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MEISTER: fostering smart e-mobility large scale adoption in European cities

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Abstract

MEISTER is a research and demonstration project with three large scale pilots in Berlin, Gothenburg and Malaga promoting and supporting 'smart electric mobility' in cities, through the design, development, implementation and evaluation of ITS solutions that address and solve current existing gaps in the state of the art of electromobility. These technological solutions, such as the e-mobility interoperability platform or the smart charging and storage platform, are packaged in the form of 5 products that are being delivered and analyzed in order to guarantee not only their technical performance within the project but their sustainability and market transferability after the project completion. MEISTER is a 36 months project funded by the European Commission under Horizon 2020, started on September 2018. It is coordinated by ETRA and counts on a strong consortium of ten partners from Spain, Germany, Sweden and Greece.

Keywords: interoperability; large scale pilot; innovation; MaaS; business models technological solutions.

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1. The need, the context

The European Union has made a commitment to ensure full coverage of electric vehicles infrastructure across its members (European Parliament, 2014). However, electric vehicles infrastructure in public areas is still considered too expensive to be deployed by the private sector, mostly due to an uncertain -in the best case- return on investment. Current business models and the revenues that are generated from electric vehicle supply equipment are not sufficient to ensure sustained, healthy market growth. This results in a lack of confidence in the electric vehicle sector as a whole and leads to uncertain users hesitating to buy electric vehicles, triggering a vicious circle of a frozen demand because of an unsatisfactory offer and vice versa.
There is a need to break this circle by designing, validating and promoting business models and ITS solutions to make it more attractive for operators to install charging infrastructure and for potential customers to use this infrastructure.

2. The project

MEISTER is a 36 months research project funded by the European Commission under Horizon 2020, started on September 2018. It is **coordinated by the company ETRA** and counts with a strong consortium of ten partners from Spain, Germany, Sweden and Greece.
Under the topic "Supporting 'smart electric mobility' in cities", MEISTER is delivering a set of ITS tools to foster e-mobility large scale adoption. The **4 objectives of the project** and its associated **achievement indicators** are:

O1. Establishment of innovative, sustainable business models for smart e-mobility: reduction of electric vehicle supply equipment installation costs in a 20% and operational costs in a 40%, reduction of electric vehicle charging prices in a 20% and to achieve 1,000 new electric vehicles.
O2. Development of an e-mobility interoperability platform: 40 operators involved, 51,500 customers registered and 6 integrated services in the platform.
O3. Integration of e-mobility in the cities' Sustainable Urban Mobility Plans and city planning process: reduction of on-street parking spaces demand in a 3%, achieve a 20% share of electric vehicles in city logistics fleets and achieve savings of 199,750 tons of CO2/year due to electromobility.
O4. Integration with smart grid services: 42 MWh of storage capacity and a 30% effective renewable energy sources usage.

As a result of these figures, the project will also have a substantial impact in terms of a reduction of emissions and environmental sustainability.
Furthermore, MEISTER products, integrated approaches, smart solutions and innovative, sustainable business models will be tested and validated in three urban areas in Southern, Central and Northern Europe: **Malaga (Spain), Berlin (Germany), and Gothenburg (Sweden)**, involving 51,500 users, 1,000 electric vehicles and 660 charging points. These three sites are EU leaders in the field of e-mobility, have complementary contexts and share a common vision on electric vehicle deployment.

3. MEISTER approach

MEISTER solutions are built on and make use of innovative yet proven ITS technologies, some of them coming from related EU and national projects and initiatives, where partners of the MEISTER consortium have actively participated and acquired a proven back record on developing and deploying e-mobility solutions.
Moreover, MEISTER ambition related to its 4 strategic objectives is to overcome the relevant state of the art gaps identified, through the development of ITS innovations and technical solutions, such as:

- Development of an e-Mobility Interoperable Platform, which ensures a barrier-free and operator-independent access to charging for end-users, by means of a fluent communication between the electric vehicle service providers and electric vehicle supply equipment operators to interchange data.
- Definition and development of a secure platform architecture in MEISTER, in order to allow a convenient payment. The work is being based on the solutions and smart data platform already in place in each pilot site.
- Integration of data from parking sensors that detect real-time status in an E-Mobility Interoperable Platform to enable integrated parking-charging information and booking services, to assist the end-user in the navigation and route-planning to available electric vehicle supply equipment.

- Development of the electric-Sustainable Mobility Urban Plans (e-SUMPs) knowledge base that contains structured information about previously implemented e-mobility measures in Sustainable Urban Mobility Plans, becoming an underlying element supporting the creation of a European eMobility Expertise Centre (EeMEC) for e-mobility deployment advice.
- Provide smart energy services for the integration of electric vehicles into the grid to lower load costs and provide flexibility to the grid.
- Facilitate and promote the use of the e-Mobility Interoperable Platform by e-mobility service providers to optimize activities related to smart charging and discharging of electric vehicles and reduce energy billing.
- Guarantee the provision of renewable energy sources to their customers either by Distribution System Operators green supply tariffs or by using Energy Service Companies services. Integrate the electric vehicle in smart grids enabling load shifting in the function of the renewable generation profile.
- Enable smart grid services through the following efforts: upgrade electric vehicle supply equipment software to accommodate next-generation communication protocols, and upgrade backend system communication protocols and algorithms.

As a reference, the following figure shows a simplified scheme of the e-Mobility Interoperability Platform that the project is demonstrating.

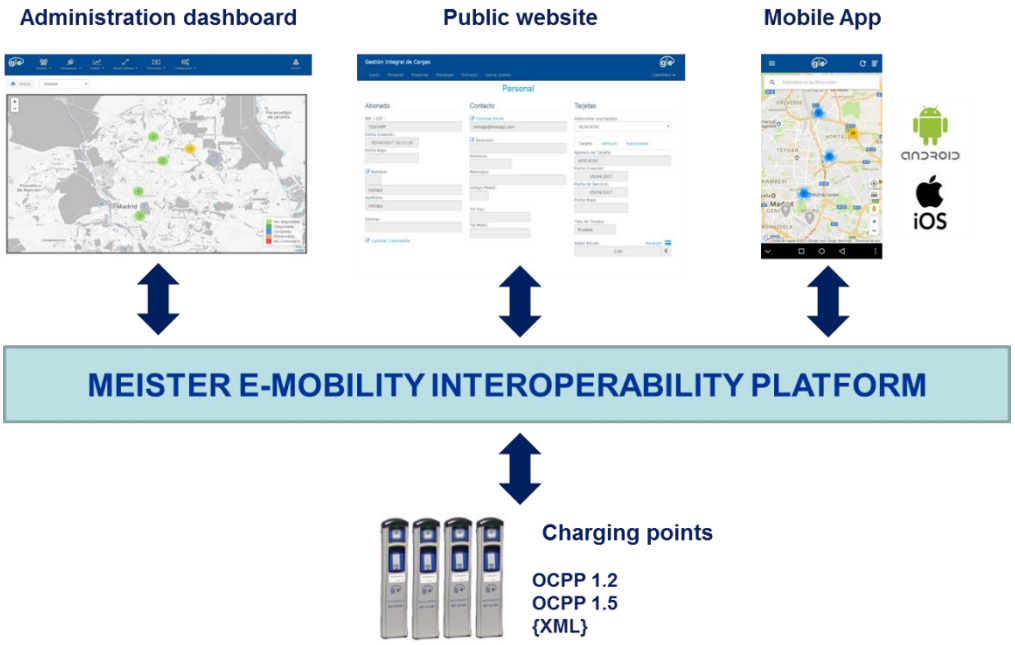

Fig. 1 MEISTER e-mobility interoperability platform scheme

4. MEISTER products

The project technological solutions addressing the previously described objectives and state of the art gaps are packaged in the form of 5 products that have been analysed in order to guarantee not only their technical performance within the project but their sustainability and market transferability after the project completion.

P1: MEISTER Replication, Market Uptake and Deployment Handbook.
This product embodies the **key outcomes of the project** which any city willing to boost the large-scale deployment of electromobility should use. This toolset includes information on the details of the business models defined by the project, how to use the technological solutions supporting their implementation (P2, 3, 4 & 5), the practical results coming from the business models validation at the project sites, and the supporting legal, administrative and financial tools to help upscale and deploy all the above.

Fig. 2 P1: MEISTER Replication, Market Uptake and Deployment Handbook

P2: MEISTER Intelligent Billing & Roaming Platform.
This product, led by ETRA, provides an operator and service provider independent platform for e-mobility providers that enables an **easy, non-discriminatory, convenient and barrier-free access to end-users for electric vehicle charging billing features** in urban areas. In cities where this kind of platform already exists, the project aims at integrating all of them in **MEISTER Intelligent Billing & Roaming Platform** (on top of existing ones), in order to enable cross-link features in all of them. The aim of this platform is to establish connections between existing charging point operators and the platform to enable the access to electric vehicle supply equipment by end customers of all existing e-mobility service providers, wherever the equipment is located, whichever electric vehicle the customer uses, whoever operates the charging point, whoever supplies the charging service and electricity. Standards and most used protocols are being adopted for roaming among involved commercial entities, charging point and the backend of the platform. Basically, this platform offers B2B services.

Fig. 3 P2 - MEISTER Intelligent Billing & Roaming Platform

P3: MEISTER Integrated Real-Time Information & Booking Services.
This product has five components: (i) the **backend (integrated services),** three frontends namely (ii) **smartphone app for individual electric vehicle drivers**, (iii) **mobility display for housing services**, (iv) **application for urban logistics companies**, and last, but not least, (v) the **smart e-mobility dashboard for the city management**. MEISTER offers new value-added and integrated electric vehicle-related services such as (i) combined smart parking and charging, (ii) monitoring and information about publicly accessible electric vehicle supply equipment, (iii) searching and routing to electric vehicle supply equipment, (iv) reservation of parking slots and charging stations. These integrated services, offered by the different e-mobility service providers and supported by real-time information, are deployed and managed by the platform and are addressed to different end-users to cover their needs and enrich customer proposition. Real-time information includes the current status of parking slots and charging points (available, not available, out of order, and momentarily not accessible). These integrated services (backend) allow electric vehicle drivers to plan their trip according to the status of their electric vehicle batteries, find and book in advance a parking spot with charging point and to be routed to it by means of a free smartphone app (frontend).

Fig. 4 P3 - MEISTER Integrated Real-Time Information & Booking Services

P4: MEISTER European eMobility Expertise Centre (EeMEC) and eSUMPS knowledge base.
The objective is to **facilitate the transferability of best practices** from the three MEISTER pilot cities -and other cities leading eMobility in Europe- to other European local governments. The EeMEC aims to be a technical, legal and financial support centre, conceived as a tool which facilitates engineering and consultancy companies to offer its services to local governments in the urban planning and Sustainability Urban Mobility Plans process. On the other hand, the aim of **eSUMPS knowledge base** is to provide means to discover solutions to e-mobility implementation that have been solved, which could be successfully applied to other cities, based on e-mobility services collected information, later adapted and structured in a knowledge database for learning purposes.

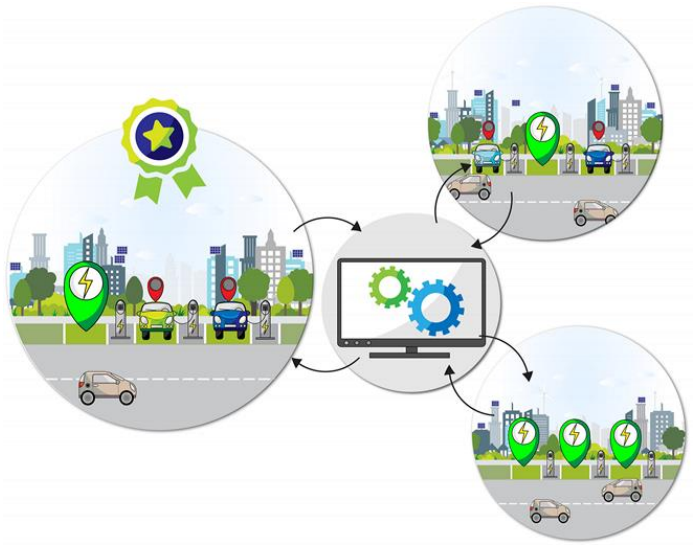

Fig. 5 P4 - MEISTER European eMobility Expertise Centre (EeMEC) and eSUMPS knowledge base

P5: MEISTER Smart Charging and Storage Platform.
MEISTER is delivering a tool/platform to be used by vehicle-sharing companies and e-fleet managers, in order to **optimize the activities related with the smart charging and discharging of the electric vehicles**, making it possible to use electric vehicles as dynamic distributed storage devices, feeding electricity stored in their batteries back into the local electric grid when needed (**vehicle-to-grid supply**), responding to the flexibility requests of the grid. For this purpose, the platform provides a reference load profile taking into consideration: (i) the renewable generation profile, (ii) the tariffs, and (iii) the requirements from the driver(s) of the electric vehicles; allowing therefore to use the vehicle to better answer to demand variations (e.g. use electric vehicles as supporting storage unit to cover peaks of demand, or even use the electric vehicles storage capability to flatten load curves). It is important to remark that the functionalities respect electric vehicle user preferences, meaning that user constraints (e.g. charge required to be completed within a certain time frame) are prioritised in the charging sessions scheduling process. In order to maximise the flexibility provided by the charging point operators, the platform includes a set of user functionalities, such as user's authentication, electric vehicle supply equipment booking and charging session start; considering different types of charging (on-demand, smart charging, smart charging with vehicle-to-grid) and therefore enables to optimally allocate any excess of energy in the distribution network helping to stabilize the grid when needed (demand-side management).

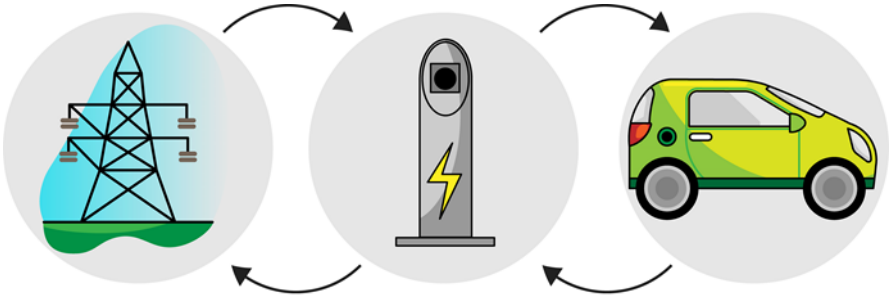

Fig. 6 P5 - MEISTER Smart Charging and Storage Platform

5. Conclusions

This paper presents the objectives and state of the art gaps addressed by MEISTER project, highlighting the development and demonstration of 5 technological solutions/products. These products aim to foster e-mobility large scale adoption by (1) demonstrating innovative, sustainable business models to lower installation and operation costs of charging infrastructure, (2) optimizing usage of infrastructure by the smart combination of charging and parking services, (3) integrating electric vehicles within urban Sustainable Urban Mobility Plans, including the establishment of electric vehicle sharing and the inclusion of electric vehicle within Mobility as a Service schemas to reduce CO_2 emissions and optimize urban space usage, (4) providing interoperable platforms and services to users for an easy, convenient and barrier-free access to charging, billing and smart grid services, including an increase of the use of renewable energy sources and self-generation to power electric vehicles.

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