



Fédération Internationale de L'Automobile
European Bureau

TOWARDS E-MOBILITY THE CHALLENGES AHEAD





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Foreword

Up to now, all efforts to make electric vehicles a common sight on our roads have been to no avail, however, with a range of new hybrid and fully electric products due to enter the market in the coming months, it looks like we may finally be on the verge of an 'eMobility' revolution for the car industry.



eMobility, referring to vehicles running on plug-in electricity for their primary energy, has now become the key word for debate at the European level. The European Union was forced to set ambitious targets to cut emissions in response to the challenges of climate change, energy security and increasing oil prices. As a result, car manufactures have come up with new innovations in areas such as batteries which have made electric vehicles a truly viable option for the first time.

By pooling the experiences of its member clubs from across the EU, this FIA paper gives a unique cross-border perspective on the critical factors on eMobility currently under debate, both for users and consumers.

There will be many challenges ahead. Consumers will not automatically shift to electric vehicles if costs are high, the right infrastructure is not in place, or if they do not understand the new technologies on offer. A range of actors including car manufacturers, battery producers, energy suppliers and distributors, and of course politicians, will have to work together to ensure that the transition to electric vehicles is a successful one.

I believe that the FIA and its member clubs are best placed to contribute to the debate on eMobility by means of engaging with our members on issues of concern to consumers such as the introduction of new technologies, the testing of new vehicles to ensure they meet the highest standards, and making the necessary services available for electric vehicles. Building on our shared experiences, we can take a leading role in the eMobility revolution underway.

Werner Kraus
Chairman of the FIA Eurocouncil
President of Austrian Automobile club ÖAMTC

EXECUTIVE SUMMARY

1

E-Mobility

As one of the biggest emitters of CO₂, the transport sector, and in particular the passenger car segment, is required to make substantial improvements in its environmental efficiency. The electrification of vehicles has often been seen as a central option to help deliver this objective. Although electrification has been a recurring theme in the history of the automotive industry, recent years have seen radical changes to the context, opening up new development opportunities for electric vehicles: climate change concerns, the increase in oil prices and long term oil scarcity, major technological innovations in areas relevant to the automotive industry (eg. batteries), the pressure on innovation within the automotive sector, and the car manufacturers' response to the EU regulatory requirements for carbon emission reductions.

A key word is eMobility. In the present paper eMobility refers to vehicles which rely on plug-in electricity for their primary energy, whether or not they have an auxiliary internal combustion engine for range extension or for keeping the battery charged up (Battery Electric Vehicles, Plug-in Hybrid Electric Vehicles and Extended Range Electric Vehicles). This is not necessarily limited to cars, but embraces power-two-wheelers, vans, quadricycles, etc.

eMobility is dominating the debate on the future of transport and is becoming popular for policy makers, research institutions and industry. National authorities and local municipalities are already supporting the introduction of such low carbon vehicles, giving them specific fiscal treatment or favouring their use over conventional cars (parking facilities, access to restricted urban areas, access to bus lanes, etc.).

Moreover, several new products are due to enter the market in the coming months, covering a wider range of possibilities, from the micro-hybrid technology already available in some models, to full electric cars, encompassing many hybrid electric technologies in between.

Moving to Electric Vehicles

But the move from a conventional car to a more electrically based mobility is not an automatic shift, particularly if users are not actively involved in the process and if they are not assisted in understanding the meaning and advantages of these new technologies.

There are not only big uncertainties surrounding the attitude and purchasing behaviour of consumers in the market place (concerns about cost, range and practicality), but also delicate public policy issues to



deal with. Authorities should support the deployment of eMobility without creating market distortions or seeking to "double-guess" market outcomes. They should adopt a technology-neutral principle: incentives should relate to the carbon emissions performance (on a well-to-wheel basis) and not to specific technologies. In addition, incentives should not create additional burdens on general energy taxation; the deployment of electric vehicles should be linked to the use of renewable energies (which will give beneficial well-to-wheel assessments); standardisation bodies and industries need to agree on common standards and protocols for battery charging systems and arrangements, and the associated information and communication systems.

Nevertheless, even with further scope for decreasing CO₂ emissions by improving the efficiency of the internal combustion engine (eg. reducing the weight components and the engine power of vehicles) and increasing the use of alternatives fuels (natural gas, clean diesel, etc.) electric vehicles could be an important way of improving individual mobility while minimising emissions, and represent an important challenge for European industries.

The deployment of eMobility, in fact, will depend not only on specific technologies that will be adopted, but on the ability to organise and manage operations of a complex landscape of players: car manufacturers, battery producers, mobility service providers, energy suppliers and distributors, and institutions.

Of course, consumers' behaviour will be fundamental and the demand for low carbon vehicles will depend on several factors: the sensitivity of oil prices; the diffusion of a recharging station network; the cost of batteries; the user-friendliness of new technologies, etc.

FIA calls for the following actions:

- 1 Promoting policies that support individual mobility according to the technology neutral principle.
- 2 Investing in all aspects of battery research and development, with the object of reducing its cost, improving its capacity/mass performance, and reducing the longer term environmental impacts of its raw materials and processing.
- 3 Establishing standards and specifications for battery charging arrangements and protocols to promote and sustain competition on the energy market and to prevent the emergence of monopolies.
- 4 Establish open standards battery packs to assist the second hand market with the verification of battery status and condition when vehicles change ownership.
- 5 Working to increase consumers' experiences with electric vehicles: running demonstration programmes to test both the technologies and the behaviour of users.
- 6 Exploring some niche markets which are already accessible and more favourable to the deployment of electric vehicles: green procurement procedures and public fleets, car-sharing schemes, small size fleets.
- 7 Promoting transparency and consistency in the carbon rating of plug-in vehicles partly to counter commercial and political pressures to present Battery Electric Vehicles as "zero emission" vehicles.

INTRODUCTION

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Importance of Individual Mobility

Mobility is a shared core value in contemporary society and has become a key concern in cities both in the developed and developing world.

In the last 50 years cars have enabled people to be flexible about where they live and work, providing them with a better accessibility to primary services, such as schools, health centers, shopping and business districts. At the same time, mobility must be sustainable, in terms of safety, affordability and impact on the environment. Now governments are focusing on the last of these three, and the key words are "Clean Mobility". This leads to programmes and actions designed to substantially reduce the carbon emissions of both private and commercial vehicles. They must meet the transport sector's contribution to the agreed targets for reductions in greenhouse gas emissions: at the EU level the overall target is a 20% reduction by 2020 compared with the 1990 reference level.

The FIA believes environmental issues are of vital importance to secure a better quality of life, and it supports technologies and policy developments which sustain individual mobility while minimising CO2 emissions.

Electrification of the vehicle fleet provides a major opportunity for decarbonising transport, and "e-mobility" is more and more seen as one of the promising policies to pursue: the EU promoted "electric vehicles" as part of its clean and energy efficient strategy; many member states have a wide-range of policies, plans and incentives which are promoting e-mobility; car producers are beginning to launch on the market new electric vehicles, as well as continuing to develop other new technologies such as fuel cells.

E-Mobility: What it is

The range of electric vehicles is a continuum, from the simple "stop-and-start" system (micro-hybrid) introduced into some models of conventional cars, up to fully electric cars, with many forms of hybrids between, including the plug-in hybrid.

For this paper, e-mobility and electric vehicles refer to two different configurations as follows:

- Battery electric vehicle (BEV), also sometimes referred as Full Electric Vehicle (FEV), charged by plugging in to a fixed electricity supply, with no auxiliary on-board power.
- Plug-in hybrid vehicle (PHEV) and Extended Range Electric vehicle (EREV): charged by plugging in to a fixed electric supply, with the battery as the primary source of energy, but with an on-board internal combustion engine (ICE) to recharge the battery and/or drive the wheels where distances exceed the battery range.



So, with the terms e-mobility and electric vehicles (EVs), we have in mind vehicles whose drive is an electric motor and which rely on plug-in electricity for their electric range, whether or not they have an auxiliary internal combustion engine for range extension or for keeping the battery charged up.

Particularly important – though not currently within the scope of the e-mobility policy – is the 'conventional' hybrid electric vehicle (HEV). Here the primary energy comes from the internal combustion engine (ICE), in which surplus and regenerative energy from the movement of the vehicle and the ICE is captured electrically and re-used. The effect is to improve vehicle fuel efficiency (in terms of petrol or diesel consumption) and therefore reduce CO2 emissions by 30% or more compared with a simple ICE vehicle.

Moreover auto manufacturers continue to drive down the CO2 emissions of the conventional internal combustion engine (ICE) as well.



Open Questions

The desired switch from conventional ICE-based mobility to electrically-based mobility poses several questions, however, regarding:

- Consumer response and meeting consumers' expectations: purchase cost and residual values, battery life and cost, road safety aspects, acceptance and usability of new technologies, the range and speed of vehicles, energy security, and the availability of recharging infrastructures;
- Public policy issues: the nature, scale and cost of incentives to encourage market adoption of different low carbon solutions, both from the supply side and the demand side; issues concerning integration into the transport system;
- Attitudes of and decisions adopted by the industry (investments, research and development, technology options, potential constraints such as shortage of raw materials, research in battery costs and capacities...);
- Questions of electricity generation capacity and carbon content, and the ability to generate electricity from renewable sources.

This paper contributes to the debate on e-mobility by presenting the FIA's views on the best way to achieve progress in this field, having particular regard to consumers' perspectives, (given that users' preferences and behaviour will be critical in driving the demand for low carbon vehicles). The aim is to identify the key opportunities, concerns and challenges, and to present some recommendations.

The paper uses the results of a survey of touring and motoring Clubs in Europe, and builds on the experience of those Clubs so far. The result of the survey is available on www.fiabrussels.com.



Policy Framework

Environmental concerns have led the European Union and its member states to introduce policies and targets for the reduction of greenhouse gases – specifically a 20% reduction at the EU level in greenhouse gases by 2020 (against a 1990 base). For many authorities the aim is also to improve air quality as well as decarbonising different transport modes.

The growing demand for transport, in particular in urban areas, will increase environmental pressures and authorities will be required to develop innovative solutions. E-mobility has been identified as a possible answer and has been given high priority, in Europe and beyond, as one of the most important contributors to sustainable transport, especially in the medium term perspective. However, it is not the only initiative available, nor does FIA believe e-mobility will on its own deliver the necessary reductions in carbon emissions required from the transport sector over the next 10 - 15 years.

EU Strategy

The EU strategy for encouraging the development and uptake of clean and energy efficient (“green”) vehicles builds on the existing 2007 strategy to reduce CO₂ emissions from passenger cars and light-duty commercial vehicles, and adopts an overall approach for decarbonising transport. Two paths need to be followed simultaneously:

- Promoting the energy efficiency of conventional vehicles (ICE, internal combustion engines) and work to further improve the quality of conventional petrol and diesel fuel;
- Facilitating the deployment of breakthrough technologies concerning alternative power-trains: alternatives fuels (liquid biofuels, gaseous fuels); electric vehicles (battery electric vehicles, plug-in hybrid vehicles, conventional hybrid and hydrogen fuel cell vehicles).

In its Communication, the European Commission introduces some specific actions for electric vehicles. These include consideration of different policy areas such as:

- Placement on the market (proposing electric safety requirements and reviewing crash safety requirements);
- Standardisation (development of a standard charging interface to ensure interoperability and connectivity);
- Infrastructures (proving a leading role in working with Member States on the build-up of charging points);
- Power generation and distribution (comparing the environmental and carbon footprint of vehicles based on a life cycle approach, evaluating the impact on well-to-wheel emissions and the increase in overall electricity demand).

Much of this policy programme will be delivered by member state governments at the national level. Meanwhile, city administrations are adopting more and more measures based on traffic management and planning powers which give special advantages to users of clean vehicles. The range of potential policy initiatives is particularly wide.

Incentives for Electric Vehicles

Many countries have tax rebate programs or incentive schemes favouring the purchase of electric vehicles. They come in a number of ways and vary in magnitude:

- A reduction in car registration tax (e.g. Austria: a € 500 bonus for alternative propulsion systems, in particular for battery and hybrid electric vehicles;
- A reduction in personal income tax (e.g. Belgium: 30% of the purchase price with a maximum of € 9,000);
- An exemption from the annual circulation tax (e.g. United Kingdom and Germany for the first five years);
- Incentives at the point of purchase (e.g. United Kingdom: £ 5,000; Spanish regional governments: between € 2,000 and € 6,000). The future of these subsidies is still unclear. As they benefit a limited number of people compared to a majority of consumers subject to the general taxation of conventional fleets, such incentives may not be sustainable as and when the numbers of electric vehicles increase substantially.
- In many cities, electric vehicles are also entitled to circulate in low emission zones, to enter areas where traffic is limited or forbidden, to access free parking spaces in central areas, to use bus lanes, and are exempted from road pricing schemes or congestion charges (where applicable). Such advantages are possible due to the limited number of electric vehicles on the roads but if the size of the electric fleet increases, municipalities and governments would need to review the practicality of such policies.

FUTURE TRENDS

3

Market Penetration Forecast

Electric mobility refers not only to cars but also to vehicles of many kinds including bikes, scooters, powered two-wheelers, delivery vans, and collective transport vehicles. However, for the purpose of this paper we are referring primarily to cars.

Drawing from a large scale review commissioned by the European Environment Agency (ETC/ACC, 2009), electric vehicles represent only a niche market in today's global fleet.

This niche has been dominated by relatively low performance light electric vehicles and converted plug-in hybrid electric vehicles, produced by small manufacturers on a small scale.

According to the European Automobile Manufacturers' Association, mass-market introduction of electric automobiles will start in 2011

and 2012, and the market share for new electrically chargeable automobiles will be in the range of 3 to 10% by 2020 to 2025, or between 450,000 and 1,500,000 units, depending on how quickly outstanding challenges can be addressed. In the US, the consultancy company Deloitte (2010) foresees a 3.1% market penetration rate by 2020 equivalent to 456,000 units.

So electric vehicles will continue to have a small market share compared to ICE automobiles, while petrol and diesel – although increasingly in conventional hybrid powertrains – are likely to remain the dominant source of power for at least the next 20 years.

This reinforces the need to continue efforts and incentives to improve the environmental performance of conventional ICE vehicles, and to encourage and incentivise the continuing development and market adoption of HEVs – as well as maintaining basic research into alternative fuels.

The electrification of individual mobility is a key element in making road transport more sustainable; but we need to improve the environmental performance of conventional vehicles.

Different Technologies Available

Large manufacturers are catching up quickly, however, and introducing plug-in hybrid vehicles or fully electric vehicles to the market. It is not clear which version of these technologies (within the same area of lithium batteries) will dominate in the near future. Moreover, electric vehicles are only one option out of the wide range of alternative technologies which have the potential in the longer term to reduce emissions and increase fuel efficiency, not to mention the still wide margins that exist for improving technologies applied to internal combustion engines. The range of options available includes:

- Alternative fuels (LPG, methane, second-generation biofuels, hydrogen) which are particularly effective in reducing CO2 levels;
- Advanced technologies in internal combustion engines, which present themselves as the most effective way to reduce CO2 emissions. These include engine downsizing, direct injection, turbo/supercharging, and variable valve control.

That is why FIA is supporting the Global Fuel Initiative through the "50by50 campaign". This initiative – which is a technology-neutral commitment – has the aim of making cars 50% more fuel efficient by 2050 worldwide, with some



intermediate steps by 2020 (30% for new cars and 20% for stock of all cars) and 2030 (50% for new cars and 35% for stock of all cars).

This is to be achieved by improving the understanding of the fuel economy potential and providing guidelines and support on the development of policies to promote fuel efficient vehicles.

This brief explanation clearly introduces some complexity and uncertainty both for consumers when choosing a new vehicle, but also for policy makers when defining a set of measures to reduce CO2 emissions. This complexity may generate confusion in the marketplace, which could affect the degree of take-up and adoption by the market.



It is not the case that one technology supersedes another one, but rather that different technologies help satisfy a wide range of demands.

Mobility Patterns and New Trends

It is important to understand the different mobility needs and demands that EVs can help meet, and the alternative travel arrangements and performance they offer to households compared with conventional ICE cars. Putting aside for the moment any breakthroughs that will extend the range of BEVs, we should note that BEVs offer a limited range compared to conventional ICE cars, with no opportunity for 'quick' refuelling (except through battery exchange).

BEVs tend to be most appropriate for urban environments with short journey lengths. This need not be a handicap provided consumers understand the difference between BEVs and conventional ICE vehicles, and the benefits BEVs can offer: zero tank to

wheel emissions, affordable recharging costs, versatility in urban environments, etc. The point is that electric vehicles offer consumers a wider choice in identifying the vehicle that best meets their need. It is not the case then that one technology supersedes another one, but rather that different technologies help satisfy a wide range of demands. Therefore, the understanding that should drive policy is that what needs to be protected is the possibility for the market to meet a wide range of demands, through a workable mix of technologies. Meanwhile, the various hybrids on the market today – including plug-in hybrids – offer a range comparable to conventional ICE vehicles.

Alongside the diversity in demands for mobility, we also observe a number of shifts in the way consumers use the automobile. The current and foreseeable high

battery costs associated with even a moderate range will continue to be a barrier to adoption of BEVs. But this can be significantly mitigated if electric vehicles are made available through mechanisms such as car clubs and 'car-to-go' schemes, which can spread the ownership cost across a number of users, or indeed through car sharing schemes and the increasing number of fleet and lease vehicles.

Observers – particularly of young people's attitudes – are commenting on a perception change from the car as something that you have to 'own' to a mobility solution that can be 'subscribed to' or simply hired 'instantly'. We observe the same pattern in bike-sharing programmes. It seems that EVs, as well as electric motorbikes or electric bicycles, may reinforce this new relationship between citizens and mobility.



KEY CHALLENGES

4

Consumer Issues

According to the FIA, the most relevant policy issue from a consumers' point of view is without doubt the **cost**. The purchase price of most EVs remains a key barrier to their adoption by the mass market and at the moment, EVs cannot compete: recent surveys conducted in Spain and Germany from our Clubs demonstrate that 40% disagree with having to pay more for an electric vehicle with features that are similar to those of a conventional vehicle.

While the higher costs of EVs are evident when purchasing the vehicle, the much lower **running costs** including lower maintenance costs are not fully factored in by the consumer at the point of purchase. For example, a typical 20 or 24 kwh battery – currently costing some €1,000 per kwh capacity - represents a major share of the initial total cost of the vehicle.

There are also uncertainties in the consumer's mind about affordability, efficiency over the long term, durability and warranty, as well as residual values. These points remain to be demonstrated. The expected remaining **battery** lifetime versus the price of a used electric vehicle may be one of the most important issues in the future: in 4-7 years we will have a used electric vehicles market and trusted information on second hand electric vehicles will be important for consumers. The barrier of asymmetric information between buyer and seller would in fact be significantly lower and consumers would be able to compare second hand e-mobility with first hand outdated cars easily. With this in mind, establishing open standards for the verification of battery conditions should be encouraged to assist the second hand market, to fix a fair resale value of the battery and to support crime prevention. The cost of energy needed to recharge EVs is also expected to rise in the future and could represent a factor of uncertainty, especially if it attracts a special tax (equivalent to the fuel tax).

The question of **cruising range** is also crucial for consumers. Although several surveys and studies show that most daily trips match the theoretical range

of BEVs, market research shows clearly the existence of 'range anxiety' among users, leading to practical decisions to limit journeys to little more than half the theoretical range. While it would be good to change drivers' perception on this issue, it is thought that BEVs will require some sort of range-extending capability before achieving wide user acceptance.

This is what the plug-in hybrid (PHEV) and the conceptually similar Extended Range EV (EREV) are designed to do – and may therefore attract a higher market interest and market share than the BEV.

Most BEVs remain vehicles that meet a specific purpose: driving in urban areas for relatively short distances and systematic daily trips. This mobility model may not attract a very large target group. Despite the trend towards greater flexibility in terms of models offered on the market, consumers are not ready to move to vehicles that are not able to meet different purposes, including going on holidays or short-break trips. BEV performance in heavy congestion, extreme weather conditions – both hot and cold, and when not fully charged, is still not sufficiently convincing to allay consumer angst. Until the technology becomes mature enough to ensure a longer cruising range, especially for the family car segment, consumers are likely to prefer conventional or hybrids cars, or the plug-in hybrid.

Experiences learnt within our Federation and obtained from our members' survey clearly show that while consumers are basically prepared to switch from conventional cars to electric power, they are not prepared to accept makeshift solutions or any compromise in **comfort** and **technicalities**. The most prominent issue is the interface and recharging station, which need of course to be standardised to avoid a situation where consumers have to carry different cables to use their vehicles in different countries or cities. The European Commission mandated European standardisation bodies to define a common charging system for electric cars, scooters and bicycles, and recommendations will probably be available in 2011, just at the moment these vehicles become available on the market.

On this point, policies which encourage fitting car parking and car ports of new apartment buildings with individual power outlets and individual billing, would facilitate flat owners and flat tenants to charge their vehicle during the night.

But technicalities refer also to how easy it will be to install a **charging station** in a domestic house (permitting process, cost of installation, safety condition, electricity rates): this can become an obstacle, as consumers who decide to purchase an electric vehicle will probably prefer to recharge it at home, taking advantage of the low electricity fares at nighttime.

The purchase price of most EVs remains a key barrier to their adoption by mass market: but there are also uncertainties in the consumers' mind about affordability, efficiency over the long term, durability and warranty, as well as residual values.

Purchasing subsidies can play a role in encouraging the take up of new technologies by early adopters, but guidelines for incentives have to take into consideration the effectiveness of stimulating future demand for EVs.

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Public Policy Issues

At the Geneva Motor Show several automobile companies presented electric vehicles models for mass sales. This means that, probably for the first time, during 2011 and in the following years consumers will have the opportunity to choose a car with a different technology when replacing their old one or when buying a new car. But will the market be able to generate a demand for EVs? Will climate change and 'green' concerns be a good motive for motorists to purchase these new vehicles?

According to the FIA, a number of elements are unlikely to play a dominant role in stimulating market interest among consumers in EVs (beyond the highly technical innovators and 'early adopters'). These include concerns about climate change, pressure on energy efficiency, the positioning of EVs as a "status" symbol or "icon" product, and imitation of the first movers. More likely, reduction in the cost of batteries, tax incentives and the increase of oil prices will be the driving factors towards a progressive transition to EVs.

Special consideration needs to be given to **incentives**. In many EU member states financial incentives are already available and the existing motoring taxation supports the deployment of clean and energy efficient

mobility for consumers. But establishing new incentives for clean and energy efficient vehicles requires careful consideration. The focus needs to be squarely on promoting clean, energy efficient mobility in a way which is technology neutral. It is critical that member states do not attempt to pre-determine which technologies are likely to become dominant, as no-one can reliably foretell how the market will develop. There is a risk of promoting or investing in a particular technology which turns out not to be the emerging favourite.

Even if there is a policy desire to move the market towards electric vehicles, the package of incentives must do so in a way which does not attempt to pre-determine exactly how EVs will emerge, or for example how the charging arrangements will work, or the relative importance of BEVs versus PHEVs. Since the ultimate aim is to reduce greenhouse gas emissions – and CO₂ in the case of transport fuels – the incentives must relate exactly to that, and performance in CO₂ terms should be based on well-to-wheel (not tailpipe) emissions. Preferably, in the long run, they should be based on lifecycle emissions (ie including the embedded CO₂ in the vehicles, batteries and their manufacture). It is crucial to develop information tools for consumers, which clearly explain how the electricity they consume has been produced, and indeed how the whole CO₂ cycle is accounted for.

The experiences of scrapping-schemes activated in many countries in recent years demonstrate that consumers can decide upon several opportunities in terms of technologies (e.g. CNG propulsion, gaseous fuel) with interesting benefits in term of CO₂ reduction.

In general, supply-side incentives should not create any imbalance of competitiveness between manufacturers. Consumer purchase subsidies can play a role in encouraging the take up of new technologies in the early stages but they should only be given when a technology is sufficiently mature for market deployment and the market is ready and able to accommodate them. In fact, incentives given at too early a stage - in the absence of an adequate infrastructure network and grid integration - could risk to hide future costs or future negative effects of the new technology. ►►

Besides, they should only last long enough to establish a viable market presence, after which normal market forces should be relied on to determine their place and share.

In any case, incentives should cover the entire range of electric propulsion, including its different components (e.g. batteries). For example, in certain places two-wheel electric vehicles are better for mass deployment than cars. In cities like Barcelona or Rome, for example, considering the intensive use of motorbikes and powered scooters today; electric motorbikes, scooters and electric bicycles could already be competitive in terms of cost and other features to compete with fuel-powered motorbikes. This could immediately yield carbon reductions as well as air quality benefits. The source of the electricity used must also be factored in with the use of renewable energy sources promoted.

Purchasing subsidies can play a role in encouraging the take up of new technologies by early adopters, but guidelines for incentives have to take into

consideration the effectiveness of stimulating future demand for EVs. Currently incentives should be better targeted towards public transport or fleet bought by small and medium size companies, where operators would more readily be able to overcome the challenges that individuals might face in choosing EVs (i.e. via central recharging stations or central maintenance services).

This would probably represent an opportunity to accelerate the adoption of grid-enabled vehicles and promote economies of scale and a reduction in the cost of batteries, if supported by an adequate company fiscal policy. This would also accelerate citizens' experience of driving EVs, and they would gradually accept switching to an EV when buying or substituting a vehicle. If we consider that one of the family cars is often just used for short journeys around town (eg to school, shops, the office) or for leisure trips, whereas the other car might be used for longer commuting trips (eg for business, family holidays, etc), most families would be in an ideal position to have one electric vehicle. ►►

Incentives must relate to the reduction of green gas emissions and performance in CO2 terms should be based on well-to-wheel (not tailpipe) emission. Preferably, in the long run, they should be based on lifecycle emission.



The price of electricity at the point of charging must be the result of competition in a liberalised market. A crucial requirement for this is a set of universal standards for charging arrangements and interfaces.

Another important policy issue concerns the way Governments will treat the energy sector. It is important to set rules that support deployment of vehicle charging opportunities, and the maintenance of competition for electricity supply in a sector that is still mostly unexplored. E-mobility should be promoted without introducing additional burdens on generalised **energy taxation**. The price of electricity at the point of charging must be the result of competition in a liberalised market. A crucial requirement for this is a set of universal (at least European) standards for charging arrangements and interfaces: this covers plugs and sockets, charging rates and smart charging principles and systems, common protocols for the communication links between the car's battery management unit and the power supply unit, and so on. This is necessary to prevent proprietary protocols and standards emerging which create barriers to entry for new suppliers, and inhibit the transfer by customers between suppliers.

These aspects are particularly important in those business models by which consumers buy the car but rent the battery (which is the most expensive component). The electricity supplied by the battery would then be paid for based on actual consumption. In this case, a new entity is added to the consumer and car producer relationship.

Strategies to influence consumer choices will need to be targeted and informative such that they motivate and empower consumers to opt for the cleanest and most efficient vehicles. The need for good information is likely to play a key role in consumers' attitudes towards electric vehicles. This can be helped by **education** as well as **direct experiences** of the new vehicles and how they work and what they are like to drive. Demonstration projects would be helpful in bringing the reality of BEVs to consumers. There is a need to fully incorporate consumers as an active part of the process in the development of all new low carbon technologies, as their perceptions, beliefs and behaviours strongly determine the success of e-mobility. Consumers must be convinced that electric vehicles are affordable, reliable and match their mobility needs. Negative preconceptions must be renamed.



There is a need to fully incorporate consumers as an active part of the process in the development of all new low carbon technologies, as their perceptions, beliefs and behaviours strongly determine the success of e-mobility.

At an early stage their feedback and expectations can be used as a driving force to facilitate the diffusion of the new technologies, otherwise electric vehicles may be off to another false start, as has already happened in the past.

Information should include the labeling system highlighting the environmental efficiency of the vehicles. Consumers respond positively to the colour banded label which they recognize, with good and efficient products having a green band and marked with an "A". These labels should be based initially on well-to-wheel not tail-pipe emissions (as is proposed for the next stage of the New European Drive Cycle, and in time, on full life-cycle carbon analysis). FIA is already active on these areas: thanks to the ECOTest Programme, FIA clubs are able to provide comprehensive well-to-wheel energy and emission assessments of all alternative technologies (using real-life driving cycles).

Despite the readiness of some individual early adopter consumers to embrace BEVs, and despite the costs, much of the early experience will be gained from exposure to fleet procurement by public bodies – for public transport services or private companies. Alternatively, EVs sharing and rental schemes linked to an intelligent transport system should effectively demonstrate the environmental and practical advantages of electric vehicles and create a new demand for small size, purely electric vehicles within cities. Shared ownership or rental of electric vehicles would represent also an important cultural instrument by which users can access a multi-modal mobility, bypassing the concept of car ownership. In this process, an important partner is **information** and **communication technology** and the ever increasing penetration of mobile devices among consumers: smartphone applications will assist in finding charging locations, setting charging times, booking charging times and slots, monitoring expenditure, providing real-time traffic information; current and future ITS technologies and services will also support the introduction of EVs, bearing in mind that many of these solutions can also serve other types of vehicles.

As the electric vehicle is a relatively new product it requires continuous investment in **research & development** to increase efficiency and reduce the cost. There is a particular need to support R&D in battery technology. This includes:

- Reducing battery mass and cost to provide longer range and lower purchase cost;
- Researching alternative materials so as to reduce long term dependence on rare earths for which supply may be limited, where environmental impacts of extraction and processing may become significant, and where geopolitical issues may become important in the long term for security of supply.

The deployment of eMobility requires a close cooperation among different stakeholders such as automotive industries, energy suppliers and charging service providers, authorities, and organizations representing users. In this area, the **role of institutions** - European, national and local - is crucial at each level to create a clear vision and a more integrated framework. This should include:

- Leading by example with green procurement procedures;
- Introducing the correct package of incentives to stimulate specific uses of vehicles;
- Working close to business and academia to refine vehicles and battery technology and support a higher volume of production;
- Integrating transport policy with urban planning, energy supply and public services;
- Encouraging measures for green consumption and developing innovative financial mechanisms;
- Fostering a better integration of EVs into the existing urban transport infrastructure;
- Setting regulatory standards for fuel consumption or CO2 emissions, possibly in a more harmonised way;
- Promoting labeling systems.

ADAC submitted for the first time an electric vehicle to a cash-test. After the good result consumers should expect to get electric vehicles that meet the same safety standards as conventional vehicles.



Safety Issues

Impacts on road safety are still relatively poorly understood for EVs and need to be further investigated. The numbers of road safety aspects which need to be addressed are looked at below in the order of importance as ranked by the automobile clubs who answered FIA's eMobility survey.

At the moment there is little information regarding the **crash behaviour** of EVs. Plug-in electric vehicles (PHEVs and BEVs) are only just beginning to be tested and this is very important in terms of creating a more confident approach to these new vehicles. Unexpected malfunctions or irregularity of equipment that could compromise the safety of drivers or passengers would represent a further failure in the deployment of electric mobility. Besides, many electric cars, especially those designed for urban use, have a small and light body, and might therefore offer inadequate passenger safety protection. In turn, however, this might offer improved pedestrian protection for vulnerable road users. One additional concern regards the crash behaviour of specific EVs: conversions of existing ICE vehicles into EVs. Such vehicles are not originally designed for conversion and converting them has an impact on the weight distribution of the vehicle (e.g. the internal combustion engine and the oil tank are removed and an electric motor and battery are added); its energy absorption potential is therefore changed. National legislation should strictly regulate these practices and correct information should be given to consumers.

As a result of the introduction of EVs, **vehicle noise** is expected to be significantly reduced for low speed driving situations and during vehicle acceleration. This is a particular concern for pedestrians, cyclists, elderly people and visually impaired people but in more general terms for all vulnerable road users not used to silent vehicles. These aspects should be addressed within the educational and training programs at schools and driving-schools courses but of course a specific legal framework is needed. The US and Japan, both countries with more experiences of electric vehicles, are adopting specific legislation or voluntary noise guidelines for the car industry and at the same time the United Nations Economic Commission for Europe (UNECE WP 29) is working on a set of minimum noise standards.



There are other safety aspects. There are concerns about the hazardous material contained in **batteries** which may pose risks in the event of a collision. An electric shock caused by an accident may ignite any stray gasoline, or start a fire in the battery or car itself. Strong safety standards have to be assured due to the high amount of stored energy.

Providers of **roadside assistance** are not yet generally trained to repair EVs nor are they familiar with the risks that such vehicles may pose. That is why it is important to encourage the funding of programs to train road assistance

providers/firefighters/emergency services, and to inform consumers on the appropriate procedures to adopt in case of breakdown. The FIA rescue sheet (www.rescuesheet.info) should be promoted widely as an additional safety information tool in the event of accidents.

Security must be assured also at the **charging station**. A large scale implementation of recharging infrastructures, which is a pre-condition for the deployment of EVs, requires high safety standards as well as specific regulation to avoid undesired effects when connected to the grid.

Another important policy issue is related to the **legal framework**. Considering the EU legislation for motor vehicles which groups all kinds of vehicles under different categories it is still unclear under which category some electric vehicles fall. This does not only concern small electric cars (quadricycle, L category, or a passenger car, M category?) but also a wide range of vehicles often produced in Asia which cannot be classified either as cars, or as motorcycles

or mopeds. Of course vehicles need to fulfill the technical requirements for homologation, but it is important to also address which license is needed and ensure the most appropriate license is required for every vehicle present on the market together with a coherent educational and training process for users.



RECOMMENDATIONS

5

E-mobility, with the definition used in the present paper, will still only represent a niche market up to 2025. While we support the trials and market roll-out of EVs, and specific measures to address the concerns and challenges we have identified, it is vital that attention should not be diverted from promoting the continuing efficiency improvements in conventional ICE-driven cars and the adoption of conventional hybrids. Together these actions offer very significant scope for reducing emissions. Tax incentives for consumers, and local incentive policies adopted by cities and towns to encourage low carbon vehicle use, must be technology neutral – with the incentives relating to the carbon-emission performance of the vehicles, preferably calculated on a well-to-wheel basis.

Furthermore, it is important to have a strategic view on clean and accessible mobility that goes beyond the car. Current use of cars is unsustainable in some cities and even if we could replace the conventional vehicle fleet with electric vehicles we would not solve the problem of individual mobility but only shift to a “green-congestion”.

Information technology will continue to reduce the need for physical movement, but we need to encourage more sustainable and low carbon lifestyles (car-sharing; car clubs; peer-to-peer car rental services; urban neighborhoods with land use policies that prevent further sprawl and ensures access to key services), without compromising individual mobility. It should not be forgotten that freedom of movement is a fundamental EU right that must be upheld.

Progressive measures concerning technological improvements, fiscal incentives, infrastructure networks, consumer information, driver behaviour and lifestyle planning have to be combined in order to achieve the most effective outcome. But if on the one hand mobility must become more sustainable, on the other hand, aspects like safety, cost, affordability, reliability and accessibility still remain key priorities for consumers.

In this context, the electrification of vehicles is part of the efforts needed to maintain mobility while reducing carbon emissions. FIA believes that the **following actions** should encourage an appropriate development of EVs in the framework of clean mobility generally:

- 1 Individual and clean mobility should be promoted according to the technology neutral principle. Policies should support hybrid vehicles and the continuing efficiency improvements in internal combustion engines as well as supporting e-mobility and its development. This reflects the current state of technologies and the forecasts that BEV and PHEV will represent only a niche market in the next 15 years. When member states promote tax, circulation and local traffic incentives, they should be related to carbon emission performance (preferably on a well-to-wheel basis), rather than to specific technologies.
- 2 Investment in all aspects of battery research and development should be promoted, with the object of reducing its cost, improving its capacity/mass performance, and reducing the longer term environmental impacts of its raw materials and processing.
- 3 Establish as soon as possible the standards of the specifications for battery charging arrangements and protocols, in order to promote and sustain competition on the energy market and to prevent the emergence of monopolies.
- 4 Establishing open standards for the testing of battery condition and expected remaining battery lifetime, in order to promote a fair resale value and crime prevention. This would help lower the barrier of asymmetric information between buyer and seller, making the second hand market more transparent for consumers.
- 5 Work to increase consumers' experiences of electric vehicles: run demonstration programmes to test both the technologies and users' behaviour. Consumers must be engaged by giving them the opportunity to drive and get used to electric vehicles (cars, scooters, bicycles).

- 6 Explore some niche markets which are already ready to be made more favourable to electric vehicles (in particular BEV and PHEV): car-sharing schemes, small size fleets, public fleets, second family cars, young people more familiar with new technologies. In particular, public authorities, by using their purchasing power to choose environmentally friendly vehicles for their fleet (as requested by the green procurement procedures), can represent an important driver of the deployment of electric vehicles, reinforcing the principle of leading by example at the same time.

- 7 Promote transparency and consistency in the carbon rating of plug-in vehicles (also recognising the challenge of accounting for carbon content in electricity, varying between countries and recharging regimes) – partly to counter commercial and political pressures to present BEVs as having “zero emissions”.

The FIA and its member Clubs, representing more than 35 million motorists in Europe, will continue to play an active part in this process providing the views of both users and consumers. With the aim to incorporate potential users in the innovation process, FIA will give contribute to the current and future debate by:

- Working to fully include consumers within the process of introducing new low carbon technologies (promoting demonstration projects, creating opportunities to disseminate and explain new technologies to consumers, making the users' voice heard in technical and policy discussions);
- Testing vehicles and mobility services for their every-day usability, safety, environment compatibility and efficiency and contributing to a more transparent market (Euro NCAP programme; EuroTest platform; EcoTest and labeling programmes);
- Increasing our services to EVs (e.g. adjusting breakdown assistance service) and also joining partnerships for developing services for EV users.

FIA MOBILITY OBJECTIVES

The objectives of the Fédération Internationale de l'Automobile in the area of automobile mobility and tourism are defined as follows:

- Promoting freedom of mobility and serve, defend and protect the interests of mobile consumers when travelling, taking into account the repercussions on the environment, safety and on other social and economic factors;
- Supporting member organisations in defining and defending a globally shared public policy vision and objectives for sustainable mobility, i.e. safe, clean and efficient, accessible and affordable;
- Facilitating the early recognition of mobility trends, thus giving member clubs a leading role for the benefit of both themselves and their members;
- Co-operating regionally in developing appropriate regional strategies, public policies and initiatives;

- Co-ordinating reciprocal services between member clubs for the benefit of their members when travelling abroad;
- Helping clubs to face global challenges, fostering growth of their membership base and the development of their services;
- Defining and putting into place the most appropriate means to exchange information, knowledge and best practices at all levels;
- Representing member clubs with our consultative status at international level;
- Supporting and creating opportunities for clubs to take an active role in public policy and promote the interests of their members;
- Lobbying for outcomes in favour of motoring clubs and motoring consumers;
- Liaising with other international organisations and relevant stakeholders.



Fédération Internationale de L'Automobile

European Bureau

The Fédération Internationale de L'Automobile (FIA) is the governing body for world motor sport and the federation of the world's leading motoring organisations.

Founded in 1904, with headquarters in Paris, the FIA is a non-profit making association. It brings together more than 220 national motoring and sporting organisations from more than 130 countries on

five continents. Its member clubs represent millions of motorists and their families.

The FIA has been dedicated to representing the rights of motoring organisations and motor car users throughout the world via campaigns and activities that defend their interests. On issues such as safety, mobility, the environment and consumer law the FIA actively promotes

the interests of motorists at the United Nations, within the European Union and through other international bodies.

The FIA is also the governing body for motor sport worldwide. It administers the rules and regulations for all international four-wheel motor sport including the FIA Formula One World Championship, FIA World Rally Championship and FIA World Touring Car Championship.

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