

Electrification Roadmap and Research Projects of the European Green Cars Initiative

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Abstract

Aiming at economic recovery and the fight against climate change, the European Commission in 2008 launched the European Green Cars Initiative, a Public-Private Partnership (PPP) for research and development on zero emission, safe and efficient road vehicles and transportation. A total of 1 billion Euros has been made available since, jointly by the European Union and the industry for collaborative research projects mainly in the field of electrification. A first European roadmap on electrification, edited by the industry, was published in 2009. An update is currently being consolidated within the broader community. It is intended to provide advice to the European Commission regarding the prioritization of topics for the annual calls for proposals. A total of more than 50 collaborative research projects addressing the roadmap topics have already been started within the European Green Cars Initiative.

Keywords: EU, Policy, EV

1 Introduction

In the European Union, electric vehicles are considered one of the key technologies for achieving the goals Europe 2020 strategy regarding climate and environmental protection, energy efficiency, and creation of growth and jobs [1]. This strategy sets the target to reduce greenhouse gas emissions by at least 20% compared to 1990 levels by 2020. The share of renewables in the energy consumption shall increase to 20%, and a 20% cut of the overall energy consumption shall be achieved. The European transport policy laid out in the “Transport 2050” white paper contributes to this strategy by aiming at decarbonizing transport, increasing mobility and removing barriers in economic key areas. The related roadmap details a multitude of initiatives targeting a dramatic

reduction of Europe’s dependence on imported oil, a cut of carbon emissions in transport by 60% by 2050, and a 50% shift away from conventionally fuelled cars in urban areas by 2030 as well as their total phase out by 2050 [2]. The corresponding research and development activities are funded within the European Green Cars Initiative.

2 European Green Cars Initiative

The European Green Cars Initiative is one of the three Public Private Partnerships (PPP) of the European Economic Recovery Plan announced by the President of the European Commission in November 2008 [3]. The objective of the initiative is to support research and development for technologies and infrastructures that are essential for achieving breakthroughs in the use of renewable and non-polluting energy sources, safety and traffic fluidity.

The main focus is on the electrification of mobility and road transport. Beyond providing loans through the European Investment Bank, the PPP European Green Cars Initiative is making available a total of one billion EUR for R&D through joint funding programs of the European Commission, the industry and the member states. This financial support is supplemented by demand side measures, involving regulatory action by Member States and the EU.



Figure 1: Stakeholder Consultations

For a rapid implementation of the PPP European Green Cars Initiative, the funding mechanisms of the 7th Framework Program (FP7) were chosen, and an Industrial Advisory Group was established as a high-level forum for a strategic dialogue between the European Commission and the involved industrial sectors. The industry is represented by members the European Technology Platforms European Road Transport Research Advisory Council (ERTRAC), European Technology Platform on Smart Systems Integration (EPoSS), and SmartGrids, and other stakeholders. They have made recommendations for the annual FP7 Calls for Proposals of the European Green Cars Initiative since 2009.

This advice is based on a continuous process of strategic stakeholder consultations, consisting of workshops and multiannual implementation plans which rest upon the long-term roadmaps and strategic research agendas (SRA) of the European Technology Platforms (see Fig. 1).

The activities of the PPP European Green Cars Initiative [4] are supported by the EU-funded Coordination Actions “PPP Implementation for Road Transport Electrification” (CAPIRE) and “Information and Communication Technologies for the Fully Electric Vehicle” (ICT4FEV).

3 Electrification Roadmap

A European roadmap “Electrification of Road Transport” was first published in October 2009 by the European Technology Platforms ERTRAC, EPoSS and Smart Grids [5]. It is the result of a taskforce for electrification which had been established by the European Technology Platforms to support the PPP European Green Cars Initiative. Starting from general considerations of the potential benefits and challenges of the electric vehicle a definition of milestones for the next decade was made. Moreover, it was indicated what research and development actions ought to be taken in the relevant technology fields in order to ensure the required innovations are made in a well-timed and balanced manner.

3.1 Benefits and Challenges

According to a well-to-wheel efficiency analysis carried out by this taskforce, a mid-sized vehicle can be operated at 25% less primary energy if equipped with a fully electric power train instead of an internal combustion engine. This can lead to a significant reduction of CO₂ emissions depending on what primary energy sources are used. Furthermore, benefits for air quality and challenges in terms of technology and materials cost as well as mobility needs were considered.

3.2 Milestones

The involved representatives of the European automotive industry agreed on three milestones:

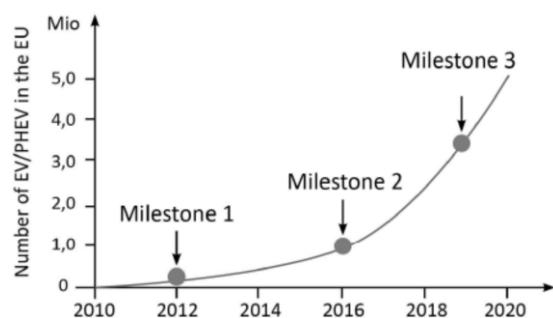


Figure 2: EV/PHEV Market Projection (accumulated)

- **Milestone 1:** Introduction of electric mobility based on adaptation of existing vehicles (2012)
- **Milestone 2:** Availability of a dedicated 2nd generation electric vehicle (2016)
- **Milestone 3:** Mass production of dedicated electric vehicles (2018-20)

It was expected that until 2020 an accumulated number of 5 million electric and plug-in hybrid vehicles would be put on the road in Europe.

3.3 Technology Fields

Required actions to master the different challenges of deploying electrified mobility on a large scale have been assessed in terms of research and development, production and market development and establishment of regulatory framework conditions. Thus, detailed roadmaps could be developed breaking down necessary steps toward the milestones within the technology fields

- Energy storage systems
- Drive train technologies
- Vehicle system integration
- Grid integration
- Safety
- Transport system integration

4 Funding Programs

The roadmaps are the basis for a prioritization of topics to be covered in calls for research proposals in the 7th Framework Program of the European Commission. Three rounds of calls have been launched so far. The first, published in summer 2009, was mainly focused on components and architectures of the electric power train, electrochemical storage applications, and demonstration of electric mobility. The second call, launched in 2010, dealt with the specific energy management, stability and safety issues of the electric vehicle as well as with system integration and manufacturing of batteries. The third call, opened in summer 2011, covered lightweight materials, power electronics, safety and durability and transport system integration. The fourth and final call for proposals of the PPP European Green Cars Initiative will be published in summer 2012. More than 300 million Euros in funding has been made available for collaborative projects in the PPP European Green Cars Initiative so far.

Complementary to these funding opportunities at the EU level, all major member states have launched programs on electric mobility, mostly focussed on the research and innovation needs of their respective industries, and including a multitude of demonstrations and fleet tests. France and Germany, e.g., have spent more than one billion EUR on the topic already, already.

5 Research Projects

A total of more than 50 collaborative research projects have already been started within the European Green Cars Initiative, most of them are dealing with electric mobility. Major road-blocks of electric vehicle development, energy storage, electric motors, safety and reliability, vehicle system integration, and the connection to the power grid are being addressed by consortia representing major companies from the European vehicle manufacturing, automotive supply as well as the electrical engineering and electronics sectors, see Tab. 1 [6].

Table1: Topics of EU-funded EV Projects

Topic	# of Projects
Energy Storage Systems	14
Drivetrain Technologies	8
Vehicle System Integration	12
Grid Integration	4
Safety	6
Transport Syst. Integration	5

6 Demonstration Sites

In several European cities, the experimental use of EVs has started in public fleets and demonstration projects. Some of those are connecting infrastructure through whole regions or set the stage for a countrywide EV use within the near future. Examples are the model regions in Germany and Austria which are installing infrastructure, setting up EV use schemes and business cases for public transport, car sharing and also private EV use with their combination depending on the specific regional conditions and requirements. Broader programs were started in Portugal and Spain. Within the MOBILE project several Portuguese municipalities are involved in promoting EVs by incentives and the renewal of public fleets. Furthermore, the related infrastructure is installed also along main highways. Similarly, the Spanish project MOVELE aims to promote the countrywide use of EVs and supports funding the required infrastructure. Another interesting and promising initiative is AUTOLIB', which is an EV car sharing that is available in the urban area of Paris from early December 2011. As for its launching, 250 EVs on 250 stations (180 among them in Paris downtown) were available. AUTOLIB' is expected to grow by the end of 2012 up to 3000 EVs which will be shared between 1200 stations in Paris and 46 cities in the Paris Region (Ile-de-France).

Coordination and synchronization of these regional EV deployment initiatives is aimed for on the European level. The European project Green eMotion draws together the results and experiences of regional deployment projects in order to develop a European electric mobility concept. This work incorporates harmonization of technology, standards, policies and regulations, solutions for recharging infrastructure and the integration of electric mobility services and ICT solutions.

7 Market Launch

European vehicle manufacturers launched a multitude of development projects on 1st generation EVs in recent years and have started mass production and commercialization. The Renault-Nissan Alliance is currently launching four different models in the European Market: Nissan Leaf, Renault Kangoo ZE, Renault Fluence ZE and the Twizy, a two-seater. By September 2012, Renault will commercialize Zoe, a 2nd generation EV. Other vehicle manufacturers will follow, soon: BMW, e.g., has announced the market launch of the i3, an EV featuring a body made of carbon fiber reinforced plastic to improve energy consumption, for 2013.

8 Outlook

Recent discussions with the involved European Technology Platforms lead to the conclusion that in order to tap the full potential of electric cars regarding energy savings and reduction of greenhouse gas emissions, it is required to not only “electrify” the common car, but to totally revise the automobile concept. This may enable synergies of improvements in various technology fields (e.g. batteries, vehicle weight, system integration etc.) which again lead to step changes in energy efficiency and cost reduction.

8.1 Roadmap Update

These views are taken into account within the current update of the roadmap “Electrification of Road Transport”. A novel milestone was added in order to project major innovative steps as described above:

- **Milestone 4:** Fully Revised Electric Vehicle Concept (2025)

This 3rd generation electric vehicle will probably be based on an entirely revised modular platform including a revised ICT reference architecture and middleware. Innovative zero-emission drive

train systems may be enabled by distinctly improved energy recovery and incorporation of a multi-fuel compatible range extender. The batteries may have enhanced bidirectional and, given the required infrastructure is in place, fast charging capabilities and especially contactless charging will be a widely available alternative for more comfort. Even charge-while-driving may be offered in dedicated areas. It can be expected that the car will be fully integrated into the multi-modal transport system. Automated and cooperative driving functionalities will be enhanced and active safety measures greatly exploited.

Once mass production is reached, the number of produced vehicles will not saturate since further advancements in technology and production processes are expected towards milestone 4. The expected major innovative steps in EV technology may additionally open new opportunities to reduce manufacturing costs and create user demand. Thus, a coherent approach outlined in the roadmap and the appropriate funding of required research and development efforts can be expected lead to continually increasing production numbers. By 2025 an accumulated number of up to 20 million electric vehicles on European roads appear to be within reach.

8.2 Enabling Role of ICT

Information and communication technologies (ICT) may enable those weight reductions and efficiency gains which are required to meet the costumers’ expectations in terms of performance, range and affordability [7], as e.g. in the electric vehicle, mechanical control functions of the power train can easily be replaced by electronic means and supported digitally by embedded software. A specific annex on ICT was thus added to the electrification roadmap in 2011.

Further annexes, dealing e.g. with simulation, competencies, the building of the required charging infrastructure, and the establishment of manufacturing facilities are currently underway.

8.3 PPP in Horizon 2020

In light of the high degree of satisfaction at both the industry and the EC sides, the PPP European Green Cars is striving for a continuation under Horizon 2020 [8], the new Common Strategic Framework for EU research and innovation funding after 2013. The updated electrification roadmap will serve as an important basis for the discussions on multi-annual implementation plans of this continued PPP.

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