2020 CiViTAS
Cleaner and better transport in cities

ECCENTRIC

# D6.3 Implementation Report WP6 Cluster 1

## Testing of EV and FCEV vehicles

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## Abstract

The cities of Stockholm, Madrid, Munich and Turku work with test fleets of electric vehicles (EVs), light electric vehicles (LEVs) and electric freight vehicles (EFVs) with selected target groups, new charging infrastructure, as well as incentives and information on clean vehicles and fuels. User groups include private persons, businesses and civil servants in the city administration. Measure implementation shows that there is interest and curiosity to test EVs and a demand for more associated facts and incentives. Testing EVs and upgrading the clean vehicle portal has generated valuable lessons learned for practitioners and policy makers. Concrete lessons concern how to organise and manage a test fleet, especially as a city authority, including test users and other involved actors. Implementation has further shed light on the risks from counteracting strategies and incentives for EV deployment, as well as opportunities for cities to create and boost the e-mobility market using procurement.


## Cluster Partners

| Organisation | Country | Abbreviation |
|---|---|---|
| Ayuntamiento de Madrid | Spain | AYTOMADRID |
| Empresa Municipal de Transportes de Madrid SA | Spain | EMT |
| Stockholms Stad | Sweden | STO |
| Mobility Motors Sweden AB | Sweden | MM |
| Green City Projekt GMBH | Germany | GCP |
| City of Turku | Finland | TUR |
| Varsinais-Suomen Liito | Finland | VSL |
| Turun Ammattikorekeakoulu OY | Finland | TUAS |

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## Table of Contents

## List of figures

## List of Acronyms

| | |
|---|---|
| ACM | Adaptive City Mobility |
| D | Deliverable |
| EC | European Commission |
| EU | European Union |
| EFV | Electric Freight Vehicle |
| EV | Electric Vehicle |
| e.g. | *exempli gratia* (for example) |
| GA | Grant Agreement |
| GCP | Green City Projekt |
| GCX | Green City Experience |
| i.e. | *id est* (that is to say) |
| LEVs | Light Electric Vehicles |
| MaaS | Mobility as a Service |
| ML | Measure Leader |
| MoU | Memorandum of Understanding |
| NGO | Non-Governmental Organization |
| WP | Work Package |
| WPL | Work Package Leader |
| WS | Workshop |

# Executive Summary

The cities of Stockholm, Madrid, Munich and Turku work with test fleets of electric vehicles (EVs), light electric vehicles (LEVs) and electric freight vehicles (EFVs) with selected target groups, new charging infrastructure, as well as incentives and information on clean vehicles and fuels. User groups include private persons, businesses and civil servants in the city administration.

In Stockholm, companies in craft and delivery services have been testing EFVs and Stockholm's clean vehicle portal has been updated to become more user-friendly. Madrid has procured EVs in the municipal fleet while expanding its fast charging infrastructure network. Turku has procured LEVs to be tested and evaluated by different departments and in Munich, a prototype of a lightweight EV with swapping battery system is used to test a business model for combined uses.

Measure implementation shows that there is interest and curiosity to test EVs and a demand for more associated facts and incentives. Testing EVs and upgrading the clean vehicle portal has generated valuable lessons learned for practitioners and policy makers. Concrete lessons concern how to organise and manage a test fleet, especially as a city authority, including test users and other involved actors. Implementation has further shed light on the risks from counteracting strategies and incentives for EV deployment, as well as opportunities for cities to create and boost the e-mobility market using procurement.

# 1 Introduction

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.

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 (CIVITAS ECCENTRIC Grant Agreement).

The overall objective of the project is to 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.

Work package 6 (WP6) comprises of seven measures to accelerate and widen the uptake of clean vehicles in Madrid, Munich, Stockholm and Turku. The underlying idea of the work package is that two issues are slowing down the uptake today: first, clean vehicles are not deployed in some specific functions or business areas; and second, clean vehicles are available in other areas but a lack of knowledge and costs are hindering their uptake.

To tackle these barriers, measures:

- Trigger the wide uptake of clean vehicles (electric, liquid biogas) by companies, municipal fleets and households, offering test fleets, new charging infrastructure, incentives and information.
- Increase participation of citizens and local stakeholders.

Measures of this WP focus on electric mobility, testing vehicles (Cluster 1) and establishing charging infrastructure (Cluster 2). (European Commission, 2016)

# 2 Explanation of the work implemented in WP6 Cluster 1: Testing of EV and FCEV vehicles

Madrid, Munich, Stockholm and Turku are working with testing electric vehicles (EVs), light electric vehicles (LEVs) and electric freight vehicles (EFVs) with selected target groups for work or leisure trips and provide proof of concept and in-depth knowledge on user experiences. Target groups range from private persons to businesses and civil servants in the city administration.

Madrid has procured EVs for their municipal fleet while expanding its fast charging infrastructure network. Similarly, in Turku, the city has procured light EVs, which city employees from different municipal departments can test during a certain period of time. In Stockholm, companies in craft and delivery services have been testing EFVs. The clean vehicle portal has been updated to become more user-friendly. Munich has used a prototype of a lightweight electric vehicle with swapping battery system to test a pilot business model for combined uses.

This report gathers and summarises experiences and lessons learned from Task 6.2 – Procurement and implementation (M3-M24). The task covers the launch of the tendering and procurement process associated to the demonstration actions, the actual implementation of the pilot projects and participatory processes accompanying the measure development (European Commission, 2016). Detailed background of the measures as well as results from Task 6.1 – Research and measure planning are presented in D6.1 Preparing for the uptake of clean vehicles (Evliati, 2017).

The report presents a technical description of the demonstration measures testing electric vehicles of various kinds, including a description of the implementation process and the analysis of the main barriers and drivers encountered during the implementation phase. The report summarises lessons learned and provides recommendations for replication.

Telephone interviews with each Measure Leader and associated partner in October-November 2018 have provided input for this report. The final draft was discussed with Measure Leaders at a WP telephone conference in December 2018.

## 2.1 STO 6.1 Offering EV-test fleets to selected target groups (Local partners 09.STO, 13.MM)

### 2.1.1 Introduction

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. 15 companies have been test-driving electric vans in Stockholm since autumn 2017. These tests will provide the City of Stockholm with data to understand barriers and opportunities for professional users of freight vehicles to shift to electric powered transmission.

### 2.1.2 Implementation

Companies participating in the test-fleet were selected through a competition held in 2017. The City of Stockholm and Mobility Motors (authorised Nissan dealer) selected applicants that are based in, or drive through, the living lab area Liljeholmen-Årsta-Hammarby Sjöstad to reach their customers.


**Figure 1** One of the test companies works with assembling charging poles. © Mikael Röhr

Companies with long driving distances were chosen to achieve higher $CO_2$ reduction during the test period (Evliati, 2017). The competition aimed at a spread across different business types in order to assess for which of them an electric van is feasible, as well as to understand what their charging patterns and needs are. The test companies are 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 wholesalers (Figure 1).

According to the original plan, 20 companies would to be recruited for the test-fleet. Due to cost reporting issues requiring lengthy clarification times, (Intermediate review May 2018) implying a certain economic risk for Mobility Motors, it was decided to proceed with 15 companies.

### 2.1.3 Stakeholder involvement

The City of Stockholm is leading on this measure in collaboration with Mobility Motors. Central in the implementation of the test-fleet are the 15 companies leasing a Nissan e-NV200. Drivers of the vehicle are key in conveying their experiences to the city, the market, and their peers. In many cases the vehicle is not assigned to a particular person but is shared among several colleagues in the company. In those cases, the "main" driver was identified and used as a contact point since data collection has started.

Soon after the vehicles were distributed, the City of Stockholm has contacted the drivers to introduce the project and the upcoming surveys. Mobility Motors has had a continuous contact with the companies in order to provide with technical support (e.g. tips on how to drive and save energy, how to register energy use, etc.).

The two-year test period is running between 2017-2019. During this period, quantitative and qualitative data is being collected. After one year of testing, drivers were invited to a lunch seminar with the aim of getting to know each other, share experiences and tips, and build a community that is part of a bigger context working towards fossil free mobility. Nearly 70% of the participating companies have access to charging infrastructure at their premises, according to responses of two surveys. Use of fast charging facilities in the city vary considerably among the companies from once a month to no need for fast charging at all (Results from EV Survey 2).

The City of Stockholm is actively working with public charging infrastructure and over 100 on-street spots are now up and running in the city centre (Figure 2).

**TEST COMPANIES**

- Building
- Airlines
- Gardening
- Bike deliveries
- Fire protection
- Ventilation
- Installation and construction
- Electricity installations
- Painting and building materials
- Acoustic consultants
- Waste management and recycling
- Real estate concern
- Food wholesaler
- Office plant solutions
- Carrier and deliveries

### 2.1.4 Business model and contractual partnerships

Test companies were selected through a competition and have received a grant which covers the price difference from leasing an equivalent fossil van. This amount is financed by CIVITAS ECCENTRIC. In return, companies are committed to provide data and be available for study visits and other exchange meetings


**Figure 2** Test van on one of Stockholm's charging streets. © Lennart Johansson

### 2.1.5 Critical challenges and success factors

One of the challenges has been reliable data collection. Drivers have to keep a daily manual logbook four times a year, recording energy use and distance driven. A few rounds of data collection have proven to be of poor quality as data was not correctly registered or came in with considerable delay. The issue can partly be explained by several drivers using the same vehicle, a poor understanding of the instructions provided as well as partners' insufficient time allocation for this task. Getting correct data from the electronic logbooks has also been a challenge. The City of Stockholm has dedicated a considerable amount of time to exchange with the electronic logbook provider and establish a clear process for delivery, as well as timing and data format.

As regards functionality of the vehicle, range and heating are two factors on the negative side. Companies that cannot plan their work and have customers spread out in many different places have a hard time managing long distances with the current range. When it comes to errands that involve long distances and big products, drivers choose an alternative vehicle in their company fleet. Heating, which is also linked to battery range, is not sufficient for businesses with plants for example and drivers appear to be rather creative in order to compensate for the technical inefficiencies (Figure 3).

On the other hand, 60% of the drivers are satisfied with driving electric at work and find the vans comfortable and pleasant. The majority of drivers are also satisfied with how charging


**Figure 3** Heating in the car is a challenge for companies transporting plants. © Mikael Röhr

works and find it convenient to skip going to a petrol station. Furthermore, participating companies have in their majority an environmental profile in their business idea and it feels good to do something for the environment. Some of them see themselves as inspirational. Drivers receive positive comments from colleagues, customers and the general public. 12 out of 15 companies attended the lunch seminar, which was organised to present the mid-term results of the measure. Participants demonstrated great interest and curiosity in the findings and thought it was fun to do something different than their daily work.

### 2.1.6 Lessons learned

Private companies involved in European projects of this kind can have a different perspective and often not speak the same language. Educating users or including extensive exchanges with involved partners and stakeholders in the project management has proven to be necessary in order to foster common understanding and bring everyone on the same page.

With regard to financing, this project is based on a grant that is evening out the price difference between fossil and electric vans of the same type. Considerable time during the research and planning phase was dedicated to finding when (that is, upon purchase or after completion of the test) and how to distribute the grant to the 15 grantees. Each option came with different complications on the reporting side. At that stage, giving the grant upon purchase in form of a reduction was seen as the least complicated option for the involved test companies. At the

same time, this has deprived the measure leader from a valuable negotiating asset and leverage in cases of poor or delayed data delivery from the test companies.

A lunch seminar with the drivers took place after the first year of the test, as data collected from before and during the test period allowed for an interesting presentation. Although there has been a concern that drivers would not have time for this exercise, participation and enthusiasm surpassed expectations. A meeting or more informal exchange with the drivers earlier in the project may have built even higher commitment and better understanding.

As regards charging patterns, businesses that can plan their work seem to not be in need of opportunity charging in the city. Although the sample is rather small to draw conclusions, it gives a first insight on the charging needs of these business actors. For users charging at home, charging stations have an energy meter, which makes it technically possible for the employee to recover these costs from the employer. This type of compensation is a matter of agreement between the employee and the employer.

### 2.1.7 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 delivery of results to ensure higher commitment.
- Consider how different businesses use opportunity charging in the inner city.

## 2.2 MAD 6.2 Test fleets, policy incentives and campaigns for the uptake of electric vehicles (Local partners 01.AYTOMAD, 04.EMT)

### 2.2.1 Introduction

Electric mobility is growing and, according to the latest update of the statistical data of the Spanish Directorate General of Traffic (DGT), more than 12,000 zero emission vehicles are registered in Madrid. Of these over 11,000 are fully electric. Fast charging infrastructure is under developed, however. The city has an on-street charging network (24 spots) and some municipal parking facilities offer charging points as well. The first two fast charging points are located in petrol stations and opened in September 2016. Several companies are starting to introduce EVs in their fleets (taxi companies, private transport companies, car-sharing companies) but the electric mobility market still needs to be boosted.

This measure's objective is to reduce energy consumption and emissions, promoting the uptake of clean vehicles and optimising the city charging infrastructure network. The measure is expected to bring at least 20 new EVs into the municipal fleet and to accelerate the deployment of the City Fast Charging Network with at least three new charging points. At least five private companies are expected to introduce electric vehicles in their fleets as a result of awareness raising activities.

### 2.2.2 Implementation

**Charging infrastructure**

Madrid's work on charging infrastructure is based on three pillars, as outlined in the City's Air quality and Climate Change Strategy 2016-2030 (Madrid City Council, 2016).

- On-street charging, indirectly managed by the City

Today there are 24 normal charging spots (3.2 – 7 kW) in collaboration with two different private charge 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 app processes the payments and provides information to citizens. The same information is also available online – now as part of the city 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.

**Charge 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 market (October 5, 2018).

The charge manager is now called electric mobility services provider.

- Off-street charging, directly managed by the City (EMT)

Off-street charging on municipal parking facilities was made possible since Empresa Municipal de Transportes de Madrid SA (EMT) has become a charge 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 3,6kW up to 50 kW) and six parkings offer normal charging infrastructure on municipal parking facilities. EMT signs agreements with specific stakeholders.

- Off-street charging, run by other actors

Around 180 petrol stations are located in the city, most of them on municipal land based on a public concession of 25 years. When signing new concessions with the City, it is mandatory to include fast charging infrastructure. To facilitate off-street charging, the City has procured nearly 40 fast chargers to be installed at petrol stations and other private land locations. The


**Figure 4** Madrid's charging map with 24 on-street charging locations. © City of Madrid

City signs an agreement with private landowners and provides the procured equipment. Land owners are responsible for operation, maintenance, management and operation for a period of four years with the possibility to extend for another four years.

**Municipal fleet**

The second line of work in this measure is the municipal fleet. Implementation started by analysing fleet requirements, in order to identify possible limitations for EVs. A clause for EVs was added in the procurement and EV providers received more points. Received offers surpassed the initial target. In 2017, 92 EVs and 23 e-motorbikes were added to the municipal fleet, and the forecast for 2018 includes 131 EVs more.

The third line of work, liaison with companies to increase EVs in their fleet, has been less fruitful. Discussions have taken place, however without having been formalised. According to the companies' perspective, the business model is not favourable enough since they have to pay for using the parking facility, which they find expensive and they expect that the city should offer this service free of charge. From the city's perspective, charging facilities at municipal parking are cheaper than those provided by private actors.

**PRICES 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 new regulation on the zero emission zone in the city centre is expected to change the situation. The zone might act as a stronger lever for many more companies to switch to EVs, as compared to the five companies which were in the scope


**Figure 5** Madrid's electric municipal fleet. © Ayuntamiento de Madrid

of this measure. In parallel, the city is drafting a new strategy for e-mobility that will be finished in the coming months.

Stakeholders involved in implementation of this measure have been 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 has been responsible for the overall procurement strategy and each department has been responsible for their own purchases. Other local actors have contributed upon invitation at a workshop in October 2018.

The taxi sector was expected to have a big potential for the transition to EVs, as car manufacturers are making new models available (e.g. new Nissan leaf with larger range). Companies in urban freight, commercial and delivery companies have also been involved in the discussions.

The measure is in line with the Air quality and Climate Change Strategy 2016-2030 (Plan A) which promotes zero emission technologies for road traffic. To ensure transition to clean fuels, Madrid also works with fast charging infrastructure at petrol stations. When petrol stations are signing new concessions, fast charging infrastructure is mandatory. This requirement also applies to petrol stations selling more than five million litres of fuels per year, as of the Spanish National Government's draft of the new Strategy to fight against Climate Change and Energy Efficiency.

Synergies with other ECCENTRIC measures can be found with MAD 5.8 purchase of hybrid buses (fully electric is not be feasible) as well as MAD 7.1 and MAD 7.6 building a consolidation centre and developing a prototype of an e-cargo vehicle.

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

The zero emissions 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 with wider time delivery windows for cleaner vehicles and access restrictions to polluting ones, public transport with 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 deployment of a wide charging infrastructure.

Implementation has taken more than two years time and is currently ongoing. Two people have been working full-time on this measure.

### 2.2.3 Business model and contractual partnerships

With regard to charging infrastructure, there are three types of contractual partnerships, depending on the role of the city. For the on-street charging infrastructure, the city has signed an agreement with two charge managers (IBIL and GIC). The second type is when the city itself acts as a charge provider via EMT for off-street charging. In this case charging equipment is procured by the city and EMT has installed fast chargers in public parking and other publicly accessible facilities. For the off-street charging infrastructure run by other actors, the city is signing MoU as the contractual partnership between the city council and different landowners

and charge managers. The latter supply the land, electricity, maintenance and service and the City owns and provides the procured charger. This was the easiest and fastest way to offer this service rather than opening a funding programme for private actors. The MoU considers a period of 4-8 years in total.

As regards fleet, a leasing agreement for four years through procurement is signed. 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 is provided by the municipal budget. ECCENTRIC funding is covering about 10% of the total for installation of charging points/spots and evaluation purposes.

### 2.2.4 Critical challenges and success factors

Implementation has run smoothly and is generally ahead of schedule with no severe challenges. The success of this measure owes to a good alignment with current local strategic priorities and in particular to the Air quality plan, which has a clear focus on clean and electric mobility.

However, electric charging infrastructure faces three specific challenges: the first is that users find rates to be too expensive and expect to be offered this service for free. Second, companies do not yet see a clear business model for using the public charging infrastructure. Third, cooperation between traditional petrol stations and the electricity sector is not enough to add charging spots there.

As regards charging the newly procured municipal fleet, Madrid will need more than 200 kWh by the end of the year. For a fleet of over 45 vehicles, capacity starts to play in. At the moment of writing, 16 EVs were in place and 30 more were expected to arrive by the end of the year (2018). Capacity has become a point of concern due to technical issues on the grid connection remaining unsolved.

### 2.2.5 Lessons learned

Working with electric mobility in Madrid has been a long-term race since 2009. 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). Fast charging in underground garages (Recuerdo, Jacinto Benavente y Marqués de Salamanca) have proved not to be as popular. On-street parking is free of charge for EVs whereas underground parking is not, 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. Instead, linked charge is preferred, in connection to home or at destination (e.g. office, theatre, restaurant, supermarket or similar).

A lesson learned is therefore that offering public fast charging might not be the right solution for the City to offer. Adapting charging time to the time that the vehicle is parked or adjusting the parking spaces in garages so that fleet or freight operators can charge overnight seem to serve the users' needs better. EMT will reconsider their strategy based on the above. Another

key outcome is the increasing demand in public residents' parking for charging infrastructure, and how to cope with this demand.

Last but not least, the approach of liaising with five companies has not proved to be as efficient when the zero emission zone will push companies more effectively to that direction.

### 2.2.6 Recommendations

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

## 2.3 MUN 6.3 Electric lightweight vehicles for car sharing and logistics (Local partner 19.GCP)

### 2.3.1 Introduction

This measure is testing 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 multipurpose sharing software (European Commission, 2016).

Its multimodal design allows for operation of both people and goods transport, such as taxi, car sharing and logistics. Shared usage and the swapping battery system reduces car ownership and long charging times, respectively. The vehicle has already been developed and the aim is to pilot a pilot business model with four vehicles for sharing. Green City Experience (GCX) is the measure leader. The measure has been broadened to include a mobility sharing concept for up to two people. The e-scooter service *Emmy* will be evaluated concerning its


**Figure 6** The prototype of lightweight electric vehicle. © Adaptive City Mobility

sustainability potential when used by those living and working within the ECCENTRIC living lab (the districts of Domagkpark and Parkstadt Schwabing) in Munich.

### 2.3.2 Implementation

**Adaptive City Mobility light vehicle**

To clarify conditions and regulations for setting up the multimodal usage of the vehicle and the installation of the battery swapping stations, GCX has 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 has collaborated with Isarwatt to ensure the usage of renewable energies. Parts of the battery swapping infrastructure have been installed in Domagkpark/Parkstadt Schwabing, drawing the attention of local residents. Two local cooperative associations, Wogeno and Wagnis, have granted access to their parking lots in order to install parts of the infrastructure.

Originally, the ACM vehicle was intended to be integrated into mobility stations and a booking app in Domagkpark/Parkstadt Schwabing. ACM is however not street legal yet, due to the homologation process that is still ongoing. Due to technical constraints and the ACM vehicle being at a prototype stage, GCX had to introduce a separate testing period. Integration of other vehicles and mobility solutions, such as e-cargobikes into the ACM system remains part of the plan, but the current business model does not allow for an economically efficient integration.

**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

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

**The emmy scooter**

While the vehicle remains to be delivered, GCX has introduced the *Emmy* scooter, which was not foreseen in the original plan of the measure. *Emmy* is an electric scooter-sharing start-up, which was launched in Berlin three years ago and operates in Munich since 2017.

**INFRASTRUCTURE**

**ACM**

- Fully equipped battery charging station
- Sharing app

**emmy scooter**

- Fixed dock station
- Analysis software

GCX has had an extensive dialogue with the company, in order to bring the sharing concept to the ECCENTRIC living lab. The service offers free-floating scooters and station-based ones, which will be regularly refilled at a fixed parking space (see Figure 7). The City of Munich has provided the parking space.

The company has agreed to grant access to certain data concerning user behaviour, as well as its customer contact data in order to implement the user survey for Emmy's evaluation. Evaluation of *Emmy* will shed light on the potential of two-wheeled EVs to substitute trips previously carried out by fossil fuel powered ones and the impact on the users' view on electric mobility in general. GCX has begun to work with *Emmy*'s evaluation.

The concept of a shared lightweight vehicle is based on the technical and technological development within the research project ACM. The latter is funded by the German Ministry of Economic Affairs. The actual testing phase of ACM is expected to take six months, while the phase involving *Emmy* is foreseen to take nine months. The start of the ACM is however dependent on when the vehicle will be delivered.


**Figure 7** Emmy scooters in Munich. © Nagy Presseamt Munchen.

### 2.3.3 Business model and contractual partnerships

The ACM vehicle and concept belong 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”. The implementation and testing of the vehicle and swapping station, however, are financed by CIVITAS ECCENTRIC to 70%.

The business model is based on reduced costs through maximised efficiency, as ACM vehicles will be used as shared vehicles and MaaS. So far, the association Wogeno has supplied a parking space in addition to the space for the battery swapping stations. That has been contractually fixed by a tenancy agreement. Pilot users participate on a voluntary basis and are not bound through a contract.

The *Emmy* company owns the scooters and GCX is responsible for evaluating their use in Munich. The *Emmy* evaluation was added onto the measure during the course of the project and is currently not financed by ECCENTRIC.

### 2.3.4 Critical challenges and success factors

Implementation of the ACM has been largely dependent on the results of the above mentioned ACM research project, where conditions are constantly evolving. The major challenge for the

test is that the ACM vehicle is not yet street-legal. Technical project partners are currently working on several technical aspects.

As a minimum requirement for the test, GCX needs to obtain at least one street-legal ACM vehicle. Successful implementation to date is due to good collaboration with local associations that provided access to their parking spaces and enabled installation of the charging stations. Target users have also been very curious and interested in testing the vehicle.

### 2.3.5 Lessons learned

Lessons learned are expected to be generated within the next year when the ACM vehicle(s) will be running and the *Emmy* survey will be ongoing. Agile project management and planning has proven to be a crucial part of the living lab approach, especially when depending on the results of a research project. In similar cases, it can be useful to plan for two project options from the beginning – one including and one excluding the results of the research project. This can act as a buffer to possible delays and complications within the first project.

When it comes to the *Emmy scooter,* pre-testing the questionnaire and getting feedback from other researchers working in neighbouring fields have proven to be constructive.

### 2.3.6 Recommendations

- Be flexible when planning an action 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. Communication contributes to a collective understanding of the insights gathered by trial and error.
- Communicate with the 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 TUR 6.4 Electrification of Municipal Fleet & Promotion of Electro-mobility (Local Partners 21.TUR, 22.VSL, 25.TUAS)

### 2.4.1 Introduction

This measure is about the City of Turku testing lightweight EVs (LEVs) for everyday use in a one-year e-mobility pilot, which includes awareness raising actions among city employees. Employess of the City are carrying out the tests. An employer mobility survey,run since 2013, has shed light on the mobility habits of some 500 employees. This year the national survey inquiry was in favour of a shift to lightweight electric vehicles.

Eight light EVs meeting different mobility needs were selected and leased by different

**Figure 8** Light electric vehicles procured and tested in Turku. © City of Turku

suppliers. The goal of the pilot is to obtain about 200 user experiences and increase the knowledge of e-mobility among the city employees. The LEVs will be tested in approximately 24 city units during the course of one year.

Employees participating in the pilot are expected to use the LEVs for commuting, travels during the workday and in their spare time.

### 2.4.2 Implementation

Step 1. Choosing the LEVs that are useful for the involved departments. Turku has carried out an analysis of current usage of vehicles and concluded that LEVs serve the participating departments' needs.

Step 2. Preparations for tendering (public procurement), including specifications and requirements. Options have been limited as there were no suppliers of this service in Turku. The aim of the pilot was to experiment with 10 different vehicles. After two bidding rounds, offers were received for nine different LEVs. Research into finding one additional vehicle will be carried out, which will then be added to the test fleet as soon as suitable providers will be found.

Step 3. Procurement decision from the executive level. Call for tender was sent to multiple suppliers via a 'light tendering' procedure, as the initial cost did not exceed the official threshold limit. Despite the lack of potential suppliers identified prior to the procurement, four suppliers initiated this type of leasing as a response to the municipality's demand and are now participating in the pilot. Providers had to offer vehicles that can be used during wintertime also. All vehicles can be charged from a regular plug and testers can charge at home or at work. A space is needed to park or store the vehicle.

**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

Step 4. Preparation and signature of contracts.

Step 5. Recruiting volunteers to pilot through the directors and management level. Testers may use the vehicles for a two-week period. In return, they have to report their experience using the vehicle at the end of the trial by answering a questionnaire. Recruiting testers for the wintertime turned out to be difficult. For this reason, a cooperation with BSR electric Interreg project was initiated: Turku University of Applied sciences will test the vehicles for two weeks in order to analyse technical issues and legal aspects of the vehicles.

Step 6. Communicating with the participants, organising and coordinating the testing periods. This step included circulating the vehicles between departments and making sure all time slots were allocated.

The test fleet currently comprises of LEVs only. No electric cars are envisaged but discussions are ongoing as to what is the best way to cater for travels carried out by car. Buildings that used to be rented by the city were recently sold out to an international company, making it difficult to acquire parking spaces. The plan is therefore to opt for car sharing in Turku's laboratory area. While certain departments in the city have today leased cars for working hours, departments in the laboratory area do not have access to car sharing.

Changes in budget from Equipment to Subcontracting were made following the actual planning of this measure. The research phase took longer than foreseen and implementation started in July 2018.

Stakeholders involved are the employees of the City of Turku (27 departments participating), including the measure leader , and suppliers of the vehicles (Skand Oy, Ewheels Group Oy, NextBike Polska S.A., Järvileasing Oy).

The measure supports Turku's vision to become carbon neutral by 2029. There is a clear synergy with Smart and Wise, one of the three spearhead projects of Turku working on digitalisation and wellbeing. There are also synergies with PSR Electric Baltic Sea Region, where Turku University of Applied Sciences is also participating. Turku is not a partner but the project uses Turku's current model in Helsinki.

The pilot covers one year plus the preparatory work before and the analysis after, reaching approximately over 1.5 years. About six months are needed to fix contracts and tendering and once contracts are signed it is necessary to assign time for testing the equipment and ensuring that it works.

### 2.4.3 Business model and contractual partnerships

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

### 2.4.4 Critical challenges and success factors

The first challenge was the lack of suppliers to provide devices that did not need registration or driving license. Only a limited number of LEVs were offered in Turku at that stage and none of the suppliers were leasing the vehicles. Quality issues with the vehicles have occurred along the way and suppliers had to correct this issue.

Managing the vehicles has been the second challenge. The City does not have enough resources to move vehicles around and manage vehicle allocation. Initially, funds were allocated for Southwest Finland to move the vehicles and carry out the surveys as regional partners. However, as the timetable has shifted from spring to autumn, regional partners do not have worktime available to dedicate. Two persons are now responsible for moving vehicles around. In case of heavy snow, a van would be needed and such a vehicle is not available. Furthermore, lack of a storage space to allow for an open booking system makes it complicated and time consuming to plan dates for each test. Minimum requirements for this measure to function is at least one person working full time for the measure. A warehouse to store the vehicles while they are not in use (i.e. between test periods) is also necessary.

Despite difficulties, Turku has created an own business model and a market for leasing light EVs. Another success factor is that the measure is very visible, being ideal for communication work on social media and internally to raise the discussion on sharing. The selected recruitment process has secured approval of the pilot at the management level and many test users have become interested in participating in the pilot.

### 2.4.5 Lessons learned

Testing period of one year has proven to be too long and booking e.g. for May next year is too far in advance to manage. Changes in the schedule occur constantly and it is challenging to ensure that eight people from each unit for two consecutive months take part. A good plan has to be in place for physically moving the vehicles from one department to the other, as this might require additional resources (e.g. personnel or a bigger vehicle). As regards contractual agreements, processes and responsibilities must be really clear from beginning to end. In cases of vandalism, it has been unclear who is responsible.

Another lesson learned concerns managing test users. Educating testers on how to use the vehicle and communicating with them takes time. Although recruiting test users through the Head of Departments worked quite well, the next step could have been done slightly differently. Allocation of testers and coordination of the testing periods is handled manually in excel sheets. A manual system allows the human factor to play in and it becomes difficult to accommodate everyone's changing schedules. A more automatic registration tool, e.g. a booking calendar, would have enabled for a more efficient process.

Last but not least, the measure has raised a discussion on how to arrange such a pilot as a local authority and what happens when the aspect of sharing becomes more prevalent, which is not clearly defined in this measure.

### 2.4.6 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 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 replace a vandalised vehicle, crash costs, sudden breakdown of equipment, who is taking care of the vehicles and the winter tyres.
- Reserve some budget for reparation costs.
- Allocate time and resources for research and communication.
- Plan for staff allocation and cost involved.

## 2.5 STO 6.5 Developing the Clean Vehicle Portal (Local partner 9.STO)

### 2.5.1 Introduction

www.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 will be redeveloped through a stakeholder dialogue to take into account the needs, which the portal does not take into account today, thus providing a comprehensive information source for environmentally friendly vehicles.

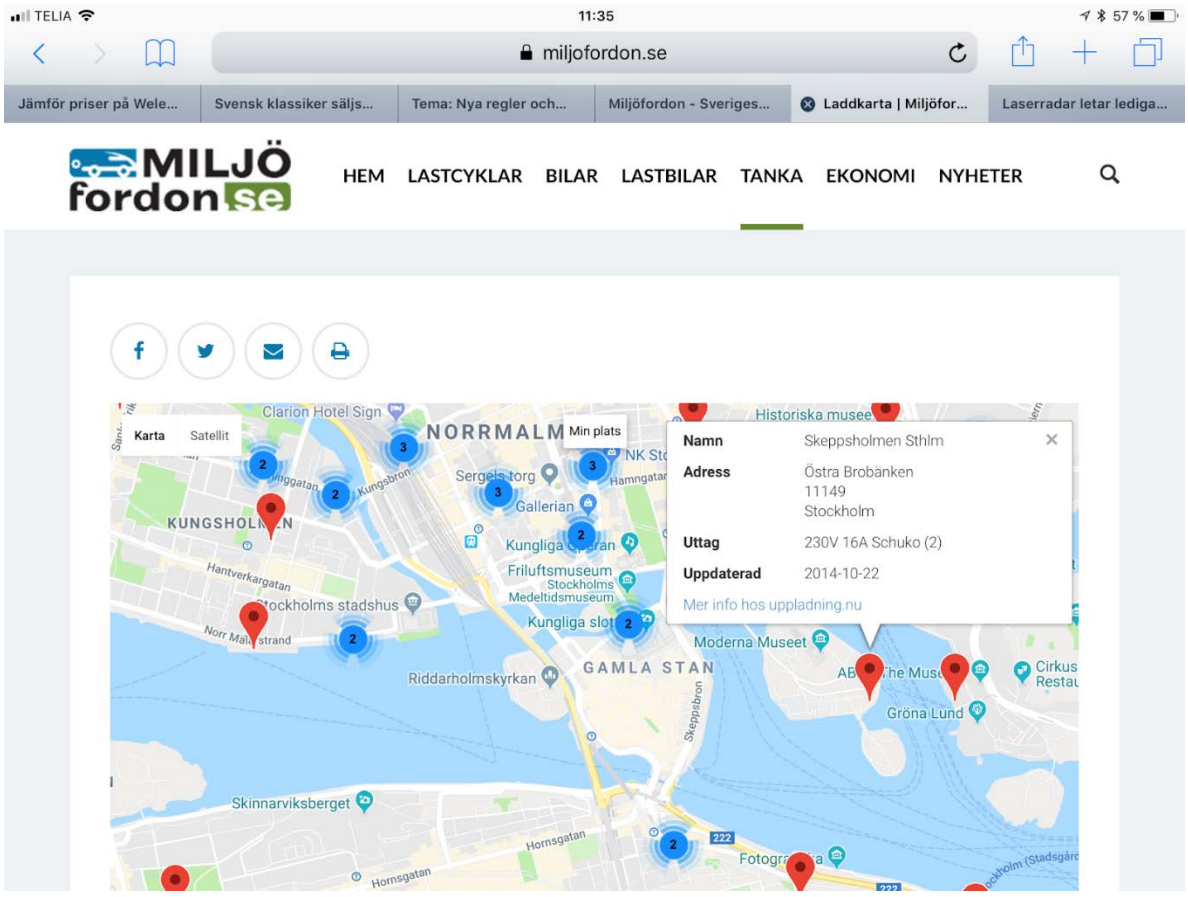


**Figure 9** Screenshot from the clean vehicle portal showing charging spots in Stockholm inner city. © www.miljofordon.se

### 2.5.2 Implementation

Three key steps can be mentioned in the implementation of this measure: information to multi-family housing associations; link to charging maps; and analysis of the target groups, beyond those who already use the website.

During the first phase, information about how to install electric charging at multifamily homes has been integrated on the portal. The usability of the charging map has been improved. Stakeholder dialogue and a usability test were carried out at a second phase. Fleet managers, private persons interested in buying new cars, sustainability managers, car dealers and NGOs have answered questions on how they search for information about clean, and particularly electric vehicles, and what would help them to promote those. A usability test has targeted users of the clean vehicle portal, who turned out to be typically middle aged men. Eight people (private persons and companies) were recruited. Usability tests were carried out in an online lab where users tested functions of the page and were interviewed on how they resonated before buying a vehicle.

During the third and final phases, both studies will give input to the further development of miljöfordon.se. New ideas will be investigated and those that are feasible will be developed and released on the web page. Work will also include search engine optimisation (SEO) to make the portal more visible when one is looking for EV information on the internet.

**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 and heavy trucks, clean fuels, regulation and incentives for clean vehicles

Changes from the original plan include electric off-road machinery, which is not available in the market. A second change is that the portal is not the central communication channel for CIVITAS ECCENTRIC by the City of Stockholm, as was initially foreseen. Shortly after the start of the project, it became clear that the target groups of the portal and the project were different: ECCENTRIC Stockholm has a local focus whereas the portal has a national one.

Fleet managers, private persons, car dealers and manufacturers, NGOs (e.g. BiogasÖst, Fores), consultants and usability experts are involved in the usability test. The main work is carried out by the measure leader (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 targeting housing associations, Fixa laddplats (STO Measure 6.7), and the charging infrastructure in Sweden, uppladdning.nu, are two examples featured on the portal.

Procurement of consultants, interviews, contribution to the test and analysis of results has required approximately two weeks full-time work.

### 2.5.3 Business model and contractual partnerships

Stockholm together with the cities of Gothenburg and Malmö run the website, which is financed on a yearly basis. ECCENTRIC finances the usability tests and staff working time. Consultants have been chosen through direct procurement. One provider was interviewed and two more received a request, out of which the cheapest solution was chosen.

### 2.5.4 Critical challenges and success factors

No major challenges have occurred as this measure is part of a project well that is well established, already up and running. Success factors include a good understanding and knowledge of the target groups, as well as access to the right contacts and network.

### 2.5.5 Lessons learned

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

As regards project management, more clarity in the measure description with a possibility to adapt to what is important here and now would have been beneficial for implementation. This discrepancy owes partly to that MLs are often not involved at the project proposal stage.

### 2.5.6 Recommendations

- Have a clear picture about why have such a webpage and for who
- Involve partners that can deliver reliable vehicle data (e.g. Bilvision autonet)

# 3 Lessons learned from implementation

This section presents the results and reflections on the Procurement and implementation phase for Cluster 1 Testing of EV and EFVs. This phase covers M3-M24 of the project. Test fleets are a common denominator for measures 6.1, 6.2, 6.3 and 6.4 while 6.5 is a communication tool. Central in all measures is stakeholder involvement, whose user experiences cover a big part of the evaluation.

Common across the measures is a need for having a clear vision of what is going to happen and for who, before the start of the project. At the same time most MLs have underlined the importance of flexibility to change plans.

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

The measures in Madrid and Turku concern electrification of the municipality fleet where the vehicle and/or service provider was selected through procurement. In the first case, procurement was carried out 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 the requested leasing as a response to the municipality demand. These two examples highlight how a city can use procurement as a leverage for driving e-mobility.

**Designing test fleets for electric mobility**

The implementation phase has generated valuable lessons as regards how to design and work with test fleets, especially as a city authority. These lessons often concern actions that could have been taken already at the previous, research and planning phase.

Managing a test fleet involves both technology and the human factor. In cases where the vehicles are selected through procurement, it is recommended to test those before launching the procurement. This is a way to ensure that the vehicle serves the purpose and minimises surprises. Even if there is no market for the required service, it is possible that procurement will create one.

In cases where vehicles are to be tested by different users in consecutive periods and different locations, it is useful to have a digital planning tools to manage users' schedules and changes that occur. What is the appropriate time (length) for testing periods is more difficult to say.

Third, when planning for a large electric fleet, it is important to analyse the grid in the parking facility prior to start. Resource capacity in terms of time and personnel is also important to plan for. Managing the human factor is presented in the section below.

**User and stakeholder involvement**

Central in the implementation of this cluster is the users' perspective, whose experiences are an important part of the evaluation. City officials, craftsmen, and other stakeholders in participating cities have shown interest and curiosity about testing electric vehicles. Recruiting the selected target groups has generally not been a challenge, with the exception of LEVs in Turku during wintertime.

On the other hand, communicating with the users, providing the right amount of information to keep them engaged and informed has been more resource and energy demanding. Test users

need guidance on how to drive and charge an EV but also on how to fill in surveys and questionnaires.

Other stakeholders, such as providers of software, equipment or services have also been involved in measure implementation. These actors often speak different languages as compared to local authorities. During implementation it was made clear that establishing contact at an early stage, communicating the milestones of the project and be transparent with them, has been of major importance.

**Public charging infrastructure**

Although this cluster mainly focuses on test-fleets, charging infrastructure (and particularly fast charging) is also part of M6.2 in Madrid. Lessons learned from implementation of charging infrastructure in Stockholm are thoroughly presented in the Deliverable 6.2 (Evliati, 2018)

The cases of Stockholm and Madrid highlight approaches and business models for cities to roll out publicly accessible charging infrastructure. Both cities promote and encourage standard charging at home or at destination. With regard to opportunity charging, Madrid focuses on public charging off-street at municipal garages and at petrol stations, while Stockholm has worked extensively with on-street charging. 24 locations on-street in Madrid can be compared with over 100 in Stockholm – in both cases offering a mix of normal and fast chargers.

Madrid procures charging infrastructure equipment even for private actors to operate and maintain, whereas Stockholm provides land access and assigns operation and maintenance fully to the providers. Both models have worked well in the respective cities, showing different ways to act as a city authority.

**Harmonising various mobility strategies**

While it is preferred to have EVs charging at home or at destination, current trends in Madrid highlight that fast charging off-street is not optimally used – one of the reasons being free parking on-street. This raises the question of how to harmonise various incentives so they are not in conflict with each other and that installed infrastructure serves actual user needs. In the case of Madrid, fast charging for private EVs does not seem to be the right solution. Instead, municipal garages could be modified, space wise, in order to accommodate fleet or freight operators for normal charge overnight.

Similarly, placement of public charging infrastructure raises the question of reserving public space for citizens versus making opportunity charging visible and accessible to curb range anxiety.

**Providing product neutral information on EVs**

The clean vehicle portal provides with facts about environmentally classified passenger cars, light commercial vehicles and heavy trucks, clean fuels, as well as regulation and incentives for clean vehicles. The portal is an example of a joint city initiative to disseminate product neutral information to buyers and drivers of clean vehicles. The portal relies on a vehicles registry and partners providing reliable data. Usability tests have shown a demand for more information about EVs and especially their range, as well as a need for stronger marketing to make the page more visible through search engines.

### Project specific lessons learned

Other lessons learned concern the structure of the ECCENTRIC project. In many cases, a rigid project description or budget division has created bottlenecks for the actual implementation that in many cases have required a more agile approach. All measure leaders have highlighted the importance of having a clear view at the start of the project, however there should be some flexibility to adapt to changing circumstances.

# 4 Conclusions and Next Steps

Testing electric vehicles of various kinds (personal cars, light vehicles and vans) and the clean vehicle portal with selected target groups has generated valuable lessons learnt for practitioners and policy makers. Concrete lessons learned concern how to organise and manage a test fleet that comprises not only of technical compartments (vehicles, parking facilities, software, managing tools and contracting) but also users. There is an interest and curiosity for testing electric vehicles. At the same time, guiding and training the test users and communicating smoothly and sufficiently with them and other involved actors, partners and providers are among the most resource intensive parts of this work.

Implementation has further shed light to risks and opportunities for cities working with electric mobility. Different business models for public charging infrastructure can work equally well in different cities but the rollout of infrastructure must be thought in the context of other incentives for EV users. Strategies and incentives that counteract one another risk to result in inefficient use of equipment, space and resources and user groups that do not have access to the type of charging they need.

On the other hand, implementation has showcased the potential of procurement to create demand and steer the e-mobility market. This is a valuable lesson learned for cities who are eager to promote clean vehicles but are seemingly constrained by what is currently available at the market. Last but not least, having worked with the clean vehicle portal has shown a demand for more information and more visibility of clean vehicle facts online.

Lessons learned at this stage have been a learning process for the involved partners and will provide feedback to the assessment of ongoing local strategies and priorities. Concrete results and measure impact as part of *Task 6.3 Demonstration and monitoring* will be the subject of the next deliverable.

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