are expected to start operating in January 2019. For monitoring and evaluation purposes, the measure remains limited to the fleet of 19 vehicles initially envisaged in the project description. The operation of the EMT charging points has been monitored since March 2018.

Concerning the charging network strategy, the municipality is following a mixed approach, combining the expansion of the EMT network of charging points at their public parking facilities

with the upgrading of the municipal on-street charging network (most of the points in the network it will offer fast charging services) and with agreements between the municipality and private stakeholders (at least 20 fast chargers will be supplied by the city council to private operators for the deployment of public access fast charging network). This new approach has been facilitated by the national government with the removal of regulatory barriers in October 2018. As required by that regulation, EMT has obtained the license as a “National Charge Manager”; this license is no longer requested, which should result in more agents considering to enter this market.

EMT has designed a corporate strategy to become a sustainable mobility services provider including offering electric vehicle charging solutions in facilities (public parking facilities mainly) managed by the company. The procurement of 14 fast charging terminals was completed in 2018, and the first fast charging stations are already operational (since first quarter 2018) in Jacinto Benavente Parking Facility (EMT) offering different charging solutions, Plaza de Colon (4 fast chargers) and 2 more EMT parking facilities. Furthermore, one slow charge hub has been installed in one of the Park and Ride facilities in Madrid, and an agreement has been signed with two “EV Charging Services Providers” for the management of the city’s “on-street charging network”. The agreement will allow an upgrade of the net with at least 12 spots with fast chargers and all of them with universal payment devices.

A strategy to engage private stakeholders in the use of electric vehicles in their fleets has been jointly defined by the municipality and EMT, considering EMT’s parking facilities as a key element.



Figure 2: ECCENTRIC at the Annual Electric Vehicle Exhibition

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1,3				
Indicator name	CO2 emissions	NOx emissions	PM emissions	Energy efficiency	VKT (vehicle-km travelled)
Type	KPI	KPI	KPI	KPI	KPI
Category	Environment	Environment	Environment	Environment	Transport system
Subcategory	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Energy consumption	General
Aspect	Emissions	Emissions	Emissions	Emissions	Total travel
Definition	Emissions (t per year of CO2)	Emissions (t per year of NOx)	Emissions (t per year PM)	Specific energy (MJ/km) consumption	Sum of all km travelled by each EV fleet
Unit	tons	tons	tons	MJ/km	km
Method of data collection	Estimate based on VKM and energy consumption	Estimate based on VKM and energy consumption	Estimate based on VKM and energy consumption	Estimate based on VKM travelled	Provided by vehicle operator
Target group	New EV in fleets	New EV in fleets	New EV in fleets	New EV in fleets	New EV in fleets
Domain	Fleets participating in the measure	Fleets participating in the measure	Fleets participating in the measure	Fleets participating in the measure	Fleets participating in the measure
Control sample	Comparison required with similar ICE vehicles in the fleets	Comparison required with similar ICE vehicles in the fleets	Comparison required with similar ICE vehicles in the fleets	Comparison required with similar ICE vehicles in the fleets	Comparison required with similar ICE vehicles in the fleets
Related measures, activities, and interference sources	Socio-economic conditions at the city level may change the service requested to the fleet vehicles	Socio-economic conditions at the city level may change the service requested to the fleet vehicles	Socio-economic conditions at the city level may change the service requested to the fleet vehicles	Socio-economic conditions at the city level may change the service requested to the fleet vehicles	

Table 5: Description of key performance indicators (KPI)

Impact	1,3		
Indicator name	Costs	System usage (new EMT charging points)	System usage (new EMT charging points)
Type	KPI		
Category	Economy	Transport system	Transport system
Subcategory	Costs	General	General
Aspect	Full costs	System demand	System demand
Definition	Average leasing and operating costs per EV	Number of charges provided to EVs.	Total energy supplied to EVs
Unit	EUR/km	Quantity/year	kWh/year
Method of data collection	Leasing (or investment) and operational costs provided by each fleet manager	Provided by EMT	Provided by EMT
Target group	New EV in fleets	EMT charging points	EMT charging points
Domain	Fleets participating in the measure	EV charging points provided by EMT	EV charging points provided by EMT
Control sample	Comparison required with similar ICE vehicles in the fleets	No	No
Related measures, activities, and interference sources	Socio-economic conditions at the city level may change the service requested to the fleet vehicles	None	None

Table 6: Description of key performance indicators (KPI)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
	CO2 emissions per year	Tons	B – A	E	Municipal EV fleet	
	NOx emissions per year	Tons	B – A	E	Municipal EV fleet	
	PM emissions per year saved	Tons	B – A	E	Municipal EV fleet	
	Average energy consumption	MJ/km	B – A	E	Municipal EV fleet	
	VKM travelled (monthly or yearly average)	Km	B – A	DC	Municipal EV fleet	
	Total costs	EUR/km	B – A	DC	Municipal EV fleet	
	Use of new EMT charging points (monthly or yearly average)	Quantity	A	E	EMT charging points	
	Use of new EMT charging points (monthly or yearly average)	kWh/year	A	E	EMT charging points	
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 7: Measure's indicators

C.1.2 Baseline

The baseline has to be set up individually for each test fleet: city fleet and private partners' fleets. Until now, there are no private partners involved in the measure; therefore, the baseline is established only for the city fleet.

In the case of the city fleet, the sample monitored consists of 19 Renault Zoe cars, used by the Waste Management Service for controlling the quality of on-street public cleaning services. These vehicles have replaced a similar number of Kia Rio gasoline Euro 5 cars, which will be considered as the baseline case. In both cases, the procurement procedure is a operating leasecontract including maintenance, which facilitates the comparison of capital and operational costs: 287.16 EUR/month in the case of Kia Rio and 420 EUR/month in the case of Renault Zoe.

The information available in the Waste Management Service provide some key data for the baseline. In accordance with this information (year 2017), the average fuel consumption of the 19 gasoline cars was 9.53 litres of gasoline/ 100 km, and the average annual distance travelled per car was 16,786 km. Making use of the COPERT⁵⁶ v.5.2 model, these figures result in the values presented in the table below for the relevant indicators for year 2017.

⁵⁶ COPERT (Calculation of Emissions from Road Transport) is a computer programme developed by EMISIA with the support of the European Environment Agency, currently used for the estimate of emissions in national inventories. <https://www.emisia.com/utilities/copert/>

Indicator	Unit	Average Car	Whole Fleet
CO2 emissions per year (ICE Euro 5)	ton/year	3.9458	74.970
NOx emissions per year (ICE Euro 5)	ton/year	0.001543	0.0293
PM emissions per year (ICE Euro 5)	ton/year	0.000525	0.0100
Energy consumption (ICE Euro 5)	TJ/km	0.05471	1.0394

Table 8: Emission baseline values for the city's test fleet (19 cars)

Yearly energy consumption would be 918 TJ/year for each car, or 17,447 TJ/year for the whole fleet.

The total costs per vehicle per year is 5,399 €, or 0.32 €/km. 64% of the cost is dedicated to leasing cost and the remaining 36% to fuel.

As for the use of the new charging points EMT is installing, their use should serve as an indicator of the increase of EVs in the city. The fares for this service are 0.35 €/kWh, except for on-street charging points, where it is slightly higher (0.40 €/kWh).

C.1.3 The business-as-usual scenario

The business as usual (BaU) scenario assumes that, in the absence of the measure, the Municipality would have continued its previous leasing scheme requesting ICE vehicles for its fleet. It can be assumed that Euro5 gasoline cars would have been replaced by Euro6 cars of similar size. There would be no changes in the services provided by the fleet.

The services provided by the fleet are not expected to change, in terms of distance or traffic conditions. Each vehicle follows different routes from day to day, in accordance with the inspection needs, following mostly primary and secondary streets. Average traffic conditions are 50% off-peak (average speed, 50 km/h), and 50% peak (average speed, 20 km/h). The table below provides the relevant indicators on emissions and energy consumption in the BaU scenario (i.e. for a small Euro6 gasoline car).

Indicator	Unit	Average Car	Whole Fleet
CO2 emissions per year (ICE Euro 6)	ton/year	3.9458	74.970
NOx emissions per year (ICE Euro 6)	ton/year	0.001689	0.0321
PM emissions per year (ICE Euro 6)	ton/year	0.000528	0.0100
Energy consumption (ICE Euro 6)	TJ/km	0.05471	1.0394

Table 9: Emission BaU values for the city's test fleet (19 cars)

Yearly energy consumption would be 918 TJ/year for each car, or 17,447 TJ/year for the whole fleet.

In accordance with COPERT results, changing from Euro5 to Euro6 technologies has no effect in terms of CO2 emissions or energy savings. Furthermore, there is a slight increase in NOx and PM emissions. This is due to the operation of the cars in urban conditions, in which the Euro6 technology for small cars cannot provide relevant improvements.

Lease costs and fuel prices are assumed to remain the same between 2017 and 2019. Therefore, the total costs per vehicle per year would be the same as in the baseline: 5,399 €, or 0.32 €/km. 64% of it for leasing and the remaining 36% for fuel.

No private companies have agreed to join the measure; therefore, there are no other fleets to include in the BaU scenario.

Concerning the charging points, it is assumed that in the BaU scenario the EMT charging points would not have been put in place, as EMT would not have considered to provide charging services in the absence of the ECCENTRIC project.

C.2 Measure results

Measure results are summarized in the table below (values are provided for the whole monitored fleet- 19 cars- and for the 5 charging points EMT has put in service in 2018. For the sake of allowing the comparison among scenarios, it is considered that the distance travelled by the municipal fleet in the three scenarios is the same, and equal to the distance reported by the electric cars during the reporting period (December 2018-July 2019), adjusted to cover a whole year (229,808 km for the 19-vehicle fleet or 12,095 km per car). Operating costs add to the lease cost the fuel costs (2018 average national values of 1.2886 €/l for gasoline and 0.2523 €/kWh for electricity).

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
CO2 emissions	Tons/year	52.359	2017	52.359	2019	8.666	2019	-43.693	-43.693
NOx emissions	Tons/year	0.0205	2017	0.0224	2019	0	2019	-0.0205	-0.0224
PM emissions	Tons/year	0.0070	2017	0.0070	2019	0	2019	-0.0070	-0.0070
Energy consumption	TJ/year	0.7259	2017	0.7259	2019	0.1268	2019	-0.5991	-0.5991
Distance travelled	km	229,808	2017	229,808	2019	229,808	2019	0	0
Operating costs	EUR/year	93,694	2017	93,694	2019	104,648	2019	10,954	10,954
Use of new EMT charging points	Quantity	0	2017	0	2019	5	2019	5	5
Use of new EMT charging points	kWh/year	0	2017	0	2019	37,814	2019	37,814	37,814

Table 10: Measure results (summary of indicators)

CO2 emissions in the “after” scenario are calculated based on the average national CO2 emissions from the electricity system in Spain (0.246 kg CO2/kWh in 2018). The average

GHG abatement cost from the replacement of the municipal fleet by electric cars is 250.72 €/ton of CO₂.

C.3 Summary: achievement of objectives

This measure has exceeded two of its three initial objectives, in both cases due to the commitment of the municipality: the number of electric cars added to the municipal fleet reached 130 units in January 2020, well above the initial objective of 20. The commitment of the municipal company EMT resulted in 5 fast-charging stations opened in different EMT-managed public parking facilities during 2018, to which it should be added 9 on-street fast-charging stations managed by the municipality as part of its own public charging network.

No.	Objective and target	Rating	Comment
1	At least 20 electric vehicles in the municipality fleet (to be translated into energy, emission reduction)	***	The number of e-cars in the city fleet reached 130 in January 2019.
2	Deployment of at least 3 new fast charging stations	***	5 fast charging stations opened by EMT 9 on-street fast charging stations (ChargeMaster) opened by the municipality
3	Agreement with 5 companies to procure electric vehicles for their fleets	O	In spite of the measure team efforts, none of the companies approached added e-cars to their fleets
NA = Not Assessed O = Not Achieved in full * = Substantially achieved (at least 50%) ** = Achieved *** = Exceeded			

Table 11: Assessment of objectives

In spite of frequent contacts with different companies (and particularly with COOLTRA and Pascual), none of them engaged in the procurement of electric vehicles as a result of this measure.

C.4 Up-scaling

The municipality's objective, as stated in measure #18 of the Air Quality Plan, is that by 2020 75% of the municipal fleet (considering scooters, motorcycles and cars) should be within the "ECO" and "CERO" emission categories. This includes, besides electric vehicles, hybrid and plug-in hybrid vehicles (PHEV), as well as those using GNC or GLP. There are no specific figures concerning electric cars.

During the 2017-2019 period, 207 electric vehicles (and 5 PHEV) have been added to the municipal fleet, through four leasing contracts (two of them launched by the Environmental Area and two by the Financial Area of the municipality). On top of that, 32 electric vehicles and 23 PHEV have been added to the city policy fleet during 2019.

The municipality has not provided any figures on its plans to add additional EV to its fleet in 2020-2023. For the up-scaling exercise, it can be assumed that a number similar to the previous period (2017-2019) could be added: 239 electric cars in total.

The EVs added to the fleet in 2020-2023 would provide emission savings of 550 t CO₂, 0.26 t NO_x and 0.088 t PM per year, and energy savings of 7.5 TJ per year.

In accordance with measure 20 of the Air Quality Plan, the charging network in the city (including all typologies, and both public and private charging points) should include 250 points

by 2022. The Plan does not differentiate how many of them should be public, and how many fast (50 kW) or semi-fast (22 kW) charging points. There are no indications that EMT or the municipality will further expand their public charging facilities: the expansion of the charging network relies, therefore, in the willingness of private companies to do so.

This measure was not successful in convincing any private company to add EVs to its fleet. Therefore, this particular action cannot be up-scaled.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

There are no deviations to report from the original plan: the initial plans on expansion of the public charging network, and on the addition of electric cars to the municipal fleet have been implemented.

D.2 Barriers

The following barriers were identified during the measure process evaluation.

D.2.1 Technological barrier

This barrier refers to the lack of adequate vehicles to meet the private companies' needs (mainly regarding range and limited model choice). Some companies (Pascual) chose plug-in hybrids as a more reliable solution for its personnel. They also considered to provide charging infrastructure at their employees' homes, as they usually take the company car home at night.

Recent market developments are expected to overcome this barrier, as European (and other) manufacturers have announced to put in the market new models, tripling the current offer by 2025⁵⁷.

Concerning charging infrastructure availability, an array of measures is under implementation, including the expansion of the public network, public grants for private charging points and regulations facilitating and, at term, making it compulsory the installation of charging points at private collective parking lots.

D.2.2 Financial

This barrier refers to the high up-front costs compared with conventional vehicles and insufficient incentives. The municipality has established some incentives (such as free parking), and the national and regional governments have established different subsidies for e-vehicles. Leasing contracts have also proved to be an effective way for the municipality (and others) to include electric cars in their fleets and to reduce the risks associated to the use of a new technology; the increase in the leasing costs compared with an ICE car is significant (45%), and can be compensated only partially with fuel savings, but it is expected to decrease in the coming years, as leasing companies get better knowledge of the risks associated to electric cars (which, in fact, are proving to be more robust than their ICE competitors), and their purchase price decreases.

Another financial barrier refers to the deployment of the public charging network, due to lack of profitability of the service. The removal of the administrative requirement of obtaining a license has facilitated the involvement of private stakeholders interested in offering charging

⁵⁷ Transport & Environment (2019). Electric surge: Carmakers' electric car plans across Europe 2019-2025. https://www.transportenvironment.org/sites/te/files/publications/2019_07_TE_electric_cars_report_final.pdf

points at their premises, with public access. The municipality has established a plan with financial incentives to support those private companies interested in providing charging points at their premises, if they can be accessed by all the public.

D.2.3 Institutional

This barrier refers to the cumbersome administrative procedures within the municipality for the procurement of new cars, which do not favour electric cars. Operating lease was identified as a convenient option to overcome administrative barriers, to limit the technological uncertainties about maintenance costs and reliability and to cope with the higher up-front costs

D.3 Drivers

The following drivers were identified during the measure process evaluation.

D.3.1 Political

Since June 2018, the national government has become more active in supporting electric vehicles. The engagement of the municipality government has also increased, linked to the approval of the Air Quality Plan (Plan A), and has materialised in the search for agreements with private companies to establish public charging point, and the approval of some additional incentives such as free parking, access to low emission zones (Madrid Central) or a zero circulation tax to EVs.

D.3.2 Cultural

A growing part of the public is becoming more sensitive to car-emissions since the dieselgate scandal, and also more interested in alternative options such as car-sharing services and micromobility solutions. Some private companies, like COOLTRA (offering thus far motorcycle-based services), are considering entering the car-sharing market with electric cars. Currently, 10 private companies are offering electric car and moto sharing services in the city.

D.3.3 Institutional

There is a keen interest within certain municipal departments (and among some civil servants) to test innovative, clean solutions. Adoption of e-cars are favoured by administrative reforms within the municipality to further decentralise its bureaucracy and decision-making processes and to stimulate the adoption of environmentally-friendly solutions, such as leasing of electric cars, with a bottom-up approach.

D.4 Supporting activities

There are no supporting activities to report linked to this measure.

D.5 Recommendations on the implementation process

Three recommendations can be highlighted, based on the measure implementation experience.

D.5.1 Government's fleets: A bottom-up approach, mainstreaming the use of electric cars

Two elements are particularly relevant in the success story of the quick expansion of electric cars within the municipality's fleet. On the one hand, a bottom-up approach, in which those directly in charge of the targeted municipal services were informed about the characteristics of electric cars and were involved in the decision-making process, so that the selected models could fit their needs. On the other hand, the design of an effective administrative mechanism for the new e-cars; instead of changing the complex rules for direct acquisition, the leasing option proved to be much quicker to implement, requiring only minor changes in the description of the vehicles within the relevant documents; it also moved to the contractor the risks associated to the lack of municipal experience on e-cars, increasing the acceptability of this option for municipal decision-makers.

D.5.2 Adaptive management

The approach to the deployment of the public charging network in Madrid had to adapt as the regulatory environment and the public's attitude quickly evolved during the project life. At the project start, in 2016, the regulatory barriers to public charging were circumvented by establishing the municipal bus company EMT as an authorised public charging provider (as was required at that time by the law). Once the national government removed these regulatory barriers in 2018, the approach evolved towards the support of private companies interested in providing such service in their premises.

D.5.3 A long-term municipal strategy to encourage the electrification of private fleets

The electrification of private fleets proved to be an objective that could not be achieved within the 4-year framework of ECCENTRIC. Changes in fleet-related decisions are not a priority for most corporate boards and relatively radical changes- like electrification- need to find champions within the organisation willing to fight a long battle; even in those cases in which corporations are open to change, the replacement of vehicles must take place at the time at which the old ones have achieved their expected lifetime.

In this context, action from the municipality has to focus on the long-term, providing companies with information on the advantages of e-mobility, supported by an attractive incentive package, so that e-cars can be considered as an option at the time each company needs to replace a part of its fleet.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed through well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the following evaluation conclusions have been formulated.

E.1 Validated direct impact

The key results concerning the observed impacts of the measure can be summarised as follows:

- **Quick expansion of e-cars within the municipal fleet.** The number of e-cars in the municipal fleet expanded substantially, well above the projects target of 20 units. This achievement can be explained by the project's adaptive management approach to make the most of some favourable drivers (Air Quality Plan, renewed political interest on e-mobility...), involvement of final users and effective implementation of administrative instruments to facilitate the access of e-cars to the municipal fleet.
- **Quick expansion of the fast-charging network in the city, with low but increasing use.** The number of public fast-charging stations in the city increased substantially, first through the involvement of EMT (charging stations in some of its public parking lots) and later through the involvement of the municipality (on-street fast-charging stations) and the private sector (municipal incentives to those providing public fast-charging stations in their private premises). Monitoring of the use of EMT stations shows a low use, which can be explained by the preference of e-car owners for much cheaper home charging and by the still low number of e-cars in Madrid: sales of cars in Madrid with a "CERO" emissions label (which includes e-cars and plug-in hybrid cars) accounted for just 1.3% of total 2018 car sales.
- **Significant reduction of emissions and energy consumption.** For the 19 cars monitored by the project, the reductions in CO₂ emissions and energy use were substantial (83%), as well as in NO_x and PM (100%). These savings came, however, at a cost: the estimated abatement cost was high, some EUR 250.72 per tCO₂.

E.2 Relevance of supporting activities

No supporting activities were implemented in this measure.

E.3 Interaction with other measures

This measure had not any significant interaction with other measures in ECCENTRIC or in other projects.

E.4 Main lessons learned

The main conclusions on the measure integrating impact and process evaluation findings can be summarised as follows:

- E-cars provide substantial reductions in CO₂ and pollutant emissions as well as in energy use (83% to 100%), without any drawbacks in terms of reliability and performance of the fleet. In spite of energy cost savings, abatement costs remain high

(EUR 250,71 per tCO₂ saved), but are expected to decrease as new e-car models enter the market.

- To achieve the expected emissions abatement results, a bottom-up approach is recommended, actively involving the vehicle users and those responsible for the municipal services to which the e-cars will be allocated. This will greatly facilitate the selection of the adequate e-car model for the envisaged service, as well as the active involvement of drivers and other personnel in making the most of the performance potential of e-cars.
- For municipal and other governmental fleets, leasing schemes are a good alternative to circumvent bureaucratic barriers for procurement, and to relieve the reliability anxiety decision-makers and users may initially experience towards a new technology. Leasing schemes currently penalise e-cars versus ICE cars (additional cost of 45%), but this gap should decrease as lessors become more familiar with e-mobility and the availability and affordability of e-cars increase.
- The public fast-charging network can be substantially expanded in the short term, but it needs an adaptive management strategy to make the most of a rapidly evolving regulatory and demand framework. The combination of direct public action (by the municipality or through a public company like EMT in the case of Madrid) and cooperation with interested private companies is an effective way to achieve a strong deployment in a relatively short time (less than 2 years in Madrid).
- In the absence of such active policies, it is unlikely that the public fast-charging network will expand, due to a pervasive low demand explained not only by the low number of e-cars on the streets, but also but the convenience and lower costs of home charging.
- The ability of local governments to stimulate and support the electrification of private fleets is limited. This is due to the low priority that most corporate boards pay to fleet-related questions, to the fact that fleet-renewal decisions are taken only when the lifetime of the existing vehicles is close to termination, and to the still widely-perceived uncertainty regarding EV technology. Public action can be designed with a long-term strategy to raise awareness among corporate decision makers in the wider context of Corporate Social and Environmental Responsibility, rather than to spend public resources in incentives that are unlikely to change this conservative culture towards what is perceived as a marginal issue within many corporations.

E.5 Long term impact

Based on the evaluation of this measure, the following long-term impacts can be expected:

- Considering a car lifetime of 10 years, savings from the BAU scenario will reach 437 tons CO₂, 0.224 tones NO_x, 0.070 tons PM and 6.0 TJ, at an additional cost of €109,547.
- A decrease in CO₂ emissions and energy consumption, as well as NO_x and PM emissions from public car fleets in Madrid. The relevance of this impact relies on the rate of electrification of public and private fleets. Whereas the municipality is actively increasing the number of e-cars (as well as plug-in hybrid cars and electric cars with extended range), in the framework of its Air Quality Plan, this effort is still jeopardised by the higher costs of e-cars and the relatively low annual mileage of most of the fleet (some 12,000 km in the case of the ECCENTRIC-monitored fleet).

- A decrease in CO₂ emissions and energy consumption, as well as NO_x and PM emissions from private car fleets in Madrid. Although these impacts have not been achieved during the project life, it is expected that the activities undertaken by the project will result in at least 2 companies including a fleet of 50 e-cars after project completion. Assuming an average annual mileage of 12,000 km, this would result in additional savings of 1,150 tons CO₂, 0.590 tones NO_x, 0.184 tons PM and 15.8 TJ

E.6 Potentials for up-scaling in the city

The following conclusions can be highlighted, based on the possibilities to up-scale this measure in Madrid:

- There are excellent prospects to further up-scale the electrification of municipal fleets with additional e-cars. This is consistent with the actions envisaged within the municipality's Air Quality Plan and should be facilitated by the shrinking trends in e-car prices. This plan has set an objective to reach a low-carbon share of 75% by 2020 and 90% by 2030 of the municipal motorcycle and car fleets. This would include EVs as well as hybrid and plug-in hybrid vehicles. The ECCENTRIC results would strengthen the case to make the most of e-cars (rather than hybrid cars) to achieve this target.
- In accordance with last year trends, it can be estimated that a minimum of 50 EVs per year will be added to the municipal fleet in 2020-2023. This is combined with an effort to adapt the municipal buildings (35 buildings have already been adapted during ECCENTRIC), in spite of the administrative and technical hurdles of such adaptation and its significant cost. Additionally, the municipality is including specific requests to include EV in its Requests for Quotations for contracting out different municipal services (waste collection, mobility...), which could result in 200 additional EV during the 2020-23 period.
- The prospects for further expansion of the public fast-charging network are also excellent. The objective of the Air Quality Plan is to reach at least 250 charging points by 2022. The municipality is establishing contracts with private companies, so that they receive municipal charging infrastructure to be installed in their premises and allowing public access to them.
- As a result of the experience gained in the deployment of fast-charging stations, EMT has revised its strategy. The deployment of charging stations in public parking facilities will no longer be a priority, as the use of these charging points by consumers is much lower than expected (EV drivers clearly prefer to rely on cheap slow-charging options at home and the park & charge option offered by EMT does not seem particularly attractive); the deployment of EMT charging stations will therefore focus on strategic locations within the city (following the positive experience of the Colon hub, three additional hubs will be installed); additionally, EMT will adapt its residents' parking facilities in order to allow 16/32 A charging.
- The impact of the activities undertaken by the municipality with private companies for the expansion of EV in private fleets has been very low. These activities aimed at providing charging infrastructure and preferential parking, and did not succeed in accelerating the uptake of EVs within the private companies approached by the municipality. One key barrier is the fact that many companies have contracted out most of their transport needs, which are provided by self-employees or small companies with

no financial capacity to go electric. There is a need to explore alternative business models to support electrification in private companies.

- However, the implementation of regulatory measures (new local mobility regulations- *Ordenanza de Movilidad*- and the expansion of the Low Emission Zone- *Madrid Central*) seems to have had a significant impact in the steady growth on EV registered in the city: from 4768 cars and 264 commercial vans at the end of 2018 to 6243 cars and 350 commercial vans at the end of 2019.

F. Additional information

F.1 Appraisal of evaluation approach

Based on the evaluation assessment for this measure, the following weak and strong points and recommendations can be highlighted for similar evaluation work in the future:

- For changes in car fleets, the “before” and BAU scenarios can be properly described through records on mileage and fuel consumptions. This information is usually recorded by most fleet managers, offer a direct way to estimate CO2 emissions and energy consumption, and it is the basis to apply emission factors on NOx and other pollutants. This approach has been followed in this measure, providing reliable results.
- Monitoring of mileage and electricity consumption for the new e-cars is better ensured through the use of a dedicated datalog system. Whereas periodic recording of car mileage is simple to do, it is difficult to register the actual kWh provided to each car at each charging event.
- Any assessment of costs on e-car use are uncertain at this stage: their prices are moving down steadily, and the diversity of financial incentives available in different countries and cities jeopardises a consistent evaluation. In the case of leasing schemes (as in this case), the financial partner is likely to apply a fee well over the additional cost of the e-car compared to an ICE car, in order to protect itself against the uncertainties linked to the performance of this new technology.
- The measure evaluation process was not able to adequately assess the impact on the private sector. During the design stage, it was assumed that ECCENTRIC would be able to attract some private companies to include e-cars and their fleets, and selected the monitoring indicators accordingly (number of companies and number of e-cars). As the interaction with the private sector proved to be much more difficult and decision-making much slower, it seems that alternative indicators should be chosen, focusing on the effectiveness of awareness raising actions and progress within the decision-making hierarchy (number of companies contacted, number of companies in which a replacement study has been undertaken, discussions at the board...).

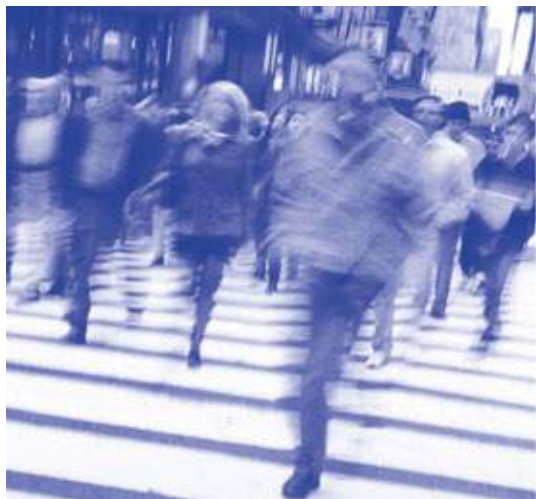
F.2 Future activities relating to the measure

Based on this measure experience, the project team recommends the following activities for the future of the measure after the project lifetime:

- To continue and expand monitoring of the e-cars within the municipal fleet. In order to strengthen the case for e-cars (and other EVs), it is necessary to gather reliable information on their performance. This can be done through continuous monitoring with IT cards and datalogs, registering mileage, energy consumption and maintenance needs.
- Revision of leasing contracts. As leasing remain too high to provide a financial justification for the use of e-cars instead of ICE cars, it is necessary to review whether leasing contracts can be revised or contracted out with more advantageous conditions for the municipality. As the reliability and affordability of e-cars increases, and the

financial partner gains experience with this technology, leasing costs should move down.

- A long-term strategy to support private companies. Based on the experience gained through ECCENTRIC, and the barriers found for the electrification of private fleets, the municipality may consider to prepare a long-term strategy based on awareness-raising and Corporate Socio-Environmental Responsibility, targeting those sectors with car fleet profiles better suited for electrification.



2020
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ECCENTRIC



TUR 6.4

Electrification of City's Fleet and Promotion of Electro-mobility Measure Evaluation Report

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Responsible Co-Author(s):	Stella Aaltonen, Anna Lilja, Heini Viljanen
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ECCENTRIC



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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Stella Aaltonen	
Anna Lilja	
Heini Viljanen	

Table of Contents

ABSTRACT.....	1282
A. INTRODUCTION.....	1283
A.1 EXPECTED RESULTS OF THE MEASURE	1283
A.1.1 Quantifiable impacts.....	1283
A.2 MEASURE DESCRIPTION	1284
A.2.1 Measure outputs.....	1284
A.2.2 Supporting activities	1285
A.2.3 Interactions with other ECCENTRIC measures.....	1285
A.2.4 Interactions outside ECCENTRIC	1285
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1285
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1285
A.5 IDENTIFIED RISKS	1286
B. MEASURE IMPLEMENTATION	1287
B.1 SITUATION BEFORE CIVITAS	1287
B.2 INNOVATIVE ASPECTS.....	1287
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1287
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1287
C. IMPACT EVALUATION FINDINGS	1291
C.1 EVALUATION APPROACH.....	1291
C.1.1 Expected impacts and indicators.....	1291
C.1.2 Baseline.....	1292
C.1.3 The business-as-usual scenario.....	1295
C.2 MEASURE RESULTS.....	1296
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1303
D. PROCESS EVALUATION FINDINGS	1305
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1305
D.2 BARRIERS	1305
D.2.1 Problem-related	1305
D.2.2 Organizational	1305
D.3 DRIVERS	1305
D.3.1 Involvement, communication.....	1305
D.3.2 Technological	1306

D.4	SUPPORTING ACTIVITIES.....	1306
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1306
D.5.1	<i>Commitment of superiors will create best circumstances for piloting</i>	1306
D.5.2	<i>Map out the barriers</i>	1306
E.	EVALUATION CONCLUSIONS	1307
E.1	VALIDATED DIRECT IMPACT	1307
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1307
E.3	INTERACTION WITH OTHER MEASURES	1307
E.4	MAIN LESSONS LEARNED	1307
E.5	LONG TERM IMPACT	1308
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1308
F.	ADDITIONAL INFORMATION	1309
F.1	APPRAISAL OF EVALUATION APPROACH	1309
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1309

List of Figures

Figure 1. Travel mode on trips under 5km during the workday	1294
Figure 2. Acceptance of vehicles tested	1298
Figure 3. Reasons for not using the LEVs	1298
Figure 4. Satisfaction in the LEVs	1299
Figure 5. Modal split among pilot participants	1301
Figure 6. LEV system usage	1302

List of Tables

Table 1: Quantifiable impacts..... 1283

Table 2: Target groups or affected parties 1285

Table 3: Measure stakeholders..... 1285

Table 5: Description of indicators 1291

Table 6: Measure’s indicators 1292

Project	City		
CIVITAS ECCENTRIC	TURKU		
Measure code	Measure name		
TUR 6.4.	Electrification of City's Fleet and Promotion of Electro-mobility		
Last update	Responsible	e-mail	telephone
5.5.2020	Stella Aaltonen	stella.aaltonen@turku.fi	+358449075983

Abstract

According to the results of the Mobility Survey for Turku city employees from 2013, 15% of all commuting was under 5km, and 42% of work-related trips (during working hours) were under 5km, and were done by a passenger car (as a driver or passenger). 31% of these work trips (during working hours) are driven by employees using their own cars. Many, if not all, of these trips could be taken with some other mobility device/form than a car. In measure TUR 6.4., the City of Turku was to test nine light electric vehicles (LEVs), including e-bikes and e-scooters, as an alternative mode of travel to and from work and during the workday. For the purpose of exploring the usability of LEVs in replacing private car use and the attitudes and experiences of employees, a survey was to be conducted to each pilot participant.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 6.4. was measured. Data was derived from surveys, LEV usage records, secondary data from the city of Turku and reference data on emissions from the national LIPASTO database.

Overall, the measure reached its objectives satisfactorily. An e-vehicle pilot was carried out with nine different LEVs. 105 Turku city employees tested the vehicles and experiences gathered among them provided a valuable viewpoint on LEV usability and the main barriers and drivers related to their potential further deployment in the city fleet. It can be stated that the potential of LEVs as an energy efficient, low-emission, low-cost and feasible alternative for replacing the use of one's own car for work-related trips has been proven based on high acceptance and satisfaction levels among the users. Whether there has been any permanent impact on the modal share of the participants remains to be seen and would need further surveys to observe. An e-mobility plan is being devised during spring 2020 based on measure experiences and experiences from other cities, hopefully resulting in further uptake of LEVs in the city fleet.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

- (1) City policy level in perspective of CIVITAS goals/ longer term:

The measure supports the target of Turku to become a carbon neutral city by 2029 by promoting and implementing sustainable, clean and energy efficient modes of transport. At city policy level, it is important to build up critical mass and markets for electric transport and logistics and innovations linked to electro-mobility. Moreover, the measure helps to overcome barriers for implementing innovative solutions and policies of future urban planning through experimental testing and linked data collection. At policy level, the goal is to convince politicians about the electrification of city transport.

- (2) Strategic level:

The goal of the measure is to increase efficiency of the use of the city fleet and reduce the need for the use of own car for work travel. The City of Turku is a forerunner city on national scale in promoting electromobility, yet there are several actions that the city could take to promote the wider take-up of e-mobility, including increasing the efficiency of shared e-mobility, electrification of the city's own fleet and favouring electric vehicles in procurement. It has been estimated that altogether app. 40 % of the city's cars could be replaced with electric cars or light electric vehicles – what is needed is piloting and promotion of different options among city employees.

- (3) Measure level:

10 different electric vehicles (e-bikes, e-cargo bikes, e-vans, and e-cars) will be tested together with different awareness raising methods for e-mobility in different city departments.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
1	The efficiency of the use of the city fleet has increased by 20% during the demonstration time	X	X								
2	The use of own car on work travel has reduced by 20% in comparison to year 2016 by the end of year 2019.	X	X								
3	Emission reductions by 10 pilot vehicles, around 10t/a reduction of CO2.	X									

Table 1: Quantifiable impacts

A.2 Measure description

The City of Turku was to test nine light electric vehicles (LEVs), including e-bikes and e-scooters, in parallel to awareness raising actions for e-mobility in different city municipal departments.

LEVs provide an opportunity to replace the use of a passenger car, especially for trips under 10 kilometres. According to the results of the Mobility Survey (2013) for Turku city employees, 15% of all commuting was under five kilometres, and 42% of work-related trips (during working hours) were under five kilometres, and were done by a passenger car (as a driver or passenger). 31% of these work trips (during working hours) were driven by employees using their own cars. Many, if not all, of these trips could have been taken with some other mobility device/form than a car.

The measure aimed to test and promote e-mobility solutions and sustainable means of transportation, carefully taking into account Turku's Sustainable Urban Mobility Strategy and other relevant strategic decisions of the city. Furthermore, the measure supported the city of Turku's target of becoming carbon neutral by 2029.

A.2.1 Measure outputs

The main outputs of the measure were the following:

- Nine electric vehicles leased
- Approximately 105 user experiences gathered and reported from LEV testers among Turku city staff



Picture 23 Turku City staff with the LEVs

A.2.2 Supporting activities

No supporting activities were identified for this measure.

A.2.3 Interactions with other ECCENTRIC measures

The measure had interactions with the two ECCENTRIC measures. Experiences were to be exchanged on pilot realisation, e-vehicle types and sharing concepts with STO 4.9. “Offering test-fleet of e-bikes and e-freight bikes” as well as MUN 6.3. “Electric light-weight vehicles – one for all” and MAD 6.2. “Test fleets, policy incentives and campaigns for the uptake of e-vehicles”.

A.2.4 Interactions outside ECCENTRIC

The measure had interactions and cooperation with Interreg Baltic Sea Region funded project “BSR – Electric - Fostering e-mobility solutions in urban areas in the Baltic Sea Region”. In Turku, the project addressed the benefits and barriers of light e-vehicle deployment in a city-owned company’s logistical functions. In addition, the measure had interactions with an ERDF funded project “New Solutions in City Logistics”, which focuses on piloting different types of e-mobility solutions to tackle the last mile problem in urban environments.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
10	Turku city staff	Turku city and region	Most Turku city employees participating in the pilot live either in the city or the surrounding region
8	Local businesses	Turku city area	The leasing companies providing the LEVs are situated within the city area

Table 2: Target groups or affected parties

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	City of Turku Staff	P	C	L	Measure leader
2	Regional Council of Southwest Finland	P	Other	P	Stakeholder involvement, campaign development
3	Electric vehicle providers	S	PR	P	Providers of light electric vehicles for leasing during the piloting
Type: P:CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders

A.5 Identified risks

Identified risk	Impact	Likelihood	Score	Mitigation actions	Responsible
The city structure changes might affect the implementation of employee tests as a significant part of city employees change organization in year 2018.	2	4	8	Co-operation with other Turku municipal companies to carry out campaigns and tests, enlarge the test areas and places	ML, SC
The city decides to change the ownership policy into leasing or external operators	3	1	4	Well informed city decision makers, integration of measure actions into other processes	ML, SC
Quality of questionnaire hinders quality of results and response rate	2	1	3	Proper planning of questions	ML, LEM
False conclusions from data gathered	1	1	2	Pretesting the questionnaire for selected test users to verify quality of the questionnaire	ML, LEM

Table 4: Identified risks

B. Measure implementation

B.1 Situation before CIVITAS

The number of electric vehicles in Finland is low especially compared to other Nordic countries. Take-up of electric vehicles on a larger scale requires actions, among others, on policies, regulations and infrastructure. Cities can act as forerunners and contribute in increasing the critical mass of vehicles needed for the larger take-up. There are several actions that cities can take to promote the wider take-up of e-vehicles, including increasing the efficiency of shared e-mobility, electrification of city's own fleet and favouring electric vehicles in procurement. The Turku City Board has made a decision to favour electric cars in procurement; however a plan for the electrification of city's fleet including studies and benefit analyses must be prepared and well promoted and piloted among the city employees. The estimation was that altogether about 40% of the city's cars could be replaced with electric ones. The usage of shared vehicles should be improved significantly among the 11 000 city employees.

Prior to the project, the city of Turku had four shared e-cars and one e-bike in use. It had been estimated that even 40% of the current city fleet in Turku could be replaced with electric cars. E-vehicles would be particularly suited within city sectors where passenger cars are mostly used for work-related trips and where most trips driven are short. Based on previous research, it has been recognized that in most cases daily total mileage or long one-way trips were not the main barriers for e-vehicle use, but the special needs that municipalities have for the vehicles (e.g. heavy duty, four-wheel drive).

B.2 Innovative aspects

Overall, light electric vehicles are still a novelty in large-scale use in Finland and even more so in organizational contexts. The measure was thereby to bring about important insights on the practical arrangements of organizing a similar pilot and subsequent implications for their deployment within city fleets.

B.3 Research and Technology Development

As part of the measure, the winter suitability of light electric vehicle was to be tested, providing valuable information on e.g. the performance of the vehicles in icy road conditions and the effects of below-zero temperatures on the vehicles' batteries.

B.4 Actual implementation of the measure

Phase 1: Research and measure planning milestones (100% completed)

The research and planning phase of this measure commenced in September 2016 and was completed in August 2017. During this phase the legislation guiding LEV use was reviewed and different options available on the market mapped. Based on information gathered, a plan was made on the type of vehicles that would be best suited for piloting purposes. This was followed by a market research mapping available service providers. A market dialogue was conducted via email and phone on available leasing options. In addition, campaign development and stakeholder involvement were commenced together with partner RCSWF.

A Turku city staff mobility survey from 2013 provided a valuable baseline for the measure. In addition, an analysis of the existing city car fleet and the potential for electrification as well as an analysis of the current usage of shared cars and bicycles in the city were performed.

Gathering of the existing gaps of travel instructions among the city employees provided additional information for the status quo. (M3-1M11)

Phase 2: Procurement & Implementation (100% completed)

The Procurement & Implementation phase of this measure commenced in September 2017 and was completed in April 2018. The invitation to tender was prepared and sent to eight different service providers, mapped out during the previous phase. Two companies provided offers on five different vehicles. Due to the lack of providers of electrically assisted bikes during the first tendering round, it was decided that a separate invitation to tender would be made directly to specific companies that provide e-bike leasing. Consequently, a bid was received from one service provider. Based on the tenders nine electrically assisted vehicles were chosen for testing purposes. (M13-M20)

Eight of the nine vehicles were pictured below in connection with the winter testing, apart from the second small standing scooter, Inokim quik, which was not included in the test. It was similar to the Xiaomi M365 standing scooter, only with sturdier tyres.

1. Ordinary electrically assisted bicycle (pedelec)
Kalkhoff Jubilee Move



2. Electrically assisted cargo bike *Babboe Big-E*



3. E-scooter with pedals
Skand ZT-09



4. Ordinary e-scooter
Skand ZT-09



5. Small standing scooter
Xiaomi Mi M365



6. Large standing scooter
Ribber



7. Fourwheeled mobility assistance scooter
Skand Leijona 1400



8. Fourwheeled mobility assistance scooter with a cabin
Skand goMOTO 2.4+



Internal arrangements of the demonstration phase took a major part of the time during this phase: enquiries to the city employees and their superiors on piloting the LEVs, developing feedback forms, and devising agreements with city employees participating in the experiment. Pilot participants were recruited both via the monthly City of Turku's Eco Support Networks newsletter and a bulletin directed at the heads of different city departments. The reason for contacting the superiors first was to guarantee their support for the piloting. Altogether 83 employees from five city divisions (Welfare Division, Education Division, Recreation Division, Urban Environment Division and Central Administration) ended up taking part in the pilot. Some employees tested more than one LEV so, all in all, there were 105 separate pilots. Preparations were also made on the circulation of the LEVs and communication elements were prepared. (M17-M20)

There were some changes to the initial plans in this measure. Originally, it was planned that the pilot would involve e-cars as well. However, due to issues with parking policies or more specifically the fact that there was no e-car charging station available at most city department's premises, e-cars were not included in the pilot at the same time with the LEVs. However, a shared e-car was tendered in early 2020 and will be available for use by city employees for the rest of the project duration. The car, Nissan Leaf, will be available free of charge during the office hours for the city employees until August. Personnel of three stakeholders can also use the car with reduced prices. In the evenings and weekends, the car can be booked by anyone in the city in their own expense.

Phase 3: Demonstration & Monitoring (100% completed)

The demonstration and monitoring phase of the measure commenced in August 2018 and was completed in September 2019. The piloting of the vehicles began on the 13th of August. At the beginning of the phase the participants were given a thorough introduction to the functioning of the LEVs and the participants signed a contract consenting to following the terms of use of the equipment. Each participant also got to test-drive the vehicles.

Two LEVs were assigned to each participating department for a maximum period of two months. During this time, each vehicle was used by one employee for two weeks at the most. Then the LEV was given to another tester within the same department. Each tester was to report their experiences on using the vehicle at the end of the two-week trial period. Collecting the data was carried out via a questionnaire. The staff were allowed to use the vehicle not only to commute and travel during the workday, but also during their spare time.

During this phase, a test on the winter usability of the leased LEVs was also carried out in cooperation with Turku University of Applied Sciences and the Baltic Sea INTERREG funded project BSR electric. The LEVs were tested during five days on the period of 16 - 30 January. The performance of the vehicles and their batteries was tested by driving various routes in and around downtown Turku by a group of student assistants. In addition, a speed test was performed in order to check the accuracy of the vehicles' speedometers and the vehicles' compliance with the current Finnish legislation on light electric vehicles. (M21-M31)

Phase 4: Conclusions & Recommendations (50 % completed)

During this phase, the user experience surveys are reviewed and analysed. An e-mobility plan for the city will be drafted during spring 2020. The plan will be connected to the planning of parking and mobility arrangements at the new working premises for city staff, to be constructed within the coming years.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact					
Indicator name	Awareness	Acceptance	Satisfaction	Contribution to Policies, Plans and Programs	Mode shift
Type	KPI	KPI	KPI	KPI	KPI
Category	Society	Society	Society		Transport system
Subcategory	Acceptance	Acceptance	Acceptance		General
Aspect	Awareness	Acceptance	Acceptance	Governance	Modal split
Definition	Awareness of e-vehicles for work use	Acceptance of e-vehicles for work use	The satisfaction in the e-vehicles	Qualitative measurement on the process to modify policies, plans, and programs (including SUMP) in a significant and definitive way.	Percentage of passengers which changed permanently of transportation mode for doing the same trip (same origin and destination, time, and frequency)
Impact					
Indicator name	Modal split	Vehicle-Km travelled	System usage	Contribution to Policies, Plans and Programs	Investment costs
Type	KPI	KPI	KPI	KPI	KPI
Category	Transport system	Transport system	Transport system		Economy
Subcategory	General	General	General		Costs
Aspect	Modal split	Total travel	System demand	Governance	Costs
Definition	Number of all trips/deliveries made by each mode for all purposes.	Sum of all kilometres travelled by a fleet or a group of users.	Average system usage (bookings, rentals, deliveries, users, passengers, etc.), in a given unit of time	Qualitative measurement on the process to modify policies, plans, and programs (including SUMP) in a significant and definitive way.	Investment costs related to the measure.
Impact					
Indicator name	Operating costs	CO2 emissions	Energy efficiency		
Type	KPI	KPI	KPI		
Category	Economy	Environment	Environment		
Subcategory	Costs	Pollution and nuisance	Pollution and nuisance		
Aspect	Costs	Emissions	Emissions		
Definition	Average operating costs of the measure	The total CO2 emissions by system users.	The total energy use by urban transport per vehicle-km (annual average)		

Table 5: Description of indicators

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement
1	Awareness	%	A	DC	Turku city staff	City of Turku
2	Acceptance	%	B-A	S	Turku city staff	City of Turku
3	Satisfaction	Score (0-5)	B-A	S	Turku city staff	City of Turku
4	Contribution to Policies, Plans and Programs	Score (0-5)	B-A	S	Decision makers	City of Turku
5	Investment costs	€	A	E	Turku city staff	City of Turku
6	Operating costs	€	A	DC	Turku city staff	City of Turku
7	Mode shift	%	A	DC	Turku city staff	City of Turku
8	Modal split	%	B-A	DC	Turku city staff	City of Turku
9	Vehicle-Km travelled	Km	B-A	DC	Fleet	City of Turku
10	System usage	Frequency (users/unit of time)	A	S	Fleet	City of Turku
11	CO2	Tons/year	B-A	S	Fleet	Turku area
12	Energy efficiency	MJ/km	B-A	E	Fleet	Turku area
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Measure's indicators

C.1.2 Baseline

The baseline in this measure represents the situation prior to the project in terms of sustainable mobility development in the laboratory area. The data collection methods for the baseline included the following:

- In 2013, a Mobility Survey was performed among the employees of the City of Turku. The survey was sent to all 12 000 city employees and 1497 responded. Data for “work day” modal split of Turku city employees was acquired from the survey. In addition, previous records of mileage compensation for use of own car (city employees) were acquired to get an idea of the use of employees’ own car for work-related trips. For some of the indicators, baseline data was not available (N/A), although initially assumed when devising the evaluation plan.
- Previous records of mileage compensation for use of own car (city employees) were used to get an idea of the use of employees’ own car for work-related trips and subsequently data on *vehicle-km travelled*. Data from 2016 was used for the baseline.
- Secondary data analysis was performed on contribution to *Contribution to Policies, Plans and Programs*.

- Reference data for *CO2 emissions* and *energy use* was derived from LIPASTO, a calculation system developed and maintained by VTT Technical Research Centre of Finland Ltd. It is used to calculate transport emissions and energy consumption in Finland, covering road, rail, waterborne and air transport as well as working machines.

KPI 2: **Acceptance** describes the acceptance of e-vehicles for work use. This was not surveyed prior to the project, hence no baseline data is available.

KPI 3: **Satisfaction** describes the satisfaction in e-vehicles. This was not surveyed prior to the project, hence no baseline data is available.

KPI 4: Contribution to Policies, Plans and Programs refers to the impact the measure may have on policies or strategies to promote e-mobility. Prior to the project, significant attention on a strategy/policy level had been placed on the electrification of urban traffic especially as part of the strategy for reaching carbon neutrality in the city by 2029. By 2016, there were ten electric or hybrid cars in the city fleet and it was estimated that almost 40 % of the vehicles could be replaced with e-vehicles. In 2015, a plan was made for the renewal of the Turku city vehicle fleet. In the plan, the electrification potential of each city department was mapped and it was recognized that the primary potential lay within the electrification of passenger cars used for driving short distances and with no particular needs for freighting. Ideas for further development on the procurement of e-vehicles and promoting the use of electrically assisted bicycles were also presented in the plan. The plan was recognized as the first step in the long process of electrification and comprehensive renewal of the city fleet. It is worth noting that other LEVs apart from e-bikes were not mentioned in the plan – however this is understandable as in 2015, they were still very marginal.

The state concludes agreements concerning land use, housing and transport (MAL) with the main city regions of Finland. These agreements enhance cooperation among the municipalities in the respective city regions and between the municipalities and the state in the steering of community infrastructure and coordination of land use, housing and transport. Unlike many other modes of sustainable transport, electromobility is not directly mentioned at all in the Turku MAL agreement (2016-2019). Overall, it can thus be stated that prior to the project electromobility was already promoted in city policies, plans or programs but it had not fully penetrated the policy level. **Score: 3.5.**

KPI 7: Mode shift & KPI 8: Modal split of Turku city employees (N=1467) during the summer months in short trips during the working hours was the following (according to the 2013 mobility survey):

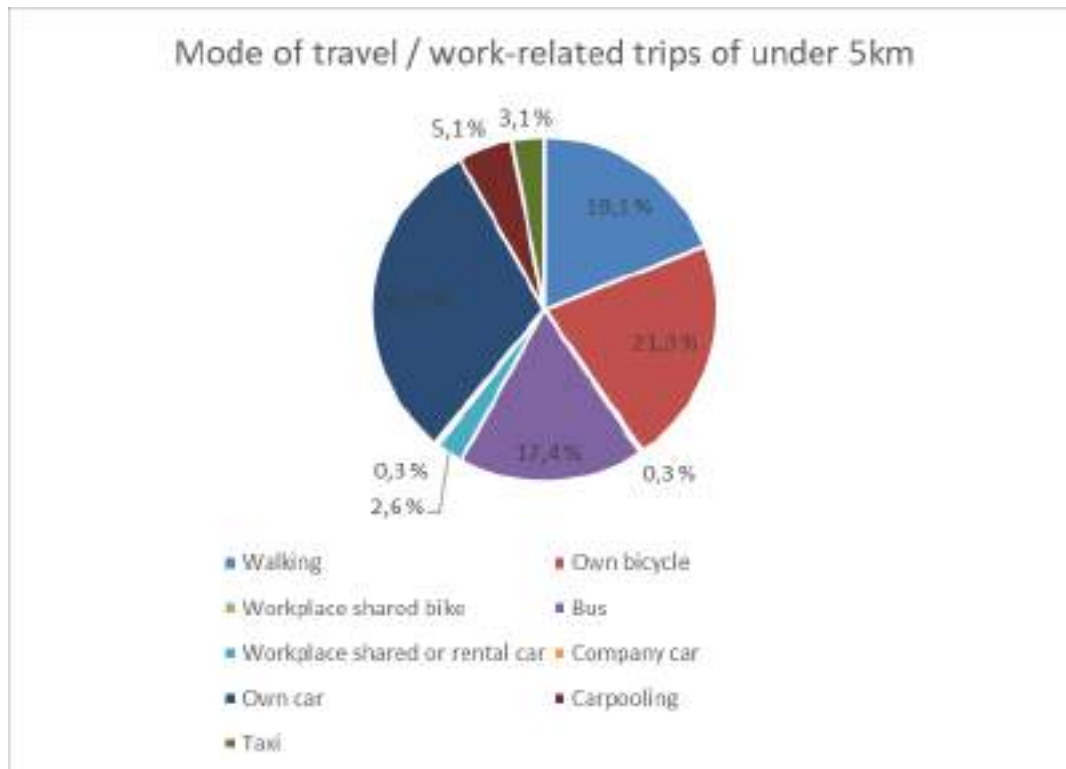


Figure 1. Travel mode on trips under 5km during the workday

It was observed that people mostly used their own car (30.9%), their own bicycle (21.3%), the workplace shared or rental car (19.1%), or the bus for short trips during the working day. Summing up all modes of travel using a passenger car (own car, company car, carpooling, taxi), the share rises to 42%.

KPI 9: Vehicle-Km travelled in this measure refers to the kilometers travelled by Turku city staff with their own cars, used for work-related trips. For establishing a baseline, figures from 2016 were employed. This data was also utilized for assessing CO₂ emissions and energy efficiency later. The data was derived from the mileage compensation records of the city of Turku. According to the data, employees were compensated for using their own cars for a total of **1 581 486km**. Financial data on the use of taxis for work purposes was available but without mileage data – hence it was not possible to include this data in the mileage calculation.

KPI 11: CO₂ emissions refers to the emissions generated by Turku city employees from use of their own car for work-related travel during the working day. The data available did not unfortunately differentiate between the employees' car type, model or motive power. Here, an average CO₂ emission of passenger cars in Finland in 2016 was thereby applied to estimate emissions generated. In 2016, this equaled 162.3g/km when applying the NEDC standard (Liikenne fakta 2020). The total estimated CO₂ emissions generated by work-related travel in the city of Turku thus amounted to 256.7t.

KPI 12: Energy efficiency in this measure refers to total energy use by work-related transport per vehicle-km. In Finland, the average age of the motor vehicle stock is generally rather high. In 2016, the average age of registered passenger cars in mainland Finland in traffic use was 12 years (Traficom 2020). Reference data for energy use was derived from the VTT Lipasto

system (VTT 2017). Assuming that most trips during working hours are driven within the urban area, a reference value of 3.0 MJ/km is applied (with an average 1,3 passengers).

C.1.3 The business-as-usual scenario

According to the SC, the e-vehicle pilot would not have been realized without project impact. The BaU for most indicators was thus similar to baseline.

Indicator	Unit	BaU	Date BaU
Awareness	%	N/A as there would not be a pilot without project impact.	2016
Acceptance	%	N/A as there would not be a pilot without project impact.	2016
Satisfaction	Score (0-5)	N/A as there would not be a pilot without project impact.	2016
Contribution to Policies, Plans and Programs	Score (0-5)	It is likely that electromobility would have been promoted on policy level even without project impact at least to some extent. Hence BaU is estimated to be 0.5 points higher than baseline.	2016
Investment costs	€	N/A as there would not be a pilot without project impact.	2016
Operating costs	€	N/A as there would not be a pilot without project impact.	2016
Mode shift	%	BaU is estimated to be similar to baseline.	2013
Modal split	%	BaU is estimated to be similar to baseline.	2013
Vehicle-Km travelled	€/project	BaU is estimated to be similar to baseline.	2016
System usage	Frequency (users/unit of time)	N/A as there would not be a pilot without project impact.	2016
CO2 emissions	Tons/year	BaU is estimated to be similar to baseline	2016
Energy efficiency	Mj/km	BaU is estimated to be similar to baseline	2016

C.2 Measure results

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Acceptance	%	N/A	2016	N/A	2016	64	2019	N/A	N/A
Satisfaction	Score (0-5)	N/A	2016	N/A	2016	3.5	2019	N/A	N/A
Contribution to Policies, Plans and Programs.	Score (0-5)	3.5	2016	4.0	2016	4	2016	0.5	0
Investment costs	€	28 321€ for leasing the tested LEVs							
Operating costs	€/km	City of Turku: 51 761€ RCSWF: 5100€							
Mode shift / Modal split	%	61	2013	61	2016	56	2019	-5	-5
Vehicle-Km travelled	Km	1 581 486	2016	1 581 486	2016	1 988 773	01/2020	-407 287	-407 287
System usage	Frequency (users /unit of time)	N/A	2016	N/A	2016	133/year	2019	N/A	N/A
CO2 emissions	Tons/year	256.7	2016	256.7	2016	309t.	2019	52.3	52.3
Energy efficiency	Mj/km	3.0 MJ/km	2016	3.0 MJ/km	2016	Scooter: 0.12MJ/km 3-wheeler 0.22MJ/km Low-power 4-wheeler: 0.3MJ/km High power 4-wheeler: 0.44 MJ/km	2019	-2.88 -2.78 -2.7 -2.56	-2.88 -2.78 -2.7 -2.56

The ex-post data was derived from several sources:

- The survey to the e-vehicle pilot participants provided data for indicators *acceptance*, *satisfaction*, *mode shift* and *system usage*. The survey was sent to each pilot participant after their period of testing. 105 employees participated in the pilot and 89 of those replied to the survey.
- Previous records of mileage compensation for use of own car (city employees) were used to get an idea of the use of employees' own car for work-related trips and subsequently data on *vehicle-km travelled*.
- Secondary data analysis was performed on contribution to *Contribution to Policies, Plans and Programs*.
- Reference data for CO2 emissions and energy use was derived from LIPASTO, a calculation system developed and maintained by VTT Technical Research Centre of Finland Ltd, and data on energy consumption from the vehicle manufacturers.
- Data on investment and operating costs were derived from the Site Coordinator.

Awareness of electric vehicles was not reviewed as part of the measure although this was originally planned as an indicator. The indicator therefore needs to be omitted.

Based on pilot results, the **acceptance** of the LEVs was rather high among the respondents. The employees used the LEVs both for work-related travel during the day and for commuting. There was no clear division on the popularity of the LEVs based on type of trip to be observed. When estimating acceptance, the willingness to use the LEV for work-related travel if one was available was reviewed specifically as the intention of the measure was to reduce the need for the use of own car for work travel. Compared with number of testers, an acceptance level was calculated. For the sake of simplicity, the e-scooters (ordinary/with pedals) were treated as one unit as were the small standing scooters (Xiaomi/Inokim quik). An overall acceptance level of 64% can be observed, although it must be noted that some of the LEVs received only a few reviews.

Which of the following LEVs have you tested?	Number of testers	Willingness to use for work-related travel	%
Ordinary electrically assisted bicycle (pedelec) (Kalkhoff Jubilee)	20	16	80 %
Large standing scooter (Ribber)	15	12	80 %
Four-wheeled mobility assistance scooter (Skand 1400)	14	5	36 %
Small standing scooter (Xiaomi)	15	13	87 %
Ordinary e-scooter(Skand ZT)	15	14	93 %
Four-wheeled mobility assistance scooter with a cabin (Skand GoMoto)	8	3	38 %
Electrically assisted cargo bike (Babboe)	3	1	33 %

Table 7: Acceptance of vehicles tested



Figure 2. Acceptance of vehicles tested

Overall, **satisfaction** on the LEVs was rather high. Driving comfort was highest with the electrically assisted bicycles and electric scooters, whereas feeling of safety while driving was considered poor only with the small standing scooters and the scooter with a cabin. As can be observed on the figure below, the reasons for not using the LEVs during the test period were mostly connected with safety aspects. The length of the trips was also a significant reason not to use the LEV, and related to the same issue, time management related reasons.

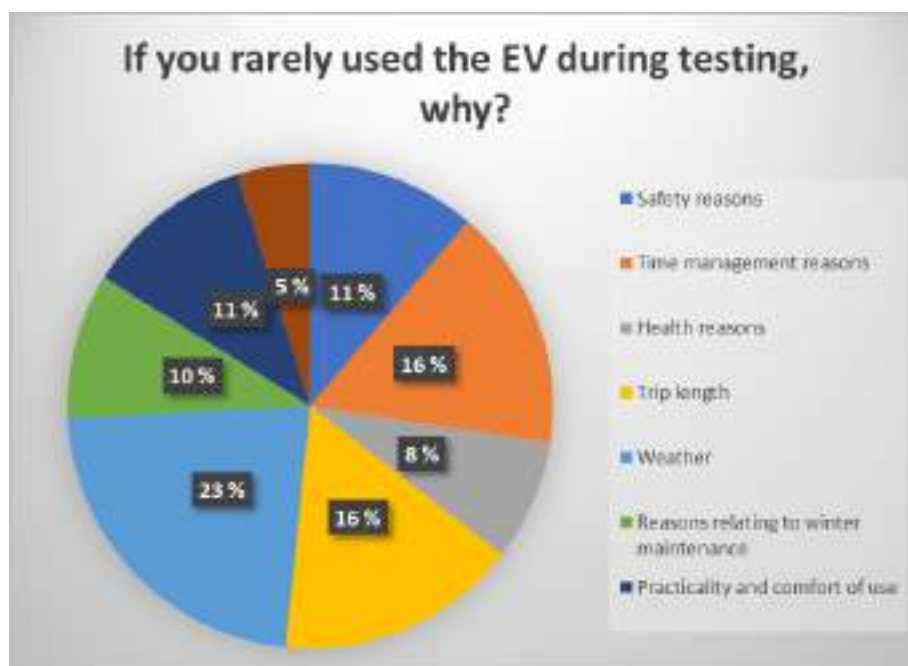


Figure 3. Reasons for not using the LEVs

When discussing **satisfaction** with the e-vehicle pilot, the following aspects were covered (followed by the total percentage of “very good or “good” reviews):

- Suitability to use (64%)
- Reliability (75%)
- Ease of storing (54%)
- Ease of recharging (74%)
- Battery life (65%)
- Handling (65%)
- Feeling of safety while driving (59%)
- Driving comfort (69%)

Based on the results, an overall satisfaction level of 67% can be observed, or 3.5 on a scale of 0-5.

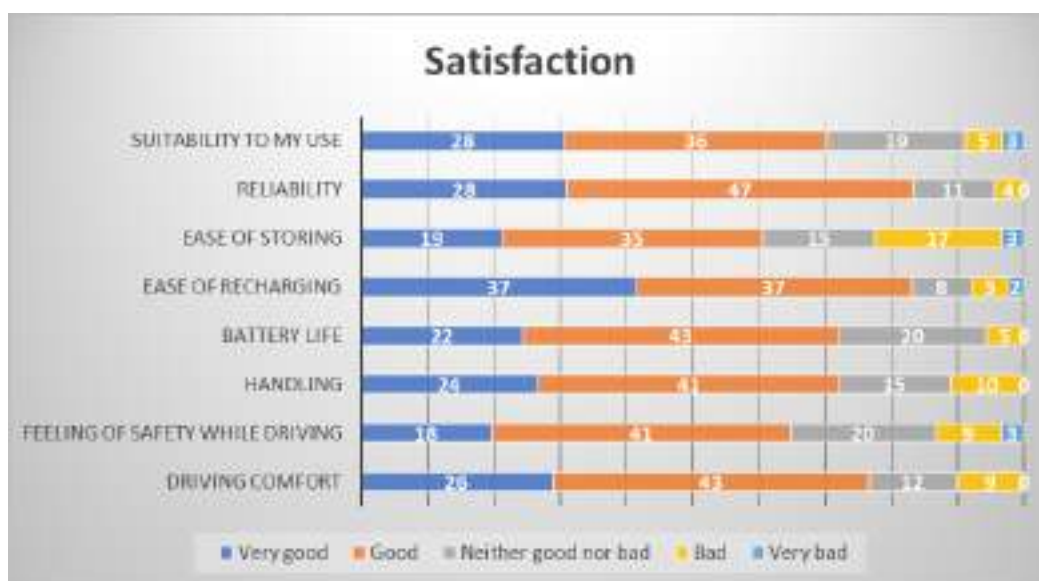


Figure 4. Satisfaction in the LEVs

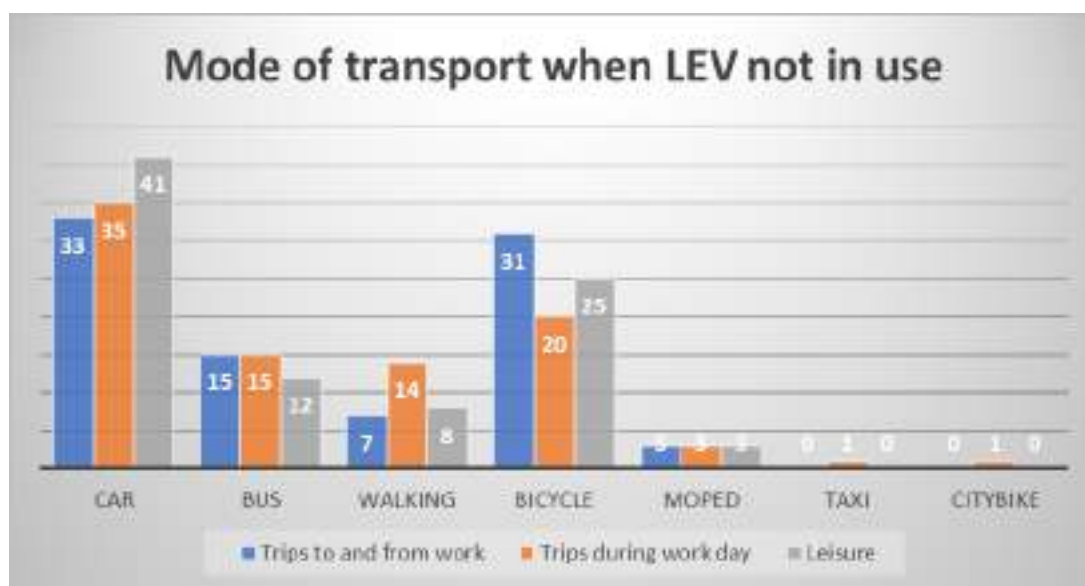
When it comes to the **Contribution to Policies, Plans and Program**, the promotion of electromobility is clearly embedded on the strategy level. In the Turku Climate Plan (SECAP) from 2018, it is stated that to promote low-carbon sustainable mobility “Car traffic emissions are reduced by investing in electric motoring and developing adequate conditions for it. Investments are also made into other emission free and / or low emission sources of energy and new alternative means of transport such as electric bicycles and automatic tools of transport.” In a similar manner, in the MAL agreement draft for 2020-2023 it is stated that “Municipalities and the state will aim to procure electric and biofuel vehicles in their fleets”. A plan on the expansion of the e-vehicle charging network will also be devised. Promotion of electromobility was thus clearly visible on policy level. However light electric vehicles were not specifically mentioned, as they were not when looking at contribution on the baseline level. It may be inferred from this that although LEVs are nowadays a very visible part of urban mobility, their potential as a mobility solution has perhaps not been yet fully recognized on policy level.

Overall, it can be estimated that the measure has had some influence on policy level development but perhaps not to a significant extent. **Score: 4.0.**

Investment costs in this measure covered the leasing costs of the LEVs. This equaled altogether 28321€.

The **operating costs** for running the pilot included staff costs for Turku city (51 761€) and for RCSWF for planning the tendering of the vehicles (5100€).

For indicators **Mode shift/Modal split**, similar data to baseline level was not available – no large-scale survey similar to the one in 2013 was carried out on Turku city employees. Mode of transport when LEV was not in use was surveyed among the pilot participants, not the entire staff. Hence the results are not entirely comparable. The participants were presented with the following question: *What would have been your mode of transport if you had not had the LEV in use?* The responses demonstrated that a majority of the trips would have been taken with a car, both during the working day, on trips to and from work and trips for leisure.



Looking more specifically at the data on work-related trips during the work day alone, the following modal split was observed (N=89):

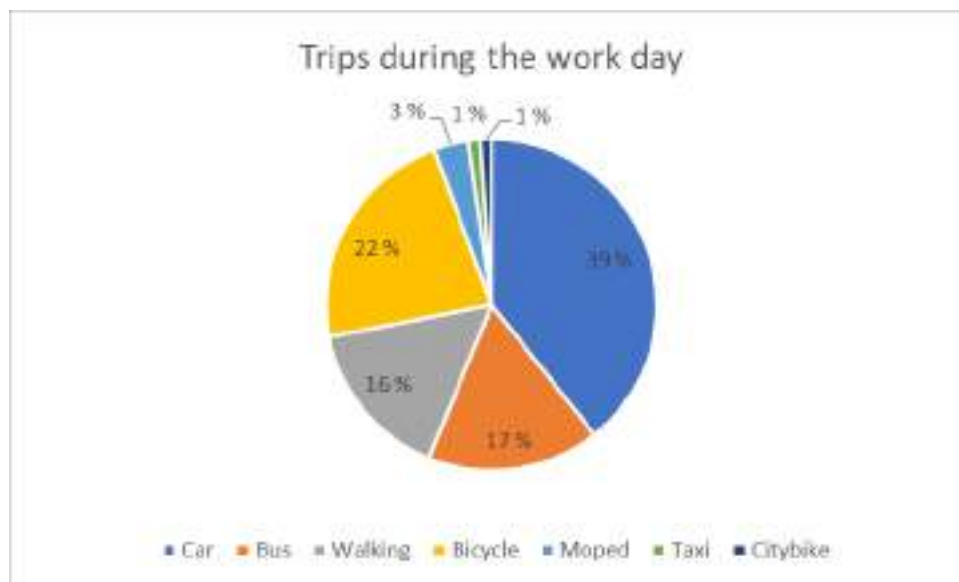


Figure 5. Modal split among pilot participants

By looking at data on what mode of transport was replaced with the LEVs tested, one could get an idea of the current modal share of Turku employees. Overall, the share of sustainable transport modes on work trips equaled 56% (bus, walking, bicycle, city bike). Compared to 2013 when the share of sustainable transport modes was 61% (walking, workplace shared bike, own bicycle, bus), a slight decrease of sustainable modes could be observed. While levels of walking and using the bus had remained the same, cycling had decreased with 1% and walking by 3%. Again, comparison was difficult not only due to the fact that the respondents were presented with different questions (“Mode of travel for work-related trips under 5km” in 2013 versus “What would have been your mode of transport if you had not had the LEV in use?”), but also because the modes of transport varied in the surveys. Due to the challenges with comparing these figures, for mode shift was reported only the share sustainable transport modes, not all the modes. In any case, these figures could only give an indication of the mode shift – making any far-reaching conclusion would have required a wider sample among the city employees.

Looking at data from mileage compensation paid to Turku city employees in 2019, the total **vehicle-kilometers travelled** by Turku city staff with their own cars, used for work-related trips, equaled **1 988 773km**. This marked a significant rise of 25.8% in kilometers travelled. With the LEVs, altogether **1191km** were driven during the workday. This mileage was, however, based on the test users’ own estimation, not data from e.g. a speedometer or a GPS. Again, financial data on the use of taxis for work purposes was available but without specific mileage data – hence it was not possible to include this data in the calculation.

Data for **System usage** of the tested vehicles was based on the survey question “*How many times a week did you use the LEV for trips to and from work or trips during the work day?*” in the user survey. In the below graphs the results can be observed.

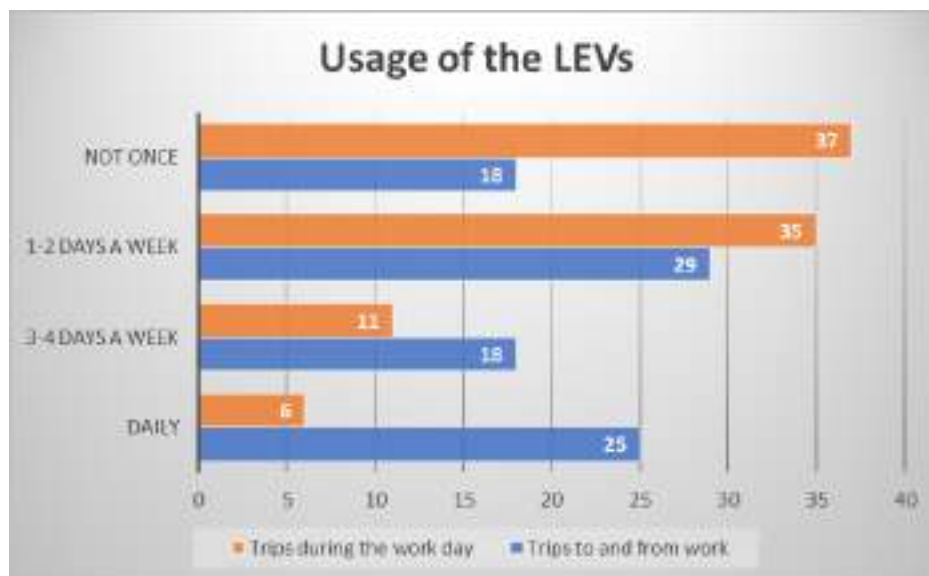
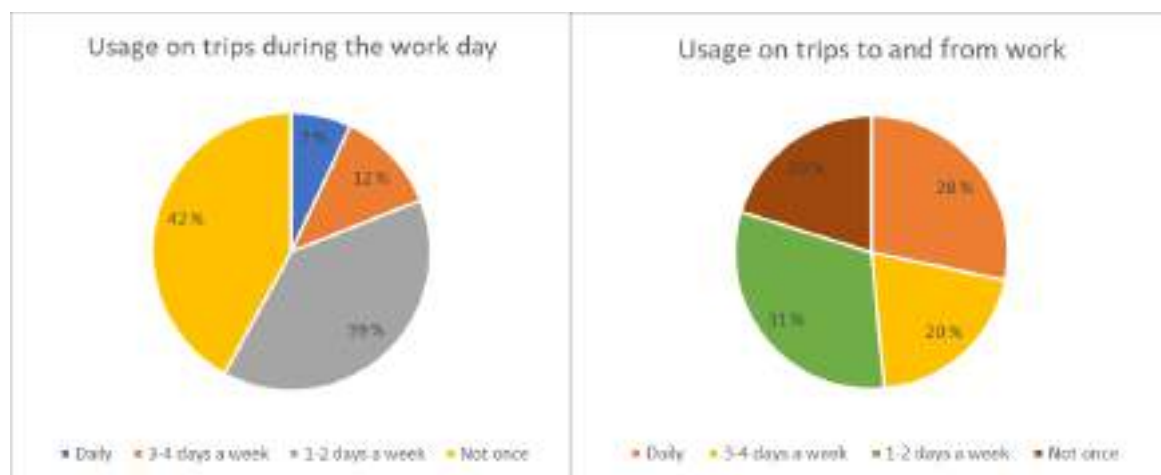


Figure 6. LEV system usage



It was interesting to observe that 42% of the test users did not use the LEVs during the work day at all. Looking at answers to the survey question “If you used the LEV only rarely during the test period, what are the reasons behind this” (a graph on this was presented under indicator “Satisfaction”), at least safety is one recurring issue. One respondent stated that during the pilot they used the LEV for most trips to and from work but dared not to drive the LEV in the city center. Yet safety was not a concern only in the center – it was stated by one respondent that they felt unsafe driving the LEV on roads where there was no separate lane for bicycles (the current Finnish traffic legislation deems LEVs – under certain conditions – equivalent to ordinary bicycles). The fact that not all the LEVs had studded tyres was clearly a barrier to using them for some of the respondents. The LEVs were considered by some respondents to be too slow for trips during the workday, or to and from work. Several respondents also indicated the cold weather and slippery road conditions as a reason for not using the LEVs. It is worth mentioning here that the winter of 2018/2019 in Turku was very cold with plenty of snowfall.

Each test user got to use a vehicle for two weeks. As the purpose of the measure was to introduce electric vehicles to the city fleet, data on trips during the workday was applied to measure system usage. Due to the fact that simply informing that system usage equaled 105 users for a period of one year would not really tell much about actual system usage, the average number of trips during the one year pilot-period was applied to give an indication of system usage. Overall, the LEVs were used for work-related trips 133 times during the year, according to survey results. It is impossible to differentiate between usage of separate vehicles as there were several breaks in their use, mostly due to weather conditions in the wintertime, and those breaks were not meticulously reported to the measure staff.

Ex-post **CO2 emissions** refer to the emissions generated by Turku city employees from use of their own car for work-related travel during the working day. The potential impact of replacement of the use of passenger cars was also reviewed based on mileage data from the pilot. Again, the data available did not unfortunately differentiate between the employees' cars type, model or motive power. Here, an average CO2 emission of passenger cars in Finland in 2019 was thereby applied to estimate emissions generated. In 2019, this equaled 155,4 g/km (NEDC). The total estimated CO2 emissions generated by work-related travel in the city of Turku thus amounted to **309t**.

With the LEVs, altogether **1191km** were driven during the workday, according to the users' own estimations. Based on the user survey, 39% of the respondents (N=89) would have used a car had they not had the LEV in use. Based on this a rough estimation can be made that the LEVs replaced 465km of car use and subsequent 0.07t of CO2 emissions, if CO2 emissions from electricity production are omitted.

The "well to-wheel" **energy efficiency** of a light electric vehicle is to a large extent dependent on the method of electricity production, and the context of their usage. An average energy consumption has been estimated by some of the LEV manufacturers but not by all. For the Xiaomi small standing scooter, for example, energy consumption according to the manufacturer was 1.1 kWh/100 km. For the purpose of estimating an average energy consumption for different types of LEVs, calculations by Saxena et al (2014) are applied. Based on their research, in city driving conditions, the average electrical consumption was 0.12MJ/km for a scooter, 0.22MJ/km for a 3-wheeler, 0.3MJ/km for a low power 4-wheeler, and 0.44 MJ/km for a high power 4-wheeler. All these types of LEVs were used in the pilot and are hence applied to evaluate energy efficiency.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	The efficiency of the use of the city fleet has increased by 20% during the demonstration time	NA	Apart from adding gas vehicles to the city fleet, no major additions of more energy efficient vehicles have been made to the city fleet. Electrification of the fleet is high up on the political agenda but plans for it have not yet been made.

2	The use of own car on work travel has reduced by 20% in comparison to year 2016 by the end of year 2019.	O	Based on data from mileage compensation, the use of own car for work travel has increased in absolute numbers. It was not specified, however, whether there has been significant changes in staff numbers in 2019. There were 11 757 staff members in 2016. For 2019 staff numbers were not yet available but it has been a downward trend – in 2018, there were 11 521 staff members. The increase in mileage driven cannot therefore be explained by any increase in staff numbers.
3	Emission reductions by 10 pilot vehicles, around 10t/a reduction of CO2.	O	Altogether 4897km were driven with the LEVs tested. Based on average car CO2 emissions (158g/km), 0,7t/a CO2 was saved.
4	The city has an approved plan for e-mobility	★	The plan will be devised during spring 2020, however it is unlikely the plan will be approved during project lifetime.
5	Changed mobility behaviour due to the electrification of city's fleet and promotion of e-mobility among the city employees.	★	Based on pilot experiences, acceptance of fleet electrification among the employees was high, as well as satisfaction. It is however inconclusive whether this will lead to permanently changed mobility behavior. What the pilot results did prove was that e-vehicles were a viable option for replacing passenger car use for trips during the working day.
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★★ = Exceeded			

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

Originally, it was planned that the pilot would involve e-cars as well. Due to issues with parking policies or specifically the fact that there was no e-car charging station available at most city department's premises, e-cars were not included in the pilot at the same time with the LEVs. However, an electric shared use car was leased in March 2020 after a tendering where two service providers gave their bids. The car, Nissan Leaf, will be available free of charge during the office hours for the City's employees until August 2020. The personnel of three stakeholders can also use the car with reduced prices. In the evenings and weekends, the car can be booked by anyone in the city on their own expense. This part of the measure is not included in the measure evaluation, however.

D.2 Barriers

The following barriers for measure realisation have been identified so far:

D.2.1 Problem-related

Promoting the use of shared electric cars was more challenging than originally estimated. The focus of the e-vehicles changed during the planning phase as it was found that having shared electric cars among the test vehicles could prove challenging due to both city parking policies and the issue of not having charging stations at each city department's parking lot. The focus was thereby shifted more to other types of shared e-vehicles and the car arrived only after the LEV pilot had already ended. In the end, the first pilot took so much time and resources that it was a good call to tender the car in a later time.

D.2.2 Organizational

Personnel changes in the early stages of the measure resulted in more focus being placed on other measures at the beginning of the project, causing a slight delay in measure planning. Better allocation of resources however ensued when more personnel was hired and the measure progressed as planned.

The organizational side of the city of Turku concerning shared vehicles has changed over the duration of the project. There is no specified person(s) responsible for the development and this is clearly an obstacle when trying to develop this issue further.

D.3 Drivers

The following drivers for measure realisation have been identified so far:

D.3.1 Involvement, communication

Despite initial worries on the willingness of city employees to participate in the demonstration, by the end of the reporting period already several city departments had expressed their interest in the pilot. In the end, 37 city departments became involved in the pilot. Overall, the commitment of the heads of department was essential in involving the employees in the test phase. The heads of department were contacted via a general city info letter and individual

contacting by the measure staff. The heads of department then communicated measure details further to the employees.

D.3.2 Technological

New potentials offered by technology are an important driver for the promotion of electromobility. Availability of different types of vehicles allowed for a wide selection of test vehicles and thus brought variety to the user experiences. It could also be stated that the measure has a strong cultural driver as small e-vehicles are nowadays seen in the city streets more and more often.

D.4 Supporting activities

No supporting activities were identified for this measure.

D.5 Recommendations on the implementation process

Some recommendations on implementation can be suggested based on process evaluation of the measure so far.

D.5.1 Commitment of superiors will create best circumstances for piloting

It is advisable to initiate a pilot the via the superiors, e-g- the heads of city departments. By contacting the superiors first, their support for the piloting can be guaranteed. They can also promote the pilot by communicating about it at regular meetings and possibly address any suspicion or negative feedback arising.

D.5.2 Map out the barriers

In order to guarantee success of an e-vehicle pilot, potential barriers to its realisation should be mapped as thoroughly as possible prior to the pilot. This was clearly demonstrated in the Turku case with e-cars as parking policies first prevented their inclusion among the piloted vehicles. Another example of a barrier could be, for example, the lack of suitable storage spaces for the vehicles at different premises, or the e-vehicles being unsuitable for icy road conditions during wintertime.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- An e-vehicle pilot was carried out with 9 different LEVs + one e-car (in Spring 2020).
- The views of the e-vehicle users were reviewed and analysed.
- An e-mobility plan is being devised during spring 2020 based on measure experiences and experiences from other cities.
- The potential of LEVs as a feasible alternative for replacing the use of one's own car for work-related trips was proven based on high acceptance and satisfaction levels.

E.2 Relevance of supporting activities

No supporting activities were identified for this measure.

E.3 Interaction with other measures

The measure had interactions with the following measures as experiences were exchanged on pilot realisation, e-vehicle types and sharing concepts with STO 4.9. "Offering test-fleet of e-bikes and e-freight bikes", as well as MUN 6.3. "Electric light-weight vehicles –one for all" and MAD 6.2. "Test fleets, policy incentives and campaigns for the uptake of e-vehicles".

E.4 Main lessons learned

The main lessons from the measure concerned the practical issues on how to organise and manage a test fleet, especially as a city authority, including test users and other involved actors.

- **The test period** of one year proved to be too long from the point of view of managing the pilot. Booking e.g. "for May next year" is too far in advance to manage. Changes in the schedule occurred constantly and it was challenging to ensure that eight people from each unit for two consecutive months take part. A good plan also has to be in place for physically moving the vehicles from one department to the other, as this might require additional resources (e.g. personnel or a bigger vehicle).
- When it comes to contractual agreements, **processes and responsibilities** must be very clear from the beginning to the end. In cases of vandalism, it was unclear who was responsible.
- Another lesson learned concerned **managing the e-vehicle users**. Educating testers on how to use the vehicle and communicating with them takes time. Although recruiting test users through the Head of Departments worked quite well, the next step could have been done slightly differently. Allocation of testers and coordination of the testing periods was handled manually in excel sheets. A manual system allows the human factor to play in and it becomes difficult to accommodate everyone's changing

schedules. A more automatic registration tool, e.g. an e-calendar, would have enabled for a more efficient process.

- **Weather conditions** can have a significant effect on the success of an e-vehicle pilot. A winter with lots of snow and/or ice on the roads combined with sometimes poor or untimely winter maintenance may lead to low participation rates for a pilot. Particularly among people who normally mainly use a car for commuting or for work-related travel during the day, wintry road conditions may present an insurmountable obstacle to even testing a LEV. Subsequently it is also important that e-vehicles are first presented to their users under favourable weather conditions. The fact that not all LEVs are by no means “winter-proof” should also not be overlooked – whether the LEVs are suitable for winter use or not should be carefully reviewed when selecting vehicles for testing.
- Potential issues with **storing the vehicles** should be resolved prior to the pilot. In a pilot aimed at a large number of employees, a suitable, safe and easily accessible temporary storing facility should be secured already prior to starting the pilot. During the Turku pilot it proved virtually impossible to transfer the LEVs directly from one department to another. Hence a temporary storage facility is likely to be needed.
- If possible, the vehicles should be acquired from **a local provider**, as when breakages occurred the waiting time for a spare part or a maintenance became remarkably long. In addition, a professional operator, either external or provided by the city, should be hired to take care of the transport and maintenance.
- Last but not least, the measure raised discussion on how to arrange such a pilot as a local authority and what happens when the aspect of sharing becomes more prevalent, which is not clearly defined in this measure.

E.5 Long term impact

The measure has provided a valuable insight into the barriers and drivers of replacing city fleets with electric vehicles. As such, it will act as a useful starting point for potential future procurements of e-vehicles to the city fleet.

E.6 Potentials for up-scaling in the city

The city of Turku has already added some biogas vehicles to its fleet. The city is committed to reducing its greenhouse gas emissions and the will to do so is apparent. This momentum should be utilized to also include electric vehicles to the fleet and to replace cars with LEVs where they are deemed suitable.

F. Additional information

F.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

- Although the pilot was received positively among city employees, it is impossible to say whether the measure has resulted in permanent changes of transport modes. To review this, a survey should be conducted among pilot participants approximately a year after the pilot has ended.
- The city employee mobility survey provided a baseline for the measure. However, it dated back to 2013 and there was naturally thus no opportunity to influence the survey questioning. This resulted in the lack of data on some indicators. In retrospect, a proper survey should have been conducted among city employees at the start of the project.
- Estimating potential CO₂ savings or energy efficiency improvements was challenging with the data available and also due to the fact that not much information was available on the exact circumstances of their use, e.g. how much the vehicles were used in city driving conditions or elsewhere.

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

- In order to review potential behaviour change among city employees (increasing sustainable transport modes) it is recommended a survey be carried out e.g. in a year after the pilot was finalized.
- The city should take bold steps in promoting e-vehicles, particularly LEVs, in their fleets. LEVs are relatively inexpensive and easy to use. Price is therefore not an obstacle for their deployment for every-day use among employees. It should, however, be assured that the LEVs are also suitable for winter conditions. In addition, some the lessons learned presented in section E4 (storing, responsibilities and liabilities) should be carefully considered prior to making the procurements.
- Different types of incentives could be tested in connection with LEV procurements in cities to overcome potential behavior barriers and suspicion related to their use among employees.

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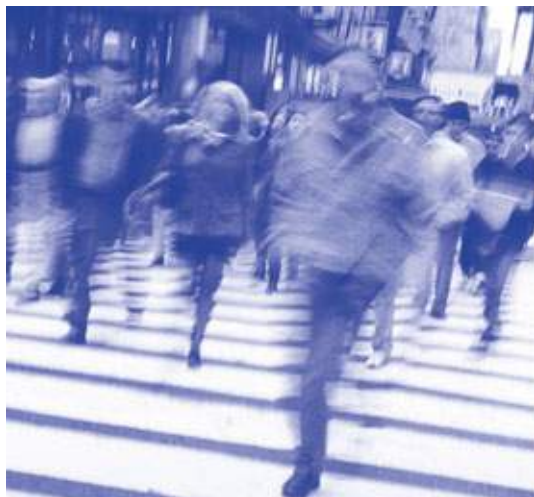
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Cleaner and better transport in cities

ECCENTRIC



STO 6.5

Developing the Clean Vehicle Web Portal

Measure Evaluation Report

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2020
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ECCENTRIC



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25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Joel Franklin	KTH Royal Institute of Technology
Anna Nordberg	City of Stockholm

Table of Contents

ABSTRACT.....	1317
A. INTRODUCTION.....	1318
A.1 EXPECTED RESULTS OF THE MEASURE	1318
A.1.1 Quantifiable impacts.....	1318
A.2 MEASURE DESCRIPTION	1318
A.2.1 Measure outputs.....	1319
A.2.2 Supporting activities	1319
A.2.3 Interactions with other ECCENTRIC measures.....	1319
A.2.4 Interactions outside ECCENTRIC	1319
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1319
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1320
A.5 IDENTIFIED RISKS	1320
B. MEASURE IMPLEMENTATION	1321
B.1 SITUATION BEFORE CIVITAS	1321
B.2 INNOVATIVE ASPECTS.....	1321
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1321
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1321
C. IMPACT EVALUATION FINDINGS	1323
C.1 EVALUATION APPROACH.....	1323
C.1.1 Expected impacts and indicators.....	1323
C.1.2 Baseline.....	1324
C.1.3 The business-as-usual scenario.....	1324
C.2 MEASURE RESULTS.....	1325
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1326
C.4 UP-SCALING	1326
D. PROCESS EVALUATION FINDINGS	1327
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1327
D.1.1 Deviation 1.....	1327
D.2 BARRIERS	1327
D.3 DRIVERS	1327
D.4 SUPPORTING ACTIVITIES.....	1327
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1327

E.	EVALUATION CONCLUSIONS	1328
E.1	VALIDATED DIRECT IMPACT	1328
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1328
E.3	INTERACTION WITH OTHER MEASURES	1328
E.4	MAIN LESSONS LEARNED	1328
E.5	LONG TERM IMPACT	1328
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1328
F.	ADDITIONAL INFORMATION	1329
F.1	APPRAISAL OF EVALUATION APPROACH	1329
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1329

List of Tables

Table 1: Quantifiable impacts.....	1318
Table 2: Target groups or affected parties.....	1319
Table 3: Measure stakeholders.....	1320
Table 4: Risk assessment.....	1320
Table 5: KPI Descriptions.....	1324
Table 6: KPI Details.	1324
Table 7: KPI Results.	1325
Table 8: Summary of Objective Achievement.	1326
Table 9: Summary of Barriers.	1327
Table 10: Summary of Drivers.	1327

Project	City		
ECCENTRIC	Stockholm		
Measure code	Measure name		
6.1	Developing the Clean Vehicle Web Portal		
Last update	Responsible	e-mail	telephone
	Anna Nordberg	anna.norberg@stockholm.se	

Abstract

Miljofordon.se is a web portal hosted by the City of Stockholm, providing an integrated information site about environmental vehicles relevant to all of Sweden. The central feature is a searchable database of environmental vehicles and their features, along with Swedish and European regulations associated with those vehicles. The site also features a fuel calculator and a map of charging locations across Sweden. There is also an opportunity to sign up for news articles relevant to the web site and environmental vehicles.

During Eccentric, the web site has been updated both in its content and its functionality, where these improvements were supported by stakeholder dialogs and user testing. The impact was measured by examining the number of visitors to the website, number of pages seen as well as the subscriptions to the newsletters. The key performance indicators are examined by using Google Analytics as well as tallying the subscriptions according to the newsletter subscription logs.

The results show an accelerating growth in visits to the web site from 43 000 sessions in 1st Quarter 2016 to over 108 000 sessions in 4th Quarter 2019. At the same time, interest in receiving news from miljofordon.se waned in the same period, with subscriptions reduced from 931 in early 2016 to 725 in late 2019. The results suggest a growing role of the web site as the main source of information, as its scope and content have expanded, as well as a growing general interest in the topics covered. At the same time, the results indicate a decreasing role of the newsletter as the promotion of membership has waned and as its content has shifted to online articles at the web site.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

An expanded range of services will support the continued development of markets for clean vehicles and fuels in Stockholm, particularly with regard to electric vehicles, charging, and environmentally friendly heavy lorries.

(2) Strategic level:

The aim of miljofordon.se is to disseminate knowledge and product-neutral information about clean vehicles, fuels, and other relevant facts to buyers and drivers of clean vehicles. The site should make it easier for potential vehicle buyers to choose clean vehicles and find clean fuels.

(3) Measure level:

The portal provides a dissemination channel connected to the other Stockholm measures.

The stakeholder dialogue and usability test provide input to further enhancing the website's functionality and quality. Some of the input results in new information and functions on the webpage.

A.1.1 Quantifiable impacts

Expect ed Impacts	An expanded range of services supports the continued development of markets for clean vehicles and fuels in Stockholm, particularly with regard to electric vehicles, charging, and environmentally friendly heavy lorries. User survey provides input to further enhancing the website's functionality and quality. Website provides an important dissemination channel for ECCENTRIC and related initiatives.	CIVITAS ECCENTRIC Objectives							
		Reduce:				Improve:			
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal	Livability	Competitiveness
ID	Quantifiable Impacts								
1	Awareness raising on E-mobility and green, environmentally friendly transport					x	x	x	x

Table 1: Quantifiable impacts.

A.2 Measure description

The website “www.miljofordon.se” is Stockholm’s and Sweden’s leading resource for facts on environmentally classified cars, light and heavy trucks, environmentally friendly fuels and the rules and benefits of environmentally classified cars. During the ECCENTRIC project, this website was developed further to be used as an information channel connected to the other Stockholm measures. It was extended with information on both environmentally friendly heavy lorries and electric vehicles. It was further developed through a stakeholder dialogue to catch needs that are not available today to provide a complete information source for environmentally

friendly vehicles. The portal was also planned to be connected to charging maps and provide information to housing associations about charging of electric vehicles.

A.2.1 Measure outputs

The output of the measure is the revised www.miljofordon.se website, expanded to include more information on environmentally-friendly heavy lorries and electric vehicles and further developed through stakeholder dialogue.

A.2.2 Supporting activities

A stakeholder dialogue and usability test (user survey in late 2018) helped identify and address functions that were previously unavailable, in order to provide a complete information source for environmentally friendly vehicles.

A.2.3 Interactions with other ECCENTRIC measures

The portal was also linked to electric vehicle charging maps and information around charging of electric vehicles at multi-family housing (this links to e.g. Measures STO 6.6 and STO 6.7).

A.2.4 Interactions outside ECCENTRIC

None identified so far.

A.3 Target groups and/or affected part of the city or region

The target groups are summarized in Table 2.

Target group		Affected area	
Type	Description	Type	Description
Fleet Managers	Profession car buyers, responsible for the cars of companies and organisations	Stockholm	All of Sweden. Miljöfordon.se is a national website
Potential buyers of new cars	People who are interested in buying new cars for themselves and their family	Stockholm	All of Sweden. Miljöfordon.se is a national website

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

The relevant stakeholders are listed in Table 3.

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR- other	Level of activity L-P-O	Role - Links
P03	Environmental Department of the City of Stockholm	P	C	L	
P10	KTH Royal Institute of Technology	P	KI	P	
P12	Consultancy companies operating as sub-contractors	S	PR	O	
P19	Potential buyers of electric vehicles	S	Other	O	
P20	Companies related to charging infrastructure	S	PR	O	
	Fleet managers and others responsible for a company's and an organization's car fleet	S	Other	O	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

At the outset of the project, risks were identified as those in Table 4.

Identified risk	Category	Mitigation actions	Responsible
Resource shortfalls (Inability to secure sufficient resources, overspending)	9 Financial	Find the most efficient ways to carry out stakeholder dialogue	City of Stockholm
Low response rate in Stakeholder dialogue	5 Involvement, Communication	Send many reminders to stakeholders	City of Stockholm
No sufficient attention and resources to evaluation tasks	9 Financial	Planning and scheduling	City of Stockholm

Table 4: Risk assessment

B. Measure implementation

B.1 Situation before CIVITAS

The project was building on an already existing the website, www.miljofordon.se. The web site is Stockholm's and Sweden's leading resource for facts and statistics on environmentally classified cars, light and heavy trucks, environmentally friendly fuels and the rules and benefits of environmentally classified cars.

B.2 Innovative aspects

New and innovative ideas for development of the webpage were expected to be outcome of the stakeholder dialogue.

B.3 Research and Technology Development

No new research or technology development was included in this measure.

B.4 Actual implementation of the measure

The project was organized such that the Measure Leader was responsible as sole formal partner, but specific tasks are sub-contracted to consultancy companies.

Phase 1: Early adjustments pre-testing

- Information about how to install charging at multifamily homes was integrated on miljofordon.se in December 2016 (see Eccentric measure 6.7).
- In spring 2017, the entire web site was moved to a new platform together with a new graphic design and improved usability.
- In December 2017, an HTTPS certificate was issued, enhancing security and improving ranking on Google.
- Information regarding trailer weights and B-class drivers' licenses was added in December 2017.
- Between June 2018 and January 2019, the ability to search car using Euroclass was added and the vehicle search and information were adapted to the newly updated national environmental vehicle regulations. Additional information on light duty trucks was added.

Phase 2: Dialog and testing

- During the period of September 2017 to September 2018, a stakeholder dialogue was carried out. Fleet managers, persons who are interested in buying new cars, sustainability managers, car dealers and NGO's were approached. They answered questions about how they search for information on clean vehicles and electric vehicles and what would help them to promote clean and particularly electric vehicles.
- In October 2018 a usability test was carried out on a sample of the target group for miljofordon.se. This usability test was used to review the web site's features and identify what needed to be improved.

Phase 3: Major improvements after testing

Both studies from Phase 2 gave input to further development of miljofordon.se. New ideas were investigated for feasibility and those that could be realized were developed and released on the web page in several iterations, mostly between April and October 2019:

- Sharing icons were added to enhance the possibility to market the page on social media.

- Graphical improvements were made to facilitate navigation of the site both on desktops and mobile phones.
- Improvements in the vehicle search and moving model search to the quick search.
- Graphical adjustments to make it easier to find calculations.
- Added information on the requirements for transport vehicles set by the National Agency for Public Procurement.

In May 2019 we also worked with SEO (Search engine optimisation) to make it easier for those who search for information on electric vehicles to find miljöfordon.se and the information provided.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

The four KPIs are all used to assess awareness-raising, with the first two KPIs focused on awareness and the remaining two KPIs focused on acceptance.

Visits to Miljöfordon.se

The first KPI for awareness is the number of sessions, or visits, to the web site, generated using the Google Analytics web statistics platform. Statistics are available on essentially any arbitrary timescale, but we have chosen to extract totals by year and quarter over the span of 2016 to 2019, using the first and last observation as the baseline and effect observations, respectively.

Subscriptions to Newsletter

The Miljöfordon.se newsletter contains regular articles on topics related to the web site, and is both posted at the web site itself and is emailed in conjunction with each new edition. The newsletter is the source of the second KPI for awareness. The KPI is simply the number of successful deliveries of the newsletter email messages. There were 28 editions of the newsletter sent during 2016 to 2019. We identify the first and last of these as the baseline and effect observations, respectively.

Pages per Visit to Miljöfordon.se

The first KPI for acceptance is the average number of pages visited per visit. This indicator, while simple to produce, is more complicated to interpret. On one hand, an increase in this KPI could suggest visitors spending more time at the site and thus more satisfied to use it. On the other hand, an increase could indicate that it takes visitors longer to find the information they are seeking, and hence the site is performing more poorly. As with total visits, we extract this data on a quarterly basis from 2016 to 2019.

Newsletter Open Rate

Finally, the newsletter's opening rate, i.e. the share of sent emails that leads to a click on a link and opening a web page, is used as a KPI for acceptance. As with the total subscriptions, there are 28 observations.

Impact	Awareness raising	Awareness raising	Awareness raising	Awareness raising
Indicator name	Awareness	Acceptance	Awareness	Acceptance
Type	KPI	KPI	KPI	KPI
Category	Society - People	Society - People	Society - People	Society – People
Subcategory	Acceptance	Acceptance	Acceptance	Acceptance
Aspect	Awareness level	Awareness level	Acceptance level	Acceptance level
Definition	Number of visit sessions to miljofordon.se	Number of subscriptions to newsletter	Pages per Session	Newsletter open rate

Table 5: KPI Descriptions.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness via Web site	No. sessions	B- I (14) – A	DC	General public (Residents,visitors), EV providers, operators, companies related to Evs, politicians	Sweden
2	Awareness via Newsletter	No. subscriptions	B – I(26) – A	DC		Sweden
3	Acceptance via Web site	Pages per session, ratio	B- I (14) – A	DC		Sweden
3	Acceptance via Newsletter	Open rate, %	B – I(26) – A	DC		Sweden
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: KPI Details.

C.1.2 Baseline

We take the start of 2016 as the baseline, represented by Q1 for the web statistics and the first newsletter of that year, sent on the 11th of January. The results are shown in the indicator summary table.

C.1.3 The business-as-usual scenario

Without the Eccentric project, the website would not be up-to-date with the expectations of the visitors. They would not easily find the information they need and they would not get the help they need to make decisions about clean vehicles and electric vehicles in particular. Consequently we would expect visits to decrease as the information relevance diminishes. The effects on pages per visit are less clear, since visitors might spend more time searching for information and not finding it, or they may lose patience faster and spend less time.

As to the newsletter, we would expect new subscriptions to drop off to a rate well below the cancellation rate of existing subscribers. The effect on acceptance of the newsletter is unclear, and it would depend on the content. If new editions are sent out, presumably these would contain new information even if the web site is not updated. Hence, there should be no change in this KPI.

In quantitative terms, we estimate the business-as-usual statistics using simple linear-regression extrapolations, based on the period of Q1 2016 to Q2 2017 for the web-based statistics, and for the newsletter, from the first proper edition on 2013-04-15 until Q2 2017. Linear extrapolations were possible for all KPIs except for Acceptance via the newsletter, where the trend was rather erratic over the entire set of observations. Instead, the business-as-usual figure was taken to be the same as the baseline.

C.2 Measure results

Awareness

Awareness via the web site was estimated to be 108,095 at the end of 2019, which represents a significant growth and exceeds the expectation based on the early trendline. However, awareness via the newsletter followed a steady downward trend, ending at 725 sessions per quarter after starting at 931 per quarter. This essentially fell in line with the early trendline, so although it represents a narrowing exposure of the newsletter, it is difficult to attribute this to the actions in the Eccentric project. Rather, the downward trend is attributed to the fact that the newsletter was marketed at its initiation but not since then, as focus has shifted to the web site itself. With each new edition sent out, a number of subscribers will tend to unsubscribe.

Acceptance

Acceptance as measured at the web site also decline, with pages per session falling from 3.92 to 2.72. However, this was slightly higher than the early trendline would have predicted. In any case, pages per session is difficult to interpret as a statistic, as mentioned earlier.

Acceptance via the newsletter varied erratically over the course of the observed years, ending slightly lower than where it began. This could be explained by a variety of factors specifically related to the newsletter itself, such as what stories or headlines were featured on the email and the degree of content already provided there versus requiring a click-through to read more.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness via Web site	# sessions	43236	2016, Q1	94000	2019, Q4	108095	2019, Q4	+64859	+14095
Awareness via Newsletter	# subscriptions	931	Jan. 11, 2016	745	Nov. 14, 2019	725	Nov. 14, 2019	-206	-20
Acceptance via Web site	Pages/session	3.92	2016, Q1	2.31	2019, Q4	2.72	2019, Q4	-1.19	+0.41
Acceptance via Newsletter	% opened newsletters	31.4%	Jan. 11, 2016	31.4%	Nov. 14, 2019	31.0%	Nov. 14, 2019	-0.4 ppt	-0.4 ppt

Table 7: KPI Results.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Awareness raising	★	Awareness increased in some ways but not all.
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★ ★ = Exceeded			

Table 8: Summary of Objective Achievement.

C.4 Up-scaling

The web portal is essentially already scaled-up, not only to all of Stockholm but even to all of Sweden since it is used nationwide as a resource for information about green vehicles.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

Only one noteworthy deviation from the original plan has been noted at the time of the final measure impact report.

D.1.1 Deviation 1

Off-road machinery – it was decided to exclude off-road machinery from the portal at this time, since there is insufficient relevant information available to provide in this kind of online interface.

D.2 Barriers

One notable barrier has been recognized so far.

No.	Barrier field	Description	Action to overcome the barrier
1	Other – technology	Certain technology is not sufficiently developed yet, for example off-road machinery, so that there are no relevant facts to summarize on the web portal.	The web is designed so that it is flexible enough to accommodate additional classes of technology in the future, as they become relevant.

Table 9: Summary of Barriers.

D.3 Drivers

One notable driver has been recognized so far.

No.	Driver field	Description	Action to make use of the driver
1	Involvement, communication	Many interested parties are highly engaged in the project and are eager to contribute their ideas and opinions to develop the web portal.	Channels for soliciting input are made available that have the capacity to receive a substantial quantity of contributions.

Table 10: Summary of Drivers.

D.4 Supporting activities

The supporting activities were essentially to prioritizing potential improvements and to help test the usability of changes.

D.5 Recommendations on the implementation process

Recommendations are specified in the final Process Evaluation Report, which was still under preparation during the finalization of this Measure Evaluation Report.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- Visits to the miljofordon.se web site increased not only steadily during the time period the improvements were made, but accelerated, suggesting a significantly broadening awareness of information about environmental vehicles.
- The news that was sent out had an overall declining role in increasing local knowledge about environmental vehicles, as efforts shifted to improving the web site.

E.2 Relevance of supporting activities

No supporting activities were included in this measure.

E.3 Interaction with other measures

One of the web site's central improvements was to stay current with content on, for example, charging locations in Sweden and on available charging technology for multi-family housing. As Stockholm charging stations were developed in conjunction with Measure 6.6 and multi-family charging information was distributed with Measure 6.7, this content was integrated into Measure 6.5.

E.4 Main lessons learned

One needs to be flexible in the project plan since conditions can change from the start to the end of the project. For example, in this case miljofordon.se was moved to a new platform at the start of the project, which we did not foresee when setting the project plan at the beginning.

E.5 Long term impact

The web site has taken a central role in Sweden as a repository for green vehicle information, at a time when interest in green vehicles is surging, hence it now has a key position in Swedish information networks over the long-term. More concretely, the information distributed on the web site will hopefully have an effect on the Swedish vehicle fleet, which as a long-term durable good will have an intrinsic impact that is long-lasting.

E.6 Potentials for up-scaling in the city

The measure is essentially already scaled up to the entire city, being a web site that is publicly available; indeed it is already seen and used as a service for all of Sweden.

F. Additional information

F.1 Appraisal of evaluation approach

The results of the appraisal are included in the final Process Evaluation Report.

F.2 Future activities relating to the measure

The web site will be continuously updated and improved in the future.



2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



STO 6.6

Master plan for developing EV-charging in Stockholm

Measure Evaluation Report

Deliverable No.:	8.5
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2020
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ECCENTRIC



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3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
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28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Joel Franklin	KTH Royal Institute of Technology
Eva Sunnerstedt	City of Stockholm
Neva Leposa	KTH Royal Institute of Technology

Table of Contents

ABSTRACT.....	1337
A. INTRODUCTION.....	1338
A.1 EXPECTED RESULTS OF THE MEASURE	1338
A.1.1 Quantifiable impacts.....	1339
A.2 MEASURE DESCRIPTION	1339
A.2.1 Measure outputs.....	1339
A.2.2 Supporting activities	1340
A.2.3 Interactions with other ECCENTRIC measures.....	1340
A.2.4 Interactions outside ECCENTRIC	1340
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1341
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1342
A.5 IDENTIFIED RISKS	1342
B. MEASURE IMPLEMENTATION	1343
B.1 SITUATION BEFORE CIVITAS	1343
B.2 INNOVATIVE ASPECTS.....	1343
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1343
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1343
C. IMPACT EVALUATION FINDINGS	1346
C.1 EVALUATION APPROACH.....	1346
C.1.1 Expected impacts and indicators.....	1346
C.1.2 Baseline.....	1347
C.1.3 The business-as-usual scenario.....	1348
C.2 MEASURE RESULTS.....	1350
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1352
D. PROCESS EVALUATION FINDINGS	1353
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1353
D.2 BARRIERS	1353
D.3 DRIVERS	1354
D.4 SUPPORTING ACTIVITIES.....	1355
D.4.1 Workshop with the energy supplying companies	1355
D.4.2 Advertisements as mean of financial support.....	1355
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1355

D.5.1	<i>The process is smoother, if supported by an important actor.....</i>	1355
D.5.2	<i>Transparent communication.....</i>	1356
E.	EVALUATION CONCLUSIONS	1357
E.1	VALIDATED DIRECT IMPACT	1357
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1357
E.3	INTERACTION WITH OTHER MEASURES.....	1357
E.4	MAIN LESSONS LEARNED	1357
E.5	LONG TERM IMPACT	1358
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1358
F.	ADDITIONAL INFORMATION.....	1359
F.1	APPRAISAL OF EVALUATION APPROACH	1359
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1359

List of Figures

Figure 1: Energy transfer from the on-street charging before Eccentric and the BaU forecast.
..... 1349

Figure 2: Measured energy transfer from on-street chargers in Stockholm, in kWh 2016-2018,
source own graph based on the data provided in “Evaluation of public charging for electric cars
in the city of Stockholm”, April 2019, p. 27..... 1350

List of Tables

Table 1: Quantifiable impacts.....	1339
Table 2: Target groups or affected parties.....	1341
Table 3: Measure stakeholders.....	1342
Table 4: Risk assessment.....	1342
Table 5: Description of indicators.....	1346
Table 6: KPI Details.....	1347
Table 7: On-street charging energy transfer, kWh, source “Evaluation of public charging for electric cars in the city of Stockholm”, April 2019, p. 27.....	1348
Table 8: Baseline indicators, results.....	1348
Table 9: BaU indicators, results.....	1349
Table 10: Baseline, BaU, and after, results.....	1351
Table 11: Summary of Objective Achievement.....	1352
Table 12: Summary of Barriers.....	1354
Table 13: Summary of Drivers.....	1355

Project	City		
ECCENTRIC	Stockholm		
Measure code	Measure name		
6.6	Master plan for developing EV-charging in Stockholm		
Last update	Responsible	e-mail	telephone
	Eva Sunnerstedt	eva.sunnerstedt@stockholm.se	

Abstract

The City of Stockholm has a goal to increase the number of EV on-street charging stations. This long-term goal responds to, and encourages, the increasing use of EVs. This provides more charging opportunities for the EV users, attracts new EV users, and thereby supports decreasing fossil fuel emissions, improving air quality and decreasing noise pollution in the city. In particular, The City of Stockholm had originally set up a goal to install 500 on-street EV charging possibilities by 2020. In 2019 this goal was revised by the City Council to 4 000 public charging units by 2022 (out of which 2 000 should be put up in public garages by Stockholm Parking Company and 2 000 on-street through the Traffic Administration within the City of Stockholm).

This measure supported the installation of the EV on-street charging. The most important outcome of this measure was the production of an interactive map published on a website, which identifies where the installations are possible and allowing the energy suppliers to reserve and install the chargers. Impact evaluation was based on several indicators. First, awareness rate counted the number of visitors to the website. Second, acceptance rate calculated the rate based on the tallied number that managed to successfully install chargers from the number of companies interested in setting up public charging. Satisfaction rate was comparing operations by using the map with the regular operations and was measured via an interview with the companies which installed charging, using a 1-5 scale (5- very satisfied). In addition, based on secondary sources, CO₂ emission savings were calculated and costs for establishing the master plan and its updates were traced.

Results show that at least 200 on-street chargers have been put in operation. From the 6 companies which reserved streets for installing EV charging, 4 had installations process in place or completed the installations by the end of 2018. The companies are generally satisfied with the website and the map, satisfaction is 3.7 (1-5 scale, 5 – very satisfied). The website supported the installations of the EV on-street chargers, which indirectly also supported the reduction of CO₂ emissions in the city. The City is supporting the continuous improvement of the process of installations and the process is ongoing.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

The city of Stockholm has a goal to increase the number of EV on-street charging stations. This long-term goal responds to, and encourages, the increasing use of EVs and thus provides more opportunities for companies with EVs and EV owners who work or live in the city to charge their vehicles and contributes to the decrease of emissions and noise pollution in the city.

(2) Strategic level:

The city of Stockholm, in order to increase the EV charging possibilities, has set up a goal to install 500 EV public on-street charging stations by 2020 in the city and the outskirts of the city. Recently, future goal has been set to install 4000 public on- and off-street EV charging stations by 2022, 2000 on- street (1000 in the inner city, and 1000 on the outskirts) and 2000 off-street by Stockholm Parkering AB (parking Company owned by the City of Stockholm).

(3) Measure level:

In order to address the goal and provide more EV on-street charging stations, the City of Stockholm, as part of the Eccentric, developed an EV on-street master plan. This plan included four parts. (1) The development of criteria for providing a coherent and consistent service of EV charging in the city. (2) A survey of potential streets and parking locations in the city (3) A dynamic online map, displaying the possible EV on-street charging locations in the city (4) A structure for the potential energy supplying companies to systematically reserve the spots on a first come first serve basis and sign a lease to establish EV-charging outlets.

A.1.1 Quantifiable impacts

Expected Impacts	Developing a master plan, including a map and a structure for installations was planned to effect many levels, some of which are hard, even impossible, to quantify. It aims to: 1) Provide a structure and a system for establishing EV on-street charging infrastructure and thus provide better access to charging for EV owners. 2) Give opportunity to more energy supplying companies to provide EV-charging services and thus contribute to the local economy. 3) The increase of EV charging stations can indirectly motivate EV car ownership, reduce noise and CO ₂ emissions in the city.	CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
		Energy use, CO ₂ emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight	Local economy
ID	Quantifiable Impacts										
1	Reduction of CO ₂ emissions	x	x								
2	Acceptance of/satisfaction by the charging infrastructure companies.					x	x	x		x	
3	Exploitation of the funding for implementation of the plan and giving opportunities to local economy								x	x	

Table 1: Quantifiable impacts.

A.2 Measure description

The idea of the measure is to develop a charging plan for electric vehicles (EVs) in the city of Stockholm. The measure included four parts.

Task (1) Criteria forming: First, the city explored the legislation and created criteria for identifying the suitable streets for EV-charging.

Task (2) Field Survey: Second part of the project was to conduct a survey in the city and identify 500 suitable places by 2017 for EV on-street charging in the inner part of the city, according to the above defined criteria. The outskirts of the city is vast, for that part of the city the criteria were identified and the companies could choose and ask the city to investigate these parts.

Task (3) Mapping: Third part of the project was to develop a dynamic map and a website, making the map available to the potential energy supplying companies so they can browse and reserve the streets to install EV charging.

Task (4) Communication and coordination: The fourth part of the project was continuous communication with the (potential) stakeholders (the energy companies), through emails, seminars and workshops. Part of this is also signing an access right agreement when works are planned and regular updating of task 2 and 3.

A.2.1 Measure outputs

The key output of the measure is Task (3) - the provision of an online dynamic map of the potential EV-on-street spots in the city of Stockholm. This map is mostly intended for the potential energy supplying companies, who have the capacity to install EV charging stations. It provides them with an overview over the existing and potential charging sites. They also

have a possibility to reserve and lease the sites. It is also part of the measure to keep the plan and the map continuously updated.

A.2.2 Supporting activities

In order to provide the map, it was necessary to develop criteria (task 1) and conduct a field survey (task 2) to identify the suitable sites. In addition, as part of task 4 - several seminars and press release have been given for the energy supplying companies.

A.2.3 Interactions with other ECCENTRIC measures

This measure interacts with measure 6.1 test fleet of EV vans for local business in Stockholm, 6.5 the website www.miljofordon.se and measure 6.7 information campaign on how to implement charging units in multifamily homes. Learnings and exchange will also be close with all the other measures in wp6-.

A.2.4 Interactions outside ECCENTRIC

While the provision of the dynamic map is at the core of this Eccentric measure which the Eccentric actors, such as Stockholm City, is steering, the city interacts with several business (operators for setting up EV charging stations), consulting companies, and other municipalities, and finally with politicians and citizens. For example, the city interacts with energy utility companies, suppliers of charging infrastructure and any other company interested in putting up on-street public charging at their own expense on city owned land. Fleet operators of EVs such as taxi companies, car sharing and carpooling companies (both fixed and free floating), courier companies, service providers using cars in their day to day operation are also interacted with. Ellevio is one major actor the city interacts with, since it is the grid owner in Stockholm. Consultancies are used for producing statistical analysis of the satisfaction with EV charging. The City is also exchanging experiences with other Swedish municipalities. Finally, politicians also play an important role setting up the goals, which was first to provide 500 places by 2020 and now an ambitious goal was set recently to establish 4000 by 2022.

A.3 Target groups and/or affected part of the city or region

The target groups are summarized in Table 2.

Target group		Affected area	
Type	Description	Type	Description
Energy utility companies	Establishing on street charging at own expense after signing an access right agreement with the city	Primarily inner city of Stockholm	The map covers the inner city of Stockholm. In the inner city it is much harder to find good locations for charging off street than in the outskirts of the city where energy utility companies tend to work together with filling stations, fast food restaurants, shopping centres and the like.
Ellevio	Grid owner in Stockholm	Primarily inner city of Stockholm	Ellevio needs to work with connecting the different charging streets and upgrade the grid accordingly
Suppliers of charging infrastructure	Cooperation with energy utility companies		
Other municipalities/cities in Sweden and Europe	Learn from the experiences of the project	Business model and legal aspects	All cities can learn from the mapping and the business model of the charging streets. Swedish cities can also learn from how we handled legal issues.
EV owners and potential EV owners	Better charging makes it possible for more petrol and diesel cars to be exchanged to EVs	The Stockholm Region	More easy and attractive to drive and operate EVs in the Stockholm Region

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

The relevant stakeholders are listed in Table 3.

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR- other	Level activity L-P-O	Role Links
P02	Citizens of the City of Stockholm	S	Other	P	
P03	Environmental Department of the City of Stockholm	P	C	L	
P10	KTH Royal Institute of Technology	P	KI	P	
P19	Potential buyers of electric vehicles	S	Other	O	
P20	Companies related to charging infrastructure	S	PR	P	
K09	Ministry of the Environment, Ministry of Transportation	S	Other	O	
	Ellevio	S	PR	P	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

At the outset of the project, risks were identified as those in Table 4.

Identified risk	Category	Mitigation actions	Responsible
Delays (implementation, data collection, dependent tasks etc.)	Operational	Be aware of the time table and take action as soon as something is not in light	City of Stockholm
Insufficient communication	5 Involvement, Communication	No action. More worried about to large interest that under communication	City of Stockholm
Resource shortfalls (Inability to secure sufficient resources, overspending)	9 Financial	Not so costly and there is plenty of resources	City of Stockholm
Conflict/Lack of cooperation with similar projects/actions/pilots	8 Organizational	Use the existing network meetings etc.	City of Stockholm
No sufficient attention and resources to evaluation tasks	9 Financial	Make procurement for support in good time and be prepared to do a lot of man-hours by ourselves	City of Stockholm

Table 4: Risk assessment.

B. Measure implementation

B.1 Situation before CIVITAS

Before Eccentric Measure, in 2014 the project “Charging infrastructure for electric vehicles – how can a city take initiatives and act?” took place. The project’s aim was to establish 10 new facilities for fast-charging and at least 100 facilities for slow charging in the city of Stockholm. The project was funded by the Swedish Energy Agency, coordinated by the Environment and Health Administration, and run by a collaboration between Traffic Administration, Stockholm Parkering AB and the Royal Institute of Technology (KTH). Thus, in 2014 more than 100 normal and 13 fast charging stations were installed. In 2016, the goal was to install additional charging stations and reach 500 by 2020. Today, the city has a goal to have 4000 charging spots in the city of Stockholm by 2022.

B.2 Innovative aspects

Mapping the entire inner city for good locations for public on street charging, established a system, which made the process known for everyone involved. Moreover, other cities can learn from these newly developed and experience based criteria. The process of how charging may be established on street is now very clear and there is a clear way on how to proceed for everyone. The business model, where private operators may put up on street charging at their own expense, signing an access agreement with the city, is new and innovative. This model makes it easier and less expensive for a city to make sure public on street charging is established.

B.3 Research and Technology Development

Compiled data from the usages of the on-street-chargers compared with information from surveys answered by the EV drivers using the public charging gives information for improvements and further roll out. How to interpret and use existing Swedish legislation in terms on access right agreements and road signs to reserve the parking places for EVs.

B.4 Actual implementation of the measure

Task (1): Formulation of criteria: 2016-now

Nine criteria for what places are suitable for EV on-street charging were developed on an on-going basis. Brief conversation with Ellevio, the grid owner, were supportive but learning by doing was most productive. For example, the places should not be used as pedestrian streets in the summer time, the plans for the future development of the area should not be interfering with the development of the charging stations. There should be enough space to clean the roads (snow), and there should be enough space for the pedestrian section. Moreover, throughout the implementation of the measure it was learnt that the most suitable parking spots for the on-street EV charging are those perpendicular and not 45° or parallel. When located on the one-way streets, the movement of the cars when leaving the parking areas should be taken into account. The signs and charging stations should also blend-in with the surroundings, colour scheme should be neutral and the citizens living there should not be disturbed. The city learnt that locating charging stations near the trees is problematic due to increased costs and decreased visibility and recognition of the signs. These criteria were developed throughout the entire time of the measure implementation from 2016-today. This was, and still is, a learning process.

The list of criteria:

- 1) Exposure: particularly visible places are rewarded since that increases visibility of charging places and motivates its (potential) use.
- 2) Parking angle: Parallel, angular, or transverse parking affect using the sites correctly when fast charging.
- 3) Trees in vicinity: When setting EV charging at parking lots near trees, roots have to be avoided. Actors need to consider the associated risks.
- 4) Streets main function: Streets with many other functions (bike lane, bus lanes, etc.) are considered unsuitable for charging places. Streets mainly used for parking are more suitable. Cities' future plans are important to consider.
- 5) Dimensions: special measures, the width and the manoeuvre space required, are defined.
- 6) Cluster of places: if several places are available, rather than a couple can decrease searching time and the costs of operations. In addition, even number of parking spots associated with fast charging provides a more efficient operations and use of space.
- 7) Summer walking streets: some streets are summer pedestrian streets. Actors need to be aware of the use.
- 8) Places near water: such places are having different purposes planned, thus, places near harbour are disqualified and places near other types of water are given low assessment grade.
- 9) Traffic: Tests have shown that in the areas with high traffic intensity, problems can occur.

Task (2): Surveying the field: August 2016-now

A consulting company was procured and according to the criteria identified, 2 500 places were progressively identified and mapped on the map when it was first released. The outskirts of the city were not mapped and for that part it turned out that the companies trying to apply for these parts have difficulties identifying which areas are private and which are public and thus available. The map was developed by a consultancy company and was first published in May 2017 and then it has been regularly updated with the new streets added. Companies were through this map first able to reserve simultaneously 10 locations, which was then increased to 30, as companies found this to be more effective – they can continue the work within the same contract without breaking the flow.

Task (3): Mapping and publishing the map: May 2017

Same consultancy as for Task 2, mapped the best locations on the electronic map on the cities web-site available to public, but its main target group is energy companies. Smaller updates on the map were regularly done and major updates was made in June and October 2019.

Task (4): Communicating and coordination: On-going

This task is an on-going task and includes exchange of information, communication with the energy companies, the grid owner, as well as other municipalities such as Göteborg, Malmö and even more with neighbouring municipalities in order to discuss, exchange and inform. The regulation on access for operators intending to install on-street charging is also communicated via the website. The energy supplying companies need to collaborate with the energy grid

owner in Stockholm, Ellevio, however the City is also supporting this communication. From October 2019 it has become easier for other companies than the larger energy utility companies to connect and install EV charging equipment in the areas where the grid owner Ellevio is planning to update the grid.

The web-site where the map is published is also a place for information about the business model and the regulations and agreements that come for private actors establishing on-street charging in Stockholm.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Putting together a Charging plan, including a map and a network will have effects on many levels, some of which are hard, even impossible, to quantify. A map will:

- (1) Provide a better overview for possible EV on-street charging locations in inner city of Stockholm and will structure the way of installing the EV on-street charging infrastructure providing a better accessibility to charging for the EV car owners working and living in the city.
- (2) Energy supplying companies will be able to, based on first come first serve basis, reserve the street and install EV charging infrastructure. This will give more companies opportunities to contribute to the installations. Thus, contribution will be made to the local economy.
- (3) Third, as a consequence, charging will be made accessible to the people working and living in the city, which will support EVs ownership. As a long-term effect, more EVs installed at lower cost will reduce the numbers of fossil fuel driven cars, which means less noise pollution, more efficient use of energy and less emissions.

These impacts are measured through the following key performance indicators (KPIs): awareness, acceptance, satisfaction, CO₂ emissions, operational costs, and investment costs. See the table 5 below:

Impact	Acceptance	Acceptance	Acceptance	Reduction of CO ₂	Exploitation	Exploitation
Indicator name	Awareness	Acceptance	Satisfaction	CO ₂ emissions	Operational costs	Investment cost
Type	KPI	KPI	KPI	KPI	KPI	KPI
Category	Society – People	Society – People	Society – People	Environment	Economy	Economy
Subcategory	Acceptance	Acceptance	Acceptance	Pollution and nuisance	Costs	Costs
Aspect	Awareness level	Acceptance level	Fulfilment of expectations	Emissions	Operating costs	Investment costs
Definition	Number of the visitors to the web-site	The percent of the companies interested in putting up on street public charging	How satisfied are the companies related to street public charging	CO ₂ -emissions saved by charging at the public charging units instead of using an equivalent petrol car	Cost for keeping the master plan updated (Costs for man hours for staff at TK and MF for keeping the masterplan updated.	Cost for establishing the master plan (Costs for consultant mapping good locations, cost for man hours for staff working for the city with the information to the map etc.)

Table 5: Description of indicators.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E- S-C	Observed group	Area of measurement
1	Awareness	#	A	DC	General public (Residents, visitors), EV providers, operators, companies related to EVs, politicians	Demonstration Area
2	Acceptance	%	A	DC		
3	Satisfaction	0-5	A	S		
4	CO ₂ Emissions	Tons/year	I(3) - A	DC	Companies participating in the implementation of the measure, City of Stockholm	
5	Operational Costs	EUR/year	A	DC		
6	Investment Costs	EUR/project	A	DC		
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: KPI Details.

C.1.2 Baseline

From 2010-2014 EV charging stations were progressively installed, but more commonly, they were placed in garages. In 2014, decision was made to install 100 normal charging and 10 fast charging stations. However, these stations were placed in an unstructured way, thus, a need for a better system emerged. By 2015, two companies, Vattenfall and Fortum installed 7 fast charging stations on street and 5 were under way to be installed in 2016.

The map was developed as part of this Eccentric measure in May 2017. It showed the possibilities for EV on-street charging and based on a first come first serve basis energy suppliers were able to reserve the streets and install EV on-street charging.

Since the measure is a newly developed map and since several KPIs are relating to the map as such, the baseline for several KPIs is not applicable (NA). In particular:

KPI 1: Awareness describes the number of visitors to the newly developed website. It uses numbers as units, and not a percentage, since it is difficult to identify which population these visitors will represent (general citizens, energy supplying company employees). Baseline for before the website existed is NA.

KPI 2: Acceptance describes the share of the companies that installed EV on-street charging as a share of the total number that expressed interest/reserved the street online. Baseline is NA.

KPI 3: Satisfaction describes how satisfied are the companies with the dynamic map, baseline is satisfaction of the companies with an alternative system, i.e. installing EV charging without using the map. Satisfaction was measured in October and November 2019 by asking the 4 energy suppliers how satisfied are they with the normal procedure of installing EV charging (without using the map), 3 out of 4 energy suppliers were reachable and graded their satisfaction with 3, 3, and 2 respectively, which is 2.7 in average. 1-5 scale was used, 1-very dissatisfied, 5-very satisfied.

KPI 4: refers to the reduction of CO₂ emissions, which is calculated by using a proxy of the amount of energy transferred from before eccentric existing on-street chargers in the city. The first four points of measurements (q4 in 2016, q1,2,3 in 2017) were taken as a baseline. This is the available, and suitable, data, since the website was up and running in May 2017 and it

takes several months to install EV charging and for the chargers to be fully operational. The transferred energy was computed by estimating how many km can be driven with that energy by an average diesel powered car. The calculations were made by using a coefficient 1.002 (to calculate the corresponding metric tons of CO₂ from the transferred kWh) for which reference is the report produced by the Swedish Energy Agency⁵⁸. In Sweden, about 40% of electricity comes from hydropower, 39% from nuclear power, 11% is from wind power, and 9% is cogeneration (mostly biofuel), solar power is less than 1%. Thus, since the electricity is not fossil fuel based, we are assuming savings can be made by using an EV as compared to a regular car. We do not account for the production of the EVs.⁵⁹

	2016Q4	2017Q1	2017Q2	2017Q3
On-street normal charging	91	2 200	3 963	12 261
On-street fast charging	44 219	63 282	71 235	110 731
Sum	44 310	65 482	75 198	122 992

Table 7: On-street charging energy transfer, kWh, source “Evaluation of public charging for electric cars in the city of Stockholm”, April 2019, p. 27.

Cumulative sum: 2016q4-2017q3= 307.982 kWh /1.002 = 307.3 metric tons CO₂ reduced

KPI 5: operational costs: baseline is 0. This KPI is measured using the cost for man hours for updating the website and the map.

KPI 6: Investment costs: baseline is 0. This KPI is measured using the cost for the development of the map.

Indicator	Unit	Before	Date Before
Awareness	#	NA	May 2016
Acceptance	%	NA	May 2016
Satisfaction	0-5	2.7	October 2019
CO ₂ emissions	Tons/year	307	Q42016-Q32017
Operating costs	€/year	0	May 2016
Investment costs	€/project	0	May 2016

Table 8: Baseline indicators, results.

C.1.3 The business-as-usual scenario

For this particular measure, for the majority of the KPIs, business as usual is the same as stated before, since the KPIs are measuring the awareness, acceptance, satisfaction, and the

⁵⁸ <https://www.energimyndigheten.se/globalassets/fornybart/hallbara-branslen/publikationer/drivmedel-2018.pdf?ResourceId=5753>

⁵⁹ Energiläget 2019, available at: <https://energimyndigheten.a-w2m.se/Home.mvc?resourceId=145396>, p. 4, 7.

cost of the website as such (see the Table 9 below). The website most likely would not have existed without the Eccentric.

Indicator	Unit	BaU	Date BaU
Awareness	#	NA	Dec 2018
Acceptance	%	NA	Dec 2018
Satisfaction	0-5	3.7	Dec 2018
CO ₂ emissions	Tons	822	Dec 2018
Operating costs	€/year	0	Dec 2018
Investment costs	€/project	0	Dec 2018

Table 9: BaU indicators, results.

When it comes to the reduction of the CO₂ emissions, we can make an estimation of the reduced CO₂ emissions due to the trend of an increase in the EV ownership and on-street charging regardless of the existence of the map. For that estimation, we drew a Trend line (see the figure below) by using the first four available measurements of the transferred energy from the on-street chargers (2016q4-2017q3) and estimating the trend to continue with the same increment. However, not only availability, but price for charging and availability of the off-street chargers (in garages) can highly influence the use of the on-street chargers. How that might affect the use of the charges in the future could not be accounted for in this business-as-usual scenario. One may assume that during the introduction period of the EV chargers, prices were lower, or even for free, in order to attract the use of the EVs. This may not be the case in the future, thus, since the trendline cannot account for these other factors, it is most likely an overestimation.

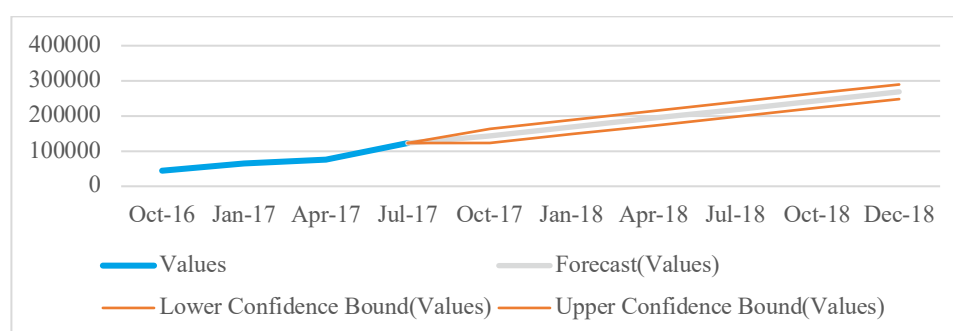


Figure 1: Energy transfer from the on-street charging before Eccentric and the BaU forecast.

According to the forecast, approximately 244.000 kWh of energy will be transferred in the last quarter of 2018 from the on-street charging. Cumulative energy transferred in 2018 would be $168.000 + 193.000 + 219.000 + 244.000 = 824.000 \text{ kWh}$, which translates into a reduction of approx. 822 metric tons of CO₂ in 2018.

C.2 Measure results

1) Awareness is measured by using google analytics, i.e. tallying the visits to the website. Measurements are provided quarterly and yearly starting from the beginning of the website, the data was collected using google analytics on a regular basis from May 2017 until the end of 2019.

2) Acceptance is measured by tallying the companies that made a reservation of the streets (to install EV charging), and tallying the companies that successfully completed installations. This was registered by the Stockholm City, which collected the applications on the regular basis from the time when the website was developed up to today. From the 6 companies which reserved streets for installing EV charging, 4 had installations process in place or completed the installations by the end of 2018, which gives 67% acceptance rate.

3) Satisfaction was measured in October and November 2019 by asking the 4 energy suppliers how satisfied are they with the procedure of installing EV charging by using the map, 3 out of 4 energy suppliers were reachable and graded their satisfaction 3,4, and 4 respectively (on a 1-5 scale, 1-very dissatisfied, 5-very satisfied). This is 3.7 in average. The satisfaction is believed to be even higher with the possibility of so called “orange streets” launched 5th of November 2019, which allows the energy supplying companies to apply for streets where Ellevio is updating the grid, the owner of the grid is evaluating this system with 5. In the interview, the grid owner expressed: *“I think the map is crucial, it facilitates and makes it easier for everyone to find a suitable place to place chargers.”*

4) Reduction of CO₂ emissions in the city is the CO₂ savings by using a proxy of the measured energy transfer from the on-street chargers in the city. According to the data collected by the energy supplying companies, through the on-street chargers 595.066 kWh of energy was transferred in 2018, which translates into approx. 594 metric ton CO₂ reduction in the city. This calculated saving is based on an assumption that citizens would alternatively drive a regular (petrol) car, and not go by walk, cycle, or use public transport. The transferred energy is lower than predicted BaU 822.000 kWh. In reality, the use of the chargers depends on the pricing and convenience, i.e. availability of all the chargers in the city, which includes off-street chargers (in garages).

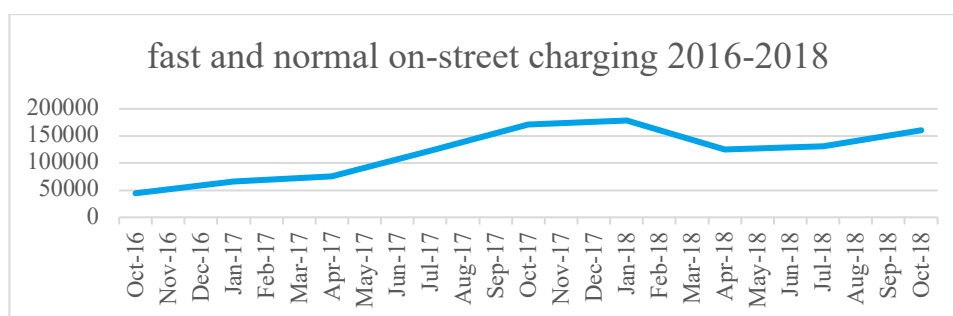


Figure 2: Measured energy transfer from on-street chargers in Stockholm, in kWh 2016-2018, source own graph based on the data provided in “Evaluation of public charging for electric cars in the city of Stockholm”, April 2019, p. 27.

Since the map supports the installation of on-street charging, the calculated energy transfer excludes off-street charging (for Before, BaU, and After). The fact that the BaU predicts a higher transfer of energy than it in reality occurs, can be explained by the fact that one of the energy suppliers introduced a fee for on-street fast charging in 2018. Moreover, during the time of this measure, 200 on-street chargers were installed, but also 1300 off-street chargers

were installed in garages and these were more common before the on-street charging became available in Stockholm. Thus the EV users had more options and could opt to use charges that are cheaper, more accessible, or more convenient in a given time. Cumulatively, the energy transfer increases over the years and on-street charging contributes to the increase. It can be discussed whether this would increase also without the on-street chargers, by using the off-street chargers more. However, garage charging in the city is typically used by companies or people who park and charge their cars there while at work. On-street charging provides opportunities also to people who live in the city (or visitors) and park and charge their cars on-streets. The availability can motivate EV car ownership among the residents.

	2016Q4	2017Q1	2017Q2	2017Q3	2017Q4	2018Q1	2018Q2	2018Q3	2018Q4
On-street normal charging	91	2 200	3 963	12 261	33 499	24 540	43 892	43 337	65 029
Off-street normal charging	47 285	55 721	49 339	42 077	72 836	66 793	68 915	60 222	93 257
On-street fast charging	44 219	63 282	71 235	110 731	137 621	153 963	80 627	88 102	95 576
Total	91595	121203	124537	165069	243956	245296	193434	191661	253862

Energy transfer.

5) Operating costs amount to 15.000 € per year. These have been calculated based on the on the standard salary levels at the City of Stockholm.

6) Investment costs account for the cost of the administration at the Stockholm city and the cost for the consultant company which developed the map. This cost is approx. 25.000 € for the project.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	#	NA	Aug. 2016	NA	Dec. 2018	1055	Dec. 2018	-	-
Acceptance	%	NA	Aug. 2016	NA	Dec. 2018	67%	Dec. 2018	-	-
Satisfaction	0-5	2.7	Aug. 2016	2.7	Dec. 2018	3.7	Dec. 2018	1	1
CO ₂ emissions	Tons /year	307	2016 q4-2017 q3	822	Dec. 2018	594	Dec. 2018	287	-228
Operating costs	€/year	0	Aug. 2016	0	Dec. 2018	15.000	2018	15.000	15.000
Investment costs	€/year	0	Aug. 2016	0	Dec. 2018	25.000	2018	25.000	25.000

Table 10: Baseline, BaU, and after, results.

C.3 Summary: achievement of objectives

The city of Stockholm is satisfied with the fulfilment of the objectives and targets. While before this project started, 2 companies were involved in the installations of the EV charging, it is now 6 companies involved, which positively contributes to the local economy. Moreover, the project is continuing, using other sources of financing, and agreement has been made with the grid owner in Stockholm around a special process, due to which it is expected that the installations will become even easier and also cheaper, also for the smaller companies to participate. The companies are generally satisfied with the website, which is continuously improved in the work-in-progress.

No.	Objective and target	Rating	Comment
1	Reduction of CO ₂ emissions	★★	The energy transferred and thus the local CO ₂ savings almost doubled, which meets Stockholms targets.
2	Acceptance/Satisfaction of the measures by the charging infrastructure companies	★★	The companies are generally satisfied with the process of EV installations via a website which meets Stockholms targets.
3	Exploitation of the funding for implementation of the plan and giving opportunities to local economy	★★★	Before the website, only 2 companies were installing EV charging, during the Eccentric project 6 companies reserved streets and 4 completed the installations. At least 10 small companies are interested to be part of it in the future. This exceeded Stockholms targets.
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★ ★ = Exceeded			

Table 11: Summary of Objective Achievement.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

There have been no significant deviations in the project plan.

D.2 Barriers

Several barriers have been experienced, and actions have been taken to overcome these.

No.	Barrier field	Description	Action to overcome the barrier
1	Spatial	Street space is in demand for many uses – there are many interests regarding how that space should be used. It takes time to identify and distribute spaces in a sound manner.	In this measure, a set of criteria has been developed according to which certain areas become more suitable for EV charging (e.g. places to be avoided are those close to the waterfront where it is planned to have pedestrian zones).
2	Institutional	The relevant laws regarding leasing and regulating street space is unclear. They are basically not adapted for street-side charging spaces. The parking laws are from the 1950s, and then no one thought of EVs. Later amendments are unclear and confusing. This project has shown itself more difficult to implement in a legal sense, and easier in a technical sense, than the measure leader initially believed.	The existing laws and regulations have been examined and interpreted by the legal staff of the City.
3	Institutional	The relevant laws regarding signposting for charging streets are complicated. Drivers do not understand the implications of the signs due to the complexity of relevant laws.	The legal situation is clear but complex to understand for drivers. Revision of signposting codes is needed to simplify the presentation of restrictions.
4	Administration	The process of installation is taking time. The energy supplying companies apply for the streets, then Ellevio investigates about the possibility and price (which highly varies depending on how far it is from a grid connection and if it needs an update), then the suppliers can decide which places they are interested in and then the city needs to conduct a technical analysis, taking 5-6 weeks, after which the grid owner can start the work which is then taking 2 weeks and after that the energy suppliers can place their equipment.	In order to speed up and ease the process, the city is trying a new way of working, so the companies could apply for places pre-prepared by the grid owner and the grid owner would suggest a possibility to prepare technical analysis in advance for some areas.
5	Responsibility is disproportionately distributed	The grid owner in Stockholm has a highly important role in the implementation of on-street charging, since they need to investigate the suitability and potential price for the set up.	Since the grid owner is updating the grid in any case, the investigation for the EV charging can be done as part of this process.
6	Different perspectives	The criteria differs between different actors, the city can set some type of criteria, according to which some places become more suitable, while the grid owner might find that these places have an expensive connection to the grid because of low capacity in the area.	Actions which could address this barrier is a clear communication of the plans and display of the criteria for each of the actor.

7	Uncertainty	The energy supplying companies did not know in advance, when applying for setting up charging on these streets, how much it will cost, since the grid owner had to conduct an investigation to determine the price (e.g. the grid is not up to date) and the cost varies a lot depending on the proximity to the grid.	The introduction of so called “orange streets” launched 5 th of November 2019 the energy supplying companies can apply for streets where Ellevio is updating the grid, which can also decrease uncertainty around the cost.
8	Geographical	If you do ground work during the five winter months in Stockholm you need to put a new layer of asphalt on when the spring arrives. This makes the investment more expensive. So far all actors have chosen to only put up chargers during the seven months when it is not “winter”. Takes longer time to get all the charging units put up.	Better planning and better preparations to use the seven months possible to the maximum.

Table 12: Summary of Barriers.

D.3 Drivers

No.	Driver field	Description	Action to make use of the driver
1	Cultural	The number of plug-in chargeable vehicles in Stockholm is growing rapidly. In 2019, 25% of all plug-in chargeable vehicles in Sweden were registered in Stockholm (and we had only 10% of the total number of vehicles in Sweden). Plug-in chargeable vehicles are over-represented here and grow most rapidly here.	The challenge is to be sure to no longer only target early-adopters but to reach the growing share of vehicle owners and operators who might have an interest in the project, hence each effort must continuously aim for a broader audience than the previous effort.
2	Cultural	EV-owners prefer to charge near home, since it is easy and convenient. Many EV-owners, however, live in the inner city and can only park along the street. Taxis, delivery vehicles and other service vehicles need fast chargers to be used optimally, and plug-in hybrids benefit from charging during the day in order to drive as much as possible on electric power. There is an increase in demand for street-charging.	Each of these segments needs to be targeted to ensure that these latent demands are matched with these new possibilities.
3	Political / Strategic	Private actors are interested in installing street chargers on city land, at cost to themselves.	The map with relevant regulations facilitates for both the City and for these actors to manage this interest soundly, and to quickly distribute and inaugurate EV-charging streets.
4	Cooperation	Cooperation with the grid owner.	Throughout the process the cooperation between the City and the grid owner has increased, thus ‘orange streets’ have been added.
5	Planning/Management	Introduction of ‘orange streets’	With introduction of ‘orange streets’ the process becomes faster and cheaper, according to Ellevio satisfaction with this new system is 5 (1-5 scale, 5 is very satisfied).
6	Corporate Social Responsibility	The motivation to show the citizens that Stockholm City is up to date and is	This motivation is important driver for all the actions taken.

		providing EV charging possibilities and for Ellevio to show that they are working on updating their grid with the new technology. Actors involved can show that they are addressing at least one of the sustainable development goals – reduction of fossil fuel emissions.	
7	Addressing Social Sustainability/Local economy	Providing more opportunities to small, local companies to sell electricity to the EV owners.	By introduction of the map and the orange streets, more (also) smaller companies have an opportunity to sell electricity and do not require extra (admin) staff, due to the support.

Table 13: Summary of Drivers.

D.4 Supporting activities

D.4.1 Workshop with the energy supplying companies

In the autumn of 2019, two different workshops took place in order to find the best way to introduce the new possibility to establish charging streets in cooperation with Ellevio as they renew the grid in Stockholm. The first meeting was held with the three actors who already have established on street charging and have access right agreements with the city. During this meeting the new possibility was presented as an idea and discussed. During the second meeting all new possible actors that we could possibly think of, were invited and a slightly revised and final procedure was presented.

The web-page was then updated and the first ‘orange street’ were marked, possible Ellevio charging streets were presented on the map on the web-site in early December, for everyone to have a possibility to sign up to.

Quite a lot of interest was shown for this new opportunity and a few new contract for charging streets have been signed. So far two new actors have signed access right agreements as a result of this cooperation.

D.4.2 Advertisements as mean of financial support

Several actors would like to put advertisements on the charging poles as a way to pay for the investment. In many cases the poles would then also increase in size to fit a larger display for the advertisements. The City Council has decided that in general no more advertisements than the once already existing should be allowed in public space on street. However, there could be a possibility to use or reduce existing advertisement space in a smarter way to promote public charging. Investigations and legal aspects are currently being studied.

D.5 Recommendations on the implementation process

D.5.1 The process is smoother, if supported by an important actor

Throughout the implementation of this measure, it was found out that it would have been effective, to have an established, good collaboration with the grid owner in Stockholm – Ellevio from the beginning of the process. The grid owner is a very important actor in this process since they investigate the places and prepare the area before any energy supplier can install

EV chargers. Thus, the process of installation largely depends on their work. The collaboration has been developed, but later on in the process. Now, through this collaboration a new plan has been established and the grid owner will prepare with cables and foundations for possible charging poles, while digging and renewing the grid because of other reasons, as already mentioned above.

D.5.2 Transparent communication

Transparent communication about the process is important so that every actor get the same information at the same time and are treated equally.

E. Evaluation conclusions

The observed impacts of the measure has been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- The City of Stockholm has not yet reached the set goal, 200 out of 500 EV on-street chargers were installed by 2020. A new goal – 4 000 chargers by 2022 was already set. The process of installations became less ad hoc and more systematized with the map which was produced in this measure.
- The website “Laddgator i Stockholm” has been visited 1055 times until the end of 2018.
- The website allows energy suppliers to reserve streets where they plan to install EV charging. Out of 6 reservations, 4 completed the installation process before the end of 2018. During 2019, 12 access right agreements for new charging streets were signed and 10 new charging streets were then completed and in operation before the winter.
- Satisfaction of the users with the process of installations without using a map is 2.7 while the satisfaction with the process by using the map is 3.7 (1-5 scale, 5 is very satisfied).
- The website and the new, ‘orange streets’, are also providing an opportunity to smaller companies to sell electricity to the EV car owners.
- The website supported the installations of the EV on-street chargers, which indirectly, and together with the available off-street chargers supported the reduction of CO₂ emissions in the city.

E.2 Relevance of supporting activities

Supporting activities were relevant.

E.3 Interaction with other measures

The learnings from this measure can be useful for the other measures, such as measure 6.1 test fleet of EV vans for local business in Stockholm, 6.5 the website www.miljofordon.se and measure 6.7 information campaign on how to implement charging units in multifamily homes.

E.4 Main lessons learned

- The process can be more effective if the main actor is on board from the beginning of the project (in this project a good collaboration with the grid owner was found to be crucial).
- On the other hand, one does not have to adjust to, and try to motivate one actor, it is likely that they will get inspired along the way in any case.

- Transparent communication about the process is important so that every actor get the same information at the same time and are treated equally.
- Learn the jurisdiction in the field and get help to understand the different legal possibilities and drawbacks. Projects like this are more likely to get hindered by legal aspects rather than technical aspects.

E.5 Long term impact

The most important contribution of this measure is the fact that the installations of EV on-street charging are not done in an ad-hoc principle (from the City's perspective), but the process is systematized and the criteria for where the suitable places in the city are is carefully thought through. This can have an important long-term impact for the city in terms of planning the city and the liveability of the city. In addition, by providing more charging possibilities, citizens can be motivated to use EV cars, which can in turn contribute to cleaner air in the city.

E.6 Potentials for up-scaling in the city

There are potentials for up-scaling of on-street charging in the city, for example to provide the map of the possible places for installations in the sub-urban areas of the city or in the neighbouring municipalities. The neighbouring municipality Sundbyberg has already started to copy the regulation and the work done in Stockholm.

F. Additional information

F.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

Impact evaluation

First, it was difficult to model Business-As-Usual for potential CO₂ savings due to on-street chargers. In reality, the use will depend on the availability of both off-street chargers (in garages) and on-street chargers. Pricing of both types will affect the use. For example, if the prices of on-street chargers increase and there is an abundance of off-street chargers at a low price (the abundance can additionally decrease the price), the use of on-street chargers may decrease. Thus, it was impossible to predict “business-as-usual” correctly. In reality, while 200 on-street chargers were installed, 1500 off-street chargers have been installed, which might lead to charging in garages being a more common practice. We will only be able to observe the real impact when the city installs 4000 chargers as it plans to do by 2022.

Second, an aspect that appear to matter as the measure evolved, was the number of local companies which reserved the streets. Throughout the implementation of this measure it appeared that more local companies could become part of the EV charging market. This was seen as a contribution to the local economy. However, in the beginning, we were not aware that this will matter, so this was not measured as a KPI. If one were to repeat this measure, the contribution to local economy, measured by the number of participating local companies could be one of the KPIs.

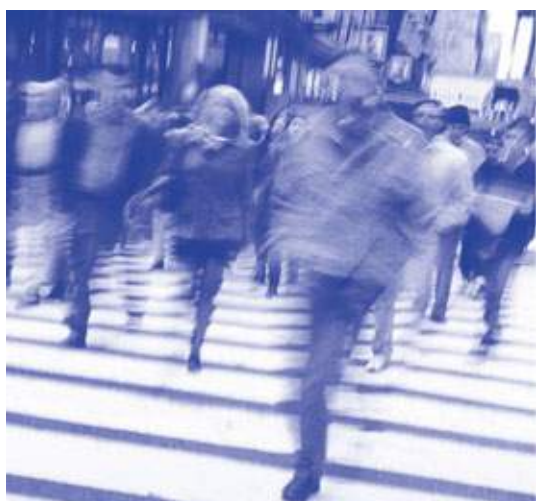
Process evaluation

Regarding the evaluation of the process, it was learned that a discussion, in the form of an interview or a workshop as compared to an online survey, is a method that can give more insights into the process and provides an opportunity to clarify any potential misunderstandings. However, such a collection of the data requires much more time to summarize and analyse the results.

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

The city is continuing with work related to the EV on-street charging. The website “Laddgator i Stockholm” is still available and is continuously updated. The city has taken up a new challenge, to install 4000 on-street chargers by 2022. Moreover, the City is testing a new way of working, this new idea emerged during the Eccentric, as the collaboration with Ellevio, the grid owner, improved. In that new way of working, the grid owner Ellevio, will as part of their regular update of the grid also pre-prepare the streets for the EV installations, so that companies will be able to install their EV charging equipment in these pre-prepared streets. This will improve, speed up the process, and perhaps even smaller energy supplying companies will have a possibility to provide electricity to EV car owners.



2020
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STO 6.7

Promote installation of EV-charging facilities in multifamily houses

Measure Evaluation Report

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2020
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1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
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8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KTH
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12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
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	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
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19	Green City Projekt GmbH	Germany	GCP
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21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
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23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Joel Franklin	KTH Royal Institute of Technology
Eva Sunnerstedt	City of Stockholm
Neva Leposa	KTH Royal Institute of Technology

Table of Contents

ABSTRACT.....	1366
A. INTRODUCTION.....	1367
A.1 EXPECTED RESULTS OF THE MEASURE	1367
A.1.1 Quantifiable impacts.....	1367
A.2 MEASURE DESCRIPTION	1368
A.2.1 Measure outputs.....	1368
A.2.2 Supporting activities	1368
A.2.3 Interactions with other ECCENTRIC measures.....	1368
A.2.4 Interactions outside ECCENTRIC	1368
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1369
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS	1369
A.5 IDENTIFIED RISKS	1370
B. MEASURE IMPLEMENTATION	1371
B.1 SITUATION BEFORE CIVITAS	1371
B.2 INNOVATIVE ASPECTS.....	1371
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1371
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1371
C. IMPACT EVALUATION FINDINGS	1374
C.1 EVALUATION APPROACH	1374
C.1.1 Expected impacts and indicators.....	1374
C.1.2 Baseline.....	1375
C.1.3 The business-as-usual scenario.....	1376
C.2 MEASURE RESULTS.....	1376
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1378
D. PROCESS EVALUATION FINDINGS	1379
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1379
D.2 BARRIERS	1379
D.3 DRIVERS	1380
D.4 SUPPORTING ACTIVITIES.....	1380
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1380
E. EVALUATION CONCLUSIONS	1381
E.1 VALIDATED DIRECT IMPACT	1381

E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1381
E.3	INTERACTION WITH OTHER MEASURES	1381
E.4	MAIN LESSONS LEARNED	1381
E.5	LONG TERM IMPACT	1381
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1381
F.	ADDITIONAL INFORMATION	1382
F.1	APPRAISAL OF EVALUATION APPROACH	1382
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1382

List of Tables

Table 1: Quantifiable impacts.....	1367
Table 2: Target groups or affected parties.....	1369
Table 3: Measure stakeholders.....	1369
Table 4: Risk assessment.....	1370
Table 5: Measure indicators for 6.7.....	1374
Table 6: Measure indicators.....	1375
Table 7: Baseline indicators.....	1376
Table 8: Business-as-usual indicators.....	1376
Table 9: Measure results.....	1378
Table 10: Objectives and targets.....	1378
Table 11: Summary of Barriers.....	1379
Table 12: Summary of Drivers.....	1380

Project	City		
ECCENTRIC	Stockholm		
Measure code	Measure name		
6.7	Promote installation of EV-charging facilities in multifamily houses		
Last update	Responsible	e-mail	telephone
	Eva Sunnerstedt	eva.sunnerstedt@stockholm.se	

Abstract

The City of Stockholm aims to reduce fossil fuel emissions. To address this goal, this measure aims to provide all the necessary information about ‘how’ and ‘why’ to install EV charging in multi-family housing in the wider area of Stockholm, i.e. the municipality of Stockholm and its neighbouring municipalities.

In particular, this communication focused measure aims to provide information to the board members of housing associations on how to install EV charging possibilities in the multifamily housing, where 50% of the Stockholm citizens live. The communication focused outputs in this measure include, instructional films, a step-by-step guide for installations of chargers, seminars, exhibitions, and document templates, among other things. The target was to attract 500 participants to the seminars and to have 600 installed chargers during 2016-2018. The goal has been reached. Only in 2018, 455 people attended the seminars and more than 600 chargers were installed. In the impact evaluation, we measured awareness, acceptance, satisfaction, CO₂ emissions and costs.

Based on the conducted surveys, we identified that the satisfaction with the seminars among the associations’ representatives was 4.25 (1-5 scale, 5 - very satisfied). We moreover found that at least 262 associations have started or planned to install EV charging in their multifamily houses in 2017 and 2018. Indeed, after the provision of a series of seminars, we are estimating that 910-1400 charging units have been installed in 2017 and 1300 were planned to be installed in 2018 or later. In sum we find the provision of information to be a good strategy for supporting the EV infrastructure installation process in the multifamily housing setting.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

The City of Stockholm has a long-term policy goal to eliminate the transport dependency on fossil fuels. Sweden aims to be fossil-free by 2045.

(2) Strategic level:

In order to decrease fossil fuel dependency, the city aims to strengthen the infrastructure needed to make EVs a realistic car choice. Since about 90% of Stockholm citizens live in multifamily houses, 50% in the co-op based housing, it is important to increase the number of EV charging possibilities in these and at the same time decrease the number of fossil driven cars.

(3) Measure level:

This measure was information and communication focused. It supported the development of EV charging infrastructure in multifamily houses by communicating the possibilities and providing instructions to stakeholders. This measure included, inter alia, a production of movies, presentations, and a step-by-step guide about the installations of chargers in multifamily residential co-operative buildings. The information was presented through a series of seminars. The information was also made available on a website. It also required a continuous updating of information. The target was to attract 500 participants to these seminars and to have 100 co-ops installing 200 charging stations per year between 2016 and 2018. This sums up to total of 600 charging stations installed during that time.

A.1.1 Quantifiable impacts

Expect ed Impact s	The measure is expected to strengthen the infrastructure needed to make EVs a realistic car choice for people living in multifamily houses, which is true for 90 percent of Stockholm's population. This is an important step to increase the number of EVs and at the same time decrease the number of fossil driven cars.	CIVITAS ECCENTRIC Objectives							
		Reduce:				Improve:			
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal Livability	Competitiveness	Efficiency of urban freight
ID	Quantifiable Impacts								
1	Reduction of CO ₂ emissions	x	x						
2	Acceptance/Satisfaction of the measures by the users					x	x	x	x
3	Exploitation of the funding for implementation of the plan and giving opportunities to local economy							x	x
4	Improvement of mobility in the City of Stockholm						x		

Table 1: Quantifiable impacts.

A.2 Measure description

This Eccentric measure was a 'communication measure'. It aimed to provide all the necessary information about 'how' and 'why' to install EV charging in multi-family housing in the wider area of Stockholm, i.e. the municipality of Stockholm and its neighbouring municipalities.

Stakeholders contributing to, and supporting, this measure are besides the City of Stockholm also the energy supplying companies installing EV charging. Stakeholders whom this communication is targeting are mostly the board members of housing associations (co-ops) and companies, who can then act as initiators for EV charging in their area of living. The majority of the citizens (90 %) in Stockholm reside in multi-family housing, which are managed by various housing associations or/and rental companies, for the rental housing. The scope of this measure is the wider area of Stockholm, this means Stockholm city and its neighbouring communities, such as Solna, Danderyd, Hanninge, Sundbyberg, Täby, Huddinge, Sollentuna, Norrtälje, Järfälla, Tyresö, Botkyrka, and Nacka.

A.2.1 Measure outputs

The following communication outputs were produced in this measure:

- 1) Instructional films promoting the installation and management of charging stations in multi-family residential buildings.
- 2) Templates for investigating interest for EV charging among the residents within the association and for inquiring about the energy supplying quote from the different suppliers for example.
- 3) A check-list: to do list in order to install EV charging.
- 4) A step-by-step guide to establish EV installation.
- 5) An example of a survey to use to find out the interest for EV charging in the estate.
- 6) An example of a letter to the board of the estate, proposing EV-charging in the estate.
- 7) A film showing the presentations from the first seminar – to be viewed afterwards.
- 8) Good examples from multi-family housing estates where charging had already been installed.
- 9) Information campaign.
- 10) Seminars.
- 11) Mini-exhibitions to showcase potential charging solutions.
- 12) A website containing all the information.

A.2.2 Supporting activities

The most important output was the seminars, which was supported by the associated website where information was provided for a later access. The seminars were also advertised in the local newspapers and the project was presented at various other occasions: seminars, workshops etc. The material has gotten attention in media.

A.2.3 Interactions with other ECCENTRIC measures

This measure interacts with the measure Measure 6.6 which refers to the on-street charging installations. Some data assembled was useful for both of the measures.

A.2.4 Interactions outside ECCENTRIC

This measure was supported not only by Eccentric, but also by the Energy Agency and by using the governmental incentives for decreasing emissions (Klimatklivet) operated by the

Swedish Environmental Protection Agency (Naturvårdsverket). Other cities and regions in Sweden are using the material and copying the events locally. There is a larger interest from all over the country. Amsterdam has had similar seminars with inspiration from this measure in Stockholm.

A.3 Target groups and/or affected part of the city or region

The target groups are summarized in Table 2.

Target group		Affected area	
Type	Description	Type	Description
Residents	Residents of multi-family residential cooperatives	Municipalities	27 municipalities in Stockholm County, including the City of Stockholm
Board members	Members of MFR cooperatives' management boards	Board members	Approximately 4 000 housing association boards contacted by mail
EV drivers	EV owners and potential new EV owners living in a MFR	City of Stockholm at is surroundings	Information through advertisements in local media and on signs on-street.

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

The relevant stakeholders are listed in Table 3.

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
P02	Citizens of the City of Stockholm	S	Other	P	
P03	Environmental Department of the City of Stockholm	P	C	L	
P10	KTH Royal Institute of Technology	P	KI	P	
P19	Potential buyers of electric vehicles	S	Other	O	
P20	Companies related to charging infrastructure	S	PR	P	
	EV owners	S	Other	O	
	EKR – Energi och Klimatrådgivningen	S	C	P	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

At the outset of the project, risks were identified as those in Table 4.

Identified risk	Category	Mitigation actions	Responsible
Under communication	5 Involvement/Communication	No action. Continue working as planned. It is a communication project, so this is crucial, so far the project has received a lot of attention, much more than estimated	City of Stockholm
Resource shortfalls (Inability to secure sufficient resources, overspending)	9 Financial	Take note of the costs and not do more than what could be affordable	City of Stockholm
Insufficient attention and resources to evaluation tasks	5 Involvement/Communication	Communication between evaluator manager and measure leaders	City of Stockholm
Priorities/Objective changes	1 Political/Strategic	No action	City of Stockholm

Table 4: Risk assessment.

B. Measure implementation

B.1 Situation before CIVITAS

The development of proper home charging was about to start when Civitas Eccentric started, around the end of 2016. At that time, while there were some records about the number of public charging facilities, there was no public record of the number of non-public charging facilities, at the multifamily housing for example.

Moreover, the interest and the need for this communication focused measure emerged as the owners of the EVs, living in the multifamily housings, expressed the need for charging stations for their vehicles. It appeared that the boards of the multifamily housing estates were concerned about the difficulties of the EV charging station installations and the related expenses. Very few were interested until the information campaign started. We assume that this is partly due to unawareness of the real costs for installations. Furthermore, there was a lack of awareness about the procedures, the real costs and the possibilities for receiving financial support for such installations from the national fund. Therefore, this measure aimed to provide information about, and instructions for, how to apply for a national funding for charging infrastructure, among other things. The first seminars were given in winter 2017, the seminars were then continued due to interest and to assure continuity.

B.2 Innovative aspects

During the process of the implementation of this measure, the EV installations, which were earlier more expensive became accessible to not only people living in multi-family houses, but also those living in single houses. The earlier installations were highly advanced and had extra capacity. Throughout this campaign, which brought together the housing estates and the companies selling the EV charging equipment, it was shown that with less power and capacity more charging units can be installed for a lower available budget.

B.3 Research and Technology Development

As in any technological development, new companies are continuously entering the market and the solutions, i.e. the installations and the equipment, is becoming more efficient. The development of the technology is improving very fast. The equipment is becoming less expensive and the load can be balanced in a better way, which improves the suitability of EV installations for the multifamily housing settings. On the one hand that can simplify the process of installations, e.g. reduced need for upgrading the local grid while charging for more cars can become possible at a lower cost. On the other hand, the technological development and changes in the equipment available on the market requires a continuous update of the information provided through this measure on the web-site and at the seminars.

B.4 Actual implementation of the measure

The measure was implemented by producing the information, creating a website to communicate the information, preparing and advertising educational seminars, and then updating the information:

- 1) Two films were produced. One *inspirational* and one *instructional* - know-how, showing experiences and practical examples of how charging facilities can be installed.
 - Made in November 2016 and updated October 2019. The inspirational film was seen ca. 16 000 times in November 2017 and the instructional film was seen

approx. 3000 times. They were shown on the website as well as on social media, such as YouTube and Facebook.

- 2) Templates for investigating interest for EV charging among the residents within the association and for inquiring about the energy supplying quote from the different suppliers
 - Made in the beginning of 2018.
- 3) Production of a check-list: to do list in order to install EV charging. This check list included for example inquiry about who owns the land,
 - Text content to templates and checklists was completed in October 2016, revised in January 2017 and updated in the fall of 2017, spring 2018 and October 2019.
- 4) A step-by-step guide.
 - Developed in the fall of 2016, revised in January 2017 and updated in the fall of 2017, spring 2018 and October 2019.
- 5) Informational campaign
 - Advertisements were done for the whole cluster of the 6 seminars, before the seminar series starts. For example, for the seminar series in autumn of 2018, the informational campaign was carried out in October/November 2018.
- 6) Seminars
 - 6 seminars were given in the evenings in a seminar series which covered Stockholm and its neighbouring municipalities. These seminars were advertised in the local newspaper in advance and were intended mostly for the housing associations board members interested in setting up EV charging in the multi-family housing. In 2018, the seminars also contained information about installing EV charging in a single family homes. The schedule and the places of the seminars were the following:
 - o Winter 2017
 - 2017-01-25 in Sundbyberg
 - 2017-01-27 in Sollentuna
 - 2017-01-31 in Stockholm (city centre)
 - 2017-02-01 in Nacka
 - 2017-02-07 in Haninge
 - 2017-02-08 in Botkyrka
 - o Autumn 2017
 - 2017-09-25 in Järfälla
 - 2017-09-26 in Danderyd
 - 2017-10-03 in Huddinge
 - 2017-10-09 in Stockholm (city centre)
 - 2017-10-10 in Tyresö
 - 2017-10-16 in Sollentuna
 - o Autumn 2018
 - 2018-11-07 in Sollentuna
 - 2018-11-08 in Norrtälje
 - 2018-11-13 in Kungsholmen (Stockholm city centre)
 - 2018-11-15 in Solna
 - 2018-11-19 in Haninge
 - 2018-11-20 in Täby

After the Eccentric, the seminars are still given. Indeed, 6 seminars have been given in the spring of 2019 and autumn of 2019 using other sources of financing.

- 7) Mini-exhibitions to showcase potential charging solutions.
 - Companies selling EV charging equipment were present at the seminars to present the solutions, through exhibitions. Thereby the interested parties could meet and talk to the installation providers, had the interest in their communities arose.
- 8) Website containing all the information. The website is for general public, everyone who is interested in how to install EV charging can find information, videos, and the above listed documents (a check-list, a survey, a step-by-step guide, contact of companies selling EV charging equipment)
 - Website “fixaladdplats” was developed in the fall of 2016, and has been in operational from November 2016. Now, after Eccentric, the content is integrated on the website managed by the Energy Agency “energiradgivningen.se” so the information can live on and be updated.

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

This measure was expected to:

- 1) Make information about EV installations in the multiple family housing more accessible for the Stockholm residents. This is done via different channels, mostly educational seminars, and the supporting website, film, and by linking users with the potential energy suppliers.
- 2) Through the provision of information about the EV charging installations and by making this process easier for the users, we are expecting to see an increase in the number of EV charging installations in the targeted multifamily houses in all parts of Stockholm City.
- 3) By improving EV charging infrastructure, we expect to see an increase in EV ownership. Egner & Trosvik 2018⁶⁰ report a positive correlation between the increase in EV charging stations and EV car ownership.
- 4) Finally, through an increase in EV car ownership, we were estimating a reduction in CO₂ emissions and improved air quality.

The measured indicators are listed and described in the table below:

Impact	Acceptance	Acceptance	Acceptance	Acceptance	Reduction of CO ₂	Exploitation	Exploitation
Indicator name	Awareness	Acceptance	Satisfaction	Satisfaction	CO ₂ emissions	Operational costs	Investment cost
Type	KPI	KPI	KPI	KPI	KPI	KPI	KPI
Category	Society – People	Society – People	Society – People	Society- People	Environment	Economy	Economy
Subcategory	Acceptance	Acceptance	Acceptance	Acceptance	Pollution and nuisance	Costs	Costs
Aspect	Awareness level	Acceptance level	Fulfilment of expectations	Fulfilment of expectations	Emissions	Operating costs	Investment costs
Definition	Number of visitors to the web-site.	% of estates who have attended the seminars and are planning to install EV charging units.	Satisfaction of estates with the seminars.	Satisfaction of energy supplying companies with the seminars.	CO ₂ -emissions saved from the charging units put up inspired by the information campaign.	Costs for maintaining the communication campaign.	Initial cost for the communication campaign.

Table 5: Measure indicators for 6.7

⁶⁰ Egner, F., & Trosvik, L. (2018). Electric vehicle adoption in Sweden and the impact of local policy instruments. *Energy policy*, 121, 584-596.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement
1	Awareness	#	I	DC	General public	City of Stockholm and neighbouring municipalities.
2	Acceptance	%	I	DC	Housing Associations	City of Stockholm and neighbouring municipalities
3	Satisfaction	1-5	I	S	Housing associations	City of Stockholm and neighbouring municipalities
4	Satisfaction	1-5	I	S	Businesses	City of Stockholm and neighbouring municipalities
5	CO ₂ -emissions	Tons/year	A	E	EV charging infrastructure	Estimation- Independent of location.
6	Investment cost	EUR/time	A	DC	City of Stockholm administration	City of Stockholm
7	Operating cost	EUR/time	A	DC	City of Stockholm administration	City of Stockholm
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Measure indicators

C.1.2 Baseline

1. Awareness refers to the number of visitors to the “fixaladdplats” website. Since the website did not exist before Eccentric, the baseline is Not Applicable (NA).
2. Acceptance refers to the percent of the housing associations which intended to install the EV charging units after attending the seminars. Since the seminars were not given prior to 2017, the baseline for acceptance rate is NA.
3. Satisfaction - housing associations is measured satisfaction with the seminars among the board members in the various housing associations. Since the seminars were not given prior to 2017, the baseline is NA.
4. Satisfaction – businesses is measured satisfaction with the seminars among the attending companies selling EV charging equipment. Since the seminars were not given prior to 2017, the baseline is NA.
5. CO₂ emissions is referring to the emissions saved before this measure. Since we do not know how many EV charging units were installed in multifamily housing before this measure started, we can only assume that not many were in place before this measure started.
6. Operating costs are before the measure 0.
7. Investment costs are before the measure 0.

Indicator	Unit	Before	Date Before
1 Awareness	#	NA	Dec 2016
2 Acceptance	%	NA	Dec 2016
3 Satisfaction Housing	1-5	NA	Dec 2016
4 Satisfaction Business	1-5	NA	Dec 2016
5 CO ₂ emissions	Tons/year	0	Dec 2016
6 Operating costs	€/year/seminar series	0	Dec 2016
7 Investment costs	€/year	0	Dec 2016

Table 7: Baseline indicators

C.1.3 The business-as-usual scenario

The business-as-usual is the same as the baseline.

Indicator	Unit	BaU	Date BaU
1 Awareness	#	NA	Dec 2016
2 Acceptance	%	NA	Dec 2016
3 Satisfaction Housing	1-5	NA	Dec 2016
4 Satisfaction Business	1-5	NA	Dec 2016
5 CO ₂ emissions	Tons/year	0	Dec 2016
6 Operating costs	€/year/seminar series	0	Dec 2016
7 Investment costs	€/year	0	Dec 2016

Table 8: Business-as-usual indicators

C.2 Measure results

1. Awareness refers to the number of visitors to the “fixaladdplats” website. It is a count, based on google analytics, of the number of visits to the website. The total number of visitors until the end of 2018 was 38.500 and 18.600 until the end of 2017, this leaves 19.900 visitors in 2018. However, we do not know what type of group have these people represented (companies, citizens), thus, we cannot calculate awareness in %.
2. Acceptance refers to the percent of the housing associations which intended to install the EV charging units after attending the seminars during 2018. It is calculated as the number of the associations intending to install, divided by the number of associations that attended the seminars.

Calculation was based on the survey conducted by the City of Stockholm in Autumn 2019. 455 people registered to the seminars given in 2018 and these were sent an online survey to fill out in autumn 2019. From the 138 who answered the question regarding the plans for installing EV charging units in their housing association, 103 answered affirmative (47 state that the projects are already ongoing, 33 plan to do so in the following year, 23 in the next years, and 35 do not have such plans). This produces according to an optimistic scenario a 74% acceptance rate. If the ones that

have not answered the survey do not plan to install, that would give 23% acceptance rate (103/455).

For comparison, 630 people registered to the seminars in the winter of 2017 (the first 6 seminars) and these were sent an online survey to fill out in autumn 2017. Response rate was 37%, which is 232 people. From 232, 159 said they are or have plans to install EV charging units in their respective multi-family houses. The optimistic acceptance rate is 159/232 – 68.5%. Since we do not know the reason why some did not fill out the questionnaire, the worst case scenario is, that those who did not answer, also do not plan to install. Thus, according to this pessimistic scenario, the acceptance rate would be 159/630, which produces a 25% acceptance rate.

3. Satisfaction - housing associations (Satis. H.) is measured satisfaction with the seminars given in 2018. Satisfaction was measured in the same survey, described above, on a 1-6 scale (1-extremely dissatisfied and 6-extremely satisfied) and was 5.1 on the 1-6 scale, which is 4.25 on a 1-5 scale.

For comparison, satisfaction with the seminars given in 2017 was on a 1-6 scale (1-extremely dissatisfied and 6-extremely satisfied) 5.2, which is on a 1-5 scale 4.3.

4. Satisfaction – businesses (Satis. B) is measured satisfaction with the seminars given in 2018 among the attending companies selling EV charging equipment. Satisfaction was measured in the same survey, described above, on a 1-6 scale (1-extremely dissatisfied and 6-extremely satisfied) and was 4.8, which is 4 on a 1-5 scale.

For comparison, satisfaction with the seminars given in 2017 was on a 1-6 scale (1-extremely dissatisfied and 6-extremely satisfied) 4.5, which is on a 1-5 scale 3.8.

5. CO₂ emissions calculation is based on the reference provided by the Swedish Energy Agency (<https://www.energimyndigheten.se/en/>) according to which CO₂ savings can be up to 1 530 kg CO₂/year/installed charging unit, provided that these installed units are in operation for at least 15 years. Based on the questionnaire responses, during 2017, 910-1400 units, average 1155, were installed due to this measure which should lead to a reduction of rounded up to 1800 ton in 2017. During 2018, 1300 units were (and were planned to be) installed. Since about 50% of the surveyed multifamily housing association have started with installations and about the same amount is planning to start with installations in the next years, we are considering 650 units for the year 2018. Since those units installed in 2017 are still in operation, this is together around 1805 units operating in 2018, which is about 2800 ton saved in 2018. In average (2017, 2018), saving is thus (1800+2800)/2=2300 per year during the time of this measure.
8. Operating costs were during 2018 the costs amount to 40.000€, 13.000€ for the printouts, advertising and 12.000€ for the renting the venues and snacks and 15.000€ for personnel. It has been learnt that advertising the whole series of seminars is more cost-effective.

For comparison, during 2017 costs for the filming one seminar printed material (design, leaflets etc.) was approx. 8.000 €. Renting the venue and provision of snacks is approx. 15.000 €, and advertising the events approx. 15.000 €. Together with the working time, which amounts to approx. 15.000 € (one person working 15-20% per year), this sums up to 53.000€.

6. Investment costs: the production of the films costs approximately 28.000 €. The movies were also updated in 2019.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After- Before	Net impact After- BaU
Awareness	#	NA	Dec 2016	NA	Dec 2016	19.900	Nov 2019	-	-
Acceptance	%	NA	Dec 2016	NA	Dec 2016	74%	Nov 2019	-	-
Satis. H.	1-5	NA	Dec 2016	NA	Dec 2016	4.25	Nov 2019	-	-
Satis. B.	1-5	NA	Dec 2016	NA	Dec 2016	4	Nov 2019	-	-
CO ₂	Ton/year	0	Dec 2016	0	Dec 2016	2300	Nov 2019	2300	2300
Investment cost	€/year	0	Dec 2016	0	Dec 2016	28.000	Nov 2019	28.000	28.000
Operational costs	€/year	0	Dec 2016	0	Dec 2016	40.000	Nov 2019	40.000	40.000

Table 9: Measure results

C.3 Summary: achievement of objectives

The City of Stockholm evaluates this measure to be successfully completed and have achieved the set targets and objectives.

No.	Objective and target	Rating	Comment
1	Reduction of CO ₂ emissions	***	Number of EV chargers installed exceeded expectations. The estimation in the CO ₂ emission reduction is exceeding the expectations.
2	Acceptance/Satisfaction of the measures by the users	***	The multifamily housing association representatives were hesitant in the beginning, the acceptance rate is higher than expected.
3	Exploitation of the funding for implementation of the plan and giving opportunities to local economy	**	The seminars supported local economy by providing an opportunity for companies selling EV charging equipment to present their equipment.
4	Improvement of mobility in the City of Stockholm	**	EV installations were provided not only for the existing EV car owners, but also others can be motivated to switch to an EV due to availability of charging in multifamily housing.
NA = Not Assessed O = Not Achieved * = Substantially achieved (at least 50%) ** = Achieved in full *** = Exceeded			

Table 10: Objectives and targets

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

There were no significant deviations from the project plan in this measure.

D.2 Barriers

No.	Barrier field	Description	Action to overcome the barrier
1	Problem-related	Technological development goes quickly, so information can become outdated.	It is important that City staff stay up-to-date and update material often, which is time-consuming.
2	Financial	First, evening seminars are cumbersome and it is exhausting for many persons in the project to stand on stage, give talks and answer many, often thorny, questions from the audience. Second, it is expensive to advertise seminars.	While in the beginning, the measure leader was giving the talks, others have been now trained to be able to do that. The knowledge transfer assured that more people feel comfortable with presenting at seminars. Regarding the advertising the seminars, the solution that was found was conducting and advertising a series of seminars (e.g. in autumn or in spring) which allows advertising once, for the whole series. When planning the series, it is made sure that seminars are not too long, and that there is a day's gap between each of the planned seminar.
3	Political / strategic	The installation process is supported by state-sponsored subsidies. However, the continuity of these subsidies is uncertain, whether they will remain in place, particularly now when there is new government yet after national elections. We do not know yet if there will be funds for 2020 and beyond.	Now a new government is in place so we hope to go out quickly with information about these subsidies, once the policy is set.
4	Involvement / communication	Difficult to reach all housing co-ops and single-family homeowners with this information. Direct post is very expensive, as are advertisements.	We targeted a dispersed sample of housing co-ops so that we can also take advantage of word-of-mouth between neighbors. We used advertisements in local press, social media, organizations for home-owners in order to spread the word effectively without too high of costs.

Table 11: Summary of Barriers.

D.3 Drivers

No.	Driver field	Description	Action to make use of the driver
1	Cultural	EV-owners have a strong desire to charge at home (this is the best charging place!)	Little was needed to make use of this, just to emphasize that the project is all about home-charging.
2	Financial	There are state-sponsored benefits to apply for, which gives up to a 50% rebate in the costs ("Klimatlivet", "Ladda-billen" and "Ladda-hemma")	We combined information about subsidies into our training on how to obtain, install, and maintain chargers.
3	Cultural	The use of EVs is increasing, and more need to charge their EVs (In Sweden, the number of chargeable vehicles is highest in Stockholm, with 25% of all chargeable vehicles in Sweden but only 10% of all vehicles).	We strived to constantly increase the range of our targeting, to keep up with this increasing share of EVs.

Table 12: Summary of Drivers.

D.4 Supporting activities

The information material has also been presented at various other occasions: seminars, workshops etc. The material has gotten attention in media.

D.5 Recommendations on the implementation process

- It is important to make sure to find a lot of companies selling the charging infrastructure and invite them to participate in a mini-exhibition to show the equipment. Make buyers and sellers meet in a positive and neutral environment.
- Be prepared to answer questions about jurisdiction, safety, grid-issues, possible incentives and also other transport related questions on the agenda in your city.

E. Evaluation conclusions

The observed impacts of the measure has been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- At least 262 of the housing associations who have attended the seminars on how to arrange the EV charging installations have installed, or were planning to install, chargers in their housing (during 2017-2018).
- Satisfaction with the seminars given in 2018 is among the housing associations 4.25 (on a 0-5 scale, where 5 is very satisfied).
- Satisfaction with the seminars among the participating energy supplying companies is 4 (on a 0-5 scale, where 5 is very satisfied).
- Due to the installations we are estimating that 2300 ton of CO₂ is saved locally, per year, during 2017-2018.

E.2 Relevance of supporting activities

Presenting the measure at various occasions, seminars, workshops and in the media was found relevant.

E.3 Interaction with other measures

Synergies with the on-street EV charging installations can be found (measure 6.6).

E.4 Main lessons learned

- Giving seminars as a seminar series is more economical.
- Seminar content has to be continuously updated in cases of technological innovations.
- Very good to have a large number of charging companies present in a mini-exhibition to show the different charging equipment.
- More people attended the meetings than had actually signed up to come.

E.5 Long term impact

Accessibility to EV charging at home can motivate EV car ownerships and thus contribute to a reduction of CO₂ emissions.

E.6 Potentials for up-scaling in the city

The seminars are given not only in the City of Stockholm, but also in the neighbouring municipalities. There is also a potential to share the information more broadly, i.e. to the region of Stockholm or even other municipalities and regions in Sweden. This has also been done. Five other regions in Sweden has received the information material and has carried out similar seminars locally (Region Skåne, Västra Götalandsregionen, Örebro, Uppsala, and Östersund). Also seminars has been held in Amsterdam with inspiration from Stockholm.

F. Additional information

F.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

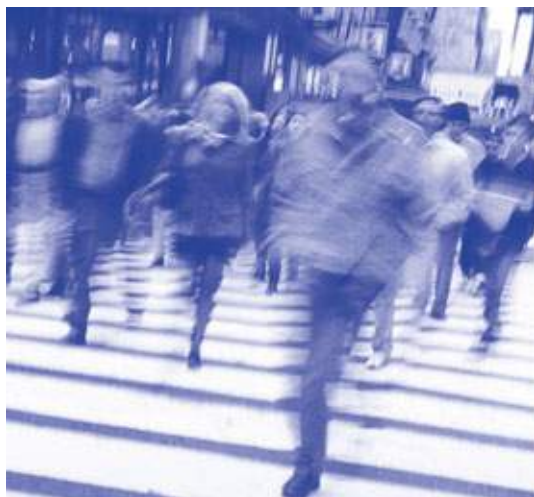
- Regarding evaluation of the impacts, not all impacts of this measure could be easily captured by the KPIs, for example, it is difficult to measure the possibility to share and use the information beyond the City, region, or countries borders.
- Regarding process evaluation, we learned that a discussion, in the form of an interview or a workshop as compared to an online survey, is a method that can provide a better understanding of the process. However, such a collection of the data requires much more time to summarize and analyse the results.

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

The seminar series will continuing even after the Eccentric-project has been finalised. Also trainings have been provided, so that more people are trained to present at these seminars. Instructions and manuscripts of the presentations has been put together to make it easy to copy the seminars both in Stockholm and elsewhere in Sweden.

The measure leader has also given a lot of presentations on seminars and events arranged by others but with the same target group.



2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



MAD 7.1

Consolidation centre with EVs and local regulations for clean urban freight logistics

Measure Evaluation Report

Deliverable No.:	8.5
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2020
CIVITAS
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ECCENTRIC



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EUROPEAN UNION

Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático SL	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures BV formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
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23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Name	Position
Luis Tejero	Ayuntamiento de Madrid. Measure leader
Alfonso López	FML. Measure team member

Table of Contents

ABSTRACT.....	1390
A. INTRODUCTION.....	1392
A.1 EXPECTED RESULTS OF THE MEASURE	1392
A.1.1 Quantifiable impacts.....	1392
A.2 MEASURE DESCRIPTION	1392
A.2.1 Measure outputs.....	1393
A.2.2 Supporting activities	1394
A.2.3 Interactions with other ECCENTRIC measures.....	1394
A.2.4 Interactions outside ECCENTRIC	1394
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1394
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1394
A.5 IDENTIFIED RISKS	1395
B. MEASURE IMPLEMENTATION	1396
B.1 SITUATION BEFORE CIVITAS	1396
B.2 INNOVATIVE ASPECTS.....	1396
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1396
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1397
C. IMPACT EVALUATION FINDINGS	1400
C.1 EVALUATION APPROACH.....	1400
C.1.1 Expected impacts and indicators.....	1400
C.1.2 Baseline.....	1402
C.1.3 The business-as-usual scenario.....	1404
C.2 MEASURE RESULTS.....	1405
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1409
C.4 UP-SCALING	1410
D. PROCESS EVALUATION FINDINGS	1411
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1411
D.1.1 Management plan and local freight partnership	1411
D.1.2 Vehicles providing last-mile delivery from the consolidation centre	1411
D.1.3 Design of regulatory tools on urban freight delivery in Madrid	1411
D.1.4 Location of the consolidation centre.....	1411
D.2 BARRIERS	1411

D.2.1	<i>Financial barrier: Location of the consolidation centre</i>	1411
D.2.2	<i>Positional barrier: Low visibility of the project</i>	1412
D.2.3	<i>Planning barrier: Vehicle selection</i>	1412
D.2.4	<i>Organisational barrier: Management plan</i>	1412
D.2.5	<i>Involvement barrier: Limited participation of stakeholders</i>	1412
D.2.6	<i>Cultural driver: Increasing interest in clean logistics</i>	1412
D.2.7	<i>Institutional: Support to clean vehicles</i>	1412
D.3	SUPPORTING ACTIVITIES	1412
D.4	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1412
D.4.1	<i>Recommendation 1: Establish a strategy to increase the number of customers of the consolidation centre</i>	1412
E.	EVALUATION CONCLUSIONS	1413
E.1	VALIDATED DIRECT IMPACT	1413
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1414
E.3	INTERACTION WITH OTHER MEASURES	1414
E.4	MAIN LESSONS LEARNED	1414
E.5	LONG TERM IMPACT	1415
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1415
F.	ADDITIONAL INFORMATION	1416
F.1	APPRAISAL OF EVALUATION APPROACH	1416
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1416

List of Figures

Figure 1: Distribution route (baseline) 1396

Figure 2: Ontime logistic centre in Villaverde. In blue, the consolidation centre dedicated to FML clean logistics (Citylogin). 1398

Figure 3: Distribution route (baseline) 1402

Figure 4: Distribution route (ECCENTRIC) 1405

List of Tables

Table 1: Quantifiable impacts.....	1392
Table 2: Target groups or affected parties.....	1394
Table 3: Measure stakeholders.....	1394
Table 4: Identified risks.....	1395
Table 5: Description of key performance indicators (KPI).....	1401
Table 6: Description of key performance indicators (KPI) (cont.).....	1401
Table 7: Measure's indicators	1402
Table 8: Factors for the estimate of emissions and energy consumption	1403
Table 9: Baseline emissions and energy consumption (2018 and average year).....	1403
Table 10: Factors for the estimate of emissions and energy consumption	1404
Table 11: BAU emissions and energy consumption (2018 and average year).....	1404
Table 12: Factors for the estimate of emissions and energy consumption	1406
Table 13: ECCENTRIC emissions and energy consumption (2018 and average year)	1406
Table 14: Modal shift achieved by the measure.....	1406
Table 15: Measure's emissions and energy saving (January 2018).....	1407
Table 16: Cost assessment (average year)	1408
Table 17: Summary of indicators' values	1409
Table 18: Achievement of the measure's initial objectives.....	1410

Project	City		
ECCENTRIC	Madrid		
Measure code	Measure name		
MAD 7.1	Consolidation centre with EVs and local regulations for clean urban freight logistics		
Last update	Responsible	e-mail	telephone
01/09/2019	Luis Tejero	tejeroel@madrid.es	91 588 46 18

Abstract

In this measure, the Municipality of Madrid in co-operation with a logistic operator (FM Logistics) is combining the implementation of an urban consolidation centre for last mile distribution, operated with clean vehicles, with regulatory measures, such as access regulations in traffic-restricted areas (by applying time windows for goods delivery) or vehicle restrictions based on weight, size and technology (zero and ultra-low emissions vehicles).

The measure is in line with Madrid's Sustainable Urban Mobility Plan (SUMP), and with the city's Air Quality Plan and Energy and Climate Change Plan. All these plans aim at improving urban freight distribution through a combination of a regulatory approach and the use of cleaner vehicles.

The design phase took place between September 2016 and February 2017. During this stage, a study on freight distribution in Madrid (also relevant for measure MAD 7.6) was completed, including some interaction with local operators, and feasible locations for the consolidation centre were identified. However, the operator was unable to produce a management plan for the consolidation centre, including distribution areas, potential clients, goods to be delivered, or services. Unfortunately, the envisaged "Local Freight Partnership", including the participation of other logistics service providers, did not materialise.

The implementation phase took place between March 2017 and February 2018. During this stage, the final location of the consolidation centre was selected (in Villaverde, in the southern periphery of the municipality), and the logistics operations were analysed in detail. For the operations, it was decided to make use of 7.5t hybrid trucks instead of electric vans as initially considered in the project proposal; however, the installation of electric charging points at the consolidation centre remained necessary, in order to support the operation of the electric prototype developed within measure MAD 7.6. During the implementation stage, a number of activities to liaise with stakeholders and potential clients were undertaken, with an aim at establishing the Local Freight Partnership envisioned in the initial project description; however, the only client interested in making use of the new clean services was SEPHORA, as the company had approved a corporate commitment to meet certain clean standards in their distribution activities. No particular activities were conducted for designing regulatory tools on urban freight delivery, as these tools were already under development in the context of the preparation of the revised Air Quality Plan and the new low emissions zone "Madrid Central"; the new norms have established differentiated time windows for urban delivery depending on the vehicle's characteristics.

The operational phase took place between February 2018 and June 2019, serving a total number of 15 SEPHORA shops in the central districts. To provide the delivery services, FM Logistic established a contract with Ontime, another operator in Madrid with a 70,000-m² logistic centre in Villaverde (Avenida Zafiro 4), a district in the south of the municipality and relatively close to the city centre. Ontime also provides the fleet (8 hybrid 7.5-t trucks) needed for distribution. The goods to be distributed through the centre in Villaverde are collected by Ontime at the FML centre in Torrejón and transported with a 40-t articulated truck.

Most of the measure objectives have been successfully achieved. The measure has been effective in substantially reducing CO₂ emissions and energy consumption (by 54%) and NO_x and PM emissions (by 94% and 63%) for the logistics operations serving Sephora. However, the volume of these operations has been low compared with the hub capacity during the demonstration stage (only 5% to 10%, depending on the month considered), as only 429 shipments/year have been transferred to the new delivery system. This limitation explains the measure's failure to achieve the expected reduction of 90t CO₂eq per year initially foreseen.

The modest number of shipments served with sustainable logistics seems contradictory with the high scores obtained in the customers' awareness and acceptance of these services. It suggests that additional marketing efforts should be undertaken to gain new customers to make use of the new "Citylogin" services.

Four main lessons can be highlighted:

- The measure has confirmed the high potential of this sustainable logistics concept (a consolidation centre served with small low-emission trucks): The emissions and energy consumption associated to these deliveries have decreased significantly, and the operational costs are lower.
- The adoption of cleaner trucks (hybrid 7.5-t trucks in this case) has been effective in providing substantial emission and fuel savings.
- It seems extremely difficult to find customers willing to make use of these new services. The consequence is that only an average of 6% of the capacity of the consolidation centre has been dedicated to these services. The remaining capacity has been used to serve shipments with distances much longer than those for which the consolidation centre can provide environmental and economic benefits. Considering the customers' answers to the survey, and their high awareness and acceptance of the concept, it is not clear why such services are not being used.
- This demonstration measure was not adequate to identify and test regulatory tools. Regulatory tools follow a specific decision-making path within local governments, which is difficult to make compatible with the particular conditions of research and demonstration projects.

A. Introduction

A.1 Expected results of the measure

The measure objectives are described as follows:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- Designing and implementing new local regulations and policies to promote the use of clean vehicles⁶¹ for urban goods distribution.

(2) Strategic level:

- Reduce traffic levels from good distribution vehicles.
- Reduce illegal parking.
- Reduce energy consumption and emissions from urban goods distribution.
- Promote the uptake of clean vehicles in urban goods distribution.

(3) Measure level:

- Develop an urban freight distribution centre.
- Manage the consolidation centre operated by electric vehicles.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives									
		Reduce:				Improve:					
ID	Quantifiable Impacts	Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight	Local economy
1	Reduction of 90 t CO2eq per year	X									
2	Reduction of air pollutant emissions		X								
3	Reduction of energy consumption	X									
4	Improved delivery service performance (optimisation of delivery vehicle use)										
5	Increased acceptance and awareness (receiver)										

Table 1: Quantifiable impacts.

A.2 Measure description

Every day, more than 33.000 operations of freight distribution take place in Madrid, inside the M-30 ring-road. This activity produces an important part of the overall transport emissions of pollutants (14% NOx emissions), and contributes to traffic congestion and illegal parking.

The Municipality of Madrid (through its Energy and Climate Change Department) in co-operation with a logistic operator (FM Logistics) is combining the implementation of an urban consolidation centre for last mile distribution, operated with clean vehicles, with regulatory

⁶¹ Clean vehicles in Spain include vehicles with a ZERO or ECO label. The ZERO label is awarded to electric vehicles (EV) and plug-in hybrid electric vehicles (PHEV) with a minimum range of 40 km. The ECO label is awarded to other plug-in hybrid electric (PHEV), hybrid electric (HEV), CNG and LPG vehicles.

measures, such as access regulations in traffic-restricted areas (by applying time windows for goods delivery) or vehicle restrictions based on weight, size and technology (zero and ultra-low emissions vehicles).

The measure is in line with Madrid's Sustainable Urban Mobility Plan (SUMP), and with the city's Air Quality Plan and Energy and Climate Change Plan. All these plans aim at improving urban freight distribution through a combination of a regulatory approach and the use of cleaner vehicles. As an initial step, the measure is expected to provide a deeper understanding of the urban logistics sector in Madrid and its stakeholders, and to support the design of new logistics products and services taking advantage of emerging new technologies to fit the needs of a multiplicity of actors.

The measure is being developed through the following stages:

Planning and research (September 2016-February 2017). It included the completion of a study on freight distribution in Madrid (in cooperation with MAD 7.6), and the definition of a management plan for the consolidation centre (distribution areas, potential clients, goods to be delivered, services, etc.). It also included the development of a "local freight partnership" including the participation of service providers, but this component has not been designed yet.

The implementation stage (March 2017-February 2018), including the creation of a consolidation centre linked to the use of clean vehicles (and implementation of electric charging points, if needed), the assignment of the clean vehicles, the liaison with stakeholders and potential clients (freight partnership), and the design of regulatory tools: time windows, positive discriminations, etc.

The demonstration and monitoring stage (February 2018 – June 2019) of the measure, including operation of the consolidation centre, the clean vehicles providing final distribution and, if implemented, regulatory reforms (followed by demonstration and monitoring of the ultra-low emissions prototype developed within MAD 7.6 since October 2019, if available).

After the conclusion of the demonstration stage, communication and exploitation activities are envisaged to disseminate the conclusions and lessons learnt, and to develop the business case for urban consolidation centres in other locations.

A.2.1 Measure outputs

- Study on freight distribution in Madrid (in cooperation with MAD 7.6).
- Definition of a management plan for the consolidation centre: distribution areas, potential clients, goods to be delivered, services, etc.
- Local freight partnership including the participation of service providers.
- Creation of a consolidation centre linked to the use of clean vehicles, including the implementation of electric charging points⁶².
- Design of regulatory tools: time windows, positive discriminations, etc.
- Definition of a business case for urban consolidation centres in other areas.

⁶² Electric charging points are not necessary for the operations envisaged within measure MAD 7.1, as the use of electric vans was dismissed in favour of hybrid trucks; however, electric charging points remain necessary for the demonstration of the electric prototype in measure MAD 7.6.

A.2.2 Supporting activities

There are no supporting activities linked to this measure.

A.2.3 Interactions with other ECCENTRIC measures

This measure interacts with measure MAD 7.6 (urban freight distribution prototype) in the study of freight distribution in Madrid. Furthermore, the new consolidation centre will serve as the operational base for the prototype.

A.2.4 Interactions outside ECCENTRIC

No interactions outside ECCENTRIC have been identified in this measure. In particular, the regulatory conditions of freight delivery operations have not significantly changed in Madrid during the project.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
8	Local businesses interested in sustainable clean supply chains		Central districts (within the M-30 ring-road)
10	Logistics operators interested in sustainable clean supply chains		Peripheral districts with industrial land, suited to host consolidation centres.

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type organisation of C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	City councillor. Environment and mobility	S	C	L	Political decision-maker
2	City councillor. Sustainable urban development	S	C	O	Political decision-maker
3	Director General Urban Regeneration Strategy	S	C	O	Political decision-maker
4	Director General Sustainability and Environmental Control	S	C	O	Political decision-maker
5	FM Logistics (Executive level)	S	PR	L	Logistics operator
6	Municipality (measure leader)	P	C	L	Measure partner
7	UPM	P	KI	L	Measure partner
8	FML	P	PR	L	Measure partner
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Budget limitations for the consolidation centre have hindered to choose a location closer to the urban core, and able to harbour more logistic activities	9 (Financial)	Change consolidation centre location, sharing the facility with other activities	FML
lack of companies which contract logistics services in the consolidation centre	8 (Organizational)	Increase clients seeking and offer alternative urban freight distribution formulas	FML
insufficient goods volume to make the consolidation center efficient/operational	8 (Organizational)	Increase clients seeking and offer alternative urban freight distribution formulas	FML

Table 4: Identified risks.

B. Measure implementation

B.1 Situation before CIVITAS

More than 33.000 operations of freight distribution take place daily in Madrid within the borders of its M-30 ring-road. This activity produces an important part of the overall transport emissions (e.g. 14% of NO_x emissions) and has a direct influence in traffic congestion and illegal parking.

FML, a logistics operator and ECCENTRIC partner, distributes deliveries to its customers in the city centre from its logistics platform “Plataforma Arvato Bertelsman”, located in Torrejón de Ardoz (A-2 motorway, PK 22.5).

One of these customers is SEPHORA, a company strongly interested in clean logistics. Before CIVITAS, the 15 SEPHORA shops in the central districts of Madrid were served from the logistics platform in Torrejón, with an average trip distance of 71.5 km (round trip) (Figure below). The SEPHORA shops were served by Mercedes Benz Atego 816 trucks, with Euro V technology.

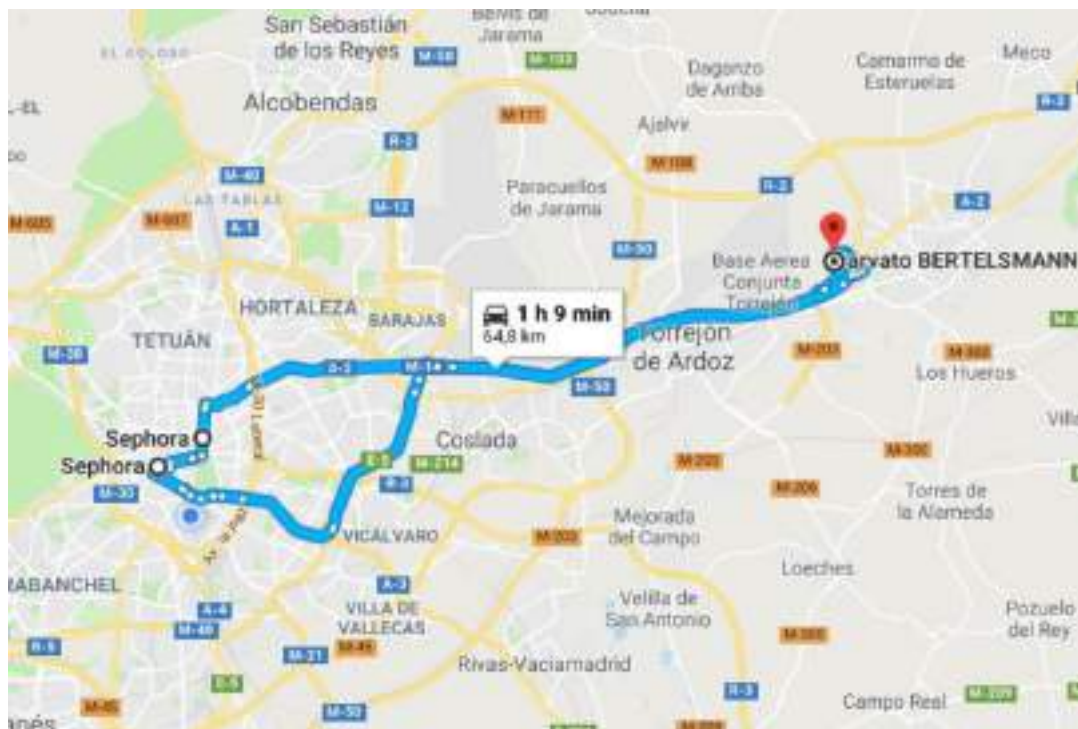


Figure 1: Distribution route (baseline)

B.2 Innovative aspects

The main innovative aspects of the measure include (1) the first consolidation centre to be established in Madrid, and (2) the use of clean vehicles (hybrid trucks) in all the operations of the centre.

B.3 Research and Technology Development

There are no R&T developments associated with the measure.

B.4 Actual implementation of the measure

The design phase took place between September 2016 and February 2017. During this stage, a study on freight distribution in Madrid (also relevant for measure MAD 7.6) was completed, including some interaction with local operators, and feasible locations for the consolidation centre were identified. However, the operator was unable to produce a management plan for the consolidation centre, including distribution areas, potential clients, goods to be delivered, or services. Unfortunately, the envisaged “Local Freight Partnership”, including the participation of other logistics service providers, did not materialise.

The implementation phase took place between March 2017 and February 2018. During this stage, the final location of the consolidation centre was selected (in Villaverde, in the southern periphery of the municipality), and the logistics operations were analysed in detail. For the operations, it was decided to make use of 7.5t hybrid trucks instead of electric vans as initially considered in the project proposal; however, the installation of electric charging points at the consolidation centre remained necessary, in order to support the operation of the electric prototype developed within measure MAD 7.6. During the implementation stage, a number of activities to liaise with stakeholders and potential clients were undertaken, with an aim at establishing the Local Freight Partnership envisioned in the initial project description; however, the only client interested in making use of the new clean services was SEPHORA, as the company had approved a corporate commitment to meet certain clean standards in their distribution activities. No particular activities were conducted for designing regulatory tools on urban freight delivery, as these tools were already under development in the context of the preparation of the revised Air Quality Plan and the new low emissions zone “Madrid Central”; the new norms have established differentiated time windows for urban delivery depending on the vehicle’s characteristics.

The operational phase took place between February 2018 and June 2019, serving a total number of 15 SEPHORA shops in the central districts. To provide the delivery services, FM Logistic established a contract with *Ontime*, another operator in Madrid with a 70,000-m² logistic centre in Villaverde (*Avenida Zafiro 4*), a district in the south of the municipality and relatively close to the city centre. *Ontime* also provides the fleet (8 hybrid 7.5-t trucks) needed for distribution. The goods to be distributed through the centre in Villaverde are collected by *Ontime* at the FML centre in Torrejón and transported with a 40-t articulated truck.

The Sephora shops are served weekly, on Tuesday morning; these services are the only ones for which the customer is requiring by contract the use of clean vehicles (i.e. these could be not only hybrid trucks, but also CNG or electric trucks or vans). *Ontime* is providing other distribution services on behalf of FM Logistic from Villaverde, eventually making use of the same hybrid trucks even if the customer is not requiring their use, as a way to optimise their utilisation.

The activities in the Villaverde consolidation centre are expected to expand. Between March and June 2019, FM Logistic improved its offices and operational area within the centre, aiming at expanding the clean distribution services to other companies, under the commercial label “Citylogin”. The area dedicated to Citylogin is indicated in the figure below.

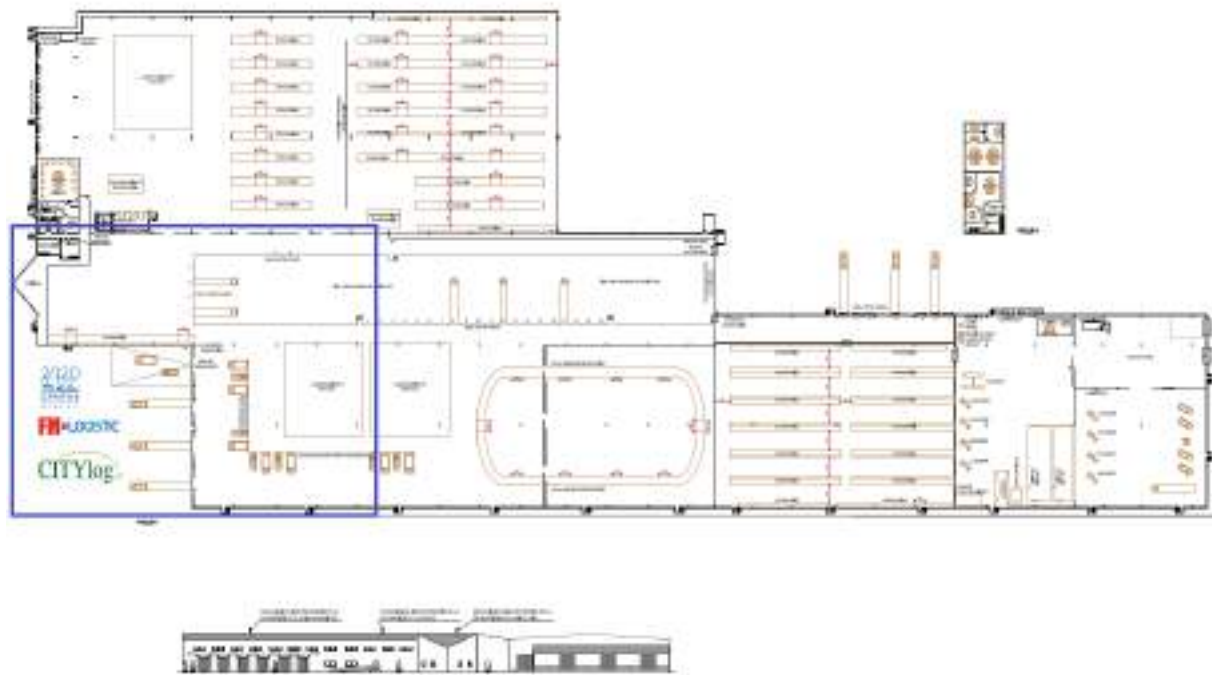


Figure 2: Ontime logistic centre in Villaverde. In blue, the consolidation centre dedicated to FML clean logistics (Citylogin).

Details on the activities to design and implement the Local Freight Partnership and to reach out to other clients have not been made available to the evaluation team. There is evidence that some members of the municipality staff involved in the measure have actively participated in the design of the new regulatory framework to access the centre of Madrid (low emission zone Madrid Central) and the management protocol in case of high pollution levels in the city, contributing in these actions with the experience gained from the implementation of this measure.

Three main changes in the measure contents can be identified compared to the initial proposal. The first one is the location chosen for the consolidation centre, which moved outside the living lab in order to find more affordable renting options. Like in the initial site, the chosen location is close to the inner beltway (M-30), although at a slightly longer distance from the city centre. The second change refers to the use of hybrid trucks, instead of the electric vans initially envisaged (the electric prototype developed in measure MAD 7.6 is expected to join this service in the future: further information on the characteristics of the electric truck prototype can be found in the measure MAD 7.6 reports). The third change refers to the lack of development of the “local freight partnership” initially envisaged, probably due to a combination of factors, including the lack of positive responses from the potential clients initially approached and the lack of alternative promotion activities from the part of the operator.

Some key findings can be highlighted during the implementation stage:

- Increasing interest from logistics operators in the operational features of clean vehicles (and particularly electric ones) for urban distribution, due to expanding market and regulatory requirements for clean mobility.
- The consolidation centre includes a “share logistics” room, in order to create synergies with operational models for other parts of the city.

- The Consolidation Centre provides clean distribution services not only to those clients who contracted this type of service for their entire distribution needs, but also to other companies with goods that cannot be fully distributed by clean vehicles (they are going to use it taking advantage of the system).

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1,2		4		
Indicator name	Emissions	VKM travelled	Modal shift	Awareness	Acceptance
Type	KPI	KPI	KPI	KPI	KPI
Category	Environment	Transport system	Transport system	Society	Society
Subcategory	Pollution and nuisance	General	General	Acceptance	Acceptance
Aspect	Emissions	Total travel	Modal split	Awareness	Acceptance
Definition	Emissions (t per year of CO ₂ , NO _x , PM)	Distance travelled based on the consolidation centre	Number of shipments/pallets served by clean logistics	Percentage of freight senders aware of the new service	Average approval score of freight senders
Unit	Tons	km	Quantity (shipments)	Score (1-5)	Score (1-5)
Method of data collection	Estimate based on VKM travelled	Provided by consolidation centre management	Provided by consolidation centre management	Survey to FLM freight senders	Survey to FLM freight senders
Target group	Operations based on the consolidation centre	Operations based on the consolidation centre	Operations based on the consolidation centre	FLM freight senders	FLM freight senders
Domain	All operations in Madrid	All operations in Madrid	All operations in Madrid	All operations in Madrid	All operations in Madrid
Control sample	Operations from alternative centre (Coslada)	Operations from alternative centre (Coslada)	No	No	No
Related measures, activities, and interference sources	External (e.g. traffic conditions) and internal (e.g. fleet renewal, management changes...) may alter performance of	External (e.g. traffic conditions) and internal (e.g. fleet renewal, management changes...) may alter performance of	None	None	None

	logistics operations.	logistics operations.			
References					

Table 5: Description of key performance indicators (KPI)

Impact	3			
Indicator name	Energy	Investment costs	Operational costs	Satisfaction
Type	KPI	KPI	KPI	KPI
Category	Environment	Economy	Economy	Society
Subcategory	Pollution and nuisance	Costs	Costs	Acceptance
Aspect	Energy	Costs	Operating costs	Acceptance
Definition	Energy consumption	Investment costs	Average operating costs per EV	Satisfaction score of (1) operator and (2) delivery receivers towards new services
Unit	MJ/year	EUR	EUR/km	Score (1-5)
Method of data collection	Estimate based on VKM travelled	Provided by consolidation centre management	Provided by consolidation centre management	Survey to FLM staff and to delivery receivers in the area served by the consolidation centre
Target group	Operations based on the consolidation centre	Operations based on the consolidation centre	Operations based on the consolidation centre	Operations based on the consolidation centre
Domain	All operations in Madrid	All operations in Madrid	All operations in Madrid	All operations in Madrid
Control sample	Operations from alternative centre (Coslada)	No	Operations from alternative centre (Coslada)	Operations from alternative centre (Coslada)
Related measures, activities, and interference sources	External (e.g. traffic conditions) and internal (e.g. fleet renewal, management changes...) may alter performance of logistics operations.	None	External (e.g. traffic conditions) and internal (e.g. fleet renewal, management changes...) may alter performance of logistics operations.	External (e.g. traffic conditions) and internal (e.g. fleet renewal, management changes...) may alter performance of logistics operations.
References				

Table 6: Description of key performance indicators (KPI) (cont.)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement
	CO2 emissions	tons/year	B-A	E		
	NOx emissions	tons/year	B-A			
	PM emissions	tons/year	B-A			
	VKM travelled	Km	B-A	DC		
	Modal shift	Quantity (shipments)	A	DC		
	Awareness	Score (1-5)	A	S		
	Acceptance	Score (1-5)	A	S		
	Energy	MJ/year	A	E		
	Investment costs	EUR	A	E		
	Operational costs	EUR/km	A	E		
	Satisfaction	Score (1-5)	A	S		
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 7: Measure's indicators

C.1.2 Baseline

The baseline considers that the distribution patterns have not changed compared with the situation prior to the ECCENTRIC projects. Therefore, the 15 SEPHORA shops in the city centre would continue to be served, as before, from FML's logistics centre in "Plataforma Arvato Bertelsman", located in Torrejón de Ardoz (A-2 motorway, PK 22.5). The total length of the route is 71.5 km (round trip) (Figure below).

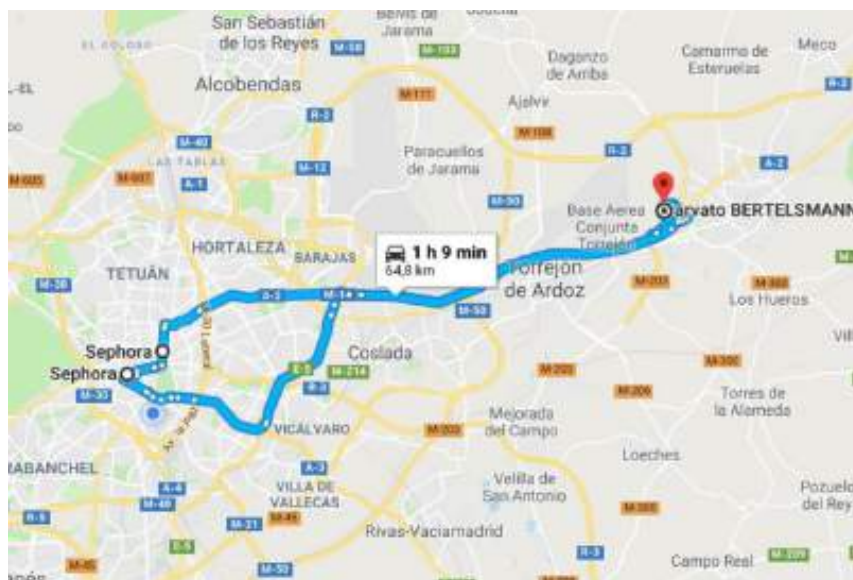


Figure 3: Distribution route (baseline)

The 15 SEPHORA shops in the central districts of Madrid would remain being served by small trucks (Mercedes Benz Artego 816, with GMW 7.5 tons), with Euro V technology.

As the number of pallets and shipments to SEPHORA vary from month to month, monitoring has been made on a monthly basis, taking into consideration the operational needs to deliver the registered freight under the baseline, the business as usual and the ECCENTRIC scenario (for the latter actual fuel consumption values were registered during the monitoring period). As a reference, in 2017, the annual number of pallets delivered to SEPHORA had total was close to 1,000 (equivalent to more than 400 shipments), but none on them was shipped using the clean logistics concept. Therefore, the reference value (2017) is zero.

Actual average consumption for the Euro V 7.5-t diesel trucks considered for the baseline was estimated based on the consumption records gathered by the operator for these vehicles. It resulted in an average of 19.20 litres/100 km. Their typical load, in weight, is 25%. These vehicles are considered to drive under a mix of interurban and urban conditions. The COPERT 5.2 software has been used to estimate emissions based on actual fuel consumption. For this, the relationship between fuel consumption and emissions has been calculated for the driving and loading conditions mentioned above. These relationships are summarised in the Table below, and can be applied to the fuel consumption values reported by FML to estimate the emissions and energy consumption:

INDICATOR	UNIT	7.5 t EURO V TRUCK
NO _x emissions	g/l gasoil	18.335
PM ₁₀ emissions	g/l gasoil	0.950
CO ₂ emissions	g/l gasoil	2,610
Energy consumption	MJ/l gasoil	35.14

Table 8: Factors for the estimate of emissions and energy consumption

In the baseline, real consumption values were registered for the consumption of the EURO V 7.5-t trucks, while serving the SEPHORA shops from Torrejón in 2017, resulting in an average of 18.10 litres/100 km. Assuming that the shipments provided within the ECCENTRIC project had been provided under the baseline conditions (i.e. from Torrejón with EURO V 7.5-t trucks), the emissions and energy consumption values are estimated as reported in the table below (for 2018 and also for an average year, considering the whole January 2018-June 2019 monitored period).

INDICATOR	Unit	2018	Avg.Year
NO _x emissions	kg/year	74.93	77.08
PM ₁₀ emissions	kg/year	4.59	4.72
CO ₂ emissions	kg/year	13535	13925
Energy consumption	MJ/year	182208	187453

Table 9: Baseline emissions and energy consumption (2018 and average year)

For cost analysis, the baseline conditions will be retained for comparison. For the other scenarios, it will be necessary to consider the additional costs associated to the business as usual (BAU) and to ECCENTRIC operations compared to the baseline.

C.1.3 The business-as-usual scenario

The business as usual scenario keeps the baseline distribution scheme in terms of routes and vehicles. It considers that the operator replaces its EURO V trucks by hybrid ones, even in the case that the ECCENTRIC measure had not been implemented, due to the interest of SEPHORA in clean logistics and the market trends. Therefore, it can be assumed that the services would be provided by small hybrid trucks (Mitsubishi FUSO). Their gross vehicle weight is 7,490 kg, and its maximum payload is 3,195 kg. The unloaded weight of the vehicle is 4,295 kg (4.295 t). The vehicle is powered by a diesel EURO-VI compliant engine with a power of 10 kW, a 20-kW electric engine and an ion-lithium battery of 2kWh.

Actual average consumption for the hybrid trucks has been monitored during the demonstration, resulting in an average during the whole reporting period of 14.12 litres/100 km, providing significant fuel savings compared with the 18.10 litres/100 km reported for the equivalent diesel truck. The table below summarise the specific emission factors per litre of fuel consumed, obtained with COPERT 5.2 following the same procedure described in the previous section (with a typical load, in weight, of 25% and mix of interurban and urban driving conditions):

INDICATOR	UNIT	7.5 t HYBRID TRUCK
NO _x emissions	g/l gasoil	2.201
PM ₁₀ emissions	g/l gasoil	0.790
CO ₂ emissions	g/l gasoil	2,610
Energy consumption	MJ/l gasoil	35.14

Table 10: Factors for the estimate of emissions and energy consumption

In the BAU scenario, consumption values have been estimated based the shipments monthly reported by FML, assuming that these shipments would be provided from Torrejon with hybrid 7.5-t trucks. The resulting emissions and energy consumption values are reported in the table below (for 2018 and also for an average year, considering the whole January 2018-June 2019 monitored period).

INDICATOR	Unit	2018	Avg.Year
NO _x emissions	kg/year	8.76	9.16
PM ₁₀ emissions	kg/year	3.15	3.29
CO ₂ emissions	kg/year	10387	10861
Energy consumption	MJ/year	139829	146203

Table 11: BAU emissions and energy consumption (2018 and average year)

The difference in costs between the BAU and the baseline scenario is due to (1) the slightly higher amortisation costs of a FUSO hybrid truck compared with a FUSO diesel truck of the same size, and (2) the lower fuel consumption of the FUSO hybrid truck. The former can be estimated as 100 € per month (considering that monthly amortisation is €500 for the hybrid truck and €400 for the EURO V diesel truck). Investment costs are €55,000 for the Fuso hybrid truck and € 44,000 for the Euro V diesel truck.

C.2 Measure results

Once the measure is implemented, the logistics operative makes use of a heavy truck (gross vehicle weight 40 tons, maximum payload 24 tons) carrying the products from Plataforma Arvato Bertelsman to the consolidation centre in the southern periphery of Madrid (Villaverde). From there, the FUSO hybrid trucks serve the SEPHORA shops in the city centre. The average distance served by the heavy truck is 32.6 km (round trip), and the average distance between the consolidation centre and the shops, 35.5 km (round trip) (Figure below).

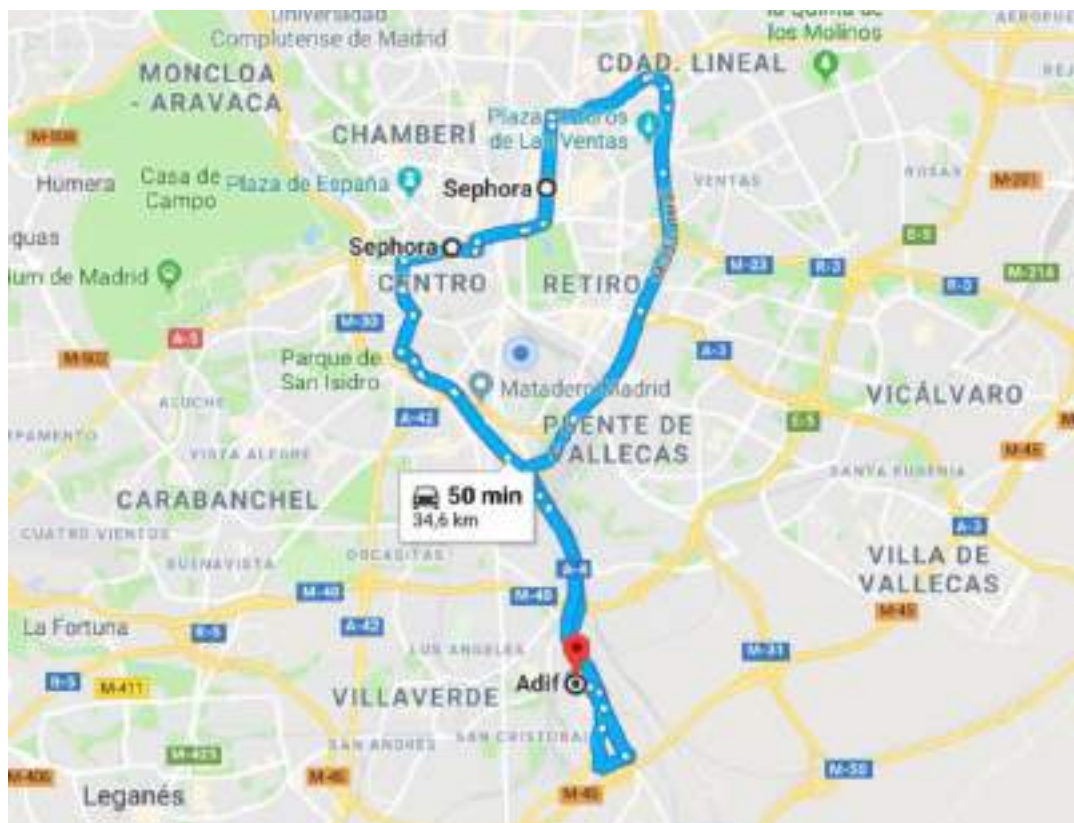


Figure 4: Distribution route (ECCENTRIC)

Actual mileage and consumption for the hybrid trucks and for the articulated 40-t truck are measured and reported on a monthly basis, resulting in an average specific consumption of 14.12 litres/100 km and 29.57 litres/100 km respectively, for the whole monitoring period. Their typical load, in weight, is 25%. They are considered to drive under urban conditions (50% during peak hours and 50% off-peak). The specific emission factors for the hybrid trucks are the same already provided in the

previous section (BAU scenario); they are provided here again, together with the ones associated to the 40-t articulated truck:

INDICATOR	UNIT	FUSO HYBRID	HEAVY TRUCK
NO _x emissions	[g/l gasoil]	2.201	0.387
PM ₁₀ emissions	[g/l gasoil]	0.790	0.304
CO ₂ emissions	[g/l gasoil]	2610	2610
Energy consumption	[MJ/l gasoil]	35.14	35.14

Table 12: Factors for the estimate of emissions and energy consumption

The resulting emissions and energy consumption values are reported in the table below (for 2018 and also for an average year, considering the whole January 2018-June 2019 monitored period).

INDICATOR	Unit	2018	Avg.Year
NO _x emissions	kg/year	4.59	4.77
PM ₁₀ emissions	kg/year	1.71	1.77
CO ₂ emissions	kg/year	6194	6384
Energy consumption	MJ/year	83381	85934

Table 13: ECCENTRIC emissions and energy consumption (2018 and average year)

As no additional clients, apart from SEPHORA have contracted the new clean logistics services during the demonstration period, the total modal shift achieved has been limited: 415 shipments in 2018 and 429 considering an average year based on the 18 months of operation:

INDICATOR	2018	Avg.Year
Shipments	415	429
Pallets	978	916
Weight (kg)	293400	274800
% total hub [pallet] capacity	6.2%	6.1%

Table 14: Modal shift achieved by the measure

The table below summarises the key indicators for the three scenarios described in this report for the average year.

INDICATOR	Unit	BEFORE	BAU	AFTER	B-A SAVING
NOx emissions	kg/year	77.08	9.16	4.77	93.8%
PM10 emissions	kg/year	4.72	3.29	1.77	62.5%
CO2 emissions	kg/year	13925	10861	6384	54.2%
Energy consumption	MJ	187453	146203	85934	54.2%
VKM (km)	km	29476	29476	16073	45.5%
Modal shift	Pallets	0	0	15096	

Table 15: Measure's emissions and energy saving (January 2018)

On-line surveys were conducted among hub staff, FML current customers and potential customers in order to evaluate the awareness, acceptance and satisfaction levels with the measure. The surveys included other questions (e.g: for staff, on job satisfaction and safety compliance; for potential customers, on service selection criteria...) that were not included in the evaluation framework and are not included in this report. The survey was answered by 7 existing customers, 11 potential customers and 22 employees.

Awareness on sustainable logistics provided by FML from the consolidation centre was assessed with a score running from 1 (no interest in the concept) to 5 (full knowledge and very high interest). The level of awareness among was significantly higher among FML customers (3.9 average), than among potential customers (3.0 average).

The level of acceptance of these sustainable logistics services based on a consolidation centre was also assessed with a score running from 1 (no interest from the customer if the cost increases) to 5 (an essential condition for the customer). The level of acceptance was significantly lower among FML customers (3.6 average), than among potential customers (4.2 average), suggesting that FML could significantly expand its operations in the consolidation centre by attracting these potential customers, rather than convincing already-existing customers to pay the extra cost for the sustainable logistics services.

The level of satisfaction was also assessed with a score running from 1 (unsatisfactory) to 5 (highly satisfactory). The resulting average score was 3.7; furthermore, compared to other delivery services available in the city, this one got an average of 4.6.

The engagement of hub employees with sustainable logistics was also high: the average score on awareness and acceptance was 3.8, and their average satisfaction with the sustainable objectives of their operations was 4.2.

Costs analysis has to take into consideration that FML has contracted out all the services, and therefore, it has not incurred in any investment costs. Accordingly, operation costs need to include the monthly rental of the consolidation centre premises and the amortisation costs of the vehicles dedicated to the operations.

Compared to the BAU scenario, the following additional costs are associated to ECCENTRIC operations: (1) monthly rent of the space used for the consolidation

centre; (2) additional administrative costs linked to each shipment from the consolidation centre; (3) additional personnel costs associated to the manipulation of each pallet in the consolidation centre; (4) amortisation of the 40-t articulated truck operating between the main logistics platform in Torrejón and the consolidation centre (in proportion to the km provided by these vehicles to clean logistics, as they are also used for regular services). It is assumed that costs at the main logistics platform in Torrejón do not change, as the number of pallets transported remains the same.

The operation from the consolidation centre provides two savings: (1) fuel savings, due to the lower mileage travelled and fuel consumption and (2) amortisation savings for the 7.5 trucks providing the last mile delivery. This second saving is justified by the fact that the 7.5 trucks need make less km on clean logistics services, and can be used to other purposes too. Additional operation costs (compared to the baseline) are presented in the table below.

Concept	Unit cost	ECC-Baseline (€/year)
Hub cost: Monthly rental	4800 €/month	3495.15
Hub: personnel	2.5 €/pallet	2290.00
Hub: Shipment documents	1.2 €/shipment	515.20
Trailer: amortisation and maintenance	4268.69 €/month	1785.68
7.5 trucks: amortisation and maintenance	3140.36 €/month	-10041.24
Fuel		-2071.57
MONTHLY TOTAL		-4026.78

Table 16: Cost assessment (average year)

Although the cost analysis of ECCENTRIC services provides a modest gain per year (€4026.78), it must be stressed that this gain corresponds to an increase in the cost of the other delivery operations carried out from the hub in order to make use of the substantial hub capacity (90% to 95% in terms of pallets) not dedicated to ECCENTRIC activities. As an average, only 6.3% of the hub operational costs (estimated at 100,000 €/year including rent, personnel and administrative costs) have been covered by ECCENTRIC operations. The other shipments served from the hub cover substantially longer distances (70-90 km, round trip), making them hardly suited to the consolidation centre concept and representing an additional cost for these operations (estimated at €144,000 per year or 35.56 €/shipment, assuming that the average travel distance from Torrejón and from the consolidation centre are the same in these shipments, which have multiple destinations in the metropolitan region): they should progressively be replaced by shipments with destination in the city centre and much shorter travel distances (below 40 km, round trip).

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
CO2 emissions	tons/year	13.92	2017	10.86	2018	6.38	2018	-7,54	-4,48
NOx emissions	tons/year	0.0771	2017	0.0092	2018	0.0048	2018	-0,0723	-0,0044
PM emissions	tons/year	0.0047	2017	0.0033	2018	0.0018	2018	-0,0030	-0,0015
VKM travelled	Km/year	29,476	2017	29,476	2018	16,073	2018	-13403	-13403
Modal shift	Shipments/year	0	2017	0	2018	429	2018	429	429
Awareness	%	0	2017	0	2018	3.9	2018	3.9	3.9
Acceptance	Score (1-5)	0	2017	0	2018	3.6	2018	3.6	3.6
Energy	TJ/year	0.187	2017	0.146	2018	0.0859	2018	-0.102	-0.060
Investment costs	EUR	0	2017	155000	2018	155000	2018	155000	0.00
Operational costs	EUR/year	-	2017	-1418.10	2018	-4026.78	2018	-4026.78	-2608.68
Satisfaction	Score (1-5)	0	2017	0	2018	3.7	2018	3.7	3.7

Table 17: Summary of indicators' values

Investment costs include the acquisition of one trailer (€100,000) and one FUSO hybrid truck (55,000). Note that although 8 FUSO hybrid trucks are serving the consolidation centre, only one is necessary for the deliveries made to Sephora; the others are providing services to other customers that have not requested Citylogic services, as a way to make use of the spare hub capacity.

Operational costs include amortization costs of the vehicles, fuel costs, and hub costs (rent, personnel and administration). These are provided as additional costs (or savings, if negative) compared to the before situation.

C.3 Summary: achievement of objectives

The table below shows that most of the measure objectives have been successfully achieved. The measure has been effective in substantially reducing CO2 emissions and energy consumption (by 54%) and NOx and PM emissions (by 94% and 63%) for the logistics operations serving Sephora. However, the volume of these operations has been low compared with the hub capacity during the demonstration stage (only 5% to 10%, depending on the month considered), as only 429 shipments/year have been transferred to the new delivery system. This limitation explains the measure's failure to achieve the expected reduction of 90t CO2eq per year initially foreseen.

The modest number of shipments served with sustainable logistics seems contradictory with the high scores obtained in the customers' awareness and acceptance of these services. It suggests that additional marketing efforts should be undertaken to gain new customers to make use of the new "Citylogin" services.

No.	Objective and target	Rating	Comment
1	Reduction of 90 t CO ₂ eq per year	O	The reduction achieved has been 54% in the operations handled by the project measure, delivering savings for 7.5 tCO ₂ eq per year. A twelve-fold increase in the number of shipments would have been needed to reach this target.
2	Reduction of air pollutant emissions	**	Significant reduction achieved in NO _x (94%%) and PM (63%) in the operations handled by this measure. A significant contribution is due to changes from Euro V to Euro VI hybrid trucks (as reflected in the BAU scenario).
3	Reduction of energy consumption	**	The reduction achieved has been 54% in the operations handled by the project measure, delivering savings for 0.1 TJ per year.
4	Improved delivery service performance (optimisation of delivery vehicle use)	**	Delivery service has resulted in better use of the 7.5 trucks, with annual savings estimated at €10,000 compared to the BAU scenario
5	Increased acceptance and awareness of sustainable logistics	***	Departing from a low level of awareness and acceptance, the measure has reached above-average values (3.9 and 3.6 over 5, respectively).
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★ = Exceeded			

Table 18: Achievement of the measure's initial objectives

C.4 Up-scaling

The up-scaling of this measure is envisaged as expansion of the Citylogin (i.e. eco-logistics) activities from the consolidation centre. Until now only 5% to 10% (6.3% in average) of the hub capacity is dedicated to such activities, as Sephora is the only customer explicitly requiring them.

Up-scaling of the measure should result in serving since the hub customers located in the city centre (within distances similar to those of the Sephora shops) instead of the current more distant customers, located elsewhere in the metropolitan area. This would provide savings in the operation of the last-mile delivery with the FUSO hybrid trucks compared to operations from Torrejon (the distance travelled by these trucks would allow to half the number of trucks needed), compensating from the higher costs due to the trailer and hub operations.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

The following deviations compared to the measure description provided in the project proposal were identified, and are presented in more detail in the Process Evaluation Report.

D.1.1 Management plan and local freight partnership

During the implementation stage, a management plan for the consolidation centre was expected to be produced by the hub operator, including distribution areas, potential clients, goods to be delivered, or services. Additionally, a “local freight partnership” including the participation of service providers was expected to be put in place. Both actions were cancelled by the measure partners.

D.1.2 Vehicles providing last-mile delivery from the consolidation centre

During the implementation stage, it was decided to provide last-mile delivery from the consolidation centre with eight FUSO hybrid trucks (7.5 t) instead of using the electric vans initially envisaged in the project proposal; this made unnecessary the installation of charging points at the consolidation centre, unless until the electric prototype developed within measure MAD 7.6 becomes operational.

D.1.3 Design of regulatory tools on urban freight delivery in Madrid

No specific activities were conducted for designing regulatory tools on urban freight delivery within this measure, as these tools were already under development in the context of the preparation of the revised Air Quality Plan and the new low emissions zone “Madrid Central”; the new norms have established differentiated time windows for urban delivery depending on the vehicle’s characteristics.

D.1.4 Location of the consolidation centre

The location finally chosen for the consolidation centre, in Villaverde district, is located outside the living lab in order to find more affordable renting options. As the initial site, the chosen site is close to the inner beltway (M-30), but at a slightly longer distance from the city centre.

D.2 Barriers

The following main barriers were identified, and are presented in more detail in the Process Evaluation Report.

D.2.1 Financial barrier: Location of the consolidation centre

The optimal location of the consolidation centre was jeopardised by financial constraints, as central locations are significantly more expensive than peripheral ones. The final location of the consolidation centre- outside the living lab and at a significant distance from the potential final destinations in the city centre- did not compromise the achievement of the measure main objectives, even if it has probably resulted in lower impacts.

D.2.2 Positional barrier: Low visibility of the project

The Consolidation Centre is sharing a larger facility with many other operators and activities. Not having an exclusive or independent centre has weakened the identity and visibility of the project.

D.2.3 Planning barrier: Vehicle selection

The selection of hybrid 7.5-t trucks for last mile distribution was not supported by a comprehensive analysis of options, in particular to use electric vehicles for these operations.

D.2.4 Organisational barrier: Management plan

The lack of an explicit management plan for the consolidation centre can have jeopardized the expansion of the operations to more clients and the optimization of hub operations to achieve the measure's targets.

D.2.5 Involvement barrier: Limited participation of stakeholders

The project has not fully succeeded in reaching out to key institutional actors (in particular those participating in the urban delivery components of the Air Quality Plan) and users (potential customers). In the first case, at least the measure has been successful in being aligned with the new Air Quality Plan, through the municipal experts involved in the measure.

D.2.6 Cultural driver: Increasing interest in clean logistics

The project has stated the increasing interest in sustainable urban logistics (consolidation centres, clean vehicles, share logistics...) concepts from logistics operators and their clients, partly as a result of the new regulations adopted by the municipality within the Air Quality Plan.

D.2.7 Institutional: Support to clean vehicles

The new regulations adopted by the municipality within the Air Quality Plan encourage the use of cleaner vehicles for urban delivery.

D.3 Supporting activities

No supporting activities have been undertaken during the reporting period.

D.4 Recommendations on the implementation process

The following recommendations were made as a result of the process evaluation.

D.4.1 Recommendation 1: Establish a strategy to increase the number of customers of the consolidation centre

Although FML is keenly marketing its clean logistics services, within the "Citylogin" label, the results during the demonstration stage have been limited. Establishing a clear strategy within this measure could result in the expansion of these services, with positive results in economic terms as well as in terms of emissions and energy savings. These actions could be further reinforced by the promotion of the Local Freight Partnership initially envisaged in the project.

E. Evaluation conclusions

The observed impacts of the measure has been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

CO2 emissions. In relative terms, the measure has achieved a significant reduction in CO2 emissions (-54% compared with the “before” scenario). However, the limited size of the operations undertaken (just 429 shipments in one year) has resulted in absolute CO2 emission savings significantly below the initial target (7.5 tons achieved compared with a target of 90 tons per year). A significant part of the emissions savings (4.5 tons) could have been achieved solely with the replacement of the Euro V delivery trucks by hybrid trucks (BAU scenario), whereas the rest (3.0 tons) are associated to the introduction of the last-mile delivery concept based on the consolidation centre.

NOx and PM emissions have been reduced substantially, combining the effect of the hybrid delivery trucks and the consolidation centre: (-94% in NOx emissions and -48% in PM emissions). Energy savings and total distance travelled have also been significantly reduced in the project operations: -54% and -45% respectively. The project has achieved its expected impacts on these particular indicators.

Use optimisation of delivery vehicles. The optimisation of the use of the 7.5-t hybrid trucks provide one of the most relevant operational savings for the logistics operator. In the case of Sephora, the distances travelled by these vehicles are cut almost by half for each shipment, and this should also be the case in other deliveries with destination in the central districts of Madrid. Shorter distances allow to dedicate these vehicles to provide additional services or to reduce the fleet size.

Investment and operational costs. The business model followed by the logistics operator in charge of this measure avoided the need for investments: the consolidation hub was installed in premises rented to another logistics company (Ontime), and the vehicles involved in the operations were operated by this company. The operating costs attributed to the project activities (shipments to Sephora) resulted in significant savings compared to the “before scenario”, due primarily to the decreased use of 7.5 trucks (equivalent to €10,041 per year) already discussed above and, to a lower extent, to fuel savings (equivalent to €2,072 per year). However, these savings cannot compensate the significant cost increase for shipments delivered from the consolidation centre to other destinations, due to the fact that these destinations are not optimal (their average distance is too high: 78 km); these results in an average cost increase of some €35.56 per shipment, with total operational costs for these shipments of €143,882. Therefore, unless the logistics operator succeeds in attracting more customers to these services, operations will not be feasible in the medium-term.

Increased awareness and acceptance. The measure has significantly increase awareness and acceptance of sustainable logistic solutions (score of 3.9 and 3.6 over 5 respectively)

among current customers of the operator (FML). However, this has not resulted in any of these customers actually hiring these services yet.

In accordance with the results summarised above, it can be concluded that the measure has reached most of its targets, in spite of the modest number of deliveries provided. The operations have confirmed the high potential of the measure to provide emission and energy savings, to reduce operating costs and to increase the satisfaction of its customers. However, the fact that the measure has been unable to increase its size in order to manage a higher number of shipments shows that the barriers identified were strong and could not be effectively removed: on the one hand, the activities to attract potential customers have probably been insufficient: more efforts, including the materialisation of the initially envisaged Local Freight Partnership, would have been necessary; on the other hand, even if the survey stated that the levels of awareness and acceptance among potential customers were high after the measure was operational, the actual barriers for these customers to adopt clean logistics were difficult to identify or were not adequately addressed.

E.2 Relevance of supporting activities

No supporting activities have been identified.

E.3 Interaction with other measures

This measure is expected to interact with measure MAD.7.6, as the electric prototype developed by the latter will operate from the consolidation centre. However, such interaction has not taken place yet, as the electric prototype has not started operations at the time of conclusion of this evaluation report. Therefore, any interaction between both measures will be reported in the measure evaluation report for MAD.7.6.

E.4 Main lessons learned

Four main lessons can be highlighted:

- The measure has confirmed the high potential of this sustainable logistics concept (a consolidation centre served with small low-emission trucks): The emissions and energy consumption associated to these deliveries have decreased significantly, and the operational costs are lower.
- The adoption of cleaner trucks (hybrid 7.5-t trucks in this case) has been effective in providing substantial emission and fuel savings.
- It seems extremely difficult to find customers willing to make use of these new services. The consequence is that only an average of 6% of the capacity of the consolidation centre has been dedicated to these services. The remaining capacity has been used to serve shipments with distances much longer than those for which the consolidation centre can provide environmental and economic benefits. Considering the customers' answers to the survey, and their high awareness and acceptance of the concept, it is not clear why such services are not being used.
- This demonstration measure was not adequate to identify and test regulatory tools. Regulatory tools follow a specific decision-making path within local governments, which is difficult to make compatible with the particular conditions of research and demonstration projects.

E.5 Long term impact

The long term impact of this measure is uncertain: on the one hand, the measure has proved the technical viability of the concept, as well as its consistency with sustainability objectives and the reduction in operational costs. On the other hand, the benefits of the measure (and particularly the economic ones) can be achieved only if the operator can attract sufficient customer to make use of a substantial part of the capacity of the consolidation centre. The demonstration showed that, in spite of wide awareness and acceptance, attracting new customers is extremely difficult.

E.6 Potentials for up-scaling in the city

The expansion of consolidation centres in Madrid is also expected to increase due to the combination of the new regulations adopted by the municipality in the city centre and new trends in retailing (e.g. global retailers opening a growing number of small selling points in city centres). On their turn, these prospects of an expanding retail market in city centres could attract the interest of investors in consolidation centres as a real estate product.

F. Additional information

F.1 Appraisal of evaluation approach

The evaluation approach for this measure has proved its effectiveness in monitoring the activity during the demonstration stage and delivering the required indicators with a reasonable effort and cost. Data collection has been based on monthly monitoring of the shipments delivered from the consolidation centre, and the activity of the delivery trucks (km travelled and fuel consumption). More detailed monitoring (through *ad hoc* real time tracking of every vehicle and shipment) was considered as an option, with no significant additional costs for data gathering, but was dismissed due to the effort needed for data processing and the complexities to properly tag some trips (such as those combining deliveries to different customers, or serving additional routes).

The administration of the survey, conducted within the demonstration period, did not raise any significant problems, probably due to the small population targeted, and the familiarity of the respondents with the logistics sector, as customers or as staff members. The main weak point is related to the inability of the survey to identify the actual reasons that have prevented all the surveyed customers to make use of the services, in spite of their high interest in them.

F.2 Future activities relating to the measure

For the remaining of the measure actions (dissemination stage) and after the project conclusion, the following activities have been considered:

- FML foresees to continue operations from the consolidation centre.
- FML is recommended to develop a marketing strategy to increase the number of shipments delivered through clean logistics from the consolidation centre, and to keep a monitoring system of at least some of the KPI, in order to include the positive environmental impact of the operations in the marketing and communication effort.
- As the market for clean logistics seems to be expanding very slowly in Madrid, further action is needed. The potential of a Local Freight Partnership, initially envisaged within this measure, could still be implemented in the remaining project lifetime.
- The positive environmental results obtained with the hybrid trucks could be further improved with the use on electric models: a transition plan to replace at least part of the current trucks by electric ones (in fact, an electric version of the Fuso 7.5-truck used in the project has recently hit the market) after their 5-year amortisation period, could be developed by the logistics operator.



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STO 7.2

Consolidating Stockholm Municipal Freights

Measure Evaluation Report

Deliverable No.:	8.5
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1	Abutment de Madrid (coordinator)	Spain	MAD
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3	Consorcio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
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17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
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23	Turku City Traffic Ltd.	Finland	TUKL
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26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Joel Franklin	KTH Royal Institute of Technology
Amanda Baumgartner	City of Stockholm
Neva Leposa	KTH Royal Institute of Technology

Table of Contents

ABSTRACT.....	1423
A. INTRODUCTION.....	1424
A.1 EXPECTED RESULTS OF THE MEASURE	1424
A.1.1 Quantifiable impacts.....	1424
A.2 MEASURE DESCRIPTION	1424
A.2.1 Measure outputs.....	1425
A.2.2 Supporting activities	1425
A.2.3 Interactions with other ECCENTRIC measures.....	1426
A.2.4 Interactions outside ECCENTRIC	1426
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1426
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1426
A.5 IDENTIFIED RISKS	1427
B. MEASURE IMPLEMENTATION	1428
B.1 SITUATION BEFORE CIVITAS	1428
B.2 INNOVATIVE ASPECTS.....	1428
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1428
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1428
C. IMPACT EVALUATION FINDINGS	1429
C.1 EVALUATION APPROACH.....	1429
C.1.1 Expected impacts and indicators.....	1429
C.1.2 Baseline.....	1430
C.1.3 The business-as-usual scenario.....	1431
C.2 MEASURE RESULTS.....	1432
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1434
D. PROCESS EVALUATION FINDINGS	1435
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1435
D.2 BARRIERS	1435
D.3 DRIVERS	1436
D.4 SUPPORTING ACTIVITIES.....	1437
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1437
E. EVALUATION CONCLUSIONS	1438
E.1 VALIDATED DIRECT IMPACT	1437

E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1438
E.3	INTERACTION WITH OTHER MEASURES	1438
E.4	MAIN LESSONS LEARNED	1438
E.5	LONG TERM IMPACT	1438
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1438
F.	ADDITIONAL INFORMATION	1439
F.1	APPRAISAL OF EVALUATION APPROACH	1439
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1439

List of Tables

Table 1: Quantifiable impacts.....	1424
Table 2: Target groups or affected parties.	1426
Table 3: Measure stakeholders.....	1427
Table 4: Risk assessment.	1427
Table 5: Key Performance Indicators.....	1429
Table 6: Key performance indicators (KPI) measurements.	1430
Table 7: KPI results - Before	1431
Table 8: KPI results - BaU.....	1432
Table 9: KPI results – Before, BaU, and After.....	1433
Table 10: Achievement of objectives	1434
Table 11: Identified barriers and planned/taken actions.	1436
Table 12: Identified drivers and planned/taken actions.....	1437

Project	City		
ECCENTRIC	Stockholm		
Measure code	Measure name		
7.2	Consolidating Stockholm Municipal Freights		
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	Amanda Baumgartner	amanda.baumgartner@stockholm.se	

Abstract

The City of Stockholm aims to reduce fossil-fuel emissions, inter alia, by improving the efficiency of freight transport. This measure examines a possibility for using waterways transportation as an alternative to land-based transport in the construction projects.

The outputs of this measure include meetings between the City of Stockholm and the Region of Stockholm discussing the possibilities for the waterway transport in the planned construction project (building an extension of a metro line) and the pilot study that examines the economic, socio-environmental impacts of waterways transport as compared to the land based transport of the construction material, such as the noise and CO₂ emissions. Pilot test was conducted in the 'real' environment and included noise measurements when loading the barges in the inner part of the city, since the data for this context was missing. Moreover, CO₂ emission savings and costs were calculated based on the secondary sources, interviews with the port workers were used for the missing data.

The results of the pilot study show that a switch to waterways transport addresses the environmental sustainability goals most significantly. The CO₂ emissions would be reduced from 3.7 kg per transported ton on land by using trucks, given loading capacity of 11 ton and 30 km trip, to 1.1 kg per transported ton when using waterways, provided that loading capacity is 2000 ton and the receiving port is about 50 km away. This relates to the fact that more material can be transported on water when using barges, i.e. 2 ton per km instead of 0.18 when using trucks on land. The exterior noise levels would not necessarily be significantly higher than in the normal procedures, given that protective material is used to reduce noise. The costs are not significantly different. Waterways transport in construction projects can be considered as an alternative transportation especially in the cities with construction sites near the water.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

The long-term objective of the City of Stockholm is to reduce fossil-fuel emissions, decrease congestion in the city, and thereby increase accessibility and improve attractiveness of the city.

(2) Strategic level:

The City of Stockholm aims to reduce fossil-fuel emissions, reduce the congestion, and improve road safety, inter alia, by improving the efficiency of the freight transport. In order to address this objective and knowing that freight transport contributes greatly to the CO₂ emissions, the City of Stockholm aims to test whether freight transport could be improved by transferring parts of the construction related transport from land to water.

(3) Measure level:

The objective of the City of Stockholm, on the measure level, is to understand the environmental, economic, and social impact of waterways transport as an alternative to transport on land.

A.1.1 Quantifiable impacts

Expected Impacts		CIVITAS ECCENTRIC Objectives								
		Reduce:				Improve:				
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight
ID	Quantifiable Impacts									
1	Acceptance/Satisfaction of the measures by the users	x			x				x	x
2	Awareness raising							x	x	x
3	Reduction of emissions	x	x							x
6	Increase of transport efficiency				x	x		x		x

Table 1: Quantifiable impacts.

A.2 Measure description

Stockholm is called 'Venice of the north' for a reason. It consists of several islands, and for the uninterrupted public transit of the citizens, these islands are connected under and above the water. When building this infrastructure, the City of Stockholm is responsible for the land and the traffic in the city, but the Region of Stockholm is responsible for the development of the public transport that connects the wider parts of Stockholm, including the building of the metro lines. One of the plans that the Region of Stockholm has is to extend the metro lines and one of the foreseen extension points is linking the central part of Stockholm with eastern parts of

Stockholm (From Kungsträdgården to Nacka). In this operation, they will use an existing access tunnel, which is currently filled with rocks. They will then blast the tunnel towards east. This construction project will thus require emptying the excavated rocks from the tunnel. Typically, in such construction projects, the rock material is loaded on trucks and then transported by road to a site where the material is crushed, sorted, and distributed as rock material in other projects.

Due to the geographically appropriate context, location near the water, and due to the plans, it was timely to propose to the Region of Stockholm whether they could use waterways instead of the land transport in this planned excavation and construction operation. However, since this has never been done before in similar cases, and since the use of sea transport for transporting rocks is relatively new, the Region was hesitant. This measure includes, therefore, to a large extent a negotiation process between the City of Stockholm and the Region of Stockholm, in which a pilot test and a physical test conducted within this measure, served as an important basis for these negotiations. In particular, while a barge can load much more material, as compared to the trucks, the noise of loading the material on barges might be disturbing and had to be tested. Using trucks would not generate the same kind of noise as the rocks are loaded onto the truck underground in the tunnel. In addition, the economic efficiency has to be tested, since maritime transport can be a subject to additional fares, port charges, and the length of operation might be extended, as transshipment is needed. The efficiency, noise and the emissions were the main measured key performance indicators within this measure, to evaluate whether it is worthwhile to consolidate the excavated rocks in this construction project by using barges in the waterways as a means of transport instead of the trucks.

A.2.1 Measure outputs

The purpose of this activity is to discuss the possibilities of switching from land to waterway transport and investigate the effects of this switch. The measure included several tasks:

- Task 1: Meetings and negotiations between the City of Stockholm and the Region of Stockholm discussing the possibilities for the waterway transport in the planned construction project.
- Task 2: Procurement and execution of a pilot study, which models and compares the two types of transport (trucks vs. barges) for the further discussions with the Region of Stockholm (Task 1)
- Task 3: Preparation of a real, physical test, which measures the noise as the material is excavated and disposed on the barges. Emissions are modelled.
- Task 4: Preparation of the report of the measurements.

A.2.2 Supporting activities

The supporting activities were the meetings between the city of Stockholm and the Region of Stockholm and the procurement of the consultancy companies, which were able to conduct the tests. The first supporting activity had an objective to improve trust between the City and the Region – as related to these particular plans/operations. The second supporting activity is necessary for the actual measure implementation.

A.2.3 Interactions with other ECCENTRIC measures

No particular interactions with other Eccentric measures were taking place, except of the common interest and exchanges around the topic of noise, which was also important part of measure 7.4.

A.2.4 Interactions outside ECCENTRIC

While Eccentric project is based at the City of Stockholm, several interactions were needed from the parties outside the Eccentric stakeholders, such as the consultancies, which could conduct the measurements or modelling of the noise and emissions.

A.3 Target groups and/or affected part of the city or region

The potentially affected target groups were public authorities, businesses, and the citizens of Stockholm. However, since this measure was not including an actual switch from the land to waterways transport, but was examining possibilities, the citizens of Stockholm were not affected by this measure. The public authorities were affected as they are part of the negotiation process. These process could have affected and inspired their future procedures. The construction businesses were affected in part, as this measure affected the potential changes in their future operations which they need to plan for.

Target group		Affected area	
Type	Description	Type	Description
City of Stockholm	With better knowledge of possibilities of using inland water ways for transport of aggregates, the city can plan for more transports on water in the procurements	Public authorities	Using barges instead of trucks leads to less construction transports on the local streets that can improve city's attractiveness.
Region of Stockholm and other public authorities	Same as above	Public authorities	
Construction companies	Better knowledge of using inland waterways for transport of aggregates can create better understanding from companies and therefore generate better planning from their point of view.		

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

The most important stakeholders in this measure were the Region of Stockholm, in particular their department of Management for extended metro and the Traffic Administration at the City of Stockholm. In addition, several partners were involved in this measure, such as the KTH as a research institute, responsible for the evaluation, and the consultancy firms (e.g. ÅF), supporting the City of Stockholm with the technical knowledge. They were responsible for the actual measurements.

No	CIVITAS Partner / other actors	Type P-S	Type organisation C-PT-KI-NG-PR- other	Level activity L-P-O	Role Links
P02	Citizens of the City of Stockholm	S	Other	P	
P04	Traffic Administration of the City of Stockholm	P	C	L	
P10	KTH Royal Institute of Technology	P	KI	P	
	The department of Management for extended metro	S	PT	O	
	Tyrens	S	PR	O	
	ÅF	S	PR	O	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

The first identified risk was political/strategic. For example, there can be a lack of interest in the waterways transportations by the key actor - the department of Management for extended metro at the Stockholm Region, which could reduce the value of conducting this study. The continuous meetings between the region and the City of Stockholm were the mitigating actions of this risk.

The second risk was related to the implementation of the measure, for example that the quality of the measurements (noise) would be of low quality or would not be consistent with the identified needs. Continuous meetings and reconciliations mitigated this risk.

The third identified risk was institutional. This includes both a lack of understanding of the identified roles and responsibilities, but also the persisting routines and practices (how processes are normally done), which were difficult to transform. This was mitigated via communication and exemplification.

Identified risk	Category	Mitigation actions	Responsible
Priorities/Objective changes	Political / Strategic	Continuous meetings and reconciliations	Stockholm city traffic administration
Lack of data/data of low quality	Operational	Continuous meetings and reconciliations	Stockholm city traffic administration
Authority is unclear, procedures, routines	Institutional	Continuous meetings and reconciliations	Stockholm city traffic administration

Table 4: Risk assessment.

B. Measure Implementation

B.1 Situation before CIVITAS

One of the main challenges for Stockholm, when it comes to handling construction waste, is the lack of space to process the material. There is usually no space to crush the excavated rock material onsite and therefore the material needs to be transported offsite. This transportation is commonly done by trucks, however, some projects in Sweden use barges instead of the trucks, mainly for the transport of gravel or crushed rock.

Before Civitas Eccentric, the Department of the Management of the Extended Metro, based at the Stockholm Regional Council, has never used the waterways (barges) for transport of construction waste. The normal procedure would be to transport the material using trucks. Trucks would be typically diesel based.

The City of Stockholm states in their policies that more freight transports should go on water. The action plan in the Stockholm Freight plan states that the city should conduct at least one pilot using barges to transport construction waste during the period of the action plan (2018-2022). This measure materialized due to this action plan.

Since the region had plans to conduct excavation in the near future in order to extend the metro lines in Stockholm, this activity provided an opportunity to test and evaluate the efficiency of using barges instead of the land transport, as a suggestion for the Region.

B.2 Innovative aspects

The innovative aspect of this measure was a test of a mode of transport in a new context. Since there was an ongoing construction plan within the Region of Stockholm, a great potential was seen to transport rock material by barge instead of using the trucks, as done typically. So far, The City of Stockholm has not been able to identify studies that test the effects of transporting uncrushed rock material on barges in an urban area. Thus, in this measure such study was conducted. The results of the study can serve not only the city and the region, but also other cities, which are perhaps considering switching from the land to the waterways in similar projects.

B.3 Research and Technology Development

While for Stockholm in this construction context waterways transport is relatively new, transport on water in general is not new. There are many new developments regarding water freight upcoming. There are also new developments within more sustainable fuel in waterways transport, such as use of electrifying barges or gas. However, as a first step, our goal was to start considering waterways as an option in the new context, i.e. in an urban area. The new technology can thereafter be included, when such practices are already established and by then the new technology might become more accessible.

B.4 Actual implementation of the measure

- Task 1: Meetings and negotiations between the City of Stockholm and the Region of Stockholm: ongoing from September 2018 – today.
- Task 2: Procurement and execution of a pilot study: September 2018
- Task 3: Preparation and execution of a real, physical test: 22nd October 2019 – 23rd October 2019.
- Task 4: Preparation of the report of the measurements: 20th November 2019.

C. Impact Evaluation Findings

C.1 Evaluation approach

The measure was first evaluated theoretically (calculated) in Task 2. Then after, a real case study was conducted. We are reporting the results of the latter study. The access tunnel in Blasieholmen is currently filled with 6.000 ton of rocks and 150 ton of these were used in a pilot test. It is estimated that the whole project will require removing 500.000 ton of rocks. This number was used in the calculations. In this test, time and noise for transporting and loading the barges were measured, while CO₂ emissions and the operation costs were calculated based on the already available data and by assembling additional information from the key actors working at ports. Transportation on land is an estimation based on other, similar, cases.

C.1.1 Expected impacts and indicators

This measure was expected to:

1. Generate acceptance of using the waterways transport as an alternative to the land transport among the concerned stakeholder.
2. Raise awareness about potentially more economically effective and environmentally friendly transport alternative.
3. Reduce the emissions.
4. Increase transport efficiency.

These impacts will be through the bellow-listed indicators, such as the acceptance, CO₂ emissions, efficient transport, and noise emissions.

Impact	Acceptance	Reduction of emissions	Reduction of emissions	Increase of transport efficiency	Exploitation
Indicator name	Acceptance	CO ₂	Noise emissions	Efficient transport	Operation cost
Type	KPI	KPI	KPI	KPI	KPI
Category	Society – People	Environment	Environment	Economy	Economy
Subcategory	Acceptance	Pollution and nuisance	Pollution and nuisance	Transport system	Costs
Aspect	Acceptance level	Emissions	Emissions	Freight movements	Operating costs
Definition	Acceptance of the concept by the interested stakeholders	CO ₂ emissions saved from using waterways instead of trucks	Noise from using barges vs using trucks. This includes interior (inside the buildings nearby the operation) and exterior noise.	Transporting more tons per kilometre by using fewer vehicles.	Cost for transport by land vs. by waterways

Table 5: Key Performance Indicators.

Acceptance refers to the willingness of the Region of Stockholm to accept the waterways as an alternative to the land-based transport. We are evaluating it as a yes/no. We have not conducted a survey with the Region, but we are estimating what their position is.

CO₂ emissions refers to the amount of CO₂ (in ton) emitted by transporting one ton of the material in the local environment where an operation takes place.

Two types of noise are reported, interior (inside the buildings close to the operations) and exterior (outside). Noise levels are estimated for the land transportation, since measurements have been done for similar projects and data is available. Noise caused by the dropping the

rocks onto the barges was measured in the area where the operations will take place. This is the noise that could be potentially disturbing. The levels are compared to the official requirements. According to the Swedish Environmental Protection Agency, the max noise levels are for the daytime on weekdays 60dBA for outside and 45dBA for inside in the residential areas (for the construction areas are levels 70dBA for exterior and 45dBA for interior noise).

Efficient transport calculates the amount of material per kilometer that can be transported using each mode of transport.

Operation costs include the cost for personnel, vehicles, and cost of the fees (port fee, road tax).

Some previously planned indicators were excluded. Awareness and satisfaction were found less relevant KPIs since this was only a pilot test. Contributions to policies was not measured, but this measure, through the acceptance KPI indirectly addresses this. Moreover, the conduction of this measure can inspire considering alternative options to the normal procedure. Some other indicators, such as energy efficiency and vehicle kilometer travelled, was replaced by efficient transport KPI, measured by the amount of material (in tons) that can be transported per km. Due to availability of the data, operating costs are added.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Acceptance	Yes/No	A	E	Tunnel construction	Stockholm Region (stakeholder)
2	CO ₂	kg/ton	A	E	Truck vs. Barge	City center
3	Noise interior	dBA	A	DC	Truck vs Barge	City center
4	Noise exterior	dBA	A	DC	Truck vs. Barge	City center
5	Efficient transport	ton/km	A	E	Truck vs. Barge	City center
6	Operating cost	€/ton	A	DC	Truck vs. Barge	Location Independent
Frequency: B: Before – I: Intermediate – I(x): Intermediate (frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Key performance indicators (KPI) measurements.

C.1.2 Baseline

This measure compares two scenarios. One is the transportation by trucks and the other is transportation by waterways. The baseline ('before') is the modelled and calculated measurement for the truck scenario. It was based on data collected by other sources (for emissions, noise) and the review of the market, such as the road taxes and diesel prices.

- (1) Acceptance rate of the main stakeholder – region of Stockholm was hesitant towards the waterways in the beginning of this project.
- (2) CO₂ emissions for the baseline are the estimated calculated emissions that would be released, if the transport was land based using trucks. The calculation was based on the data and regulations in Sweden. Based on the database provided by the Environmental Protection Agency in Sweden, where national averages are provided, a

truck run on diesel emits 1.88 kg of CO₂ and if run by petrol, 2.28 kg of CO₂⁶³. The total amount, for the transportation of 500.000 ton of material given that a truck can carry 11 ton (according to the Swedish regulations), is 1.839.000. This means that 3.7 kg of CO₂ is emitted for transporting 1 ton of the rock material by trucks.

- (3) Interior noise was calculated by taking the highest noise levels from the trucks from the two areas nearby the planned operations, Blasieholmen 29 dBA and Strandvägen 24dBA. The first noise level is taken into account.
- (4) Exterior noise was calculated by taking the highest noise levels from the trucks at the areas where the operations are planned for, 59 dBA at Blasieholmen and 54 at Strandvägen. 59 dBA is considered. However, these levels can go up to more than 80 dBA at the most exposed areas in the first, and 77-78 dBA in the second area.
- (5) Efficiency was calculated as ton/km. A truck is allowed to load 11 tons, so if only one load was needed to be transported to a place 30 km away, the efficiency would be 0.4 ton/km. In the current scenario, the tunnel is according to the estimations filled with 500.000 tons of material and the area of the disposal is approx. 30 km away. This means 45.454 loads are needed. Taking into account that a truck drives there and back, 90.909 trips are required. This adds up to 2.727.270 km. The efficiency is approx. 0.18 ton/km.

However, these are approximated and simplified calculations. Moreover, one has to be aware that these calculations are case specific. It highly depends on the fact how far the area of unloading /disposal is and loading capacity may vary a bit.

- (6) Operating costs was calculated by accounting for the distance dependent costs (maintenance costs, operating cost) and time dependent costs (salary). 19.854.545 + 71.418.000 = 91.272.545 SEK, which is 182 SEK / ton, or 17.5 €/ton.

Indicator	Unit	Before	Date Before
1 Acceptance	Yes/No	No	May 2016
2 CO ₂ emissions	kg/ton	3.7	Nov 2019
3 Interior noise	dBA	29	Nov 2019
4 Exterior noise	dBA	59	Nov 2019
5 Efficiency	Ton/km	0.18	Nov 2019
6 Operating costs	€/ton	17.5	Nov 2019

Table 7: KPI results - Before

C.1.3 The business-as-usual scenario

This measure compares land (truck) transportation vs. waterways (barges) transportation, wherein the first is the most common one, and thus represents “business-as-usual”. Thus, in this measure business as usual scenario is the same as the baseline.

⁶³Environmental Protection Agency, <https://www.naturvardsverket.se/Stod-i-miljoarbetet/Vagledning/Luft-och-klimat/Berakna-dina-utslapp-av-luftfororenningar/>, accessed 2020/03/20.

Indicator	Unit	BaU	Date BaU
1 Acceptance	Yes/No	No	May 2016
2 CO ₂ emissions	kg/ton	3.7	Nov 2019
3 Interior noise	dBA	29	Nov 2019
4 Exterior noise	dBA	59	Nov 2019
5 Efficiency	Ton/km	0.18	Nov 2019
6 Operating costs	€/ton	17.5	Nov 2019

Table 8: KPI results - BaU.

C.2 Measure results

The results of the measure are referring to the second scenario, i.e. transportation by using the barges. For that scenario, measurements refer to the physical pilot test conducted in the area where the operations are intended to take place. In the measurements and calculations, it is compared between using two small barges and one large barge, the results in the table refer to the latter.

- (1) Acceptance rate of the main stakeholder – region of Stockholm of the operations being conducted by waterways. While it is unsure if this will happen, the Region of Stockholm has open up a procurement for waterways transport.
- (2) Local CO₂ emissions are calculated using an estimate emission of 2.73 kg per litre of the fuel oil and taking into account that the first port where it is possible to crush the rock is located 52 kilometres south of Stockholm. The calculation further considers fuel consumption (100litres per hour, or 6.75 litres per kilometres) and loading capacity (2000 ton for a large barge and 1000 for a smaller barge). It considers both the number of truck trips needed for loading the barge (in the port area) and the number of trips using the barge to transport the 500.000 ton (250 trips x 52km x 2 to the area and return). Truck trips are here shorter, 0.2 km to the barge and 1.3 km in the area 28 of them per day (10 hour working day is considered), all together 70.643 kg CO₂ emissions and for the barge trips (250 trips required, 25.928 km) 477.373 kg CO₂. Total CO₂ for the project when using one large barge is 557.705 kg, which is 1.1 kg/ton, and for two small barges it would be 751.889 ton, which is 1.5 kg/ton.
- (3) Interior noise was measured for three different scenarios for loading the barges at the three different locations (office area Blasieholmen, residential area Blasieholmen and Strandvägen). One is loading the barges 3 times per hour with a maximum 10-ton load. Second is measuring noise levels if barges are loaded 3 times per hour with a maximum 20 ton, which is equal to 6 loadings with 10 tons. Third option is 6 loadings per hour where maximum load is 20 tons. Results for all three scenarios are very similar. We are reporting the second scenario in the table below, for the residential area of Blasieholmen, which is 32 dBA. The noise level for the office area of Blasieholmen is 34 dBA and Strandvägen 26 dBA. The results for the other two options are almost identical. This is within the suggested maximum limits (45dBA).
- (4) Exterior noise was measured using the same locations and scenarios as (3). Also here the scenarios produce very similar, almost identical, results. The second option here is

59, 57, 51 dBA at the three location. In the residential area of Blasieholmen is 57 dBA. This is within the max limits (60dBA).

- (5) Efficiency is calculated as ton/km. A barge can be loaded with 2000 ton and if the place where the load can be disposed is about 50 km away (this can differ, but it is likely that the water transport will require a longer distance in general). This is 40 ton/km. For the taken project, if the tunnel is filled with 500.000 tons of material, then 250 trips x2=500 trips are needed (also for returning). This is 250.000 km travelled. This is 500.000 ton / 250.000 km = 2 ton/km. However, these are approximated and simplified calculations. Moreover, one has to be aware that these calculations are case specific. It highly depends on the fact how far the area of unloading /disposal is and loading capacity may vary a bit.
- (6) Operating costs include the truck costs (distance, time dependant) + cost of vessel operations including coast for personnel + freight charge + pilotage + fairway fee + fuel cost + unloading cost. In part trucks are still needed for the transportation from the tunnel to the docking area, this is about 0.2 km to the barge and 1.3 km within the area. In the scenario taken these costs are for a large barge: 0.08 + 14.28 + 40 + 0.6 + 5.88 + 1.16 + 0.86 + 10 = 72.87, rounded up to 73 Million SEK, which is at the current conversion rate (10.5) 6.900.000 €. This is 145.8 SEK/ton, or 13.8 €/ton. For the two barges, the total cost is 95.590.396 SEK, which is 191 SEK/ton, or 18 €/ton. This data is based on the interviews with the key actors, working at ports.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
1 Acceptance	Yes/No	No	Nov 2019	No	Nov 2019	Possible	Nov 2019	NA	NA
2 CO ₂ emissions	kg/ton	3.7	Nov 2019	3.7	Nov 2019	1.1	Nov 2019	-2.6	-2.6
3 Interior noise	dBA	29	Nov 2019	29	Nov 2019	32	Nov 2019	3	3
4 Exterior noise	dBA	59	Nov 2019	59	Nov 2019	57	Nov 2019	-2	-2
5 Efficiency	Ton/km	0.18	Nov 2019	0.18	Nov 2019	2	Nov 2019	1.82	1.82
6 Operating costs	€/ton	17.5	Nov 2019	17.5	Nov 2019	13.8	Nov 2019	-3.7	-3.7

Table 9: KPI results – Before, BaU, and After

In summary, if we compare transportation by trucks and by barges, there is not much difference when it comes to noise or operating costs, although transportation by barges can be a bit cheaper option while the interior noise is a little higher. There is, however, a larger difference in the CO₂ emissions. The impacts of the switch from using trucks in the transportation related to the excavation operations are thus mostly environmental. Social aspects, in terms of noise, appear to be within the required limits and do not particularly differ from the business as usual (truck transportation). However, it might be more appreciated among the citizens if trucks were not occupying the roads, and passing by through the city center, although the citizens might

become accommodated to these normal procedures as well. In terms of economic impacts, the costs depend on the type of a barge and a truck used, according to the currently allowed 11-ton truck load, using one large barge appear economically competitive, while two barges might be a less economical option.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Acceptance/Satisfaction of the measures by the users	0	It is uncertain whether the planned operations will be conducted by using trucks or barges
2	Awareness raising	NA	This was not assessed
3	Reduction of emissions	NA	This was not assessed
4	Increase of transport efficiency	NA	This was not assessed
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★★★★ = Exceeded			

Table 10: Achievement of objectives

D. Process Evaluation Findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

The measure initially aimed to work towards establishing a goods consolidation centre, which plan was aborted and exploration of the freight using waterways was instead conducted.

Goods consolidation centre

The measure planned to evaluate a goods consolidation centre, a centre which could consolidate the freight flows that the City owns (e.g. food to schools, paper supply). However, after the pre-study was delivered to the politicians, it became unclear whether there was any interest or not and how to proceed with the implementation. Thus, new options have been sought.

Inland waterways and excavated materials

The measure then found a particular focus on inland waterways as a means to consolidate the outflow of excavated materials from building sites. This focus was chosen because transportation of excavated materials accounts for a large part of heavy goods vehicle road traffic in Stockholm and due to recent plans of the Stockholm Region to extend metro lines, in which such excavation project will become relevant. For this reason, the City of Stockholm was keen to test and evaluate the potential of using barges to consolidate heavy masses for trans-shipment out of the city.

D.2 Barriers

The barriers and the actions taken to overcome these barriers are listed in the table below.

No.	Barrier field	Description	Action to overcome the barrier
1	Positional	In the case of excavated matter from the Metro extension projects, there is a risk that the client has come too far already in the process, and therefore will have difficulty shifting to waterborne transport.	Alternate projects will need to be identified to take the focus of the measure, where a shift to waterborne transport remains feasible. The results from this investigation will also be used in the early stages of coming infrastructure projects, with the aim to show the benefits and feasibilities of using the water ways before clients start to plan towards using road transportation.
2	Practice/Routine	It is a normal procedure to transport material by using trucks, thus, a suggestion to transport it by waterways would require a shift, change in the normal procedures.	The measure included a high number of meetings as well as conducting several pilot tests based on which one could evaluate if waterways could be an option.
3	Responsibility	While the City of Stockholm owns the land in Stockholm, it is the Stockholm Region, responsible for building the underground, thus decision-making is not simple.	This measure included a negotiation process and the two pilots showing which were produced in this measure served as a basis for the continuous discussions with the Stockholm Region to see if the waterways could be considered as an option.
4	Practical	One of the identified concerns was the suitability of the operation in the residential/inner city areas due to the noise of loading the material on barges.	Material (e.g. a soundproof wall or protective material on the barge such as sand) can be used to reduce the noise levels. Such practice, i.e. using these kinds of protective material, can make operation suitable even for the residential, city areas.

Table 11: Identified barriers and planned/taken actions.

D.3 Drivers

The following drivers have been identified as helping the success of the measure, and several actions are proposed to help capitalize on these.

No.	Driver field	Description	Action to make use of the driver
1	Market-based	Several different actors are interested in getting started with waterborne goods shipping in the City of Stockholm.	Reaching out to the most interested actors, so that a partner with a high engagement-level can be involved.
2	Data/knowledge	While several actors have preconceived notions about waterborne transport, that it is expensive, tedious and difficult, by having the access to knowledge and data (through consultancy companies), the preconceived notions can be questioned.	Provision of results about the expenses, environmental, social benefits and difficulty of waterborne transport in a dialogue with the potential actors.
3	Political/strategic	The city of Stockholm supports waterborne transport. The use of such transport could also contribute to a 'good name', being recognized as a supporter of an environmentally friendly type of freight transportation.	The city of Stockholm has put in their climate action plan that we should use waterways for aggregate transportation where possible.

Table 12: Identified drivers and planned/taken actions.

D.4 Supporting activities

The supporting activities are the meetings between the city of Stockholm and the Region of Stockholm and the procurement of the consultancy companies, which were able to conduct the tests.

D.5 Recommendations on the implementation process

- It is important to look into possibilities of using waterways for transport in an early stage when planning a construction project, to examine whether there are any sites feasible to load/offload the materials from.
- It is also recommended that the cities have knowledge about their quays and their connection with possible waterways and also with the land infrastructure. Today in Sweden different actors have access to different information and it is challenging to get an overview of possible loading/offloading sites in the city. A suggestion would be to have a map including both land, quay and water infrastructure to easier get an overview of the possibilities.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

Waterways freight transport when compared to the land-based transport using trucks can produce the following direct impacts:

- Barges can load up to 2000 ton of material whereas a truck can load 11 ton, thus the efficiency is according to this project calculated to be 2 ton/km in the first case and 0.18 ton/km in the second case, which depends on how far the place of disposal is.
- Using waterways transport can lead to a significant reduction in CO₂ emissions, from 3.7 kg/ton to 1.1 kg/ton (2.6 kg/ton reduction), provided a loading capacity of 11 ton and 30 km trip in the first case and 2000 ton and a 50 km trip in the second case.
- Loading the material on the barges can lead to a slight increase in the interior noise, while the exterior noise appears to blend into the background noise more.
- Operation costs for the waterways are comparable with the truck-based transportation.

E.2 Relevance of supporting activities

The meetings and support from the consultancy companies were highly important in this measure.

E.3 Interaction with other measures

This measure did not interact with other measure.

E.4 Main lessons learned

- It is feasible to use the waterways in the city.
- It is important to evaluate this possibility early (e.g. before the type of transportation in a construction project is already selected).
- Use of protective material (e.g. a soundproof wall or protective material on the barge such as sand) can decrease noise levels, which makes waterway transport of construction material a suitable option even for the inner city areas.

E.5 Long term impact

The results of this measure show that the emissions could be significantly reduced, if (parts of) freight transport shifted from being land-based to waterways.

E.6 Potentials for up-scaling in the city

There is a company now looking for possibilities to use the waterways when building the tunnel in the neighbouring city Nacka. We are still waiting for the results from the procurement of the tunnel from Blasieholmen. The city of Stockholm has also put in their climate action plan that we should use waterways for aggregate transportation where possible.

F. Additional information

F.1 Appraisal of evaluation approach

When it comes to the evaluation of the impact, some data had to be collapsed into one indicator to fit the structure of this report. For example, noise levels vary across space and time, yet, one KPI had to be reported within this report. Moreover, when it comes to the social sustainability indicators, it is first of all difficult to capture and report a “shift in practice” through a numeric indicator. Yet, a shift in practice appears the most important aspect, and an important barrier, of this measure. Moreover, regarding the social aspects of sustainability, it is difficult to measure “acceptance” levels of a measure, which has not even taken place.

Regarding the evaluation of the process, it was learned that a discussion, in the form of an interview or a workshop as compared to an online survey, is a method that can give more insights into the process and provides an opportunity to clarify any potential misunderstandings. However, such a collection of the data requires much more time to summarize and analyse the results.

F.2 Future activities relating to the measure

The city of Stockholm is looking for possibilities to use the waterways when building the tunnel in the neighbouring city Nacka. We are still waiting for the results from the procurement of the tunnel from Blasieholmen. The city of Stockholm has also put in their climate action plan that we should use waterways for aggregate transportation where possible.



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MUC 7.3

Sustainable city logistics by combining E-cargo-bike-delivery-services with a flexible storage system

Measure Evaluation Report

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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
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12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
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	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
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21	City of Turku	Finland	TUR
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22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

* Partners with changes pending of GA amendment

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List of Co-authors

Johannes Horvath	

Table of Contents

ABSTRACT.....	1447
A. INTRODUCTION.....	1448
A.1 EXPECTED RESULTS OF THE MEASURE	1448
A.1.1 Quantifiable impacts.....	1448
A.2 MEASURE DESCRIPTION	1449
A.2.1 Measure outputs.....	1449
A.2.2 Supporting activities	1449
A.2.3 Interactions with other ECCENTRIC measures.....	1449
A.2.4 Interactions outside ECCENTRIC	1449
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1450
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1450
A.5 IDENTIFIED RISKS	1450
B. MEASURE IMPLEMENTATION	1451
B.1 SITUATION BEFORE CIVITAS	1451
B.2 INNOVATIVE ASPECTS.....	1451
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1451
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1451
C. IMPACT EVALUATION FINDINGS	1453
C.1 EVALUATION APPROACH.....	1453
C.1.1 Expected impacts and indicators.....	1453
C.1.2 Baseline.....	1455
C.1.3 The business-as-usual scenario.....	1457
C.2 MEASURE RESULTS.....	1459
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1463
D. EVALUATION CONCLUSIONS	1464
D.1 VALIDATED DIRECT IMPACT	1464
D.2 RELEVANCE OF SUPPORTING ACTIVITIES	1464
D.3 INTERACTION WITH OTHER MEASURES.....	1464
D.4 MAIN LESSONS LEARNED	1464
D.5 LONG TERM IMPACT	1465
D.6 POTENTIALS FOR UP-SCALING IN THE CITY	1465
E. ADDITIONAL INFORMATION.....	1466

E.1	APPRAISAL OF EVALUATION APPROACH	1466
E.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1466

List of Figures

Figure 1: Location of storage boxes, 12/2019.....	1452
Figure 2: Average division of a German delivery fleet, 05/2018	1457

List of Tables

Table 1: Quantifiable impacts.....	1448
Table 2: Target groups or affected parties.....	1450
Table 3: Measure stakeholders.....	1450
Table 4: Risks.	1450
Table 5: Emission Factors (HBEFA, 2015)	1456
Table 6: CEP branch emissions in Munich 2017	1456
Table 7: Emission Factors (HBEFA, 2020)	1458
Table 8: CEP branch emissions in Munich 2020	1458
Table 9: Number of box openings, 07/2017 – 11/2019	1460

Project	City		
ECCENTRIC	Munich		
Measure code	Measure name		
MUC 7.3	Sustainable city logistics by combining E-cargo-bike-delivery-services with a flexible storage system		
Last update	Responsible	e-mail	telephone
25.03.2019	Johannes Horvath	johannes.horvath@mu- enchen.de	+49-(0)89-233- 21953

Abstract

The measure MUC 7.3 aims to test a sustainable and efficient logistic system by providing boxes for temporary storage of parcels. The measure addresses any kind of delivery companies in Munich's urban area. The idea of an emission-free last mile delivery by cargo-bikes is pursued. Another objective is to avoid high traffic by delivery trucks in dense housing areas.

There are eight boxes being installed in Munich. These storage boxes are self-opening by an app and powered by integrated solar panels. This type of storage system is very innovative and new for the cargo-delivery landscape in Munich. The micro depot locations are defined in cooperation with the micro depot manufacturer and the courier company which uses the boxes.

The Measure Evaluation Report gives information about the main objectives and assessment methods of the impact evaluation. Three different evaluation stages measure the impact of the implementation: The Baseline data, which is obtained during the first survey period, the Business as Usual scenario which shows the general development occurring in the region without the measure's implementation and the ex-post data, which focuses on the impact of MUC 7.3.

Evaluation results for MUC 7.3 were mainly retrieved from interviews conducted with the measure's subcontractor. Due to the fact that no comprehensive assessment of regular statistics was done by the subcontractor, there is only data about the number of box opening during the project lifespan.

It turns out that measure MUC 7.3 is easy to implement but the usage by courier, express and parcel (CEP) companies is not yet very high. The courier company does not very frequently use the boxes (35 box openings during the project lifetime) and bigger CEP companies are not interested in the usage due to different requirements and specifications they need regarding the micro depot design. The measure will not outlive ECCENTRIC but there is a chance of developing a new concept for a storage box system that meets the requirements of the delivery and courier firms.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/longer term:

- To promote and implement a sustainable, clean and (energy) efficient urban transport measure for goods delivery
- To overcome barriers for implementing innovative and ambitious measures and policies through experimental testing and targeted research

(2) Strategic level:

- Finding a possible solution to reduce the delivery of goods by common cars and trucks in the city centre as far as economically possible without lowering the quality of service

(3) Measure level:

Short term objectives:

- Shift the modal share of RAPID's deliveries within the city center from car to (cargo)-bicycle delivery
- Gain operational experience with this new kind of logistic system
- Find additional logistic companies to use the system

Long term objectives:

- All kinds of logistic companies and specialized service providers shall participate in this logistic system
- Installation of a denser network of boxes to extend the capacity of the system and to reduce travel times and distances
- Development of additional services
- Cost-effective operation of the system

A.1.1 Quantifiable impacts

Expected Impacts	Increased distribution efficiency. Extension of delivery area by cargo bikes, reduced kilometers of delivery trucks/cars. Reduce emissions from urban freight logistics.	CIVITAS ECCENTRIC Objectives								
		Reduce:				Improve:				
		Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Livability	Competitiveness	Efficiency of urban freight
ID	Quantifiable Impacts									
1	Acceptance of the flexible storage system by the users (couriers, drivers)								X	X
2	Satisfaction with the use the flexible storage system								X	X
3	Mode shift from cars to bikes	X	X		X			X		X
4	Avoided VKT by delivery trucks, increased km by cargo bikes	X	X		X					X
5	Reduced emissions CO2	X								
6	Reduced emissions NOx		X							
7	Reduced emissions PM		X							

Table 1: Quantifiable impacts.

A.2 Measure description

The volume of traffic caused by delivery services has increased rapidly with the success of e-commerce. Conflicts between pedestrians, cyclists, cars, other road users and delivery services are growing. Dangerous situations occur, e.g. in cases of wrong parking. Moreover, the accessibility of inner-city locations becomes more and more limited for cars and trucks.

Under these circumstances, the delivery of goods by (cargo) bikes has a great potential to keep the city accessible for freight transport and to improve road safety. Compared to ordinary bicycles, cargo bikes have a higher load capacity and facilitate the bundling of deliveries. To extend the use of cargo bikes, a flexible storage system will serve as an interface where cargo can be handed over from cars to cargo bikes and vice versa. Due to limited space in the city, a system of flexible boxes will be used to help delivery services to continuously optimise their disposition.

This measure will test several boxes and logistic systems in co-operation with delivery companies in Munich's urban area. MUC 7.3 is a measure which is independent from the Living Lab (Domagkpark and Parkstadt Schwabing).

The key investment will be the installation of several boxes for the temporary storage of parcels. Boxes are planned to be located at the boundaries of the city centre. Initially, the system will be tested by the local partner RAPID Kurierdienste KG (courier service), who offers delivery by car and (cargo) bike alike.

A.2.1 Measure outputs

The direct output is the acquisition and testing of micro depot boxes for temporary storage of parcels, where goods can be transferred from cars to cargo bikes (and vice versa) for inner-city delivery within the operations of a courier service. Together with the logistics company RAPID, a concept was developed and the specifications of the micro depot boxes were determined. In total, eight micro depot boxes were installed at the borders of the inner city of Munich which are being tested by RAPID (for details see Chapter B.4).

A.2.2 Supporting activities

To enable courier drivers to use the micro depots and to make them understand the concept and idea, there are small information events planned. These events should increase the usage of the boxes and raise the awareness of the new emissions lowering way of last-mile-delivery. In addition to that, guidelines/short instructions are planned to be developed by the hardware manufacturer.

A.2.3 Interactions with other ECCENTRIC measures

None

A.2.4 Interactions outside ECCENTRIC

There are two other Horizon 2020 projects within different departments of the City of Munich, SmarterTogether and City2Share. These projects also have measures being implemented in the field of cargo-bike delivery and/or logistics. As the ML of MUC 7.3 is well connected to other departments, there have been verbal exchanges about the logistics focused measures.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
10 - other	Courier Services	City	(inner) City of Munich
10 - other	CEP companies	Other	Companies using the storage box system

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role - Links
1	RAW (Department of Labour and Economic Development)	P	C	L	Measure leader
2	RAPID (test company, couriers)	O	PR	P	Test the flexible storage system, provide feedback for further development
3	Provider of flexible package system (micro depots)	O	PR	O	Provide and install the flexible storage system
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Category	Mitigation actions	Responsible
Courier Company does not cooperate in testing any more	Involvement	Look for other companies, improve/changes boxes	ML
No company can provide needed micro depot boxes.	Problem-related	-	ML
Courier/delivery company cannot use boxes.	Technological	Look for other companies, improve/changes boxes	ML
Couriers' business model does not fit the micro depot concept	Institutional/ Organisational	Develop a concept together with all participating stakeholders to increase acceptance.	ML, courier service, couriers
Couriers not willing to adapt the boxes and change their delivery behaviour (route)	Institutional/ Organisational	Develop a concept together with all participating stakeholders to increase acceptance.	ML, courier service, couriers

Table 4: Risks.

B. Measure implementation

B.1 Situation before CIVITAS

Munich is a fast-growing city where delivery traffic is increasing rapidly due to the growing e-commerce sector. In addition to the classic parcel delivery to the customer's front door, there are parcel stations or boxes installed within the city to pick up parcels autonomously or there are shops where personalised parcels can be stored and picked up.

The concept of keeping delivery trucks outside the city centre by offering them a storage system for their parcels close to the city boundaries is new as the concept of combining cargo-bike delivery with a flexible storage system did not yet exist within the City of Munich.

B.2 Innovative aspects

There are several solutions to prevent having too much delivery truck traffic within the city centre, e.g. parcel stations or post boxes where customers can pick up their parcels. Nevertheless, the idea to find a cooperative solution between classic delivery companies focusing on truck delivery and courier companies with more sustainable delivery options is very innovative for Munich because there is no such solution in place.

B.3 Research and Technology Development

Research and technology development is not very new to Germany's delivery landscape. Other German cities are pursuing the same objectives and implementing similar concepts but within another/bigger scope already for some years. The technology of self-sufficient boxes (with solar panels), an accompanying app and this smaller scale for storages boxes is new, though.

B.4 Actual implementation of the measure

Research & Planning

The following milestones have been achieved:

- Specification of boxes and IT application.
- The research design and methodology were determined in the evaluation plan in June 2017.
- On the 6th of July 2017, the first test storage system (micro depot) has been installed west of the city center. It has been used for testing by the local partner RAPID courier services. The box was accepted by the management of RAPID, but for a better (network-) effect, it was suggested that four boxes are needed.

Procurement & Implementation

- In December 2017, the City of Munich made a tendering of four micro depots, which was won by Paul Wolff (boxes) & PAKETIN (IT). The 2nd micro depot was installed on 26th of February 2018 in the northern part of the inner city. The 3rd and 4th micro depot were installed on the 19th of March 2018 in the southern and eastern part of the inner city.
- Through dissemination activities, the new micro depot measure is known regionally and even nation/EU-wide and delivery service provider from Germany and beyond with local activity in Munich showed interest in joining/using the measure concept and/or box.

Demonstration

- Starting from March 2018 RAPID tested and used the four micro depots in the form of a test-operation
- In September, RAPID left the project, as the micro depots were not reliable enough for productive operation. Specifically, the door-opening system did not function properly in many cases, so that packages were stuck in the depot and the courier company had to deal with the resulting delay.
- Additionally, the support of the system providers (both hardware and IT) was not helpful to solve the problems. However, RAPID agreed on joining the project again, if new micro depots will be provided, even though the first set of depots was repaired and had no more malfunctions.
- Thus, after the courier company dropped out, ML decided to re-launch the measure by starting a new tender for a second set of four micro depots which ended in March 2019.
- Meanwhile, ML searched for and contacted 19 Cep companies with cargo bike schemes, willing to use the first set of micro depots. Even though several companies showed interest in using the micro depots in their respective cargo bike scheme, the micro depots were finally rated as unsuitable for their systems due their size, missing parking space for cargo bikes, etc.
- The second tender was won by PAKETIN and the new micro depots were installed in June. For three of the four micro depots, the same location was used and the new micro depots were put aside the old ones. For one location, this was not possible due to infrastructural installations and a new location was found.
- In July 2019, RAPID started to use the micro depots for their operations again

Currently there are eight boxes installed, Figure 1 shows a rough map of the micro depot locations. The map is created by the ML.



Figure 1: Location of storage boxes, 12/2019

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact	1	2	3	4	5
Indicator name	Acceptance	Satisfaction	Mode shift	VKT	CO2 Emissions
Type	KPI	KPI	KPI	KPI	KPI
Category	SOCIETY-PEOPLE	SOCIETY-PEOPLE	TRANSPORT SYSTEM	TRANSPORT SYSTEM	ENVIRONMENT
Subcategory	Acceptance	Acceptance	General	General	Pollution and nuisance
Aspect	Acceptance level	Satisfaction	Modal split	Total Travel	Emissions
Definition	acceptance of the flexible storage system by the couriers and drivers	Users average reported satisfaction with the flexible storage system	Percentage of cargo deliveries which changed modes for the same trip (same origin and destination, time, and frequency). The main mode of a trip is that used for the longest stage of the trip by distance. For instances with stages of equal length, the mode of the last stage is used.	Cargo vehicle kilometers replaced by bike kilometers	Total CO2 emissions produced by the whole delivery chain
Unit	Percentage	Score (1-5)	Percentage (various values)	kilometers	Tons
Method of data collection	Workshop / Focus groups and personal interviews with bike and car couriers to learn about their experiences when using the flexible storage system	Workshop / Focus groups and personal interviews with bike and car couriers to learn about their experiences when using the flexible storage system	System statistics to calculate a) number of trips by mode, b) distance travelled by mode, c) origin and destination of trips by mode	System statistics to calculate a) number of trips by mode, b) distance travelled by mode, c) origin and destination of trips by mode	Data collection on the motorized fleet in order to estimate emission factors for CO2, NOx and PM and therefore the emissions that can be avoided.
Target group	Couriers and drivers using the system	Couriers and drivers using the system	Cargo deliveries in the flexible package system, also	Delivery fleet	Delivery fleet

Impact	6	7	INPUT	INPUT
Indicator	NOx emissions	PM emissions	Investment Costs	Operating Costs
Category	KPI	KPI	KPI	KPI
Category	ENVIRONMENT	ENVIRONMENT	ECONOMY	ECONOMY
Subcategory	Pollution and nuisance	Pollution and nuisance	Costs	Costs
Aspect	Emissions	Emissions	Investment costs	Operating Costs
Definition	Total NOx emissions produced by the whole delivery chain	Total PM emissions produced by the whole delivery chain	Total capital costs for purchase of equipment related to the cargo bikes and flexible storage systems. Preparation and design cost is defined as total costs expended setting up the measure covering a time period from the initiation of the measure preparation until the start of the measure implementation.	Personnel and maintenance costs for running the measure divided per time period
Unit	Tons	Tons	Euro	Euro / (time usage unit)
Method of data collection	Data collection on the motorized fleet in order to estimate emission factors for CO2, NOx and PM and therefore the emissions that can be avoided.	Data collection on the motorized fleet in order to estimate emission factors for CO2, NOx and PM and therefore the emissions that can be avoided.	Data from financial reports, controlling	Data from financial reports, controlling
Target group	Delivery fleet	Delivery fleet		

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Acceptance	%	B – A	E	Micro depot users	Munich
2	Satisfaction	Score (0-5)	I – A	E	Micro depot users	Munich
3	Mode Shift	%	B – A	E	Micro depot users	Munich
4	VKT	Km	B – A	E	Micro depot users	Munich
5	CO2-Emissions	Tons	B – A	E	Micro depot users	Munich
6	NOx-Emissions	Tons	B – A	E	Micro depot users	Munich
7	PM-Emissions	Tons	B – A	E	Micro depot users	Munich
	Investment Costs	€	I – A	DC	-	-
	Operating Costs	€/time or usage	I – A	DC	-	-
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

C.1.2 Baseline

It was very difficult to obtain Baseline data for MUC 7.3 because no assessment of regular statistics was done by the micro depot manufacturer or the courier service due to unavailability of data or insufficient monitoring. Hence, the following KPI are answered with estimations resulting from interviews with the ML and key stakeholders who were involved in the implementation and usage of the micro depots.

The Baseline evaluation includes the period from 07/2017 until 05/2019. This is the so called first implementation phase with the first set of boxes. After 05/2019 there were new micro depots installed due to technical problems which occurred with the initially implemented boxes (see B.4, p. 1451).

Addressing Indicators "1 – Acceptance" and "2 – Satisfaction"

The KPI **Acceptance** can be measured by the number of openings of the micro depots. These openings are theoretically tracked by the micro depot's accompanying mobile app which helps the courier drivers to open the boxes.

According to the hardware manufacturer's statement, the data is difficult to access and consequently difficult to interpret, though. There is no regular monitoring done on part of the micro depot manufacturer or the courier company, which is solely using the storage boxes. Unreliable communication between key-stakeholders and time-consuming data acquisition make it more difficult to gain data for evaluation purposes.

During the first period of storage box implementation, between 07/2017 until 05/2019, there were no successful box openings by the courier drivers. Acceptance could not be measured quantitatively but by qualitative statements obtained from interviews with the management of the courier service. RAPID's management assumed that their employees are accepting the concept but there was no reliable user experience survey done.

The score for the KPI **Satisfaction** is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI.

Due to the fact that there were zero openings of the micro depots in the first two years after measure implementation, it can be assumed that there is a satisfaction level of 1 among the box users. At least they know about the storage boxes and were trying to use them multiple times, even though it was not successful due to technical problems.

All in all: Interviews with the ML show that there is a general acceptance and satisfaction among the courier service management but there must be other barriers which complicate the usage of the micro depots and therefore aggravate a proper usage. To gain more insights about the main usage barriers, several qualitative interviews are planned in cooperation with the ML. The impact evaluation will include more qualitative information gained from the measures' key stakeholders (see section C.2, p. 1459).

Addressing Indicators "3 – Mode shift/ modal split" and "4 –VKT"

Due to mentioned reasons above, **mode shift**/modal split cannot be assessed as defined in section C.1.1.

Regarding the **VKT** a Sustainability study of the German Parcel and Express Logistics Association (cf. BIEK, 2017) reports about 11,8 million km traveled by delivery companies in

Munich per year. 1 046 delivery vehicles have an annual transport capacity of 879.8 million parcel-km for a distance of 11,8 million km.

Regarding the particular measure MUC 7.3 there is no reliable information on how the courier company is using the micro depots, if a bike or a delivery truck is being used or how the deliveries are shifted from one mode of transport to the other. As of 07/2019 50 courier drivers have access to the micro depots and 25 are actually using it. This information comes from an informal e-mail exchange between ML and courier company.

Addressing indicators "5 - CO₂ Emissions", "6 - NO_x emissions", and "7 - PM emissions"

Emissions are calculated based on emission factors from the standard database "HBEFA" (*Handbook Emission Factors for Road Transport*) and information about both VKT. See Table 5 for the used emission factors, based on the German fleet average. The number of hybrid/electric delivery vehicles is too low to be considered as a separate category.

In order to estimate Baseline-emissions, the HBEFA emission factors for light commercial vehicles (LCV) and for private cars (PC) being used for cargo delivery for 2015 were used as no numbers for 2017 were available.

Thus, the following factors are used:

Pollutant	Vehicle	Emissions per VKT
CO ₂	LCV	265,3 g/km
NO _x	LCV	1,628 g/km
PM	LCV	0,045 g/km
CO ₂	PC	186,839 g/km
NO _x	PC	0,608 g/km
PM	PC	0,008 g/km

Table 5: Emission Factors (HBEFA, 2015)

Taking the HBEFA emission factors of 2015 and an annual VKT of 11,8 million (cf. BIEK, 2017) the following emissions can be calculated:

Pollutant	Emissions (2017)
CO ₂	2.876 t
NO _x	15,9 t
PM	411 kg

Table 6: CEP branch emissions in Munich 2017

Data on **investment and operation cost** was obtained for ex-post evaluation when the implementation phase is completed.

C.1.3 The business-as-usual scenario

For **Acceptance, and Satisfaction**, no significant changes are expected in the BaU-scenario.

Mode Shift & VKT

The modal split and VKT in the conventional sense cannot be specified for this measure, therefore both KPIs can be examined by literature and articles that state the following development for the upcoming years:

According to a study by Intraplan Consult GmbH (2019), the number of shipments in Munich is expected to grow by 12,6% from 102 million to 115 million shipments between 2019 and 2022. However, the average weight per shipment is decreasing steadily. In 2019, the transport volume of the CEP-branch is ca. 730.000 tons, which corresponds to a share of 1,7% of the volume of truck traffic in Munich. This number is higher than the German average, reflecting a higher importance of CEP-traffic in Munich. Until 2022, the transport volume for CEP-shipments is expected to grow by 8,0% to 790.000 tons. Thus, the transport volume is growing slower than the number of shipments due to reduced average weight per shipment.

The same growth rate is expected for the mileage associated with CEP-deliveries, which was 11,8 million in 2017 with a growth rate of 3,36% p.a. and increases to 12,6 million VKT in 2019 and can be extrapolated to 12,9 million VKT in 2020. Thus, an increase of the VKT by 8,0% is being expected from 2019 to 2022 or a growth of 2,6% p.a., respectively (cf. BIEK, 2017; Intraplan, 2019).

Figure shows the average division of a German delivery fleet. Light commercial vehicles (LCV) have a share of deliveries of 66%, followed by passenger cars (PC) with 25% and heavy trucks with a share of 9%. Heavy trucks are mainly being used for overland tours and can be neglected in the urban context. Mode shifts in the CEP branch are not being assessed in the study. Source of the division numbers is the BIEK Compendium part 2 as of May 2018.

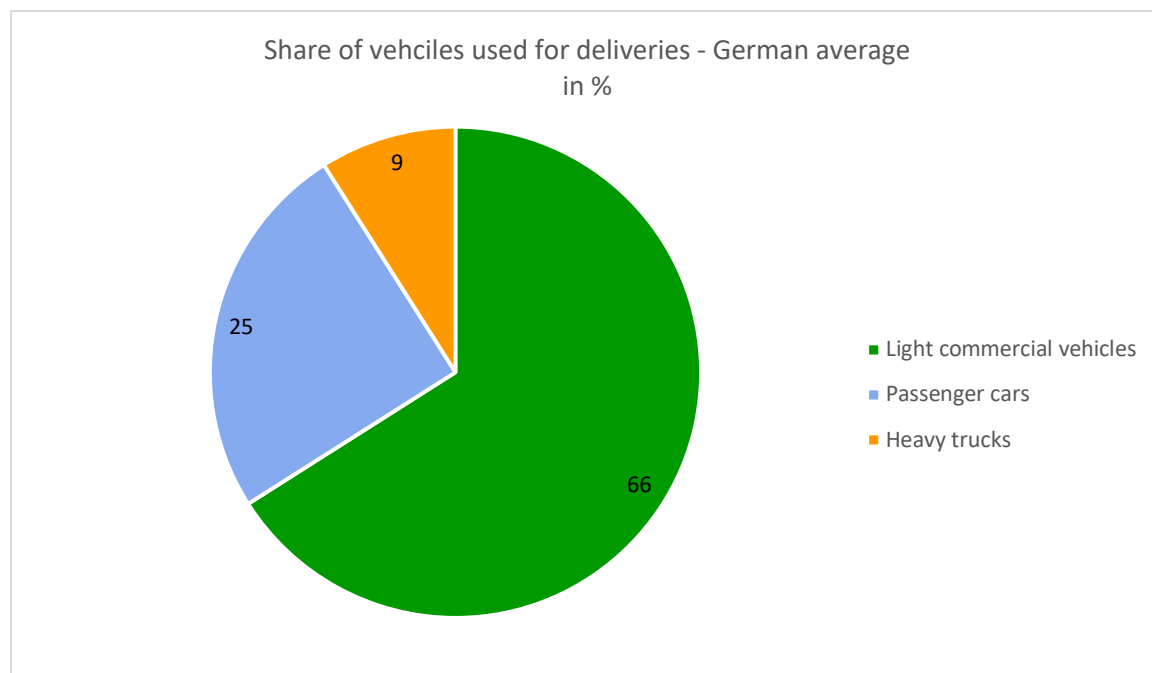


Figure 2: Average division of a German delivery fleet, 05/2018

Emissions

Emissions for the BaU-scenario are calculated based on emission factors from the standard database "HBEFA" and information about both VKT and the vehicles being used. See [Table](#) for the used factors, based on the German fleet average. The number of hybrid/electric delivery vehicles is too low to be considered as a separate category.

In order to estimate BaU-emissions, the HBEFA projected emission factors for light commercial vehicles (LCV) and private cars (PC) were used for parcel delivery for 2020 as well as the by 2.6% increased VKT from 2019 to 2020, that were assumed in the section "Mode Shift & VKT".

Thus, the following factors are used:

Pollutant	Vehicle	Emissions per VKT
CO ₂	LCV	256,332 g/km
NO _x	LCV	1,071 g/km
PM	LCV	0,02 g/km
CO ₂	PC	181,887 g/km
NO _x	PC	0,449 g/km
PM	PC	0,004 g/km

Table 7: Emission Factors (HBEFA, 2020)

This results in the following emissions for 2020:

Pollutant	Emissions (2020)	% change to 2017
CO ₂	3.049 t	+6,02 %
NO _x	11,6 t	-27,04 %
PM	202 kg	-50,85 %

Table 8: CEP branch emissions in Munich 2020

C.2 Measure results

The following table shows the measure results of MUC 7.3. In some cases, the Business as Usual scenario is valued as not assessed (NA) because there would not be any other development without the implementation of this measure.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After–BaU
Acceptance	#	0 box openings	07/2017-05/2019	NA	-	35 box openings	06/2019-12/2019	+35	NA
Satisfaction	Score 0-5	1	05/2019	NA	-	2	12/2019	+1	NA
Mode shift	%	NA	05/2018	NA	2020	NA	-	NA	NA
VKT	km	11,8 million	2017	12,9 million.	2020	NA	-	NA	NA
CO2 emissions	tons	2.876 t	2017	3.049 t	2020	NA	-	NA	NA
NOx emissions	tons	15,9 t	2017	11,6 t	2020	NA	-	NA	NA
PM emissions	tons	411 kg	2017	202 kg	2020	NA	-	NA	NA
Investment Costs (gross)	costs related to people and their time period: none				costs of equipment: rental or leasing cost 35.945,76 €				
Operating Costs (gross)	Transfer of micro depots within the city (per depot) 250 €								

The Ex-post data refers to the usage period of 05/2019 until 11/2019. Statistics of box openings could be obtained from the hardware manufacturer. Other information is retrieved from interviews with the ML and other key stakeholders.

Addressing Indicators "1 – Acceptance" and "2 – Satisfaction"

In order to evaluate the **Acceptance** and **Satisfaction** of the new implemented cargo-bike delivery and the storage system, several telephone interviews were held with important stakeholders, like the ML, and subcontractors, like the service provider or delivery or courier firms.

Box location	# openings old box	# openings new box
Anzinger Straße	1	12
Dietlinden-/Biedersteiner Str.	2	16
Zenettistraße	-	3
Bernhard-Wicki-Straße	0	3
Thalkirchener Straße	0	-

Table 9: Number of box openings, 07/2017 – 11/2019

Table shows that there are in total 35 micro depots openings registered in the system of the storage box deliverer (data conducted in 08/2019). Those 35 box openings are the only openings done during the entire measure implementation since the first box was set up in July 2017.

The “old boxes” are to be assigned to the period from 07/2017 until 05/2019. In this period there were no box openings due to several problems: Regarding the hardware and software of the boxes, the courier drivers had difficulties to open them and resisted to use the micro depots as they were not working properly and the whole procedure was just too time-consuming. As a result, the ML had to search for a new micro depot supplier and in parallel try to fix the old boxes so that the drivers could potentially still use them for their daily parcel delivery. During the search for the new micro depot boxes, the old ones had been fixed and they are working properly since 03/2019.

The “new boxes” are assigned to the period from 06/2019 until 12/2019. There are still the same subcontractors (due to the best price-performance ratio) delivering the hardware and software solution for the micro depots but there is a better communication among those key stakeholders. Additionally, the app developed to a more user friendly and intuitive platform for the courier drivers. This was stated in an interview with the courier firm.

The score for the KPI **Satisfaction** is to be chosen from a zero to five scale (0-5). Zero means no satisfaction or zero shows that there are no other developments without the implementation of the measure. Five stands for the highest degree of fulfillment of the KPI. Because of a very incomplete set of useful data for impact evaluation, the score for satisfaction cannot be measured by quantitative data. Several interviews with the ML, potential delivery firms, the

hardware manufacturer and the courier firm help to gain an overview of the general level of satisfaction. In total five interviews were conducted to gain the following insights:

Comments from the delivery companies' view:

- Micro depots of MUC 7.3 are too small for their purpose
- There is a lack of comfort for the courier drivers
- The micro depot locations are not optimal

Exemplary and most frequently mentioned micro depot requirements⁶⁴:

- Size: depending on number of parcels, but generally starting from ~30 m²
- Type of depot: can be stationary (e.g. in a multi-story car park) or mobile (e.g. parked commercial vehicle, truck swap body)
- Location: as densely populated residential areas as possible, areas with high traffic and parking pressure
- Access: suitable for max. 7.5 t trucks
- Employee comfort: good public transport connections, changing area and toilet
- Others: Power supply, data connection

Because of the low number of box openings since the measure implementation it can be concluded that the satisfaction level remains low (score 2). Even though there are more box openings, there does not seem to be much more satisfaction. Regarding the entire period, a micro depot was only opened about once in a week.

Addressing Indicators "3 – Mode shift/ modal split" and "4 –VKT"

Due to mentioned reasons above, no assessment of **mode shift**/mode split or **VKT** can be conducted.

There is no reliable information on how the courier company is actually using the micro depots, if bikes or delivery trucks are being used, etc. As of 11/2019, still 50 courier drivers have access to the micro depots and 25 of them are actually making use of the micro depots. This information comes from another informal e-mail exchange between ML and courier company.

Regarding the VKT there is some informal information of the courier company assuming that each courier driver cycles about 50-100 kilometers a day, depending if an electrified bike is used or not. This number is not very precise as there is no actual data tracking made by the courier company itself.

Addressing indicators "5 - CO2 Emissions", "6 - NOx emissions", and "7 - PM emissions"

The **emissions** are to be calculated by the number and type of cars which are substituted by cargo-bikes. Due to a major lack of data, there is no regular monitoring done on part of the courier company. Unreliable communication between key-stakeholders and time-consuming data acquisition make it more difficult to gain data for evaluation purposes.

Several interviews with delivery firms gave some assumptions about numbers for truck-cargo bike-substitution and the number of vehicle kilometers traveled. But these numbers are not reliable enough to use them for valid emission calculation.

⁶⁴ These requirements may vary in detail depending on the interviewed delivery service, but they represent the most frequently mentioned points.

A usual delivery truck drives about 17 kilometers a day within the associated delivery area (Interview, District Operations Manager, CEP company). There is no accurate information how many kilometers a courier driver is cycling in a day. Another information was given by a well-known German delivery firm, which is partner in a similar project but with a bigger scope in Berlin. There has been an evaluation about the number of trucks which have been substituted by cargo-bikes. It was observed that five delivery trucks were substituted by three cargo-bikes and two trucks. This information is retrieved from a telephone interview with the aforementioned company which is a potential user of the storage boxes of MUC 7.3. Another model quarter project in Munich for sustainable urban electro mobility, City2Share, had a similar measure with focus on cargo bike logistics. They measured that 20 delivery trucks could be substituted by 24 cargo-bikes (cf. City2Share).

Addressing Indicators "Investment costs" and "Operational costs".

The KPI cost is divided into **investment cost** and **operating cost**. Those costs were obtained in 09/2019 when the measure was up and running for about 2 years. There were no costs related to people and their time other than ML or other equipment costs. The only costs that occurred during the implementation phase are rental and leasing of the storage boxes, which is in total 35.946 Euro. If there is a transfer of a micro depot necessary, the transfer would cost about 250 Euro per depot. Otherwise there are no operational costs occurring.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	To promote and implement a sustainable, clean and (energy) efficient urban transport measure for goods delivery.	★	The measure for a sustainable, clean and (energy) efficient urban transport for goods delivery was implemented but could have been promoted better to raise the awareness.
2	Find a solution to reduce the delivery of goods by common cars and trucks in the city centre.	★★	The solution to reduce the delivery of goods by trucks was found: the storage system with micro depots.
3	Shift the modal share of RAPID's deliveries within the city center from car to (cargo)-bicycle delivery.	NA	There has no mode shift been noticed since the micro depots are implemented in the city. None of the delivery firms is delivering cargo/goods to the boxes.
4	Gain operational experience with this new kind of logistic system.	★★	Knowledge is gained but the usage has to be promoted in a better way. For a better usage of the boxes, the logistic concept has to adapt to the business model of the couriers.
5	Find additional logistic companies to use the system.	O	There were 19 logistic companies addressed to use the storage system but they do not want to use the micro depots because they are too small for the amount of parcels they want to deliver.
6	All kinds of logistic companies and specialized service providers shall participate in this logistic system.	O	The wide range of companies did not take part in the measure due to their specialized requirements.
7	Installation of a denser network of boxes.	★	In the first implementation phase there were 4 boxes, now there are 8 micro depots installed but the second load of boxes was installed at the same locations, except two new locations. Thus, the network is not yet very dense.
8	Development of additional services.	O	No additional services have been developed.
9	Cost-effective operation of the system.	★	Low operational cost but also low usage.
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded			

D. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

D.1 Validated direct impact

- There are eight properly working storage boxes implemented in Munich.
- One courier service company is using the boxes, 25 couriers are registered in the accompanying app, theoretically all 50 couriers could use the micro depots.
- Projecting the number of 35 box openings, they are opened about once a week.
- There is no validated impact to be measured for MUC 7.3 because the micro depots were not sufficiently used by the key stakeholders as expected.
- In addition to that, no assessment of regular statistics was done by the micro depot manufacturer and the courier service due to unavailability of data or insufficient monitoring.

D.2 Relevance of supporting activities

- Planned supporting activities like workshops for courier drivers to make them aware of the storage system and explain the procedure did not take place during the implementation of the measure due to limited interest by the courier service.
- The guidelines on how to use the boxes were provided by the micro depot manufacturer. But it remains unclear how much added value they have.

D.3 Interaction with other measures

There was no interaction with other measures.

D.4 Main lessons learned

- The concept was very new to the courier companies and therefore, the usage was not as high as expected.
- All stakeholders have to be stronger involved during the planning and concept development right from the beginning to include the needs and pain points of the key-stakeholders.
- The size of the boxes is not big enough for most CEP companies. They need depots with the size of containers and partially/fully equipped with restrooms, electricity and other amenities.
- Main reason for not or relatively rarely using the micro depots: the courier drivers are self-employed and costs will increase if they use the micro depots due to their pricing scheme. It is difficult to interfere in their individual business model.
- Another reason for the low usage can be found in the orders processed via the micro depot. There is no differentiation between the inserting and collecting courier. Otherwise no courier would use the box because additional costs occur. The additional costs are currently absorbed by RAPID. But RAPID can only contribute to a very limited extent on their own expenses. This could probably have been prevented by looking deeper into the processual details.

D.5 Long term impact

- Regarding the current status, execution and design of the micro depots, there probably will not occur long term impacts as it is unclear if a delivery truck is substituted with a (cargo) bike: With the current concept emissions will probably not decrease and no mode-shift will occur.

D.6 Potentials for up-scaling in the city

- In principle, the storage box system is very simple and easy to use but the interest among CEP companies and other courier services is very low.
- Because of that, it is not foreseeable that delivery trucks are being substituted by cargo-bikes and with that, a lowering of emissions within the City of Munich.
- But there are some smaller companies interested in the usage of the boxes (e.g. a laboratory). This is reported by the courier firm who is in close contact with their customers.

E. Additional information

E.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

Evaluation actions were difficult to carry out because there was no data tracking or monitoring done by the subcontractors. The hardware manufacturer had difficulties to extract data from the system. The courier company does not track their rides either so that there is no reliable database. There should have been a contract between the ML and the subcontractors which regulates a monitoring and data tracking and a data release on particular dates during the project lifetime.

Qualitative interviews which have been conducted with the ML, the hardware manufacturer and potential box users (CEP companies) were highly revealing and gave helpful information about the general views and helped to answer the KPIs acceptance and satisfaction. Unfortunately, several approaches to talk to the management of the courier company have not been successful. This would have been a very important stakeholder to give information about the barriers which occurred on part of the couriers.

E.2 Future activities relating to the measure

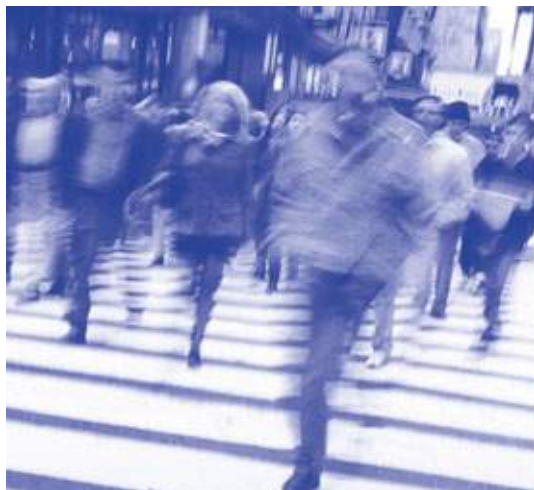
Here are presented the recommendations for the future of the measure after the project lifetime.

Due to ML's information the measure MUC 7.3 will not outlive the project. The usage is just too low to keep the project running and the expected impact did not occur. In addition to that, the renting period of the micro depots ends in 2020.

Nevertheless, the ML's Department of Labour and Economic Development of the City of Munich tries to develop a new concept which fulfils the requirements for micro depot hubs for the CEP companies. Probably another pilot will be rolled out within the next years.

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2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



STO 7.4

Night delivery with clean and silent vehicles

Measure Evaluation Report

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Responsible Co-Author(s):	Robin Billsjö, Joel Franklin, Romain Rumpler, Siddharth Venkataraman, Joram Langbroek
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List of Co-authors

Joel Franklin	KTH Royal Institute of Technology
Robin Billsjö	City of Stockholm
Joram Langbroek	KTH Royal Institute of Technology
Romain Rumpler	KTH Royal Institute of Technology
Siddharth Venkataraman	KTH Royal Institute of Technology
Joram Langbroek	KTH Royal Institute of Technology

Table of Contents

ABSTRACT.....	1475
A. INTRODUCTION.....	1476
A.1 EXPECTED RESULTS OF THE MEASURE	1476
A.1.1 Quantifiable impacts.....	1477
A.2 MEASURE DESCRIPTION	1477
A.2.1 Measure outputs.....	1477
A.2.2 Supporting activities	1477
A.2.3 Interactions with other ECCENTRIC measures.....	1477
A.2.4 Interactions outside ECCENTRIC	1477
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1478
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS.....	1478
A.5 IDENTIFIED RISKS	1479
B. MEASURE IMPLEMENTATION	1480
B.1 SITUATION BEFORE CIVITAS	1480
B.2 INNOVATIVE ASPECTS.....	1480
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1480
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1480
C. IMPACT EVALUATION FINDINGS	1482
C.1 EVALUATION APPROACH.....	1482
C.1.1 Expected impacts and indicators.....	1482
C.1.2 Baseline.....	1483
C.1.3 The business-as-usual scenario.....	1484
C.2 MEASURE RESULTS.....	1485
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1487
D. PROCESS EVALUATION FINDINGS	1489
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1489
D.1.1 Evaluation.....	1489
D.1.2 Vehicle delivery	1489
D.2 BARRIERS	1490
D.3 DRIVERS	1491
D.4 SUPPORTING ACTIVITIES.....	1491
D.5 RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1491

<i>D.5.1 Pilot / Earlier experiences.....</i>	<i>1492</i>
<i>D.5.2 Knowledge about key competences of partners.....</i>	<i>1492</i>
<i>D.5.3 Have clear roles defined.....</i>	<i>1492</i>
E. EVALUATION CONCLUSIONS	1493
E.1 VALIDATED DIRECT IMPACT	1493
E.2 RELEVANCE OF SUPPORTING ACTIVITIES	1493
E.3 INTERACTION WITH OTHER MEASURES	1493
E.4 MAIN LESSONS LEARNED	1493
E.5 LONG TERM IMPACT	1493
E.6 POTENTIALS FOR UP-SCALING IN THE CITY	1493
F. ADDITIONAL INFORMATION	1495
F.1 APPRAISAL OF EVALUATION APPROACH	1495
F.2 FUTURE ACTIVITIES RELATING TO THE MEASURE	1495

List of Figures

Figure 1: Driving noise diesel vs. hybrid mode	1485
Figure 2: Delivery noise	1486

List of Tables

Table 1: Quantifiable impacts.....	1477
Table 2: Target groups or affected parties.....	1478
Table 3: Measure stakeholders.....	1478
Table 4: Identified Risks.....	1479
Table 5: Expected impacts and indicators	1482
Table 6: Indicator units and description	1483
Table 7: Indicator results - Baseline.....	1484
Table 8: Indicator results - BaU.....	1485
Table 9: Indicator results, Before, BaU, After.....	1487
Table 10: Summary of Objectives Achievement.....	1488
Table 11: Summary of Barriers.....	1490
Table 12: Summary of Drivers.....	1491

Project	City		
ECCENTRIC	Stockholm		
Measure code	Measure name		
7.4	Night delivery with clean and silent vehicles		
Last update	Responsible	e-mail	telephone
	Robin Billsjö	robin.billsjo@stockholm.se	

Abstract

The City of Stockholm strives to promote a sustainable, clean and efficient urban transport. In order to address this long-term goal of the city, innovative technological solutions are often required. This measure tests and evaluates a possibility for transferring some freight transports, which are typically conducted during the day, to the night time using modern sustainable vehicles.

In this measure 1 Plug-in hybrid electric vehicle was conducting night time deliveries to 6 locations, taking three delivery routes from the beginning of 2019. Noise and air emissions are minimised by automatically switching from diesel mode to battery mode when entering urban areas. Two sets of data were collected, i.e. *acoustic data*, that measured noise levels and *transport data*, comparing the night time driving time, time accuracy of time keeping, and emission levels to the synthesised routes data based on the day-time deliveries.

The results of this measure show that night time deliveries are more time- and energy efficient, can lead to reduced emissions, while the delivery noise slightly adds to the background levels. In particular, time necessary for a delivery during night time is in average 30% shorter than a comparable day time delivery, while the accuracy of time keeping can be slightly improved (from 91-95% in this case). Using a hybrid truck for goods deliveries can lead to a 40% decrease in carbon dioxide emissions (about 80kg decrease per operation) while the noise of the actual delivery levels has been observed to add a substantial 2 dBA to the existing background noise level, measured at a façade some 5 meters from the source, during noisy segments of the night, and for a noisy location in the city. Unless the equipment in the final stage of the delivery is improved (to be more silent), night time deliveries are found to be still more suitable for the areas of the city where background noise levels are already elevated, such as main streets.

A. Introduction

A.1 Expected results of the measure

The measure objectives are:

(1) City policy level in perspective of CIVITAS goals/ longer term:

- The City of Stockholm strives to promote and implement sustainable, clean and (energy and time) efficient urban transport measures. In order to address this long-term goal of the city, innovative technological solutions, as well as innovative practices are often required.

(2) Strategic level:

- In order to support the long-term goal of implementing sustainable, clean, and efficient urban transport and to smoothen an introduction of a novel procedure and technology, this particular measure provides some evidence by comparing a 'traditional' and a 'new' way of conducting urban freight logistics. In particular, the measure tests and compares normal procedures, day-time deliveries - using regular vehicles, with night time deliveries, using modern vehicles.

(3) Measure level:

- The evaluation of the measure particularly focuses on transport efficiency, air emissions and noise. Transport efficiency and air emissions are studied comparing night to daytime deliveries by using fleet management system data. Noise is studied by KTH within a context of research building on a pilot project report from 2017.

A.1.1 Quantifiable impacts

Expected Impacts	By extending the existing scheme Stockholm City (one of few cities holding a night ban) continues as one of few global cities testing off-peak deliveries. Expected impacts were more efficient transportation and handling of goods, improved work environment and an increased use of clean vehicles. Moreover, learning was to be gained related to how to enable night deliveries without disturbing the residents.	CIVITAS ECCENTRIC Objectives								
		Reduce:				Improve:				
ID	Quantifiable Impacts	Energy use, CO2	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal	Livability	Competitiveness	Efficiency of urban freight
1	Increase of transport efficiency		x		x			x		x
2	Maintaining noise at acceptable levels	x						x		x
3	Reduction of air pollution		x							

Table 1: Quantifiable impacts.

A.2 Measure description

The measure evaluates and compares night-time delivery using hybrid vehicles with a traditional day time delivery, using regular vehicles. In particular, three night-time delivery routes serving six McDonald's restaurants located in central Stockholm are used. A plugin hybrid electric vehicle (PHEV) delivered by Scania were used by the company Havi logistics. The city of Stockholm issued a permit for the vehicle to perform these deliveries during night time, which we call off-peak hours (22-06) allowing an exemption from the night ban normally applied to heavy trucks due to the risk of disturbing residents. Transport efficiency, noise levels and emissions (CO₂, NO_x and PM10) were evaluated. In order to reduce vehicle noise and improve safety, geo-fencing was tested to force electric propulsion in populated areas. Geofencing means that connected vehicles automatically adapts to local traffic rules when entering a predefined zone.

A.2.1 Measure outputs

The measure produced several outputs:

- Launch of the night time deliveries: 1 vehicle, three delivery routes and 6 locations - beginning of 2019.
- Transport data: assembled by autumn 2019.
- Acoustic data: assembled by winter 2019.

A.2.2 Supporting activities

The activities supporting this measure were regular meetings between the City of Stockholm, KTH, HAVI, McDonalds, and Scania.

A.2.3 Interactions with other ECCENTRIC measures

This Eccentric measure did not particularly interact with any other measure.

A.2.4 Interactions outside ECCENTRIC

The city of Stockholm interacted with several contractors and policy making authorities during the project. In addition, the city has investigated how the night ban evolve by identifying a list of parameters to be fulfilled in order to get an exemption. The city also established routines for

the handling and monitoring of night permits. This was a parallel ongoing activity. The city has also conducted another parallel off-peak project in which recycling material compactors were collected from centrally located underground facilities and were transported out from the city to recycling facilities using a PIEK certified biogas truck. The city also aims at reforming the night ban to promote more clean and silent freight transports during the off hours.

A.3 Target groups and/or affected part of the city or region

The target groups are summarized in Table 2.

Target group		Affected area	
Type	Description	Type	Description
Shippers	Companies issuing goods to be delivered in Stockholm	Urban areas	Streets in urban areas throughout the city covered by the night ban.
Receivers	Businesses receiving delivered goods in Stockholm	Urban areas	Streets in urban areas throughout the city covered by the night ban.
Carriers	Transport providers operating in Stockholm	Urban areas	Streets in urban areas throughout the city covered by the night ban.
Residents	Residents in the city who risk being disturbed by night deliveries.	Urban areas	Streets in urban areas throughout the city covered by the night ban.
City of Stockholm	The Stockholm transport administration being responsible for the handling of permits and target of possible complaints.	Urban areas	Streets in urban areas throughout the city covered by the night ban.

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

The relevant stakeholders are listed in Table 3.

No	CIVITAS Partner / other actors	Type P-S	Type organisation of C-PT-KI-NG-PR-other	Level activity of L-P-O	Role Links -
P02	Citizens of the City of Stockholm	S	Other	O	
P03	Environmental Department of the City of Stockholm	P	C	P	
P04	Transport department of the City of Stockholm	P	C	L	
P10	KTH Royal Institute of Technology	P	KI	P	
	Havi logistics	S	PR	P	
	LOTS group	S	PR	O	
	McDonald's	S	PR	O	
	Scania	S	PR	O	
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

At the outset of the project, risks were identified as those in Table 4.

Identified risk	Category	Mitigation actions	Responsible
Important tasks/decisions missing from the schedule	7 Planning	Continuous meetings and reconciliations.	KTH/City of Stockholm
Delays (implementation, data collection, dependent tasks etc.)	Operational	Well prepared and transparent procurement process	KTH/City of Stockholm
Inefficiencies with stakeholders (conflicts, turnover, no support, disengaged)	5 Involvement, Communication	Well prepared and transparent procurement process	KTH
Under communication	5 Involvement, Communication	Continuous meetings and reconciliations.	KTH/City of Stockholm
Resource shortfalls (Inability to secure sufficient resources, overspending)	9 Financial	Well prepared and transparent procurement process	KTH
Legal & regulatory issues	2 Institutional	Involvement of stakeholders at the city of Stockholm with regards to existing and future policy framework	City of Stockholm
Problems in procurement	8 Organizational	Well prepared and transparent procurement process	KTH
Insufficient attention and resources to evaluation tasks	9 Financial	Well-designed evaluation activities	KTH/City of Stockholm
Lack of data/data of low quality	Operational	Well prepared and transparent procurement process	KTH/City of Stockholm

Table 4: Identified Risks

B. Measure implementation

B.1 Situation before CIVITAS

An off-peak deliveries pilot project ran in Stockholm in 2014-2016. The two vehicles used in the pilot project are still conducting night deliveries. Apart from a few exceptions, such as the newspaper distribution and a possible one-time exemption for unique deliveries such as the transport of large house modules for construction projects, the majority of freight transports in Stockholm are conducted during daytime.

B.2 Innovative aspects

The delivery vehicle is Scania's first prototype of a Plug-in hybrid electric vehicle (PHEV). Charging infrastructure was installed providing a possibility to test charging during delivering goods in order to extend the range of electric kilometres. Geofencing (digital rules in predefined zones influencing connected vehicles) was tested to force electric propulsion in populated areas of the city. Sophisticated noise measurements allowed for separating noise generated from the delivery, the vehicle or the background sound level on the street.

B.3 Research and Technology Development

Acoustic research was carried out to measure the noise levels connected to operating this Plug-in hybrid heavy duty vehicle. Compared to the measurements in the previous (pilot) off-peak delivery project, the measurement equipment has been improved and fixed noise recorders have been used to better be able to differ between the background sounds and the sounds originating from the operation of the delivery vehicle.

B.4 Actual implementation of the measure

The measure is a joint activity by KTH and the City of Stockholm in which KTH is primarily responsible for the procurement of the delivery scheme with a PHEV and the acoustic research while the city of Stockholm is responsible for the overall planning, city permit and transport efficiency evaluation.

- The procurement was done by KTH in collaboration with the City during the summer and autumn of 2017 leading to a winning consortium with Scania, HAVI logistics and McDonalds franchise. A contract was signed between KTH and Scania early 2018.
- During 2018 the city of Stockholm and KTH have worked together with the winning consortium in the detailed planning of the measure. During the autumn of 2018 the preparations were intensified including detailed route planning, loading zone adjustments, procurement and detailed planning of transport efficiency evaluation, charging infrastructure preparations, final mounting of the truck including geofencing support to force electric propulsion and noise measurement equipment. In all these activities, the city of Stockholm and KTH were working together with the consortium. Due to technical difficulties in developing the new truck the time plan was revised a couple of times.
- The night time deliveries were launched on January 13th 2019 and were running since.
- Data collection was verified at the start of the project and then regular checks of the quality of the data collection were done throughout the project.
- Unforeseen technical or operational issues forced adaptations of the delivery scheme after start.
- Starting deliveries in January allowed for data collection during different seasons and temperatures, presenting different preconditions for the PHEV.

- Transport data (emissions and efficiency) was collected and analysed by the company Lots Group, procured by the city of Stockholm. Data collection was an ongoing activity January 2019-August 2019.
- The baseline for the transport data was extracted from the HAVI owned vehicles, for which the window period mid-January 2019 to late August 2019 was used.
- The analysis was performed under hand when possible and a final report was completed in September 2019.
- Acoustic data (noise) collection as well as analyses was an ongoing activity conducted and analysed by KTH starting in December 2018 and continued until autumn 2019. The measurement equipment was developed in order to be able to distinguish sound from the operation of the vehicle and the delivery from background noise.

C. Impact Evaluation findings

C.1 Evaluation approach

For the efficiency and air pollution emissions the measure was evaluated by comparing the measured key performance indicators (KPIs) for the Plug-in hybrid electric vehicle (PHEV), performing three routes, for the night-time deliveries, with data from four different reference vehicles. For the comparable day-time deliveries, none of the reference vehicles performed the exact same route as the PHEV at night. Thus, by using GPS data, different road segments were linked together creating synthetic routes identical to those of the night deliveries. The synthetic routes could be considered as both a baseline and a business-as-usual scenario since they represent day time travel routes matching those of the night deliveries. For the acoustic measurements, the measure compared the background levels with the noise when the delivery does occur at one of the six locations. It also compares the diesel vs. battery mode noise of the vehicle.

C.1.1 Expected impacts and indicators

In the table below are listed the KPIs for this particular measure, which correspond to the environmental, economic, and social aspects of sustainability.

Impact	Transport efficiency	Transport efficiency	Reduction of nuisance	Reduction of nuisance	Transport Emissions	Transport emissions	Transport emissions	Acceptance
Indicator name	Driving time	Accuracy of time keeping	Driving Noise	Delivery Noise	CO ₂ emissions	PM ₁₀ emissions	NO _x emissions	Acceptance level
Type	KPI	KPI	KPI	KPI	KPI	KPI	KPI	KPI
Category	Transport	Transport	Environment	Environment	Environment	Environment	Environment	Society
Subcategory	Quality of Service	Quality of service	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Pollution and nuisance	Acceptance
Aspect	Time travelled	Service reliability	Noise	Noise	Emissions	Emissions	Emissions	Acceptance
Definition	Potential time saved by using night hours	On time deliveries according to pre-planned route	Diesel vs. electric mode of travel	Existing noise levels compared to off-peak situation	Existing emissions levels compared to off-peak situation	Particle pollution night time vs day time delivery scenarios.	NO _x pollution in night time vs. day time delivery scenarios.	Acceptance of night delivery among the drivers.

Table 5: Expected impacts and indicators

In the beginning of the project, the planned KPIs were also awareness, satisfaction, operational costs, and investment costs. In 2017, it was however decided that it was not feasible to measure these KPIs. For the satisfaction and awareness it was difficult to identify which target groups to consider. When it comes to the operational and investment cost, the partners were protective over such data sharing, so the data retrieval was not possible.

Moreover, since the synthesized routes (using the same distance) were used for calculating the baseline and comparing the night vs. daytime delivery for the 'time travelled' KPI, the previously defined KPI 'the vehicle-kilometre travelled' became redundant. Creating same daytime routes just for the purpose of measurements in this project, would cause unnecessary emissions. However, we do assume that kilometre travelled would be longer during daytime, because trucks often have to circulate and change routing due to lack of available loading zone, or they might take alternative (longer) routes to avoid traffic.

On the other hand, we are now reporting two types of noise levels. One refers to the driving noise. This relates to the switch from the diesel mode in less populated areas to the electric mode in more populated areas. The second type of noise refers to the delivery noise, which

describes how much the delivery event adds to the already existing background noise during night time. See the table above and below.

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S- C	Observed group	Area of measurement
1	Driving Time	min	A – I (cont.)	DC	Night delivery scheme and relevant daytime equivalent	Fleet
2	Accuracy of time-keeping	%	A – I (cont.)	DC		Demonstration area
3	Driving noise	dBA	A – I (cont.)	DC	Vehicle, delivery addresses and chosen route sections.	Evaluated corridor/area
4	Delivery noise	dBA	A – I (cont.)	DC	Chosen delivery location	Evaluated corridor/area
5	CO ₂ emissions	Kg CO ₂	A – I (cont.)	DC	Night delivery scheme and relevant daytime equivalent	Route chosen
6	PM ₁₀ emissions	G	A – I (cont.)	DC	Night delivery scheme and relevant daytime equivalent	Route chosen
7	NO _x emissions	G	A – I (cont.)	DC	Night delivery scheme and relevant daytime equivalent	Route chosen
8	Acceptance level	yes/no	A – I	DC	The vehicle driver	The night delivery
Frequency: B: Before – I: Intermediate - I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Table 6: Indicator units and description

C.1.2 Baseline

Since deliveries were not carried out in the same transport pattern before the introduction of night deliveries there is no relevant real case which could serve as baseline. Therefore, as described above, GPS data from four different vehicles in the HAVI transport fleet has been used to create synthetic routes corresponding to the night routes.

(1) Driving time is the total driving time for the accumulated three sections taken for normal, daytime operations. It includes Section A, which is from Tuna gårdsväg 4 – Götgatan 91-Hornsgatan 88-HAVI Warehouse (44.9 km), section B, which is from the same starting point to-Katarinavägen 1-3-Folkungagatan 50 and ending at the start (52.5 km), and section C, which also starts and ends at the same point, making deliveries at Sveavägen 71 and Liljeholmstorget 94 (54.1 km). For a regular, daytime delivery, the total transportation of the three routes takes 208 minutes. Section A takes 60 minutes in average, Section B takes 79 minutes in average, with similar results regardless of the time of delivery. Section C takes 67 minutes if delivery is done between 07:00-12:00 and 76 minutes if delivery is done between 12:00-17:00.

(2) Accuracy of time-keeping is calculated as a percent of the on-time deliveries from the total number of deliveries delivered on time. In the scenario of a regular delivery, from the 816 deliveries, 747 were delivered on time, which produces 91.5% punctuality.

(3) Driving noise emissions are measured by equipping a plug-in hybrid electric vehicle (PHEV) with a noise monitoring system. The baseline refers to the driving in the less populated areas, peri-urban areas, using an engine. The driving noise levels when using the engine is 81.2 dBA.

(4) Delivery noise emissions here reported are the measurements from the Folkungagatan delivery location where the microphone was installed on the façade, with an averaged base level of 65 dBA. The baseline represents the background levels (night time) when no delivery was scheduled. The delivery noise was also measured at the source (vehicle) at all the six delivery locations (Götgatan, Hornsgatan, Slussen, Folkungagatan, Sveavägen, Liljeholmen). These measurements, close to the noise source, cannot be easily compared with the façade

measurements and would be an overestimation – due to high levels being so close to the source. These are therefore not reported in a condensed form here.

(5) CO₂ emissions are emissions calculated for reference vehicles. A vehicle which operates fully on diesel emits 188.5 kg for the total transport route, for the inner city part it is 83 kg.

(6) PM10 emissions of particles is for the reference vehicle 1.3 grams for the total transport route.

(7) NO_x emissions is for the reference vehicles 67 grams for the total transport route.

(8) Acceptance level baseline represents the acceptance of the normal procedure, driving day time. This was not specifically evaluated. Thus the result is not available (NA).

Indicator	Unit	Before	Date Before
1 Driving time	Min	208	2018/10/25-2019/08/21
2 Accuracy of time-keeping	%	91.5%	2018/10/25-2019/08/21
3 Driving noise	dBA	81.2	Dec 2018-Dec 2019
4 Delivery noise	dBA	65	Dec 2018-Dec 2019
5 CO2 emissions	Kg	189	2018/10/25-2019/08/21
6 PM10	g	1.3	2018/10/25-2019/08/21
7 NOx	g	67	2018/10/25-2019/08/21
8 Acceptance	Yes/NO	NA	-

Table 7: Indicator results - Baseline

C.1.3 The business-as-usual scenario

The business as usual scenario would be to continue the day time deliveries using regular vehicles. In this case the baseline is same as business-as-usual scenario.

Indicator	Unit	BaU	Date Before
1 Driving time	Min	208	2018/10/25-2019/08/21
2 Accuracy of time-keeping	%	91.5%	2018/10/25-2019/08/21
3 Driving noise	dBA	81.2	June 2019-Dec 2019
4 Delivery noise	dBA	65	June 2019-Dec 2019
5 CO ₂ emissions	Kg	189	2018/10/25-2019/08/21
6 PM10	G	1.3	2018/10/25-2019/08/21
7 NO _x	G	67	2018/10/25-2019/08/21
8 Acceptance	Yes/No	NA	-

Table 8: Indicator results - BaU

C.2 Measure results

The results are measurements for the night deliveries using PHEV, using the same route as described in the baseline scenario at the above indicated 6 locations.

(1) Driving time is the total driving time for the accumulated three sections taken for night-time operations (section A, B, and C), which is 151.5 km in total. For the night-time delivery, the total transportation of the three routes takes 144 minutes. Section A takes 45 minutes in average, Section B takes 48 minutes in average, and Section C takes 51 minutes.

(2) Accuracy of time-keeping is calculated as a percent of the on-time deliveries from the total number of deliveries. From the 475 deliveries, 453 were on time, which represents 95.4% punctuality.

(3) Driving Noise when PHEV operated on electric mode, in the populated part of the city, is at the speed level of 30 km/h, half past midnight, about 73.8 dBA. This is 7.4 dBA less than when operating on diesel mode. See the Figure below.

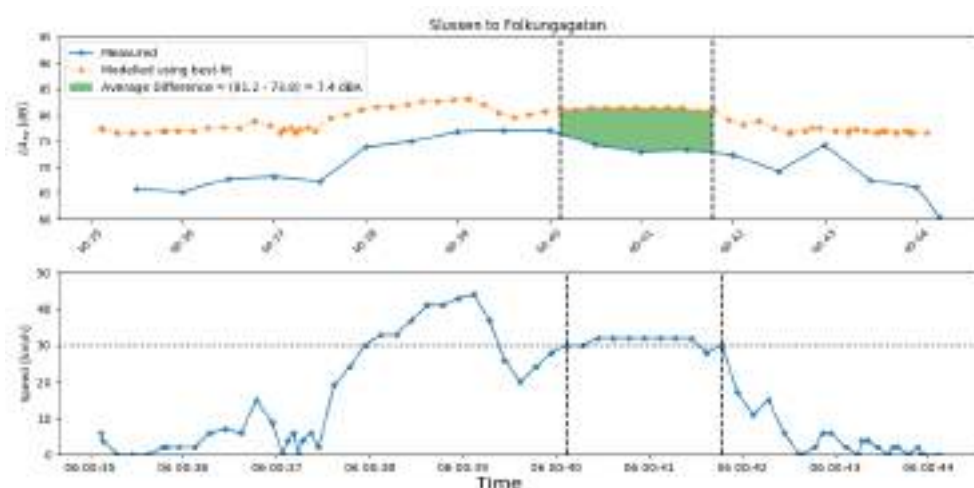


Figure 1: Driving noise diesel vs. electric mode

(4) Delivery noise: measured at the façade of Folkungagatan delivery location, a noisy area of the city, at a time segment when background noise level is high, where the stationary

microphone (approx. 5 metres from the source) was available, is approximately 67 dBA when the deliveries were scheduled at night time (the grey area marked in the Figure below). This is approximately 2 dBA higher than when the deliveries were not scheduled.



Figure 2: Delivery noise

Driver behaviour (e.g. avoiding listening to music loud) and last-metre delivery equipment (e.g. the trolleys) is crucial for the reduction of disturbing noise. The City of Stockholm received no complaints about the noise from the citizens, however, the background levels are rather high for the night time in this location.

(5) CO₂ for the PHEV vehicles is 105.7 kg for the total route, and 0 kg in the inner city, when fully operating on batteries. This is 83.3 kg less than for the regular operation.

(6) PM₁₀ emissions of particles is for the PHEV vehicle 0.9 grams for the total transport route, which is 0.4 grams less than the regular vehicle.

(7) NO_x emissions is for the regular trucks 10 grams for the total transport route, which is 57 less than for the regular ones.

(8) Acceptance is based on the answers provided by one driver who was on the 17th of May asked about their attitude towards night deliveries. His view was generally positive. To the question whether he would consider continuing driving at night, he answered affirmatively. However, he was not asked about (comparison with) the day deliveries. Thus we cannot determine whether the acceptance level is higher for either (the night vs. day) type of deliveries. Also, measurements are based on the one driver who has been conducting the deliveries at night within this measure.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
1 Driving time	Min	208	2018/10/25-2019/08/21	208	2018/10/25-2019/08/21	144	2019/01/13-2019/08/21	-64	-64
2 Accuracy of time-keeping	%	91.5%	2018/10/25-2019/08/21	91.5%	2018/10/25-2019/08/21	95.4%	2019/01/13-2019/08/21	3.9%	3.9%
3 Driving noise	dBA	81.2	June 2019-Dec 2019	81.2	June 2019-Dec 2019	73.8	June 2019-Dec 2019	-7.4	-7.4
4 Delivery noise	dBA	65	June 2019-Dec 2019	65	June 2019-Dec 2019	67	June 2019-Dec 2019	2	2
5 CO ₂ emissions	kg	189	2018/10/25-2019/08/21	189	2018/10/25-2019/08/21	105.7	2019/01/13-2019/08/21	-83.3	-83.3
6 PM ₁₀	g	1.3	2018/10/25-2019/08/21	1.3	2018/10/25-2019/08/21	0.9	2019/01/13-2019/08/21	-0.4	-0.4
7 NO _x	g	67	2018/10/25-2019/08/21	67	2018/10/25-2019/08/21	10	2019/01/13-2019/08/21	-57	-57
8 Acceptance	Yes/No	NA	-	NA	-	Yes	17 th May 2019	NA	NA

Table 9: Indicator results, Before, BaU, After

C.3 Summary: achievement of objectives

This measure used only one PHEV vehicle for the night deliveries, however, the potential of such operations are related to a reduction in air emissions and increased transport efficiency. The results of this measure show that night time deliveries are more time and energy efficient, and lead to reduced emissions. As shown in Table 9, time necessary for a delivery is in average 30% shorter than a comparable day time delivery, while the accuracy of time keeping can be slightly improved, from 91-95%. Using a hybrid truck, which operates on diesel in the peri-urban areas and uses a battery in the urban areas, can reduce noise by 7.4 dBA and leads to a 40% decrease in carbon dioxide emissions (about 80kg decrease per operation). PM₁₀ and NO_x emissions also decrease. The deliveries have been reported to add a significant 2 dBA to the existing noise levels (measurements conducted in a noisy area, at a time segment when background noise level is elevated) and are found more suitable for the areas of the city where the background levels are already elevated. The noise levels can be reduced by using electric mode in the more populated areas. It was found though that the final few meters are the most problematic, due to the sound of the trolleys, pallets. Thus by improving the equipment, night

time deliveries could potentially be scaled up to all parts of a city, but so far, we found them most suitable at night in the already noisy areas, i.e. close to the main streets or in a garage deliveries.

No.	Objective and target	Rating	Comment
1	Increase of transport efficiency	★★	
2	Maintaining noise at acceptable levels	★★	
3	Reduction of air pollution	★★	
NA = Not Assessed O = Not Achieved in full ★ = Substantially achieved (at least 50%) ★★ = Achieved ★★ = Exceeded			

Table 10: Summary of Objectives Achievement.

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

D.1.1 Evaluation

The city of Stockholm originally had the whole evaluation budget before doing a budget transfer to KTH for the noise evaluation and research.

D.1.2 Vehicle delivery

Delay in Vehicle Delivery – Deliveries were scheduled to start in the early Autumn of 2018 but had to be postponed due to difficulties related to the vehicle manufacturing (vehicle is a prototype for Scania's first PHEV).

D.2 Barriers

No.	Barrier field	Description	Action to overcome the barrier
1	Institutional	Noise is the biggest barrier. We cannot introduce night transports if we cannot fulfil maximum noise levels decided by the Swedish EPA. Especially one of the restaurants is extra sensitive due to its surroundings and street design.	Noise has been given a rigid specification in the procurement of the silent delivery vehicle. In addition, drivers will be trained in the use of mechanical loading/unloading equipment to help minimize noise disturbances during delivery. Both the PHEV and the electric pallet loader truck used are PIEK certified for silent deliveries.
2	Legislative	Night ban due to national noise regulation.	City can issue an exempt, for cases when night deliveries can be allowed.
3	Planning	Messy situations with taxis and private cars blocking on street loading zones might create an obstacle for success.	Conflicts with other on-street uses constitute an important source of data on the operations of the delivery vehicles. Rather than preventing conflicts, the most important thing with this project is to collect high-quality data on these conflicts so that a future expansion can take this into account, such as by complementary regulation of curb space.
4	Cultural	Complaining neighbours disturbed by added noise might prevent the project from succeeding.	Silent equipment (pallet loaders), rubber mats for offloading, disabled reverse alarm, were not yet used, but were indicated in this project as having potential to improve the silence of the procedures. Moreover, education of drivers (not to listen to the music out loud) is important to minimize noise during deliveries and awareness of the citizens that they can complain. While in the earlier, pilot project, residents complained in one case, so it was taken off the night schedule, no one complained in this case.
5	Practice/Routine	Noise generated at the delivery point (the last few meters) could disturb the citizens. The trolleys, the pallets, and the refrigerators which sometimes need to be run on diesel.	While the deliveries on quieter residential streets may be more difficult due to noise, the delivery on the main streets, where background noise is already elevated, are more feasible.
6	Implementation	Noise measurements – issues with the installations of the microphone (the rules and who can issue the permit) and technical complications.	Identify all steps at an early project stage to secure necessary permits.

Table 11: Summary of Barriers.

D.3 Drivers

No.	Driver field	Description	Action to make use of the driver
1	Technological	Night transports tend to be faster and thus have the possibility to lower costs which creates demand from the market.	The project collected data on these possible benefits, so that possible future actors could better understand the advantages.
2	Political/ strategic	Less congestion and local pollution are important drivers for the City to introduce night transports.	City support for the project has been forthcoming due to its alignment with its long-term goals.
3	Political/ strategic	Lowering CO ₂ emissions is an important driver for both the city and private actors to work for night transports.	City and commercial support for the project has been forthcoming due to its alignment with their long-term goals.
4	Process/strategy	Scania, KTH, and the City of Stockholm were involved in a pilot project 2014-2016 where night time goods deliveries were investigated. This produced pre-knowledge.	Based on the experiences from the pilot project, KTH developed a more sophisticated noise measurements this time. Scania was aware that good planning is needed (they conducted site visits). The existing knowledge about the locations allowed selection of the restaurants located close to the main roads, where noise levels are higher, since these were assumed as locations where night deliveries could work (and not on the smaller, quiet streets). It turned out, this worked well, no residents complained.
5	Collaboration	Consortium (Scania, HAVI logistics, McDonalds) were collaborators	The companies applied to the procurement call of the City of Stockholm as a consortium.
6	Data availability	Since Scania was involved in the pilot project, with connected vehicles, they collected, and had a lot of data.	Routes based on which synthetic routes were developed and then compared with the night time deliveries.
7	Knowledge/improved silence practice	Using improved, silent equipment	Due to previous experience (that the last few meters of the delivery are noisy) Havi bought a silent pallet truck for a more silent material handling.
8	Training	Training the drivers and prepare them for night operations.	Drivers were educated about night time procedures – not to play loud music, talk on the phone, not to disturb the neighbours.

Table 12: Summary of Drivers.

D.4 Supporting activities

The consortium had some supporting activities, such as site visits, regular meetings, and detailed planning.

D.5 Recommendations on the implementation process

Implementation process can be smoothened when there are earlier experiences, when the key competences known, collaboration established and the responsibilities clearly defined.

D.5.1 Pilot / Earlier experiences

This measure has conducted a pilot study between 2014-2016, which produced a lot of experiences and learnings, i.e. it was learnt that the last few meters in the delivery are most important for the noise production. Experiences from the pilot project thus helped improve the sophistication of the noise measurements and the improvement of the vehicle equipment in the present measure.

D.5.2 Knowledge about key competences of partners

In the earlier, pilot project, Scania has tested food deliveries to hotels and restaurants, and the pilot project was a collaboration between KTH, Scania, and the City of Stockholm – this earlier experience provided knowledge about the partners' key competences and it was faster to establish a future collaboration.

D.5.3 Have clear roles defined

In the project there was some confusion about the roles, so in some parts, the KTH was doing the procurement of the vehicles and was first intending to conduct an innovation type of procurement, but then they realized it was not the right type whereas the City had the budget for the evaluation and it was delayed. It was suggested that it would have been more optimal, if the City did the planning and the procurement.

E. Evaluation conclusions

The observed impacts of the measure has been reviewed, by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- Night-time deliveries can be up to 30% shorter than comparable day time deliveries.
- Using a hybrid truck, which operates on diesel in the outskirts and uses a battery in the inner part of the city, can
 - o reduce driving noise by 7.4 dBA,
 - o decrease carbon dioxide emissions by 40% per operation.
- Accuracy of time keeping can be improved.

E.2 Relevance of supporting activities

- Sites visitations can improve the implementation of the measure.
- Regular meetings can improve/support collaborative process.
- Detailed planning

E.3 Interaction with other measures

No particular interactions have been undertaken, but through noise measurements interactions with measure 7.2 are possible and ideas around charging needs/possibilities in particular parts of the city could be shared with measure 6.6.

E.4 Main lessons learned

- Involvement: High level of involvement in the project is necessary (regular meetings)
- Reality check: It is necessary to examine (the suitability) of the places, by conducting site visits
- Plan: it is useful to plan in detail and to communicate the plan through regular meetings.

E.5 Long term impact

This measure used only one PHEV vehicle. However, night deliveries using hybrid vehicles have a potential for:

- improved energy efficiency (due to shorted time needed)
- improved delivery accuracy (due to less traffic at night)
- decreased emissions (due to use of a hybrid vehicle)
- noise regulation (using diesel mode outside of the city vs. battery mode in the inner city)

E.6 Potentials for up-scaling in the city

The city has already taken up an up-scaling project in relation to waste management. In that case the truck is not a hybrid plug in, but it is using a biogas. However, the operations are still conducted during the night time and according to the conducted study, the travel times at night were 25-30% shorter. The night operations used less fuel (2.7-3.6 litres/100km less) compared to morning operations and they were also more reliable, they varied +/- 15% whereas day time operation vary by +/- 22%. There are potentials for other types of night time deliveries and the

city is continuing to learn from the existing projects and developing new ones. We would recommend night time deliveries for any (bigger) city, which has a lot of trucks in a rush hour.

F. Additional information

F.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

In terms of impact evaluation, the noise measurements were much richer and variable, i.e. the result depends on the distance from the source, place and time of measurement. However, the result had to be condensed in this report, to report one-two KPIs. When it comes to emissions and efficiency, it was possible to create synthetic routes and calculate KPIs since the suppliers collected enough data for the day time operations. The pilot/previous study was supporting the knowledge – what type of data is, and will be, needed.

When it comes to the process evaluation, it was learned that a discussion, in the form of an interview or a workshop as compared to an online survey, is a method which can give much more insights into the process and provides an opportunity to clarify any potential misunderstandings. It is furthermore useful for the text to be checked by the involved actors for verification. However, such collection of the data and verification requires much more time for summarizing, analysing, and verifying.

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

The City of Stockholm using the experiences and collaborations from this present project as part of another two-year project trying to develop a step-by-step guideline about how to introduce night time deliveries for any city to use, by the end of 2021.



2020
CIVITAS
Cleaner and better transport in cities

ECCENTRIC



TUR 7.7

Introducing biogas for urban freight logistics

Measure Evaluation Report

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2020
CIVITAS
Cleaner and better transport in cities
ECCENTRIC



THE CIVITAS INITIATIVE
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Project Partners

Partner nº	Organization	Country	Abbrev.
1	Ayuntamiento de Madrid (coordinator)	Spain	MAD
2	Grupo de Estudios y Alternativas 21, S.L.	Spain	GEA21
3	Consortio Regional de Transportes de Madrid	Spain	CRTM
4	Empresa Municipal de Transportes de Madrid S.A.	Spain	EMT
5	Universidad Politécnica de Madrid	Spain	UPM
6	Ingeniería y Diseño S.L	Spain	AVIA
7	FM Logistic_Iberia*	Spain	FM
8	Ingeniería y Consultoría para el Control Automático S.L.	Spain	ICCA
9	Stockholms Stad MF	Sweden	STO
10	Kungliga Tekniska Högskolan	Sweden	KHT
11	Carshare Ventures B.V. formerly Flexidrive Sverige AB*	Netherl.	FLEX
12	UbiGo Innovation AB	Sweden	UBIGO
13	Mobility Motors Sweden AB	Sweden	MM
14	Cykelkonsulterna AB	Sweden	CYKEL
15	GoMore ApS	Denmark	GOMORE
16	Landeshauptstadt München	Germany	LHM
	MVG_Münchner Verkehrsgesellschaft mbH	Germany	MVG
17	Quartiersgenossenschaft DomagkPark eG	Germany	DOMAGK
18	Green City e.V.	Germany	GC
19	Green City Projekt GmbH	Germany	GCP
20	Technische Universität München	Germany	TUM
21	City of Turku	Finland	TUR
	Union of the Baltic Cities_ Sustainable Cities Commission	Finland	UBC
22	Regional Council of Southwest Finland	Finland	RCSF
23	Turku City Traffic Ltd.	Finland	TUKL
24	Western Systems Oy	Finland	WS
25	Turku University of Applied Sciences	Finland	TUAS
26	Gasum Oy*	Finland	BVK
27	Municipality of Ruse	Bulgaria	RUS
28	Club “Sustainable Development of Civil Society”	Bulgaria	CSDCS
29	ICLEI - Local Governments for Sustainability	Germany	ICLEI

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List of Co-authors

Jari Hietaranta	Stella Aaltonen
Matti Ojanpää	

Table of Contents

ABSTRACT.....	1503
A. INTRODUCTION.....	1504
A.1 EXPECTED RESULTS OF THE MEASURE	1504
A.2 MEASURE DESCRIPTION	1504
A.2.1 <i>Measure outputs</i>	1505
A.2.2 <i>Supporting activities</i>	1505
A.2.3 <i>Interactions with other ECCENTRIC measures</i>	1505
A.2.4 <i>Interactions outside ECCENTRIC</i>	1505
A.3 TARGET GROUPS AND/OR AFFECTED PART OF THE CITY OR REGION	1505
A.4 STAKEHOLDERS: ECCENTRIC PROJECT PARTNERS AND OTHER IMPORTANT ACTORS	1505
A.5 IDENTIFIED RISKS	1506
TABLE 4: TABLE IDENTIFIED RISKS	1506
B. MEASURE IMPLEMENTATION	1507
B.1 SITUATION BEFORE CIVITAS	1507
B.2 INNOVATIVE ASPECTS.....	1507
THE INNOVATIVE ASPECTS OF THIS MEASURE ARE ASSOCIATED WITH THE FOLLOWING ISSUES:	1507
B.3 RESEARCH AND TECHNOLOGY DEVELOPMENT.....	1507
B.4 ACTUAL IMPLEMENTATION OF THE MEASURE	1507
C. IMPACT EVALUATION FINDINGS	1510
C.1 EVALUATION APPROACH.....	1510
C.1.1 <i>Expected impacts and indicators</i>	1510
C.1.2 <i>Baseline</i>	1511
C.1.3 <i>The business-as-usual scenario</i>	1514
C.2 MEASURE RESULTS.....	1514
C.3 SUMMARY: ACHIEVEMENT OF OBJECTIVES	1519
D. PROCESS EVALUATION FINDINGS	1520
D.1 DEVIATIONS FROM THE ORIGINAL PLAN	1520
D.2 BARRIERS	1520
D.2.1 <i>Political/strategic</i>	1520
D.2.2 <i>Institutional</i>	1520
D.2.3 <i>Positional</i>	1520
D.2.4 <i>Planning</i>	1521

D.3	DRIVERS	1521
D.3.1	<i>Political/Strategic</i>	1521
D.3.2	<i>Communication</i>	1521
D.3.3	<i>Financial</i>	1521
D.4	SUPPORTING ACTIVITIES.....	1521
D.4.1	<i>The expansion of the gas filling station network</i>	1521
D.4.2	<i>Communication and campaigning</i>	1522
D.4.3	<i>Rise in the production of biogas</i>	1522
D.5	RECOMMENDATIONS ON THE IMPLEMENTATION PROCESS	1522
D.5.1	<i>Biogas promotion on municipal level needs to be supported by an efficient filling station network</i>	1522
D.5.2	<i>Communication and marketing is needed</i>	1523
E.	EVALUATION CONCLUSIONS	1524
E.1	VALIDATED DIRECT IMPACT	1524
E.2	RELEVANCE OF SUPPORTING ACTIVITIES	1524
E.3	INTERACTION WITH OTHER MEASURES	1524
E.4	MAIN LESSONS LEARNED	1524
E.5	LONG TERM IMPACT	1525
E.6	POTENTIALS FOR UP-SCALING IN THE CITY	1525
F.	ADDITIONAL INFORMATION	1526
F.1	APPRAISAL OF EVALUATION APPROACH	1526
F.2	FUTURE ACTIVITIES RELATING TO THE MEASURE	1526

List of Figures

Figure 1. The awareness of alternative sources of car fuel/2016	1511
Figure 2. The awareness of alternative sources of car fuel/2019	1516
Figure 3. Registered gas passenger vehicles in Turku 2014-2019.....	1522

List of Tables

Table 1: Quantifiable impacts.....	1504
Table 2: Target groups or affected parties.....	1505
Table 3: Measure stakeholders.....	1505
Table 4: Table identified risks	1506
Table 5: Description of key performance indicators (KPI).....	1510
Table 6. Website visitor numbers.....	1512
Table 7. Biogas sales in the Turku area / 2016-2017	1512
Table 8. CO2 emissions / diesel trucks.....	1513
Table 9. Google analytics from Gasum.fi.....	1516
Table 10. Biogas sales in the Turku area / 2018-2019	1517
Table 11. CO2 emissions / biogas trucks.....	1518

Project	City		
ECCENTRIC	Turku		
Measure code	Measure name		
TUR 7.7.	Introducing biogas for urban freight logistics		
Last update	Responsible	e-mail	telephone
11.5.2020	Matti Ojanpää	matti.ojanpaa@gasum.com	+358400299798

Abstract

Within measure TUR 7.7., the City of Turku was to cooperate with relevant stakeholders in order to promote the use of biogas for heavy duty freight vehicles. Gasum Biovakka Ltd. was to invest in two biogas trucks and use them in the company's own waste and organic fertilizer logistics as an example of short-distance transport. One LBG truck was planned to be running a route between the Turku Waste Water Treatment Plant and Gasum's biogas production plant transporting sludge that is processed to biogas. The other truck was to be delivering nutrition waste from biogas plant to local farmers. In addition, the city of Turku was to promote the use of biogas by 2 – 3 delivery vans or similar which operate e.g. food transport in the city area.

The Measure Evaluation Report presents information on the main objectives, assessment methods and results of the impact evaluation. Data was gathered in three stages: the baseline to present the situation prior to the implementation of the measure, Business-as-Usual scenario to estimate general development in the area were the measure not implemented, and the ex-post when impact of TUR 7.7. was measured. Data for evaluation was derived from Gasum Ltd. company statistics, driver interviews, vehicle usage logs, the Technical Research Centre of Finland Ltd. and the measure leader.

As a result of the measure, two biogas trucks were operating in Turku and experiences had been gathered on their suitability for the specific purposes of freight. The city of Turku had succeeded in promoting biogas vehicles among its fleet, proven by the addition of 15 new gas vehicles to the fleet in 2019. All in all, biogas vehicles had proven a feasible and environmentally friendly alternative to diesel/petrol vehicles in heavy traffic and among city fleets. The use of biogas as transportation fuel increased during the project and the number of registered gas vehicles rose significantly in Turku. Although these developments cannot be entirely be attributed to project impact due to the strong contributing influence of the measure's supporting activities, the measure provided a fine opportunity for showcasing biogas use in heavy traffic and served effectively in promoting biogas as a viable option for passenger cars. LBG/CBG trucks have proven a viable and cost-efficient alternative in heavy traffic, a development to be attributed to project impact to a large extent.

A. Introduction

A.1 Expected results of the measure

(1) City policy level in perspective of CIVITAS goals/ longer term:

On city policy level, objectives related to the CIVITAS objectives and the CIVITAS thematic fields of this measure (clean fuels and vehicles and urban freight) were to promote and implement sustainable, clean and energy-efficient urban transport measures and to change transport behaviour on wider scale by testing new innovative measures.

(2) Strategic level:

On a strategic level, the measure aimed to establish a network of biogas filling stations along the main roads in Finland, to promote LBG as a transport fuel for the general public and especially for cargo companies.

(3) Measure level:

- First freight companies and vehicles using LBG as an energy source
- First passenger cars using CBG, cars available in the local market
- Biogas vehicles being competitive among fossil fuel vehicles (users are not so dubious anymore)

A1.1 Quantifiable impacts

Expected Impacts	ID	Quantifiable Impacts	CIVITAS ECCENTRIC Objectives									
			Reduce:					Improve:				
			Energy use, CO2 emissions	Air pollution	Road accidents	Road congestion	Accessibility for all	Social inclusion and equal opportunity	Liveability	Competitiveness	Efficiency of urban freight	Local economy
	1	Annual reduction of 100t of NOX emissions, 3 t of Atmospheric particulates (PM) and 30 000t of CO2 emissions	X	x							x	
	2	% of produced biogas used as traffic fuel (target: 20% of present biogas production of the 2 existing biogas plant)	x	x							x	
	3	%/Number of freight logistics managed by City of Turku using biogas	x	X							x	

Table 1: Quantifiable impacts

A.2 Measure description

Within this measure, the City of Turku was to cooperate with relevant stakeholders in order to promote the use of biogas for heavy duty freight vehicles. Gasum Biovacka Ltd. was to invest in two biogas trucks and use them in the company's own waste and organic fertilizer logistics as an example of short-distance transport. One LBG truck would run a route between the Turku Waste Water Treatment Plant and Gasum's biogas production plant, transporting sludge that is processed to biogas. The other truck would deliver nutrition waste from a biogas plant to local farmers. In addition, the city of Turku was to promote the use of biogas with 2 or 3 delivery vans or similar which operated e.g. food transport in the city area.

A.2.1 Measure outputs

The direct measure output was to be the procurement and use of two biogas trucks in the Turku area.

A.2.2 Supporting activities

The developments on the construction of the gas filling station network along the main national roads in Finland were strongly to contribute to the measure goals. This process was initiated by Gasum Ltd.

A.2.3 Interactions with other ECCENTRIC measures

The measure had no interactions with other ECCENTRIC measures.

A.2.4 Interactions outside ECCENTRIC

The nationally funded project “New solutions in city logistics” was to provide valuable new information about the possibilities of LBG as a source of fuel in urban environments especially in the first/last mile context.

A.3 Target groups and/or affected part of the city or region

Target group		Affected area	
Type	Description	Type	Description
10	Biogas vehicle providers	Nation-wide	
2	Turku City staff, users of biogas vehicles in city logistics functions	Turku city area	
2	Car drivers or other motorists interested in gas-fuelled vehicles	Turku area	

Table 2: Target groups or affected parties.

A.4 Stakeholders: ECCENTRIC project partners and other important actors

No	CIVITAS Partner / other actors	Type P-S	Type of organisation C-PT-KI-NG-PR-other	Level of activity L-P-O	Role – Links
1	Gasum Ltd	P	PR	L	Measure leader
2	Freja Ltd	S	PR	P	Subcontractor to Gasum Ltd.
3	City of Turku	P	C	P	Partner in the measure, promotion of biogas vehicles in city operations
Type: P: CIVITAS partner – S: other stakeholder Type of organisation: C: City - PT: Public transport company - KI: Knowledge institution (e.g. university) – NG: Non-Governmental Organisation – PR: Private company Level of activity: L: Leading role – P: Principle participant – O: Occasional participant					

Table 3: Measure stakeholders.

A.5 Identified risks

Identified risk	Impact	Likelihood	Score	Mitigation actions	Responsible
Gaps in data due to technical problems e.g. biogas trucks breaking down during implementation period	3	1	4	Ensuring that maintenance of trucks is up to date and high level	ML
Quality of questionnaire hinders quality of results and response rate	2	1	3	Proper planning of questions	ML, LEM
False conclusions from questionnaire data being gathered	1	1	2	Pretesting the questionnaire for selected test users to verify quality of the questionnaire	ML, LEM

Table 4: Table identified risks

B. Measure implementation

B.1 Situation before CIVITAS

Prior to ECCENTRIC, there were two standard diesel trucks taking care of the waste logistics between the biogas plant and the wastewater treatment plant in the Turku area. No biogas filling stations were available nearby. In Finland, the use of biogas as a transportation fuel was overall still minimal. The potential was remarkable as it has been estimated that biogas could reach an 18 % share of all transportation fuels. In general, there were many reasons for underdevelopment – the bulk of the research and pilot projects have been focused on electric transport and only little attention has been focused on heavy transport. In addition, the infrastructure for LBG /LNG distribution has been rather poorly developed so far. In Finland, for example, the only biogas stations were located in southern Finland prior to the project.

B.2 Innovative aspects

The innovative aspects of this measure were associated with the following issues:

- (1) Use of new technology: LBG was still relatively new source of transportation fuel
- (2) Targeting special user groups in logistics and transportation companies (heavy transport)
- (3) New physical infrastructure solutions: new arrangements in infrastructure were needed to promote wider LBG usage as a transportation fuel.

B.3 Research and Technology Development

The biggest input for this measure was to highlight that the usage of LBG does not need any changes technically. The same engines can use bio-based fuel without any large technical changes. The measure was to demonstrate the pros and cons of using biogas as transportation fuel as opposed to traditional fuel technologies.

B.4 Actual implementation of the measure

This measure proceeded according to initial plans to a large extent. The measure was well pre-planned and hence the procurement process was started early on in the project.

Phase 1: Research and planning (100 % completed)

The research and planning phase of this measure commenced in September 2016 and was completed in April 2017. The phase included the following activities:

- The preparation of the truck procurement documentation by Gasum Ltd. The city of Turku prepared the tender documentation for gas vehicles. (M1-M8)
- Market discussions were conducted with stakeholders and truck vendors. At the same time, the city of Turku prepared for the documentations for gas vehicle tendering. (M1-M8)
- Baseline data was preliminarily mapped with TUAS. (M1-M11)

Phases 2: Procurement and implementation (100 % completed)

The procurement and implementation phase of this measure commenced in May 2017 and was completed in August 2017. The first step was to secure LBG distribution for the trucks. This was done by opening a public filling station in Turku that supplied both CBG and LBG,

thus enabling the initial growth of the number of biogas vehicles in the Turku area. This station was not a part of CIVITAS ECCENTRIC and would have been opened regardless.

The phase included the following activities:

- Gasum Ltd evaluated the tenders and did some tests, after which the truck providers were chosen in August 2017. The choice was made for a Scania LBG truck and Iveco LBG/CBG-hybrid truck. Both trucks have less horsepower than the diesel versions that were being replaced and they were 2-axis models instead of 3-axis. This was due to the fact that at the time of the procurement, there were no high power 3-axis LBG trucks available on the market. (M9-M11)
- The city of Turku tendered for four gas vehicles, one to be used at the environmental department and three at the social department. Tenders were sent out in May 2017 and a procurement decision was made in July 2017. (M9-M11)
- An information event on biogas directed at the greater public was also planned during this period. (M8-M11)

Phase 3: Demonstration and monitoring (100 % completed)

The demonstration and monitoring phase started in September 2017 and continued until May 2019 (M13-M32). As explained earlier, one LBG truck (Scania) started running a route between the Turku Waste Water Treatment Plant and Gasum's biogas production plant transporting sludge that is processed to biogas. The other truck (Iveco) started delivering nutrition waste from the biogas plant to local farmers. However, once the weather conditions worsened by the arrival of winter, it turned out that the 2-axis model was not suitable for the operating environment of the Iveco truck. The route in question had a lot of back roads in rural areas and the traction was not good enough. Also, due to having less horsepower, the nutrition liquid container could not be operated in full capacity. Therefore, accelerating and braking would put the liquid in motion and cause steering problems. This truck was then transferred to Freja Logistics and has since been operating on standard roads with solid loads, solving the aforementioned challenges.

The phase included the following activities:

- A biogas information event was organized on the 7th of September 2017. (M13)
- Planning of the next information event took place. (M13-M32)
- The company Freja Ltd was chosen as a subcontractor for running the Iveco truck. (M28)
- Collection of technical data from the LBG trucks by Gasum Ltd. (M12-M32)
- The city of Turku organized a stakeholder forum on alternative fuels in South-West Finland in August 2018. (M24)
- Summary of results of the stakeholder forum and plans for future use. (M24)

Phases 4: Conclusions and recommendations (60% completed)

The phase started in May 2019 and was to be completed by August 2020 (M48). Most of the data linked with the LBG trucks has so far been collected and analysed. At this point, some preliminary conclusions can be made on measure success:

Research & Planning

- The potential impact and scalability of the measure is constrained by external factors because the LBG filling infrastructure is still quite limited in Finland. Therefore the operating radius is restricted to the Turku area as one of the trucks is a LNG/CNG hybrid.
- In fact, the different considerations of the environmental benefits of gas as an alternative fuel will determine the development of the vehicle gas filling network through Europe (CNG city centre/LNG highway corridors).

Procurement & Implementation

- As a result of the uncertainties of market development, the number of LBG truck manufacturers and models is still limited, with only a few options to choose from.
- With regard to technical issues, one of the potential barriers identified during the planning phase was that currently the motors in LBG trucks have less horsepower than their diesel counterparts, thus reducing their competitiveness.



Picture 1. The Scania gas truck and gas filling station in Turku

C. Impact Evaluation findings

C.1 Evaluation approach

C.1.1 Expected impacts and indicators

Impact					
Indicator name	Awareness	Acceptance	Satisfaction	Contribution to Policies, Plans and Programs	Vehicle-Km travelled
Type	KPI	KPI	KPI	KPI	KPI
Category	Society	Society	Society		Transport system
Aspect	Awareness	Acceptance	Acceptance	Governance	Total travel
Definition	Awareness of biogas as traffic fuel	Acceptance of biogas as traffic fuel	Satisfaction of biogas truck drivers on truck performance	Qualitative measurement on the process to modify policies, plans, and programs (including SUMP) in a significant and definitive way.	Sum of all kilometers travelled by a fleet or a group of users.

Impact				
Indicator name	Investment costs	Operating costs	CO2 emissions	Energy efficiency
Type	KPI	KPI	KPI	KPI
Category	Economy	Economy	Environment	Environment
Aspect	Costs	Operating costs	Pollution and nuisance	Pollution and nuisance
Definition	Capital investment costs of the measure	Average operating costs of the measure	Total CO2 emissions of the fleet	The total energy use by urban transport per vehicle-km (annual average)

Table 5: Description of key performance indicators (KPI)

No.	Indicator	Data units	Frequency B – I (xx) – A	Method DC-E-S-C	Observed group	Area of measurement
1	Awareness	Number of visitors	B-A	DC	General public	Turku area
2	Acceptance	Kg	B-A	DC	General public	Turku area
3	Satisfaction	Score(0-5)	B-A	S	Truck drivers	Turku area
4	Contribution to policies, plans, and programs	Score (0-5)	B-A	E	Decision makers	Turku
5	Vehicle-km travelled	Km	B-A	DC	Trucks	Turku area
6	Investment costs	€	B-A	DC	Trucks	Turku
7	Operating costs	€	B-A	DC	Trucks	Turku

8	CO2 emissions	CO2 (tons)	B-A	DC	Trucks	Turku area
9	Energy efficiency	MJ/km	B-A	DC	Trucks	Turku area
Frequency: B: Before – I: Intermediate – I(x): Intermediate(frequency) – A: at the end of the CIVITAS operation period						
Method: DC: Data collection – E: Estimation – S: Survey						

Measure's indicators

C.1.2 Baseline

The main baseline data considered the transportation on the pilot route being operated with conventional diesel-fuelled trucks. In addition, the baseline situation of LBG sales was considered via data collection from secondary quantitative sources acquired from Gasum Ltd. In addition, an interview was conducted with the biogas truck drivers to estimate driver satisfaction. Investment and operating costs were derived from the measure leader.

KPI 1: Awareness describes the general interest expressed towards biogas as a traffic fuel. In 2016, use of biogas as a transportation fuel was still relatively marginal, as was the overall awareness of alternative fuel sources. According to a web-based survey commissioned by Gasum Ltd in 2016, 8% (n=308) of the respondents were aware of biogas as a potential transportation fuel. The combined awareness for biogas, natural gas or gas was 45%.

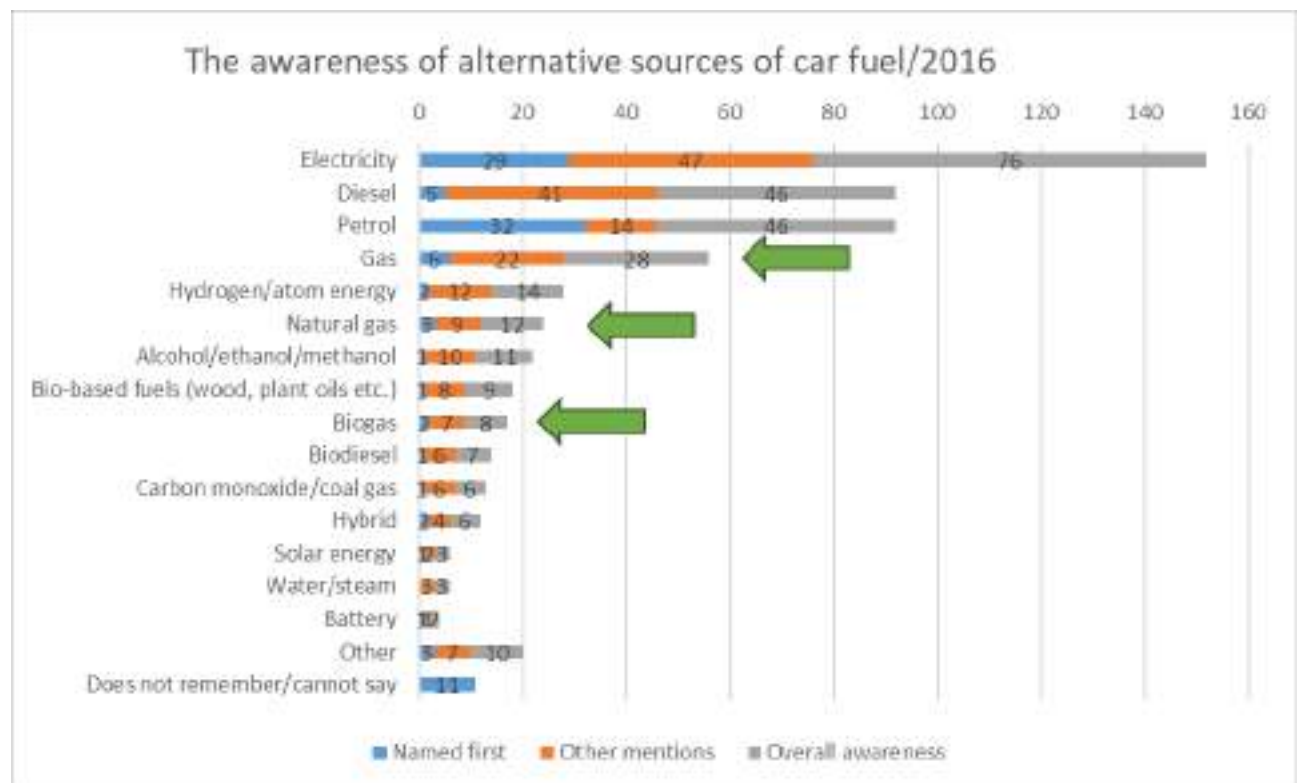


Figure 1. The awareness of alternative sources of car fuel/2016

Data for awareness on biogas as a traffic fuel specifically in the **Turku area** was derived from the website analytics of www.gasum.fi. According to Google Analytics data, between 1.1.-31.12.2016 there were 3798 visits to the Gasum website. More specific visitor behavior is presented on the table below.

City: Turku	Acquisition			Behaviour		
	Users	New users	Sessions	Bounce rate	Pages/session	Avg. session duration
Jan.1, 2016- Dec 31, 2016	3798	3457	4930	56,09	2.28	00:01:45

Table 6. Website visitor numbers

KPI 2: Acceptance refers to the use of biogas as a traffic fuel, obtained from biogas filling statistics in the Turku area, measuring the increase of biogas sales. The data was provided by the ML. Again, here it should be noted that the number of gas filling stations at the beginning of the project was minimal as the first station in the area was opened in 2016. For the baseline, figures from 2017 will therefore be used – as of 2017, there were stations for both CBG and LBG available.

Biogas sales, Turku area (kg)	2016	2017
Turku CBG	3 437	38 609
Turku LBG	-	13 947
Total	-	52 556

Table 7. Biogas sales in the Turku area / 2016-2017

KPI 3: Satisfaction estimates the perceived satisfaction in driving a biogas truck as opposed to a diesel-operated truck of the same size. Here, a targeted interview was performed to two drivers and the traffic manager at Freja Ltd. The baseline describes satisfaction in driving a diesel-operated truck as the route in question was driven with one prior to the project. On a scale of 1-5, the drivers expressed they were very satisfied with driving a diesel truck on the route. Both drivers graded their satisfaction with the grade 5.

KPI 4: Contribution to Policies, Plans and Programs relates to the impact the measure may have on policies or strategies to promote use of biogas as a traffic fuel. Prior to the project, significantly more attention on a strategy/policy level was placed on the electrification of private cars and cargo delivery as opposed to biogas use. In Turku, however, an investigation into the potential use of biogas as transportation fuel was initiated by the city, Åbo Akademi University and some companies already in 2010. The primary goal of the investigation was to find a sustainable public transport solution based on the use of biogas. Preliminarily it was estimated that the city would get its first biogas buses in 2016. However, in the end, the city council made a decision to favor electric and hybrid buses in public transport instead.

The state concludes agreements concerning land use, housing and transport (MAL) with the main city regions of Finland. These agreements enhance cooperation among the municipalities in the respective city regions and between the municipalities and the state in the steering of community infrastructure and coordination of land use, housing and transport. In

the Turku MAL agreement (2016-2019), use of biogas as traffic fuel is not mentioned at all. Overall, it can thus be stated that prior to the project biogas was not strongly promoted in city policies, plans or programs. **Score: 2.**

KPI 6: Investment costs on the baseline level in this measure refer to the investment costs of a 2-axis diesel truck. According to the ML, the investment costs of a similar model of diesel truck as the biogas procured were approximately 100 000€. Variations between types and models exist.

KPI 7: Operating costs of a conventional diesel-operated 2-axis truck (Iveco EURO VI model semitrailer) were estimated at 32 000€/a. The calculation was based on 95 500 km driven per year on an average consumption of diesel 25 l/100 km, the price of diesel being 1.34€/l at the time of writing. The test route was relatively flat with a $\frac{3}{4}$ share of road driving and $\frac{1}{4}$ of urban driving. This equaled to 0.335€/km.

KPI 8: CO₂ emissions: the calculated CO₂ emissions of an EURO VI model diesel truck according to (VTT Technical Research Centre of Finland Ltd, 2017) were the following, dividing the share ($\frac{3}{4}$) for road driving and urban driving ($\frac{1}{4}$). CO₂ekv (g/km) for diesel trucks: **640 g//km** for half full load.

The Iveco truck operated by Freja Ltd on varying routes drove a total of 95 500km in 2019. The Scania truck drove a regular route of 16km in one direction 5-6 times a day, 5 days a week. Using the smaller number of daily trips (5), the number of total 32 km round trips for the Scania truck was thereby 25 trips per week, 1300 trips per year, which totaled at 41 600km/year. The total yearly mileage with the two trucks amounted to 137 100km. Had these routes been driven with EURO VI model diesel trucks, would the CO₂ emissions thus have amounted to 87.7t/year.

Vehicle type	Mileage / 2019 (km)	CO ₂ Total (t)
EURO VI model on the Topinoja route	95 500	61.1
EURO VI model used by Freja Ltd.	41 600	26.6
Total	137 100	87.7

Table 8. CO₂ emissions / diesel trucks

KPI 9 Energy efficiency of a diesel-fueled truck was calculated from the EURO VI diesel truck energy consumption, divided with km's driven (VTT 2017). On a 50% payload, the energy efficiency of a semitrailer truck was 11.2 MJ/km.

C.1.3 The business-as-usual scenario

According to the ML, without project influence Gasum Ltd would not have invested in the two biogas trucks, at least not in the near future. Thereby for some KPIs, BaU is similar to baseline.

Indicator	Unit	BaU	Date BaU
Awareness	No. of visits	Efforts to promote biogas in vehicle fuel would have taken place also without project effort. It was thus estimated that the number of visits would at least triple from the baseline level.	2016
Acceptance	Kg	The expansion of the gas filling station network would have proceeded without project influence. It was thus estimated that acceptance would have at least tripled during the project duration.	2016
Satisfaction	Score (0-5)	BaU was estimated to be similar to baseline.	2016
Contribution to Policies, Plans and Programs	Score (0-5)	The new Renewable Energy Directive includes a legally-binding EU-wide target of 14% renewables in the transport sector by 2030. This includes a sub-target of 3.5% for advanced biofuels and biogas. Based on this, it is likely that biogas as transportation fuel will be promoted on policy level more strongly than before. Thereby BaU was likely to concur with the after-scenario.	2016
Vehicle-km travelled	Frequency (users/unit of time)	The same routes and mileage would have been driven with diesel trucks, thus BaU was estimated to be similar to baseline.	2016
CO2 emissions	tons	BaU was estimated to be similar to baseline.	2016
Energy efficiency	MJ/t	BaU was estimated to be similar to baseline.	2016
Operating costs	€/km	BaU was estimated to be similar to baseline.	2016
Investment costs	€/project	BaU was estimated to be similar to baseline.	2016

C.2 Measure results

Values obtained for the selected KPIs are summarised in the table below, followed by a discussion of the results.

Indicator	Unit	Before	Date Before	BaU	Date BaU	After	Date After	Difference After-Before	Net impact After-BaU
Awareness	No. of visits	3798	2016	11500	2016	28699	2019	24 901	17 199
Acceptance	kg	52 556	2016	158 000	2016	377 177	2019	324 621	219 177
Satisfaction	Score (0-5)	5	2019	5	2019	4.5	2019	-0.5	-0.5

Contribution to policies, plans, and programs	Score (0-5)	2	2016	4	2016	4	2019	2	0
Vehicle-km travelled	km	The total mileage driven with the two biogas trucks in 2019: 137 100							
CO2 emissions	tons	87.7	2016	87.7	2016	9.6	2019	-78.1	-78.1
Energy efficiency	MJ/km	11.2	2016	11.2	2016	10.35	2019	0.85	0.85
Investment costs	€	100 000	2016	100 000	2016	129 600€ (Scania) 103 900€ (Iveco)	2019	29600 / 3900	29600 / 3900
Operating costs	€	0.335	2016	0.335	2016	0.275	2019	-0.06	-0.06

The ex-post data was derived from several sources:

- Information on awareness and acceptance was derived from Gasum Ltd company data (sales, website analytics).
- An interview was conducted with the biogas truck drivers to estimate satisfaction.
- Mileage data was received from Freja Ltd, operating the Iveco truck, and Gasum Ltd, operating the Scania truck.
- Reference data for CO2 emissions and energy efficiency was derived from VTT, the Technical Research Centre of Finland Ltd.
- Investment and operating costs were derived from the measure leader.

General interest expressed towards biogas as a traffic fuel increased within the duration of ECCENTRIC. According to a web-based survey commissioned by Gasum Ltd. in 2019, 10% (n=308) of the respondents were aware of biogas as a potential traffic fuel. The combined **awareness** for biogas, natural gas or gas was 54%.

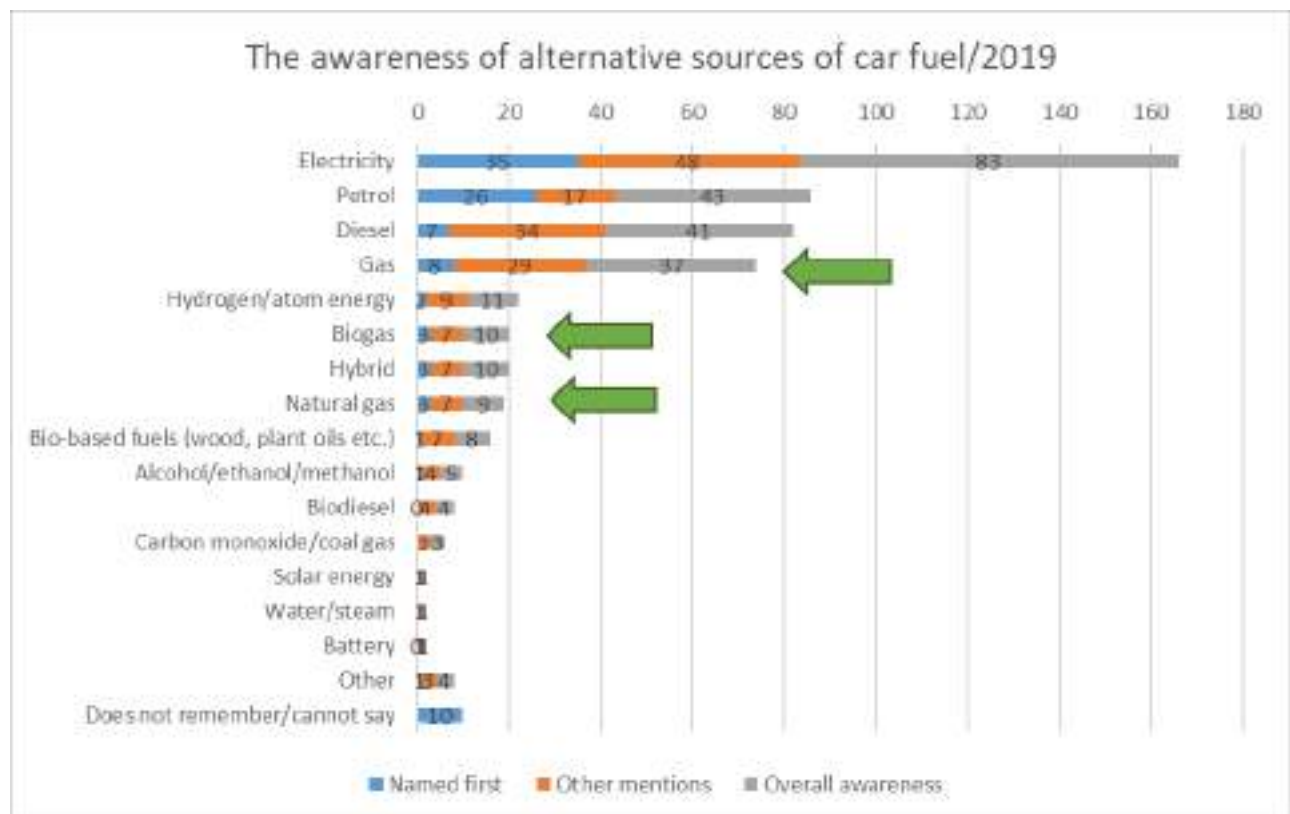


Figure 2. The awareness of alternative sources of car fuel / 2019

When looking at data on awareness of gas as a traffic fuel specifically in the Turku area, a significant rise could be detected. According to the Google Analytics data presented below, between 1.1.-31.12.2019 there were 28 699 singular visits to the Gasum website, which showed a 655% rise from 2016. More specific visitor behavior was presented on the table below in comparison to 2016 figures. Naturally this could not be altogether attributed to project influence and the specific interest in LBG as opposed to LNG cannot be differentiated based on the data available. The concurrent developments on the construction of the gas filling station network along the main national roads in Finland was surely the main contributing factor to the rise in awareness – without offer, demand cannot rise indefinitely.

City: Turku	Acquisition			Behavior		
	Users	New users	Sessions	Bounce rate	Pages/session	Avg. session duration
Jan.1, 2016- Dec 31, 2016	3798	3457	4930	56.09	2.28	00:01:45
Jan.1, 2019- Dec 31, 2019	28 699	23 399	41 581	49.21	2.49	00:02:22
% Change	655.63%	576.86%	743.43	12.25%	8.91%	35.15%

Table 9. Google analytics from Gasum.fi

There was a significant increase in the use of biogas as transportation fuel during the project. This rise in **acceptance** cannot be completely attributed to project impact as the concurrent process of widening the filling station network has been a prime promoter of sales of CBG/LBG. However, in the Turku area it is likely that project influence has made a difference via the measure promotional activities. This was also demonstrated by the fact that gas as a transportation fuel was one of the procurement criteria for Turku City fleet acquisition between 2017-2019. This resulted in the procurement of 15 new gas vehicles for the city fleet, to add to the previous four gas vehicles. It could be stated without hesitation that the promotional activities of the project together with the widening of the gas filling station network contributed to these procurements.

During the project, the number of stations in the Turku area increased from just one station to three. Raisio and Salo are medium-sized towns nearby Turku. The sales of biogas are demonstrated below. The total number of biogas sold in 2019 was used as an indicator of acceptance ex-post.

Biogas sales, Turku area (kg)	2016	2017	2018	2019
Turku CBG	3 437	38 609	138 167	138 228
Turku LBG	-	13 947	20 336	30 035
Raisio CBG	-	-		72 016
Salu CBG	-	-	51 897	136 898
Total	3 437	52 556	210 400	377 177

Table 10. Biogas sales in the Turku area / 2018-2019

Satisfaction with driving a biogas truck was estimated high. As with the baseline, a targeted interview was performed with two drivers and the traffic manager of the Iveco truck. On the whole, the drivers expressed they were very satisfied with driving a biogas truck on the route. No problems were linked with the source of fuel. Any problems that had incurred were linked more with the other technical aspects of the used truck. A biogas truck is more silent compared to a diesel one. The only real negative aspect mentioned was the filling up of the tank, which takes more time compared to filling up with diesel. The time spent for filling up a gas truck is around 7-12 minutes longer. A scale from 1-5 was used to estimate satisfaction (1 being very dissatisfied, 5 very satisfied), and the drivers interviewed gave the overall score of 4.5 on satisfaction with the biogas truck.

The promotion of biogas as a transportation fuel is now more embedded to city **policies, plans and programs**. The City of Turku Sustainable Energy and Climate Action Plan 2029 (SECAP, 2018) includes an action card for promoting transport use of biogas, improving refuelling opportunities of biogas, creating fruitful conditions for biogas production and increasing the number of gas vehicles. The draft version of the MAL agreement for 2020-2023 in Turku includes a general statement on “the City and government pursue to transition their fleet into electric and biofuel-based vehicles”, whereas in the previous MAL agreement bio-based fuels were not mentioned at all. What is most remarkable, however, is how the tendering criteria for

the city fleet has changed to favor gas-fueled vehicles for the 2017-2019 period. Prior to ECCENTRIC, there were only four gas-fueled vehicles in the city fleet whereas now there are 15 more, and the amount could be doubled in 2020 if the gas vehicles prove satisfactory. Overall, it could thus be stated that the promotion of biogas as a feasible option for traffic fuel has succeeded within the city both on practical and policy level. **Score: 4.**

KPI 5 Vehicle-km travelled refers to the amount of kilometers driven on the target route. In 2019, altogether 95 500km were driven with the Iveco truck around southern Finland on varying routes. With the Scania truck, a regular route of 16km between the Turku central wastewater treatment plant Kakola in the city center and the Gasum Ltd biogas plant in the Topinoja area was driven 5-6 times a day, 5 days a week. The total mileage in 2019 equaled 41 600km. The total yearly mileage of both trucks, 137 100km, was applied in the following calculations for CO₂ emissions and energy efficiency.

The investment costs of a biogas truck were slightly higher than those of a similar model diesel truck. The investment cost of the Iveco Stralis NP semitrailer biogas truck purchased within ECCENTRIC was 129 600€, VAT 0%. For the Scania truck, 103 900€, VAT 0%.

The operating costs of the biogas trucks were somewhat lower than the costs of operating a new diesel truck of the same size. The main difference comes from the energy price as no major costs are incurred from different engine technology. According to truck operator Freja Ltd, the operating costs of Iveco Stralis NP tractor unit used amounted to approximately 26 274€/year. The calculation was based on 95 500 km driven per year on an average consumption of biogas of 18.1 kg/100km, the price of biogas being 1.52€/kg at the time of writing. The test route was relatively flat with a $\frac{3}{4}$ share of road driving and $\frac{1}{4}$ of urban driving. This equaled to 0.275€/km. Compared to a diesel truck of the same size, the costs of operating a biogas truck were thereby approximately 17.9% lower.

As a vehicle fuel, biogas produces approximately 85% less **carbon dioxide emissions** than gasoline. Emissions were based on data available from VTT, the Technical Research Centre of Finland Ltd. The estimated CO₂ekv (g/km) for the gas trucks, using LBG as fuel: **70 g/km** for half full load.

The calculated CO₂ emissions of the two biogas trucks were the following:

Vehicle type	Mileage / 2019 (km)	Total
Scania G 340 LA4x2MNA	95 500	6.7
Iveco Stralis NP	41 600	2.9
Total	137 100	9.6

Table 11. CO₂ emissions / biogas trucks

When compared to the CO₂ emissions of a EURO VI model diesel truck, a total CO₂ reduction of 87.7t could be observed on the operating routes.

The average **energy efficiency** of the biogas truck was approximately 10.35MJ/km. The difference to an average EURO VI model semitrailer (11.51MJ/km) is thus not very significant.

C.3 Summary: achievement of objectives

No.	Objective and target	Rating	Comment
1	Annual reduction of 100t of NOX emissions, 3 t of Atmospheric particulates (PM) and 30 000t of CO2 emissions	★	The calculated annual emission reduction of CO2 brought by the measure was 87.7t. The reduction in PM or NOx emissions was not included in the calculations.
3	%/Number of freight logistics managed by City of Turku using biogas	NA	The goal in the city of Turku was eventually to promote the use of biogas within its own fleet, not in freight logistics as such. Hence achievement of this objective cannot be estimated.
4	Growth of the biogas ecosystem in Turku region has been supported	★★★	The project has supported the use of biogas as traffic fuel substantially, combined with the supporting activities by Gasum Ltd.
NA = Not Assessed O = Not Achieved ★ = Substantially achieved (at least 50%) ★★ = Achieved in full ★★★ = Exceeded			

D. Process Evaluation findings

Here the main findings of the process evaluation are summarised. More details are available in the Process Evaluation Report of this Measure.

D.1 Deviations from the original plan

One significant deviation occurred from the original plan. For the procurement of the LBG trucks different vendors and models were evaluated in order to find the best solution for the requirements. The choice was made for a Scania LBG truck and Iveco LBG/CBG-hybrid truck. Both trucks have less horsepower than the diesel versions that were being replaced and they were 2-axis models instead of 3-axis. This was due to the fact that at the time of the procurement there were no high power 3-axis LBG trucks available on the market. This has since changed but it is not economically feasible to replace the current trucks with more powerful ones. The LBG trucks started operating early in the autumn of 2017. However, once the weather conditions worsened by the arrival of winter, it turned out that the 2-axis model was not suitable for the operating environment of the Iveco truck. The route has a lot of back roads in rural areas and the traction was not good enough. Also, because of less horsepower, the nutrition liquid container could not be operated in full capacity. Therefore, accelerating and braking would put the liquid in motion and cause steering problems. This truck was transferred to Freja Logistics and has since operated on standard roads with solid loads solving the aforementioned challenges.

D.2 Barriers

The following barriers for measure realisation have been identified so far.

D.2.1 Political/strategic

From a political point of view, the need for a stronger push for biogas promotion on city level was clearly indicated as a barrier. Currently it seems that biogas has been somewhat overshadowed by the strong focus on the electrification of city fleets. In order to have more push for biogas promotion in the city a stronger formulation of policy on use of biogas as a traffic fuel in city operations would have been needed. Discussions have been conducted on this issue on city administration level. Biogas has even been included in some invitations to tender as a selection criterion, and during 2019, 15 biogas vehicles were leased for city operations. This barrier has thereby been overcome at least to some extent. The fact that the purchase cost of a biogas vehicle is low in comparison to electric vehicles has helped in this.

D.2.2 Institutional

The contracting out of logistical functions is an issue in promoting the use of biogas. There are limits to what can be demanded from functions that have already been outsourced. However, in new invitations to tender biogas can be included among the selection criteria.

D.2.3 Positional

Unlike many of the other Turku measures, which share similar barriers and drivers, TUR 7.7 has been somewhat isolated from the other measures and according to the ML and SC, not many activities to exchange experiences with other cities have taken place. It seems that this isolation may also explain to some extent the lack of involvement of stakeholders in the

measure – there hasn't been much interaction between the measure, other measures, stakeholders or city officials.

D.2.4 Planning

As explained above in the deviations of the measure, some safety issues sprung up as the other biogas truck procured was found unsuitable for winter use in its regular route (for the said route a 3-axis truck would be needed instead of 2-axis one). An alternative route was thus canvassed. This is a barrier that would, however, have been difficult to avoid to begin with due to the fact that at the time of the procurement, there were no high power 3-axis LBG trucks available on the market.

D.3 Drivers

The following drivers for measure realisation have been identified so far.

D.3.1 Political/Strategic

The measure has created both regional and national momentum for more extensive use of biogas in heavy freight traffic. From a communicative perspective, the utilisation of sewage sludge has clearly brought an image benefit for the measure. The ML reported that inquiries about biogas have notably increased since the project started at Gasum Ltd. The financial push provided by the project has thereby clearly provided momentum for the increased interest in the use of biogas as transportation fuel in Finland, combined with the concurrent process of widening the gas filling station network in Finland.

D.3.2 Communication

Turku biogas trucks act as a driver nationally to promote more extensive use of biogas in heavy freight traffic, providing one of the first examples of their suitability for different types of routes.

D.3.3 Financial

Funding made available for the biogas truck procurements can be seen as a clear driver for the measure. Without project funding, it is unlikely Gasum would have procured the LGB/CBG trucks within the near future.

D.4 Supporting activities

D.4.1 The expansion of the gas filling station network

The significance of the supporting activity of expanding the gas filling station network cannot be underestimated when discussing measure process or its impacts. The developments on the construction of the gas filling station network along the main national roads in Finland strongly contributed to the fulfilment of measure goals. When the project started, there were very few gas filling stations available whereas at the end of 2019, the gas filling network had extended to 48 stations around Finland. The improved filling network has very likely had an impact also on the increase of passenger gas vehicles in Turku, which can be observed from data on the number of registered gas vehicles, presented below (Tilastokeskus 2020). The rise clearly concurs with the opening of the gas filling stations in Turku and nearby municipalities.

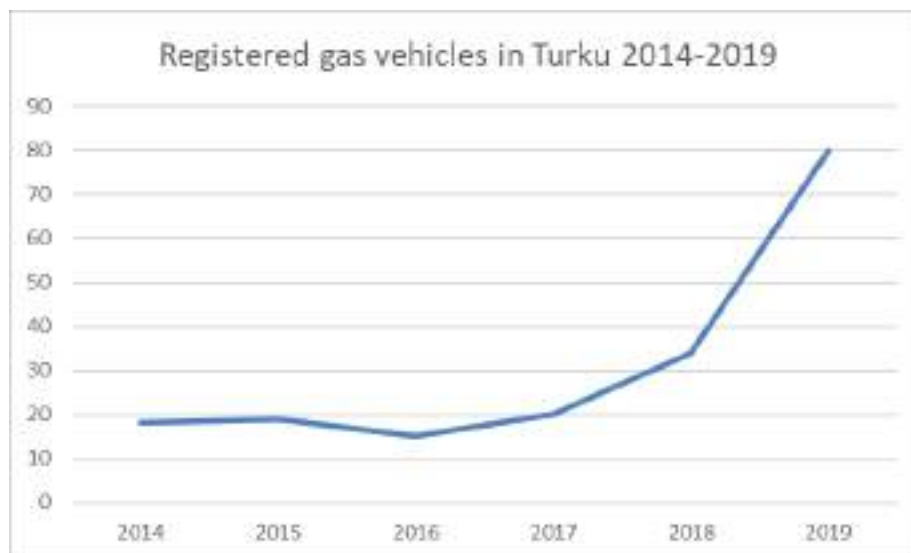


Figure 3. Registered gas passenger vehicles in Turku 2014-2019

D.4.2 Communication and campaigning

Gasum Ltd. has also campaigned strongly to promote the use of biogas as a traffic fuel. The company has teamed up with car manufacturers (such as SEAT) and offered two years of biogas free of charge when a new gas car is bought. In addition, gas filling has been offered with a fixed price, e.g. 59€/month. This strong focus on marketing is likely to have contributed to the fast rise in gas vehicles purchased in Finland.

D.4.3 Rise in the production of biogas

Biogas production has risen steadily over the years. In 2016, 647 GWh of biogas was produced, out of which 24 GWh as vehicle fuel. In 2018, approximately 101 GWh of biogas was fed into the gas network (Energiavirasto 2019)⁶⁵. It has been estimated that a realistic potential for biogas production in Finland could reach 10-15 TWh/year. If all of that was used as transportation fuel, it would account for a minimum of 18% of all road traffic fuel consumption.

D.5 Recommendations on the implementation process

Some recommendations can be highlighted based on process evaluation.

D.5.1 Biogas promotion on municipal level needs to be supported by an efficient filling station network

It is evident that the procurement of (bio)gas vehicles on municipal level is a political decision. A push for more environmentally friendly transport in city fleets needs to be coupled with expansion of gas filling network in order to become a feasible choice for municipalities in their efforts to reach their transport-related climate targets. Municipalities should thus work to promote the expansion of the filling station infrastructure as well.

⁶⁵ Energiavirasto 2019. Kaasun toimitusvarmuus vuonna 2019. <https://energiavirasto.fi/documents/11120570/12722768/Raportti-kaasun-toimitusvarmuus-2019.pdf/7325ed49-38a0-e8d4-6d70-f527e2e4bc2d/Raportti-kaasun-toimitusvarmuus-2019.pdf>

D.5.2 Communication and marketing is needed

Still a somewhat novel issue to the greater public, biogas vehicles as a viable option for more environmentally friendly personal transport still needs strong promotional activities. Focusing on the resource efficiency aspect is a strong image benefit. In order to promote more extensive use of biogas in heavy freight traffic, examples of their suitability for different types of routes should be further promoted among companies.

E. Evaluation conclusions

The observed impacts of the measure have been reviewed by having well-structured discussions with Measure Leaders, Site Coordinators, external experts, stakeholders, etc. Based on this, the evaluation conclusions have been formulated.

Here these conclusions are summarized in bullet points to highlight the key elements and results of the evaluation.

E.1 Validated direct impact

- Two biogas trucks are operating in Turku.
- The city of Turku has succeeded in promoting biogas vehicles among their own fleet.
- The use of biogas as transportation fuel has increased during the project.
- The number of registered gas vehicles has risen significantly in Turku.
- LBG/CBG trucks have proven a viable and cost-efficient alternative in heavy traffic.

E.2 Relevance of supporting activities

The importance of the expansion of the LNG/LBG biogas filling station network cannot be underestimated when discussing overall project impact. This has strongly contributed to the achievement of project objectives. However, the benefit has been mutual – without promotional activities by projects such as ECCENTRIC and without user experiences from different vehicle types (heavy traffic, city fleets), there would probably not be as much interest on biogas as a viable option for transportation fuel.

E.3 Interaction with other measures

No interactions with other measures were identified for this measure.

E.4 Main lessons learned

- Biogas vehicles have proven a feasible and environmentally friendly alternative to diesel/petrol vehicles in heavy traffic and among city fleets.
- A potential barrier is that currently the motors in LBG trucks have less horsepower than their diesel counterparts, which may in some cases reduce their suitability for certain functions. However, this barrier is valid only for the Finnish market, since the trucks in Finland require more horsepower than other European markets due to the forest and paper industry requirements.
- Another potential barrier is the LBG filling infrastructure – if it's not expansive enough, the operating radius especially with heavy traffic may prove too limited. Gasum is currently building 50 new LBG filling stations in Finland, Sweden and Norway which will cover the requirements of the logistics market.
- It was originally planned that the city of Turku would promote the use of biogas by 2 or 3 delivery vans or similar which operate e.g. food transport in the city area. This did not take place as there was no incentive budget that could be used for this, and information provision alone was not appealing enough for the companies. It would have helped to take this into account when planning the project.
- It is important to include the biogas communication material systematically to the different communication channels.

E.5 Long term impact

The measure has provided a fine opportunity for showcasing biogas use in heavy traffic and served effectively in promoting biogas as a viable option for passenger cars. During the project, the number of biogas vehicles (passenger cars) has risen significantly. It has been estimated that the only real limiting factor for increasing the share of biogas among transportation fuels in the long term is its production capacity.

E.6 Potentials for up-scaling in the city

When the project started, Turku city had four gas vehicles in use in its fleet and at the end of 2019, 15 more were procured. The current procurement contract also includes an option for more purchases if the user experiences are positive. Potentials for upscaling abound, also given by the fact that nowadays the price level of biogas vehicles is almost similar to traditional gasoline or petrol vehicles. The expansion of the filling station network also supports up-scaling.

F. Additional information

F.1 Appraisal of evaluation approach

Here is given a critical reflection on the evaluation approach for this measure, indicating weak and strong points and giving recommendations for similar evaluation work in the future.

- All in all, no major obstacles occurred during evaluation. For process evaluation, a better grasp on stakeholder views barriers and drivers would have been welcomed.
- Due to the strong contributing influence of the measure's supporting activities, it was very difficult to differentiate between project impact and the impact of those supporting activities. This clearly hindered assessing direct project impact.
- Some of the indicators (awareness, acceptance) entailed really more of an impact from the supporting activities than direct project activities. In retrospect, these indicators should have been reformulated to gain a better view on direct measure impact. A better grasp on biogas awareness, for example, would have been obtained from a city-wide survey.

F.2 Future activities relating to the measure

Here are presented the recommendations for the future of the measure after the project lifetime.

Improved EU legislation on heavy vehicle emissions is bound to create more momentum to LNG/LBG usage in the future. Measure results prove biogas vehicles to be a feasible and cost-effective and alternative to diesel/petrol vehicles both in heavy traffic and among city fleets, especially while only few options are still available for electric heavy traffic and often battery range issues limit the use of electric vans/cars in some city functions. Plenty of upscaling potential thereby exists for gas vehicles both with private companies and the city with their own or subcontracted fleet. It is recommended that biogas usage is included in tendering criteria of both cities and companies. With the continuously expanding gas filling station network, there are no major hindrances foreseen for further use of gas vehicles.