

## GREEN EMOTION - INTEGRATED EUROPEAN DEMONSTRATION ON ELECTRO-MOBILITY

Christine SCHWAEGERL  
Siemens AG - Germany  
[Christine.Schwaegerl@siemens.com](mailto:Christine.Schwaegerl@siemens.com)

Claudia SCHMITT-LÜHMANN  
IBM Deutschland GmbH - Germany  
[Claudia.Schmitt-Luehmann@de.ibm.com](mailto:Claudia.Schmitt-Luehmann@de.ibm.com)

### ABSTRACT

*This paper describes concepts and first results of the European FP7 project Green eMotion that aims with a 50 million € budget and 42 partners, all of them important players from industry, utilities, electric vehicle manufacturers, municipalities and universities, to demonstrate an integrated European solution on electro-mobility. It started in March 2011.*

*The partners have joined forces in order to develop and demonstrate a framework and marketplace for electric vehicles in Europe. The marketplace is seen as one major milestone in this context to provide consumer convenience, new services for market actors and new tools for the operation of smart electricity grids. The project lays a special focus on the interoperability of the electro-mobility technology and on a smooth functioning of the EU single market.*

*The paper discusses business models, ICT requirements and standards.*

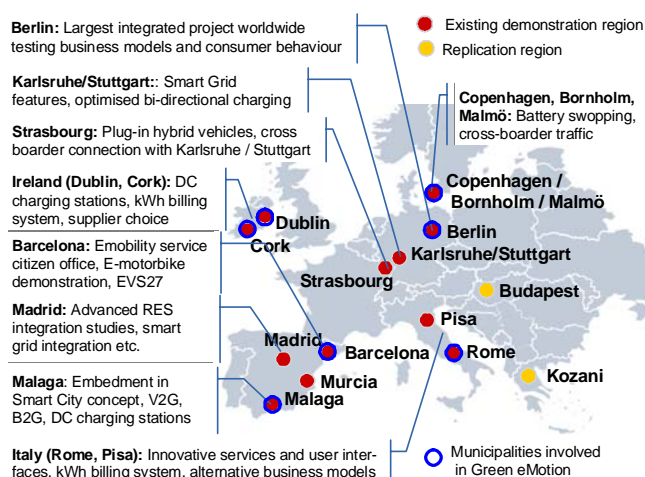
### INTRODUCTION

Currently a significant number of isolated demonstration projects for electro-mobility are carried out in Europe without sufficient exchange and connection between the important players which is necessary to reach sustainable results and facilitate the required interoperability and consumer convenience needed for a mass market rollout. By merely extending and combining these projects no real impact will be achieved because consumer acceptance can only be created at a large scale if a holistic user-friendly framework is created.

Important players from industry, the energy sector, municipalities as well as universities and research institutions have joined forces in order to develop and demonstrate a framework and marketplace for electric vehicles in Europe. The marketplace is seen as one major milestone in this context to provide consumer convenience, new services for market actors and new tools for the operation of smart electricity grids. The

project Green eMotion therefore has a special focus on the interoperability of the electro-mobility technology and on a smooth functioning of the EU single market.

14 ongoing (or starting) and 2 future regional demonstration projects are connected by Green eMotion and the results will be used to design an interoperable and scalable framework which will subsequently be demonstrated in the regions involved (Figure 1).



**Figure 1 – European Demonstration within Green eMotion (status 2011)**

The partners share the conviction that transport as a network industry must be approached as a system integrating the elements ICT, services, interoperable equipment (vehicles and recharging infrastructure), grid infrastructure as well as policies, incentives and urban mobility concepts to ensure a smooth and efficient interaction and in the end a self explaining overall market system (Figure 2).

The project Green eMotion is based on the conviction that electro-mobility in Europe has to be approached in a systematic and holistic way making use of innovative ICT (information and communication technology) solutions and involving regional stakeholders at the same time. The technical solutions

must be interoperable, scalable and standardized to enable a mass market rollout.

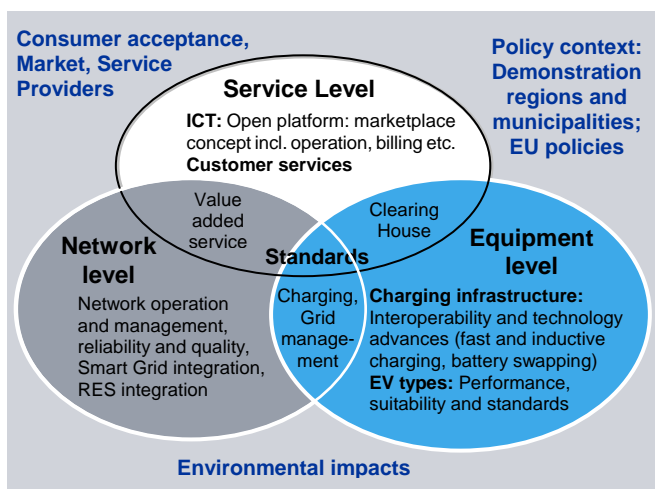


Figure 2 – Levels of EV integration

Therefore, the concept of Green eMotion (Figure 3) is based on the following three main pillars:

- Connection of different regional demonstration activities to leverage on results
- Development and demonstration of a Marketplace
- Supporting standards and interoperability.

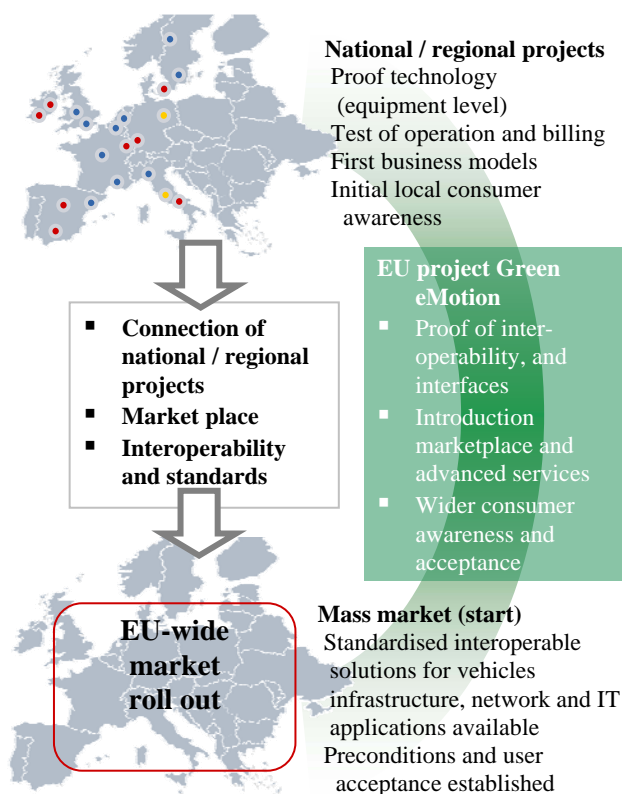


Figure 3 – Concept of Green eMotion

## SUCCESS FACTORS FOR MARKET INTRODUCTION

To prepare a mass rollout of plug-in hybrid and full electric vehicles across Europe all stakeholders involved face significant challenges which need to be thoroughly understood and addressed accordingly to allow for a viable ecosystem.

The **CUSTOMER** acceptance of electric vehicles (EV) depends strongly on the economic aspects of the total cost of ownership (acquisition, vehicle maintenance, price per km / mile, tax, insurance etc.) and on reliability aspects related with overall EV condition, with battery health and range to ensure individual mobility. In addition personal convenience and social recognition of EV usage will play an important role.

Besides the most obvious technical challenge for the **OEMs** to deliver EV batteries with a long range – independent of weather conditions – and with a long life time to a reasonable pricing, there is a list with other critical technical success factors for mass adoption of EV:

- Enable vehicle interfacing with other devices like power socket, plug, connectors, recharger and batteries
- Enable communication between vehicle / driver and the different related devices (car, meter, mobile phone, PDA, Telematic units). Coming along with the support of ICT specific standards and protocols
- Capability of being connected to the grid in terms of plug, mode of charging and type of charge allowed (slow, fast or ultra-fast).

To overcome the customers’ concern of running out of energy in the midst of a journey additional driver support like information of battery conditions, extended roadside assistance, specific driver trainings etc. are required. To enable EV maintenance capabilities dealers and repair shops needs to be equipped and the staff trained.

Those capabilities and support functions need to be established according to the expected driver habits and mobility patterns – which means substantial investments in infrastructure beyond the regional scope of the demo regions.

The key question to be answered for rural and urban **REGIONS** is how to build up a holistic mobility

concept which balances the investment in charging infrastructure with an intelligent combination of various transportation means. For example trains could be a natural compliment to electronic vehicles for long distance driving. To illustrate the type of mobility concepts one possible scenario could be: Commuters drive with their EVs, leave them in a special parking zone with recharging facilities, and continue by train to city centre. Individual transportation within a city is performed via public transports or EV car sharing models.

To allow for such scenarios the allocation of recharging infrastructure is crucial. It is relatively easy to include charging poles while designing and planning new housing areas, but in existent areas the right amount and locations of poles is most challenging. Location optimization capabilities to allow for the “right” location and location guidance services for drivers will be needed to lower investment cost in the regions.

**INFRASTRUCTURE PROVIDERS** need to overcome both technologic and economic challenges. Technological requirements comprise different types of charging techniques and connections:

- Charging type (normal or fast charging, inductive charging, battery swapping etc.)
- Safety issues related with wired connections in public areas
- Alignment of technical infrastructure with electrical network topology
- Standards for interaction between charging pole and vehicle (including different languages and devices)
- Reliable operation suitable for mass-market
- Automatic identification of customers for charging type and billing.

To address economic risks related with installation and maintenance costs of the infrastructure, rollout plans need to ensure that always sufficiently ahead of vehicle rollout appropriate infrastructure is established. Optimal plans must therefore consider:

- EV rollout plans
- Travel patterns in different regions
- Local travel and parking patterns
- Charging behaviour (refilling immediately or only when battery is depleted)
- EV range
- Number of charging spots per vehicle
- Grid topology.

**UTILITIES / ENERGY PROVIDERS** have to solve two major issues: first the management of the EV charging grid and second the enablement of flexible charging and billing processes.

The management of the EV charging grid comprise:

- Provision of adequate capacity independent of energy mixes
- Orientation of needs of EV customers
- Common standards and principles
- Monitoring and controlling mechanism
- Enhancements of grid management tools including smart grid schemes.

Allowing for flexible billing to EV customers means for example the introduction of roaming mechanism for customers charging in other regions than the customer’s energy provider. In addition the solution must incorporate the requirements of European energy market rules, allowing for free access to all market players – including any energy vendors selling electricity at any tariff to EV customers.

Considering the challenges of the different stakeholders it becomes quite obvious that established EV mass markets will allow for new business models of the current and of potential new players. The majority of the business models are based on an EV marketplace which integrate the isolated information and which can therefore deliver the needed customer services. Therefore one major purpose of Green eMotion is to design, implement and proof such a Marketplace.

### **MARKETPLACE SOLUTION CONCEPT**

The marketplace is seen as the key enabler for electromobility by offering a multitude of services. The different actors will be connected; an end-to-end information flow will be enabled and will therefore allow for EV-user convenience in billing and new high-value transportation services.

Services can be categorized into

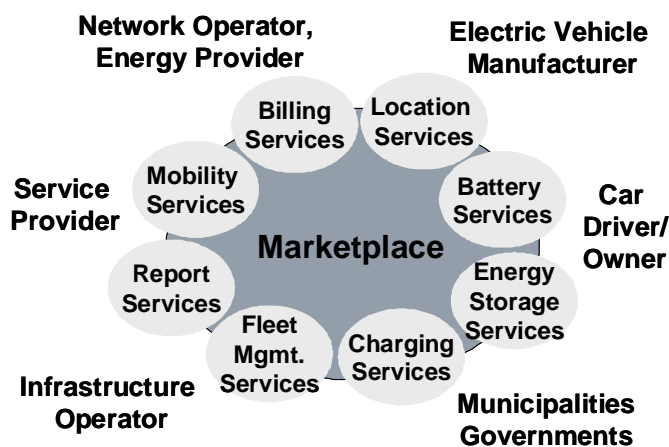
- Core marketplace services – like security services, user authentication, logging, reporting, data storage etc.
- Basic end-user services – like customer helpdesk, in vehicle support while driving, guidance to e-Infrastructure, roadside assistance and customer training.
- Clearing House services - roaming functionality that enables customers to use

the whole charging and service infrastructure across Europe, while the related billing determinants are exchanged among the involved stakeholders for billing and settlement.

- Value added services – like carbon and environmental impact monitoring, fleet management, preventive maintenance and intermodal mobility services etc.

Moreover a central marketplace ensures that legal requirements, guidelines and regulatory frameworks of all EU member states are properly reflected and strictly adhered and proper data communication (between vehicle and infrastructure and between infrastructure and grid) is warranted.

The gathered data can also be used to inform governments, EV manufacturers, electricity system operators, urban planners, and all relevant stakeholders, about the key technical, commercial and social drivers to enhance effective and clean widespread deployment of electrical mobility (Figure 4).



**Figure 4 – Overview EV Marketplace**

To support the requisite business processes needed for European wide mobility of EV the market place will be public and based on open architecture, common standards and protocols and open standard interfaces. The technology used in this marketplace is therefore flexible, scalable and state of the art including:

- standards for the information flow
- standards for technology infrastructure
- state of the art architecture principles.

Overall the Marketplace will deliver benefits for all stakeholder groups:

### Consumer convenience for EV-users

- Enabling various driver services such as various charging fees, incentive structures and payment options
- Enabling roaming for vehicles travelling beyond regional and country borders

### New services for market actors

- Reduction of costs of installing and operating in-home and public charging spots through open platform integration and scale economies for EV specific business processes
- Support of intelligent transportation systems and innovative fleet management

### Operation of electricity grids and integration of renewable energy systems (RES)

- Enable local energy storage and demand shift capability
- Minimize impact on utility grid infrastructure due to localized charging concentration
- Support integration of larger shares of RES
- Support generation driven demand instead of demand driven generation

## SUMMARY

The project Green eMotion aims at enabling mass deployment of electro mobility in Europe. The project members will develop and demonstrate a commonly accepted and user-friendly framework consisting of interoperable and scalable technical solutions in connection with a sustainable business platform. The Smart Grids development, innovative ICT solutions, different types of electric vehicles as well as urban mobility concepts will be taken into account for the implementation of this framework.

The created virtual marketplace is the most appropriate EV business model that could lead to a socially acceptable and commercially viable transition to the envisaged large-scale rollout, also taking into account system impact and environmental impact. The result is a cost-effective and green mass rollout of electro mobility in Europe.

The project Green eMotion is a great leap forward into a greener and more sustainable future in Europe.

## ACKNOWLEDGEMENT

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