GEODE position paper on Electric Vehicles

GEODE Working Group Smart Grids

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Groupement Européen des entreprises et Organismes de Distribution d' Energie
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Purpose of the paper

The following paper will illustrate the potential of electric vehicles (EV[1]) to contribute to combat climate change and the hurdles which have to be overcome to make EV available and attractive to the mass market, then continuing to discuss the impact of e-mobility on the electricity market. Special attention will be paid to demonstrate the impact of EV on the electricity distribution grids and what the distribution system operators (DSO) need to be able to assume the role as the connector between the electrified mobility and the electricity industry. In addition to that we point out that the customers´ needs has to be met to successfully introduce EV.

Electric mobility and the energy targets of the EC

The European energy and climate policy aims at achieving the following energy targets[2]:

- A 20% cut in CO_2 emissions by 2020
- A 20% increase in the use of renewable energy by 2020
- A 20% improvement to end energy efficiency by 2020
- A reduction in dependence on oil and gas third-party states (increasing security of supply)

The transport sector is responsible for around 20% of the entire CO_2 output of the EU. Indeed, CO_2 emissions arising from the transport sector are steadily rising. Electric mobility presents an opportunity to buck this trend. If you could charge an electric vehicle (EV) with the average EU electricity mix, this would result in CO_2 emissions of around 80[3] gCO_2/km. However, if the electricity used to charge an electric vehicle came from renewable energy sources (RES) or at least carbon poor or neutral energy sources, the level of CO_2 emissions per km could be reduced to practically zero, with an additional decrease in CO2-emissions. When compared to the CO_2 output of passenger cars in the EU (around 160[4] gCO_2/km), electric mobility represents an opportunity to make enormous savings. An increased use of electric vehicles also reduces air pollution and noise in urban areas, both causing substantial health problems for human and wild life.
By the same token, electric mobility can have a significant impact on the dependence of the EU transport sector on crude oil products (currently around 97%). Moreover, it is possible to improve final energy efficiency significantly by using an electric engine instead of internal combustion engine, in other words to improve energy efficiency by increasing electricity consumption.

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[1] The following text uses the term e-mobility / electric vehicles to refer to standard passenger cars which make full or partial use of electrical energy stored in a battery to power themselves and which are charged via the electricity grid (e.g. plug-in hybrid EV, pure EV, etc.).
[2] For current activities and plans regarding EVs of the EU see appendix 1
[3] Source: [Eurelectric]
[4] Source: [Eurelectric]

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Availability (status quo) and the characteristics of electric vehicles

The concept of electric mobility is currently everywhere you go – however, on closer inspection, there are hardly any electric vehicles available for the mass market. Products that are currently on the market are 2-wheelers such as scooters, electric motorbikes, Segways, limited production EVs or conventional cars which have been converted. The first EVs from large producers are not due to be introduced to the European mass market until 2011, 2012 or even later.
There is an enormous drive to make the core element of electric mobility, the battery, fit for the mass market (the lithium-ion technology seems to be very promissing). Despite all the efforts being made, we assume that mass market, purely battery-driven EVs will differ significantly from conventional cars with regards to

- the distance which can be travelled on a single "tank" (in most cases not more than 150 km)[5],
- the frequency of charging stops (the optimum situation would be to have a plug socket available during every stop, e.g. at home)
- the length of time needed to "fill" the car (can taket up to five hours or more for 100km of driving range).

The mobility needs of customers have to be satisfied

In order to be able to sell the concept of electric mobility on a large scale, the mobility needs of the customers (journey to and from work, etc) need to be satisfied. Analyses of individual traffic habits demonstrate that the majority of daily trips are within the driving range of pure EVs and that the vehicle is parked for as much as 23 hours a day. A significant proportion of individual mobility needs could potentially be covered by electric vehicles.
In any case, it will not be possible to completely replace conventional cars. Given the characteristics of EVs (limited driving range, prolonged filling stops) a completely new mobility behaviour and mindset is required from the customers. New mobility models have to be developed which ensure the full range of mobility needs are met, while also providing high levels of convenience at affordable prices. To this end, encouraging electric individual traffic to dovetail with public transport will become increasingly important. Park & Ride (P&R) facilities on the outskirts of cities could be examples of suitable crossover points between electric individual traffic and public transport. In addition to this, the concept of car pooling will grow in importance.

A filling respectively charging station infrastructure has to be built in a cost effective manner

Types of charging stations:

[5] The range given does not represent a universal constant. The figures are based on data from manufacturers and only provide an illustration of expected ranges. The problem of limited range is somewhat mitigated by plug-in hybrid EVs and EVs with range extender.

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Electricity charging stations can be ordered according to charging speed, i.e. according to the required charging performance. Table 1 below compares the charge performances to the charging speeds for a driving distance of 100km.

Type	Load [kW]	Duration of charging process for a distance of 100km
Slow/normal charge	1.5	approx. 10 hours
Slow/normal charge	3	approx. 5 hours
Fast charge	10	approx. 1 ½ hours
Fast charge	20	approx. ¾ hour
Ultra-fast charge	175	approx. 5 minutes

Table 1

In view of the length of time cars can remain stationary (up to 23 hours) and that it should be technically straightforward to set up slow/normal and fast charging "pumps" (e.g. suitable plug sockets in garages) they should assume centre stage.
It should be possible to reduce charging time by using ultra-fast charging stations. As far as ultra-fast charging stations are concerned, the considerable expense with regards to integration into the grid (more on this later), which increases in line with the load of the charging process, together with safety aspects and the capability of the battery technology, all have to be taken into account.
In addition to this, efforts are being made to develop a battery exchange system (flat batteries out, charged batteries in) that should also make it possible to speed up the charging process. To make this possible, it is necessary to standardise the batteries of the different car manufacturers and have a suitable number of charged batteries in stock.
We assume that slow and fast charging will dominate in the short-to-medium term. In the long term ultra-fast charging stations will become increasingly important, to complement slow and fast charging stations. The future role of battery exchange systems is strongly dependent on the success of standardisation of the battery systems used in EV by different car manufacturers.

Where do you charge?

In view of the limited driving range of EVs, it will be necessary to set up a correspondingly close-knit network of electric charging stations.
There is a extraordinarily diverse demand for charging possibilities in areas such: home in the garage of single, detached or semi-detached houses, in/on parking lots, in park & ride facilities, on company premises for company-owned vehicles, employees' and customers', in supermarket car parks, streetside parking in cities, etc.

Who sets up the charging infrastructure?

A whole range of companies, organisations and institutes are interested in setting up charging stations: Utilities which recognise a potential business opportunity, shopping centres, hotels, companies which equip their fleet with electric vehicles and would like to offer their employees and customers electric charging stations, car park and park & ride facility operators, the automobile industry in order to be able to sell EVs, cities and local communities in order to cut CO_2 emissions and traffic noise, etc..

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In principle a large pool of potential investors who would be prepared to fund the installation of electric charging stations exist. The markets need for cheap and timely deployment of charging infrastructure should be met by a large variety of operators on the market. A large number of actors are likely to find optimised business solutions and develop new business and keeping costs low for the end user.
From GEODES point of view it is possible and cost effective to set up a network of electric charging stations based on free market principles. The market will build-up the charging infrastructure in accordance with the growing needs of customers in a cost-effective manner.
On the other hand, the lack of standards for charging stations and the scarcity of supply of EVs contain the ingredients of a potential stranded investment.

Standardisation is essential

In order to reduce the risk of a stranded investment in charging stations, it is absolutely key to have standards in place for plugs, plug sockets, etc. On the other hand the customer perspective is key in standardisation to make it possible for an EV owner to charge his or her EV in a simple and secure manner. The goal is to enable EVs to be charged at any public electric charging station, irrespective of who built the charging station or which car manufacturer produced the EV. Such standardisation activities must be pursued at least at the European level.

An adequate legal framework is vital

In order to be able to introduce electric mobility, it is of key importance to have a set of appropriate and harmonised regulations and legislative decrees in place at European, national and local levels in order to make EVs available to the mass market (actually there are almost no EVs available for the mass market), to set incentives for customers to buy EVs, etc.

The impact of charging EVs on the electricity consumption respectively generation is marginal

EVs need electricity to run on and not petrol or diesel. If we were to assume that approximately 10% of conventionally powered passsenger cars in the EU will be replaced by purely electric vehicles, the annual electricity consumption would increase by approximately 1.5%[6]. The additional electricity required is approximately on a par with the annual increase in energy consumption within the EU and does not represent a major challenge for the electricity industry to meet.

[6] Source: [Eurostat 1,2]; Assumptions: 18kWh / 100km; 10,000km distance travelled annually

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Impact of charging EVs on the electricity distribution grid

When assessing the impact of EV on the electricity grid, the expected **load (kW)** is a key parameter. The following example (Table 2) is intended to illustrate this in terms of the number of additional transformers needed.
We assume that a park & ride facility on the edge of a city with 1,000 parking spaces, for example, is equipped with 100 charging stations. Assuming that EV drivers will all arrive at the P&R facility at around the same time (because they want to go to work), the charging processes will start almost simultaneously.

Type	Charging time for 100km of driving range	Peak load for charging 100 EV simultaneously	Number of additional needed transformers[7]
Slow / normal charging	approx. 5 hours	300 kW	approx. 1
Fast charging	approx. 1 ½ hours	1,000 kW	approx. 2
Fast charging	approx. ¾ hours	2,000 kW	approx. 4

Table 2

This simplified example demonstrates that a high degree of simultaneity and speed/load of the charging processes would bring the existing grid to the limit of feasible performance (up to 4 additional transformers are required). Moreover, this could happen even with a low penetration of EV in the event of a geographic accumulation of charging points (e.g. P&R). The impact on the existing distribution grid depends strongly on local conditions and has to be judged individually for each line.

Adding a large number of EV new loads to the grid is not a unique situation for the DSOs, they have the skills to deal with. From the technical point of view, every kind of charging technology, from slow/normal charging to ultra-fast charging, can be connected to and integrated into the electricity grid. The question is what is needed to reconcile the customers' mobility needs to economic costs.

From the customer's point of view, a 5-minute refuelling stop is what they are used to, making a refuelling time of anywhere between 45 minutes and five hours or more seems completely unacceptable. Is it always necessary to charge the battery as fast as possible if the car is parked, for example, during the day at a P&R or during the night in a garage? Taking into account that passenger cars are parked nearly 23 hours a day and the majority of journeys made during a day cover a distance of less than 100km, an extended charging time is, in many cases, not an issue. In any event, more experience and investigations are needed to understand the customers´ need and charging patterns.

Another factor that has to be considered in the question of integrating EVs into the electricity grid is the impact of charging processes on the power quality of the grid voltage. Especially the power electronics used to convert the alternating grid voltage into a suitable direct voltage for EV batteries, together with asymmetrical phase

[7] The reference is a transformer with 630kVA. By way of illustration: a transformer of this size is able to supply around 150 customers.

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loading, "contaminate" the grid voltage. Further studies to quantify these effects are necessary.

Solutions to facilitate the integration of EV into the electricity distribution grids

No specific action needs to be taken concerning the issue of grid integration in the short term (low penetration of EV).

In the medium-to-long term, however, it will become necessary to extend electricity distribution grids in a well directed and timely fashion. As far as the integration of charging stations into the grid is concerned, the principle "slow is cheap" governs charging speeds and the associated loads. In order to uphold this principle, there is the option of developing intelligent solutions respectively charging strategies which help to minimize the impact on the grid while, at the same time, fulfilling customer needs ("full" tank when starting the EV).
Smart/controlled charging respectively intelligent load management: Depending on the capacity utilisation in the supply line to, for example, the P&R car park, the total available charge performance or possible charging speed is determined. This can be done by setting a standard value or by being divided up in accordance with the individual needs of the EVs waiting to be charged. A pre-condition is to upgrade the electricity distribution grids with intelligence.
Moreover, there is the added possibility to influence the charging process by means of tariff-based incentives:

- The charging speed determines the cost of charging.
- Using so-called "time of use" tariffs could also create incentives which encourage owners of EVs to charge at times of low network capacity utilisation (e.g. day vs. night)

A key element is that DSOs are part of the process to construct charging stations, the development of business and market models and intelligent solutions in good time for the optimal set up of electricity grids. Furthermore, it is vital that the costs incurred by DSOs are fully recognised by regulatory bodies so that these costs can be recouped via grid tariffs.

EVs, a part of the Smart Grids

Historically, electricity grids were built for large dispersed power plants generally located in load centres. The energy was fed in at high voltage levels and distributed via the transmission and distribution grid to the consumers. The energy flow happened unidirectionally. The control and communication systems generally terminated in the substations.
The tasks for the electricity market are changing in line with the development of the energy policy of the EC. Besides the growing number of wind parks we are facing a rising number of decentralised power plants, using RES to convert to electricity, which have to be integrated at low and medium voltage level. The volatility of RES such as

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wind or solar power has to be addressed. Storage technologies and controllable loads (demand side management) are growing in importance. In this context, smart meters[8], with their communication infrastructure, represent a key component of the smart grids as a gateway to the customer. Within the smart grids, EVs can act as a new and flexible player that, on the one hand, can operate as a controllable load or storage facility (smart/controlled charging) and, on the other, can serve as a decentralised feeder (vehicle-to-grid[9]). The distribution networks and the interlinking with regards to information- and communication technology form the basis of interaction between the different market players.
The distribution grids have to be upgraded to be capable of handling the interaction of the different players and to ensure an adequate quality of supply under these changing conditions. A high level of involvement of the DSOs in the developing process the electricity networks of the future – so called smart grids - is a key factor for success.

For more details, we would like to draw your attention to the SmartGrids paper by GEODE, which is going to be published later in 2010.

An innovation and investment friendly legal and regulatory framework is needed

In order to align fully the electricity and transport sector, all the relevant parties must demonstrate a firm commitment to R&D. Visionary business models have to be developed and their compatibility with the rules of the unbundled and liberalised electricity market has to be checked, while hurdles to overcome have to be identified. New technologies have to be developed, implemented and tested within demonstration projects. Model regions are an important tool for testing the practicability of innovative solutions and business models and to learn about the customers´ need and charging pattern. The exchange of information at a national and international level about the lessons learned from the various R&D activities and demonstration projects is essential.
The DSOs in Europe are strictly regulated by national regulatory authorities. Tariffs and permitted revenues are commonly set by incentive-based regulations. Their main objective is to increase the efficiency of the DSOs and to lower tariffs for customers. To sum up, the DSOs in Europe are under considerable pressure to keep their costs low – there is virtually no room for R&D expenditure and next to no incentive to invest in innovative technoligies or beeing part of demonstration projects.
In order for DSOs to have the possibility of demonstrating a stronger commitment to R&D and to be part of the creation process of the electricity networks of the future – the smart grids – an additional innovation factor has to be iintroduced into regulatory frameworks. In this context, it is of considerable importance for national legislators and, by extension, the regulatory authorities, to implement the requirements set out by internal energy market regulations (section 37, paragraph 8[10]).

[8] For more details we would like to draw your attention to the SmartMetering paper by GEODE, from November 2009
[9] The feasibility of V2G solutions depends heavily on the capability of the battery (limitation on load cycles). Depending on the development of the battery, V2G may become reality in the long term.
[10] *In fixing or approving the tariffs or methodologies and the balancing services, the regulatory authorities shall ensure that transmission and distribution system operators are granted appropriate incentive, over both*

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Using new solutions and innovative technologies to equip the electricity grids with more intelligence (information- and communication technology, sensors, etc.) to handle the described new challenges, is linked to investments in which there are considerable hidden risks. To this end on the one hand an investment friendly climate has to be established through an adoption of the implemented regulation models and on the other hand the rising potential risk of the investments (early adoptions) has to be taken into consideration. Anyway it is vital that the costs incurred by DSOs are fully recognised by regulatory bodies so that these costs may be recouped via grid tariffs.

The role of the DSOs by bringing EVs on the roads

EVs are supplied with the required electrical power via the electricity grid. As a result, in a liberalised and unbundled electricity market grid operators are tasked with connecting the necessary electric charging stations to the electricity grid and to meter and gather the data of the used electricity.
From our point of view it has to be a technical requirement to integrate DSOs in the installation process of charging stations, also beyond the meter e.g. in parking garages, in good time in order to be able to set up grid networks optimally and cost effective. Due to the necessity of the tight involvement of the DSOs it would also be beneficial to allow DSOs to provide and offer their know-how for new services and products to customers on the free market along with other actors. In addition to that DSOs should have the possibility to set up and run charging stations.
What is the optimal solution for each country - and perhaps within countries - may vary substantially. It is up to DSOs together with other market players to accommodate a variety of solutions depending on local needs.

Electric mobility – a new and mobile customer on the electricity market ?

End customers in the liberalised electricity market are entitled to choose their provider and to be able to switch providers within three weeks. Examples of end customers include detached houses or car parks. A detached house is assigned a single distribution network operator who is responsible for the connection to the grid and recording electricity consumption.
In contrast to this, if we theoretically consider the EV as an end customer, the EV is different to a detached house in that it is a mobile customer. For instance, an EV can commute between the distribution networks of several grid operators during a journey between one charging station and another, effectively switching grid operators several times a day – something previously unheard of in the electricity market. Even more questions are raised when the issues of traveling abroad, assigning a provider and individual billing for charging are addressed. The limits of the existing market models and rules of the electricity market would be quickly reached or even exceeded.
If you consider that it costs around € 3 to provide EVs with enough power to travel 100 km, of which only around 1/3 (i.e. € 1) can be attributed to the free market, the ability of EVs to freely choose their supplier when charging is only of secondary importance.

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the short and long term, to increase efficiencies, foster market integration and security of supply and support the related research activities.

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However, care should be taken that system costs does not explode and jeopardize a cost-effective deployment of charging infrastructure.
The interests of the customers must be paramount when thinking about integrating EVs into the electricity market. The goal is to enable EVs to be charged at any public electric charging station, irrespective of who built the charging station. With this in mind, the solutions we are looking for be in keeping with the motto “keep it cheap and simple”.

Conclusion

EVs are able to make a significant contribution to efforts to reach the EU's energy targets by cutting CO_2 emissions, improving final energy efficiency and reducing dependency on products of crude oil. The additional energy required to charge EVs and to achieve energy targets such as improving end energy efficiency is marginal. An example of this is that, in order to convert 10 % of the EU’s fleet of passenger cars to electrically powered one´s, a mere 1.5 % of additional electricity would be consumed.

A number of key conditions have to be met before EVs can be introduced to the mass market:

- The availability of EVs for the mass market. Although EVs might be on everyone's lips at the moment, there are in fact, on closer inspection, no EVs available for the mass market.
- The mobility needs of the customers have to be satisfied. The characteristics of purely battery-powered EVs (limited driving range, etc.) have to be taken into consideration when developing business models.
- A close-knit network of charging stations has to be set up in a cost effective and therefore market driven manner. The markets need for cheap and timely deployment of charging infrastructure should be met by a large variety of operators on the market.
- Standardisation is crucial to both limit the risk of stranded investments and to enable EVs to be charged at any public filling station, irrespective of who built and operates the charging station or which car manufacturer produced the EV.
- An adequate legal framework.

Generally adding a large number of EVs new loads to the grid is not a unique situation for DSOs, they have the skills to deal with. The impact of charging EVs through the electricity grid can be simplified along the lines of the principle "slow is cheap". The question is what is necessary to reconcile the customers' mobility needs to economic costs. From the viewpoint of DSOs represented by GEODE, possible and necessary measures for integrating EV into the grid are:

- In the short term (low EV penetration), integration into the existing electricity grid does not require any special treatment.
- In the medium to long term, with a growing EV penetration:
  - a well directed and timed expansion and upgrade with intelligence of the existing electricity distribution grid will become necessary
  - The development of intelligent solutions to meet the mobility requirements of the customers on the one hand and to minimise the

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impact on the grid on the other hand has to be facilitated (smart / controlled charging respectively intelligent load management).
  - Set up monetary incentives through grid tariffs to influence the charging process (e.g. day vs. night, etc.)
  - Power quality aspects have to be taken into account

The implemented incentive-based regulation models in most EU countries focus on providing incentives to reduce costs. The DSOs in Europe are under considerable pressure to keep their costs low – there is virtually no room for innovation.
From GEODE´s point of view a key element of success is that DSOs are part of the process to install charging stations, the development of intelligent solutions, business and market models in good time to be able to set up electricity grids optimally and in a cost effective way:

- To this end, regulatory models must enable the possibility and set incentives to get involved in R&D and demonstration projects and to invest in intelligent technologies and solutions - investment and innovation friendly regulation models are needed.
- Anyway it is vital that the costs incurred by DSOs are fully recognised by national regulatory bodies so that these costs may be recouped via grid tariffs.
- Due to the necessity of the tight involvement it would be beneficial to allow DSOs to provide and offer their know-how for new services and products to customers on the open market along with other actors.

Care needs to be taken when integrating EVs into the liberalised electricity market that the degree of complexity in the system, and there the overall system costs, does not get out of hand. Considering EVs as mobile customers on the electricity market, something completely new and unforeseen, has the potential to do this. As a result, the focus must be on keeping it “cheap and simple” for the sake of the customer.

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List of Abbreviations

DSO	distribution system operator
EC	European Commission

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EU	European Union
EV	electric vehicle
R&D&D	research & development & demonstration
RES	renewable energy sources
V2G	Vehicle to Grid

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Appendix

Afterwards the plans and activities on EU-level and in Spain and the Netherlands regarding the introduction of EV are described in short.

Appendix 1 – Plans, activities of the European Union regarding EV

Earlier in April, the European Commission published the energy and climate change work programme 2010 and intentions 2011. It envisages a legislative proposal by the EC for a regulatory framework on Smart Grids, which will address the various issues linked to Smart Grids deployment as EV and open access to the grids.

The Spanish Presidency of the EU (first semester 2010), has put forward the development of EV as a priority of its Agenda in the context of the fight against climate change. The European Commission has tabled on 28th April 2010 Communication on European common strategy for encouraging the development and eventual widespread use of clean and energy efficient vehicles. The strategy contributes to the Europe 2020 objectives of smart and sustainable growth. It contains an Action Plan composed of concrete and ambitious measures to be implemented by the Commission. The strategy also aims at achieving common standards for electrical cars so that they can be charged everywhere in the European Union.

Appendix 2 –Activities in Spain

Spanish Government is pushing very hard for the development of electric car industry in Spain and wants to have a leading position within the EU. Last November 2009, the Minister of Energy reached an agreement with the private industry to build charging stations to supply EV with electricity. In this charge stations will be able both to replace battery with a new one and charge the car with electricity. Companies are studying how to build private charging points in private parking lots for a private consumer to allow night charging of the car.

The Government has recently presented its plan for the introduction of electric cars up to 2014. It has been granted up to 240 million € that are already budgeted. The Government has also announced grants up to 20% of the car cost, limited to 6.000'-€/unit. The plan envisages the implementation of a new reduced electricity tariff, to promote night charging of the car. The plan also creates a new actor, "a charging operator", to allow large commercial areas to sell energy at the energy charging stations.

According to Energy Minister the success of electrical cars will depend on the purchasing price, maintenance costs and benefits provided.

Large energy companies as well as construction companies are interested in leading electrical car business. They are developing partnerships with municipalities that are planning to build the first charging stations in Spain. This is the case in Madrid (municipality, ENDESA, Iberdola, Union Fenosa and ACS), Barcelona (Endesa) and Sevilla.

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The car manufacturers believe that electric cars could have a 15% market share on the next years and in five years they expect around 1 million electrical cars circulating within the country. The energy consumed by those cars will provide 500 million € to electricity companies.

ENDESA is determined to lead the development of electric cars in Spain. ENDESA has agreed a joint venture with car manufacturers, Renault, Volkswagen and Continental to develop a three years research project on electric cars and its technology, called “Ehire”. The project has a budget of 10 million €. Renault plans to produce 4 different types of electric car. ENDESA will contribute by analysing the needs of infrastructure as regards communication with energy supplier, load management and tariff system taking into account security of supply and interoperability.

At the same time, IBERDROLA is playing an important role in the project “Cenit Verde” lead by SEAT (car manufacturer) that analyses electric cars viability and the importance of Smart Grids for their deployment. This project is financed by a Public Centre for Technical Industrial Development (CDTI) and has a budget of 40 million € and a duration of 4 years. 16 companies participate in the project eg Endesa, ACS (construction), Siemens and others.

It is expected that electric cars to be plug into the network should become available by the end of this year. As a first step, buyers will be companies for their own employees but on a second step they should be available to all consumers.

Appendix 3 – Activities in the Netherlands

Policy of the government

The Ministry of Transport has developed a project plan to accelerate the introduction of electric vehicles in the Netherlands.
The high lights of this plan are:

- The ambition of the plan is to make the Netherlands a guide country as well as an international testing country for electrical driving for the period 2009 to 2011. This will then be the starting point for a large scale market introduction of electric driving.
- The contribution of the Government will be about 65 Million Euro
- The investments from private companies are estimated at about 500. Million Euro

There will be a 3 step government contribution:

- Introduction of a core team to accelerate the market developments and remove the barriers: Achieve cooperation between government and private companies
- Actions by the government in following areas:
    - Demonstration projects: Subvention programmes in cooperation with the development of smart grids.

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* Launching customer ship: Federal and city governments will buy electrical vehicles to increase market growth.
    * Charging and energy infrastructure: Government stimulates the adoption of the electric grid as well as the charging points. The use of green energy will be a precondition.
    * Research, development and production of electric vehicles: Government will stimulate investments to develop the production of the electric vehicles and parts.
    * Building coalitions for cooperation.
    * Stablishing buying syndicates for electric vehicles (government use) and stimulate city distribution centres to use electrical vehicles.
    * Financial stimulation and a low taxes for electric vehicles.
* Coordinated and phased market approach (to achieve the goals of the climate programme, the electric vehicle cannot be introduced at once; therefore other interim solutions have to be considered, such as plug in hybrid cars)

<u>Roadmap for the introduction of electric vehicles (forecast):</u>

* 2009 - 2011: Demonstration projects – some ten up to some hundred vehicles
* 2012 - 2015: Upscale to 15.000-20.000 vehicles
* 2015 - 2020: Further upscale to 200.000 vehicles
* 2020 and further: Matured market 1.000.000 vehicles in 2025

Project City of Amsterdam

The city of Amsterdam started a project to stimulate electrical driving. The project introduces at least 200 electric vehicles and built at least 200 electrical charging points within the timeframe from 2009 to 2011. Furthermore the city of Amsterdam will introduce several parking places for electric vehicles and as well stimulate other public transport to use electricity, such as taxi, scooter and ferries. The Government contributes this project financially with about 10 million Euros between 2009 and 2015 (ca. 6,05 million Euro for 2009 till 2011). Three Million Euros is reserved to encourage private companies provide electric vehicles.

Project city of Rotterdam

The City of Rotterdam wants to stimulate electric driving within the period 2009 to 2015. Within the next few years the city aims to have 1,000 electric vehicles by 2013. For the longer term, the goal is 200,000 electric vehicles within the City of Rotterdam. The City of Rotterdam will contribute the project with 2 million Euro.
Afterwards general measures of the project are described:

* Creating charging infrastructure within bicycle parking places (2009 – 2010)
* Making car parks suitable for the charging infrastructure (2009 – 2010)
* Creating charging infrastructure for electric cars in car parks (2009 – 2014)
* Parking licence for electric vehicles
* Lobbying
* Projects for charging infrastructure (not general for vehicles)
* Further projects will concern external parties. Proposals for projects can be sent to the city.

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Project of grid operators

The network operators of the Netherlands have constituted a foundation to take care of the installation of about 10.000 charging points for electric vehicles within the next three years. Nine grid operators of the Netherlands all cooperating in a foundation (all, except one). The project started at 14th of October 2009. The goals of the Project are:

- Meeting the expectations of the government to stimulate electrical transport
- Participate in the development of the electric grid in an early stage. This can be of great importance for the grids of the future.
- Getting experience with the administrative handling of the charging.

The electric vehicle can be charged by using an electric charging card.
Further Information: http://www.e-laad.nl/

Other Projects

- The City of ´s Hertogenbosch and the province Noord-Brabant started a project to introduce electric transport in the city. 11 charging points have already been built. The city aims to have about 50 electric vehicles and 3 electrical buses before June 2010. For 2020 the provinces' goal is to have 200.000 electrical vehicles. The city as well as the province contributes to the project with one million euros a piece. The project is a cooperation between the city of 's Hertogenbosch, the province of Noord-Brabant, the grid operator Enexis, the energy company Essent, the public transport company Arriva and car sharing company Greenwheels.
- The postal company TNT aims to have 100,000 vehicles with alternative fuels. They started tests with electrical vehicles on the northern Islands of the Netherlands. They have asked for support for the Government of the provinces.
- The Utility Eneco plans to purchase 500 electric vehicles within the next 4 years.
- The utility Essent will have 100 employees driving an electric vehicle by the end of 2010.

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