



Deliverable 2.4

The key features of successful implementation of Electromobility

Prepared by:

**Jaime Briales, Municipal Energy Agency of Málaga
jbriales@malaga.eu**

**Alfonso Palacios, Municipal Energy Agency of Málaga
apalacios@malaga.eu**

**Eduardo Poyato, Municipal Energy Agency of Málaga
agenciaenergia1@malaga.eu**

Date: December 4th, 2014

Version: 7.0

Document Information

Authors

	Name	Company
Key author	Jaime Briales, Alfonso Palacios & Eduardo Poyato	Málaga
Further authors	Stine Helms & Kasper Brenøe Isbrand	The City of Copenhagen
	Simon Hayes	Barcelona
	Michael Hajesch & Holger Braess	BMW
	Giovanni Coppola	Enel
	Cristina Corchero & Miguel Cruz	IREC
	Linnea Roddar	Malmö
	Olivier Paturet & Sara Tij	Nissan
	Valy Lioliou	PPC
	Gabriele Giustiniani & Fabio Nussio	CTL & Rome

Distribution

Dissemination level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Revision history

Version	Date	Author	Description
1.0	November 16 th 2012	Key authors and further authors	1 st draft
1.1	November 30 th 2012	Key authors	Feedback on 1 st draft
2.0	December 10 th 2012	Key authors and further authors	2 nd draft
3.0	December 21 st 2012	Key authors	1 st draft of final report
3.1	January 7 th 2013	Key authors and further authors	1 st draft of final report including comments and changes
3.2	January 21 st 2013	Carlos Castejón, Endesa	1 st draft of final report including comments from external reviewer
4.0	January 28 th 2013	Key authors	2 nd draft of final report
4.1	February 1 st 2013	Key authors and further authors	2 nd draft of final report including comments and changes
5.0	February 22 th 2013	Key authors and further authors	Final report ready for submission to the project coordinator
5.1	March 1 st 2013	Key authors and further authors	Final report ready for submission approval
6.0	May 23 rd 2014	Key authors and further authors	1 st draft of updated version of final report
6.1	July 7 th 2014	Key authors	Feedback on 1 st draft
6.2	August 13 th 2014	Key authors and further authors	Final updated report ready for Project Coordinator's approval and submission
7.0	December 4 th 2014	Key authors and further authors	Final updated report is revised based on comments

			from external reviewer appointed by the EC and ready for Project Coordinator's approval and submission
--	--	--	--

Status	
For Information	
Draft Version	
Final Version (Internal document)	
Submission for Approval (deliverable)	X
Final Version (deliverable, approved on)	

Table of Contents

1	Executive Summary	6
2	Introduction	9
3	Barcelona	11
4	BMW	16
5	Copenhagen	19
6	Enel	25
7	IREC	28
8	Málaga	34
9	Malmö	40
10	Nissan	45
11	PPC	47
12	Rome and CTL	50
13	Other contributions	56
13.1	Lessons learned by Better Place	56
13.2	Lessons learned from the Iris experience (ESB)	59
14	Conclusions	69
14.1	Infrastructure	69
14.1.1	Infrastructure EVSE	69
14.1.2	Infrastructure Billing System	69
14.1.3	Infrastructure Deployment	70
14.2	Vehicle	71
14.2.1	EV Design	71
14.2.2	EV Batteries	72
14.2.3	EV Maintenance and Repairs	72
14.3	Policies, financial incentives, marketing and communications	72
14.3.1	Regional or national financial incentives	72
14.3.2	Local incentives and legislation	73
14.3.3	Regional or national incentives and legislation	73
14.3.4	Marketing and communications	74
14.4	Urban Freight Electric Vehicles	75

List of Abbreviations

AC	Alternating Current
BEV	Battery Electric Vehicle
CA	Consortium Agreement
CCS	Combined Charging System
CHAdemo	Charge de Move (“Charge for Moving”)
CO ₂	Carbon Dioxide
CP	Charging Post/ Charging Point
CPO	Charging Point Operator
DC	Direct Current
DoW	Description of Work (Annex I of Grant Agreement)
EFV	Electric Freight Vehicle
EU	European Union
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
EVSP	Electric Vehicle Service Provider
FP7	7 th Framework Program
GeM	Green eMotion (EU R&D project)
HOV	High Occupancy Vehicle
ICE	Internal Combustion Engine
ICT	Information and Communication Technologies
ID	Identification Number
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
IT	Information Technology
LTZ	Limited Traffic Zones
NOC	Network Operations Centre
OEM	Original Equipment Manufacturer, i.e. Electric Vehicle Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
PPP	Public Private Partnership
RFID	Radio Frequency Identification
VAT	Value Added Tax
VRT	Vehicle Registration Tax
WP	Work Package

1 Executive Summary

In this report, the partners of the different demo regions describe the aspects they consider most important for the successful deployment of electromobility in the different cities and regions of Europe.

Many different considerations must be taken into account in order to successfully implement electromobility in our cities. Factors such as infrastructure, management systems, the electric vehicles themselves and the backing of local and national governments are key to achieving this goal. Below is a brief description of the key areas covered by the partners in these three areas:

- Infrastructure:

- **Standard criteria for the development of fast and slow charging infrastructure:** An overall deployment model for infrastructure development would be recommendable. A suitable strategy would be to promote standard charging points in homes and workplaces, where electric vehicles are parked for longer. In addition, fast charging stations are necessary in order to provide a quick solution for users of electric vehicles. For this reason, some partners recommend installing fast charging points on motorways, in filling stations and public car parks, and/or at major junctions.
- **Standardised fast and slow charging protocol:** It is necessary to achieve infrastructure which is standardised, easy-to-use and compatible with all electric vehicle systems on the market. To this end, we recommend installing plug-in chargers for fast and slow AC charging and also for fast DC with CHAdeMO and Combo interfaces.
- **Standardisation of signage and use of ITs to locate charging points:** It must be easy for users to locate the infrastructure. There needs to be a common signage system for the identification of charging points in towns and regions throughout Europe. Websites, car navigation systems and smartphone applications could be used to facilitate location and also offer details such as available plugs, forms of payment and consumption cost.
- **Simplification of the billing system, both domestically and in roaming:** The billing system must be straightforward, confidential and secure, with full reassurance for users. Customers should be able to pay for the charging service at any charging point, with the information necessary for recharging being transmitted among the different operators. This is only possible with a fluent communication between the EV service providers and EVSE operators to interchange billing data. For a convenient payment, a secure roaming architecture that might consist of several interconnected roaming services is necessary.
- **Less administrative bureaucracy:** Finally, some partners have found that national legislation needs to be amended in order to remove the bureaucracy involved in setting up this type of facility. Actions in this regard need to focus on cutting red tape whilst speeding up approval processes and implementation times.
- **Integration in the grid:** EVSE installations should be totally integrated in the grid, and manageable and controllable from a remote distance.

- Vehicles:

- **Promote price competitiveness of electric vehicles:** These comments are meaningless if there are no vehicles on our streets. The current EV price is the main barrier that discourages the potential user, because currently the cost of a new EV is - in some European countries - roughly the double compared to a conventional car with a combustion engine. Car manufacturers must

strive to ensure that the price of electric vehicles comes down to make them more competitive compared to conventional vehicles.

- **Extended variety of EV designs:** The upcoming EV users should be able to find the most appropriate EV type which serves their needs. A more diverse supply of EV types will meet the users' different needs making EVs more attractive to buy.
 - **Break through the "range anxiety" barrier:** Many potential users of electric vehicles suffer from "range anxiety" as a result of electric vehicles having less autonomy than conventional vehicles. Normally, the increase of autonomy or capacity of a battery implies the increase of weight. However, the new generation batteries, such as lithium-air type, are able to increase energy density, which allows the enhancement of the autonomy, without increasing the weight. This kind of batteries is still under research, but the forecast is that these batteries will be commercialized before 2020. This would help to reduce fears that the electric vehicle may not have sufficient range to reach its destination. Another solution would be to provide users with reliable statistics on average daily vehicle mileage, which is significantly lower than the average mileage which can be achieved with current batteries.
 - **Appropriate maintenance network:** It is necessary to have access to a large number of high quality professionals. The implementation of the electric vehicle requires qualified professionals and a maintenance workshops network.
- **Policies, financial incentives, marketing and communications:**
- **Grants and subsidies:** With the aim of encouraging citizens to purchase EVs and reduce the price gap between a conventional car and an EV, grants have to be given to drivers who replace their old ICE car with an EV.
 - **Financial incentives and tax breaks for EVs:** If we want more electric vehicles on our streets, local and national governments need to encourage citizens through a series of tax breaks and financial incentives. Vehicle registration costs and road taxes have to be reduced or simply removed for EVs,
 - **General local incentives for EVs:** Apart from financial support, we need to encourage potential users of electric vehicles with other incentives. Local governments should provide incentives such as use of High Occupancy Lanes, access to restricted areas, preferential parking spaces and/or free or reduced parking rates in regulated areas to stimulate the market for sustainable transport solutions and to set a good example, municipalities could add EVs to their fleets.
 - **Promotion and dissemination of green transport:** Finally, local and national governments need to highlight that EVs do not only have zero tail-pipe emissions while on the move – significantly improving local air quality – they can also be made close to CO₂-free depending on the primary energy source used. EVs also produce less noise than ICE cars. They also need to emphasize that EVs are a real alternative to ICE cars. Both advantages and disadvantages have to be mentioned.

Local, regional and national governments should promote and develop activities such as dissemination campaigns, international conferences, public events, information points, fairs and promotional activities. In addition, the test drive consisting in EV trials, pilot demos, car sharing initiatives, etc. should be implemented.

- **Freight Urban Electric Vehicles:**

Implementation of electric freight vehicles (EFVs) is not a new phenomenon. Over the last two decades several trials and demonstrations have been undertaken but the actual implementation of EFVs in city logistics operations is still limited.

Some advantages of the implementation of freight electric vehicles in urban areas could be:

- The enhancement of public acceptance of electro-mobility with positive experience of urban delivery.
- Better coordinated transport and value added services for the consignees in the city center.
- Less congestion and reduction of the negative environmental side effects of transport in the city center.

It is very important **to understand the specific needs of different supply chains**. The good distribution is different in every case: there are different needs as weight, delivery times, refrigerated vehicles, etc.

Among the key features to deploy the urban freight electric vehicles would be: planning and organization of the urban freight distribution network, the creation of **green logistic centers and loading and unloading charging areas, access to controlled zones** with small electric freight vehicles, the **application of the new ICT technologies** for the management and control of urban freight distribution, **reduction in the mobility taxes or purchase taxes for freight electric vehicles and incentivize Zero Emission & Zero Noise** delivery in urban areas.

The main conclusions extracted from this deliverable are taken into consideration at the end of the document. Reading these conclusions is basic to understand the key features highlighted by the partners.



2 Introduction

These are the profiles of the partners of this deliverable:

Partner	Sector	Demoregion
CPH	Municipality	Demo region DK 2 – Copenhagen
Barcelona	Municipality	Demo region ES1 – Barcelona and Malaga
BMW	Electric Vehicle Manufacturers	
Enel	Utilities	Demo region IT1 – Italy
IREC	Research Institutions and Universities	Demo region ES1 – Barcelona and Malaga
Málaga	Municipality	Demo region ES1 – Barcelona and Malaga
Malmö	Municipality	Demo region SW - Sweden
Nissan	Electric Vehicle Manufacturers	
PPC	Utilities	
Rome	Municipality	Demo region IT1 – Italy
CTL	Research Institutions and Universities	Demo region IT1 – Italy

During a workshop in the spring of 2014 the partners exchanged knowledge with partners of task 1.4 'Test and local evaluation of policies and incentives' and task 9.1 'Consumer acceptance and social impacts in the built environment'. The partners were then asked to fill out a template divided into the following sections and subsections:

- Infrastructure
 - Infrastructure EVSE
 - Infrastructure billing system
 - Infrastructure deployment
- Vehicle
 - EV design
 - EV batteries
 - EV maintenance and repairs
- Policies, financial incentives, marketing and communications
 - Regional or national financial incentives
 - Local incentives and legislation
 - Regional or national incentives and legislation
 - Marketing and communications
- Urban Freight Electric Vehicles



Based on their own and other partners experiences, they were asked to describe the key features which their organization think are necessary for a successful rollout of EVs in Europe. Below you can read their main recommendations. For an in depth description please read the full report.

In section 13 you can read about lessons learned by Better Place Denmark and Ireland's largest energy provider, the ESB.

3 Barcelona

Infrastructure

Infrastructure EVSE

The public Charging Points (CP) of Barcelona constitute an infrastructure that has grown through public-private partnerships built upon a “seed tender” public investment that provided some 20 CPs connected to and managed from a Network Operations Centre, NOC and having common specifications for charge points that include multiple smart card interfaces (RFID included). Other sites have commented on the economies of scale of standardised equipment. The first benefit of the NOC is that information from a variety of stakeholders’ charging points is centralised into a common set of statistics concerning usage. Furthermore, the EV users benefit from being able to use all the charging points joined to the network with just one card. This interoperability is a key feature that has contributed to the size of the achieved implementation.

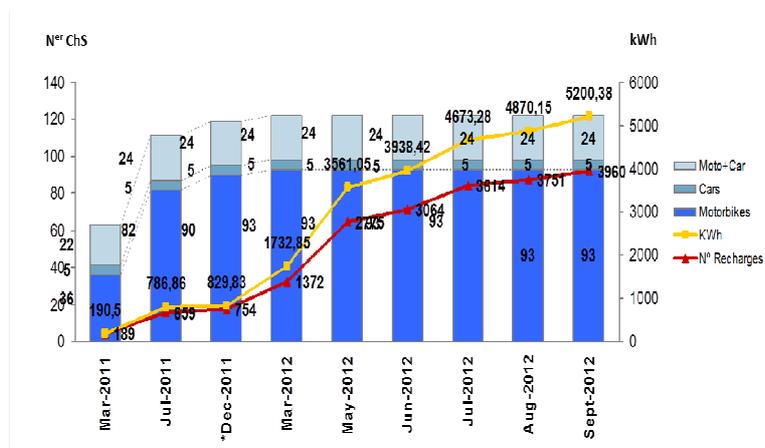
Infrastructure Billing System

Electric vehicle owners can register for a User Card that gives access to free-of-charge charging (until end 2015). Interoperability is achieved in terms of card user n^o and vehicle type. Whilst this charge point infrastructure specification (RFID and other card interfaces) is a basic steps towards supporting secure billing systems that can be implemented by Charge Point Operators the market is not yet mature enough for any of them to introduce tariffs for using the infrastructure.

Endesa has demonstrated (EVS-27, November 2013) access to a Barcelona CP from the GeM demonstration region in Italy based upon the Marketplace specifications drawn up in WP3, (and vice versa). Given the state of market development, Barcelona’s work towards interoperability is aimed at developing access for users from neighbouring regional and national initiatives, and looking to migrate to smartphone-based access.

Roaming is a function that would enable users to continue to have access to the complete network of charging points.

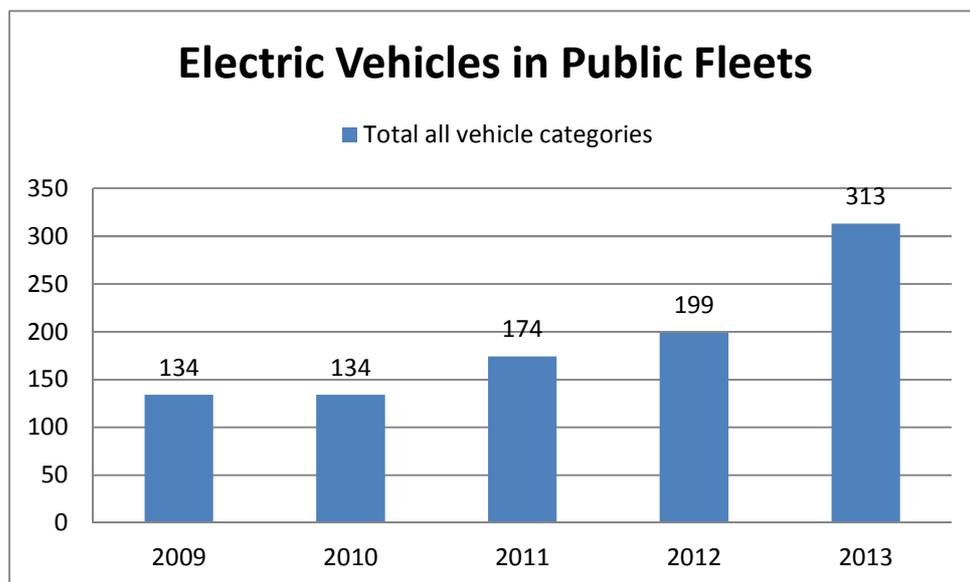
Infrastructure Deployment



The above graphic describes the evolution of the public CP deployment and its usage. At the end of 2013, of a total of 430 EV card users, some 50 are actively using the infrastructure (some 250 points) - mainly e-scooters – making around 200 recharges per month. The low level of use (of the charging services) is consistent with the general result presented in WP1 (that on-street re-charging is the less-used CP infrastructure).

The low level (of on-street charging) also reflects the disappointing uptake of electric vehicles in the general marketplace. So, whilst knowledge has been gained (for example, as to which locations are being used, charging habits, etc.) the low number of private users has orientated new deployment efforts towards supporting operators who are more interested in incorporating EVs in their fleets.

Thanks to an active EV procurement policy (see for example D2.1 at <http://www.greenemotion-project.eu/dissemination/deliverables-urban-concepts.php>) there are now over 300 EVs (mainly vans) in public fleets, recharging at depots. This type of CP infrastructure deployment has a high level of use with Fleet Operators collaborating with Energy and EV Providers to make a variety of decisions that ensure a progressive deployment of infrastructure.



Learning from this 1st-phase of deployment, Barcelona is focussing its infrastructure deployment effort along two main lines. The first is to make a smaller number of on-street CPs more attractive for Fleet Operators (taxis and commercial vans); the next generation CPs are semi/fast charge points, with the intention of having some kind of reservation system. The second “key feature” is to ensure that the CPs already deployed are available for EV users registered in the neighbouring municipalities of the Metropolitan Area.

Municipalities need to cooperate so as to adapt the traffic circulation regulations, the design layout and the signing of parking infrastructures – particularly for on-street parking, but it is also important to develop ICT systems that can offer an open service. The card or smartphone that identifies the user (and the vehicle that the user has elected to use) need to be minimally integrated by the CP management networks such that points with appropriate specifications are made available and so that possible abuses of the services are detected.

Barcelona has gained experience in the design of e-scooter on-street charge/hire points. It works with the Municipal bus operator – TMB – to introduce electric buses. In addition to this are important initiatives for hybridising 100 diesel buses and the acquisition of electric minibuses.

With respect to the Sustainable Urban Mobility Plan 2013-2018 the most important intermodal development is probably the effort to promote e-bikes as a way of extending cycling levels in the city.

Vehicle

EV Design

The use of smaller electric vehicles (small cars, e-scooters and Pedelecs or electric bikes) is an emerging trend that clearly responds to the market situation (higher cost of larger electric vehicles and economic crisis). These trends are seen from the EV User card registrations, and the changes in the city vehicle stock. A growing number of electric cargo-bikes are being used for the last-mile delivery of goods in the historic centre of the city.

Battery renting is a sensible way of reducing the up-front cost of an EV car/van for the user.

EV Batteries

The larger the vehicle (and functions like heating, air-conditioning..), the more important the battery performance becomes. With the smallest electric vehicles the batteries can be removed from the vehicle, re-charged and re-inserted by the user or the fleet manager (as happens with the MOTIT e-scooter sharing service).

Monitoring of battery performance will be particularly important for vehicles using fast-charging. The current action to deploy a dozen fast-charge points for e-taxis during 2014 is a relevant experience for Barcelona.

Given that urban trips cover short distances, manufacturers of urban vehicles should consider modularizing the battery so that battery pods can be charged and fitted into the vehicle according to the travel needs.

Others

It is important to monitor the evolution of the EV penetration in the city vehicle stock; this can help identify the key trends and achievements (e.g.: resulting from public fleet procurement) and facilitate adjustments to be made to the actions planned.

Policies, financial incentives, marketing and communications

Regional or national financial incentives

Without a national project for recharging infrastructure (MOVELE 2009-2011) it is unlikely that Barcelona would have invested in charge points to the extent that it has, and the initiative to ensure a common card for service access might not have taken place. Further grants should be directed to ensure that ICT solutions facilitate open access to services across metropolitan areas / regions.

It is very important that grant support is available to local authorities who are collaborating with fleet operators in developing infrastructure that exploits the value of public road space. Support is needed for services that manage access to reserved spaces and fast charge points.

National funding has also facilitated electric vehicle acquisition. Without this, public procurement policies for EV fleets would not be possible – and CP infrastructure at fleet depots would not be developed.

National and regional funding is also of central importance to the projects promoting electric public transport and the (regional) development and manufacture of electric scooters.

Local incentives and legislation

Pro-active EV procurement for municipal services is seen to be of central importance for the successful roll-out of EVs in Europe.

Once a municipality has adopted a pro-active EV procurement policy, the next-most important action is to favourably integrate EV incentives within the municipal parking policy. At municipal level, Barcelona has revised local ordinances (laws) adopting measures that favour on-street paid parking free for EVs (all cases) and for PHEV (when being charged) and new off-street parking construction (2% of spaces equipped with charging points).

The national-level incentives for EV purchase have been renewed this summer. The regional-level incentives (discounts on toll tariffs) have now been rolled out and are being assessed regarding their contribution to air-quality improvement plans (the consensus on meeting EU directives is broad, as is the interest in avoiding penalties for non-compliance). The local measures (free parking, free charging at public points) are now being coordinated through city-metropolitan authority agreements; the next years should see residents outside the city who own EVs being eligible for the incentives adopted by the city. Another (evolutionary) change is that there may be less public charge points in the future (than the 250 points) as the authorities seek partnership developments with fleet operators (who – amongst other things - appreciate FCO (Full Cost of Ownership) arguments more than individual citizens). The newer generation of charge points will be fast-charge, with improved functionality (booking, space management with improved user-interfaces (smartphone)). New opportunities to promote EV uptake are continually being examined, and the electric public bike pilot is one such initiative (300 e-bikes to be trialled next year in the “bicing” service (6000 bikes)).

The phrase “evolution, not revolution” is increasingly used to describe how the EV market will happen. The explanation is an appreciation of the need to integrate technological developments across different industrial sectors (automation, energy...) as well as infrastructure planning and regulatory processes. In spite of the possible changes that could occur from electoral processes, there is underlying acknowledgement that suggests that incentives adopted and reported in Deliverable 2.4 will not only be kept in place, but will be subject to evolutionary improvements, up to 2020.

The mass market uptake of EVs is dependent upon an evolutionary improvement of costs and performance with respect to the (increase in) costs of fossil-based fuels. As this happens, the incentives will adapt according to need policy needs.

Regional or national incentives and legislation

Regional collaboration has facilitated the adoption of the following measures:

- Toll reductions (Tabasa operator)
- Electric vehicle use of BUS/HOV (High Occupancy Vehicle) lanes
- Territorial integration (standardized signing)

A significant proportion of trips made in the city originate from areas beyond the city limits. Metropolitan / regional cooperation needs to be intensified such that EV users get a seamless and easy access to charging services across the territory.

Marketing and communications

Barcelona Municipality continues to support the LIVE initiative that serves as a common platform for engaging external actors. Barcelona has evolved into a consortium of private and public stakeholders at the metropolitan level, that use LIVE as a platform for promoting electro-mobility.

The web-site (www.livebarcelona.cat) has been running since July 2010. It communicates the charging point network, the procedures for obtaining an EV user card and the incentives and advantages of electro-mobility. There is a need for a communication channel that provides a centralized point for gathering and disseminating information, and which keeps “plugging away” reminding everyone about the environmental advantages of less noise and improved air quality.

A variety of outlets provide test (car) drives and (scooter) rides. Some of these initiatives are developing into electric vehicle rentals (especially for scooters, but also for small cars like the Twizy model). Expo Electric is an annual event (Sept/Oct) where members of the public can see the latest EV models.

Barcelona is promoting one of the world’s first initiatives for e-scooter sharing – branded as MOTIT. This service has been launched based upon battery-swapping, with the system operator taking care of ensuring the vehicles at point of service have charged batteries.

Urban freight electric vehicles

In Barcelona, thanks to the pro-active EV procurement policy, public electric vans comprise about half the total EV stock, and electric trucks of public fleets are also notable in number. The city now has more than 300 electric vehicles in the public fleet (refuse collection, street cleaning) and aims to increase this to achieve a 30% share (some 500 vehicles).

The re-orientation of infrastructure deployment towards collaborations with private fleet operators (more intelligent charge points, with value-added service such as space reservation) is the Municipality’s response to the relative success of the e-van uptake and the disappointment with CP roll-out aimed at citizens.

As operators of fleets, freight operators have a better understanding of the full costs of EV ownership / rental (compared to individuals). They are also open to partnerships with local authorities (in Barcelona partnerships have successfully implemented silent night deliveries with several supermarket operators, and this is the type of collaboration that is now being sought to promote e-van deployment).

Preferential access to controlled zones is still being examined, but is problematic because the levels of pedestrian movement are very high. (Electric) cargo-bikes are being trialled (SMILE project) and the costs of using such vehicles to break the supply chain for the last-mile delivery are reduced; publicity revenues can also help offset the additional cost.

4 BMW

For a city eMobility and eCar Sharing in theory are important modules to achieve sustainable mobility. In order to significantly contribute to sustainability objectives, both mobility concepts are required to be in place at large scale. But in practice, when it comes to implementation (let alone scaling), from a political point of view, both are considered a problem rather than a solution. This paradox is basically due to two reasons: First, in public opinion the existing parking pressure is perceived to be increased, and, second, stakeholders are affected but they are not involved in the change process to shape the transition from status quo to sustainable mobility.

Against this background, there are several success factors to implement and scale eMobility and to achieve public acceptance:

- **Link to Municipal Sustainability Strategy:** eMobility as pure technology does not have a genuine value for a city. Therefore, number one priority is to show that eMobility supports a city to achieve its own sustainability objective. This is the precondition for cities to engage themselves in shaping the framework conditions in favor of eMobility – a key success factor.
- **Sustainable urban Mobility is a Systems Innovation:** With a sustainable urban mobility strategy it is key to understand that no stakeholder alone can implement it. Moreover, only a collaborative platform like a **Multi-Stakeholder-Process** can overcome the challenges: e.g. to achieve a robust acceptance in the political arena and to overcome the chicken and egg problem with regard to e.g public charging infrastructure.
- **Cities should aim at improving quality of life in the first place:** Residents, retailers and other stakeholders are often suspicious when cities try to implement public charging or eCar Sharing. They fear a negative impact on their habitual behavior and don't see the direct or indirect benefit for themselves even though they are not going to use those solutions. Therefore, cities should emphasize improving quality of life and ask under which conditions this can be achieved. It is important to understand that a **holistic approach** is required addressing all sorts of mobility requirements and concerns. The holistic approach should address all sorts of user segments, local, regional and interregional mobility as well as all sorts of regulations (land use, parking, car sharing, etc.). In the sense of a 360° approach it is of utmost importance to address stakeholders' requirements properly in the first place.

Infrastructure

Infrastructure EVSE

- Standardized connectors for AC and DC charging guarantee compatibility EV with EVSE.
- Otherwise customer frustration if EV cannot be connected due to incompatible standard → hence now focus on Type 2/ Type 2 CCS connector plus Multistandard fast charging approach (CCS + CHAdeMO) for a transition phase in order not to exclude present CHAdeMO vehicles.
- Important cost issue from customer point of view: lower electricity cost (than gasoline cost per mile) required in order to amortize EV extra cost → hence public charging cannot be twice/ triple the electricity cost than at home (only modest extra for public charging acceptable).

Infrastructure Billing System

- E-roaming is crucial from a customer point of view; national + cross border e-roaming needed.
- Hence deployment of Green eMotion Approach with EU wide market place connections.
- In addition EU wide approach for contract free charging & cash equivalent payment useful → needs to be standardized.

Infrastructure Deployment

- Dense network required.
- Fast charging along corridors / major roads required in order to allow regional e-mobility (up to ~ 150 km distance).

Vehicle

EV Design

- EVs need to address emotions → no boring design!
- Efficiency is a key to high EV performance (see comment on batteries below).

EV Batteries

- Longer range requires higher capacity or more efficient vehicles, ideally both delivers adequate range.

Incentives, Marketing, Communications and Policies Local financial incentives

Regional or national financial incentives

- User benefits are the number one success factor: As long as electric vehicles suffer from disadvantageous cost structures user incentives are the number one success factor. They are not justified because of the technology as such but only because the technology provides benefits for the public.
- First User needs to achieve positive/ equal TCO (Total Cost of Mobility) with conventional vehicle! → hence operational cost + invest + residual value after average holding time (3-5 yrs) have to reach at least sum of conventional vehicle TCO; incentives can help closing the current gap.

Local incentives and legislation

- Welcomed from OEM side.
- User benefits shall address the most pain point in daily urban life. The three most important pain points are: parking, parking, and parking. Therefore the most important incentive to switch over to sustainable mobility is privileged on-street parking for EVs. Nota bene: not only at charging stations but also beyond.

- Even though parking privileges on public ground are most effective, the cost burden is with car drivers. Therefore, in order to make the transition process politically smooth also financial support should be applied. Nota bene: only as a complement to parking privileges. Financial aid as stand alone measure will not unfold sustainable effects.

Regional or national incentives and legislation

- Must have for the EU EV Policy Set!! Experience from actual projects (e.g. TEN-T) shows that funding can lower the investment hurdle for private/ industrial investment.
- Here we need sufficient public commitment until reasonable EV penetration rates haven been achieved (e.g. until 2020).
- Public Charging Infrastructure is key: In order to exploit the benefits of eMobility and eCar Sharing for cities, both solutions should be scaled. This requires a dense public charging network on public ground for on-street parkers and car sharing alike. On-street parkers represent the dominant part of the market potential in cities and they require public charging on public ground next to their homes. This is key to minimize the uncertainty of getting access to a charging spot when required. Compared to all other destinations, users return home every day and not every other day. Also eCar Sharing requires public charging on public ground in order to maximize the benefit for users.

Marketing and communications

- Part of OEM business, should be solved by competition!
- eCar Sharing is of strategic importance: For public or private investors it is important that charging stations are utilized. Their risk is tremendously high if they just rely on a communicated ramp-up curve. Therefore, eCar Sharing is of utmost importance because those fleets provide at least base-load demand. But also for cities eCar Sharing is of high value. It is not only stimulating demand for on-street parkers by its sheer presence in the streets and the possibility of easy test-drives. Moreover, in addition to emissions reduction, eCar Sharing addresses also land use and search traffic issues.

Urban freight electric vehicles

- Needs support from local authorities; with access regimes e.g. to pedestrian areas or early deliveries at night due to lower noise urban freight EVs could generate a positive business case for customers without financial incentives.
- Could enhance public acceptance of electric mobility with positive experience of urban delivery (today noisy diesel LDVs drive around...)

5 Copenhagen

Infrastructure

Infrastructure EVSE

A common EU standard will make the drivers able to charge at any charging point, and that will help to support the adoption of EVs. Until now there has not been a common EU standard for charging, but in June 2014 the Parliament decided on setting a type 2 standard from 2015 and COMBO-2 from 2018. In Copenhagen all new contracts with service providers made after July 2013 obligate these service providers to follow EU standards.

Infrastructure Billing System

The driver must be able to pay for electricity at any charging point. A nationwide infrastructure should be supported by IT and communications systems. Charging in Copenhagen is usually facilitated for users by a charge point access card allowing drivers to log into secure accounts, choose the electricity supplier per transaction and prepay using a debit or credit card. However, access through a call to a customer service is already available, and access through applications is currently being developed by various service providers. Pricing for charging without a subscription is made public by the service providers on their web page. Users with a subscription are usually offered reduced rates.

Infrastructure Deployment

In order for people to buy EVs, they need to feel sure not only that the vehicle will suit their needs, but also that the EV can be used for all purposes including long distance travels from one end of the country to the other. A challenge is thus posed in cases where there is a lack of nationwide infrastructure. Working to obtain a nationwide infrastructure for EVs is therefore highly recommendable.

Moreover, municipalities must cooperate in order to make common guidelines for establishing charging points. This approach will make it easier for the service providers and thus support the roll out of the infrastructure on a larger scale.

Moreover, many citizens live in apartment blocks without private parking facilities, and it is thus necessary to establish a public accessible infrastructure in the strategy. The public accessible infrastructure must be operated on a commercial basis.

Additionally, service providers should ensure that key maps outlining the locations of CPs are available to all EV users and accessible through the internet. Some service providers have developed an app for smart phones, which is very convenient for the users.

In order to encourage inter modality and facilitate transport for citizens, service providers should promote installation of CPs at car parking areas close to bus, train and metro stations. The municipalities can then support the promotion by allowing service providers to reserve parking spaces at the most attractive locations closest to bus and train networks, airports etc. A current pilot test running in Copenhagen lead by the Capital Region of Denmark is working to establish car sharing at specific locations along a central bus route in Copenhagen. About half of these shared cars are EVs.

Last but not least, both local and national authorities should work to install wind farms or other kinds of renewable energy so EVs can be fuelled by renewable energy, emphasizing the whole point of the electric vehicles. Authorities should thus maintain focus on need for EVs to be charged by renewable energy.

Vehicle

EV Design

The supply of EVs is limited. A more diverse supply of EVs will meet the users' different needs and making EVs more attractive to buy.

EV Batteries

It is essential that both batteries and other components of the car are reliable. If the cars repeatedly breaks down or the batteries run out of power in an untimely manner, potential buyers will be discouraged and EVs gain a bad reputation. Range anxiety is still an issue for potential buyers although 96 % of all car trips made in Copenhagen can be made by EV.

EV Maintenance and Repairs

See above.

Policies, financial incentives, marketing and communications

Regional or national financial incentives

Due to the price gap between conventional cars and EVs, it is important to focus on financial incentives to stimulate the EV market. Exemption from the VRT, grants for EV purchasers as well as other kinds of financial incentives will most likely encourage more people to buy EVs, as the price gap between a conventional car and an EV is then reduced. These incentives must gradually be phased out as the demand for EVs increases. In Denmark, electric cars are exempt from a vehicle registration tax (VRT) until the end of 2015 which is from 105% to 180% of the dutiable value¹ on new cars. EV's are also exempt from green tax in general. Green tax is determined on the basis of a car's fuel consumption, that is, the fewer kilometers a car drives per liter of fuel; the higher is the green tax. Since an EV does not use any fuel at all, EV owners are relieved from paying green tax.

Local incentives and legislation

Municipalities and authorities in general should strive to create a flexible and lucrative environment for EV operators in order to encourage operators to establish CPs. For instance, the municipalities' review of operators' applications should happen through a fast and effective process and there should only be one liaison with each municipality in regards to applications for establishing CPs, as transparency will thus be increased and confusion avoided. Also municipalities can ease the process by only imposing limited requirements on the EV operators concerning the standard and design of CPs.

¹ VRT is calculated as 105% of the part of the dutiable value under EUR 10,000 and 180% on the part of the dutiable value exceeding EUR 10,000.

It is highly recommended that all municipalities work out a strategy for the promotion of EVs and the roll-out of EV infrastructure. A strategy with clear aims and methodology will help the municipalities keep the focus on and the overview of the EV development as well as increase transparency for all interested parties in regards to EVs.

In closely populated cities where it is usually difficult to find a parking space, reserved parking spaces as well as free parking for EVs will provide incentives.

Moreover, more and more municipalities impose congestion fees on drivers in order to improve the city environment and health of the citizens, and it could be considered to exempt EVs from the fee due to the alternative vehicle's advantages.

In addition, municipalities can lead the way and adopt policies to buy their own EVs, so the municipal car fleets are gradually replaced by EVs. That way, municipalities can set an example, increase awareness of EVs and stimulate the EV market. Also, EVs are more expensive than conventional cars, and that means that the demand is also lower, which again keeps the prices high. Hence, municipalities, regions or governments may choose to stimulate the market and create demand by buying EVs themselves and replacing their car fleets with EV fleets. Once more EVs are sold, the production costs will go down and so can the sales price. Since 2011 all passenger vehicles bought by the City of Copenhagen have been EVs or hydrogen cars. The goal in Copenhagen's Climate Plan is to reach an EV/hydrogen car share of 85 % for passenger cars by the end of 2015 and 100 % by 2025.

Lastly, municipalities should also encourage their general suppliers to use EVs. This could for example be done by demanding low carbon footprints or simply a certain share of EVs in the fleet from their suppliers, but also by participating in OPIs developing solutions to fit their needs. See the Urban Freight paragraph in chapter 14.4 for a specific example from Copenhagen.

The City of Copenhagen has implemented several initiatives in order to encourage Copenhageners and commuters to replace their ICE car with an EV: The City is working with external partners to establish an infrastructure for EVs on public land and parking spaces with charging facilities are reserved for EVs on public land. The City has set a goal that by 2025, 20-30% of all light vehicles and 30-40% of all heavy vehicles will run on new fuels by 2025. To meet this goal the City has to implement more initiatives than those it has already implemented. The City of Copenhagen also has a goal that 85 % of the Administration's own passenger cars must be powered by electricity or hydrogen by 2015 – by September 2014 the City had reached a share of 60 %.

The initiatives mentioned below may all potentially have positive effect on the EV market, but are not yet implemented in Copenhagen:

Free Parking/Reduced Parking Charges

Free parking or reduced parking charges for EVs in the City where parking is expensive, is considered a valuable incentive to increase the share of EVs. EVs were actually allowed to park for free in Copenhagen in the pay-and-display zones until December 1st 2011. However this practice was stopped, because the Minister for Transport stated that the law does not give the City the necessary powers to exempt EVs from parking charges. Since December 2011, the City has repeatedly approached the Minister of Transport with a request for the necessary powers to reduce parking charges for environmentally friendly cars in public payment zones. It is now expected that the Danish Parliament before the end of 2014 will pass an amendment to an Act which will give municipalities an opportunity to reduce parking charges for environmentally friendly cars in public payment zones. Exactly how the City will decide to use the new law has not yet been decided but will be probably be decided in the first quarter of 2015.

Environmental zones

The City would like to establish environmental zones in Copenhagen which we believe would be a very efficient tool to get decrease the number of ICE cars and increase the number of more EVs in the city. Unfortunately the City does not have the necessary power to do so and the Danish Parliament will not pass an amendment to an Act which would give the City the possibility to do so.

Two way car sharing

In Copenhagen there is a number of suppliers of traditional car sharing (two way car sharing). A small part of these shared cars are EVs. The City would like the number to increase as it is a great way to introduce a large number of people to the advantages of EVs. However, EVs on the market – which are affordable - do not fulfill the typical driver's need as many do long trips. As EVs and their driving range improve, it is likely that the car sharing suppliers will be more willing to replace parts of their fleet with EVs. Since two way car sharing is known to replace 5-10 private cars they pay very little to park in the pay-and-display zones in Copenhagen.

One way car sharing/ city cars

During the last year or two, private companies have been very interested in establishing one way car sharing systems/city cars in Copenhagen. The City has been asked by potential operators if they too would be entitled to pay as little as two way car sharing companies for parking in the pay-and-display zones in Copenhagen. The City has been in dialogue with other cities with two way car sharing systems in order to estimate the effects of one way car sharing. The conclusion was that one way car sharing does not have the same traffic-reducing effects as two way car sharing systems, and therefore they cannot be offered reduced parking charges.

If the law is changed and the City gets the necessary powers to reduce parking charges for environmentally friendly cars in public payment zones, the City could decide to include one way EV-car sharing if the cars shared are EVs. The Technical and Environmental Department recommended this approach to the Technical and Environmental Committee of Copenhagen on September 22nd 2014, but the Committee decided not to approve the suggestion because it implies a loss of parking revenue, that needs to be covered ahead of such a decision. It will be decided on next year's budget negotiations (September 2015) whether the city will offer free parking/reduced parking charges to one way EV-car sharing.

Apart from the initiatives already mentioned, the City is currently researching for other ways to increase the share of EVs. These include the following:

- Research on how to incorporate demands about EVs and other green transport in the city's public tenders and general purchases. The City's spending budget is yearly close to 1.5 billion euro, so the potential impact is quite large.
- Public/private EV projects
- Development and use of city logistics providers run with EVs
- Influencing fleet owners in to replacing ICE cars with EVs

However, the City has no influence on two factors which the EV adoption is highly dependent on:

1. **Development of the EV market:** A mass market uptake of EVs will be highly dependent on the development of the EV and the battery technology and especially EV prices. If car manufacturers start to produce and sell EVs that can compete with ICE cars on both price, range, comfort, design etc. the EV market will much likely experience a breakthrough. This is up to the car and battery manufacturers and not something that we as a city can control.

- 2. Tax exemption:** Since 1984, electric cars have been exempt from vehicle registration tax (VRT) which is from 105% to 180% of the dutiable value on new cars. This means that the price gap in Denmark between electric cars and conventional cars is not as big as in many other countries. The exemption will last until the end of 2015, unless the Danish Parliament decides otherwise. Today the price of a VW e-Golf is DKK 286.000. If EVs were not exempted from VRT, the price would be DKK 714.000. It is very unlikely that we will experience a breakthrough on the EV market if the exemption is not prolonged or an alternative solution is found

To conclude, the main factors in enabling a breakthrough for EVs will be the general development of EVs by the car manufacturers and national decisions such as tax exemption in our opinion. The City of Copenhagen can help accelerating the EV-adoption but the City cannot make it happen.

Regional or national incentives and legislation

It is important that national and local authorities cooperate and that both listen to the other part in regards to legislation. E.g. if local authorities wish to introduce a piece of legislation (for instance free parking for EVs), they need to check with the national authorities that the necessary legal provisions are there. On the other hand, national authorities should be aware of a potential need for changes in the law in order to facilitate the implementation of e-mobility.

Furthermore, local authorities (if possible in regards to national legislation) could demand that all new parking facilities on private land should equip a number of parking spaces with charging facilities and reserve these for EVs.

Marketing and communications

There are still some barriers concerning EVs; EVs have a limited range and some potential buyers fear that an EV will not suit their needs if they have to drive long distances. Furthermore, renewable energy for charging is still under development, so some may feel that an EV is not green enough, and lastly the market price for EVs is still quite high compared to conventional cars. Therefore it is especially important to accentuate positive experiences and success stories about EVs.

If a municipality has EVs as part of its fleet, the city can brand itself in regards to green transportation. This measure would both put focus on the municipalities and on EVs.

Furthermore, campaigns allowing people to test an EV will additionally contribute to the promotion of EVs as the operators involved can provide PR and the test drivers can tell others about their experiences. Also, such campaigns are likely to gain attention from the media, which again will serve to create focus on EVs.

Additionally, it is necessary to increase the public's awareness of EVs and the number of CPs being deployed. Furthermore, PPP financed campaigns, with the aim of families/persons test driving an EV for a period of time may serve as an effective way of promotion as the test drivers will (hopefully) become comfortable driving an EV and can give statements about their experiences.

Similar to the projects allowing families to test an EV for free for a period of time, companies could be inspired and organise EV rentals – perhaps in cooperation with cities. That way both citizens and companies could rent an EV for a limited time period and experience the benefits firsthand without having to consider the investment or risk of buying a new car.



Urban freight electric vehicles

The City of Copenhagen has taken part in the development of a city logistics provider that uses EVs in their fleet. 'Citylogistik-kbh' is the Copenhagen version of a smarter and greener concept for freight transportation in urban areas. A consolidation center is established at the edge of the city center where to transport operators can deliver their goods for the inner city. From the consolidation center Citylogistik-kbh delivers the goods to the consignees in optimized electric vehicles. This reduces uncoordinated freight transport in the city center with has the following positive effects:

- Better coordinated transport and value added services for the consignees in the city center.
- Less congestion and reduction of the negative environmental side effects of transport in the city center.

The Danish Transport Authority is supporting the demonstration period in next 3 years with DKK 6.2 million kroner making the total sum of the project almost DKK 13 million. With Copenhagen Business School (CBS), Department of Operations Management, as project leader, a unique consortium has been formed with the private operator Citylogistik-kbh ApS, The Danish Technical University (DTU Transport), The Transport Innovation Network (TINV) and CBS. These partners will be working together across disciplines - and rationales for that matter – making sure that Copenhagen also in the future will have a sustainable City logistic solution.

6 Enel

Infrastructure

Infrastructure EVSE

For the definition of infrastructure requirements, clients' behaviour must be modelled taking into account two kinds of client:

- Clients provided with a private parking place (e.g. house or apartment garage).
- Clients that normally park their vehicles on the street.

The clients without a private parking facility (approximately 34% in Italy) shall completely depend on public recharging infrastructure.

On the contrary, it is assumed that clients provided by a private parking place, will mostly charge their vehicle while in the garage, while using the public infrastructure under some specific circumstances (for example when a journey exceeds battery capacity).

In both cases, clients shall be put in the condition to charge their vehicles when needed and without modifying their normal habits; hence the charge activity shall take place during normal parking time.

To meet the different needs and lifestyles of customers, an advanced charging system based on the presence of different types of charging stations is needed: simple and cheaper indoor devices to be used in private garages and more complex and robust outdoor devices to be installed in streets, parking areas, courtyards and similar places.

Both infrastructures must be compliant with all the actual international standards about charging system for electric vehicle (IEC 61851 Electric vehicle conductive charging system, IEC 62196 Plugs, socket-outlets, vehicle couplers and vehicle inlets - Conductive charging of electric vehicles).

The electric mobility represents an opportunity also for the grid management, considering the future massive introduction of Renewable and Distributed Energy Resources. For this reason the infrastructure should be fully integrated in the grid asset and remotely manageable and controllable to guarantee the possibility to manage and control it.

To determine the best charging profile taking into account contractual tariffs and grid conditions, it's necessary an active collaboration between the charging point and a smart vehicle taking advantage of the vehicle-to-charging-point communication. Enel is involved in the definition of the ISO-IEC 15118 protocol for the communication between vehicle and charging points.

Infrastructure Billing System

Different secure payment procedures should be guaranteed and the infrastructure should be compliant with the current rules of the energy free market, allowing the customer access with its energy tariff provided by her/his energy supplier: thanks to the use of a revenue grade meter inside the stations the customer shall be able to subscribe a contract with any energy supplier and to access any public charging points at any time. Every supplier should receive from the Clearing House the details of their customer's

operations (energy distributed and timestamp). As a result, each customer should receive energy bills from his/her energy supplier while being able to recharge at every charging point on the territory.

The authorization should be requested to the clearinghouse at the beginning of the charging operation, forwarding the contract ID and receiving, in response, client's profile details (contractual information or pre-paid card information). Such details could be used to determine the best charging profile (in terms of power and time) taking into account contractual tariffs and grid conditions.

Infrastructure Deployment

In addition to the low power AC infrastructure, an AC FAST CHARGING STATION is needed in order to reduce range anxiety of customers. This charging station will support the arrival in Europe of EVs designed to 43kW AC quick charge standards. This kind of EVs uses the drive train controller inverter to achieve the conversion of AC energy into DC energy to the battery and in this case the vehicle could be able to charge at a power equivalent to the engine power, for example 75kW for a 100 horse powered vehicle. This solution is compatible with all power levels (single- or three- phase supply) up to 43 kW. This intermediate power levels extend battery life and put less pressure on the power grid than the DC fast-charging. In addition this technology allows to the vehicle to save the cost of a separated on-board charger and allows to the infrastructure providers to avoid the external charger which converts AC power from the grid to DC voltage and current appropriate to the vehicle battery.

Therefore AC fast-charging stations are easier and more cost-effective of traditional DC fast-charging stations and take the benefits of use AC Type 2 connector that is a standardized solution unlike the ChadeMo one that is the most widely used option for DC connection but that is not an internationally standardized solution.

This fast charge stations will be installed along highways or service stations to offer a 15-30 minute charging service and will contribute to alleviate psychological hurdles for electric vehicle customers by overcoming range anxiety and addressing certain high daily kilometer needs.

Vehicle

EV design

Currently, an electric vehicle is more expensive than a conventional vehicle with the same features, so they are inaccessible for the most of the potential users. It is essential to get cheaper electric vehicles to motivate the user because the current cost is a difficult barrier that discourages the future user.

As described above the use of the drive train controller inverter to achieve the conversion of AC energy into DC energy to the battery could be a way to reduce the cost of the vehicle.

Batteries

To reduce range anxiety of the customers, battery capacity should be increased.

Maintenance and repairs

An electric vehicle is more reliable and requires less maintenance than a conventional vehicle because it has less mechanical elements. Even the batteries don't require maintenance but are the more wearable parts and for this reason we think that they should be rent and not sell to allow customers to change it without problems when out of order.



Policies, financial incentives, marketing and communications

Regional or national financial incentives

Incentives for those buying an electric car and a national program for the construction of stations for the recharging of electric vehicles are needed, so as to guarantee minimum levels of their accessibility. There would also be provisions to promote research in electric vehicle technology.

Electric vehicles should be exempt from the annual circulation tax or ownership tax for five years from the date of their first registration.

Local incentives and legislation

EVs should access the limited traffic zone in the city and they should have reserved parking for the recharge.

Marketing and communications

Car manufacturer should more and better promote their electric model, even with public events and test drives by citizens.

7 IREC

Infrastructure

Infrastructure EVSE

The strategy of the public charging service should be an open system for compatible operators. That means that a government gives access to any operator that accomplishes the minimal requirements that allows any European user to access the recharging service in a secure way. In that sense, the figure of the recharging manager will determine the model to follow.

The list of short-term actions to accomplish is:

- To define and reach a consensus in the minimal needs of the public recharging service.
- To determine the minimal protections for an electric service in a public space.
- To prevent the vandalism and an inadequate use of energy.
- To develop the signpost required.
- To standardize the recharging system in an electric and mechanic level (considering inputs from GeM standardization activities).
- To limit the use of the charging service: time restrictions (in blue or green areas) or time for urgent charging.

In a medium/long term the business models should be defined as well as a unique way of payment.

Infrastructure Billing System

One of the main objectives of Green eMotion project is to provide real interoperability in the EU which would let customers with a foreign EVSP be authorized to recharge regardless the region in which they actually are by accessing regional back-end and getting authorization feed back from the EU Clearing House service running in a pan-European MarketPlace.

The same objective should also be applied to a local scale by doing activities in order to achieve a correct operation, moving the information between different operators allowing every customer to charge in all charging points within a city. European cities should be aware of GeM advances in billing system definition for promoting operators to join the pan-European MarketPlace.

Infrastructure Deployment

Due to the reduced autonomy of the EVs, an important distribution of charging points in the territory is needed, especially, in the roads that condense a high number of commutes.

The optimal charge in that case would be the fast charge, but the real priority is the charging at home during the night. During the last years, due to economic and technical reasons the public infrastructure was based in the normal charging. However normal charging points will be substituted by fast charge in the medium term. To decide the location of the public infrastructure, Urban Mobility Plans, local mobility data must be used. A specific methodology must be designed to decide the optimal location of the points within the cities or regions, taking into account both users and operators.

In parallel to the development of the infrastructure, a data base would be required to identify the location and typology of the charging point as well as its main characteristics. This data base should be accessible to the EV users to know the location of the charging points, and should be linked to GeM pan-European MarketPlace.

For that matter, the actions would be:

- To analyse the main mobility axes among the main cities.
- To determine the optimal number of charging points in the main cities and surrounding.
- To determine the optimal number of charging points for in the axes identified as main mobility axes among the main cities.
- To introduce the fast charge gradually according to its development.
- To facilitate economic support to develop the recharging infrastructure.
- To create a data base service accessible to the EV users and linked to GeM Marketplace.

The promotion of linked charging infrastructure is crucial, i.e those charging points located at home, office, or that places where users park their vehicles assiduously. The time of recharge of an EV is really higher compared with the conventional vehicles and the evolution of the technology of batteries and charging systems foresees that the normal charging will be predominant in medium and long term.

According to this view, it seems essential that every vehicle counts on a linked or residential charging point that allows recharging where the vehicle is usually parked such as homes and offices. Then, these charging points promote the introduction of EVs since the charging will be mostly during the night, improving the economic efficiency of the electric system, the security of the supply and the introduction of renewable energies.

The connection of EVs to the grid can create problems related to the electric quality parameters that, for a high penetration of EVs, could hinder the connection of the vehicle or decrease the supply quality. For that reason power quality studies should be performed at country level, considering specific low voltage topologies that can put differences among European countries.

For that reason it is recommended to perform an analysis of a fleet recharging in the same place will determine the maximum number of vehicles that can be connected without harmonic filtering or power factor correctors. The recommended analyses are:

- Supervision and monitoring of the charging process
- Detection of anomalies in chargers and batteries
- Creation of graphic informs of events, number of charges, voltage levels, current levels and power levels.
- Analysis of the harmonic filtering.

In the case of a public parking with a centralized management of the charging system it should also analyse:

- The number of vehicles charging
- Charging periods
- Performed charges
- Cost of the service invoiced to the client

The results from the analysis will allow defining the requirements of the charging points in a public parking with a medium number of vehicles.

Vehicle

EV Design

The industry related to the Electric Vehicle forms a very heterogeneous group, including business traditionally not related with the automotive industry. For solving the problems related to the networking among these varieties of companies, the aim of this measure would be to determine a joint strategic vision and create an industrial cluster with the actors involved.

Some of the actions required to reach this objective would include:

- Support to formalize and dynamize the industrial cluster related to the EV.
- Synchronization of the different private and public strategies to optimize the strategies and actions planned. Also, to align the actions with national and European strategies.
- To boost multidisciplinary testing facilities to provide the different agents a common place to study and test under the criteria of maximum utilization of the equipment investment. It also aims to promote alliances between the actors.
- Inter-cluster initiatives and support to the clusters that already exists such as the energy efficiency cluster or the vehicle one.
- Surveillance and monitoring of the strategic indicators that will determine the rate of penetration and industrialization of the EV: number of commercialized model of vehicles, annual sales according to the level of hybridization, number of charging points, cost of fabrication of EVs, new actors involved, batteries manufactures, grants and subsidies, European guidelines, regulation, etc.
- Strategic marketing to provide a unified response and consolidate an image of the capacities of the industry in front of the electric vehicle.

Batteries

Nowadays it is crucial to promote activities related to residual batteries even though it is going to be a profitable business in the long-term. Batteries may have a "second" life; one possibility is to recycle the lithium. This activity will depend on the raw material prices when a considerable amount of EV (especially hybrids initially) reach the end of its useful life. Another residual value is the use of batteries as support elements of the electrical infrastructure (energy buffer) through the accumulation of a large number of batteries. It would be recommended to create working groups at regional level for involving all agents that could participate in such activities. In the case of Catalonia, the Waste Agency has leaded this activity and technical meetings involving car manufacturers, waste companies and research centers are periodically organized.

Maintenance and repairs

The Public Administration shall become a proactive agent that gives more transparency about all the questions related with the EV: the purchase, the maintenance, the life cycle, associated technologies, etc.

The successive implantation of the electric vehicle implies the acquisition of new knowledge by professionals of the future. In this regard, the involvement of the local Government is essential to introduce the new knowledge in a flexible way in the correspondent academic fields.

Besides, it is an opportunity of professional retraining in some emerging fields that can be framed in the policies orientated to look for a new job to the unemployed. Also, that new knowledge should be provided to actives professionals related to EV and its technologies.

The sectors and professionals affected would be:

- Transport and maintenance of vehicles
- Garages
- Insurance surveyors
- Driving schools
- Fleet responsible
- Property managers
- Installers of the electricity sector companies
- Technicians and designers involved in the design of facilities
- Public services, emergency and parking staff, among other.

R&D efforts for developing the EV requires more engineers and graduates with a strong expertise in the electric vehicle and the technology related. For that purpose, the University can become the reference to acquire this knowledge. A great proposal would be to include aspects related to the EVs in some degrees, to promote the creation a master of science specialized in the EV or including the EV in the existing ones related with engineering, automotive or energy.

Policies, financial incentives, marketing and communications

Regional or national financial incentives

The cost of the batteries and the small production of EVs make them less competitive that the internal combustion ones. It is foreseen that the prices will decrease in the next years but, until then, the EV market would require grants and incentives for the purchase of that kind of vehicles.

The purchase of pure electric cars is foreseen to increase and some actions should be taken in this direction:

- To maintain and gradually increase the budget to replace the old vehicles for new ones under an energy diversification criteria.
- As the offer of EVs increase, it is proposed to separate the budget according to the different technologies in order to promote mainly the electrical vehicles and the plug-in electric vehicles.

Local incentives and legislation

The citizens take decisions about mobility based in 2 factors: the travel time and the money spent; for these reasons the actions that affect these factors will change the mobility pattern. In one hand, the possibility to circulate in the bus-HOV (High Occupancy Vehicles) lanes, less congested, could reduce the travel time and, in the other hand, to reduce the tolls for clean vehicles could also be a good argument to change the mobility patterns into more sustainable ones.

Some actions to be considered are:

- to reduce the toll for the high occupancy vehicles (3 or more people) and the electric vehicle,
- to authorize the EVs to use the bus-HOV lanes,
- to define the informative signals that will inform about the EVs rights to use the bus-HOV lanes,
- to define the informative signals that will orientate the EV drivers to use the toll lanes with the applicable reduction,
- to define the informative signals that will inform about service areas with charging infrastructures,
- to make diffusion of the previous measures.

The approach to these measures would require a previous determination of their cost and the establishment of the needed compensatory measures.

Regional or national incentives and legislation

The public charging infrastructure should aim to provide to the potential EV users a charging point near their houses, complementary to their linked charging point. It should also aim to be used in case of emergency, which in a long term will be their only function.

The promotion of linked charging points would consider the following strategies:

- Promoting the most adequate technical solutions for the electric system, introducing, for example, demand management mechanisms.
- Reviewing the current legislation to overcome some barriers for the installation of private charging points. In this sense Spain has modified the regulation framework of neighbourhoods, low voltage facilities, and electricity retailing.

For reaching the objective of this measure, the following actions should be taken:

- To give economical support for the EV users that would like to install a recharging point.
- To promote the installation of charging points in new buildings, prioritizing the public buildings.
- To analyze the regulatory framework applicable to charging stations to detect the possible barriers and propose modifications to overcome them.
- To elaborate a guide for the users to facilitate the proceeding of installing a recharging point.
- To adapt current Low Voltage Electric Regulation involving technical and security conditions required for private charging points.

Marketing and communications

One of the main challenges of the EV is the lack of information of the citizens about the characteristics and limitations of reliability, autonomy and possible uses of the vehicle. The Public Administration should inform the potential users about the usability of the vehicles, the advantages and disadvantages as well as the most common problems that could present and how to solve them.

The aspects recommended to be informed are mainly:

- Advantages of the EVs in terms of energy and environment
- Available technologies
- Real cost of the vehicle (during all the life cycle considering consumes and maintenance)
- Currently incentives and policies of the public administration related to the EV
- Public and private charging infrastructure
- Doubts and responses about the related problems such as the recharge in a homeowners association, what to do when you are left with no battery on the street, the repairs, the assurance, etc.
- How to drive efficiently, optimize its use and when and how to recharge the vehicle.

To provide this information in an accessible and unified way, some actions are also suggested:

- To create a website to integrate all the fields of this strategy, putting the stress in the aspect more related to the final user but also in the potential fleets for private enterprises or public entities.
- To elaborate a communication plan and a brand image that integrates different public promotions that can include:

- Elaboration of triptychs to answer the main doubts of the potential users.
- To come to term with the cities that impulse campaigns to facilitate the deployment of the EV in their municipality, as the Barcelona city hall is doing through LIVE office.
- The organization and participation in informative seminars to potential users.
- To attract international congress related with the EV.
- To boost the initiatives or pilot projects that can become relevant to make the citizens aware of the benefits of the EVs. For example, a low cost renting service of EV in order to let people try the new technology by theirs own.
- To prepare studies to discover the future tendencies of the consumers related with the electric mobility.

The information plans, even if they are relevant to give a real impulse to the EV, should be reinforced by projects that are able to demonstrate the reliability, autonomy and benefits of the EV in real operations. Additionally, these projects could implement two more and relevant functions: on one hand, a test for technologies, public services or business models and, on the other hand, an important tool to test the products developed by the EVs manufacturers and the associated infrastructure or services.

The pilot projects can be classified as:

- Technological projects.
- Demonstrative projects.

Projects with a pedagogical focus aim to make the citizens aware with the objective of improving the demand of EVs with emblematic projects and impact on the media.

Urban freight electric vehicles

Two main key features will affect the electrification of urban freight vehicles; the infrastructure deployment and the incentives.

Within the cities, a specific infrastructure deployment must be done for the freight vehicles in order to allow their normal behavior. This specific infrastructure would contemplate some actions:

- To consider dedicated charging infrastructure for freight vehicles
- To install the charging infrastructure in the neighborhood of the delivery destinies.
- To study deeply the locations with high freight vehicle activity to avoid queues in the charging infrastructure during rush hours.
- To study the possibility of establishing a booking system
- To study the possibility of installing dedicated charging points in the key locations of the greatest companies which electrify their freight vehicle fleet. For instance, supermarkets, malls, ...
- To incentive the introduction of these electric fleets, the preferable locations for these charging stations are corners near the primary city markets or near the delivery stations of main companies.

For incentivizing the companies to electrify their fleet of freight vehicles, some reduction in the mobility taxes or purchase taxes will be convenient. These measures will mitigate the initial rejection of the companies and the difference in costs between ICEV and EV.

Another key feature is the preferential access to controlled zones with small electric freight vehicles that covers the last-mile delivery together with public incentives that helps offset the additional costs.

8 Málaga

Infrastructure

Infrastructure EVSE

An European standardized charging point system is required and must be familiar to manufacturers (charging points, and vehicles) and suppliers. Moreover, standardization simplifies manufacturing systems, reducing high costs of charging points. A significant reduction in costs would persuade hesitant candidates about its installation.

Charging stations should include the most common types of plugs in the electric vehicle market (e.g. Combo and Chademo for fast charging and Schuko/household plug and Type 2 for standard charging) in order not to create any doubt in the potential customers. Also, the infrastructure should be easy handling by everyone regardless of age, gender, academic formation, etc.

Infrastructure Billing System

An intelligent management using an easy standardized system with a fully confidential and secure billing system is essential to ensure to users the security required in the payment system. Undefined systems and having a lack of security on payment produce confusion and rejections.

Also, roaming and clearing is a very important aspect in billing system. Users should have access with the same RFID card to the complete network of charging points with different EV service providers and EVSE operators without any limitations.

Infrastructure Deployment

Datas from several systems in different demo regions could provide essential information to establish general guidelines with suitable places to install charging points.

To start with, without a statistical basis confirming it, we think that the deployment model of charging infrastructures needed to start the mass deployment of electric vehicles would be:

- Fast charging stations on highways, public parkings, gas stations and strategic locations in the city to ensure user's recharging on their trips and their way back.
- Standard charging stations at homes, workplaces, transport stations, hospitals, malls, hotels, public parkings, etc. Places where electric vehicles park for longer in order to ensure the recharge in common places.

Every of those places must have easy, convenient and visible road signs, allowing every user to identify the situation of the system. Likewise, appropriate media information (websites, smartphone apps...) should be at electric vehicle's user disposal, in order to provide him locations of charging points every time and everywhere and also other information about them as plugs, operators, forms of payment, costs...

Municipalities or companies could encourage intermodal transport between electric vehicles and other kind of transport (e-bicycle, e-bike, rail, buses, metro, etc.), installing charging points, exclusive parking areas and/or encouraging the development of electric transport companies in transport centers.

Lastly, it is impossible a mass deployment of charging infrastructure without enough power guarantee on the grid to cope it.

Vehicle

EV design

Currently, an electric vehicle is more expensive than a conventional vehicle with the same features, so they are inaccessible for the most of the potential users. It is essential to get cheaper electric vehicles to motivate the user because the current cost is a difficult barrier that discourages the future user.

Vehicle manufacturers should consider swapping vehicles batteries for other future generation. This possibility would provide sure to the prospective buyer because his vehicle will not be obsolete in a medium-long term.

Moreover, communication channels are required to transmit information and needs among citizens, governments and vehicle manufacturers. Also, manufacturers should analyze user requirements for their designs. Many users of electric vehicles perform the same daily trip and they require vehicles with special features like space in their boot to carry on shopping, baby accessories, etc.

Batteries

We have to break the barrier called "range anxiety" created on the user due to electric vehicle has lower autonomy than the traditional one. There are different solutions that could help to overcome the problem commented:

- To increase capacity or performance battery. It will have a greater autonomy.
- To let users know that the daily average use of a vehicle per user is significantly below the average range that provide current batteries².
- Establish a coordinated network of recharging infrastructure, proposed on the above paragraphs, which would make the user forget the "range anxiety".

The owners of a traditional vehicle are accustomed to refuel their vehicles in a few minutes. To recharge the electric vehicle with a standard duration between six to eight hours is a serious obstacle. It is crucial for potential EV users getting to know that an EV use based on standard (slow) charge during night at home or during working hours (by using standard charging points in parking) solve this boundary with no losses of time. In addition, the possibility of having fast charging points as support for occasional charging ensures the availability of EVs, being necessary by using them only about 15-20 minutes to charge batteries.

However, the doubts about the batteries and its features are one of the most important obstacles to be overcome. There are some questions that should be resolved such as long-term performance of the batteries, the influence of the fast charge on the life, the influence of added values of the vehicle such as air conditioning, heating, radio, lights, etc.

Maintenance and repairs

² According to official EU statistics in the annual summary published on the website of Eurostat in 2009, an average of 34 km were travelled daily by EU-27 passengers in 2006, 26 km of which by passenger car (http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-DA-09-001/EN/KS-DA-09-001-EN.PDF).

An electric vehicle is more reliable and requires less maintenance than a conventional vehicle because it has less mechanical elements. We have to tell the user that the current electric vehicle has more reliability than the first generation one.

Although the maintenance level is lower than conventional fossil fuel vehicles, to increase the sure of the potential user is necessary there are qualified people and a maintenance network that repair every breakdown.

Policies, financial incentives, marketing and communications

Regional or national financial incentives

Electromobility has to be supported by local, regional and national government institutions. Those have to provide economic incentives to users and companies involved. On that way, authorities show that they are involved on electromobility.

We have to encourage the citizen through financial assistance to cheap the current high cost of the electric vehicle at local, regional and national level, such as those are offered by the Andalusia Energy Agency³. In addition, local, regional and national government institutions should create and promote grants to install charging points at homes⁴ and work places.

Also, registration taxes of electric vehicles (VRT) should be free, achieving a reduction of the initial price.

All these financial incentives have to be for long term in order to avoid any uncertainty for potential users because there are companies that make studies to change their fleets.

Local incentives and legislation

Citizens sometimes find a lot of bureaucratic obstacles when they want to install a charging point. Municipalities, governments and utilities should facilitate the processing and permits for the installation of charging points in public and private areas.

Municipalities should reduce rates for electric vehicles parking in underground public parkings and parking regulated areas on surface with rates should be free for them.

Also, road taxes have to be free or reduced by municipalities and these should allow access for the electric vehicles to restricted areas for the movement of traditional vehicles, canceling or lowering access charges if they exist. We would achieve a positive discrimination with local measures like these.

Another way to encourage the deployment of electromobility is creating new exclusive parking spaces in public areas for electric vehicles. Municipalities could book a limited number of places among the existing avoiding an excessive reduction of spaces for fossil fuel vehicles in order not to damage the electric vehicle image.

³ Efficient Vehicle Program of the Andalusia Energy Agency includes grants for the purchase of electric vehicles, if they invest more than €3,000 (excluding VAT) and less than €50,000, and are not also funded through leasing or renting. The grant depends on the type of vehicle. Grants achieve up to 4.500€.

<http://www.agenciaandaluzadelaenergia.es/administracion/ayuda/transporte-movilidad/renovar-flota>

⁴ Andalusia Energy Agency provides grants for the installation of charging points, if the investment exceeds €3,000. The grants will depend on remote management charging point or to be installed in a new housing development or rehabilitation.

<http://www.agenciaandaluzadelaenergia.es/empresas/instalacion-de-equipos-de-carga>

In addition, if municipalities are going to buy new vehicles, replacing traditional fuels vehicles with them, they should create local regulations to made purchasing departments to include a percentage of electric vehicles in public fleets.

Finally, it is very important to have a common strategy among municipalities at regional or national level. There are incentives that only can be enjoyed by citizens in a determined city because their electric vehicles show a special badge that identifies them locally, but other users can not make use of these incentives because they live in border towns and they are not registered in the first one.

In Málaga, some successful initiatives have been taken into account as well as implemented. These initiatives are the following:

- Accessibility to restricted areas
- 15 exclusive parking places for EVS (currently, there are 220 EVs aprox.)
- Allowances for parking fees: 10% reduction in surface parking lots and 45 minutes for free for underground parking lots.
- Road taxes reduction in 75%.

From our point of view, these initiatives are quite suitable for users right now. Indeed, the statistical surveys show that aftermath the implementation of these measures in the city, EV users feel comfortable with them. Nevertheless, to accelerate the adoption of EV by 2020, it is highly recommended to improve the above mentioned privileges. In addition, it would be convenient the accomplishment of new initiatives.

To keep on encouraging the citizens to use the electric vehicle, the enhancement of these privileges should be accomplished by addressing the following measures:

- Increase the number of EV exclusive parking places, according to the EV fleet in Málaga.
- Increase up to 100% the percentage of parking fees reduction in surface parking lots.
- Increase up to 1 hour the free fee for underground parking lots.
- Increase up to 100 % reduction of road taxes for EV (it depends on the national regulation).
- Apply this kind of initiatives in dormitory-towns too.

It is envisaged that the EV fleet will increase up to 7% of the total amount of cars for 2025. Once the EV fleet is large enough and it may turn into an unsustainable situation, we should reconsider the adopted measures.

Málaga is developing a deep analysis of the city and a detailed technical-economic plan about geographic expansion locations for charging stations and fast standard. The fast charging points are convenient to be installed in:

- Main roads which connect the city of Málaga with the municipalities of the province of more than 25.000 inhabitants.
- In Andalusian's capitals which are in a radius of 300 km.

It is necessary to establish the charging points in a way that allows citizens not to experiment the so-called range anxiety. In addition, the charging infrastructure should be present in service areas and petrol stations.

There have been undertaken other initiatives as a trial, such as: car sharing and EV cars renting. Málaga city council will try to encourage the implementation of this kind of measures in a very short period of time.

In addition, there are two mobility sectors that are susceptible to be introduced massively into the EV marketplace: taxis and buses. This is due to they constitute a great opportunity to achieve the massive acceptance of e-mobility, considering that these sectors may bring citizens closer to the electric vehicles.

As a first step, Municipal transport company has already purchased 4 hybrid buses and it is also planned the acquisition of electric buses in a medium term.

As second step, Malaga city council has started relationships with taxi association in order to introduce electrical technology in taxi fleet into the city.

Finally, intermodality is considered as another measure to adopt, since the metro of Málaga has been recently inaugurated, and it is a great opportunity to create the suitable interconnection between all the ways of transport in the city.

Regional or national incentives and legislation

Regionals and national authorities can boost development of electric vehicles and their infrastructures by promoting the installation of charging points at homes, workplaces, hospitals, shopping centers, hotels, highways and transportation centers. So, the authorities should make changes in the law in order to facilitate the implementation of e-mobility.

Otherwise, it is essential to legislate aspects such as the installation of charging points in residential buildings, the establishment of a minimum number of parking spaces with charging points for each new number of parkings places and the creation of a minimum number of charging points in municipalities according to the number citizens.

Also, it is necessary to reduce administrative bureaucracy involved in this kind of infrastructures.

Marketing and communications

All the above mentioned is useless without a proper and organized dissemination. It is very important to increase the spread of the positive aspects of electric vehicles (air quality, less noise...) in the mass media and the establishment of information points about electric vehicles and charging points. Another way to get the aim is making public events with electric vehicles, demo of infrastructures, etc.

Many people have doubts about the electric vehicle. The best way to dispel them is doing test drives with electric vehicles, so the citizens could try them and tell their experience to other potential users. Another way is establishing a network of car sharing.

Urban freight electric vehicles

Before setting the basis for freight electric vehicles in cities, it is very important to understand the specific needs of different supply chains. Authorities and stakeholders should ensure the pooling of all the requirements and need: it is not the same the distribution of perishable products, bottles, pharmaceutical products, material construction... Everyone has different needs as weight, delivery times, refrigerated vehicles... It is important establishing measures to foster collaboration and coordination among distributors, general administration and all stakeholders implicated.

Also, the planning and organization of the urban freight distribution network is essential and the following aspects must be addressed:

- Characteristics of the city.
- Urban planning, road network and access roads.
- Traffic congestion, low-speed stretches of route (speed limits)
- Distribution needs to access to end customers and the objectives to be achieved.

On the other hand, the analysis of the costs of investment and the distribution of all the agents that make up the supply chain and define how to address them must be considered.

Several aspects related to infrastructure must be taken into account, such as the promotion of the creation of green logistic centers with charging points. In these logistics centers, companies could exchange goods between big and little electric vehicles for the last mile.

It would be necessary loading and unloading areas equipped with recharging points in urban areas where freight electric vehicles can be charged while parked.

Regarding optimization of this infrastructure, there are some actions that must be considered: signaling and accessibility of the recharging points on the one hand; and the application of the new ICT technologies for the management and control of urban freight distribution by logistics operators and supply companies on the other hand. The standardization of these recharging points is also essential.

In general, lowering prices of the electric vehicles could improve the settlement of the freight electric vehicles in urban areas. Developing regulations and tax incentives or the establishment of agreements with the government could also help to the freight electric vehicles fleet adaptation.

Finally, the main barrier for the person who drives a freight electric vehicle could be the worry concerning range, so-called "range anxiety". As an example, there are some electric refrigerated truck models manufactured by the American company Smith already in the market⁵. This kind of vehicles can be usually driven 130 kilometers in a single charge. However, it is likely that the delivery companies need more than this distance per day to deliver their products.

⁵ http://www.smithelectric.com/wp-content/themes/barebones/pdfs/SmithEdisonSpecSheet_OUS_2011.pdf

9 Malmö

Infrastructure

Infrastructure EVSE

One key aspect of EV infrastructure development is to make everything connected, accessible and easy to use. The end customer does not have to have knowledge of who is providing the electricity, who owns the back-end system or what identification procedure (cards/tags) that should be used. The whole infrastructure must be pedagogically and intuitively designed. With this in mind, standardization is probably one of the key factors in implementation of a European wide EV fleet.

Infrastructure Billing System

To make the payment system easy to use is of great importance and Malmö is working together with the region to ensure this.

Infrastructure Deployment

Most charging happens at home or at work since this is where cars reside most of the time. Developing infrastructure with this in mind is important as well as development of public spaces where fast chargers and battery switch stations could be important. EV buyers need feel that infrastructure is well established, and that various services are connected to ease the range anxiety.

It is crucial to develop an easy-to-use user identification system to make the use of the EV infrastructure attractive and a strong competitor to the conventional fuel infrastructure.

Another key factor in promoting EV use is a user-friendly charging infrastructure, with charge points (CP) in strategic places throughout cities that are open for public use. Recharging network enhancing is crucial for an increase of the EV car fleet; Malmö is working continually on this with collaboration with energy companies and producers of the CPs and within Green eMotion Malmö has increased public charging points. Improvement of charging network has been a continue work within Green eMotion and Malmö will keep this work up in the future in new constellations and in new projects.

To increase fast charging points and battery switch stations along major highways connecting the larger cities are very important, especially in a country where long distances are common, such as in Sweden. The geographical long stretch of Sweden makes the short range of EVs a major issue and it could be handled with a well-developed charging infrastructure.

From a city planning perspective one major importance is to combine EVs and public transport, for example to build charging infrastructure close to bus/train stops, focus on the mobility of people and see EVs as part of the wider task to make mobility in both urban and rural areas fossil free to the extent it is possible. In this development service providers and public transport operators should collaborate to find common user identification to make the integration between EVs and public transport as smooth as possible.

In Malmö a solar powered EV parking for carpool EVs is available in the Western harbour area. It is important to communicate and to show that EVs may, and should be powered by renewable energy such as solar energy.

Fast charging stations are not yet very common in the area. However various partners (electricity companies, CP producers and carpooling companies) are working together to increase the number of CPs and the municipality of Malmö is working actively to promote this. Malmö is using a webpage⁶ which EV users and developers constantly update. This webpage is open for public and all public charge points are easily accessible on i.e. a smartphone. The webpage covers charge points all over Sweden.

Vehicle

EV design

The most heard argument against EVs today in Sweden is by far the price of the car. The buying cost of a new car is about the double compared to a conventional car with combustion engine. This makes the EVs a non-option to families buying a private car. The high cost argument is also heard in companies when they are to buy company cars, but since there might be a marketing value to it the benefits could outrun the costs.

The cost issues are important to have in mind when a shift from car with conventional combustion engines to EVs is desirable. The choice to buy an EV has to be attractive in many aspects.

Finally, an electric car is financially attractive and financially beneficial when you compare an EV with all costs from a conventional car.

EV Batteries

A common notion and an often heard critique against EVs is the potentially short range of the vehicles. This is a major issue in countries with large distances such as in Sweden. This critique is further strengthened in regions with cold climate. In Northern Sweden, problems with shorter range during the cold winter have been experienced, which is partly caused by a raised need of heating in the EV, hence less power to fuel driving. Also, cold temperatures make batteries less effective and the capacity decreases. This is not a major issue in the Malmö region since days with extreme cold are few.

Another issue of EVs is the potentially low second hand value. This since the quality of the batteries decreases with time and this has a major impact on the vehicles performance.

EV Maintenance and Repairs

EV market is yet too small in Sweden and Malmö, for companies to have a business model for the EV fleet. However, second hand market repairs and maintenance will certainly become a lucrative business as soon as the EV fleet is large enough.

⁶ www.uppladdning.nu

Policies, financial incentives, marketing and communications

Regional or national financial incentives

National financial incentives are by far the most important incentive for EVs in Sweden. Today EVs are too expensive to public. Compared with neighboring countries like Denmark and Norway, very few EVs are on the roads. Those countries clearly show the power of some incentives such as exception to VRT for EVs. However, Sweden does not have VRT so in order for an exception or a decrease to be effective it would have to lower the initial expense of buying an EV to begin with. In Malmö, the biggest and most important work lies on increasing the number of EVs owned by public, in order to get a more climate friendly car fleet.

Comparing the incentives in Denmark and Norway to the incentives in Sweden, might give a guidance of the importance of lowered or removed VRT for EVs rather than a special grant, which is the case in Sweden today. This grant is today, 2012, about € 4000.

The idea of providing the installation of personal charge points at home for free to the first 2000 customers buying an EV (like in Ireland) is an interesting idea, and a good way to create a more user-friendly charging infrastructure.

For the specific incentives and policies that are introduced on the national level the reduction of national vehicle ownership tax for EVs and financial support in purchasing EVs are extremely helpful but still low compared to a regular conventional car. Economic relief for buying EVs or flexible and innovative business models could still be improved to further increase benefits for the buyers. At the municipality level there is not much leverage in changing this. On the local level, lobbying this through existing channels available is the only way to try to influence this. It is a highly political question both nationally and locally and there are no sign of increased financial support on the national level.

What must be done is according to our experience so far, a stronger national political commitment and vision in order to enable a wider deployment of EV infrastructure and to be ready for mass market uptake of EVs. This means more budget for "sustainable transportation" within the public body and regulations pro EV's to be more easily managed and recognized, in the whole city.

Local incentives and legislation

Public charging is free in Malmö and the charging is included in the parking fee. The charging will continue to be free in the coming years and there is no discussion to put a fee on the energy.

Free parking for e-vehicles in areas where parking normally has to be paid was initiated 2007 and ended 2009. This incentive was not that successful from the city perspective as Malmö's current policy is that we do not want more cars in the city, which is a political decision. For this reason, this incentive is not compatible with the overarching goal in Malmö, to decrease car use in the city centre.

Initially there will be no charging fees at public parking facilities. Sweden has very few EVs on the roads at the moment and free charging is an important incentive to motivate potential electrical vehicle (EV) buyers. The cost today is the parking space. This can be motivated today with a higher value on land than on electric energy in the City of Malmö.



One strategy to get more EVs on the roads would be to focus more on the reduction of initial buying cost and second the focus on incentives for using EVs, e.g. free parking. Those incentives are important, but ineffectual if there are no EVs using them.

Direct purchasing of EVs by local/national bodies is important to show good example, this is a continual work within Malmö and we are working on implementing an EV strategy for the whole municipality and will work to promote further investment in EVs in all departments.

Free parking for more environmental friendly cars were once implemented over a couple of years in Malmö, but as the city has a political will to not give appropriations to any cars in the central parts of the city, it is not possible to implement such incentives at this point, neither driving in the bus lanes. As we work towards focusing to ease the mobility of people mainly through increasing public transportation, biking possibilities and walking in the city center. To regulate more in order to “receive the outcome that you want” (eg. cleaner air, less noise disturbance etc.) it is being discussed and talked about in many projects to use this tool of regulation/incentives more, however, there are not yet established ideas, neither initiatives that anytime soon will be lawfully in force. To free ground in order to relive the issues of establishing public charging points could definitely be overlooked.

Marketing and communications

Promotional activities and communication are important because both public and private actors have limited knowledge about EVs. Below are two examples of how the City of Malmö works with EV communication.

The City of Malmö is co-arranging the Öresund Electric Car Rally, together with other partners like the City of Copenhagen and the City of Helsingborg. The Öresund Electric Car Rally is a way to show EVs to the public, and each city is hosting specific events during the rally, to further promote EVs. At these events, there are EVs for people to try and drive. In Malmö we have, together with our energy company, had test families were they could use an EV for 3 months. This gives the opportunity for people to try an EV in their daily life. To get into an EV and realize the potential is very important to change the common viewpoint in Sweden; that EVs are no substitute for a conventional car.

Urban freight electric vehicles

In Malmö there are discussions and plans to introduce electric vehicles in goods distribution and also in city logistics where goods are delivered into the city centre with small EVs and electric freight bicycles.

Local logistic companies are interested in taking part in this change and during the fall new projects will be formed to manage this. Malmö has established contact with companies involved in providing vehicles and surveys has been done to understand the reasoning of various stores in the city centre regarding sustainable distribution of goods.

A key feature to make this successful is to have one or many suitable and working business models to be able to continue without subsidies and project financing. Malmö will focus on the clean logistics in the years to come and merge different vehicle, such as heavy duty trucks running on 100% biogas, establish logistic centres where it's possible to reload onto electric freight bicycles or smaller EVs for transporting the goods the last mile.



The role of the municipality is to be ahead with new ideas and get companies and partners together and be involved in the planning process without taking charge of this; to be a facilitator. Malmö will do a pilot-project for the internal goods to schools and kindergartens during fall of 2014 to present the positive outcome of this type of urban logistics.

10 Nissan

Infrastructure

Infrastructure EVSE

- Mode3 should be widely implemented with type2/ (type3) connector in line with local regulation.
- Quick charging can feature connectors (CHAdeMO, AC, CCS) that are most adapted to the sales of EVs in a given region.

Infrastructure Billing System

- Simple and convenient system must be implemented. The system should allow for roaming and avoid closed networks.
- Billing for the electricity consumption in normal charging is questionable, parking can be charged separately and at a discount.
- Billing for Quick charging can be done using a flat fee rate. The rate should be affordable enough for the user and attractive enough for the operator/investor.

Infrastructure Deployment

- In the early phase EV Charging infrastructure should be deployed using the existing connectors.
- The EV charging infrastructure should be visible, affordable, and convenient.
- Home and Office charging in mode3 represent the base solution and should be incentivized as much as possible.
- Smart charging should be incentivized so that charging takes place at the optimum time and price.
- Quick Charging outside of home/office should be prioritized as it allows fast turn around time and maximum service to the user.
 - It allows alleviating some of the questions EV considerers may have and provide a much needed extended range to existing users.
 - It also provides a solution for EV users who don't have a private garage or office charging.
- EV deployment policies should be combined with grid balancing and Renewable energy deployment policies as they are inter-related at regional level.

Policies, financial incentives, marketing and communications

Regional or national financial incentives:

- Incentive plans should make a separation between Battery EV and other EVs (PHEV, REEV, etc..) and give BEV a significant bonus as they represent a positive asset to the community at large:
 - BEV deliver zero emission and zero noise and therefore can contribute significantly to Urban Air Quality policies,
 - BEV can also support the smart integration of Renewable Energy Sources.

- Incentives should be made clear for the long term to avoid any uncertainty for fleet owner and private customers.

Local incentives and legislation:

- Use of bus lanes, free entry in urban toll systems, exclusive access to certain areas, free parking, and free normal charging should be considered as “accelerators” in the adoption of BEV in urban environments.
- Cities should implemented urban toll systems in preparation for the implementation of Zero Emission, Zero Noise zones.
- Vehicles are already in the market, safe & affordable. They should be given priority in public tenders, and promoted to private customers.

Regional or national incentives and legislation:

- Access to public ground should be facilitated to EV charging points operators.

Marketing and communications

- Communication should be made on the reasons why EV is receiving so much support: Air Quality is the major thrust.
- Battery Electric Vehicles delivering zero emission should be given maximum priority in city centers (Bus lanes, free parking, etc...) as they represent a positive contribution to air quality.
- Cities should promote the use of EVs in every form as it contributes positively towards better air quality.

Urban freight electric vehicles

- Apply/extend EV incentives to e-vans.
- Install Quick Charging points in loading/unloading zones.
- Incentivize Zero Emission & Zero Noise delivery in urban areas.

11 PPC

Infrastructure

Infrastructure Billing System

It is important that the applied billing procedures will be simple and clearly defined in order to be widely accepted by the EV users. There may be personal credit cards involved or prepaid cards easily acquired. Upcoming EV users need to be informed about the different methods that may be used for paying their EVs charging while they need to be assured about the security of the respective transactions as well.

Furthermore, the interoperability of the billing system is very important. Billing data, such as energy consumed, time of charging, user identification etc., should be transmitted in uniform data format implied by specific standards.

Last, but not least, security issues are of great concern. The billing system should ensure the safe and reliable data exchange. These data must be available only to authorized users either in aggregated or detailed format.

There should be no discrimination against the conventional loads, concerning the billing process. Since EV charging needs provoke an additional demand to the system, there is a need for price incentives mechanisms with global implementation, such as multi-tariff schemes, in order to avoid high grid loading and prevent market price peaks.

Since EVs can be considered as flexible loads, there are opportunities for the development of new business actors, such as EV aggregators, that will be responsible for supplying and managing EV demand. EV aggregators will be able to manage EV demand, through bilateral agreement (contract) with the end-users, by setting price-based incentive policies (i.e. multi-tariff schemes). The tariffs should be designed in a way that allows aggregators to maximize their profits as well as minimize the end-users' charging cost.

The next issue concerns the roaming procedures that need to be established in order for the EV users to know that they may easily move in various areas without having any geographical limitations. Roaming billing system is considered to be crucial for the wide deployment of EVs as it will allow the unhampered transportation of EVs in areas outside the coverage network of the contracted supplier.

Infrastructure Deployment

The development of the EV charging infrastructures needs to be planned in order to have the expected results. The charging points need to be installed at appropriate places that easily serve the EV users' needs. Furthermore, the selection process needs to take into account certain other aspects such as accessibility, coverage area, required grid reinforcements and the combined usage of other transport means (i.e. near train stations). Even if it is important for the EV users to know that they will easily charge their EV, care must be taken in order for the charging network not to be oversized. At the first stage of e-mobility deployment special attention must be given in signing of the relative EV charging points especially in areas where citizens are not well aware about EVs.

Even though the installation of charging infrastructure in public areas is subject of free market, there should be some minimum pre-requirements in planning the installation of charging spots that should be

fulfilled in order to facilitate electro-mobility. The minimum range of the coverage area and the density of EV charging stations should be planned by an institutionally accredited authority. Further issues such as parking place acquirement, ownership of the infrastructure, grid reinforcement, and their depreciation mechanism as well as, installation of public charging posts with no big market interest should be somehow clarified.

EU standards for charging infrastructure are necessary in order to ensure interoperability.

Vehicle

EV Design

The most appropriate EV type for every customer is considered to be site specific and highly dependent on the purpose that is intended to be used for (e.g. short driving distances in highly traffic areas or in suburban roads with limited car traffic, etc.). A commercially extended variety of EV types needs to be assured in order for the upcoming EV users to be able to find the most appropriate EV type which serves their needs.

Moreover, there should be common specifications for EV defining their operational characteristics.

EV Batteries

The increased cost of the EV battery is considered to be one of the most suspending factors for the wide use of EVs and there need to be certain solutions in order to overcome this problem. Currently, there is much effort in reducing this cost while increasing the battery autonomy but there is still much to do in this area. Buying only the car and leasing the battery could be an appropriate method for accommodating this issue. Refurbishing and reusing retired EV batteries for less demanding energy and power applications can give EV owners an opportunity to reclaim a portion of the purchased price of the battery.

The technical specifications of EV batteries should be available in a way that is easily understandable the widest possible end-users.

EV Maintenance and Repairs

The maintenance procures for EVs are significantly decreased compared to the respective ones for conventional vehicles. However, it is important that there will be appropriate facilities where the required maintenance and repair procedures will be performed. The personnel at the existing car service facilities should be trained concerning the operational characteristics of the EVs while additional equipment may be required for completing the various tasks.

Incentives, Marketing, Communications and Policies Local financial incentives

Regional or national financial incentives

In order to achieve the wide deployment of EVs, it is important to establish appropriate incentives. This procedure may be considered even more important in countries that face certain financial problems, such as Greece, and the cost of EVs is nowadays considered to be extremely high.



The different incentives within the EU between different countries, are causing problems to local importers of EVs, because second-hand or new electric cars can be purchased with reduced prices in another country that apply other incentives, creating an unequal competition in the local market sales of EVs.

Local incentives and legislation

Incentives may be established at either a national level and involve reduced road taxes or at a local community level and involve developing facilities especially for EVs (i.e. parking places). It is, therefore, evident that a strong liaison between all involved participants needs to be established in order to develop an effective support framework for electro-mobility.

Marketing and communications

For many countries electro-mobility is a concept that has many issues that need to be further clarified. Most people are not adequately aware of the benefits of electromobility and, for this purpose, appropriate dissemination campaigns need to be established in order to help upcoming EV users to overcome their reservations concerning EVs (i.e. the range anxiety). Furthermore, such procedures may be extended to include existing EV users in order to inform them about the most appropriate usage of their vehicles (i.e. effective charging process). EV trial driving is the most appropriate methods for introducing electro-mobility to drivers. The analysis of several EV pilot demos showed that end-users overcome their doubts and diffidence for electro-mobility after trial driving of electric vehicles for a few days. That is why in Greece, we give the possibility to local or national authorities of driving electric vehicles for some period in the frame of GeM, having such the opportunity to make them aware of all the details and the reality of e-mobility implementation.



12 Rome and CTL

Infrastructure

Infrastructure Billing System

In order to help users to approach to e-vehicle the billing system must be easy and interoperable. For example a chip in the car should communicate the name or identifier of the owner of the car allowing charging the cost of the recharging directly on its account thus avoiding paying procedures.

Infrastructure Deployment

One of the first requirements is that recharging infrastructures should be standard all over Europe but probably one of the main issues related to recharging infrastructure is the cost of a mass deployment of such infrastructures. To overcome this barrier the recharging infrastructure should be built on a long time planning base. Consider also that, at least at the first stage, the recharging infrastructures will not be so many for this reason on one hand they must be as much as possible interoperable (in one recharging station should be possible to find fast charging, normal charging and different type of plugs). On the other hand developing of specific apps and road signs showing where the nearest charging point is could help.

Vehicle

EV design

Users thinking about e-vehicles probably think about something innovative. For this reason an e-vehicle must be different and must have a different design concept compared to ICE vehicles in order to make e-vehicle identifiable. Since the e-engine takes less space than ICE engine e-vehicles should be smaller and at the same time with more space inside to make the travel experience more comfortable.

EV Batteries

Batteries are probably one of the weak points of e-vehicles and also many users think that e-vehicles have a short autonomy. Beside the need of long lasting and reliable batteries it is important also to communicate that, on this topic, many step forward has been done. Batteries have now a longer duration and are also more reliable.

EV Maintenance and Repairs

Users now approaching e-vehicles are facing the problem related to the missing of repairing workshops network.

Vehicle manufacturers, in order to fill this gap, should provide together with the vehicles at least for the first 2/5 years a full assistance.

Policies, financial incentives, marketing and communications

Regional or national financial incentives

The cost of e-vehicles, together with the short autonomy, is probably the main barrier to e-vehicle diffusion. This gap can be partially recovered at least with some incentives at national and local level. A possible list of incentives can be:

- In many European countries tax on ICE vehicles are very high. The reduction or elimination of these taxes on e-vehicles is a relevant incentive in itself;
- At local level, only for the first years, e-vehicles should not pay for entering Limited Traffic Zones of Urban areas or should be allowed to enter in LTZs even if ICE vehicles are not allowed. This is a feature that can push rich people to pay for an expensive e-vehicle for entering in areas where, otherwise they can not enter (something exclusive).
- Not paying for parking places is one other possibility always at local level.
- Loans with no interests to buy e-vehicles are one other possibility.
- Moreover should also be studied if there are niches where e-vehicles can easily enter. For example car sharing in urban areas can be a niche where e-vehicles can enter immediately creating a market for such kind of vehicles.

Local incentives and legislation

In the Rome Metropolitan area, the use of private vehicles (60%) is still prevalent, while public transport has grown in the last decade and now stands at 21% (compared to 16% in 2004), with peaks of 26-27% during rush hours. Heavy use of private vehicles is reflected in the size of the fleet: Rome has a total fleet of 2,800,000 vehicles (including 700,000 motorcycles and mopeds), with a 2011 rate of motorization of 978 vehicles per thousand inhabitants. Alternative transport systems and soft mobility is showing up to now modest progress.

Starting from 2013, the new Administration has built the new General Traffic Master Plan (the Rome SUMP), where the territory is divided into six areas. For each area, the Plan is proposing specific objectives and prevalent actions to recover balance among all modes and healthy quality of life with the necessary contribution to the improvement of the air quality.

Bike sharing, car sharing and electric mobility modes were left marginal in the last years, due to a lackness of development policies, differently from what is occurring in other European Capitals. In the new perspective, these systems should be an integral part of a new mobility policy, offering more extensively alternatives for mobility of city users. From Old Town these systems will be diffused in external areas, mainly in PT hubs and nodes and in zones subject to traffic restraint measures, or with high population density and tourism sites. On the other hand, the motorization rate should decrease to lower level.

Pro-active EV procurement for municipal services is seen to be of central importance for the successful roll-out of EVs in Rome. Examples are the introduction of 10 e-cars (Citroen C0) in the public car-sharing fleet, managed by RSM and Rome Municipality, from 15/12/12 open to general public, registered to the service. More, Rome has the biggest e-bus fleet of Europe; at the moment 50 e-buses are operating in the inner center. 14 Citroen C0 were incorporated in 2013 in the MP fleet in routinely operation, in order to provide data to plan future update of the fleets of the municipal companies.

More over Rome City Council already approved in January 2014 the Public Tender to identify private subjects for new Free-flow Car Sharing service in the city Rome, defining the minimum standards that expects specific incentives for services made with e-vehicles like the free license and a reduced operating perimeter (35 skm instead 70 skm). An e-vehicle operator was found compliant with the tender and was



selected by the Municipality. Its initial service will put up to 50 small e-vehicles (Renault Twizy) should be available for public service since beginning of 2015.

Once a municipality has adopted a pro-active EV procurement policy, the next-most important action is to favourably integrate EV incentives within the municipal policy. At municipal level, Rome revised local ordinances (laws) adopting measures that favour on-street paid parking free for EVs (all cases) and access to traffic limited zones.

More, Rome city center is a Limited Traffic Zone (LTZ), where only authorized users can access with their private vehicles, paying a high cost for permission. To support the diffusion of e-vehicles, since March 2011, the access to the LTZ is free through registration,

From November 2015, the core of the city center (Tridente area) is pedestrian 10 am – 8 pm and only e-cars can access it.

E-vehicles are allowed for free movement in environmental emergency days and in the 4 car-free Sundays (when thermal car circulation is stopped). Free parking in the blue-charged places is also now operational: these are demo measures to promote the diffusion of e-mobility, to be evaluated at the end of the project in order to understand future steps.

Differently from the starting planning, where Rome was thinking to electro-mobility as marginal and limited to short-range demonstration, the new city program for e-mobility expects a large scale diffusion of this modality, supported by City policies to promote e-mobility, to favor the implementation of harmonized recharging network, the introduction of e-cars in the public car-sharing and testing of e-cars in public fleet, like the Urban Police one.

The New Traffic Master Plan includes issues for the short term scenario (up to 2017), strategic for the development of electric mobility like testing of new signs for charging stations and effective control against the illegal occupation, criteria redefinition for selection of sites for public charging, incentives for the construction of facilities for corporate fleets, promotion measures and incentive for managers of private parking sites near interchanges or in the historical centre, that are willing to offer up services and care for e-vehicle at an agreed price.

New opportunities to promote EV uptake are continually being examined, and the electric public bike pilot for Urban Police to be trialled next year is going towards this direction.

In this positive policy framework, it's important to highlight that e-Mobility diffusion is anyway not yet achieved in Italy. The e-vehicle market in Italy is subject to the historical moment that Italians are experiencing is not the ideal for a new car, especially if electric, and data presented for April 2014 confirm this aspect. Market for hybrid vehicles is keeping positions (1,414 cars in Italy for the first quarter) with an increase on 2013, while the market for electric vehicles in April is just 47 total electric cars sold in Italy, against 132 in March and about 800 for entire 2013.

The market penetration of e-vehicle is remaining low also in the city of Rome notwithstanding the proactive legislation due to limited autonomy of e-vehicles, the recharging time, uncertainties on the maintenance (batteries) and their higher purchase cost. The e-vehicle is still perceived only for city application, limiting in this way the interest in the general public. The extended dimensions of the city and the general policy of the city to limit the motorization rate are not encouraging people to buy these cars, that are perceived as not the first car for the family.

First experiences in public fleets are also evidencing higher operational costs, like in e-Bus, and higher difficulties reported by people using them in car-sharing schemes. For freight operators, the limited charging possibilities and autonomy are reducing their potential. Taxi drivers are now considering and



extending use of hybrid cars where e-vehicle are limited to few unites for large operators, just “to demonstrate” their environmental sense. Same approach is coming from freight operators, where use of bimodal or hybrid vehicles is beginning, unless some electric experiences from operators in special frameworks.

As a consequence, key features we think are necessary for a successful rollout of EVs in large city like Rome are a more extended autonomy, the strong reduction of recharging times, comparable purchase costs with the same typology of hybrid cars and a clear evidence of maintenance costs, including batteries, both for private use and public fleets.

Policy factor and incentives are part of this demo and testing stage: once the technology will be proven and successful, these incentives will be progressively reduced in order to anyway respect the need to reduce the motorization rate in the city. At the moment and as said before, the City of Rome with its new traffic masterplan is supporting the full exploitation of the e-mobility plan, with positive possibilities for such modality.

Regional or national incentives and legislation

National financial incentives started again on May 6, 2014, based on Law 134/12 for the contributions for the purchase of low emission vehicles, with the aim of promoting sustainable mobility. The measure has an environmental and experimental objective and is not a measure of support for the vehicle market. The grants aim to encourage the purchase of alternative fuel vehicles (electric, hybrid, natural gas, bio-methane, LPG, biofuels, hydrogen) and carbon dioxide (CO₂) emissions, discharge, not exceeding, respectively, 120, 95 and 50 g / km.

The measure does not favor particular technologies, but consider the actual emission limits in accordance with the recommendations of the "technological neutrality" expressed by the European Commission (21 CARS, CARS 2020) and the OECD.

Based on the monitoring of the measurement made in 2013, half of the available resources for 2014 is intended for company vehicles and those for public use (taxis, car-sharing, rental, shipping services, etc.). The incentive is subject to the scrapping of an old vehicle with the exception of funds (50%) used for vehicles with emissions no higher than 95 g / km of CO₂ (mainly electric and hybrid) which is not mandatory destruction and which are open to all categories of buyers, including private citizens.

To date, for the category of emission ≤ 50 g / km had a total fund of M€ 31.0 and presently are still available € 6,354,895.31. For vehicles with CO₂ emissions not exceeding 50 g / km the contribution for all eligible vehicles can reach 20% of the total cost of the vehicle as a result of the purchase contract (and before taxes), with a maximum of € 5,000 and, for vehicles purchased in 2015, the contribution for all eligible vehicles can reach 15% of the cost of the total cost of the vehicle with a maximum of € 3,500.

Rome is inside the Lazio Region, where reductions and exemptions in annual tax for electric vehicles, or hybrid petrol / electric or dual petrol / hydrogen are established. Motor vehicles, motorcycles and mopeds in two, three or four wheels, powered by an electric motor, are exempt from paying taxes for five years from the date of first registration. At the end of this period, electrical vehicles will have to pay a fee equal to a quarter of the amount for the corresponding gasoline vehicles, while for motorcycles and mopeds vehicle tax must be paid in full.

From 2014 onwards, the Lazio Region has a temporary exemption - three years (36 calendar months) from the date of registration for newly registered motor vehicles with hybrid gasoline / electric power, or dual petrol / hydrogen.



For what regard insurance of electric vehicles, until some years ago, electric scooters and motorcycles enjoyed large discounts and benefits on insurance policies. Now, some insurance companies sensitive to environmental issues still have policies relating to scooters and motorcycles electrically powered, eligible for a discount that can be up to 50%.

Marketing and communications

According to our opinion e-vehicles are perceived by potential users still with some limitations in particular they have high acquiring costs and they have a limited autonomy.

Beside the fact that probably, in the long run these two problems will be solved it is also important to stress those strong aspects of e-vehicles that can affect management costs of such vehicles.

First of all the recharging cost of e-vehicles is lower than ICE ones this aspect should be better stressed. E-vehicles probably need less maintenance of ICE ones and also this aspects should be better stressed.

Urban freight electric vehicles

E-Vehicles are being used for urban freight deliveries in several EU Countries, specifically in the Express Courier and parcels sector, due to the range they can provide for last-mile distribution and to the load capacity.

Urban freight requires specific solutions to specific urban context and related problems. For this reason it is needed to approach the issues considering the different interested supply chains (e.g. fresh food, ho.re.ca., high-value brands, grocery) and the different distribution channels (e.g. large retail distribution, independent carriers), which involve different type of carriers with low operative margins not able in most of the cases to invest in electric vehicles. For this reason, it is fundamental to understand the specific requirements of the so-called fleet owners or managers, who in principle are devoted to invest in electric vehicles (e.g. capacity, logistics needs, range, cost).

It is also to be considered the role of municipalities which regulate the access to the urban centers and may incentives the use of electric vehicles in urban freight. Public policy makers should be aware of the features of the urban freight industry, since inappropriate policy measures at a local level will have an impact on the efficiency and cost of urban freight transport, which will at some point have a detrimental impact on the local economy and/or environment. Public intervention may be useful to create awareness and stimulate solutions.

In Rome, due to the progressive closing of the central zones to private traffic, “last mile freight projects” are emerging, with the creation of a freight terminal to serve the central historical part of the city, dedicating e-vehicles for deliveries inside the zone. The development of a sustainable business model is involving the testing of a last-mile delivery service with electric vehicles, whose first phase was already carried out in 2013 using two Renault Kangoo.

In general, Rome is seeking the feasibility to introduce electric vehicles for freight distribution especially for the whole city center, with the possibility to have a “van-sharing” scheme in correspondence of the new last mile terminals.

Rome is also analyzing the effects of the new regulations of freight delivery recently issued. The new rules (since 1st November 2011, updated in 2014) are characterized by a strong reward system aimed to encourage more environmentally friendly vehicles (LPG, CNG, electric, hybrid) and to discourage obsolete vehicles. This is made by a huge discount on the LTZ permit’s price and by allowing low



emission vehicles to enter the freight LTZ also out of the time windows that diesel/petrol vehicles have to respect. There is also a progressive ban of older vehicles. Rome is also favoring the exchange of experience with cities that strive to discourage the circulation of pollutant vehicles in sensitive areas of the city such as the historical center.



13 Other contributions

13.1 Lessons learned by Better Place

Infrastructure

The European Commission should provide regulation for a simplified and accelerated permitting and processing for deployment of charge spots and battery switch stations. So, they should mitigate regulatory hurdles for the deployment of electric vehicle infrastructure and create incentives for the roll out of electric vehicle-charging facilities, including those to facilitate long distance driving.

Such regulation should provide guidelines to municipalities, regions and Member States to avoid different rules and enable harmonised and quick deployment of infrastructure across the EU.

The EU can adopt legislation by setting mandatory targets for electric vehicle charging infrastructure in each Member State. Such requirements can include:

- Overall minimum coverage of (public) charging infrastructure;
- Specific quotas of coverage for long distance driving (e.g every 50km);
- Limited time procedures and costs for permits and grid connections for charge spots and battery switch stations.
- Utilities and DSOs should support the connection of charging equipment by reducing connection fees of charging infrastructure compared to buildings and houses. Such logic should be applied, if charge spots can be monitored remotely and smart grid functioning applied.
- In open access it should be allowed to use the infrastructure of other service providers if a roaming agreement exists or by the use of pre-paid cards. No other special rules should be applied on the service provider at this stage of market penetration. Once electric vehicles gain higher market volumes more regulation can be considered.

Other recommendations about infrastructure would be:

- Create incentives for charging solutions of electric vehicles that allow shifting electricity load in time (as opposed to unmanaged charging) to minimize additional required investments to the electricity infrastructure and maximize the uptake of renewable electricity in the EU; smart charging and smart grids.
- Focus on electrification of road transport including for long distance driving (i.e. alternative re-fuelling stations such as fast charging stations and battery switch stations) and use the limited available sustainable biofuels only in transport modes where no feasible alternatives for oil are available.

On the other hand, it is essential that municipalities work closely with the local distribution system operators (DSOs) to pre-identify urban locations for deployment of electric vehicle infrastructure.

Strategies for deployment of charging infrastructure have to be integrated with the long-term municipal construction planning, as well as the settlement of the planning of charging infrastructure across all municipal departments who are affected or somehow involved in the processes to ensure effective procedures.



The utilities have an important role in the development of intelligent smart grid solutions, which should be rewarded by government incentives during the initial phases. In order to develop a sustainable smart charging infrastructure – new investments should be given to develop a charging infrastructure that can support intelligent charging.

The key lesson learned based on the Better Place experiences in Denmark is that battery switching works as an infrastructure for long distance electric driving.

About battery switch stations, some recommendations would be:

- Battery storage:
 - Charged batteries ready to be switched. Charged batteries will be moved to a free position in the rack.
 - Uncharged batteries ready to be charged. Uncharged batteries will be put in queue waiting to be charged, if no free charger is available.
 - Tool boxes for different types of batteries; in order to handle more than one battery form factor, it's needed to hold more than one tool box for switching battery.
 - Defect batteries ready to be picked up for repair. If by any mishap a battery is deemed defect, we need to store the battery, until we can pick it up for repair.

- Charging: Intelligence ensures minimum power consumption based on demand and supply.

Policies, financial incentives, marketing and communications

Regional or national financial incentives

Clear incentives should be given to consumers purchasing electric vehicles to assist the upscale of e-mobility during the transition phase. Once electric vehicles reach a certain number incentives should be lowered.

Local, regional or national incentives and legislation

There must be coordination between different stakeholders who are influenced by the deployment planning. Showing the good example by adopting electric vehicles in the municipal fleet of vehicles is essential.

There should be support for quick processing of permits for deployment of charging infrastructure as well as in terms of investments in public charging infrastructure.

About incentives, some recommendations would be:

- Free parking should be given to electric vehicles during a transition phase to greener transportation. Such legal ground should be established to ensure that all municipalities can differentiate parking charge based on the environmental impact the vehicle causes.
- Special parking places should be reserved for electric vehicles in public parking sites to allow for installment of charging infrastructure. Such measures will need the necessary legislation to be in place, which is not the case today.



These incentives should be given to companies and employees who choose electric vehicles as their company cars. It could be considered if incentives should also be given to people employed in the public sector who would use their electric vehicle during working hours instead of an ICEV.

There is a need for a clear strategy on the uptake of electric vehicles in each Member State. This would require collaboration between relevant ministries, politicians, research institutions and the energy sector as well as stakeholders within the electric vehicle ecosystem to decide on a collaborative approach.

Member State should clarify how they accelerate the uptake of electric vehicles by putting the infrastructure in place:

- Make new buildings electric vehicle-ready, implying to include cabling for charge spots for in electric vehicles.
- Allow batch applications for permits to install charging infrastructure.
- Give the right to install a charge spot in a shared or public parking (similar to the French regulation) as well as in private households.
- Review and simplify metering requirements.
- Public procurement of electric vehicles.
- Support schemes for infrastructure such as loan guarantees and direct subsidies.



13.2 Lessons learned from the Iris experience (ESB)

Background

The eCar Ireland Project was initiated in 2009 with the support of the Irish Government, the ESB (largest electric utility company) and the Renault-Nissan Alliance. The Irish Government agreed to provide some financial purchase incentives, ESB agreed to provide a basic national charging infrastructure and Renault-Nissan agreed to supply electric vehicles. Despite being launched while the financial recession was at its deepest and the country was entering a bailout from the European Commission, the European Central Bank and the IMF, there was an air of optimism about its success. However the reality of new car registrations plunging 70% took its toll as did the loss of consumer confidence in the purchase of all consumer goods. Now that economic recovery (and new vehicle registrations) has started it is opportune to reflect on the lessons learnt about what is needed if a major customer behaviour shift such as the widespread deployment of a new technology such as electromobility is to take place.

Overview

Based on the experience in Ireland there are four components to a successful growth of electric vehicles among the general population:

- Supply of EVs in adequate numbers and models.
- Financial and non-financial incentives.
- Charging infrastructure.
- Public Education & Awareness.

There are also some other issues that have come to light over the course of the project and these should be borne in mind also.

Supply of EVs in adequate numbers and models

The market for conventional cars is very ingrained. The automotive industry has been very efficient in understanding and satisfying customer needs. Most automotive brands offer multiple models to meet all possible customer needs. In a relatively large market such as the UK where there are 2 million new cars a year sold there are about 400 different models available. In a small market such as Ireland where prior to the recession there were something under 200,000 new cars sold (and now only about 100,000 per year) there are approximately 250 different models on offer. In most markets it is rare that the leading model holds more than 5% share.

Because of the capital intensive nature of automotive production and because once produced cars have a relatively long life being sold on often many times, new technology while perhaps relatively easy to introduce takes a long time to become established in national and continental vehicle stock. For instance Fuel injection has been in existence for almost 100 years but only became more widely used when emissions regulations forced the abandonment of the carburettor. Even then it took nearly twenty years to be established in the existing vehicle stock. The key learning is that it is steady if slow progress that is the best that can be expected.

Financial & Non-Financial Incentives

The initial price of an EV is high relative to its internal combustion engine vehicle equivalent. This is mainly due to the high cost of the battery but the smaller volumes mean that the electric vehicle cannot



benefit from economies of scale at this stage of its development. To counteract this, different supports have been considered.

- **Financial Once-off**

- **VAT Reduction:** There is no VAT reduction in any EU country although in Norway the normal VAT on motor vehicles is reduced to zero.
- **Purchase Price Subsidy:** To kick start the market it is generally accepted in most countries that a purchase price subsidy of the order of €5,000 is needed. This is of course expensive for many governments and cannot and should not be continued indefinitely. There it is recommended that it be applied for a certain number of cars and/or a certain period of time (say three years) after which it should be reviewed. The building of a market is assisted by the stability of having the incentive in place for a number of years.
- **Reduction in Vehicle Registration Excise Tax (where applicable):** Vehicle Registration Tax (VRT) varies considerably across the EU. It is usually based on one or more of the following parameters:
 - Open Market Retail Price of a Vehicle,
 - CO2 or other emissions,
 - Engine displacement or power and vehicle weight.

In some countries EVs are exempt from VRT and initially this was the case in Ireland. However while wishing to support EVs, the Government decided that, particularly in the time of austerity, this shouldn't be irrespective of the value of the car. Hence they modified the VRT regulations to grant a maximum VRT relief of €5000 on the purchase of an EV and €2,500 on a PHEV. This means that EVs such as the Nissan Leaf, Renault Zoe and BMW i3 do not attract any VRT charge but more expensive vehicles such as the Tesla Model S or the BMW i8 are not exempt. They do however qualify for the €5,000 and €2,500 reduction respectively.

- **Financial Ongoing**

- **Reduction in Annual Road Circulation (or Road Use) Tax:** Annual Circulation Tax on motor vehicles in most European countries is some hundreds of euro a year. Electric Vehicles are exempt for this tax in some countries such as Norway, the Netherlands, Austria and Germany (for 10 years). In other countries there is a reduction e.g. Sweden (50%). In Ireland this tax is based on vehicle emissions and zero emission vehicles attract the lowest (but not zero) tax rate. This incentive is useful but not usually decisive in the decision to purchase an EV.
- **Reduction in Company Car Tax on Executives (Benefit-in-Kind):** The percentage of cars bought by companies is significant and in many countries e.g. in the UK it exceeds those bought by private customers. In most countries where a person has the use of a car bought by his company the tax authorities calculate an amount of "equivalent salary" for this and add this to the persons' income for income tax calculation purposes. It is often called Benefit-in-Kind (BIK). The higher the initial price of the car the higher the tax as it is usually levied as a percentage of the market price. From the individual's perspective they pay the additional tax but otherwise get free use of a new car every 3 or 4 years (depending on the company policy). They also have no running cost as the company pays for fuel, insurance and maintenance. The electric vehicle has a higher initial cost and so would normally attract a higher BIK tax charge. The lower fuel and operating costs accrue to the company and not to the individual. Therefore electric vehicles are not attractive to executives as company cars unless there is a modification of the BIK tax system. This effectively means that 50% or more

of the potential car market is excluded. This is therefore a highly significant tax in the context of developing the electromobility market.

In some cases (some companies in the Netherlands for instance) where a PHEV is provided by a company to an executive they want the executive to maximise “electric driving” rather than using fossil fuels. They do so by the company paying for all electricity used but the executive has to pay for any petrol or diesel used.

- **Accelerated Depreciation on company bought vehicles:** Accelerated depreciation is another incentive for companies to buy electric vehicles –either cars for executives or commercial vehicles (providing of course the company is making sufficient profits to offset against the depreciation. Where company tax is low as in Ireland the benefit is less than it would be in countries where company tax is higher.
- **Other Incentives**
 - **Exclusive or Priority access to Parking Spaces:** Once a recharging infrastructure has been established one of the biggest frustrations for the EV driver is to arrive at a charge point that he knows from his electronic app is “free” only to find it blocked by an internal combustion engine car. That in many countries this happens legally is a double frustration. This has been tackled both in Ireland and in Northern Ireland (which is part of the UK). In Ireland primary legislation already allowed the Transport Minister designate regulations concerning parking. Using this power, regulations were adopted under which it is now illegal for any vehicle to park in an “EV designated Charging Space” unless it is an EV that is charging. A “Designated Spot” is defined, under a separate regulation, as one which is so marked in specified lettering of a certain dimensions. In Northern Ireland it was necessary to introduce primary legislation into the Northern Ireland Executive and to identify each parking spot in this legislation. Again “designated spots” had to be marked in lettering between certain minimum and maximum sizes. This was done there.
 - **Free Parking Spaces:** Once the availability of parking is secure the next incentive is the cost of it. This is usually a matter for local municipalities rather than national governments. There has been a mixed attitude to this in Ireland. In principle most municipalities are in favour but given the current financial situation some say they cannot afford the loss of parking income.
 - **Free Motorway Tolls:** Motorway tolls are usually not a significant incentive for EVs given the usual driving pattern. However often in the vicinity of major cities there are tolled roads or bridges. In Norway where commuters face tolls on a daily basis this incentive is seen as significant. In Ireland there hasn’t been any concession on tolls for EVs but at least one toll company has agreed to review its policy at least for a period.
 - **Access to restricted zones (congestion or low emission) in cities:** There are no low emission or congestion zones in Irish cities although Dublin City Council is reviewing its policy on an ongoing basis. Access to the London congestion zone is believed to be a worthwhile incentive for EVs in the UK.
 - **Access to exclusive traffic lanes (Bus or high occupancy lanes):** Access to bus lanes for EVs is an emotive topic and is often opposed on two grounds. The first is that at least some bus lanes are already highly used by buses, taxis and emergency vehicles. Allowing further access for certain class of vehicles e.g. EVs, would militate against the original objective – improving the speed and service of public service vehicles. The second is that the authorities already have a difficult task in policing the use of bus lanes and allowing EVs access would make policing them more difficult. Because of the difficulty in identifying EVs from conventional vehicles would create an atmosphere of non-compliance which would

encourage conventional car drivers to ignore the regulations and use the bus lanes on the basis that “others were doing it without sanction”. The solution to the first is to examine each bus lane and if one is genuinely “full” then it would not be appropriate to permit EVs access. However access need not be refused for all on the basis of one or two being “full”. It could be that complete access could be allowed to most bus lanes and restricted (or even no) access to a smaller number of bus lanes. The access could be subject to annual review and/or for a temporary period again subject to review. With regard to the second concern a method of identifying the EV is required. This could be through the use of a special sticker, registration plate or electronic tag where such is in use in the jurisdiction. Unless an electronic/ camera surveillance system is in place it may also be necessary to consider how to communicate to other drivers that the vehicle is an EV to avoid to impression that the law is being flouted.

- **German parking & access Incentive legislation:** In Germany the Federal Government passed a law on Sept 24th 2014 allowing local authorities restrict parking at charging points to electric vehicles and also allowing them give free parking for EVs or for PHEVs whose CO2 emissions are 50g/km or whose autonomy is 30km on pure electric driving (40km from 2018). The law will also allow municipalities grant passes to EV drivers to give them access to restricted areas such as low emission, congestion or low noise zones as well as allowing access to bus lanes. The law will expire in 2030.
- **UK parking & access Incentive legislation:** In August 2014 the UK Government announced a £500 million fund to incentivise EVs. Under this £35M is allocated for local authorities to compensate them if they permit EVs use bus lanes and have access to free parking.
- **Norway parking and access incentives:** In Norway EVs have had free parking and access to bus lanes for a number of years.

Charging Infrastructure

- **How to plan infrastructure or what basis to install charge points**

The “chicken-and-egg” dilemma of charging infrastructure and cars is often debated. In Ireland the original plan was to develop a national infrastructure with high density charging in the cities. Due to the recession the sale of cars was less than anticipated forcing a re-evaluation of the infrastructure plan. However those that had bought EVs had varied travel patterns and lived in different parts of the country. It was realised that the hundreds of then existing EV drivers needed an extensive rather than a dense infrastructure. Consequently it was decided to continue with the “national footprint” so that charge points are installed all over the country. The densities in the urban areas have been reduced to meet the needs of the drivers there. This has led to the revised policy of installing AC charge points on a widely dispersed scale across the country and installing fast chargers on all motorways and main routes at intervals of 60km. This policy has ensured that even a small number of EV drivers are not restricted in their driving due to infrastructure shortage. As the number of EVs has started to increase the low density has led to queues forming and complaints of non-availability of charging in some locations. However by monitoring this (and hopefully getting better at forecasting) it has been possible to tackle this “problem of success”. Similarly the density of charge points in urban areas can be expanded on the basis of actual need rather than speculation. A similar conclusion has also been reached in Italy.
- **The use of single or double headed charge points**

Double headed charge points have the advantage that they significantly reduce the cost per point of installation. Another advantage is that they provide some insurance against out of service of a

single point. However they also cater for queues and growth. In the event that the local authority has concerns about losing two parking spaces for other vehicles it is possible to initially restrict one of the spaces only for the exclusive use of EVs and keep the situation under review. It has been the Irish experience that double headed charge points is a good policy decision.

- **The lack of a business case for infrastructure in the immature state of the market**
Without an adequate number of EVs as customers it is very difficult to construct a business case for investment in public charging. The best case is made by speculation now in the hope that the first mover advantage gained will yield long term success. In Ireland the Government decided that the investment should be made by the electric utility (which it owns). That is one way of overcoming the investment dilemma but in many countries it has been decided that a market investment solution should be found. If so then then some process of making it attractive to investors needs to be found.
- **The practical problems of planning permissions/ permits.**
Irrespective of the investment issues most organisations installing public charging points have found that there are practical issues that can be at least frustrating and often quite difficult to overcome. The most significant of these is planning permissions permits. While the need for caution is understood the risk of uncontrolled expansion of charge points everywhere is slim given the lack of business case. But subjecting a public charge point to the same planning regulations as a new building is excessive.
- **UK regulations on parking permits**
In the UK regulations were changed so that in general charging points are exempt from planning regulation providing they are under 1.6m in height (for ground mounted units) or are under 0.2m³ in volume for wall mounted units. Charge points on highways, near listed buildings or if photovoltaic canopies are required are not exempt. For on-street locations a charging points space may require a “change of land use” and in this case a Traffic Order Regulation is required.
- **Ireland regulations on Parking Permits**
In Ireland the electric utility is exempt from planning permissions for electric distribution equipment under 11m³ in volume. The Government decided to clarify the situation with respect to charging points and issued a regulation to the effect that charge points under 0.5m³ on the public roadway and under 3m³ elsewhere are exempt from planning permission permits. This has enabled the deployment of charge points to proceed without undue bureaucratic delay. In practice the utility erecting chargepoints always consults with the local authority to ensure that the latter does not perceive any abuse of the power granted by the government regulation.
- **Home Chargers**
The need for and the provision of home /office chargers is an interesting issue. This definition covers long period charging and in most cases was 3.7kW (16A 230V single phase) although in past year there has been a tendency for some EV drivers to consider 7.4kW (32A 230V single phase) chargers as the more recent electric cars now all have at least 6.6kW on-board chargers. The other option is for EV drivers to use a mode 2 cable and charge at a standard domestic socket. This is often promoted by the car dealers as the “cheaper” option for the customer and “just as good”. However many car dealers don’t realise that the EV will not draw 16A from a standard domestic (Schuko) socket on the European mainland or even 13A from the British flat pin plug (B.S. 1363) in the EU countries where that is the standard (UK, Ireland, Malta and Cyprus). Standard domestic plugs are not designed to carry their “rated current” continuously for six or eight hours without overheating. Therefore the car manufacturers de-rate the drawing current where a mode 3 connection is not detected. In all cases (both Schuko and BS 1363 type installations) the car battery management system limits the drawing current to 10A. This equates to a power of 2.3 kW, some 40% lower than what’s possible from a typical 16A mode 3 charger.

- **Ireland Home Charger Incentive**

In Ireland it was decided that the first 2000 purchasers of an EV would be given a free home charger. This was done for three reasons:

- As an aid to help the development of the market.
- To promote safe charging standards (there was a risk that customers might try to use extension leads with domestic sockets even if advised not to do so).
- To establish a direct relationship with the purchasers so that they could be approached directly about participation in surveys etc. without any data protection complications.

- **Provision of Chargers in New Developments**

Like public charging the installation cost is as much as the hardware cost. For electromobility to develop properly every driver should have, wherever possible, a proper mode 3 charger available for overnight charging. This would be greatly facilitated if all new dwellings were fitted with such a device. A second best solution would be that all new dwellings would have the wiring for such a charger installed at construction. The prospective EV driver then would at least only have to provide the charge point itself. Where a fully functional charge point is fitted and installed it is referred to as an “Active Charge Point”. Where the wiring only is installed but left ready for fitting a charge point it is referred to as a “Passive Charge Point”. The London guidelines require 16A 230V single phase to be available but recommend that due to the small additional cost the wiring itself should be capable of carrying 32 A 230V for future proofing.

- **London Regulations re Chargers in New Developments**

In Oct 2009 the Mayor of London issued a plan for the provision of both active and passive charging points in new developments in the city. Following public consultation this was later amended slightly and incorporated in the “Supplementary Planning Guidelines, Land for Industry and Transport issued in Sept 2012. In Annex 6 the revised requirements are set out as follows:

Parking Spaces Intended for	Residents	Employees	Visitors/ Shoppers/ Clients
Active (per cent of Total Spaces)	20%	20%	10%
Passive (per cent of Total Spaces)	20%	10%	10%
Total (active + Passive as per cent of Total Parking Spaces)	40%	30%	20%

- **Ireland Regulations re Chargers in New Developments**

There is no such requirement in Ireland although it has been discussed.

Public Education and Awareness

- **Why Electromobility is good for society**

Electric vehicles are considerably more energy efficient than their petrol or diesel equivalents. They have zero tailpipe emissions and as a result help to improve the local air quality. The OECD estimates that outdoor pollution kills more than 3.5 million people a year globally. It has estimated the cost of air pollution deaths to its 34 member countries is \$1.7 trillion and that about half of these air pollution deaths are due to road transport.

Electric vehicles do not create any carbon dioxide emissions at point of use although there can of course be emissions created at the point of generation of the electricity. This will vary from country to country depending on the generation mix. EU regulations have dictated that the



average emissions from new cars in 2015 should be 130 g/km and by 2021 it should be no greater than 95 g/km. The regulations relate to tailpipe emissions and so EVs are counted as zero emission. However to understand better the societal benefits of EVs it is notable that a typical EV such as a Nissan Leaf using the average electricity mix (2009 is the latest year for comprehensive data) would have a total emission (including electricity generation) of 56 g/km. According to Eurelectric by 2020, 34% of European electricity will be generated from renewable sources and by 2050 European electricity will be carbon neutral.

The other societal issue that can be improved with EVs is noise. Noise from transport is by far the most widespread source of noise exposure, causing the most annoyance, sleep disturbance and public health concerns. Road traffic noise is the most significant contributor to environmental noise, with the CE Delft report (Traffic Noise Reduction in Europe, August 2007) estimating that approximately 210 million EU citizens are regularly exposed to 55 decibels (dB) or more.

In Ireland ESB (the utility responsible for EV infrastructure) developed a programme of briefing for media. Motoring correspondents are mainly interested in the key aspects of the car – performance, design and cost. On the other hand energy and environmental correspondents are more interested in the “bigger picture” issues. The automotive suppliers have relationships with the motoring correspondents while the utility has ongoing relationships with the energy and environmental correspondents. Therefore in the overall plan the automotive companies dealt with motoring correspondents supported as required by the utility. On the other hand the utility led the dealing with the energy and environmental correspondents, and arranged test drives for them with cars supplied by the automotive suppliers. The programme also included utility personnel providing media interviews on the societal aspects of EVs.

It has to be realised that the number of people who will buy an EV “for societal benefits” is small and so difficult to justify the effort on short term vehicle sales. However we believe it is a key part of the long term conditioning to make the new technology acceptable to people generally.

- **Benefits of Electromobility to the electricity sector**

- The electricity sector is a special case of the “social good” that is assuming that improvements in efficiencies are passed on to customers and not kept as super profits by the industry. From studies done in a number of countries it is clear that there is adequate capacity in the European Electrical system to power all of the internal combustion cars in Europe by electricity. Figures from Eurelectric and studies by ESB in Ireland suggest that if 100% of cars were electric then it would add about 20% to the total amount of electricity required in a country. If all of this charging happened outside of peak times, then in theory at least, it could be provided without any more transmission or generation assets. This would mean a 20% increase in usage of the existing assets and this increased load factor should tend to reduce the average price of electricity, not just for EV drivers but for every electricity user. On the other hand if a significant portion of this charging took place at peak time, the opposite would be the case. The electricity system load factor would decrease tending to increase the average price of electricity. Therefore “smart charging” by which the electric vehicle charging takes place in a way that does not impact on the electricity system peak is in everyone’s long term interest – the EV driver and the general electricity customer.
- In Ireland in 2010 16% of annual electricity was generated from variable non-synchronous sources (wind). By 2015 this is expected to rise to 26% and to 37% by 2020. To facilitate this it has been necessary to permit up to 50% of the instantaneous electricity come from variable asynchronous sources. By 2020 it will be necessary to allow this limit increase to 75%. Wind generation has had to be curtailed since 2010 because unlike other countries with significant interconnection it is not possible to spill the excess, even at negative prices. Increasing the



night load by EV charging would improve the operation of the Irish electric system and also reduce the curtailment of wind generated electricity production.

- There is a need to communicate to the public and to regulatory authorities about the benefits to the “electricity system” of electromobility. This has happened in Ireland. How these benefits should be shared by different parties is a debate that needs to take place on an informed basis.
- **Additional Benefits to System Operation:** The control of EV load by the transmission system operator (TSO) or distribution system operator (DSO) gives great flexibility in system operation. On a micro level the DSO can shed or increase non-essential EV load in order to control loading parameters on costly assets such as cables or transformers. On a macro level the TSO can use EV load as a mechanism to minimise the impact of large system frequency events and to reduce the requirement for costly and polluting fast acting diesel or gas generators at peak times.
- **Benefits of Electromobility to the individual**
 - The most obvious benefit to the driver of an EV is the reduction in fuel costs. In Ireland and in most countries the “fuelling cost” of the EV is about 10% to 20% of the cost of an internal combustion engine. In addition maintenance and servicing costs are much reduced.
 - In Ireland and elsewhere many insurance companies offer up to 20% discount on insurance premiums for drivers of EVs. This is following an assessment of the risk profile.
 - There are the indirect benefits of any incentives such as “free parking” etc that may be on offer in the country.
 - Many EV drivers report a reduced stress experience due to the lower noise levels and the driving ease.
 - All of these benefits need to be communicated to the public and to prospective purchasers.
 - EV drivers themselves are an important audience as they can greatly influence others to purchase an EV. Therefore they should be targeted with information that will support the decision they have made to become an EV driver and give them the sort of information they can use to persuade others.
 - In Ireland an electronic newsletter for EV drivers and other interested parties was launched and has been very successful in keeping drivers up to date with developments. The drivers themselves have their own separate website and information is indirectly provided to this also.
 - In Ireland it was recognised that a public awareness campaign was needed and this was done through the mechanism of a “Great Electric Drive” in which members of the public were invited to become an “EV Ambassador”. If successful they would be given the use of an EV for 3 months and they in turn had to participate in blogs, local promotions and special EV awareness visits to schools. The first time this was run (in 2012) it attracted 12,000 applicants for 8 EVs (mainly Mitsubishi iMiEVs). The second phase was run in 2014 with a wider range (Renault Zoe, Nissan Leaf, BMW i3 and Mitsubishi Outlander) and 12 EVs. It attracted 20,000 applicants and the event itself made national news on both TV and press media.



- In Jan 2014 the UK Government (through the Office for Low Emission Vehicles) and in conjunction with the Society of Motor Manufacturers and Traders) launched a campaign to debunk common myths and misconceptions that put drives off switching to EVs or PHEVs, such as cost and range. The campaign was supported by the Automotive OEMs BMW, Nissan, Renault, Toyota and Vauxhall. The 12-month campaign called “Go Ultra Low” was launched by the Deputy Prime Minister and featured print, media and online advertisements as well as a celebrity ambassadors’ programme, online community campaigns and fleet partnerships. There was also a dedicated website provided to give customers a one-stop opportunity to get all the information.
- The main lesson to be learnt is that the communication task is great and that a coordinated approach is best. Different players will have a different focus but to get the best results there should be an overall framework within which all operate.
- Interoperability: As charging infrastructure projects have developed the issue of travelling in an EV to a neighbouring jurisdiction has been highlighted as a potential barrier to EV adoption. Before the GeM project even started this was particularly evident in London and Amsterdam where multiple charge point access cards and permissions were required to charge in different boroughs in the city. EMobility operators and the EV industry have addressed this issue significantly through the adoptions of open systems (Open Charge Point Protocol – OCPP). This open system is currently in use in the Republic of Ireland and Northern Ireland (part of the UK) which allows EV users to use a single charge point access card for both jurisdictions. Similar systems are working or in development in others regions in Europe. The issue is of course being addressed as a central part of the GeM project through the establishment of a European market place and clearing house for EV roaming.
- **What are charging points, where are they and how do they work**
 - Once public charging points start to be deployed the public should be informed. There tends to be a lot public and media interest and a lot can be done by PR events and briefings. In this way the cost can be minimised.
 - It was the experience in Ireland that even when the national media had had enough stories on EV charge points, local media were still interested in the introduction of charge points to their areas.
 - Similarly it was possible to generate media interest in the introduction and operation of Fast Chargers as a separate story.
 - Even when the media interest wanes the EV drivers need to be kept informed on plans and developments with the EV charging infrastructure.
 - It should not be assumed that the EV dealers are sufficiently knowledgeable on the plans for and operation of public charging to properly brief the new purchasers. In particular they lack confidence in their knowledge of electricity generally and electrical safety to answer the questions the public have. The car companies seek to develop their dealers’ product knowledge but while some become well versed in the operation and features of their EV, they usually haven’t the background or experience to deal with the broader questions. Therefore there is a need to both educate the dealers but also provide information for the public. To be successful the dealers’ education should be planned on an ongoing/ refresher basis and not viewed as a once-off event.



Other issues

- **Cross Ministry Issue**

Electromobility is a complex issue and responsibility cuts across conventional government ministry functions. For instance Government ministries that have responsibility for Transport, Energy and Environment all have a role. Where a country has an automotive industry or even hopes to develop its engineering sector with respect to EV charging or even its IT capability then the Ministry with responsibility for Industry and Employment needs to be involved in the country wishes to establish any sort of a first-mover advantage in any of these areas. Considering the need for incentives and the importance of the transport sector in government taxation the Ministry for Finance will need to be involved. Countries that establish a good cross ministry policy and working relationship tend to be more successful at developing electromobility.
- **Regulatory Issues**

In Ireland the infrastructure (at least for the initial phase) has been provided by the utility. In other countries this isn't the case. The regulation regime for the electricity industry was established before EV charging was envisaged. If it is desired for the utility to be the main provided there may be a need to clarify the existing regulations, Where this is not the case problems have arisen with the law concerning the right to sell electricity.

Summary

- The key learning from the Irish Project is that electromobility requires a multi-faceted approach. Progress will be slow unless all of the elements required are implemented equally. While individual actors all have different roles to play, a coordinated approach will increase the likelihood of success. The Automotive industry needs to supply a variety of electric vehicles as one or even a small number of models will not be sufficient.
- While financial incentives, both one-off and ongoing are desirable, non-financial incentives such as access to parking and to restricted areas/ lanes are possibly more important.
- With respect to infrastructure it is believed that a widespread footprint rather than density is the key initial requirement. The immature market caused by the low EV numbers means that there is no immediate commercial business case for the provision of infrastructure. Some process needs to be considered to deal with this. The planning permitting process presents practical problems for the provision of public infrastructure and needs to be addressed. The provision of home chargers is often seen as an optional extra but it in the experience of Ireland this should be given more priority.
- A comprehensive public education and awareness is essential. This should educate the relevant authorities and the public about the societal benefits of electromobility. That should provide the backdrop against which awareness campaigns on the benefits to the individual are developed. There is also a need for practical information for EV drivers on charging point location and use.
- The cross functional nature of the issue means that a cross Government ministry approach is best suited to dealing with electromobility.



14 Conclusions

14.1 Infrastructure

14.1.1 Infrastructure EVSE

The objective is to make the entire infrastructure **easy** to be used.

The need of a **standardized system** is a key aspect agreed by all partners and important efforts are being accomplished related to common standards.

On the one hand, it is essential that EVSE installations are totally **integrated in the grid**, and manageable and controllable from a remote distance for reducing peaks and congestions. A smart recharging infrastructure is needed in order to accomplish peak modulation requests coming from the DSO. In particular, a fast and secure communication layer has to be established between the points of delivery and some sort of EVSE back-end, which will be communicating either via the marketplace or directly with the DSO IT system.

On the other hand, it is also important that the public charging service strategy is an open system for the European users controlled by a recharging manager, for compatible operators that accomplish the minimum security requirements.

Some partners point out that most manufacturers prefer that the solution is a Chademo DC Fast Charging but some other relevant manufacturers support the so-called Combo connector, which combines AC and DC in one socket. I.e.: Charging points using jointly several protocols and standards, enabling the possibility of **using both CHAdeMO and COMBO** systems in the same facility, would probably boost the deployment of e-mobility.

Moreover, standardization simplifies manufacturing systems, **reducing the high costs of charging points**. A significant reduction in costs would persuade hesitant candidates about its installation and its massive acceptance.

14.1.2 Infrastructure Billing System

The infrastructure must be a **simple, easy, convenient and intelligent** billing system that allows all EV drivers to charge at any public charging point. The identifier in use should be **standardized** and based on RFID technologies charging card. The objective is the interoperability and to recharge the vehicle regardless the region with the pertinent previous authorization that each EV user has from his operator, forwarding the contract ID and receiving the best charging profile.

Therefore, partners agree that a roaming billing system is considered to be crucial for a wide deployment of EVs and it must be possible to issue a contract with any energy supplier and to access any public charging point at any time without any geographical limitations. **Roaming and clearing** are both crucial for the final acceptance of users. This is only possible by creating a fluent communication between different EV service providers and EVSE operators based on transparent pricing, so that users will have access to the complete network of charging points.

Moreover, the billing system must be easy to use **and secure** to operate. The customer must be able to pay for electricity at any charging point which can transmit the information between different operators. It



is very important to ensure the security required in the payment system by means of a **safe and reliable data exchange**.

14.1.3 Infrastructure Deployment

Almost the whole set of partners consider the creation of a **deployment model for charging points** as decisive. A deployment model is required in order to install charging points at any appropriate and accessible place.

It is important to take into account that information from databases of EV card users will improve the EV charging points locations. Databases from utilities and projects like Green eMotion and Zem2All could be an example. These projects will have databases which indicate how charging points have been used by citizens.

In a second phase, according to the results obtained from the database of the EV card, the deployment model would be redefined. In that way, you could know which charging points are the most used, according to their locations (shopping centers, highways, gas stations, major streets, suburbs) or which kind of charging point (standard or fast) are being used.

Firstly, some partners think that an appropriate strategy would be **promoting standard charging points** at homes, workplaces etc. where EVs are parked for a long time.

Secondly, fast charging stations are needed to supply a quick solution to EV users. So, some partners agree that **fast charging points** must be installed along highways, gas stations, public parkings and/or main street crossings in order to offer the fast charging service demanded by the user. The identification of these charging points **location** is fundamental, which is achieved by creating an accurate **signalling** that allows a visible, affordable, and convenient charging infrastructure. Municipalities have to develop an easy, convenient and visible identification system, allowing every user to identify the CP's location.

Moreover, it is necessary to have charging stations available to all EV users including for long distance travels, so that users can find them along major highways which connect the largest cities.

The owners of a traditional vehicle are accustomed to refuel their vehicles in a few minutes. To recharge the electric vehicle with a standard duration between 6 to 8 hours is a serious obstacle. It is crucial for potential EV users to know that an EV use based on standard (slow) charge during night at home or during working hours (by using standard charging points in parking) solves this boundary with no losses of time. In addition, the possibility of having fast charging points as support for occasional charging ensures the availability of EVs, as it is possible to charge batteries in only about 15-20 minutes.

A priority for companies and municipalities is to encourage an **intermodal transport** system between electric vehicles and other kinds of transport. It is necessary to promote CPs in parking facilities and close to trams and/or bus stations and train networks.

In particular, municipalities must cooperate in order to make **common guidelines** for establishing charging points. This approach will make it easier for the service providers and thus support the roll out of the infrastructure on a larger scale. Also, these CPs must be available to all EV users through **websites and apps** for smart phones.

It is essential municipalities work closely with the local distribution system operators (DSOs) to pre-identify urban locations for deployment of electric vehicle infrastructure.



Strategies for deployment of charging infrastructure have to be integrated with the long-term municipal construction planning, as well as the settlement of the planning of charging infrastructure across all municipal departments who are affected or somehow involved in the processes to ensure effective procedures.

The utilities have an important role in the development of intelligent smart grid solutions, which should be rewarded by government incentives during the initial phases. In order to develop a sustainable smart charging infrastructure – new investments should be made to develop a charging infrastructure that can support intelligent charging.

Utilities advise that connection of EV to the grid might cause a decrease of the supply quality, especially due to a high penetration of EVs, so it is necessary to control the grid so it will not become overloaded. The charging will be mostly during the night, so that the economic efficiency of the electric system would improve and it would be possible the security of the supply and the introduction of **renewable energies** (wind turbines or solar photovoltaic).

Specific studies have been carried out in GeM regarding grid impact (see deliverables 4.3 and 8.2) and the benefits of managing the charging process (see deliverables 5.5 and 8.2):

- a) Fast charging points (CPs) have higher power ratings and it is recommended to connect them close to the point of connection of the installation in circuits separated from slow CPs.
- b) Fast chargers and slow on-board chargers usually have harmonic filters which are designed for operating points around the charger's rated power. As a consequence, they typically lose their effectiveness when the charger is working far from its design power. Upgrades in charger designs are needed in order to improve the harmonics emission for wider operating levels to prevent Smart Charge strategies from having a negative impact on power quality.
- c) Fast charges may generally be considered non-dispatchable loads, since EVs have to be fully charged as fast as possible once the EV is connected to the CP. Thus, the power consumed in fast charges limits the peak shaving capabilities and any other potential energy management strategy of the installation. The introduction of vehicle-to-grid (V2G) functionality could help reduce the peak power consumption of the whole installation. This would especially be feasible for commercial EV fleets such as the Endesa's eParking, where the typical depth of discharges of the EVs after its daily usage are low and driver behaviour patterns are known.
- d) For the installations with single-phase, slow CPs it is important to equally distribute the connections of such CPs among the three phases of the installation in order to minimize the contribution to voltage unbalances. Furthermore, one possible functionality of smart charge algorithms would be to balance the power flowing through the three phases.

14.2 Vehicle

14.2.1 EV Design

Most partners agree that the **current price** of the EV is the main barrier that discourages the potential user, because currently the cost of a new EV is - in some European countries - roughly the double compared to a conventional car with a combustion engine. As a result, only small electric vehicles or e-



scooters are starting to emerge in big cities for short driving distances in highly trafficked areas or in suburban roads with limited car traffic. Renting a battery is a way of reducing the initial acquisition cost of an EV.

Currently, the supply of EVs is limited. However, a commercially **extended variety of EV design** needs to be assured in order for the upcoming EV users to be able to find the most appropriate EV type which serves their needs. A more diverse supply of EV types will meet the users' different needs making EVs more attractive to buy. At the same time, an EV should be as comfortable and spacious as a traditional vehicle.

14.2.2 EV Batteries

The autonomy of the battery is currently the weakest point of the battery design. This is due to the electric vehicle has lower autonomy than the ICE car, therefore, the so-called "range anxiety" concept, related to the user's perception, appears. **Increasing the capacity** of the battery is one way to break this barrier. Nowadays there are some companies investigating the increase of battery's energy density, which allows the increase of autonomy, without increasing the weight. The Lithium-air batteries constitute an example⁷.

The price of the battery is still high, which makes the entire vehicle be expensive, and be perceived as unattractive. Generally, there is a large potential for PHEV which can have a rather small and hence inexpensive battery for everyday driving but still offer long-range driving.

In addition, the design of several car functions like heating, air conditioning, lights and radio must be taken into account because all of them can cause a decreasing **reliability and performance** of batteries.

14.2.3 EV Maintenance and Repairs

It is essential for a successful EV deployment that its reliability competes with the combustion engine vehicles. **Less maintenance** and lower cost are the trend. Due to the absence of mechanical components, the maintenance of EVs is significantly less compared to the respective ones for conventional vehicles.

However, users still have concerns about the maintenance: the implementation of the electric vehicle requires qualified professionals and a **maintenance workshops network**.

14.3 Policies, financial incentives, marketing and communications

14.3.1 Regional or national financial incentives

Currently, it is more expensive to purchase an EV than an ICE car. For this reason some cities are employing financial consumer incentives to boost the demand for vehicles and charging infrastructure. These include grants or tax credits on EVs, discounted tolls and parking fees, and access to restricted areas. Financial incentives for consumers at national and local levels are lowering upfront costs for EVs. Incentives like these are necessary to accelerate the adoption of EVs but they need to be phased out gradually.

It is recommended that governments make a plan for establishing a national infrastructure for EVs and that they allocate funding for this. Without national co-financing it is likely that the siting of charging points on public land country-wide will be patchy.



14.3.2 Local incentives and legislation

Municipalities play a very important role in order to get the mass deployment of EVs in the urban areas.

Firstly, getting a permit to establish and run charging points causes a lot of problems in some municipalities. Local authorities should **facilitate the licenses and permissions** needed for the installation of charging points in public areas.

Secondly, in most big cities, it is difficult to find a vacant parking space, so an incentive is to **reserve parking spaces for EVs**. Also, municipalities should **reduce rates for electric vehicles** parking in payment areas such as underground parking or surface parking areas with rates.

Thirdly, there are incentives for the EV user to get access to **high occupancy lanes (HOV)**⁷ and get **access to restricted areas** of the city (cancelling or lowering access charges if they exist). It would be a positive discrimination with local measures like these ones. Following some of the inputs of the partners, privileges like private parking space and bus lane access should not be granted if they are going to be removed shortly after.

Fourthly, municipalities could **reduce road taxes** for electric vehicles. Some municipalities impose high road taxes or congestion fees on drivers in order to improve the city environment and health of the citizens, and it could be considered to exempt EVs from the fee as EVs do not only have zero tail-pipe emissions while on the move – significantly improving local air quality – they can also be made close to CO₂-free depending on the primary energy source used.

Fifthly, municipal fleets should be gradually replaced by EVs such as electric trucks, hybrid diesel buses, reuse collection and street cleaning vehicles. Local regulations should be modified to assure that a percentage of **public fleets are EVs**.

And finally, it is highly recommended that **municipalities work out a common strategy** for the promotion of EVs and the roll-out of EV infrastructure. Sometimes, there are incentives that only can be enjoyed by citizens of a determined city because their electric vehicles show a special badge that identifies them locally, but other nearby users cannot make use of these incentives because they live in border towns and they are not registered in the first one.

However, most of the cities agree that local incentives and legislation are not enough to accelerate the EV adoption. The main factors are an evolutionary improvement of cost and performance of the EV as well as a strong national political commitment and vision. More budget and regulations pro EVs are needed.

14.3.3 Regional or national incentives and legislation

⁷ A high-occupancy vehicle lane is a restricted traffic lane reserved at peak travel times or longer for exclusive use of vehicles with a driver and one or more passengers, including carpools, vanpools and transit buses. The normal minimum occupancy level is 2 or 3 occupants. Many jurisdictions exempt other vehicles, including motorcycles, charter buses, emergency and law enforcement vehicles, low emission and other green vehicles, and/or single-occupancy vehicles paying a toll. HOV lanes are normally created to increase higher average vehicle occupancy and person throughput with the goal of reducing traffic congestion and air pollution although their effectiveness is questionable (http://en.wikipedia.org/wiki/High-occupancy_vehicle_lane).



Cooperation between national and local authorities is essential and they must agree on **legislation for EV charging points** at homes, workplaces, hospitals, shopping centers, hotels, highways and transportation centers. The installation of charging points in residential buildings is essential to legislate. Even though parking is a local issue, the national law must be adapted to reserve parking space at charging points.

For this reason, the authorities should update the law to enable these kinds of installations and facilitate the adoption of e-mobility. It is necessary to **reduce the administrative bureaucracy** involved in this kind of infrastructures and to shorten the planning and approval processes. Some aspects such as the location, the minimum number of parking spaces and charging points in residential buildings for a new number of parking places, must also be considered.

Regional collaboration should also facilitate measures like **toll reductions in highways**, to facilitate the introduction of EVs.

Moreover, measures such as giving allowance for EVs in **high occupancy lanes** could be considered by local, regional and national authorities. If these high occupancy lanes can be used by EV users, this measure would promote the use of electric vehicles.

14.3.4 Marketing and communications

A common appreciation is that in many countries, citizens as well as public and private institutions have a lack of knowledge about EVs, and the electro-mobility has many issues that need to be further clarified. Information related to characteristics and limitations of reliability, autonomy and possible uses of the vehicle should be provided to the citizens. This is crucial to eliminate the existing barriers, such as high price, limited range and the concern related to the source of electricity.

Within the **EV positive factors dissemination**, special attention is drawn to the municipalities and cities as these are essential for the rollout of EV regarding the associated policy making, regulatory needs and incentives.

The Public Administration should inform the potential users about the following aspects:

- Advantages of the EVs in terms of environmental performance. EVs have improved environmental performance, manifested in reduced CO₂ emissions and reduced local emissions, compared to the ICE car.
- Available technologies.
- Total cost of ownership. Currently the purchase price of an EV is significantly higher than an ICE car but if you add maintenance costs etc. the total cost of ownership might be at least comparable or lower. Currently incentives and policies of the public administration related to the EV.
- Public and private charging infrastructure.
- Doubts and responses about the related problems such as the recharge in a homeowners association, what to do when you are left with no battery on the street, the repairs, the assurance, etc.
- How to drive efficiently, optimize its use and when and how to recharge the vehicle.

Dissemination campaigns, public events and promotional activities should be frequently organized. As an example, different actions such as EV days, EV rallies and races, demonstrations of infrastructures



and international congresses have taken place under the Green eMotion project. You can find a list of events and conferences where Green eMotion will be presented in 2014 at the Green eMotion website⁸.

Physical and virtual initiatives have been launched to promote electro-mobility in cities. Information points and websites should integrate all these strategies and offer different communication local plans to show public promotions and create a brand image.

Test drive campaigns such as pilot demos and trial driving allow people to test an EV for a period of time so drivers can tell others about their experiences. Moreover, a possible way to reduce costs for the user could be for private operators to organize EV rentals in cooperation with cities. Other kind of test drives could be the implementation of **carsharing** initiatives and the creation of electric driving schools to familiarize people with this kind of vehicles⁹.

14.4 Urban Freight Electric Vehicles

Implementation of electric freight vehicles (EFVs) is not a new phenomenon. Over the last two decades several trials and demonstrations have been undertaken but the actual implementation of EFVs in city logistics operations is still limited. Because of their environmental performance and reduced noise level they are often permitted in larger geographical areas and time windows in cases where any of those restrictions exist. E.g. in Barcelona EFVs are used for night deliveries to supermarkets. Some advantages of the implementation of EFVs in city logistics operations could be:

- The enhancement of public acceptance of electro-mobility with positive experience of urban delivery.
- Better coordinated transport and value added services for the consignees in the city center.
- Less congestion and reduction of the negative environmental side effects of transport in the city center.

Before implementing EFVs in city logistics operations, it is very important **to understand the specific needs of different supply chains**. The good distribution is different in every case: there are different needs as weight, delivery times, refrigerated vehicles, etc. It is important establishing measures to foster collaboration and coordination among distributors, general administration and all stakeholders implicated.

It is also to be considered the **role of municipalities** which is to be involved in the planning process and get companies and partners together. Municipalities regulate the access to the urban centers and may stimulate the use of EFVs in city logistics operations. Measures both supporting the usage of EFVs and discouraging the usage of ICEs are required. E.g. EFVs could be permitted access to Limited Traffic Zones.

Within the cities, a specific **infrastructure deployment** must be done for the freight vehicles in order to allow their normal behavior. This specific infrastructure would contemplate some actions.

Also, the **planning and organization of the urban freight distribution network** is essential and the following aspects must be addressed:

- Characteristics of the city.
- Urban planning, road network and access roads.
- Traffic congestion, low-speed stretches of route (speed limits)
- Distribution needs to access to end customers and the objectives to be achieved.

⁸ <http://www.greenemotion-project.eu/dissemination/events.php>

⁹ <http://www.electricdrivingschools.co.uk/>



Several aspects related to infrastructure must be taken into account, such as the creation of **green logistic centers** with charging points. In these logistics centers, companies could merge different vehicles and exchange goods between them. It could be also possible to reload onto electric freight bicycles or smaller EVs for transporting the goods the last mile.

It would be necessary to have **loading and unloading areas** equipped with recharging points in urban areas where freight electric vehicles can be charged.

An **application of new ICT technologies** for the management and control of urban freight distribution by logistics operators and supply companies would also be needed.

Currently the purchase price and total cost of ownership (TCO) for EFVs are significantly higher than for conventional vehicles. As operators are usually more focused on short term benefits, the wider uptake of EFVs is difficult. For this reason supporting measures are in place, such as fewer restrictions for EVs than for ICEs, lower taxes and purchasing subsidies.