ACEA position paper on electrically chargeable vehicles
23 November 2012

Executive Summary

1. Electric mobility will make a useful and important contribution towards ensuring sustainable mobility and meeting the transport demands of the future.

2. EU vehicle manufacturers are world-wide technology leaders in fuel efficiency and safety. EU manufacturers aim for EU leadership in engineering and the manufacturing of electrically chargeable vehicles (see definitions in part 2 of the position) to support the sustainability of the transport sector and EU to become world leading market.

3. Additional progress towards CO2 reduction will come from further improved internal combustion engines, alternative propulsion technologies and the development of other alternative energy sources. Low-emissions vehicles offer the most convincing solution on the road to sustainable mobility.

4. Electrification of the mobility and transport system can only be a part of a long lasting solution. There is no silver bullet. Electrically chargeable vehicles may bring many benefits for towns and cities, such as very low to zero tailpipe emissions and reduced noise. However the freedom for the consumers to select any technology should be guaranteed.

5. Electric mobility poses many questions with the answers having to cover a multitude of interdependent parameters. Significant simultaneous investments by a variety of stakeholders will be necessary to ensure barriers to market acceptance are eliminated and to realise electro-mobility’s potential.

6. The EU is challenged with defining a clear roadmap together with all stakeholders involved and defining clear policy support measures for R&D&I on sustainable transport solutions, rules for ensuring the functioning of the EU internal market and competition, market introduction of such vehicles as well as the manufacturing of electrically chargeable vehicles and components. The EU Commission has a clear leading role in defining those strategies. The US, Japanese and Chinese governments already support the new technology intensively, and this poses a challenge to European vehicle makers in terms of their global competitiveness.

7. Electric mobility is a shared responsibility of the participating industries, scientific institutes and governments and can only be realised if based on an integrated approach, coordinated collaboration and competitive-neutral guidelines of all key players throughout EU and if possibly globally. This requires a framework encouraging the market launch of electrically chargeable vehicles without hampering the introduction of this technology by solving all challenges right from the beginning.

8. CO2 savings will be maximised if the well-to-wheel impact is clearly addressed at all stages of the fuel and energy chain – low carbon energy production such as
renewable energy production is key to achieving the CO2 savings potential. Any framework needs to clearly identify and address the stakeholders’ responsibility and sphere of influence (vehicle manufacturers do not have any influence on the well-to-tank chain (emissions)).

9. **Realistic process towards the electrification** of the vehicle is essential; it should be based on sound objectives and factual analysis of (expected) stakeholders’ behavior, requiring a multilateral scope from all involved. **Overly high expectations** risk hampering the ongoing industry efforts for a successful introduction of this new technology, which would result in a delay of the exploration and deployment of the full CO2 reduction potential of this promising technology.

10. The internal combustion engine using conventional fuels will remain the dominant source of power at least in the coming decade. There is still some potential to improve the efficiency of conventional vehicles. However, this is limited by physics. Moreover, the **costs to further reduce CO2 emissions will be even higher** in the future given that combustion engine technology is already highly developed. Higher costs for industry are also associated with **market introduction of new technologies**.

11. Cost-effectiveness assessments and suitable framework conditions are essential pre-conditions to ensure **affordability** of future mobility solutions, including introduction of electrically chargeable vehicles.

12. Uncertainty in framework conditions makes quite difficult to assess a realistic share of new registrations related to electrically chargeable vehicles. From the perspective of the automobile industry, we expect it in the range of **2 to 8% for the next decade**. Current economic situation, lack of implementing standardisation and insufficient charging infrastructure are hurdles for higher market uptake and create a high level of uncertainty for the industry. The internal combustion engine using conventional fuels will remain the dominant source of power at least in the coming decade. The market penetration of electrically chargeable vehicles will depend on the extent to which the following **tasks and requirements** can be met:

   - **The customers** need to accept some specific characteristics of new technologies such as different driving or recharging requirements. The education/information for customers is the responsibility of all stakeholders involved.
   - **The energy sector** is responsible for the build-up of a recharging infrastructure which is the prerequisite for a customer’s acceptance of electrically chargeable vehicles. An encouraging framework is required to build up an infrastructure. Customers should have the free choice among different energy suppliers and access to all charging stations independent of the charging station or energy provider. Customer-friendly operation and billing systems need to be EU wide harmonised.
   - **National governments** need to provide appropriate and predictable technology-neutral market incentives, particularly during the introduction phase of this new technology in the market as well as ensuring stable regulatory framework and R&D&I support. New technologies generally come
in low volume and at significant cost premiums first, which needs to be off-set by a positive policy framework.

- **EU institutions (namely European Commission)** must ensure level playing field across EU 27, respect to the EU State Aid rules and the same conditions to be applicable throughout the internal market of the EU. The Commission should continue publishing guidelines on national incentives and supportive schemes for ECVs to streamline them across the EU and use other tools on EU level to facilitate market uptake of low emitting transport solutions (e.g. super-credits within CO2 legislation or harmonisation of charging infrastructure).

- The **automobile industry** needs to offer attractive electrically chargeable vehicles, maintaining high safety and comfort standards. The automotive industry, including the suppliers, needs to further reduce the costs of the key components for electrically chargeable vehicles (in particular of the battery system) and to tackle technical challenges such as cruising range, battery durability and reliability.

- **Standardisation bodies and the industry** need to agree quickly on standards and common interfaces (e.g. vehicle-to-infrastructure) for Europe as a whole to avoid a fragmented pattern of local competing and incompatible solutions. The goal must be to establish world-wide standards.
1. Introduction

Protecting the natural environment, oil depletion, using limited resources responsibly and mitigating the effects of man-made climate change is one of the key sustainability challenges that industrial society faces nowadays. Reducing CO2 emissions is a global challenge that affects us all. Solutions must be framed around a global, holistic approach. The transport sector must be firmly embedded in an economy-wide carbon-reduction framework, while also working to maximise CO2 reductions through an integrated approach linking technology, energy, government and consumers.

European automobile manufacturers are technology leaders and innovation is unlocking more sustainable transport opportunities. An important challenge is to make sure that transportation remains affordable. Progress towards CO2 reduction will come from further improved internal combustion engines, alternative propulsion technologies and the development of more alternative energy sources. Low-emission vehicles offer substantial part of the future solutions towards sustainable mobility, keeping in mind that integrated approach is necessary for implementation.

E-mobility and transport as such must be seen in a broader context and as a part of the European sustainable growth and competitiveness. All efforts should have been made to support transport with incentives rather than burdening it\(^1\). All existing forecasts agree that transport demand will increase in line with GDP and with trade growth. It is obvious that all transport modes will need to increase their efficiency in order to cope sustainably with such demand. That does not mean that preference should be given to any mode of transport of technology. **A technology-neutral policy** reinforces the potential for overall technological progress and enhances the competitiveness of the EU economy as well.

Still, an easy answer to the challenges of future transportation cannot be given. *Electrification of the mobility and transport system can be part of the long lasting solution*, but this is no silver bullet. Consequently, new concepts and new technologies need to be developed to launch electrically chargeable vehicles suited for both individual and public mobility and for goods distribution in urban areas. While urban areas create specific mobility needs due to often congested conditions and a typically limited traveling distance, other transport needs do require larger daily driving distances at higher speed. All these diverse transportation needs will lead to further diversification of future vehicle types and their propulsion, and electric drive-trains will cover a large area of the consumers’ requirements.

It is also necessary to note that e-mobility poses many questions with the answers having to cover a multitude of interdependent parameters. Significant simultaneous investments by a variety of players will be necessary to ensure barriers to market acceptance are tackled and to realise electro-mobility’s potential. It should be imperative to address all the ways for reducing CO2 with all the relevant stakeholders in an **Integrated Approach**, not just vehicle technology.

---

\(^1\) See also ACEA position on White Paper on Transport
2. Electrically chargeable vehicles will cover part of the consumers’ requirements

Alternative fuels are a further part in the jigsaw puzzle to sustainable mobility. Automakers support a widely available, diverse range of low carbon and renewable energy sources and technologies that include biofuels, CNG, LPG, clean diesel, hybrids, electricity and hydrogen (e.g. fuel cell vehicles). The energy sector needs to contribute by providing alternative fuels and energies as well as a refueling and recharging infrastructure.

The electrification of the vehicle involves breakthrough technologies and will change the current perception of driving and mobility. When speaking about electrically chargeable vehicles (ECVs), the following basic possibilities must be included:

- ECVs with no other energy source than the battery - Battery electric vehicles (BEV)
- ECVs using different energy sources (with no fixed lines or borderlines among technologies due to the development and overlapping):
  - Electric vehicles with the mobility assistant using energy from the battery and limited amount of energy from the combustion engine for emergency purposes under given technical limits.
  - Extended-range electric vehicles (EREV) which use a battery as the main energy source, but use a combustion engine driven range-extender running on hydrocarbons, after the batteries are depleted.
  - Plug-in hybrid electric vehicles (PHEV) which use battery as the main energy source for daily trips, but can also run in common hybrid mode using the combustion engine running on hydrocarbons if necessary.

In short, electrically chargeable vehicles are cars, trucks and buses that comply with all applicable safety and regulatory standards, designed for volume production. They are powered from on-board batteries, which can be charged with off-board electric energy, i.e. from the electric grid. They also include vehicles with integrated combustion engines that help to overcome the limitations of electric propulsion, such as limited range.

3. Integrated approach

The major challenges/requirements for the successful commercial introduction of ECVs can be identified as the following:

- Customer acceptance (vehicles for a variety of customer needs, affordability)
- Readiness/availability of recharging infrastructure
- Vehicle energy storage system (costs, need for further R&D&I)
- Appropriate market incentives (public policy)
- Standardisation (common interface vehicle-infrastructure)

---

2 These definitions are to simplify the understanding of public audience and do not suggest any changes in the current type approval or other valid legislation.
3 When using word “batteries”, also solutions with super capacitors are included.
- Low carbon energy production
- Adjusting and restructuring the supply chain for ECVs to ensure sustainable production and supply

**Therefore, significant simultaneous investment** by a variety of players will be necessary to ensure barriers to market acceptance are tackled and to realise electromobility’s potential.

Success of the electrification of the transport system is built on, and requires, the **coordinated collaboration of all key stakeholders** and contributors, i.e. the so called Integrated Approach:

<table>
<thead>
<tr>
<th><strong>Integrated approach (coordinated collaboration)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Customer</strong></td>
</tr>
<tr>
<td>Society</td>
</tr>
<tr>
<td>Acceptance</td>
</tr>
<tr>
<td>Affordability</td>
</tr>
<tr>
<td>Availability</td>
</tr>
<tr>
<td>Image</td>
</tr>
<tr>
<td><strong>Infrastructure provider</strong></td>
</tr>
<tr>
<td>Availability</td>
</tr>
<tr>
<td>Affordability</td>
</tr>
<tr>
<td>Information</td>
</tr>
<tr>
<td><strong>Automotive industry</strong></td>
</tr>
<tr>
<td>Reliability</td>
</tr>
<tr>
<td>Availability</td>
</tr>
<tr>
<td>Affordability</td>
</tr>
<tr>
<td>Information</td>
</tr>
<tr>
<td>Supply chain</td>
</tr>
<tr>
<td><strong>Governments</strong></td>
</tr>
<tr>
<td>EU</td>
</tr>
<tr>
<td>Harmonised</td>
</tr>
<tr>
<td>public policy</td>
</tr>
<tr>
<td>Incentives,</td>
</tr>
<tr>
<td>Information</td>
</tr>
<tr>
<td>and long-term</td>
</tr>
<tr>
<td>stable</td>
</tr>
<tr>
<td>framework</td>
</tr>
<tr>
<td><strong>Standardisation</strong></td>
</tr>
<tr>
<td>Intra-EU and</td>
</tr>
<tr>
<td>international standards (global solution for the</td>
</tr>
<tr>
<td>industry)</td>
</tr>
</tbody>
</table>

**4. Main requirements and conditions for successful market introduction**

Respecting the Integrated Approach principles, there are a number of key challenges that should be tackled by the different stakeholders. Successful market introduction of ECVs should be synchronised efforts of the following groups:

**4.1 Customer and society**

The internal combustion engine using conventional fuels will remain the dominant source of power in the coming decades. There is still some potential to improve the efficiency of conventional vehicles. However, this is limited by physics. Moreover, the costs to further reduce CO2 emissions will be even higher in the future given that combustion engine technology is already highly developed, especially in Europe, where the most progress has been made on fuel efficiency so far. Cost-effectiveness assessments and product diversity are therefore of crucial importance, in view of **affordability** and customers’ use patterns.

Consumers have expectations and routines in line with their individual mobility needs and habits that need to be met, involving issues such as affordability of mobility as well as convenience of driving and recharging. Society is used to highly-developed internal
combustion engines and the associated filling-station infrastructure. These expectations need to be considered in the development of new technologies and infrastructures.

In addition, customers need to accept some specific characteristics of new technologies such as different driving or recharging requirements. The education and information for customers is the **responsibility of all stakeholders** involved, from the policy makers and the energy suppliers to the vehicle manufacturers.

The main requirements of customers are:

- Improve battery performance according to customers needs
- Availability of appropriate mileage extension solutions (plug-in hybrid, range-extender, fast re-charging etc.)
- Affordability (purchase price as well as cost of ownership) AND/OR acceptance of premium
- Availability and convenience of recharging
- Comfort of driving
- Vehicles for variety of customer needs
- Clear understanding of advantages and limits of ECVs
- Positive societal image
- Trust in technology robustness and quality

All key stakeholders expect a clear market signal from customers about their demands and requirements.

### 4.2 Energy sector and infrastructure providers

Without an **appropriate recharging infrastructure** electrically chargeable vehicles cannot successfully be introduced in the market. The public sector, infrastructure providers and the energy sector will have to build up a recharging infrastructure as a prerequisite for customer’s acceptance of electrically chargeable vehicles. An encouraging framework is required to build-up an infrastructure.

An appropriate infrastructure delivers the **availability and necessary density of recharging possibilities**. In a first phase, recharging places should be installed at strategic locations – including public parking places, workplaces and truck or bus depots - and on main roads:

- Identification of the early adopter hotspots and build capacity there
- Public recharging stations (parking garage, shopping mall, Park & Ride, dedicated parking spots along streets…)
- Home/depot recharging
- Workplace recharging

Customers should have the **free choice between different energy suppliers** (from which utility they get their electricity) and **access to all charging stations** independent of the charging station provider or energy provider (e.g. national/international roaming).
**Customer-friendly operation and billing systems** need to be EU wide harmonised. This includes different payment systems such as cash equivalent, credits cards, prepaid card, electric vehicle identification with monthly bill, etc.

The first generation of electrically chargeable vehicles does not offer full vehicle-to-grid communication capabilities (e.g. intelligent recharging with link to smart energy management). In the future, it will be important to recharge vehicles in an intelligent manner in order to prevent charging at peak loads for the power networks and to allow customers recharging at low costs (variable pricing of electricity in order to control electric power market demand). The **tariffs for recharging ECVs at home should not be higher than those for normal household appliances**. A durable stable price relation to conventional fuels has to be ensured. This builds up trust in e-mobility for all users and investors.

Once a large volume of electrically chargeable vehicles has reached the market, it is likely that some extra supply of electric energy will be needed. However, even broad introduction of electrically chargeable vehicles would not meet the limits of generating capacity: assuming the future energy consumption of an electrically chargeable passenger cars to be in the order of 100-120 Wh/km and assuming an average 10,000 km traveled per year, it follows that **1 million vehicles will require about 1 TWh of energy** which is only a minor fraction of the annual electricity output of the EU (2006: 3,400 TWh, source Eurostat).

1 mio. vehicles → 1 TWh of energy → +0.03% of annual electricity output of the EU

As far as possible future options are concerned, the vehicle battery may be used to **feed energy back into the grid** whenever the price for control energy or balancing energy is particularly high. Many **technological, safety and legal issues still have to be resolved** up till then (e.g. negative effects on the durability of the battery, the power grid and consumer convenience). The priority of the automobile industry is to charge the vehicle while optimising battery life. However, vehicle batteries might one day be able to serve as bi-directional energy storage devices that will compensate for fluctuations in wind energy, for example.

Main tasks and requirements:

- Availability and capability of the grids to charge a higher number of ECVs at different hours of the day (peak hours)
- Availability/ sufficient density of charging infrastructure (home/depot, city, along motorways, work places, etc.) and consumer convenience
- Conditions of use that do not compromise flexibility, affordability, comfort, fair charging
- Technology (charging time, plug or inductive) for mobility.

Electrically chargeable vehicles have the potential to be a sustainable long-term solution for mobility. Significant progress has been made over the last few years, but real breakthroughs are still required. CO2 savings will be maximised if the **well-to-wheel impact** is clearly addressed at all stages of the fuel and energy chain – low carbon energy
production such as renewable energy production is key to realise CO2 savings potential. Any framework needs to clearly identify and address the stakeholders’ responsibility and sphere of influence, considering also the contributions coming from the batteries production (from the raw materials) and recycling phases (vehicle manufacturers do not have any influence on the well-to-tank chain (emissions)).

While battery electric power does not create any tailpipe emissions, it is important to also improve the well-to-tank impact, i.e. the level of emissions from generating electricity by the energy sector. Only renewable electricity production will automatically increase the benefits of electrically chargeable vehicles. It should be noted, that well-to-tank emissions are determined by the national energy mix which cannot be influenced by the manufacturers. Thus, the automotive industry sees the need for a framework which clearly identifies/addresses the stakeholders’ responsibilities. EU vehicle manufacturers are open to discussing a range of policy instruments supporting such an approach.

Electrically chargeable vehicles can make use of the existing grids for distributing electric energy, which, however, needs to be adapted and extended once a larger volume of electrically chargeable vehicles reach the market and new recharging technologies are developed. In most cases, recharging will occur at home or at the workplace (or depot in the case of commercial vehicles) by connecting to the existing recharging infrastructure.

4.3 Industry and suppliers of key technologies

Several European vehicle manufacturers are operating small series of electrically chargeable vehicles to gain further experience with the technology in daily use, to increase customer awareness, and to analyse customer patterns concerning recharging of vehicles.

The key component for both performance and costs of an electrically chargeable vehicle is the energy storage system. Today it is expected that the energy storage system will be a lithium based battery system. The following can be assumed for passenger cars:

- Today’s costs of a Li-Ion battery system are about € 600 – 800/kWh.
- The expected typical driving range requirements, based on current driving patterns, for electrically chargeable vehicles will be up to 150 km which will require an electric energy consumption up to 20kWh (small/compact car). It follows that the battery costs for an electrically chargeable vehicle can add € 6,000 – 16,000 to the cost per vehicle.
- The additional costs are compared to a vehicle with an internal combustion engine and without electrification. Further components to be considered are costs for power electronics (e.g. performance control unit), cooling, wiring, etc.

The extent of additional costs mentioned above cannot be fully compensated by industry’s cost reduction efforts (economies of scale, learning curve) in the mid-term. Therefore, subsidies and incentives are necessary to foster the market introduction of such vehicles.

It has to be taken into account that a battery system includes, besides the battery cells, components for interconnections and packaging as well as electrical and thermal...
management equipment. All these additional components have a significant influence on the overall volume, weight and cost of a battery system.

Even if a lot of progress has occurred in terms of energy content related to volume and weight of a modern battery, specific energy and energy density remains about hundred times lower than that of fuels for combustion engines. This fact is one of the main challenges for electric mobility, as it influences both costs and usability.

To overcome, in the long term, the performance hurdles of Li-ion technologies, it is necessary to continue investing in R&D&I for further improvement of the overall comfort and performance of electrically chargeable vehicles.

It should be noted that Lithium and rare earths as raw materials are at this stage sufficiently available. Nevertheless it could become a future challenge and therefore it is important to ensure sustainable access to those materials.

Main tasks and requirements:

- Reliable technology (battery, electrically chargeable vehicle integration)
- Long-term durability
- Affordable technology
- Availability of electrically chargeable vehicles in the requested segments
- Full integration in servicing and dealer infrastructure
- Maintaining high safety and comfort standards
- Guidelines for first responders (road and emergency services, etc.)

4.4 National governments and EU institutions

EU vehicle manufacturers are world-wide technology leaders in fuel efficiency and safety. Electrically chargeable vehicles provide the opportunity for further EU leadership in engineering and manufacturing.

The EU institutions are challenged to define a clear roadmap with all stakeholders involved and ensure policy support for R&D&I, rules for ensuring the functioning of the internal market and competition, market introduction of such vehicles as well as the manufacturing of electrically chargeable vehicles and components. The European Commission has a clear leading role, namely to ensure harmonised approach throughout EU, respect EU State Aide rules and avoid fragmentation of internal EU market as various EU Member States have already implemented certain supportive policies for market uptake of electrically chargeable vehicles. Technology neutrality in this respect should be respected.

Governments of USA, Japan and China already support the new technology intensively, and this poses a challenge to European vehicle makers in terms of their global competitiveness.

A successful market introduction of electrically chargeable vehicles depends on an appropriate market incentive system at national level. New technologies generally first come in low volume and at a significant cost premium, which needs to be off-set by a
positive policy framework so that vehicles remain affordable and mobility is guaranteed. **Therefore, subsidies and incentives are necessary to foster the market introduction of cost-intensive technologies** and not a “technology push”. With decreasing costs of the key components, mainly the battery system, and increased market volumes it is expected that the subsidies can be phased out over time. Electrically chargeable vehicles can only become a success if, ultimately, a broader market penetration of this power-train technology can take place without any financial incentives. But in order to achieve a large scale replacement of the conventional fossil-based combustion engine by electrically chargeable vehicles, there is a need to support the evolution of today’s technologies.

Examples for market incentives:

- Tax incentives (exemption registration tax and annual circulation tax) and direct purchase subsidy
- Faster depreciation
- Incentives for commercial customers and public fleets
- Company cars: favorable “benefit-in-kind” taxation
- Subsidies for home/office charging infrastructure
- Incentives for OEMs and industry (production electrically chargeable vehicles, R&D&I funds, etc.)
- Administrative simplifications for designation of public parking space for electrically chargeable vehicles
- Encouragement of new user models (example Germany: interchangeable license plates for electrically chargeable vehicles and conventional vehicle)

Like domestic current, electricity for electrically chargeable vehicles must not be subject to additional taxes or fees. The same level playing field as with other electricity consuming products is required. This is the only way that the higher purchase costs of an electrically chargeable vehicle can be approximately amortized during the automobile’s life.

4.5. Global regulatory framework and harmonization

Comprehensive standards and norms have to be created to ensure the vehicles can be easily connected to the grids in order to recharge the energy storage system. **The goal must be to establish worldwide standards** in order to avoid market fragmentation and to reduce costs (economies of scale). The automotive industry already announced its proposal towards harmonised system for charging and calls for quick progress in EU and global standardization activities including the involvement of the International and European Standardisation Bodies.

Standards and common interfaces (e.g. vehicle-to-infrastructure) need to be agreed upon quickly for Europe as a whole to avoid a fragmented pattern of local competing and incompatible solutions. This would provide European industry with a unique opportunity to establish themselves as world leaders in electrically chargeable vehicles and related transport systems.
Additional technical issues with a need for EU-wide and possible global harmonisation:

- Standardisation (plug, phases, data protocol)
- Cross-national compatibility
- Data protection (personal, business)
- Safety requirements for recharging/discharging places
- Safety requirements while recharging/discharging the battery, e.g. short circuits
- Charging cable at the car or at the recharging station
- Technical approval body for recharging places
- Periodic inspections & maintenance of recharging places
- Liability clarification
- Convenient billing systems

The technical requirements for the **type approval system of electrically chargeable vehicles have to be extended and harmonised.** The vehicle manufacturers support the use of UNECE Regulations for electrically chargeable vehicles type-approval, and assume that some of the necessary Regulations, in addition to Regulation 100, will be made mandatory in the framework of the implementation of the General Safety Regulation. However, some of the UNECE Regulations listed in 2.1.1. (Regulations 51, 83, 85 and 101) are not affected by the General Safety Regulation. It should be ensured that the corresponding EC Directives or Regulations contain the necessary requirements for electrically chargeable vehicles.

There is also a need to update existing regulations which limit the global development of new technologies. The **transport of Li-Ion Batteries** regulated under “Transportation of dangerous goods” (UN recommendation, regulated by ICAO/IATA*) is an example. Currently, the transportation of Li-Ion batteries by airfreight is limited to max. 35 kg and requires special cargo planes. That means, the industry needs to use more expensive and logistically much more challenging ways for transportation of such batteries (transport by sea, road transport). Airfreight of components is essential in developing of new technologies and ensuring an adequate service and maintenance for the customer globally. The transport limitation of 35kg needs to be terminated or increased to 400 kg at least. The automotive industry suggests proceeding commonly with all stakeholders involved and supported by the EU and national governments in updating of existing regulations.

* ICAO – International Civil Aviation Organisation, IATA – International Air Transport Association
5. Conclusions – expected market penetration of electrically chargeable vehicles

From all the above, the successful introduction and market penetration of electrically chargeable vehicles depends on many factors such as customer acceptance, infrastructure availability, market incentive systems, attractiveness of alternative mobility solutions, vehicle energy storage system, etc. A more detailed description of the tasks and requirements are mentioned in chapter 4. An integrated approach of all stakeholders is needed for the sustainable and affordable mobility in future.

Having in mind progress made so far and integrated approach needed, the automobile industry expects the share of ECVs within new registrations in the range of 2 to 8% for the next decade. Current economic situation, lack of implementing standardisation and insufficient charging infrastructure are hurdles for higher market uptake and create a high level of uncertainty for the industry.

The market penetration will depend on the extent to which the tasks and requirements (as addressed in this paper) are addressed and fulfilled as well as the technology develops and customers perceive electric mobility. The total amount of electrically chargeable vehicles (in units) in the whole vehicle parc would by then be higher due to increased market penetration of the vehicles from the near future onwards.

It is obvious that ECVs do not represent silver bullet towards sustainable transport in the future but do represent a part of the global solution. Diversified transport modes and technologies will be required to fulfill different consumer requirements in the future.

**********