# Position Paper

Brussels, 1 February 2010

## Electric Vehicles:
## Issues for the European Engineering Industries


**Executive Summary**

The successful deployment of electric vehicles in Europe has the potential to support EU policy priorities, in particular climate protection, the security of energy supply and the competitiveness of European industries. Research and Development activities in the field of electric vehicles, charging infrastructures and supporting services are a great opportunity for innovation and growth of European engineering companies that Orgalime represents. Although we see the electric car as a promising area of technological development, a number of issues and potential hurdles to the successful roll-out of e-vehicles need further cooperation among stakeholders and coordination with policymakers.

In the present position paper we elaborate in the first place our industries' positions and recommendations on safety issues because firstly charging their e-vehicles could expose users to dangerous conditions they are not yet used to and secondly the level of safety of installations in buildings risks being undermined. We believe that standardisation and the EU Commission will have an important role to play to ensure security and equipment safety which could otherwise hamper the introduction of e-vehicles. It will be essential to ensure that the proposed equipment solutions comply with all essential requirements and that moreover compliance of products to safety standards is strictly enforced through proper market surveillance authorities in Europe.

Orgalime believes that mode 3 charging as defined in IEC/EN 61851-1 should become the normal charging mode and be progressively imposed and that a special plug for mode 3 needs to be designed and standardised. Installations must be in conformity with best industry practices and therefore Orgalime recommends that installations should be carried out by authorised professionals. International standardisation bodies are very active to rapidly develop global standards for electric vehicle charging. Once the work is completed in IEC committees, Orgalime takes the view that the EU should discuss the possible harmonisation with the engineering and automotive industries. Orgalime therefore welcomes the Commission's proposal to issue a mandate to the European standardisation bodies in 2010 with the aim to adopt a European harmonised approach for charging systems.

Furthermore energy and power management are key functionalities to consider when developing both regulation and standards in the area of charging infrastructure. It is important that charging infrastructures designed today already take into account future developments in the area of e-mobility. Beyond the necessary control and regulation functions for charging, the communication capabilities of the equipment to the vehicle or to the grids should include some other functions that will be required by the user and the grid in the future.


*Orgalime, the European Engineering Industries Association, speaks for 33 trade federations representing some 130,000 companies in the mechanical, electrical, electronic, metalworking & metal articles industries of 22 European countries. The industry employs some 11.1 million people in the EU and in 2008 accounted for some €1,885 billion of annual output. The industry not only represents more than one quarter of the output of manufactured products but also a third of the manufactured exports of the European Union.*


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## 1. THE CONTEXT

### 1.1 The political context – following up the Electra report and Communication

In 2008, the ELECTRA report "Twenty solutions for growth and investment to 2020 and beyond" outlines technologies and solutions to address the EU's energy efficiency and CO2 reduction targets. In the follow up to this report, the European commission, in its ELECTRA Communication "For a competitive and sustainable electrical engineering industry in the European Union" issued on 29 October 2009 comments extensively on the electric car in the following terms:

"In the long-term mass production of electric cars will help car manufacturers to achieve Community CO2 emissions targets for passenger cars and will contribute to the overall aim of reducing CO2 emissions — provided that electricity is generated from renewable or low-carbon sources. Besides low greenhouse-gas emissions, these vehicles have no pollutant tailpipe emissions such as particulates and nitrogen oxides and produce only low noise. Electric vehicles could potentially be used to store energy in a distributed energy system and may thus contribute to eliminating peak loads in the network. According to the CARS21 mid-term report, in the short to medium term, hybrid technologies (hybrids and plug-in hybrids) are likely to be used alongside internal combustion engines. For the medium to longer term, fully electric vehicles and hydrogen-powered vehicles are the most promising options. However, strong efforts to make electric cars a commercially viable option are still necessary. A significant barrier is the cost of electric vehicles related to the cost of high power-density batteries, the continuous R&D investment and small economies of scale at the early stages of market introduction. The short driving range and scarce charging infrastructure are practical problems for consumers. Finally, there is a need to ensure the proper functioning of the internal market of electric vehicles through the adoption of harmonised approval requirements."

Moreover, European regulators also see that the electric vehicle has a role to play, in particular due to the high potential to reduce carbon emissions of the transport sector: electro-mobility is therefore likely to be taken up by most member states in their national energy strategies.

### 1.2 Need for coordination within the EU

While the market for electric vehicles is still in its infancy, some governments, cities and private platforms within EU member states have launched different initiatives with sometimes considerable budgets to encourage and steer the deployment of the electric car. In order to avoid a situation where we find ourselves with different incompatible technical solutions within the European Union and to avoid wrong investment decisions concerning the necessary infrastructure (charging, payment etc.) for e-mobility Orgalime sees a clear need for the European Commission to coordinate different stakeholders' activities.

The Research & Development activities in the field of electric vehicles, charging infrastructures and supporting services are a great opportunity for innovation and growth of European engineering companies. Orgalime believes that our industries will play a key role in moving towards a "new sustainable market economy" which will provide sustainable growth and employment in Europe (EU 2020 Strategy). We therefore call on policymakers within the EU to support R&D activities in the field of electric vehicles and create appropriate framework conditions for R&D.

Although the electric car is seen as a promising area of technological development, there are a number of issues raised by the development of this technology, some of which call for a collaboration within our industry and between our industry and the utilities and automotive industries, while in other areas a link up with regulators and with standardisation are essential.



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In the present position paper we therefore look at the issues for our industry and chart possible areas for further work as activities around the issue of the electric vehicle evolve at the European level. This position paper does not cover hybrids and hydrogen-powered vehicles.

## 2. ORGALIME AND THE ELECTRIC CAR?

Orgalime represents the European Engineering Industries. The industry is the major supplier of equipment and systems to:

- the automotive industry in the area of machinery, motors and mechanical, electrical and electronic components, batteries, etc...
- the electric utilities industry where it provides the equipment and systems for the generation, transmission, distribution and management of electricity
- housing and building infrastructures through the supply of electrical installations and the other active components

The electrical and electronic industries represented by Orgalime are the essential link between the car industry on the one hand and the utilities/electricity providers on the other hand to enable a proper and safe development of e-mobility. Given the importance of ensuring a proper interfacing between the electricity networks and vehicles, Orgalime sees a clear need to co-ordinate different activities around the launch of the electric vehicle with a view to facilitating favourable conditions for the development and deployment of the required infrastructure while respecting a number of requirements which are specified hereafter. Such coordination would aim to speed up the deployment of the technology required through aiming to ensure interoperability as soon as possible.

## 3. THE ISSUES

From the viewpoint of the engineering industry, and in particular the electrical equipment industry represented by Orgalime the following are the main issues which will need to be dealt with:

- What are the safety aspects generated when linking vehicles to the energy networks?
- What are the requirements of the automotive industry, notably in the area of charging infrastructures? (Quick charge, slow charge?)
- How to ensure the correlation between ongoing and planned industry driven product development programmes and the standardisation processes?
- What are the business models and commercial issues linked to the charging infrastructures (What type of infrastructures and where? What payment and financing and tax systems?)?
- What are the issues raised with the electric utilities industry and in particular in the area of energy and power management?
- How to develop a policy and possible methods to recycle batteries for providing driving power?

We develop hereunder some initial thoughts on the issue of safety, but do not attempt to go further into the requirements of the automotive industry which would need to be discussed with them, as would specific elements, such as energy management, with the electric utilities industry.

## 4. SAFETY ISSUES

For the first time we are envisaging the regular link up of vehicles to the electricity network for the purpose of recharging batteries on a regular basis. Already from the early years in school, the population needs to understand the basics of an electric vehicle and therefore it seems important to support and coordinate communication campaigns in this regard throughout Europe.



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If vehicles have a relatively long life, electrical infrastructures, whether in a private house, apartment building or on the street always are a long-term investment and we also know that private homes change electricity installation at the earliest after 25 years.

Given the very different approach to the issue of safety in vehicles and safety in electrical networks, and the need to find long term and preferably harmonised solutions throughout Europe at least, a certain number of issues need to be dealt with at a very early stage. These include:

### 4.1 Security and equipment safety is the highest requirement

Electric vehicles recharging infrastructures will have to meet a certain number of requirements which themselves will be subject to regulations – either already existing national or European regulations or new ones. The following aspects need to be carefully taken into consideration when regulating essential requirements for recharging infrastructures:

Charging their electric (EV) or hybrid vehicle (PHEV) could expose users to dangerous conditions they are not yet used to. Users of the e-car usually rarely manipulate anything exceeding 2 k at home will then frequently manipulate high power and it can not be excluded that children are playing with the material involved. They may not only use the equipment in the protected indoor environment (garage, parking) but also in external conditions (e.g. at parking meters). The consumer might end up with the necessity to connect a cord at both ends, which is not usual.

Finally the car may in the future become a power source and a storage for electricity (Vehicle to Home, Vehicle to Grid functions), which means that consumers must become accustomed to reversing the flow of power.

Because security/safety is the highest requirement, all the manufacturers concerned and the public authorities must ensure that recharging equipment takes into account all the electrical risks: a failure in the system such as a damaged cable or connection or an improper installation; an improper manipulation by the user like putting the fingers or objects in the plug or on the prongs to try and clean it or misuse such as connecting the wrong plug.

Orgalime therefore believes it is imperative that all the manufacturers concerned and the public authorities take an uncompromising attitude towards safety. It will be essential to ensure that the proposed equipment solutions comply with all essential requirements of existing legislation, such as the Low Voltage directive.

### 4.2 The level of safety of installations in buildings should not be undermined

Present EU regulations for electrical installations in private homes and dwellings and company buildings have brought electric safety to a very high level which must not be undermined in any EU-country. Because it has taken a long time to achieve the level of safety we have today, installations for the electric car must comply with the maximum of security requirements. To achieve this, Orgalime recommends taking into account the following considerations:

#### *4.2.1 Charging modes: In the medium-term mode 3 charging should become normal charging mode*

Although it is important to have a possibility of fast charge[1] to reassure customers and to allow the take up of the electric car for instance for taxis, we think that 90% of charging globally should be done in slow charge in order to allow off-peak charging in which case electricity is also more likely to be low carbon (e.g. wind energy during night time).

[1] See Annex 1 Charging modes



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Orgalime believes that mode 3 charging as defined in IEC/EN 61851-1 (see Annex 1 electric-vehicle charging modes) should become the normal charging mode in the medium-term and be progressively imposed. If Mode 1 charging to domestic sockets will continue to be used in the beginning[2], we believe that a high level of security must be guaranteed through a residual current device (RCD), an overcurrent protection on the supply side and earthing testing on the car side. Moreover mode 1 charging makes an efficient energy and power management capability impossible.

We are aware of the fact that many people do not possess their own private parking with the possibility of off-peak charging overnight and therefore we think it is a key issue for the promotion of the e-vehicle to provide adequate infrastructure for slow charge outside private homes as well.

### *4.2.2 Installations in conformity with best industry practices*

Installations will need to be in conformity with best industry practices in order to ensure safety of life and property.

Orgalime therefore recommends that installations should be carried out by authorised professionals.

The market promotion of completely defined solutions instead of parts being selected and assembled on a case by case basis on the spot as well as proper maintenance could also increase the safety of installations. Furthermore there is also a need for training of car garage technicians to handle electric vehicles, their high voltage equipment and the battery. Technicians in garages must have the same level of competence as electricians as regards the electric vehicle.
Education and professional training therefore also need to be considered in the context of electro-mobility.

### *4.2.3 Special plug for mode 3 to be designed/ standardised*

A large number of European countries (11 out of 30 CENELEC countries) require mechanical protection, namely protecting plugs with shutters if they can be under power against accidental touch or object intrusion.

Orgalime believes that this requirement of IP44[3] level must be imposed for electric vehicle charge installations. The features of the shutter capability still need to be decided.

There is a clear need for a unique standard electric vehicle coupler (electric vehicle inlet plus connector). There is also a clear need for a unique standard for the plug on detachable cords and socket-outlet on the infrastructure. But there is no need for the same device on both sides of the detachable cord (plug at infrastructure end, connector at vehicle end), which would bear the risk to over-specify both. In addition, for safety reasons, it is preferable that the plug on one side of the cord and the connector on the other side should be different in order to avoid dangerous connections.

[2] In Nordic countries millions of winter-heating and charging poles installed as networks on the parking lots are being used today already for heating the cars and top-up charge of batteries and are likely to continue to be used for the years to come for charging electric-vehicles.

[3] IP44 means that the equipment is protected against the ingress of solid foreign objects ≥ 1,0 mm in diameter and against ingress of splashing water



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The complete system including fixed installations, mobile or fixed cord devices and the electric vehicle itself must be safe and therefore security must be analysed by all stakeholders' experts.

Orgalime welcomes the Commission's proposal to issue a mandate to the European standardisation bodies in 2010 with the aim to adopt a European harmonised approach for charging systems. The mandate should take into account all safety aspects mentioned in this paper as well as electromagnetic compatibility.

### 4.3 The role of standardisation

*At present, different standa*rdization committees within ISO (aspects related to the electric vehicle as a whole) and IEC (aspects related to electrical components and electric supply infrastructure) are working on the electrification of cars at the international level. IEC is being very active to rapidly develop global standards for electric vehicle (EV and PHEV) charging. The work is done in particular by TC 64 (Electrical installations), TC 69 (Charging Systems, definition of charging modes), SC 23H (Physical Connectors: plugs and sockets for industrial purposes).
The standardisation relating to the communication protocol from the vehicle to the grid is to be treated by an ISO/IEC joint working group. The tasks of the joint working group consist in working out standards for the bidirectional energy flow vehicle/grid, the payment for the energy charged by the car, the compensation for the energy delivered by the car and intelligent communication which is needed for energy metering and defining the user readiness for charge.

Orgalime believes that the first step is the completion of the ongoing work of international standardisation committees which is scheduled by the end of the first quarter of 2010. Regulators should not push for any specific solution for the plug and the socket-outlet until work is completed in IEC committees in order to guarantee the functionality and the level of safety needed for systems and devices. If in April 2010 it turns out that several technical solutions meet the necessary functional and safety requirements, Orgalime takes the view that the EU should discuss with the engineering and automotive industries the possible harmonisation of the solution for this and for other areas.

If the European Union were to move fast enough to develop European standards there is a chance for it to be adopted by other countries which would give European industry a competitive advantage and facilitate exports.

### 4.4 Competitive solutions are essential

Orgalime believes that for the development of the electric vehicle industry and its supporting infrastructures, international competition will be very intense. Therefore the economic competitiveness of solutions from European industries will be crucial. Hence, the standards should not impose over specification to the charging infrastructure. In addition, safety requirements which will increase the cost of e-vehicle infrastructure must become a competitive advantage for European producers of infrastructures and not a burden.

Therefore it is essential that European regulation is adopted in time and that moreover compliance of products to safety standards is strictly enforced through proper market surveillance authorities in Europe.

### 4.5 Solutions for battery recycling and storage

The existing recycling systems of the starter batteries in cars are not yet capable of recycling the batteries supplying the driving power. Due to the much larger weight of the batteries and the larger amount of chemical substances the recycling of these batteries is a challenge to tackle. These substances (such as hydrogen fluoride compounds) are not only environmentally unfriendly, but also dangerous for human beings.



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Orgalime believes that the problems linked to the recycling of batteries could become an obstacle to the large scale introduction of e-vehicles on the markets in Europe. We therefore need to develop an environmental-friendly policy and methods to recycle batteries supplying driving power.

Batteries of electric and hybrid vehicles can, despite all safety precautions, catch fire. Storage in garages must therefore be secured through several means: sufficient ventilation, a fire and heat detection and alert device and the external indication of the stored battery type and method to extinguish fire (for fire brigades).

## 5. ENERGY AND POWER MANAGEMENT ARE CRITICAL

### 5.1 Key issues for energy and power management

Energy and power management are key functionalities to consider when developing both regulation and standards in the area of the charging infrastructure. This needs to be discussed with the electrical utilities industry.

In order to allow for load management, the charging systems' communication capability needs to be standardized. If one of the goals to be achieved will be peak shaving of electricity demand to the electric networks, as a means to reduce CO2 emissions, then the majority of charging of electric vehicles will have to be done at times when the "greenest" and cheapest electricity is available and not during peak hours (e.g. around 7 p.m. and 9 a.m.).

Secondly, if the take up of the electric vehicle develops, given the stress under which energy grids are in many countries due to insufficient investment in transmission infrastructures, a proper load management will help to ease stress on the grids, thereby helping to reduce the risk of blackouts. Nevertheless Orgalime also believes that with the rise in the number of e-vehicles there will clearly be a need to reinforce and adapt the electrical distribution grids to deal with issues such as harmonic distortions and increasing power demand in certain zones including at certain times of the year.

Thirdly in a not too distant future, electric vehicles might operate as energy storage for the grid which means that the flow of current will need to be two way. The charging infrastructure designed today must already take into account future developments and offer switch solutions. According to our industries' experts appropriate technical solutions should be ready by 2010 or 2011.
It is of great importance to develop innovative energy management systems allowing the integration of renewable energy sources and the electric vehicle which have the potential to level the random energy production by wind and solar plants. However, this requires smart energy management systems, not only dedicated to the large distribution grids but also to small and medium size grids (the micro smart grids).

### 5.2 Communication: provisions for the communication vehicle to grid and vehicle to home must be foreseen

Certain features of the charging infrastructures will favour the deployment of the electric vehicle if they respond to the needs of the user who might want to use the charging point in his neighbours' house or anywhere else and immediately wants to know and pay the cost of charging his batteries.
Orgalime industries believe that the Commission should establish some minimum requirements applicable to the equipment for charging mode 3.

Beyond the necessary control and regulation functions for charging, the communication capabilities of the equipment to the vehicle or to the grids should include some other functions: The complete supervision of what happens during the period of charging (including tracking of the



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alarms and faults) as well as metering functions that would immediately show the cost of recharging and allow to pay immediately. Such provisions could be subject to a dedicated norm.

The different aspects of energy management that will be required by the e-car user and the grid in the future will require intelligent plugs and socket-outlets that are able to be switched on, off or in reverse mode at distance. Therefore standardisation of plugs is not only a question of mechanics, but also of attached intelligence and communication protocol.

## 6. AVAILABILITY OF CHARGING POINTS

Electric vehicles can not be driven for a long time searching for an appropriate charging station. In order to allow users to improve their mobility and reduce useless energy consumption for searching charging points, a communication and information infrastructure is needed to rapidly find charging points for e-car batteries.

In order to ensure a rapid deployment of sufficient charging points, Orgalime would recommend legislative provisions that every new building should provide charging points for e-vehicles. Some Member States (e.g. France) have already included such obligations into their national legislations.

## 7. CONCLUSION

Orgalime representing the European Engineering Industries, including the electrical equipment industry which is going to provide the necessary infrastructures for e-mobility, sees a clear need to co-ordinate different activities to launch the e-car within the EU and abroad so as to ensure that any electric vehicle can safely charge anywhere while at the same time guaranteeing a fair level playing field for the European industry.



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# Annex 1 - Electric-vehicle charging modes

**Mode 1/non-dedicated outlet:** Slow charge only. Connection of the EV to the AC supply network (mains) utilizing standardized socket-outlets (usually rated up to 16A), at the supply side, single-phase or three-phase and utilizing the power and protective earth conductors. The use of mode 1 charging requires a residual current device (RCD) and an over-current device on the supply side.

**Mode 2 charging/non-dedicated outlet with in-cable protection device:** Slow charge only. Connection of the electric vehicle to the AC supply network (mains) utilizing standardized socket-outlets, single-phase or three-phase and utilizing the power and protective earth conductors together with a control pilot function between the electric vehicle and the plug or in-cable control box.

**Mode 3 charging/dedicated outlet:** Slow or fast charge. Direct connection of the electric vehicle to the AC supply network (mains) with a specific plug; control and protection function permanently installed in the infrastructure.

**Mode 4 charging/DC. Connection:** Quick charge (30 to 10 minutes). Indirect connection of the electric vehicle (EV) to the AC supply network (mains) utilising an off-board charger. 43 kW or more. Control and protection function permanently installed in the infrastructure