ECCENTRIC

Replication Package

Promoting the uptake of Electric Vehicles

Author: Maria-Angeliki Evliati

Co-authors: Alexandra Bensler, Sergio Fernández Balaguer, Enrique Garcia, Helber Lopez, Anna Norberg, Heini Viljanen

CiVITAS 2020
Cleaner and better transport in cities
ECCENTRIC

THE CIVITAS INITIATIVE IS CO-FINANCED BY THE EUROPEAN UNION

www.civitas.eu/eccentric

THE CIVITAS INITIATIVE
IS CO-FINANCED BY THE
EUROPEAN UNION

ECCENTRIC
Replication of EV charging infrastructure

Publisher: ICLEI European Secretaria

Authors: Maria-Angeliki Evliati

Co-authors: Alexandra Bensler, Sergio Fernández Balaguer, Enrique Garcia, Helber Lopez, Anna Norberg, Heini Viljanen

Graphic Design Template: Laura Sarlin, UBC SCC

Design & Layout: Rebekka Dold | www.rebekkadold.de

Images on cover page: City of Stockholm
Bert Ola Gustavsson, Mosebackemedia
Yoko Correia Nishimiya, Unsplash

Date of publication: October 2020

This publication has been developed within the European **"Innovative solutions for sustainable mobility of people in suburban city districts and emission free freight logistics in urban centres. — CIVITAS ECCENTRIC"** project, co-funded by the European Commission, co-ordinated by the City of Madrid and managed by EMT and GEA21.

Abstract

In the CIVITAS ECCENTRIC project, the cities of Stockholm, Madrid, Munich, and Turku worked with test fleets of electric vehicles (EVs), light electric vehicles (LEVs), electric freight vehicles (EFVs), and new charging infrastructure, whilst also offering incentives and information on clean vehicles and fuels. User groups included private individuals, businesses, and civil servants in the city administration. The implemented measures provide cities that are interested in replication with effective processes and methodologies.

This report presents a replication package that is based on the lessons learned during the implementation of measures for promoting EVs. The package includes a technical description of the measures and the implementation process. Drivers, barriers, success factors, and foreseeable impacts are presented in a comprehensive manner in order to inspire other cities and provide them with guidance.

Market availability of electric vehicles or services, charging infrastructure, financing mechanisms and incentives, as well as political commitment and cross-sectoral collaboration are key drivers for introducing EVs and EFVs in city and business fleets. Barriers involve data collection, grid and infrastructure issues, and a reluctance to have EVs and new concepts. Regulatory changes are often necessary to enable the use of new concepts and business models. Conclusions highlight the importance of pilots in getting new user groups familiar with new technologies, involving stakeholders throughout the process, and using procurement as a tool in pursuing climate and mobility strategies.

Table of Contents

List of Figures

List of Tables

List of Acronyms

ACM	Adaptive City Mobility
CO2	Carbon Dioxide
EU	European Union
EFV	Electric Freight Vehicle
EV	Electric Vehicle
e.g.	exempli gratia (for example)
H2020	Horizon 2020
i.e.	id est (that is to say)
LEV	Light Electric Vehicle
MIT	Motorised Individual Transport
TCO	Total Cost of Ownership
ULEZ	Ultra Low Emission Zone
VKT	Vehicle kilometre travelled

Executive Summary

In the framework of CIVITAS ECCENTRIC, the cities of Stockholm, Madrid, Munich, and Turku have worked with test fleets of electric vehicles (EVs), light electric vehicles (LEVs) and electric freight vehicles (EFVs), and new charging infrastructure, while also offering incentives and information on clean vehicles and fuels. The implemented measures aimed to trigger a wide uptake of clean vehicles, particularly electric, by companies, municipal fleets, and households, and to increase the participation of citizens and local stakeholders. In Stockholm, companies in craft and delivery services tested EFVs and Stockholm's clean vehicle portal was updated to become more user-friendly. Madrid procured EVs in the municipal fleet while expanding its fast charging infrastructure network. Turku procured LEVs to be tested and evaluated by different departments. In Munich, a prototype of a lightweight EV with a swapping battery system was used to test a business model for combined uses. To support other cities seeking inspiration and guidance in this field, this report brings together drivers, barriers, success factors, and expected impacts that are transferrable across local contexts in Europe. Conclusions from the project highlight the need to promote EVs as part of a holistic view on urban mobility planning, otherwise contradicting strategies and incentives risk counteracting the potential benefits of EVs. Regulatory updates are often necessary as new business models appear. At the moment, users are curious about EVs and there is a favourable political and economic environment in Europe for this type of investment, opening up a window of opportunity for testing and evaluating the potential of EVs in various sectors. Procurement and pilot projects are useful tools for cities that are seeking to promote the uptake of EVs and gain acceptance among new user groups.

1 Introduction

1.1 Purpose of this document

This document is tailored following the practical needs of project developers, planners, and technical staff from cities to develop innovative measures, consider potential barriers, and select appropriate solutions to match their contexts. It provides evidence that particular measures have been successfully implemented in a city and have good replicability potential. In CIVITAS ECCENTRIC, five cities (Turku, Stockholm, Ruse, Madrid, and Munich) implemented a total of 50 innovative, sustainable urban mobility measures. The measures addressed a variety of urban mobility challenges, organised in different thematic clusters. This document is intended to equip practitioners and decision makers with the information needed to replicate measures included in the thematic cluster, "Testing of EV and FCEV vehicles", or aspects of these measures. Replicability refers to the possibility of transferring results from a pilot case to other geographical areas. These areas, of course, have different local contexts and conditions. When a specific measure proves 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), adjusting its implementation to the local conditions. The report contains a description of measure implementation and concrete recommendations for practitioners (chapter 2), draws lessons learned from a strategic perspective (chapter 3), and presents policy recommendations (chapter 4).

1.2 Target group

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

2 Testing electric vehicles in ECCENTRIC

In Stockholm (STO 6.1), companies in craft and delivery services tested EFVs. The pilot tested and evaluated functionality and acceptance among users, providing the City of Stockholm with data to understand barriers and opportunities for professional users of freight vehicles to shift to electric-powered transmission. Prior to the project, knowledge among the target group (craftsmen and delivery services sector) on EFVs was rather low. Vans and light trucks account for 19% of passages in Stockholm inner city (Trafikanalys, 2019).

Madrid (MAD 6.2) renewed its municipal fleet by replacing over one third of it with EVs and evaluated performance when used by inspection services, Municipal Police, and Mobility Agents. The public charging infrastructure network was improved by increasing the number of fast charging stations and paying special attention to the quality of the service and setting new models of public-private collaboration. Madrid also promoted the use of EVs in private fleets through new regulation and strategies on air quality, climate change, and sustainable mobility, such as 'Madrid Central' Ultra Low Emission Zone (ULEZ) or the new Urban Sustainable Ordinance, which were approved during the course of the CIVITAS ECCENTRIC Project.

Munich (MUN 6.3) tested a prototype of a lightweight EV with a swapping battery system to assess and develop a business model for combined uses. Shared usage and the swapping battery system can reduce car ownership and long charging times. Due to licensing issues, the prototype was tested during special events in the CIVITAS ECCENTRIC living lab (the districts of Domagkpark and Parkstadt Schwabing) in Munich.

Turku (TUR 6.4) procured and tested LEVs and an EV with employees from different departments for commuting, work trips, and leisure time. The pilot provided the City of Turku with valuable input for its e-mobility plan, which was prepared in Spring 2020.
Stockholm's clean vehicle portal (STO 6.5) was updated to become more user-friendly. The portal is Stockholm's and Sweden's leading resource for facts on environmentally-classified cars, light and heavy trucks, clean fuels, as well as regulation and incentives for clean vehicles.

Measure implementation has shown that there is interest and curiosity testing EVs and a demand for more associated facts and incentives. Concrete lessons include how to, especially as a city authority, organise and manage a test fleet, including the involvement of test users and other involved actors. Implementation has further shed light on the risks posed by contradicting strategies and incentives for EV deployment, as well as opportunities for cities to create and boost the e-mobility market.

Table 1: Measures of this cluster

Measure	Main focus	City	Partner(s)
STO 6.1 Offering EV test fleets to selected target groups	Companies testing light commercial vehicles	Stockholm	City of Stockholm Mobility Motors
MAD 6.2 Test fleets, policy incentives, and campaigns for the uptake of electric vehicles	Electrification of municipal fleet, charging infrastructure	Madrid	City of Madrid EMT Madrid
MUC 6.3 Electric lightweight vehicles for car sharing and logistics	EV prototype for combined uses and swappable batteries	Madrid	Green City Experience GmbH
TUR 6.4 Electrification of municipal fleet & promotion of electro-mobility	Municipality testing LEVs and EVs	Turku	City of Turku Turku University of Applied Sciences Regional Council of Southwest Finland
STO 6.5 Developing the clean vehicle portal	Information on EVs and charging infrastructure	Stockholm	City of Stockholm

2.1 Offering EV-test fleets to selected target groups, Stockholm

About the measure

Craftsmen and delivery services are, according to previous studies, contributing to a substantial part of daytime traffic through the city (Trivector, 2016). With an expected increase of e-commerce in the coming years, electric vehicles for these business users are becoming important to test and improve. Fifteen companies began to test-drive electric vans in Stockholm in Autumn 2017. These tests provided the City of Stockholm with data to understand barriers and opportunities for professional users of freight vehicles to shift to electric-powered transmission.

Implementation

The companies that participated in the fleet test were selected through a competition. The competition aimed to gather different business types in order to assess for which of them an electric van would be feasible, as well as to understand their charging patterns and needs. The selected companies were active in fields like building and real estate maintenance, such as painting, ventilation, cleaning, electricity installations and construction, courier and delivery services, waste management and recycling, gardening services, and wholesale (Figure 1). The City of Stockholm led this measure in collaboration with Mobility Motors. Central in the implementation of the test fleet were the 15 companies that leased a Nissan e-NV200. The drivers of the vehicle are key in conveying their experiences to the City, the market, and their peers.

Figure 1: One of the test companies works with assembling charging poles

© Mikael Röhr

During the two-year test period, both quantitative and qualitative data was collected. Nearly 70% of the participating companies had access to charging infrastructure at their premises, according to the responses in two surveys. The use of fast charging facilities in the city varied considerably among the companies, from once a month to there having been no need for fast charging at all (Results from EV Survey 2). The City of Stockholm is actively working with public charging infrastructure (Figure 2).

Figure 2: Test van on one of Stockholm's charging streets

Business model and contractual partnerships

Companies to test the electric vans were selected through a competition and received a grant that covered the price difference compared to leasing an equivalent fossil-fuelled van. This amount was financed by CIVITAS ECCENTRIC. In return, the companies committed to providing data and to being available for study visits and other exchange meetings.

Lessons learned

Training users and extensive exchanges with partners, subcontractors, and stakeholders that are involved in project management has proven to be necessary in order to foster a common understanding. Reliable data collection, both from the manual drivers' logs and the electronic logbooks, was a challenge and the City of Stockholm dedicated a considerable amount of time to establish a clear process for data delivery, timing, and formatting.

With regard to vehicle functionality, range and heating were two factors that were regarded as being on the negative side. Companies that cannot plan their work and have customers in many locations found it difficult to manage long distances with the current range. For long distance errands and heavy loads, drivers chose another vehicle from their company fleet. Heating, which is also linked to battery range, was not sufficient for businesses with sensitive products, such as plants (Figure 3).

Figure 3: Heating in the car is a challenge for companies transporting plants

© Mikael Röhr

On the other hand, nearly 70% of the drivers were satisfied with driving electric at work and found the vans to be comfortable. The majority of the participating companies had an environmental profile and expressed that it felt good to do something for the environment. The majority of drivers were also satisfied with how charging worked. Businesses that can plan their work did not seem to need opportunity charging in the city. For users that charge at home, charging stations have an energy meter, which makes it technically possible for an employee to recover these costs from an employer.

Recommendations

- Ensure all parties involved are on the same page about what is expected to be delivered.
- Establish contact with the test drivers at an early stage.
- Provide the grant, if possible, after the delivery of results to ensure higher commitment.
- Consider how different businesses use opportunity charging in the inner city.

2.2 Test fleets, policy incentives and campaigns for the uptake of electric vehicles, Madrid

About the measure

According to the data from the Spanish Directorate General of Traffic (DGT) in 2018, more than 12,000 zero-emission vehicles were registered in Madrid, out of which over 11,000 were fully electric. Fast charging infrastructure is underdeveloped, however. This measure's objective was to reduce energy consumption and emissions, promote the uptake of clean vehicles, and optimise the city's charging infrastructure network. The measure was expected to bring at least 20 new EVs into the municipal fleet and to accelerate the deployment of the city's fast charging network with at least three new charging points. In addition, it was aimed that at least five private companies would introduce electric vehicles in their fleets as a result of awareness raising activities.

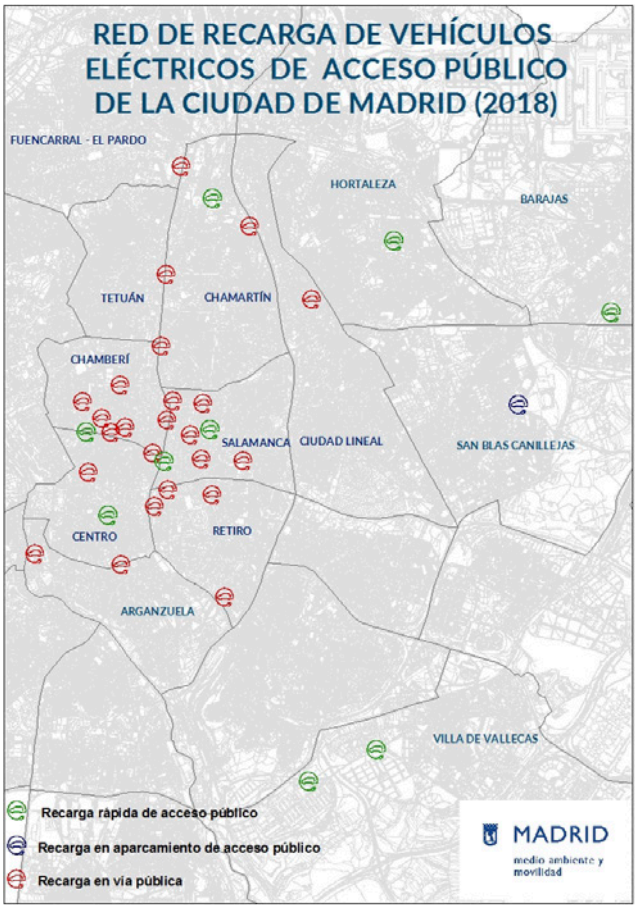
Implementation

On-street charging is indirectly managed by the City of Madrid. In 2018, there were 24 normal charging spots (3.2 – 7 kW), which were installed in collaboration with two different private charging managers. Under the scope of this measure, the City established a Memorandum of Understanding (MoU) with these actors to upgrade 12 of them into fast charging and

to make them more user-friendly. An application processes payments and provides information to citizens. The same information is also available online – now as part of the City's website – and a direct link to electric mobility (Figure 5) is provided. Colón Square is the first charging hub, offering up to four chargers in the city centre.

Off-street charging is directly managed by the City, specifically Empresa Municipal de Transportes de Madrid SA (EMT). Off-street charging in municipal parking facilities was made possible since EMT became a charging manager, having the right to sell electricity. EMT has 94 charging spots in different parking facilities. Three electric hubs provide both normal and fast charging (from 3,6 kW up to 50 kW) and six parking facilities offer normal charging infrastructure in municipal parking areas. EMT signs agreements with specific stakeholders.

Figure 4: Madrid's charging map with 24 on-street charging locations



© City of Madrid

Charging manager

is the legal figure allowing an actor to sell electricity in Spain. It was a decision by the Spanish Government to ease access to the market.

The charging manager is now called electric mobility services provider.

The second line of work in this measure was the electrification of the municipal fleet. Implementation started by analysing fleet requirements. The received offers surpassed the initial target. Already in 2017, 92 EVs and 23 e-motorbikes were added to the municipal fleet, and the forecast for 2018 included an additional 131 EVs.

Liaison with companies to increase the number of EVs in their fleet was less fruitful. Discussions took place, however without having been formalised. According to the companies' perspective, the business model is not favourable enough since they would have to pay for using the parking facility, which they found to be expensive. From the City's perspective, charging facilities at municipal parking facilities are cheaper than those provided by private actors. The new regulation on the zero-emission zone in the city centre is expected to change the situation.

The stakeholders that were involved in the implementation of this measure were EMT, several departments within the City of Madrid (Governmental Area of Economy, Police Department, Mobility Agent Department / Traffic Enforcement Officers, Madrid Public Health Service, and Government Area of Environment and Mobility). EMT was responsible for the overall procurement strategy and each department for their own purchases. Other local actors contributed upon invitation at a workshop in October 2018.

Figure 5: Madrid's electric municipal fleet

© Ayuntamiento de Madrid

Pricing and payment methods

Fast charging on-street (Colón)

Price: 0,40 euros/kW

Time: up to 60'

Fast charging (in garage)

Price: 0,35 euros/kW

Time: up to 60'

Payment method: app

The taxi sector was expected to have a big potential for the transition to EVs, as car manufacturers are making new models with longer range available. Companies in urban freight, and commercial and delivery companies were also involved in the discussions.

Air Quality and Climate Change Strategy 2016-2030 (Plan A)

The zero-emission zone in the central district, "Madrid Central", was launched in November 30, 2018, with a trial period until March, 2019. The zone is larger than the previous one and access restrictions are based on vehicle technology and environmental classification.

The zone will give regulatory incentives, such as free access to emission-free freight vehicles. It also forbids on-street parking for all vehicles except for ECO (e.g. LPG, CNG) and CERO (EVs).

Plan A further addresses urban freight (e.g. allowing for wider time delivery windows for cleaner vehicles and restricting access to polluting ones), public transport (e.g. offering clean fleet and intermodality advantages), e-shared mobility, municipal tax advantages for clean vehicles (e.g. circulation tax, parking fees), electrification of the municipal fleet, and the deployment of wide charging infrastructure.

Business model and contractual partnerships

With regard to charging infrastructure, there are two types of contractual partnerships, depending on the role of the City. For the on-street charging infrastructure, the City signed an agreement with two charging managers (IBIL and GIC). The second type is when the City itself acts as a charging provider, via EMT, for off-street charging. In this case, charging equipment was procured by the City and EMT installed fast chargers in public parking and other publicly-accessible facilities. As regards the fleet, a leasing agreement for four years was signed through a procurement process. Contracts can be renewed, and this goal is included in the Air Quality Plan.

Most of the budget for procuring fast chargers and deploying the charging network for the fleet was provided by the municipal budget. CIVITAS ECCENTRIC funding covered about 10% of the total for the installation of charging points/spots and evaluation purposes.

Lessons learned

The success of this measure was owed to a good alignment of the measure with local strategic priorities and, in particular, to the Air Quality Plan, which has a clear focus on clean and electric mobility. However, the deployment of public charging infrastructure faces three specific challenges: users find rates to be too expensive and expect this service for free; companies do not yet see a clear business model for using public charging; and cooperation between traditional petrol stations and the electricity sector is not enough to offer charging spots there. Looking at the trends of the five fast charging spots, EV owners are only keen to use the fast charging infrastructure in free access areas (Colón Square). On-street parking is free of charge for EVs, so there is no incentive for EV owners to use underground parking.

However, Madrid does not promote on-street charging due to legal, administrative, and technical difficulties, as well as an explicit aim to recover public space for citizens according to Plan A. Offering public fast charging might not be the right solution for the City to offer. Adapting charging time to the time that a vehicle is parked or adjusting the parking spaces in garages so that fleet or freight operators can charge overnight seem to serve user needs better. Another key lesson relates to the increasing demand for public charging infrastructure for residents, and how to cope with it. The large-scale electrification of the municipal fleet highlighted the importance of capacity and grid connection issues.

Recommendations

- If you have charging in underground garages, think about easing access and making the garages attractive to use, such as by avoiding the requirement for users to pay additional fees (e.g. parking time).
- Take advantage of fleet renewal processes when contracts are ending.
- Take advantage of public procurement to push the market forward.
- Give bonuses for electric vehicles in the procurement process.
- Engage and cooperate with the private sector through agreements.
- Do not be overambitious, fulfil citizens' needs step-by-step.
- Have a flagship initiative that generates high visibility in the city. Taxi and car sharing companies have, in the past, contributed to the visibility and adoption of hybrids and fully-electric vehicles, respectively.
- Use regulations to provide incentives for shifting away from fossil-fuelled vehicles, such as a reduction in the local tax, reduced parking, and free access to specific areas for EVs.
- Analyse the capacity of your facility prior to procuring a large number of vehicles, so that all vehicles can charge there.

Target users of ACM

- Inner city delivery and courier services
- Bakeries
- Eco-taxis
- Business fleets with corporate car sharing
- Mobile nursing services
- Community fleets
- Hotels

2.3 Electric lightweight vehicles for car sharing and logistics, Munich

About the measure

This measure tested the Adaptive City Mobility (ACM) concept, which provides a new solution in e-mobility and fits into the evolving ideas of the shared economy, urban commons, and MaaS. ACM is based on three innovations: a new lightweight EV (maximum 450kg, L7E classification), a flexible manual battery swapping system (100kg), and integrated fleet management and multi-purpose sharing software (European Commission, 2016).

Its multimodal design allows for the operation of transport for both people and goods, such as taxi, car sharing, and logistics. Shared usage and the swapping battery system reduces car ownership and long charging times, respectively. The ACM vehicle was already developed, and the aim was to pilot a business model with four vehicles for sharing. Green City Experience (GCX) was the measure leader. The measure was broadened to include a mobility sharing concept for up to two people.

Implementation

To clarify conditions and regulations for setting up the multimodal usage of the vehicle and the installation of the battery swapping stations, GCX had an intense exchange with several departments of the City of Munich as well as the Bavarian Ministry of the Interior, Structures, and Transport. GCX collaborated with Isarwatt to ensure the use of renewable energies. Parts of the battery swapping infrastructure were installed in Domagkpark and Parkstadt Schwabing, drawing the attention of local residents. Two local cooperative associations, Wogeno and Wagnis, granted access to their parking lots to allow for the installation of parts of the infrastructure.

Originally, the ACM vehicle was intended to be integrated into mobility stations and a booking application in Domagkpark and Parkstadt Schwabing. ACM was, however, not yet street legal, due to the homologation process and GCX introduced dedicated testing events. The integration of other vehicles and mobility solutions, such as e-cargobikes, into the ACM system remained part of the plan, but the business model did not allow for an economically-efficient integration.

Domagkwerk helped GCX explore and develop possible use cases for the concierge service (last mile delivery/logistics) that was provided in Domagkpark. The Technical University of Munich (TUM) and the City of Munich (KVR) contributed by providing existing knowledge on the mobility attitudes and behaviours of residents of the district. GCX optimised marketing and communications strategies according to the user groups that were identified during the research and planning phase. Several talks and discussion rounds took place with taxi drivers in Munich, the Chambers of Commerce and Trade (Handwerkskammer and IHK), as well as delivery service companies (UPS and DHL).

Figure 6: The prototype of a lightweight electric vehicle

Business model and contractual partnerships

The ACM vehicle and concept belongs to the ten partners of the ACM research consortium, which is sponsored by the German Federal Ministry of Economics and Energy (BMWi) and its technology program, "ICT for Electromobility III: Integration of commercial electric vehicles in logistics, energy, and mobility infrastructures". Approximately 70% of the total cost for the implementation and testing of the vehicle and swapping station, however, was financed by CIVITAS ECCENTRIC.

The business model is based on reduced costs through maximised efficiency, as ACM vehicles will be used as shared vehicles and as part of MaaS. The association, Wogeno, supplied a parking space, through a tenancy agreement, in addition to the space for the battery swapping stations. Pilot users participated on a voluntary basis and were not bound by a contract.

Lessons learned

Agile project management and planning proved to be crucial, since the test was dependent on the results of a research project that was developing a prototype. Planning for two options from the beginning, one including and one excluding the results of the research project, can act as a buffer against possible delays and complications. Successful implementation was owed to good collaboration with local associations that provided access to their parking spaces and enabled the installation of the charging stations. Target users were also very curious and interested in testing the vehicle.

Recommendations

- Be flexible when planning an action that is based on the outcome of a research project.
- Be prepared to adapt and take in new technologies and concepts.
- Communicate steadily with project partners, official institutions, and site managers to achieve the collective goals.
- Communicate with potential pilot users and be transparent in case there are delays.
- Involve local stakeholders and co-create measures that correspond to local conditions and constraints.
- Enable dialogue between different project partners and other CIVITAS projects.

2.4 Electrification of the Municipal Fleet & Promotion of Electro-mobility, Turku

About the measure

The City of Turku tested lightweight EVs (LEVs) for everyday use in a one-year e-mobility pilot, which included awareness raising actions among city employees. Employees of the City carried out the tests. An employer mobility survey from 2013 shed light on the mobility habits of approximately 500 employees and the results showed to be in favour of a shift to lightweight electric vehicles.

Nine light EVs that met different mobility needs were selected and leased by different suppliers. The goal of the pilot was to obtain about 200 user experiences and increase the knowledge of e-mobility among the City's employees. Employees participating in the pilot were expected to use the LEVs for commuting, travels during the workday, and travels in their spare time.

Implementation

The aim of the pilot was to experiment with 10 different vehicles. The first step was to choose the appropriate LEVs for the involved departments. Once tendering (public procurement) was completed, the City received offers for nine different LEVs that would also be usable during wintertime. All vehicles could be charged from a regular plug and testers would charge at home or at work. Despite the lack of potential suppliers in the area, four suppliers initiated this type of leasing in response to the municipality's demand and participated in the pilot.

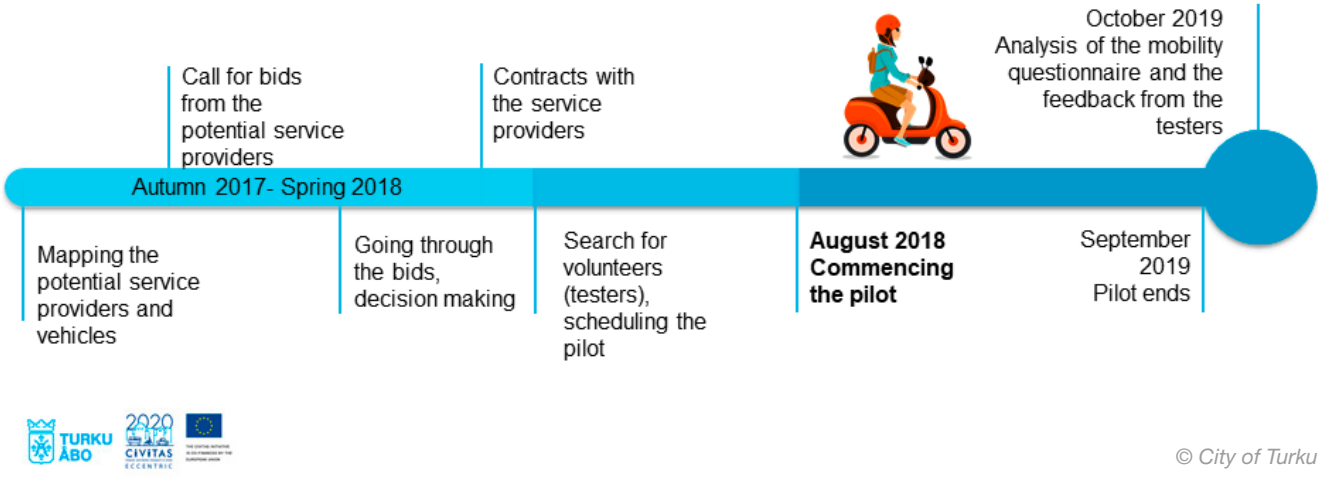
How does it work?

- Each unit gets to test two vehicles for two months.
- Each unit has eight users.
- Users get one vehicle for personal use for two weeks.
- The vehicle may be used for commuting and leisure.

Figure 7: Light electric vehicles procured and tested in Turku

© City of Turku

Figure 8: Pilot timeline in Turku



© City of Turku

The recruitment of volunteers was done through the directors and at the management level. Recruiting testers for the winter period turned out to be more difficult. Communication with the participants, and organising and coordinating the testing periods was key. The test fleet was comprised of LEVs and a shared electric car.

The stakeholders that were involved were the employees of the City of Turku (27 departments participated), including the measure leader, and suppliers of the vehicles (Skand Oy, Ewheels Group Oy, NextBike Polska S.A., Järvileasing Oy). The pilot, including the preparatory work and the analysis after, covered a period of 1.5 years. About six months were needed to fix contracts and tendering.

The measure supported Turku's vision to become carbon neutral by 2029 and there was a clear synergy with the Smart and Wise project[1] and the BSR Electric Baltic Sea Region project[2].

Business model and contractual partnerships

Turku signed one-year leasing contracts with four different suppliers. The suppliers owned the vehicles and after the pilot, the City of Turku had the opportunity to buy the vehicles at a pre-established price. Furthermore, the City was responsible for internal and external communication. Users were contractually bound by the terms of use of the equipment and also data collection. The measure was financed entirely by CIVITAS ECCENTRIC and had a budget of up to €40,000 for service procurement and up to €5,000 for equipment procurement.

Lessons learned

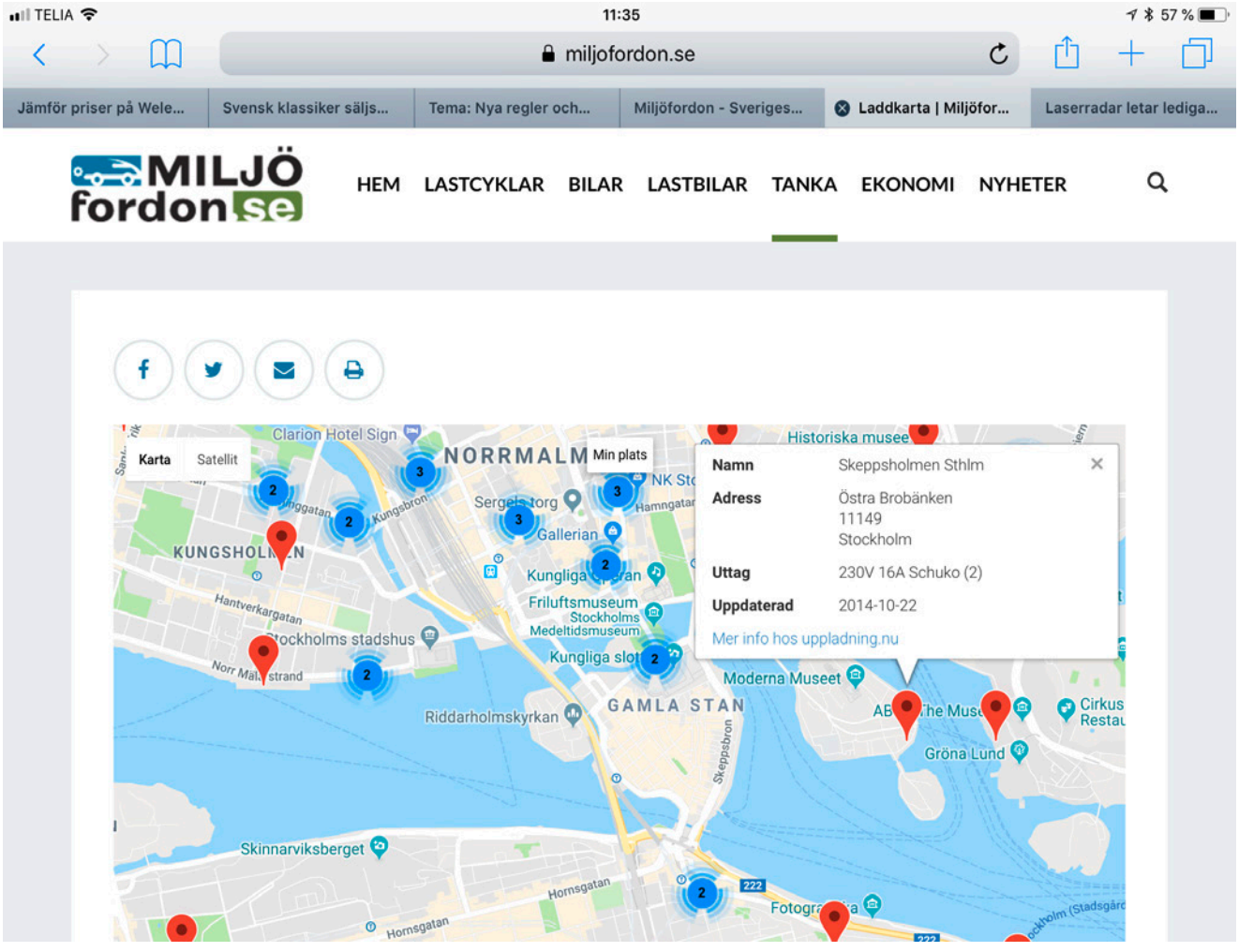
Turku created a business model and a market for leasing light EVs. The measure was very visible, as it was ideal for communication work on social media and internally to raise the discussion on sharing. The selected recruitment process secured the approval of the pilot at the management level and many test users became interested in participating. On the other hand, training testers on how to use the vehicle and communicating with them was time intensive. A one-year testing period proved to be too long to manage and the pilot would have profited from a more thorough plan for managing the vehicles and physically moving them around. The pilot made evident that processes and responsibilities must be really clear in contractual agreements, e.g. in cases of vandalism. Finally, the measure raised a discussion on how to arrange such a pilot as a local authority and on what happens when the aspect of sharing becomes more prevalent.

[1] https://www.turku.fi/en/smart-and-wise
[2] https://projects.interreg-baltic.eu/projects/bsr-electric-121.html

Recommendations

- Have a clear overall picture already at the beginning of the project.
- Find what you want and try it out in advance. Many vehicles look quite good on paper, but they might not be as functional in reality.
- If there is a lack of suppliers, talk to potential ones because they may be interested creating a new line of business.
- Send a call for tenders to a large number of possible operators, even to those who do not have a rental service ready.
- Determine the implementation process in advance.
- Think about the storage and transportation of the vehicles.
- Take time to carefully prepare the call for tenders and contracts. Indicate responsibilities in case of vandalism.
- Agree in advance: who will cover the costs of replacing a vandalised vehicle, crashes, and sudden breakdowns of equipment, as well as who will take care of the vehicles and the winter tires.
- Reserve some budget for reparation costs.
- Allocate time and resources for research and communication.
- Plan for staff allocation and costs involved.

Figure 9: Screenshot from the clean vehicle portal showing charging spots in Stockholm inner city



© www.miljofordon.se

2.5 Developing the Clean Vehicle Portal, Stockholm

About the measure

Miljofordon.se is Stockholm's and Sweden's leading resource for facts on environmentally-classified cars, light and heavy trucks, environmentally-friendly fuels, as well as regulations and subsidies for environmentally-classified cars. The aim of the portal is to disseminate knowledge and product-neutral information about clean vehicles, fuels, and other relevant facts to buyers (public bodies and private individuals) and drivers of clean vehicles, making it easier for potential vehicle buyers to choose clean vehicles and find clean fuels.

For this measure, the website was redeveloped based on the input that was received through a stakeholder dialogue process that was designed to consider different stakeholder needs, which the portal did not consider previously. By considering different stakeholder needs, the website acts as a comprehensive information source for environmentally-friendly vehicles.

Implementation

Three key steps were taken in the implementation of this measure: the provision of information to multi-family housing associations; improvement in the usability of charging maps; and an analysis of the target groups, beyond those who already used the website. During the first phase, information about how to install electric charging in multi-family homes was integrated on the portal. The usability of the charging map was improved. A stakeholder dialogue and a usability test were carried out during the second phase. Fleet managers, private individuals interested in buying new cars, sustainability managers, car dealers, and NGOs answered questions about how they search for information about clean, and particularly electric, vehicles and what would help them to promote those. Usability tests were carried out in an online laboratory where users tested functions of the page and were interviewed on how these resonated with them before buying a vehicle. During the third and final phases, both studies gave input into the further development of miljöfordon.se. New ideas were explored, including search engine optimisation (SEO) to make the portal more visible when an individual searches for EV information on the internet. Fleet managers, private individuals, car dealers and manufacturers, interest organisations, consultants, and usability experts were involved in the usability test. The main work was carried out by the City of Stockholm, with the help of a consultancy company.

The clean vehicle web portal has a national focus and is an umbrella information board for several other sustainable mobility solutions both in Stockholm and in Sweden. The information campaign that targets housing associations, Fixa laddplats, and the charging infrastructure in Sweden, uppladdning.nu, are two examples that are featured on the portal.

Clean Vehicle Portal in a nutshell

- City of Stockholm, Gothenburg, and Malmö run the website.
- Autonet provides automatic data updates daily.
- Electric scooters, bikes, and heavy trucks are manually updated.
- Buyers and drivers of clean vehicles can find information on environmentally-classified passenger cars, light commercial vehicles, heavy trucks, clean fuels, as well as regulation and incentives for clean vehicles.

Business model and contractual partnerships

Stockholm, together with the cities of Gothenburg and Malmö, runs the website, which is financed on a yearly basis. CIVITAS ECCENTRIC financed the usability tests and staff working time. Consultants were chosen through direct procurement.

Lessons learned

In Sweden, there is no registry for electric scooters and electric bikes and it is difficult to collect this information. With regard to cargo bikes and heavy trucks, Stockholm collects data with the help of a consultant and then the data is fed into the system manually. This is manageable because cargo-bikes and heavy trucks are a smaller market.

Recommendations

- Have a clear picture regarding why it would be of interest to have such a webpage and for whom.
- Involve partners that can deliver reliable vehicle data (e.g. Bilvision autonet).

3 From ECCENTRIC cities to replication in other places

The implemented measures provide cities that are interested in replication with concrete processes and methodologies, as well as business models. In order to enable replication, an in-depth analysis is required to understand the drivers and barriers that facilitate or obstruct the effective and successful introduction of electric vehicles in various sectors and services, either as a pilot or as a standard option. Finance and governance aspects are included in this analysis. The key requirements to implement measures of this kind are the market availability of vehicles and services, charging infrastructure, financing mechanisms, political commitment, as well as cross-sector collaboration.

Drivers

Market availability of e-vehicles or services

The implementation of test fleet relies heavily on the market availability of e-vehicles or services. Light vehicles, personal cars, and light commercial vehicles (light trucks) that are appropriate for the particular area of operation need to be market available. Furthermore, services that go beyond owning the vehicles, such as leasing or sharing, are the increasingly preferred option amongst organisations and business users that are seeking to maximise capacity utilisation or lacking the capacity to manage a fleet in-house. The Turku experience demonstrates that public procurement may create a market for new services. Tendering for LEVs for the municipality in Turku resulted in new business offerings by several different suppliers, leading to new leasing opportunities and business markets.

Charging infrastructure

The second prerequisite for electric fleets is charging infrastructure. For business users, charging infrastructure at the workplace is crucial. This is where the vehicle would be parked overnight and where electricity costs for slow charging (2,3 - 7,4 kW) are low and competitive. Charging facilities along the routes a company operates in is a facilitating factor when it comes to delivery or maintenance services. However, many business users do not view public charging, and especially fast charging, as the preferred choice. This is due to high costs that outweigh the otherwise low operating costs of EVs, especially when considering the low electricity rates linked to slow charging. Other factors that contribute to lower operating costs are a less frequent need for service and better fuel or vehicle efficiency.

Light electric vehicles can charge through a normal electricity plug and do not require dedicated infrastructure, however an appropriate storage space must be available. For large-scale fleet electrification, the city or organisation needs to investigate the grid supply and sign an agreement with the grid owner prior to installing charging infrastructure. In cases where the city rents the parking facility, an agreement with the property owner is also necessary (Evliati, 2020).

Financing mechanisms and incentives

To date, the purchase price of EVs is still a barrier for many business users and private individuals when it comes to choosing a vehicle. Even if the total cost of ownership (TCO) of EVs is in many cases lower than the TCO of conventional vehicles, there is a tendency to overlook this in procurement processes. Mechanisms to bridge the price difference between conventional vehicles and electric ones can be found in incentives that are provided by the regional or national level, such as the bonus-malus system in Sweden (Transportstyrelsen, 2020), additional cost subsidies as part of pilot projects (e.g. CIVITAS ECCENTRIC) or using TCO calculations in procurement processes instead of purchase costs.

Using the existing structures

The deployment of EVs makes use of the same mechanisms and structures that are in place for regular private vehicles. Street space, financing and insurance, as well as the image and the status quo of motorised individual transport are being used to position the EV in the market and find a place for it in the political agenda.

Political commitment and pressure for action

Political commitment is key in supporting pilots or innovative procurement in order to achieve fossil fuel-free cities. Innovative procurement sets environmental requirements and promotes greener vehicles and services, even though the purchase price alone can be higher. Political support is also important when new types of business models and charging infrastructure (e.g. shared uses of vehicles, battery swapping systems in mobility hubs) need to be explored. The level can vary from municipal to national, depending on which authority is in charge of urban planning and parking regulations.

Citizens are increasingly requesting action against pollution in cities and climate change. EVs have been marketed as part of the solution, even if CO2 savings are only local. This puts pressure on decision makers to legislate and regulate in order to facilitate access to new powertrain technologies.

Cross-sector collaboration

E-mobility and charging infrastructure is at the intersection of traffic, urban, and environmental planning, making it necessary to engage different departments in the city administration. Besides factual expertise, diffusing knowledge on e-mobility usually requires technical support when it comes to procurement and regulation issues, as well as human resources. Engaging actors at a national level might be necessary in order to solve regulatory issues that go beyond the municipal mandate. German law, for example, does not allow for multi-purpose vehicle use (e.g. using the same vehicle for pizza delivery and taxi services). For the implementation of the ACM lightweight vehicle, the Bavarian State Ministry of the Interior helped to find a temporary solution for the vehicle demonstration. However, long-term policies are required in order to enable take-up and commercialisation for multiuse purposes.

Wider networking is necessary to identify relevant test users (e.g. delivery services and craftsmen), provide access to test locations, or communicate and advertise the pilot to other relevant target groups for replication purposes. Some examples of networks in the Munich measure have been the Chamber of Commerce, Chamber of Labour, and other economic stakeholders. Network operators are also crucial for the set up and installation of charging infrastructure. Grid ownership and operation varies between countries.

Pilot design and management

When carrying out pilots, mobility experts need to consider a few aspects in advance. First, mobility experts need to design the concept. Ideally, the test should be part of a wider plan; however, this is not always possible when working with innovation.
Second, mobility experts need to recruit users and manage the pilot setup. It is important to assign sufficient time and human resources to design the concept, identify and recruit appropriate users, and run the pilot. The project manager must communicate with the selected user groups before the pilot starts in order to, if possible, co-create the process (e.g. the mobility concept in Munich) and throughout the pilot to identify and solve any obstacles. Contracting and insurance, data management, and the responsibilities of the user and contractor must be clarified right from the start. When it comes to test fleets, having a plan or a concept even for the period after the pilot has concluded is important, including with regard to available options after the leasing period and who will be responsible if the fleet is purchased.

Car dependency

Car-dependent cities, cultures, and institutions are more attractive for EV deployment than markets where the use of motorised individual transport (MIT) is more restricted.

Barriers

One size does not fit all

Just as every other product, EVs, in their current format, are not a universal solution for all types of businesses, user groups, and areas of operation. Their technical specifications (e.g. loading capacity, heating) often imply an impact on or compromise with range, making certain user groups uncertain about being able to carry out their work.

In CIVITAS ECCENTRIC, this was exemplified by a fire protection firm that was testing a light van in Stockholm as well as by police officers and mobility agents that were controlling traffic – sometimes off-road – using e-motorbikes in Madrid. Madrid's municipal police service also tested a number of plug-in hybrids and considered them inappropriate due to an insufficient driving range. In Turku, while LEVs would have been perfect for home care services due to a lack of parking, tight schedules and particularly long distances made LEVs less attractive. Combined with the high investment cost, EVs become a less attractive choice for some user groups or areas of operation.

In parallel, market offers vary across Europe. In regard to light commercial vehicles (LCV), a lack of competitive offers is apparent in Spain. Until last year, only two vehicles (Nissan and Tesla) were available for taxi services; however, the offers are expected to increase during the course of 2020. To overcome this barrier, cities and companies may focus on those groups and areas of operation that are compatible and appropriate for electric mobility. The ability to plan one's own trips results in a lower need for opportunity charging and seems to be an enabling factor for EVs.

Data collection

Data collection can be challenging and time-consuming, especially when it involves manually registered data or user experiences. Even though formally agreed, the commitment of test users in registering and handing data in a consequent manner can be quite low in reality, resulting in a poor quality of data and conclusions with a high level of uncertainty. Collecting user feedback is a challenging task and requires clear structures among project partners and participants in order to ensure the collection of high-quality data. While expecting 100% user feedback is not realistic, a sound project management and incentive in connection to the output (e.g. no upfront finance) can facilitate a reasonably good flow of information. Telematic devices may further help to gather information (e.g. use of energy, driving distances) that is important for fleet management and follow-up.

Grid and infrastructure issues

Grid issues and infrastructure issues are likely to occur. Response from grid companies on electricity supply might take a long time. In Spain, grid connection works are usually one of the most common causes of delay in charging infrastructure renewal works. To tackle this barrier, Madrid signed collaboration agreements for the energy transition with the main electric energy distribution companies in the city (Figure 10). Communication between systems, for example charging infrastructure and back office, can result in a non-functioning infrastructure, even though it is in place.

Different standards on charging infrastructure and EVs may also cause compatibility issues and have a negative impact on user experience. This was illustrated in Turku, where it was not possible to charge the EV at every charging station, requiring the user to check compatibility in advance through a webpage service.

Reluctance for EVs and new concepts

A reluctance for EVs and new concepts is still prevalent among organisations and individuals. Politicians and city officials may be reluctant in cases of procurement, where the criterion is often the purchase price. To overcome this barrier, it is necessary to highlight other benefits, considering operating costs and other values. Besides contributing to better air quality, EVs are pleasant to drive and offer a better environment for the driver thanks to the silence in the cabin. Moreover, companies might experience that there are too little incentives for investing in EVs. Madrid has offered municipal charging infrastructure premises to

Figure 10: Test fleets, policy incentives, and campaigns for the uptake of electric vehicles (Madrid)

© EMT Madrid

logistics companies in order to facilitate electrification in the sector. The interest has, however, been quite low since the companies would have to pay for charging.

New vehicle concepts that allow for shared uses – both passenger and logistics – may clash with existing regulations. Adaptive City Mobility (ACM) in Munich, where the electric lightweight vehicle with a swappable battery system was piloted, highlighted this issue. Furthermore, there can be scepticism among private and business users as to whether the LEV concept can fulfil their core mobility needs. Bilateral discussions and co-creation with potential customers have proven to be an effective strategy to overcome this barrier, helping them to understand the benefits of the concept from the start.

Time intensive planning phase

Grid issues and infrastructure issues are likely to occur. Response from grid companies on electricity supply might take a long time. In Spain, grid connection works are usually one of the most common causes of delay in charging infrastructure renewal works. To tackle this barrier, Madrid signed collaboration agreements for the energy transition with the main electric energy distribution companies in the city. Communication between systems, for example charging infrastructure and back office, can result in a non-functioning infrastructure, even though it is in place.

Different standards on charging infrastructure and EVs may also cause compatibility issues and have a negative impact on user experience. This was illustrated in Turku, where it was not possible to charge the EV at every charging station, requiring the user to check compatibility in advance through a webpage service.

Contractual matters

Finally, yet importantly, contractual matters or tensions that are connected to a lack of clarity in expectations might also arise during the operational phase. More often the rule than the exception, there is a risk that contracts between the service providers and the client are not precise enough as this is an innovation pilot and many aspects are unknown in advance. This can regard basic maintenance, such as changing tires, breakdowns or vandalism, or even the sharing of responsibilities throughout the pilot.

Table 2: Drivers and barriers for the uptake of EVs

Drivers	Barriers
Market availability of e-vehicles or services	One size does not fit all
Charging infrastructure	Data collection
Financing mechanisms and incentives	Grid and infrastructure issues
Political commitment	Reluctance for EVs and new concepts
Cross sectoral collaboration	Time intensive planning phase
Pilot design and management	Contractual matters

Success factors in testing EVs

Users

Central in the success of piloting vehicles are the users. A good understanding and knowledge of the target groups, as well as access to the right contacts and network has contributed to the identification of relevant contacts, either as users or as process facilitators. In all cities, the approached users were interested, curious, and open to testing new EVs, LEVs, EFVs, designs, and concepts. Private and business users of the ACM sharing concept in Munich found the vehicle to be fun to use, gave positive feedback on ACM, and suggested new ways for how it could be used, thereby helping new ideas to emerge. The municipal users in Madrid were satisfied with their EVs and the majority of business users of EFVs in Stockholm stated that they would recommend other companies to invest in electric vehicles. Users in Turku described the LEVs as handy and nice.

Visibility

Driving electric vehicles in urban areas is a very visible way of testing new technological solutions. Test users often become messengers and foster a dialogue among customers, colleagues, and the public.

Favouring landscape factors

Landscape factors, such as public opinion, local and national strategies, and the economic situation, are also important. Many leaders of the CIVITAS ECCENTRIC measures spoke about good timing to test and invest in electric mobility. In Madrid, measure implementation coincided with the City Council's drafting of the Air Quality Plan and Strategy, opening for new actions with a strong focus on mobility. The regional government in Madrid also promotes electric mobility through its programmes. At the same time, an open debate regarding which actor in society shall lead electrification, resulted in a positive attitude towards EV investments by the media. The years of the economic crisis are also behind Madrid and other cities in southern Europe, and these cities have a better budget today than they did in the previous decade.

Stockholm and Turku aim to become fossil fuel-free and carbon neutral by the end of this decade. Short-term pilots tend to be more easily accepted and there is more room for experimentation with new solutions when funding comes from external sources, rather than the city's own budget.

Landscape factors that affect the piloting of EVs in different sectors

- Local and national instruments to incentivise clean vehicles and infrastructure among private individuals and businesses (e.g. tax relief, free parking, purchase bonus).
- Local and national strategies for carbon neutrality.
- Sharing economy boom that offers a variety of new shared vehicles.
- Market availability of e-versions for nearly all types of vehicles (light vehicles, private cars, light freight vehicles).
- Debate / raising awareness on climate change and climate action favouring zero-emission technologies and new ways of travelling in the city.
- Mobility experts are keen to influence modal share towards cleaner modes.
- The general public is curious to test new technologies.

Ensuring long-term sustainability – from pilot to full-scale

The CIVITAS ECCENTRIC project financed different parts of measure implementation. Three out of five measures were pilots, while the other two were extensions of an ongoing process or project. Conducting an e-mobility pilot as a city entails taking on a facilitating role amongst many partners, solving issues with service providers, the fleet, and users, as well as handling feedback from citizens and eventual delays in delivery. Besides the drivers and success factors presented above, a full-scale introduction of EVs in city and commercial fleets necessitates a few additional aspects. For cities that are testing new vehicles, it is easier to justify full-scale investment when the results are clear (e.g. lower emissions, lower total costs), are fit for the purpose, and contribute to the city's strategy. Investment in LEVs, for example, can easily be motivated if they prove to be able to replace car trips. New concepts, such as ACM, can be upscaled if the swapping battery system and multi-purpose use can generate income and if the demand among business and private users is high. A long-term mobility concept or a process for management, sharing, and operation is also necessary. GCX has developed the business concept for the energy supply and the mobility concept. These could not be tested 'in the field' during long-term tests due to the technological state of the ACM vehicle and its infrastructure. Regulatory changes are therefore necessary to enable the use of new concepts, which the current legislation does not foresee. Furthermore, various skills and competences are necessary, which normally are spread across the city administration and beyond. Involving colleagues with expertise in procurement and law as well as marketing and networking activities will ensure that the process is legally sound and correctly communicated (Table 3).

Table 3: Recommendations for introducing EVs, LEVs, and FEVs in business fleets

• Carefully study the experiences from similar projects.
• Have a clear and realistic idea of what is aimed at and why, but be flexible to adapt to changing circumstances.
• Explore and identify which unit in the city is the most appropriate to take ownership of the process and define the division of responsibilities, if other units in the city or the region are involved.
• Analyse the capacity of your facility prior to procuring a large number of vehicles, so that all vehicles can charge there.
• Involve subcontractors early and dedicate time to get all involved partners on board, foster a common understanding, and align expectations.
• Train and assist users in using and charging the vehicles.
• If commitment relies on a grant or subsidy, provide the grant, if possible, after the delivery of results to ensure higher commitment.
• Take advantage of fleet renewal processes, when leasing contracts are ending.
• Do not own the fleet yourself; lease it and prepare detailed contracts, including specific information about responsibilities and sanctions if the provider cannot deliver according to the contract.
• Use public procurement to push forward the EV market.
• Communicate the call for tender to as many vehicle providers as possible, even to those that do not offer leasing services.
• Plan for the steps after the pilot, e.g. selling the vehicles to the test users.

Foreseeable Impacts

Awareness and visibility of electric mobility

A key aspect in test fleets is the user experience. Test-driving an EV is the best way for new users in various sectors to be acquainted with how it functions and overcome range anxiety. The demonstrations have led to an awareness of EVs among a wide group of municipal employees and private company users, not limited to craftsmen and delivery services. The majority of users were satisfied with driving electric and there is a clearer understanding for which type of users an EV is more appropriate. Municipal EVs driving through the city are a very visible way to set a good example and to demonstrate the effort cities are making for better air quality and meeting their environmental targets. It is also a first-hand promotion for service providers of clean technologies. Visibility can in turn initiate or widen the dialogue on electric mobility. The ACM test, for instance, made the topic of shared uses, lightweight vehicles, and swapping batteries more visible in Munich, Germany, and beyond.

Impact of LEVs on car use and other modes of transport

Whether LEVs replace car trips or other modes of active or public transport is still open for debate. For the test group in Turku, the car was the prevalent option when travelling longer distances, but LEVs were a viable alternative for shorter distances and during leisure time. Tests like those carried out in CIVITAS ECCENTRIC may highlight where the potential for a shift can be found – use in urban or peri-urban areas, type of LEVs, type of target group, and type of trips (leisure or work). At the same time, the link between supporting EV and supporting MIT is clear. EVs can potentially perpetuate the prevalence of the private vehicle over other modes of transport.

Impact on air quality

Test fleets demonstrate the potential for air quality improvement in specific sectors and user cases for which electrification is appropriate and feasible. Although the impact on air quality throughout the pilot per se might be difficult to assess, test fleets help to identify the relevant sectors and target groups and illustrate the potential of a full-scale introduction of EVs in business fleets.

Impact on urban space

Despite the positive impact on local air quality, EVs are still advocates of motorised individual transport. Longer vehicle life cycles, structural changes in the market, and the perpetuation of car dependency can therefore compromise the use of public space in the coming decades.

Feedback to the car industry for technical improvements

User views on the vehicles' functionality, including aspects like range, noise, heating, and loading capacity, may give valuable feedback to the car industry when it comes to technical improvements. The testing of ACM and the communication around it has, for example, contributed to the discussion and the creation of start-ups with lightweight vehicles (e.g. Citroen).

Examples of indicators for measuring the success of test fleets

- Acceptance.
- Impact on walking, cycling, public transport, and conventional car trips.
- Frequency of technical failures of vehicles, battery, and charging.
- Changes in mobility patterns.
- Business potential.

4 Policy Recommendations

This section presents concluding policy recommendations for policy and decision makers that are interested in implementing EV test fleet measures in their cities.

Electric mobility must be part of urban (mobility) planning

The use of public space is highly contested and the rise of EVs and charging infrastructure will make it an even more contentious in the decades to come. Promoting the uptake of EVs for passenger transport is, in essence, promoting motorised individual transport (MIT). Decisive action to counteract this aspect of EV and charging infrastructure deployment is crucial. Particularly important are the efforts to reduce the space that is available for MIT, including roads, parking, servicing, maintenance, and associated infrastructure.

Failing to counteract the attractiveness of MIT and the resulting (established) car dependency, neutralises any benefit that EVs can bring in favour of sustainable mobility. The perpetuation of old policies and mobility behaviours blocks the abatement of vehicle kilometres travelled (VKT), keeping congestion at least at the current levels. Local contaminants will not decrease either, because an immediate adoption of EVs and charging technologies is not expected, and none of the CIVITAS ECCENTRIC measures proves it differently.

From this perspective, efforts and resources for EV deployment can only contribute to sustainable urban mobility if they are accompanied by parallel and even stronger actions to counteract MIT, car dependency, and VKT. In the long term, failing to fight back local contaminants and congestion today is likely to hinder economic performance and competitiveness in the future, endangering EV technologies themselves.

Utilising the full pilot potential

Testing EVs and infrastructure during smaller scale pilots is the best way to diffuse knowledge and collect valuable feedback. New potential users have the opportunity to get familiar with emission-free vehicles under real life circumstances. Citizens tend to approve changes more easily if they are informed beforehand and their opinion is asked. The threshold is also lower if people know this is a pilot and not necessarily a permanent solution. For cities, pilots offer good way to test and validate new technology and assess functionality before launching large-scale procurements. Likewise, business users can test and validate the technology that fits their needs. Peers recommending EVs is a much more effective tool than wide communication channels for reaching out to the wider public.

Procurement as a tool to create and boost the e-mobility market

With regard to the measures in Madrid and Turku, which were concerned with the electrification of the municipal fleet, the vehicles and service provider were selected through a procurement process. In the first case, procurement was done in connection to ending contracts and was used to favour EV providers. Offers surpassed the initial target. In the second case, procurement was used to create a new market for LEVs. Four suppliers in Turku initiated the type of leasing requested in response to the municipality's demand. These two examples highlight how a city can use procurement as a lever for e-mobility.

New business models call for regulatory updates

New concepts and products, such as multi-user and multi-purpose vehicles and swapping battery systems, are emerging to solve issues, such as underused vehicle capacity and charging. Since these concepts are new, they are often not included in existing legislation, like many other EV-related issues. Regulations can therefore impede piloting and slow down the potential of these solutions. The classification of vehicles (e.g. e-scooters, light EVs like ACM) that do not fall into an existing category and multi-purpose use for both logistics and passengers are examples of local or national regulations that need

to be updated. A battery swapping system would potentially require integration into mobility stations, for which different actors need to come together and plan accordingly.

User and stakeholder involvement

Co-creation and communication with users regarding the pilot aim and process is fundamental. Key stakeholders within the city, at the regional level, and at the national level, as well as providers and operators need to be involved during the design phase of the pilot and must remain active throughout implementation. In case of new business models, such as the shared use and swapping battery system, it is important to develop ideas together with city stakeholders and other actors in order to have products and services that function and serve their purpose. A continuous involvement of and feedback from users can help to match relevant testers with products in the long run, and aid communication with providers.

Holistic thinking when designing EV fleets

Thinking thoroughly about the aim and scope of the pilot as well as how to achieve the highest impact is key. Ideally, pilots should contribute to the city's mobility and environmental strategies and be part of a wider plan. Managing a test fleet involves technology, the human factor, and a number of regulatory and administrative aspects. For public bodies, the purchase of goods and services goes through public procurement. Although there might not be a market-available service at that point, it is possible that procurement will create one and it is therefore important to include as wide a group of potential providers as possible.

Regarding the choice of the vehicle, it is advisable to involve models from several manufacturers, to enable comparison and facilitate market uptake later. It is also advisable to test those before launching the procurement, in order to minimise surprises. Planning for a large EV fleet requires analysing the grid in the parking facility prior to the start when charging infrastructure must be available and functioning. Resource capacity in terms of time and personnel is also important.

In public-private collaboration, it is advisable for the City to have access to or even manage data collection. In the case of subsidy dependencies, it is important to make sure to provide the funding afterwards.

Take advantage of the structures in place

Existing economic and social structures with the prevalence of motorised individual transport can facilitate the large-scale adoption of EVs. The predominant position of MIT in public and political discussions should be utilised to speed up actions for new power technologies (e.g. new business models and regulatory updates). Moreover, car dependency ensures the success of commercialisation strategies. An active and healthy car market facilitates the transformation of the associated products and services, such as power supply, insurance, financing and maintenance, to serve the new vehicles and its users properly.

5 Conclusions

The experiences of the four cities in CIVITAS ECCENTRIC that implemented the five measures for the uptake of electric vehicles highlight important factors that may be relevant for other cities. The examples from CIVITAS ECCENTRIC indicate the following:

- Test fleets are key in getting new users acquainted with clean technologies and identifying the sectors and user cases where electric vehicles are appropriate. They offer an excellent opportunity to bend boundaries and scepticism on functionality and costs and provide solid ground to justify long-term investment.
- Users are curious and there is a favourable political and economic environment in Europe for this type of investment, opening up a window of opportunity for testing and evaluating the potential of EVs in various sectors.
- Despite the plethora of tests, data collection is still challenging.
- Fleet electrification requires cross-disciplinary competencies and stakeholder involvement is crucial in carrying out pilots or introducing EVs in various sectors.
- EVs have to be promoted as part of a holistic view of urban and mobility planning. Otherwise its benefits can be outnumbered by its drawbacks and secondary effects.
- Procurement is a powerful tool for driving electrification in cities and there is a need to use it actively in pursuing local air quality and mobility strategies.

6 Sources

CIVITAS ECCENTRIC, Survey 2 on experiences from driving an EV.

Electro- EMT, Prices for charging *https://www.emtmadrid.es/* (in Spanish)

European Commission, 2016. Grant Agreement Number 690699 CIVITAS ECCENTRIC, 27 May 2016

Evliati Maria-Angeliki, 2017. Deliverable 6.1 Preparing for the uptake of clean vehicles, CIVITAS ECCENTRIC, October 2017.

Evliati Maria-Angeliki, 2018. Deliverable 6.3 Implementation Report Testing of EV and FCEV vehicles, CIVITAS ECCENTRIC, November 2018.

Evliati Maria-Angeliki, 2020. Deliverable 6.4 Replication package EV charging infrastructure, CIVITAS ECCENTRIC, June 2020.

Madrid City Council, 2018. Puntos de recarga eléctrica, *https://www.madrid.es/*

Madrid City Council, Plan A: Plan de Calidad del Aire y Cambio Climático de la Ciudad de Madrid, *https://www.madrid.es/UnidadesDescentralizadas/* (in Spanish)

Power Circle, 2020. Statistics on chargeable vehicles in Sweden, March 2020.

Trafikanalys, 2019. Tunga och lätta lastbilars transporter–fokus urbana miljöer, PM 2019:4. Available at: *<https://www.trafa.se/globalassets/pm/2019/pm-2019_4-tunga-och-latta-lastbilars-transporter.pdf>*

Transportstyrelsen, 2020. Bonus malus-system för personbilar, lätta lastbilar och lätta bussar. Available at: *https://www.transportstyrelsen.se/bonusmalus*

Trivector 2016, Vem kör i Stockholms innerstad på vardagar, April 2016 (in Swedish)

CiVITAS
Cleaner and better transport in cities
ECCENTRIC

THE CIVITAS INITIATIVE
IS CO-FINANCED BY THE
EUROPEAN UNION

Contacts:

Project Co-ordinator
Francisco Lopez Carmona, City of Madrid
lopezcfjo@madrid.es

Project Management team
Isabela Velázquez & Carlos Verdaguer, GEA 21
ivelazquez@gea21.com
cverdaguer@gea21.com

Irene Blázquez Jimenez, EMT Madrid
eccentric@madrid.es

Project Evaluation Manager
Helber Lopez Covaleda, TU Munich
helber.lopez@tum.de

Project Dissemination Manager
Esther Kreutz, Union of Baltic Cities
esther.kreutz@ubc.net

Site Managers
Juan Azcarate, City of Madrid
azcaratelj@madrid.es

Stefan Synek, City of Munich
stefan.synek@muenchen.de

Nikolay Simeonov, City of Ruse
n.g.simeonov@gmail.com

Paul Fenton, City of Stockholm
paul.fenton@stockholm.se

Stella Aaltonen, City of Turku
stella.aaltonen@turku.fi

Work Package Leader Clean Vehicles
Maria-Angeliki Evliati, City of Stockholm
maria-angeliki.evliati@stockholm.se