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e-Mobility to add new innovative mobility solutions for citizens and local authorities

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Abstract

This paper discusses of preparation of electromobility (e-Mobility) pilots and involvement of city administration and authorities pursuing target users for a new kind of e-Mobility offering using electric L-category vehicles (EL-Vs) as an extension of personal shared mobility and eventually an integrated part of electric Mobility-as-a-Service (eMaaS). The cities of Torino, Venaria Reale and Villach with the extension of City of Calvià (Spain) are involved in a European jointly funded research and innovation project to provide citizens, elderly people and tourists an innovative means of e-Mobility in the urban context. The actual pilots will start this summer, and the first results of user experience and feedback will be available in the autumn 2019.

Keywords: electric L-category vehicles EL-V, e-Mobility, user involvement, administration cooperation, eMaaS, electricity utilities.

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1. Introduction

1.1. Setting the scene

Deployment of e-Mobility services within cities has a great potential to improve the local urban mobility towards more environmental solutions. Electric vehicles (EV) like electric cars, electric quadricycles, electric motorcycles and bikes (powered two-wheelers, PTW), and various new forms of light two-wheeled electric devices are the movable parts of this equation. The fixed parts like recharging and parking & locking of the electric vehicles are more of public authority and private companies' cooperation task; they are the actual and tangible enablers.

Four European cities have joined their forces and experiences in a European Commission co-funded project STEVE - '*Smart-Taylored L-category demonstration Electric vehicle in heterogeneous urban use cases*'. The target of STEVE is to introduce light electric vehicles, namely electric quadricycles and e-Bikes to enhance the urban mobility services from their specific political incentive perspectives. Target is to add e-Mobility services within the framework of electric Mobility-as-a-Service (eMaaS).

1.2. Common approach of the involved cities

The cities of Turin (Italy), Venaria Reale (Italy), Villach (Austria) and Calvià (Spain) differ in focus and objectives. The cities took into account their local challenges and specified, designed, and deployed their targeted e-Mobility frameworks. The cities have addressed full scale of local aspects in mobility needs, target users, legal frameworks and deployable infrastructure in their implementations towards their goals in e-Mobility improvements. The authorities consider that the most valuable results concern the multiple user categories and local authorities.

Each city varies from each other in population, geographical location, mobility services and intentions to proceed towards the global goal of introduction of MaaS. The cities address light electric vehicles quadricycles and e-Bikes. Some have already operational electric car sharing schemes in commercial operation, e.g. Turin. In some of the cities, their broader target is to extend their generic approach in mobility services towards eMaaS.

Each city will implement a charging station scheme that supports the selected EL-Vs and e-Bikes. Some cities have to go through a public tendering process for the charging infrastructure to allow the EL-V-sharing scheme development. Each city will also define parking policy for EVs in general and specifically for EL-Vs.

1.3. Specific targets of the involved cities

Turin is the capital city of the Metropolitan City of Turin and of the Piedmont region. The population of the city is around 900 000, while the population of the metropolitan area is estimated to be 1.7 million inhabitants. The City of Turin has recently completed the Cycle Mobility Plan that defines the city's bicycle network and the necessary interventions. Since 2010, ToBike has operated a bike-sharing service across the city centre with 140 stations available. MIMOTO is a scooter-sharing service operating in Turin. In addition, there are three car-sharing companies with about 600 vehicles and a station-based EV-sharing service with approximately 150 EVs. The City of Turin will integrate EV-L-sharing with the overall mobility service package available for the general public.

Venaria Reale is a medium size peri-urban Italian city on the belt of Turin, with approximately 34 000 inhabitants accompanied by almost one million visitors to several UNESCO sites. City of Venaria Reale is quite modest in figures but very active in their actions. The approach of City of Venaria Reale is to raise awareness of e-Mobility solutions and possibilities that EL-Vs can provide to foster shared mobility services in the area.

Villach is located in the south of Austria at a central traffic junction. The city has almost 62,000 inhabitants. In 2018, the new mobility concept was adopted, which, in addition to redesigning public transport, also provides for the expansion of e-Mobility and the use of vehicle-sharing services. The challenge the City of Villach is facing is high proportion of motorised private transport. For an Austrian city, a relatively high proportion of the journeys is covered by bicycle and the cycling infrastructure itself is well developed in Villach. The approach of City of Villach is to promote environmentally friendly forms of mobility, and to reduce the proportion of motorised private transport. Villach will use the mobility solutions currently being developed in the STEVE project even after the

end of the project. There will be reserved parking spots for STEVE EL-V-sharing to guarantee that the vehicles can be charged at any time. The e-Bike-sharing service will be integrated into the City App by Villach's city marketing, which represents a unique basis for future multimodality, gamification and further incentive instruments. Therefore, the City App remains available after the testing period.

Calvià is the second most important municipality on the Balearics Islands with more than 50.000 inhabitants, and this area welcomes more than two million tourists every year. Calvià is a tourism municipality located on the Island of Mallorca. Mobility is a very big issue on the island and in Calvià. The municipality consists of separate urban areas that are not very well connected by public transport. To help solve the problem, the municipality built *Passeig Calvià*, a long pedestrian and bicycling promenade joining all the municipalities' urban areas. Calvià has seen an opportunity thanks to STEVE to promote e-Mobility with the e-Bikes and has identified and defined new tourist routes especially for e-Bikes. Mallorca is one of the Spanish regions with the largest number of charging points for electric vehicles, and Calvià is going to invest in setting up new e-chargers especially for e-Bikes along the tourist routes identified.

2. Initial steps toward deployment

2.1. Selection of the electric vehicles

Turin has already an established EV-sharing service available. However, the new target is to introduce electric L-category vehicles (EL-V) for piloting of new kind of shared electric vehicle. For the demonstration purposes, there are six electric quadricycles fitted with advanced user interface, data communication system and data collection service as well as TSP Control Centre. The JAC EL-Vs of the STEVE have been homologated according to the Italian law and can be used in the entire urban area except for the high-speed motorway around the City of Turin.

The EL-Vs are equipped with tracking system, gamification app, energy-based ECO-driving assistance system, state-of-art driver behaviour measuring, and a route selector to select the best path based on energy-efficiency criteria. The EL-Vs come with all-inclusive insurance covering the driver-passenger as well as people and other objects in the surrounding environment. The similar EL-Vs will be used also in Venaria Reale and Villach.



Fig. 1: JAC Quadricycles for Turin, Venaria Reale and Villach

In Venaria Reale there are almost no EV in the circulating stock of cars. Before national or regional initiatives, the city of Venaria Reale has provided rules and incentives for sustainable mobility, like free urban parking spots for recharging EL-Vs, first net of charging points in public and private city spaces, and incentives for buying electric vehicles (250 euro for each e-Bike or similar one-two-three wheels electric vehicles). The city is investing in e-Mobility as forerunner in the area, in order to start a mind shift of citizens favourable to e-Mobility solutions and possibly boosting the focusing of the e-Mobility market. This concept uses two JAC quadricycles, Fig. 1.

Villach will take advantage of JAC quadricycles that are available at three unmanned charging stations, each with two charging slots. The vehicles are equipped with digital remote system for locking and unlocking through connection with the HMI device using the STEVE user app. The remote opening and locking system via an app will be used for the first time in Villach. Another aspect in e-Mobility in Villach are the rentals of e-Bikes. There will be 50 Kalkhoff Jubilee Advance i7 e-Bikes available at 11 eCompact stations in the city and its vicinity. The e-Bike sharing scheme will be run by a private bike rental company using its own e-Bikes equipped with a locking

and charging terminal fixture. The e-Bikes will be autonomously charged upon return to the station. This service will be the first self-service e-Bike rental in Carinthia since all existing services involve personnel engaged with handing out and receiving the bikes. The successful business case will lead to enlarging the fleet and the number of rental stations. The system should be interesting for private entities such as hotels, shopping malls or other institutions who would like to have e-Bike stations in front of their buildings.



Fig. 3: e-Bike and the locking and recharging station details

Calvià will use various electric vehicles in the project. There are Twizzy EL-Vs and light electric vehicles such as e-Bikes and segways. Municipality has made agreements with different 'rent an e-Bike' companies in the municipality for them to take part in the project implementation. The Municipality has committed to install different e-chargers for e-bikes in strategic points around the municipality. Target is to increase the awareness and to promote the use of e-Mobility services. The rent-e-Bike companies will support the project and help to use the SAMAY App developed for the project. The service in Calvià will be mainly addressed to tourists as well as for the residents, improving e-Mobility in the municipality and allowing for more sustainable mobility. The fact of involving private actors will allow this service to continue being offered after the project finishes. On the other hand, the fact that this new service will be up and running, will attract new e-Mobility businesses to the municipality.



Figure 2 Twizzy and e-Bike in Calvià

2.2. Defining the operational driving domain

2.2.1. Setting the scene

In each of the cities, the selected operational driving environment (ODD) varies significantly. In the city centre, the ODD are focused to support shorter journeys than outside the dense centre areas. In some cases, the selected ODD cover specific routes where the usage of EL-Vs is more convenient and the gamification aspects may be introduced. In one case, the already available City App will be enhanced to cover also e-Mobility. Thus, more serious impact on gamification is expected covering the three aspects of marketing, awareness and brand loyalty.

2.2.2. Specific targets of the involved cities

City of Torino has defined several specific routes for the EL-Vs. The routes cover a.o. various campus areas in the city: automotive engineering campus, technical university main campus, architecture campus, and Lingotto campus. The predefined and preferred routes will be covered with the EL-Vs.

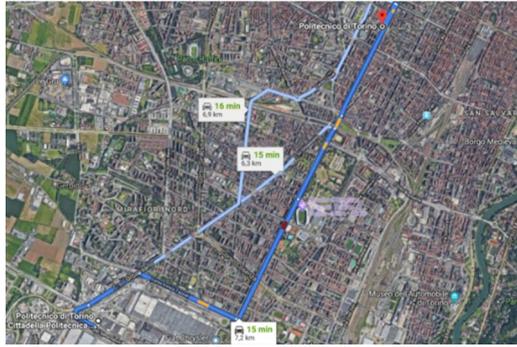


Fig. 4: An example of Torino preferred routes between the main campus and automotive engineering campus

City of Venaria Reale has pointed out those recurrent and most dense journeys that engage the present fleet of cars. The quadricycles' operational driving domain (ODD) will be consequently matched against the present scenario in terms of economic savings, travel time saving, environmental impacts, operational factors, transport means and all the perceived users' experience of EV and equipped devices. Currently there are several trials planned with general public and tourists in order to gather information about their propensity toward e-Mobility.

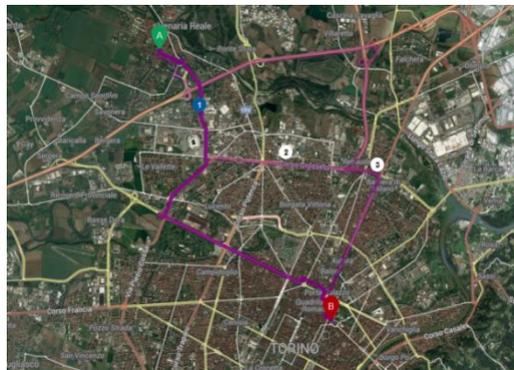


Fig. 5: An example of routes between cities of Venaria Reale and Torino

In the **City of Villach** quadricycles will be operated between three charging stations located at the main railway station in Villach, at the major industrial facility and at the campus of the university of applied studies. The company employees, municipality personnel and the university as well as the students will likely use the quadricycles to commute between the charging stations, and different areas in and around Villach. On working days rental will be limited to 2 hours of maximum duration in the time between 8am – 6pm. After 6 pm users will be allowed to drive home and keep the vehicle until the next day, returning it at 8 am at the latest. This will make the quadricycles suitable for commuting.

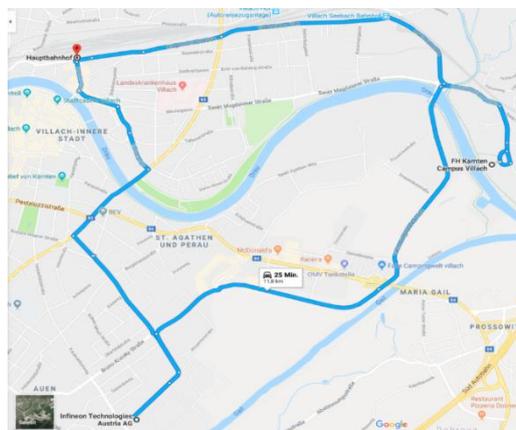


Fig. 6: Routes will run between the three charging point of quadricycles

In Calvià, there are various routes among several touristic routes for e-Bikes. For identifying these routes, Calvià had the pleasure of counting on expertise from officers from the Malta Planning Authority who, as part of an

Erasmus+ project were involved in the project. The selected routes are two urban routes and two mountain routes. The idea is for tourists to get to know the municipality by using the routes that connect the different urban areas, and for those not so fit to be able to discover incredible mountain landscapes that today only very fit cyclists can do, by going on one of the mountain routes.

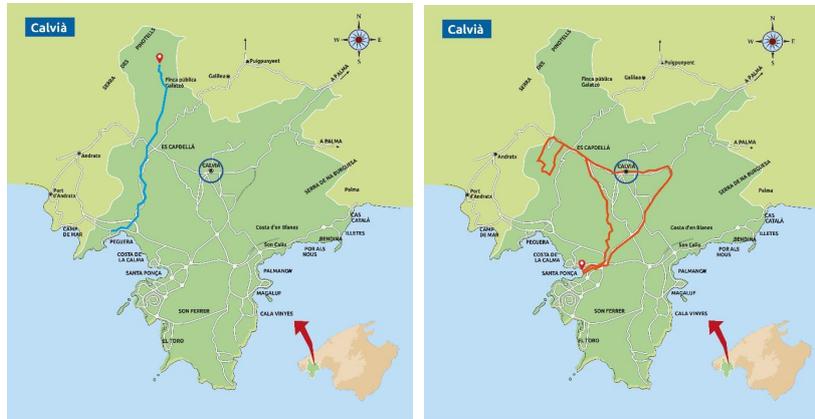


Figure 3 Road and mountain routes in Calvià

3. Involving end users

3.1. First EL-V-sharing users

The first user category includes a controlled group of registered users whose mobility behaviour will be closely monitored for achieving a successful evaluation and valid status analysis of the Key Performance Indicators (KPI). In a further step, the project will involve general public addressing citizens of different ages, commuters and tourists. People are the most significant stakeholder group when talking about vehicle sharing, naturally, after the availability of vehicle-sharing system is in place. There are several categories where users are in the centre of system as indicated by Anttila et al (2018).

Table 1. Overview of user groups and EL-Vs.

City	Controlled user category	Target user category	EL-V types
Torino	Commuting employees Municipal workers	Citizens, tourists, elderly citizens	JAC quadricycles
Venaria Reale	Municipal workers	Municipal workers	JAC quadricycles
Villach	Infineon employees, CUAS employees	Commuters, citizens, tourists	JAC quadricycles e-Bikes
Calvià	Municipal workers from Calvià	Tourists Residents	e-Bikes

In **Torino**, the first users are City Mobility Division employees. Toward autumn, the EL-Vs will be tested also by general public, elderly people and for goods delivery. The City has recruited the users among the target group, giving the priority to staff who regularly use the city-owned cars for work related travel. A compulsory internal test drive will be fixed to show to the users how to drive a new kind of EL-V and the liability on its use. Users are instructed about the general procedures together with the targets and objectives linked to the pilot, and the routes and specific requirements. Another set of the adopters are the professional van drivers of a distribution company who will go under the same initiation process as the civil servants.

Venaria Reale is at the very beginning of the paradigm shift toward e-Mobility. The users of e-Mobility services will be the ones that can rely on a wide availability of charging infrastructure, with large and numerous spaces dedicated to e-Mobility both in public and private parking as well as in commercial, recreational and service areas. The e-Mobility users appreciate new spaces of private nature, e.g. blocks of buildings, industrial clusters and residential parts. The air polluting is no longer evident discussion issue, thanks to the car circulating restrictions.

In Villach the controlled group will be restricted to 50 users for each period of three months. The periodical change of the user groups will involve a significant number of participants while still allowing for sufficient time for getting familiar with the e-Mobility services. Within the controlled group, a particular interest is in an international company that has made a significant investment that will see a substantial extension of company's facilities in the period 2019-2021. This investment will further increase the already significant number of commuting employees.

In Calvià, the controlled users will be municipal workers that already use EL-Vs in their day-to-day activities: the police department in charge of beach surveillance with segways, the department of youth with Twizzy EL-V and municipal worker from the tourist office in Paguera with an e-Bike. This means that there are around 10 people with different EL-Vs and following different routes using the SAMAY App developed in the project. Later in October/November 2019, the users will be more tourists and residents.

3.2. Toward larger and public use

The involved cities all are targeting to offer a new kind of e-Mobility service to their inhabitants as well as tourists visiting the cities and their attractions. Currently due to legislation, homologation and prototype vehicles, several issues prohibit driving the EL-V without a qualified driver on-board. It is anticipated that when these issues will be overcome the full potential of EL-Vs will be developed and EL-Vs will be part of local eMaaS concepts.

In Torino, the specific vehicle category offers a new kind of e-Mobility service. For the City, the EL-V are an interesting mobility service to add to the City's mobility service platform *Muoversi a Torino* (a.k.a. MaTo, engl. Mobility in Turin) which include already public transport and other forms of e-Mobility services, and once available, the extent of MaaS platform. This will enable a more accessible sharing of various kinds of EVs and support multi-modal integration. The main task is to expand alongside of the current EV fleet of local partners by encouraging a wider use of electric vehicles in general. In piloting phase, general public and elderly people will be the subject of the second phase. This will take place during major outdoor public events promoted by the City. Due to current Italian legislation and insurance aspects, general public has only limited rights for driving the prototype EL-Vs, thus there will be a City employee in the EL-V together with an external person. Eventually, when legal issues with EL-Vs and their ownership are solved, the full scale of public use is expected.

The city of **Venaria Reale** will implement a specific type of EV sharing scheme, so called micro-car-sharing. It will involve both private and public efforts, resources and needs. It will be a station-based car sharing, used firstly by employee but also open to citizen and tourists. The overall economic sustainability of this system and its possible enlargement will depend on the critical mass of users and the renting of the fleet. Venaria Reale suffers from the same restrictions of EL-V driving as Torino, thus all general public involvement in current situation will take place on closed areas. EL-Vs will be used primarily by the controlled target group. For the demonstration, 32 users have been recruited on a voluntary basis among the City administrators in the various municipality sectors and in the subsidiary company.

In Villach, in the development phase of the next mobility concept, the stakeholders identified that mobility services and solutions are acceptable to the citizens only if they are comfortable for the users. The STEVE project gives the City of Villach the opportunity to address this issue. It is essential that it is not only about the question of moving from point A to point B, but about a bundle of measures, that makes the mobility offering attractive. These include, for example, attractive parking facilities, various kinds of subsidies, combinations with other products and an easy, intuitive way to book and use the service. The main target group will be commuters, students, citizens and tourists. The aim is to extend the pool of e-Bike users to people who would normally drive passenger cars. In addition, the e-Bike sharing scheme will be implemented for the general public without any limitation regarding the number of participants. After analysing the user experiences through feedback and questionnaires, the service will be expanded in terms of both content and location. This means that local entrepreneurs who wish to offer their customers, guests and/or employees an additional mobility service have this possibility via STEVE. The City of Villach has decided that future EV stations will be included in two major construction projects.

For **Calvià**, it is important to develop new mobility services that will increase tourist satisfaction and at the same time increase the quality of life of residents. The STEVE project has given Calvià the opportunity to discover and generate new services to the tourists and residents, by generating new business models based on sustainability. The policies of the municipality are aligned with the regional policies addressed at reducing the number of traditional vehicles on the roads and on promoting e-Mobility services. At national and regional level different subsidies to buy EL-Vs and to install e-chargers already exist.

4. Target benefits for local authorities

4.1. Torino

Electric extension of Mobility as a Service (i.e. eMaaS) combines highly innovative technology and new business models to create the conditions for even larger scale adoption of Electric Vehicles (EV) in various modes and with multiple stakeholders. The City is piloting EL-V-sharing for continuous mobility needs a.o. between the major university campus areas. The other aspect is to test the EL-Vs in the hands of city personnel that has to travel between the various road constructions sites in the city area.

Some routes crosses the city from north to south with distances spanning from 6.3 km to 9.1 km. Depending on the time of day, the route can be very busy due to the high traffic toward the industrial premise, which is very close to the intended destination. This route will make it possible to analyse the impact of heavy traffic on trip time and energy consumption.

Another route crosses the city from west to east and is shorter in comparison to the previous case (2.9 km). Nevertheless, it is interesting as it entails crossing a steep overpass over the railways that, depending on the time of day, is highly congested. Moreover, it entails a fast lane alongside the “Parco del Valentino” rarely congested, and a combination of fast but congested lanes in the proximity of “Porta Nuova”, the most central train station in the city, and the POLITICO main campus. This scenario will make it possible to analyse the impact of mixed routes, energy consumption and travel time.

4.2. Venaria Reale

The current first activities will be mainly an experimental communication campaign influencing citizens and visitors. The persuading role of a small but recurrent circulating fleet of quadricycles used by local employees is a powerful evidence of e-Mobility benefits. The north-west of Italy is the most polluted area in Europe and public administrations have the duty and right to act against these conditions. Especially with private and public EV fleets, the City of Venaria foresee a great amount of benefits (from economic to environmental), new jobs and potential new services for the territory. The City has many data regarding mobility coming from different services and devices. Firstly, the city has installed 300 new parking payment meters and has engaged two companies (*Pynq and EasyPark*) for the digital payment of parking services. Second, the city collects information about the e-Bike-sharing flows with the *ToBike Service* that has the most extensive bike-sharing station network in the metropolitan area with a wide set of different bike path connecting with the other territories.

Moreover, monitoring cameras will be installed at all main entrances to the City. These devices, together with those provided by STEVE technical partners, are like antennas for monitoring traffic volumes and needs. These systems give valuable information and (but also sensitive) data of car parks and mobility patterns (vehicle type, time, etc.). The City of Venaria Reale has the role to provide the new Sustainable Mobility Plan (SUMP). It is the general program, which set ahead the policies for mobility and the new infrastructure for the City. It will organize the parking system in order to facilitate new sustainable services as e-parking systems within the city. The Mobility Plan includes and encourages carrying out the electric charging station development for enhanced e-Mobility. The city will integrate the information coming from local devices on road usage with the public and private mobility services at metropolitan and regional level. The crown jewel is the "Movicentro" project, which is a regional mobility node, connecting with public transport (bus - railways - taxi) with private commuting (cars). In year 2020, this new facility will rise in front of railway station connecting citizen and tourists to regional Airport, Turin and the main cities of the Province adopting car-sharing/pooling and e-Mobility services to shift to a new level of sustainable mobility.

4.3. Villach

e-Mobility is a building block for implementing environmental goals in the field of transport and at the same time improving the quality of life for the inhabitants. It is also necessary that electricity for mobility services are generated from renewable energy sources. The Carinthia region has more than 70 % of the electricity renewable, and this will continue to rise in the coming years.

The expansion of e-Mobility is based on several pillars:

- Expansion of infrastructure (fast chargers in public spaces, charging facilities in private garages)
- Provision of sharing services (by third parties, the city of Villach is not a mobility operator)
- Financial support for e-Mobility
- Preference for various kinds of electric vehicles, e.g. through free parking
- On-going awareness raising among citizens
- Active role model for the administration

Gamification is not only about marketing; it is foremost about usability, about getting people to use the offered set of services, about giving people something they long for, want and eventually need. The last should be the final target. The authorities should be able to convince people that the offered services will be citizens' ultimate toolbox. When people use the City App more frequently to achieve this, a catch is needed.

5.4 Calvià

The Municipality of Calvià is a *SmartDestination* recognised by the Spanish Ministry of Tourism. It belongs to the Spanish network of *SmartDestinations*. At the same time, Calvià is also working closely with the Island Council of Mallorca in the implementation of the *SmartIsland Mallorca* project. In both the *SmartDestination* and *SmartIsland* projects, mobility is a key pillar where the island and Calvià are committed to invest.

The introduction of EL-Vs as a new e-Mobility service for the tourism sector is important to demonstrate the commitment of Calvià with a better and more sustainable mobility plan for the municipality and for the island. Considering the great amount of tourists visiting the island and the municipality every year, the introduction of a new service by use of e-Bikes will reduce the CO2 emissions, noise pollution and parking problems. Of course, all the measures that Calvià is going to implement are thought of from a global perspective and this means that other aspects such as e-charging stations for all types of EL-Vs and *SmartParking* facilities are also going to be set up and implemented.

4.4. Utilities

Electricity utilities have full expertise in providing energy, grid and a variety of end customer services as well as the construction, maintenance and operating of power stations for e-Mobility services. Due to this knowledge, e-Mobility solutions are matching businesses. Customer loyalty is an important topic and strengthens by increasing the range of services from a partner they already know.

One of these additional services is considered to be electric vehicle sharing. By providing the grid and the energy for example in residential buildings, other services are the installation of a photovoltaic system, e-Mobility hardware for private use or EV sharing. This establishes the full service palette on energy systems in the one-stop shop partner providing.

5. Current deployment activities

The involved cities are preparing themselves currently to commence the pilot demonstration according to their detailed plans as described by Einwögerer et al (2019). The target user groups in each city have been recruited and the briefing and training has started in some of the cities and will start early this summer in the rest. The EL-Vs are available in the cities and the recharging infrastructure has been designed, purchased and will be installed by the responsible entities by autumn 2019. The first set of results and user experience will be available this autumn and will be analysed in the paper subject to be accepted for the presentation in the TRA2020 Conference.

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