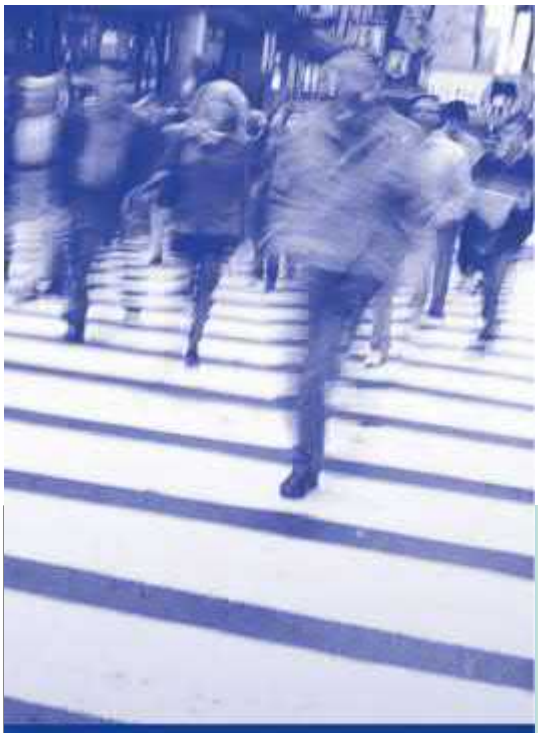

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Abstract

This report is focused on upscaling and replication potential of the WP5 demonstration measures dealing with ***Testing and operating clean and silent vehicles***. The document includes a short description of each measure, an overview of lessons learned and conclusions from Cluster 2 measures as well as specific experiences and recommendations for two different topics: electromobility in public transport and e-mobiity stations.

WP5 Efficient and clean public transport; CLUSTER 2, Testing and operating clean and silent vehicles

Measures TUR 5.7 (Introduction of Electric Public Transport); MAD 5.8 (Electric and hybrid buses for Public Transport) and MUC 5.9 (e-Mobility Stations).

Project Partners

Organisation	Country	Abbreviation
Ayuntamiento de Madrid	Spain	AYTOMADRID
Grupo de Estudios y Alternativas 21 SL	Spain	GEA21
Consorcio Regional de Transportes de Madrid	Spain	CRTM
Empresa Municipal de Transportes de Madrid SA	Spain	EMT
Universidad Politécnica de Madrid	Spain	UPM
Avia Ingenieria y Disegno SL	Spain	AVIA
FM Logistic Corporate	Spain	FM LOGISTIC
Stockholms Stad	Sweden	STO
Kungliga Tekniska Hoegskolan	Sweden	KTH
Flexidrive Sverige AB	Sweden	FLEXI
Carshare Ventures BV	Sweden	CARSHARE
Ubigo Innovation AB	Sweden	UBIGO
Mobility Motors Sweden AB	Sweden	MM
Cykelconsulterna Sverige AB	Sweden	CYKEL
Gomore APS	Sweden	GOMORE
Landeshauptstadt Muenchen	Germany	LHM
Münchner Verkehrsgellschaft mbH	Germany	MVG
Domagkpark Genossenschaft EF	Germany	DOMAGK
Green City EV	Germany	GC
Green City Projekt GMBH	Germany	GCP
Technische Universitaet Muenchen	Germany	TUM
City of Turku	Finland	TUR
Varsinais-Suomen Liito	Finland	VSL
Turun Kaupunkiliikenne OY	Finland	TUKL
Western Systems OY	Finland	WS
Turun Ammattikorekeakoulu OY	Finland	TUAS
Gasum Biovakka OY	Finland	GASUM
Obshtina Ruse	Bulgaria	RUSEMUN

Club Sustainable Development of Civil Society Association	Bulgaria	CSDCS
ICLEI European Secretariat GMBH	Germany	ICLEI
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List of Acronyms

ACM	Electric light weight vehicles for car sharing and logistics (prototype)
CO_2	Carbon Dioxide
D	Deliverable
EC	European Commission
EFV	Electric Freight Vehicle
EV	Electric Vehicle
FCEV	Fuell Cell Electric Vehicle
e.g.	*exempli gratia* (for example)
i.e.	*id est* (that is to say)
KPI	Key indicators
LEV	Light Electric Vehicle
MIT	Motorised Individual Transport
MSP	Mobility Service Providers
ML	Measure Leader
NOx	Nitrogen Oxides
PT	Public Transport
TCO	Total Cost of Ownership
VKT	Vehicle-Kilometer Travelled
WP	Work Package
WPL	Work Package Leader

Executive Summary

The document includes guidelines for the replication of the measures demonstrated within the cluster *Testing and operating clean and silent vehicles,* including recommendations and lessons learned, as well as general conclusions.

The demonstration actions are focused on testing and operating clean and silent vehicles (fully electric and hybrid ones) in real operation conditions. This cluster also includes the implementation of (e-)mobility stations (initially 2, currently 4), by combining public transport, car-sharing, and bike–sharing in Munich Living Lab, a new urban area of one of the demo cities.

The measures presented in this report are examples of the introduction of cleaner public transport buses (electric or hybrid ones) as well as new and integrated sharing mobility services complementing public transport in existing and new urban developments which highlight the role played by the City Councils regarding the provision of financing, regulation and policy instruments, public land, the necessary recharging infrastructure to support electric vehicles and communication campaigns Also, the European Commission funding (through CIVITAS ECCENTRIC project) has been a key point.

Financing the high costs of electric and hybrid buses (up to twice the price of a Diesel bus) and the fear of adopting a new and different technology (technological reliability, charging options), the existing regulatory framework (that in many cases does not take into account electric vehicles or shared mobility systems) and the reluctance of shared mobility operators to be integrated into a common digital mobility service app or mobility platform are the biggest barriers to the adoption of a more sustainable and clean transport system.

This needs to be addressed through a different political and administrative processes in which the municipalities must adopt a leader role to overcome these barriers and upgrading the transport systems making them cleaner, more energy efficient and more sustainable.

Detailed background of the measures, as well as the results from tasks 5.1 and 5.2, are explained in deliverables D5.1 “Preparing for an efficient and clean public transport system” and D5.2 “Testing and operating clean and silent vehicles”.

The following chapters outline the upscaling and replication potential of the demonstration activities for efficient and clean public transport solutions in Madrid, Munich, and Turku as well as conclusions and recommendations regarding success factors and barriers at different levels.

1. Introduction

1.1. Purpose of this document

In CIVITAS ECCENTRIC, five cities (Turku, Stockholm, Ruse, Munich, and Madrid) have implemented in total 51 innovative sustainable urban mobility measures. The measures were addressing a variety on urban mobility challenges, organized in different thematic clusters. This document is intended to equip practitioners and decision makers with the information needed if they want to replicate measures of the thematic cluster “Testing and operating clean and silent vehicles” or aspects of these measures.

Replicability refers to the possibility of transferring results from a pilot case to other geographical areas. These areas have, of course different local contexts and conditions. When a specific measure proved to be successful in one area of a European city, it should be possible to transfer it to another city (or another area of the initial city), considering, the local conditons and conditionalities.

1.2. Target group

This document is tailored following the practical needs of project developers and planners / technical staff fom cities to develop innovative measures, to consider potential barriers and to be able to select the appropriate solutions to match their contexts. This document provides evidence that measures have been sucessfully implemented in a city and have a good replicability potential.

2. Summary of the Cluster: Testing and operating clean and silent vehicles

In the last decade, European cities have made significant steps forward in the delivery of sustainable urban mobility policies, proving that major impacts in terms of congestion and reduced emissions can be achieved through ambitious measures.

At the same time, peripheral districts remain largely unaddressed, with the effects of flagship projects being rarely transferred to these areas. Recent or future urban growth processes are posing additional pressure to peri-central areas. The main common challenges are to relieve central areas through clean and efficient urban logistics, as well as to increase the attractiveness and sustainable mobility of suburban districts.

To tackle these common challenges, the cities of Madrid, Stockholm, Munich, Turku, and Ruse have formed the CIVITAS ECCENTRIC consortium. The overall objective of the CIVITAS ECCENTRIC project is "t*o demonstrate and test the potential and replicability of integrated and inclusive urban planning and sustainable mobility measures that increase the quality of life of all citizens in urban areas, with a particular focus on suburban districts and new developments and the clean organisation of urban freight logistics"*.

The main objective of WP5 is to demonstrate, in the outskirts of the different living laboratory areas, efficient and clean public transport solutions to increase attractiveness and conditions for sustainable mobility in peripheral districts. To achieve this goal, these living labs will implement different measures with the following specific objectives:

- Increase the use of public transport in the consolidated districts out of the city centre.
- Increase the efficiency and environmental performance of the public transport fleet, and consequently reduce energy consumption and associated emissions.
- Accelerate the introduction of e-mobility in cities.

WP5 has implemented ten measures in all the consortium cities that could be grouped into two main clusters:

- **Cluster 1, Reorganising public transport network**: high level PT services corridors, speed up core bus routes, reorganisation of bus lines and provision of new lines and services (adaptive public transport priority and night services).

  This cluster also includes the provision of bike-sharing and car-sharing schemes as well as elements of the public transport chain.

- **Cluster 2, Testing and operating clean and silent vehicles** (fully electric, hybrid and CNG buses) in normal operation conditions.

  This cluster also includes the implementation of (e-)mobility stations, by combining public transport, car-sharing, and bike–sharing in a new housing area of one of the demo cities.

Cluster	Measure	City	Partner(s)
2	TUR 5.7	Turku	TUR, TuKL, TUAS
2	MAD 5.8	Madrid	EMT, CRTM
2	MUC 5.9	Munich	LHM/ VMG

Table 1: Overview of the cluster 2 measures included in WP5

The European Commission's Urban Mobility Package and the European Parliament's initiative report on Urban Mobility both state the urgency of addressing the challenges regarding air quality, CO_2 emissions and noise as well as traffic congestion.

In this context, a new approach is required to integrate transport policy with urban planning, air quality and vehicle emissions regulations to address a new urban mobility culture and to shift towards cleaner and efficient urban mobility systems.

In a multimodal and sustainable transport system approach, the use of clean vehicles in public transport should become a priority. For urban areas, this implies a shift in public transport fleets from diesel buses to renewable or alternative fuels or electric buses.

On the other hand, the shared mobility systems (car, bicycle, and motorbike), are growing exponentially in many European cities, offering a transport alternative tailored to the new citizens' needs. In addition, being electric vehicles or low emissions, they are contributing greatly to improve the cities' air quality.

In this context of change, the CIVITAS ECCENTRIC project and specifically WP5 cluster 2 measures regarding efficient and clean public transport solutions are an exceptional opportunity to share valuable experiences (and tested in the laboratory areas) with other cities allowing them to improve their sustainable mobility strategies.

The measures presented in this report are examples of the introduction of cleaner public transport buses (electric or hybrid ones) as well as new and integrated sharing mobility services complementing public transport in new residential developments (e-mobility stations).

3. From ECCENTRIC cities to replication in other places

When talking about replication, demand must match supply: the measures implemented by the ECCENTRIC cities should provide effective processes, methodologies and technological packages to cities interested in replication.

WP5 cluster 2 is focused on testing and operating clean and silent vehicles and the implementation of (e-)mobility stations (initially 2 stations: currently 4). It includes three measures implemented in the cities of Madrid, Munich and Turku:

3.1. Brief summary of the respective measures

- **TUR 5.7: Introduction of Electric Public Transport**

Figure 1: Electric bus charging

City of Turku has set the goal of becoming CO_2 neutral by the year 2029.

The series of measures that will support the achievement of this goal was based on the decision to switch to electricity as the primary source of energy in public transportation.

This measure introduces a pilot project that is the first step in that process. The pilot consists of one bus line (between airport and ferry terminal, 12.6 km in total length) operated with six electric buses supported by quick charging stations at each end of the line and an overnight charging station at the bus depot. Only during the port rush hours, the transport schedule is complemented with two low-emission diesel buses.

Before piloting with fully electric vehicles, the only experience of alternative fuels the City of Turku had, was provided by the hybrid buses. For this reason, the project has been a major research, procurement, and training effort.

As electric buses are a somewhat new development in Finland, the measure provides valuable information particularly during wintertime, when electric buses are more affected by the specific conditions.

Regarding challenges, the main ones are as follows:

- Implementing relatively new and untested technology.
- Reaching a level of reliability comparable with conventional vehicles.
- High workload for drivers and supervisors.

The main actions taken have aimed at piloting the first electric bus line, planning for extension of electric bus lines, development of charging solutions and analysis of use, and marketing and communication campaigns.

As a result of the measure, six electric buses are out in the traffic, partly funded by CIVITAS 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, because of more environmentally friendly solutions (less emissions and less noise).

During the first operational 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. Also, in terms of the operational levels, the vehicles are yet to reach their planned yearly goals. Turku winter conditions also presented some challenges for 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 has particularly contributed to proving that PT electrification can be a very much viable option of organising public transport towards carbon neutrality.

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.

- **MAD 5.8: Electric and hybrid buses for public transport**

Figure 2: New CIVITAS ECCENTRIC Diesel-hybrid buses operating in line 140

The main objective of this measure is to provide the best possible public transport service using a “clean” bus fleet in areas which lack high-quality public transport services. The environmental performance and attractiveness of the city of Madrid’s public transport service will thus, in general, improve as a result, and be better suited to compete with private car use, introducing at least six (finally 9) hybrid electric buses to Madrid’s existing bus fleet to test and use them in real-life conditions in the city’s living lab (in two south-eastern peripheral districts of the city out of the first ring road: the Living Lab of Puente de Vallecas and Villa de Vallecas).

The measure is consistent with the Air Quality Plan and the actions of Madrid’s Sustainable Urban Mobility Plan (SUMP). It is also aligned with EMT’s strategic plans regarding clean fleet uptake, and the experience will be used to better understand the performance of these types of buses and therefore to help better define EMT Madrid’s own strategy on fleet renewal.

New hybrid diesel buses are included in the EMT fleet for the first time.

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.

The main challenge was to assess the performance of buses to check its reliability compared to traditional diesel ones, including the total life cycle cost, maintenance needs and environmental performance.

The expected impacts include:

- A reduction in energy consumption and emissions by 30% (compared to previously used diesel buses which were providing the service before the hybrid buses - based on data from 2017), as well as reductions in noise.
- Furthermore, the positive assessment by users of the new buses in terms of attractiveness and comfort, thus increasing their use of the service.
- Finally, energy savings resulting in operational cost savings, compensating the increased capital costs of the new buses.

Overall, the achievement of the objectives has been satisfactory. Only the 30% reduction in energy consumption and CO_2 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 NOx and PM emissions than on CO_2 emissions, as the new hybrid buses combine the effect of fuel savings and a cleaner Euro VI engine.

The impact of this measure on Madrid's air quality is, therefore, well aligned with the objectives stated by the municipality in its last Air Quality Plan. Furthermore, actions that affect air quality have, in the end, effects on climate change mitigations.

The main output of this measure will be the guidelines for selecting major EMT's fleet renewal to be undertaken in the coming years.

Despite 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.

- **MUC 5.9: (E-)Mobility stations at the Development Area Domagkpark**

Figure 3: (E-)mobility station in Domagpark

This measure aims to implement in a new housing area in Munich a new multimodal mobility service: (e-)mobility stations. This is achieved by combining and providing different sharing offers with charging infrastructure and general information about the different mobility options. This will allow the residents to live a car-free life or at least to have significant lower mobility costs. These stations are easily accessible in close location to public transport services. These mobility stations are a physical "hub" that feature a new design and represent a new means of providing access to these services in Munich. They are combined with new regulations that enable reserving parking space only for car-sharing vehicles. The stations are provided by the City, which is offering a platform for all interested private mobility suppliers.

There are four mobility stations distributed across 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 motorised individual transport, the e-mobility stations are a central measure within Munich's CIVITAS ECCENTRIC context. Other CIVITAS ECCENTRIC measures are planned to become part of the mobility stations, e.g. the E-Trike or the electric light weight vehicle ACM.

A great challenge but essential backbone of the mobility station services is represented by the provision of one common booking service where all sharing services are available. Consequently, the aim is to collect all relevant stakeholders within the existing mobility app of MVG (Munich public mobility provider) to allow an easy way of online booking from everywhere.

The actions related to these stations have been accompanied by communication campaigns combined with an innovative direct and dialogue marketing campaign for every household and as many companies as possible, within the Living Lab (see CIVITAS ECCENTRIC measure MUC 2.9 of mobility management).

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

The mobility stations are an implemented measure easy to upscale or replicate because there are already four mobility stations which have been implemented in the Living Lab. Investment and operational costs can be numbered quite precisely.

In fact, Turku and Madrid have initiated processes to replicate this concept within their CIVITAS ECCENTRIC development.

3.2. Evaluating the replication potential of measures

The European Commission is working to improve citizens' quality of life by promoting sustainable urban mobility and increased use of clean and energy efficient vehicles. Clean buses and shared mobility in urban areas have an important role to play in achieving EU policy objectives of reducing emissions of greenhouse gases, air pollutants and noise, and consequently have relevant health benefits to the citizens.

Nevertheless, regarding clean vehicles the potential of innovative technologies (biofuels, hydrogen and fuel cells, and battery electric and hybrid electric vehicles with plug-in) is not widely used due to concerns about technological reliability and high costs, in particular electric battery and fuel cell buses.

The three measures outlined in Section 3 are being developed in three European cities (Turku, Madrid, and Munich) and are practical examples of trends and challenges already identified in Europe.

The main lessons learned during the implementation processes are summarised as it follows.

3.2.1 Drivers and barriers to be expected

Requirements to be considered in procurement and implementation of clean buses (electric and hybrid)

- The technology is relatively new and untested (compared to diesel vehicles). There are few manufacturers and products to choose from and very few manufacturing standards. This limits the available options and may, in some cases, make electric and hybrid vehicles a less appealing alternative.
- Charging infrastructure options are a key point to be considered mainly regarding with the high costs. It is also important to evaluate the need of on-board auxiliary power (e.g. a diesel engine for charging the battery, the so-called range extender).
- Extra care should be taken when evaluating the supplier's technical and financial capabilities and their references when procuring vehicles. Depending on the type of contract it may be advisable to set sanctions for the amount of time the vehicles are out of order (due to e.g. break down), specific demands for dealing with technical problems (e.g. deadlines) and specifying the number of vehicles in reserve.
- From the testing point of view, it is better to start with small pilots. Restricted procurements work well if there is a clear understanding of the requirements and technical details of the vehicles, charging stations and service; limiting the number of tenders for the final round of competitive bidding can be helpful. However, big tenders make it possible to get better prices from bus manufacturers.

Adopting new technology and long-term vision (fully electric buses)

- It should be expected that adopting new technology will cause problems. In general, this means delays and emphasis on reliability and the importance of preparing for setbacks by allocating sufficient staff and other resources to avoid excessive workloads and related problems. Having spare vehicles ready at hand has proven more important than anticipated, and the lack of vehicles can easily become a bottleneck.
- Winter operation of electric buses can be a significant challenge afecting the general performance level achieved by the new technology.

  The cold weather reduces the performance of the batteries of electric vehicles (by slowing down the electrochemical reactions that occur in the batteries), reducing the acceleration of the vehicle and its autonomy. On the other hand, the vehicle can also lose power. The cold also affects the loading times of vehicles, that are longer.

There are heating / cooling[1] systems in the batteries to prevent these problems from affecting normal use of vehicles. But heating the batteries implies using the battery's own energy and, therefore, reduces its autonomy.

- Large scale transition to electric vehicles in public transportation depends to a great extent on the development of battery technology. The life span of batteries and the cost of replacing them is a major component in the total cost of ownership. Also, now the capacity and weight of batteries are perhaps the most important limitations to the use of electric buses.
- Regarding electric bus charging, stopping at the same spot on quick charging stops accelerates the wear of the road surface causing extra cost of repair and/or need for extra investment.
- Based on public transport operator experience, to scale up towards a fully electric bus the most significant characteristic of the bus route is to allow low and constant average speed.
- On the other hand, the suitability of available electric vehicles for a given type of traffic should be considered when planning the long-term transition to electricity.

Adopting new (e-)mobility stations

- The design of new mobility concepts must be focused on feasibility and financing and its implementation implies redefining urban planning and mobility schemes. In this context, it is necessary to develop tools to integrate shared mobility as a new mode in planning and modelling the cities.
- The location of these mobility stations must be carefully selected to be able to arrange all individual elements of the mobility station. So, it is a key point to start early enough with the involvement of all relevant planning stakeholders .The (e-)mobility stations combine and provide different types of shared mobility services in connection with and complementary to the use of public transport. The tender process for future mobility providers should clearly specify the quality standards for services. This is, no doubt, time consuming.
- Special attention must be paid to electric charging infrastructures and parking enforcement at the mobility station. As shared / electrical mobility are relatively new concepts, it is key that urban planners are made aware of the need to plan new urban developments (residential, industrial, services, etc.) already equipped with charging stations for electric vehicles.
- On the other hand, the integration of all mobility providers to operate through a common mobility service application or platform is a relevant aspect regarding the success of the service that can require the development of an open data regulation for mobility providers.

[1] On the other hand, excessive heat accelerates electrochemical reactions and in this case the battery could give more power, it would discharge earlier and it will also age earlier. It also decreases the autonomy of the vehicle.

- Be aware of the need for parking enforcement at the mobility station. Parking enforcement is a key for the operation of exclusive parking spaces for shared vehicles. To recognise parking occupancy of the parking space on site, a sensor or parking detection could be integrated.

Communication campaigns and actions

- Awareness and acceptance for the new mobility services and infrastructures need to be developed carefully to get more users to utilise sustainable and multimodal transport system.
- Communication actions informing users (citizens) and bus drivers about the service improvements thanks to the new clean buses (electric or hybrid) are especially useful to help the adoption of new clean fleets and new patterns of mobility.
- Regarding mobility stations, it is key to closely link infrastructure development and communication campaign as well as provide a good recognisable brand of mobility station.

The following barriers were identified during measures planning, implementation, and demonstration phases:

- **Organisational**

  Changes of key personnel involved in the measure development can have a significant effect on the results of the measure.

- **Financial**

  An electric / hybrid bus is an expensive investment, and this might delay further procurements and the long-term objectives of the measure to promote and implement sustainable, clean and (energy) efficient urban transport.

- **Operational**

  The internal PT operator procedures to assign the new clean buses to specific lines can result in delays: e.g. in Madrid it took some time until the adequate route serving the living lab was identified and the operational planning was adapted to include the new hybrid buses assigned to the line as well as the relocation of the old ones to be substituted.

  On the other hand, ongoing construction works in new development areas hinder the implementation and completion of mobility stations.

The following drivers were identified during the phases:

- **Political / strategic**

  Commitment of key actors (City councils, political stakeholders, operating companies) to promote the adoption of PT new clean technologies / (e-)mobility stations has been a major driver for the measures.

  The alignment of the measures to key actor's strategic objectives contributes to overcome the implementation challenges in a relatively easy way.

The goals to be achieved have been largely supported politically and larger scale electrification / fleet renewal of public transport is part of the cities's climate objectives.

- **Planning**

  The measures in Madrid and Turku were pre-planned to a good extent before their official starting time, which meant that procurement and implementation could get started in the earliest stages of the CIVITAS ECCENTRIC project. A procurement process of this size could not be carried out within a usual project time scale. Hence the success of the pre-planning has been essential for measures objective completion.

- **Organisational**

  The strong role of EMT (Madrid Public Transport company) and Turku City Traffic Ltd. and the commitment of the companies's Management Boards to PT clean fleet technologies (electrific / hybrid buses) have been an essential driver in the implementation processes. Both companies have successfully promoted PT fleet renewal and electrification on political and strategic level.

3.2.2 Foreseeable Impacts

Regarding clean PT vehicles (electric or hybrid ones) the expected impacts include:

- An overall strengthening of the traditional benefits of public transport.
- A reduction in energy consumption and emissions (compared to previously used diesel buses which were providing the service before the hybrid or electric buses), as well as reductions in noise.
- Furthermore, it is expected that the new buses will be positively valued by users in terms of attractiveness and comfort, thus increasing their use of the service.
- Finally, energy savings are expected to result in operational cost savings, compensating the increased capital costs of the new buses.

The evaluation of the Introduction of Electric buses in Turku highlithed the following topics:

- Noise level of bus traffic declines on the routes that are operated with electric buses.
- Customer satisfaction increased due to more comfortable rides and better service quality.
- Driver satisfaction increased due to more comfortable driving environment (less vibration, lower noise level).
- Cost efficiency of bus traffic increases because of lower operation costs (energy + maintenance).
- Citizens are more satisfied of public transportation because of more environment friendly solutions (less emissions + noise).

The evaluation of the first hybrid buses in Madrid Public Transport states that the measure has been successful in achieving significant reductions in the emissions of CO_2 and key pollutants (NOx 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 replaced Euro IV diesel buses will be recovered in less than 5 years, considering an average annual mileage of 50,000 km, due to fuel and maintenance savings.

No.	Indicator	Data units
1	Satisfaction	Score (0-5)
2	Contribution to Policies, Plans and Programs	Score (0-5)
3	Investment costs	Euro
4	Operational costs	Euro
5	Vehicle-Km travelled	Kilometres
6	Accuracy of time-keeping	Percentage
7	CO2 Emissions	Tons of CO2
8	NOx emissions	Tons of NOx
9	PM emissions	Tons of PM
10	Energy efficiency	MJ/km
11	Noise level	dB(A)

Table 2: KPIs clean PT vehicles

(e-) Mobility Stations impact differently car owners and captive riders of Public Transport. For the first ones, these facilities enable the possibility of lower car ownership rates. For the latter, they provide an increase of the mobility options, which is desirable for low income households. A careful consideration of its effects in the different target groups and the overall outcome is recommended, before committing to these solutions. When addressing the different target groups correctly, the expected impacts can include:

- Enabling multimodal behaviour, by including more sustainable options into the modal choice selection, and therefore reducing car dependency.
- An overall reduction of Vehicle-Kilometre Travelled (VKT), on account of the modal shift to public transport and active mobility.
- Reduction of CO_2 emissions within the project lifetime.
- Reduction of NOx and PM emissions.

- Following reduced car dependency, an eventual 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 can use cars through sharing systems.

The evaluation of the e-Mobility stations shows that residents which are making use of the mobility offers are very satisfied with the mobility stations and the selection of vehicles as well as the services which are being provided (76% of all users).

In general, the usage rate of mobility stations is quite low and cannot promote a positive modal shift towards more sustainable transport options within the short project lifetime. Residents obviously need more time to change their mobility behaviour. The system usage increased significantly after the first wave of the mobility marketing campaign took place in 06/2019 (see measure MUC 2.9a of mobility management).

To raise the awareness of the mobility stations and make them more visible, residents wish to have a more striking colour marking of the station and to integrate the service into Munich's mobility apps.

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 are aware of the vehicles and services the mobility station offers but do not use them. Conventional car-sharing is still the most frequently used mobility option, pursued by e-carsharing, bikesharing or the e-cargo-bike sharing.

No.	Indicator	Data units
1	Awareness	%
2	Acceptance	%
3	Satisfaction	Score (0-5)
4	Mode Shift	%
5	Car Ownership	Cars-to-inh. ratio
6	Vehicle-Km travelled	Km
7	CO_2-Emissions	Tons
8	NOx-Emissions	Tons
9	PM-Emissions	Tons
10	Access to Mobility Services	%
11	Relative Travel Cost	Ratio (travel cost/income)
12	System Usage	# of rentals
13	Investment Costs	€
14	Operating Costs	€/time or usage

Table 3: KPIs (e-)mobility stations

3.2.3 Policy Recommendations

The addition of clean and silent vehicles to public transport fleets should have the users (current and potential) at the center of the decision-making process. If basic expectations are already covered (punctuality, reliability, speed, connectivity, etc.), new technologies should be of great help to increase satisfaction and secure high ridership levels.

On the other hand, these additions will not compensate for existing deficiencies of the basic service expected from public transport. In those cases, satisfaction and ridership figures will benefit more from improving in other operational areas than the powertrain technology.

As for (e-) mobility stations, can enhance largely the benefits of public transport if panned carefully. Planners should look at the specific impact in travel behavior of the different target groups with access to the mobility station. For regular drivers, mobility stations can mean the possibility to become multimodal at some point, opening the door for less car dependency and some savings in VKT, emissions, etc. For traditionally disadvantaged groups, mobility stations can provide access to modes (and opportunities) not available for them before.

Noteworthy is also the increased mobility for groups already good served. Mobility stations and the mobility options provided there can mean a step back on their sustainable mobility behavior, by replacing public transport trips and legs done before by cycling or walking.

Some recommendations can be highlighted for the implementation process:

- Planning is of essence

  To facilitate the process of 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.

  Early involvement of local stakeholders and planners of the city is crucial for success of the planning process of mobility stations.

- Compare a broader range of technologies, if possible.

  E.g., the scope of measure developed in Madrid 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.

- Political will and commitment is needed to implement clean and silent PT systems

Implementing a system based on novel technology (electric or hybrid ones) is bound to have some setbacks and failures, possible 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.

- Aligning investments with city strategies is also crucial to get political support.
- When there are measures with a similar goal synergy effects can be comparable, and the projects can benefit from each other.
- Finally, as it has been stated before, the communication and marketing policy of the project, as well as the feedback of the participatory processes, is a key point for the project success.

4. Example measure

4.1. Measure MAD 5.8 Electric and hybrid buses for Public Transport

Madrid has focused in 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 line close to the CIVITAS ECCENTRIC living lab in Madrid.

This way, by reducing energy consumption, CO_2 emissions and noise, the company has cooperated in achieving city goals in this regard, whereas improving the service provided to citizens.

Figure 4: Electric and hybrid buses for public transport (measure MAD 5.8)

Implementation

The key steps of this phase are:

- No infrastructure was required for the solution to function.
- Nevertheless, despite the provisions made for the demonstration, service provision has occasionally deviated from the initial plans following the decisions of the depot managers, 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 the selected bus line. These changes have not been substantial enough to compromise the reliability of the results obtained on passengers' satisfaction, fuel consumption and emissions, but need to be considered.

- 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 (the number of hybrid buses was increased from 6 to 9) and to the partial provision of services in the pilot line by conventional diesel buses.
- The main stakeholders involved, besides EMT, have been the City Council and Madrid Transport Authority (CRTM, which need to authorize new operational aspects due to the new bus characteristics -timing, frequencies, etc.) as the main public administrations interested in improving city transport conditions.
- Though the measure was implemented in a "standalone" way, for replication purposes it may be worth to link it with other ones such as specific bus corridors.

Business model and contractual partnerships

- The measure is owned by EMT, the public transport operator of the city in charge of the bus service.
- Buses were purchased via an open procurement process financed by the City Council. Procurement was concluded in December 2016. Before entering in operation in the living lab, the buses were operated in other peripheral lines, as a testing. The operations started on 1 October 2018.
- 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.
- Operating costs have been cut by more than half (51% 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.

Critical challenges and success factors

- Madrid measure MAD 5.8. was influenced by one main driver (political one) which is the priority given by the City Council and the EMT Management Board to fleet renewal. This priority was not in place at the time the CIVITAS 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. This has been also one of the main success factors.
- Among the barriers and difficulties, the main one is related to operational aspects. Due 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.

- The measure has been successful in achieving significant reductions in the emissions of CO_2 and key pollutants (NOx and PM), as well as in energy savings.
- As indicated above, operating costs have decreased by 51%, 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 resulted from the bus use.
- 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.
- 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.

Lessons learned form implementation/replicability

- Hybrid buses provide an effective alternative for the replacement of diesel buses, as they provide CO_2 emission and fuel savings of more than 20%, reduction in NOx and PM emissions, and significant customers' satisfaction; noise reduction is the most valued improvement by users:
  - Diesel-hybrid buses do not show significant additional repairing costs vs diesel ones.
  - The reliability (days/hours out of order due to breakdowns) is like diesel buses.
  - Diesel-hybrid buses do not show any significant difference with conventional diesel ones regarding seasonal weather conditions affecting their performance
- Hybrid buses are also economically efficient, as the additional costs can be recovered in less than 5 years, due to fuel and maintenance savings.

Recommendations

- Among the recommendations, two main ones can be highlighted, based on the implementation process experience for this measure:
  - **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.

- **Compare a broader range of technologies**, if possible: the scope of this CIVITAS ECCENTRIC measure aimed at testing hybrid buses against 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.

4.2. Measure MUC 5.9: Intermodal (E-)Mobility Stations

Mobility stations offer diverse mobility services, including various shared electric vehicles, that complement public transport. This means everyone can choose the most appropriate means of transport for meeting the different mobility needs associated with family, work, everyday life, and leisure. The goal is to ensure better quality of life and maximum mobility without the need for owning a car.

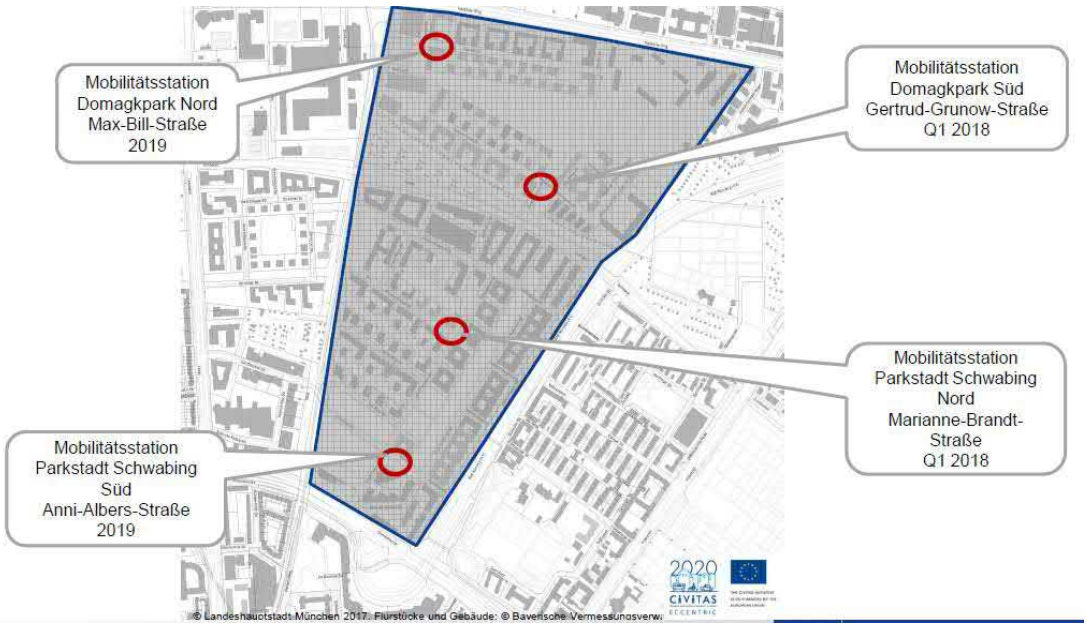

Figure 5: Mobiilty stations in the Living Lab (as of 04/2020)

The characteristics of these e-mobility stations are as follows:

- Gertrud-Grunow-Straße (operational since 07/2018):
  - Carsharing: 5 reserved places for free floating carsharing (ShareNow, Oply, SixtShare, Miles):

    - 1 car of STATTAUTO in public space.
    - 1 e-van 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.
  - Bike sharing station of MVG Rad, with 10 bikes.
  - e-scooter sharing of emmy (free floating).
  - 2 charging points for electric cars, with one reserved parking place for charging cars.
- Marianne-Brandt-Straße (operational since 07/2018):
  - Carsharing: 10 reserved places for free floating carsharing (ShareNow, Oply, SixtShare, Miles):
    - 1 e-vehicle of STATTAUTO in public space.
    - between 2 und 8 cars of STATTAUTO on private ground of a housing association in the Marianne-Brandt-Straße (number is depending on the month).
  - Bike sharing station of MVG Rad, with 10 bikes.
  - e-scooter sharing of emmy (free floating).
  - 4 charging points for electric cars with one reserved for E-carsharing.
- Max-Bill-Straße (operational since 10/2019):
  - Carsharing: 6 reserved places for free floating carsharing (ShareNow, Oply, SixtShare, Miles):
    - 1 car of STATTAUTO above ground in public space.
  - Bike sharing station of MVG Rad, with 10 bikes.
  - Space for free floating bike sharing providers (Donkey Republic, JUMP).
  - e-scooter sharing of emmy (free floating).
  - 4 charging points for electric cars (by SWM) with two reserved parking places for charging cars.
- Anni-Albers-Straße: planned for Q2/2020:

Implementation

In the new urban area of Domagkpark and Parkstadt Schwabing, several mobility stations have been established. Carsharing, e-scooters, and various types of rental bikes from Munich-based providers, like emmy[2], MVG Rad, ShareNow or STATTAUTO, are available at these mobility stations. The services are supplemented by charging stations for electromobility. This measure combines these shared mobility services with access to public transport services, like trams and buses. It is the first

[2] Emmy: the bike sharing provider company.

time that the City of Munich is using the new German Car Sharing Act to make public space available for car-sharing services. New road traffic signs and markings have been introduced in the district, which will apply to all mobility stations in Munich in future.

The launch of the e-mobility stations is accompanied by a marketing campaign to address all residents within the Domagkpark area (which is a purely residential area) but also companies and employees of the neighbouring residential and business area, Parkstadt Schwabing. Both these districts are Munich's 'living labs' in the CIVITAS ECCENTRIC project, and together have an outreach of approximately 8,000 residents.

No special important settings and preconditions to implement the measure.

The main steps for the implementation of this measure have been:

- 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 the 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 plans for two mobility stations completed.
- Phase 2: Procurement and Implementation
  - Construction process for two mobility stations initiated and continuously accompanied.
  - Procurement process for two 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.
  - Opening of first two stations in July 2018.
  - 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 monitoring
  - 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.

- Demonstration and testing activities of newly invented vehicles (Electric light vehicle measure MUC 6.3a and E-Trike measure MUC 3.4).
- Intensification of marketing and communication activities (usage of social media channels).
- Evaluation data query in Q1/2020 completed.
- 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.
- Opening of fourth station in Q2 2020.

Regarding measure deviations, due to changed traffic planning and new construction projects around the Anni-Albers-Straße in the district Parkstadt Schwabing, the mobility station originally planned for the Annie-Albers-Straße could not be implemented. An alternative site for the mobility station in the Parkstadt Schwabing is planned. Implementation conducted in Q2/2020.

Planning and implementation of the first mobility stations took longer than for the subsequent stations as initial development of signage, marking, design, marketing, communication channels, installment and procurement processes, involvement of stakeholders and working processes is faster or not needed again. Overall, 1 and 1.5 years are needed to implement a mobility station depending on the frame conditions of each mobility station.

Resources of all participating stakholders were needed in the different stages of implementation. Early involvement of local stakeholders and planning community of the city has been a key success factor for organising time, funding and knowledge resources.

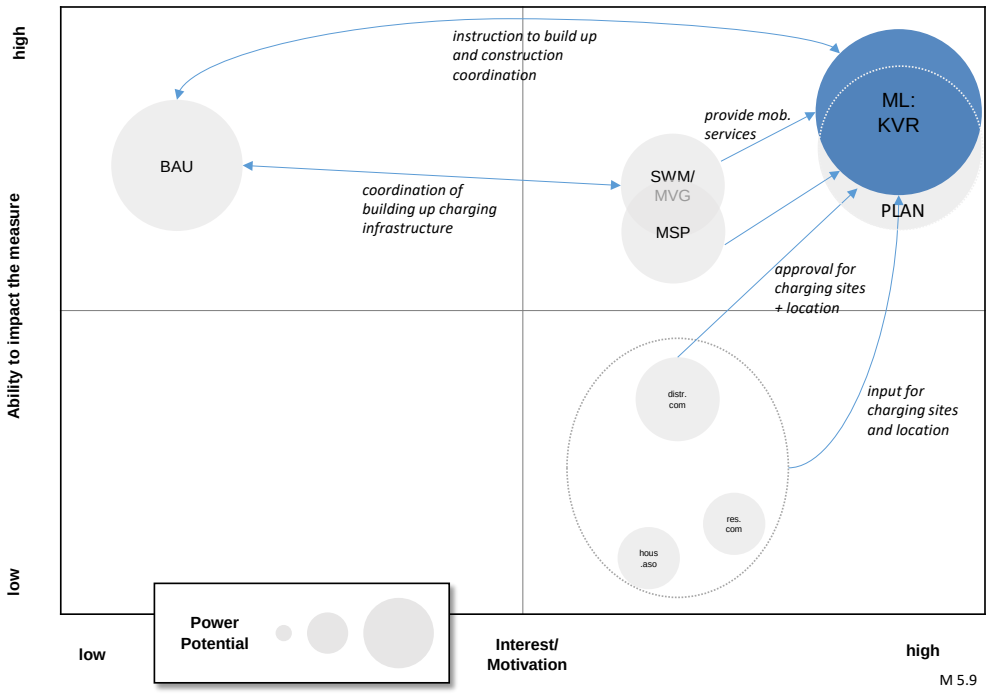

Figure 6: Stakeholder Analysis

In the research and planning phase, interdisciplinary working group for mobility stations were set up with all stakeholders. Involvement of stakeholders depended on the different implementation steps. As measure leader, the City of Munich (Department of Public Order, KVR) was involved in all implementation steps. Other departments of the City of Munich, e.g. the Department of Urban Planning were involved in the coordination and construction process. The SWM/MVG were responsible for the construction and coordination of charging infrastructure and MVG Rad service.

The mobility service providers integrated their services into the stations and supported marketing activities. The district committee was the cooperation link between the residents and the measure leader and were responsible for the political communication at the beginning as well as awareness rising in later statges for the mobility stations. The Housing Association was in charge of the mobility planning and the housing development. The resident community, including the local business representatives, were the target group for the measure and worked also as lobbying group.

All mobility stations are equipped with free-floating and stationary carsharing spaces (number of spaces varies), on-street markings and signage for carsharing, an information pillar, AC charging infrastructure and a stationary bikesahring station. Some mobility stations were built completely new and parking spaces were newly constructed.

For the first time two newly developed vehicles are planned to be part of a shared fleet: ACM electric light vehicle (see measure MUC 6.3a) and E-Trikes (see measure MUC 5.6). Also emmy, a scooter-sharing service (see measure MUC 5.10 -prior MUC 6.3b), is now also part of the mobility offer at the stations.

The first broad marketing campaign for mobility stations started with the opening of the first two stations. This was an ongoing marketing campaign using social media

channels and other materials were highly distributed. Furhter communication campaigns for mobility stations were a joint marketing action with measure MUC2.9. The marketing campaign of measure MUC 2.9a supported the awareness of mobility stations and their offers among the residents and employees in the area. The combination of an innovative direct and a dialogue marketing campaign for every household and as many companies as possible within the development area will improve the measure's effectiveness. It offers information and guidance and will thereby fortify the usage of the new offer (see measure MUC 2.9a).

Cooperation with mobility service providers must be practiced actively with marketing campaigns for their offers. The first wave of the mobility marketing campaign took place in 06/19 and was continued in 2020 with the goal to promote mobility stations and their offers.

Business model and contractual partnerships

Costs of planning:		
• Development of information pillar graphics	1.600 €	**Overall costs of planning:**
• Icon development for mobility stations	4.300 €	
• Mobility stations Wortmarke	1.300 €	**7.200 €**
Costs of infrastructure per station:		
• Charging infrastructure (2 AC charging stations)	10.000 €	**Overall costs of infrastructure per station:**
• Information pillar production	540 €	
• Information pillar shield bearer	450 €	
• Signage and marking	1.350 €	
• Rental bike system (MVG bike station)	3.750 €	**16.000 €**
Costs of communication:		
• Planning and concept of communication campaign	5.000 €	
• 3 videos (Total costs incl. conception, production, postproduction)	9.000 €	
• Flyers (Conception, drawing, image rights, printing, dispatch)	900 €	
• Merchandise/Give aways (Concept, drawing, production, dispatch)	2.200 €	**Overall costs of communication:**
• Billboards	800 €	
• Opening event (Catering, decoration, equipment)	1.900 €	
• Promotion Articles (Sweatshirts, T-shirts, Base-Caps, Jackets)	3.600 €	**23.500 €**
Operating costs:		
• Rental bike system per month	330 €	
• Monthly rental or leasing cost per e-vehicle (Leasing contract for 48 months)	530 €	**Overall operating costs:**
• Social media marketing costs per month	500 €	
• Film and picture material per month	540 €	**1.900 €**

Table 4: Costs for the implementation of a mobility station

The main topics are:

- All mobility stations are on public gound of the City of Munich.
- An important stakeholder needed to complete the offers of the mobility stations are the mobility service providers (MSP). Involvement and cooperation of MSP is voluntary. They have a high interest in bringing in their vehicles and services (car-sharing, (e-) scooters, cargo- and normal bikes, in connection and complementation with the use of public transport like trams and buses). They make use of the good visibility of the measure and position themselves on the mobility market. Their ability to impact the measure is comparable to the MVG because they basically provide mobility services.
- All mobility stations are financed by CIVITAS ECCENTRIC budget.

- The different type of costs to implement one mobility station are shown below:

Critical challenges and success factors

There are two main challenges to implement mobility stations:

- The first challenge is defined by the ongoing construction work in the living lab. The implementation of the measure is dependent on the respective construction progress. A close cooperation between the measure leader and the Building Department could help to make the process more transparent and predictable. The dependence on the construction progress can be classified a high risk because this can be the reason for delayed launch of the other planned mobility stations.
- The second challenge can also be traced back to the construction progress in the Domagkpark residential area. Due to ongoing construction work, the launch of the mobility stations was delayed. The evaluation period is now shorter than planned (only 12 months) due this delay. Since mobility behaviour changes are slow according to experience, there is little change in behaviour during the observation period. The shortened evaluation period of the mobility stations can be classified as a medium risk. But taking this into account for the final evaluation, it helps to eliminate this risk.

Three key success factors can be mentioned:

- The parking management scheme which is also being implemented in the living lab where e-mobility stations are implemented.
- The media-effective opening event of the first two mobility stations and ongoing marketing campaign.
- The direct and dialogue mobility marketing campaign of measure on direct marketing in the living lab.

Looking back at the measures' development these three supporting actions have had a positive impact on the process:

- The parking management scheme (implemented almost city-wide) is subsequently addressing all 3,100 households of the living lab. It was first introduced in Domagkpark and next being implemented in Parkstadt Schwabing. The parking management regulates on-street parking and aims to limit car traffic within this area. The public parking space in the Living Lab is subject to considerable congestion and leads i.e. to illegal parking (also on parking spots dedicated for mobility stations) and furthermore creates dangerous situations for people walking or cycling (see online: Munich City Council resolution of 06.12.2017).
- Another supporting activity was the media-effective event when the first two mobility stations were opened in 07/2018. About 60 participants, among them local press, all mobility service providers offering their services at the mobility stations and the major of the City of Munich joined the event. Local press

released articles about the event and promoted the project city-wide. Residents walking by the event stopped and got attracted to the mobility station offers.

- The direct dialogue marketing campaign offered all kind of information and voucher material about mobility option in the living lab and adjacent areas. All households were addressed by the campaign and could take the chance to get an individual consulting about suiting mobility offers. 34% of the households which ordered information material, asked especially for information about the mobility stations (as of 08/2019).

Lessons learned form implementation/replicability

- 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 must be practiced actively with marketing campaigns for their offers.

Recommendations

- The implementation of a parking management can be crucial for the success of mobility stations. It can lead to less parking pressure, illegal parking on reserved carsharing spots and in general less parking on-street. Hence, frequent, and regular monitoring not only at the start of the parking management seems to be important. The responsible local authority should therefore place a special focus on the monitoring of areas with mobility stations.
- A media-effective opening event can be an important driver for promoting the concept of mobility stations and the operating MSP. Especially the presence of recognized persons of high degree of popularity, like the Major, can raise the

awareness and acceptance of mobility stations. Thus, the local and regional press must be made aware of such events. For a sustainable promotion and awareness of the mobility offers, marketing and communication campaigns can be an important driver. Marketing activities should be realized via different channels. Social media channels are one important medium but also dialogue mobility marketing campaigns can have a high impact on the awareness and use of mobility stations. Marketing activities should go hand in hand with the implementation of mobility stations and include an individual consulting about suiting mobility offers among residents

- The mobility stations are easy to upscale because there are already four mobility stations which have been implemented in the living lab. Regarding the upscaling potential of mobility stations beyond the project, a smaller sized and more decentralised concept of mobility stations seems favourable towards only a few large centralised mobility stations in a city. It is also important, that mobility stations are not perceived as a singular mobility measure, but rather they are embedded in a city-wide mobility concept.

Finally, investment and operational costs can be numbered quiet precisely.

5. Conclusions

The measures presented in this report are examples of the introduction of cleaner public transport buses (electric or hybrid ones) as well as new and integrated sharing mobility services complementing public transport in existing and new urban developments which highlight the role played by the City Councils regarding the provision of financing, regulation and policy instruments, public land, the necessary recharging infrastructure to support electric vehicles and communication campaign. Also, the European Commission funding (through CIVITAS ECCENTRIC project) has been a key point.

Financing the high costs of electric and hybrid buses (up to twice the price of a Diesel bus) and the fear of adopting a new and different technology (technological reliability, charging options), the existing regulatory framework (that in many cases does not take into account electric vehicles or shared mobility systems) and the reluctance of shared mobility operators to be integrated into a common digital mobility service app or mobility platform are the biggest barriers to the adoption of a more sustainable and clean transport system.

This needs to be addressed through a different political and administrative process in which the municipalities must adopt a leader role to overcome these barriers and upgrading the transport systems making them cleaner, more energy efficient and more sustainable.

The final decision for the inclusion of new technologies and services into the portfolio should keep the user at the center, by assessing the potential impact in satisfaction levels, mobility behaviour, and ridership.

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