

ICT for the Fully Electric Vehicle

Research Needs and Challenges Ahead

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"Every vehicle digital"

Speech of Commissioner Neelie Kroes at the annual EUCAR reception on 8 November 2010

For 30 years I've taken an interest in keeping the car industry competitive. Only a year or two ago I was sitting in crisis meetings, where the future for much of the sector looked grim. I am very pleased to see that you are in a much better position today.

But we cannot ignore that context. At the national and EU level we took a decision that the automotive sector is critical to Europe's future. With a whole industrial ecosystem and 12 million jobs depending on it, this was the reasonable position to take. But more than that, we said that we needed an industry that could be in the driver's seat globally.

To reinforce our position we have to improve the very basics of the sector in a way that ad-hoc crisis aid cannot: only sustained excellence in research can ensure the future successes of this industry. With the worst of the crisis behind us, now is the right moment to discuss how to get there.

I am convinced that one critical aspect of your efforts has to be European collaboration.

I know that your sector has the capacity to do great things. During the Public Private Partnership (PPP) conference in Valencia in April this year I sat in a car of the future.



If that car's capabilities are an indication of what investing in research can deliver, then I urge you to get the relevant Member State Ministers sitting in such cars tomorrow to help secure the support you need to get those ideas to market.

Here EUCAR's partnership model has played a long-standing role – and the EU can play an important role, too. We see that in efforts like the Green Car Public Private Partnership, and ahead of this Wednesday's revival meeting of the CARS21 initiative I am once again reminded of the links between this work and the wider Digital Agenda for Europe.

Digital Agenda for Europe

On that note, I should say that the Digital Agenda for Europe is the EU's most comprehensive digital action plan ever. Our goal is using ICT to improve daily life. There can be few better places to start than with mobility and the ICT ecosystem that supports it.

So when I speak about "Every European Digital," what I want you to hear is "Every vehicle digital." In this way, your daily work is a key part of Europe's digital transformation.

Take your industry's massive need for chips and embedded systems, for example. We are working to help address those needs through our ENIAC and ARTEMIS partnerships with industry and Member States. These Joint Undertakings are up and running – now we need to make sure they implement the right strategy. Your industry has an important role to play here to help get everybody's commitment: Member State governments will listen to you if you explain the benefits and necessity of European research collaboration of this kind.

Work to advance telemetry and GPS and specific projects like eCall are also part of a long-term push to deliver smart mobility and new platforms for innovation. The Digital Agenda, the Competitiveness and Innovation Programme and the Intelligent Transport Systems action plan could not be more closely linked.

I am personally very passionate about the valuable role that common standards have to play in going digital. Think about how they could speed up the delivery of fully electric vehicles. It is clear, in my mind anyhow, that we will depend on ICT and the results of your research, for all types of future mobility.

Future research

With that in mind, there are three additional priorities I want to mention:

1. Convergence of Future Internet and connected cars

Europe leads in wireless communication to and from vehicles. That is critical to improve both safety and efficiency. And to convert this into global market success global cooperation and standardisation will be required.

This is where the EU's Future Internet Public Private Partnership comes in. We need the automotive and ICT communities side-by-side. That way we can seize the opportunities of the next generation of wireless broadband, beyond 3G, to meet the growing demand for connectivity in cars.

In other words, we can stay in the lead if we collaborate. Mess it up and we will be left behind.

2. Electric Vehicles

Electric vehicles are where ICT and green cars truly meet. And as with connected cars, we need co-operative research to help develop global standards. Only then will electric vehicles reach their potential. The EU will continue to be there playing a full role in the financing of this work.

3. The future of manufacturing

You are the last large manufacturing industry left in Europe. While it may sometimes seem like we have an alphabet soup of initiatives at the Commission, more than ever, these pieces of work are joined up. Vice President Tajani's industrial policy initiative continues this and the Factories of the Future and Green Cars PPPs are just two examples.

Conclusions

Let's keep and extend collaboration at the European level. Pre-commercial collaboration in research can be key for staying competitive. Reducing risks and costs can give you a better shot at global leadership in the future.

Please see the Digital Agenda as your agenda too. We need each other to deliver mobility that is connected, smart, safe and clean.

Neelie Kroes

Vice-President of the European Commission

Executive Summary

In reaction to the global economic crisis, the European Commission adopted in November 2008 the **European Economic Recovery Plan** as a comprehensive stimulus to drive Europe's economy out of the economic downturn. This plan includes three Public Private Partnerships (PPPs) to support innovation in **manufacturing**, in the **construction** industry and the **automobile** sector ("Green Cars").

The **European "Green Cars" Initiative (EGCI) PPP** is a package of **€5 billion** consisting of loans from the European Investment Bank and FP7 research grants. As a result of the **first calls for proposals published in 2009 and 2010**, with a total indicative budget of **€197 million, 50 research projects were selected**.

DG INFSO's participation in the EGCI is focused on **Information and Communication Technologies (ICT) for Fully Electric Vehicles**.

This brochure provides an insight into the benefits, technological challenges and the role of ICT for Fully Electric Vehicles, and depicts a roadmap for industrially driven research in this sector. It sets the scene and gives an overview of the projects resulting from the first two calls for proposals under this objective and presents the content of upcoming calls.

The EGCI has rapidly brought **industrial research and policy makers together**. Its results will contribute to a more sustainable and greener mobility in Europe, increasing the quality of life of its citizens while improving the competitiveness of the European ICT and automotive industries.

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1. Setting the Scene

1.1 The European Recovery Plan

The recent global economic crisis has ridden every major car manufacturer in Europe. The limited access to credit, associated with high credit costs, has directly affected the manufacturers and their suppliers in sustaining production and investments. The consumers' reluctance to make new investments and their difficulty to finance expenses has translated into a drop in demand for all types of vehicles. Furthermore, the high product complexity and diversity has lead, in conjunction with the dropping sales, to a structural overcapacity within this sector ^[1].

In reaction, the European Commission adopted in November 2008 the European Economic Recovery Plan. It is a comprehensive stimulus to drive Europe's economy out of the crisis and is based on a fundamental principle and two key pillars (Figure 1). The fundamental principle is solidarity and social justice and addresses mainly the preservation of jobs and the long-term job prospects of the unemployed.

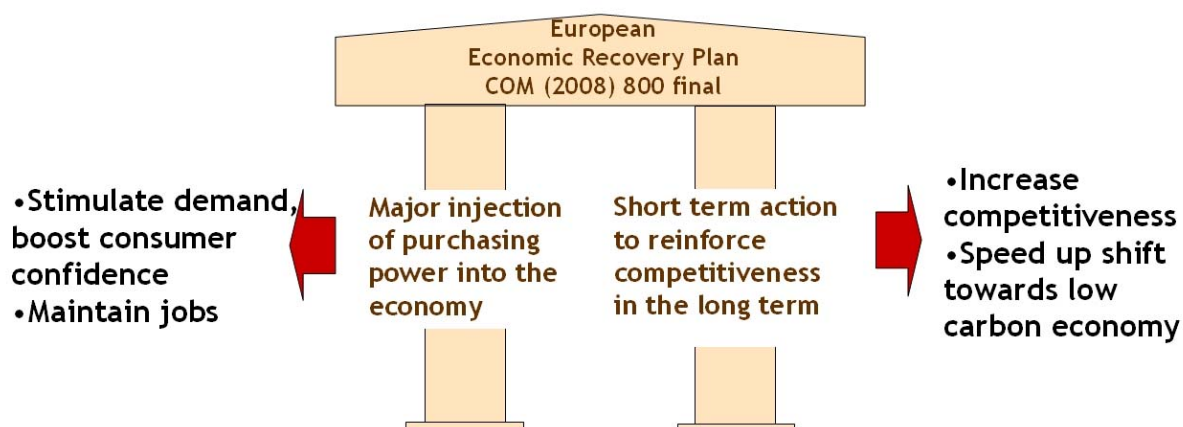


Figure 1 - The two pillars of the European Economic Recovery Plan

The first pillar of the European plan is a **shared fiscal stimulus of € 200 billion**, a major national and European injection of purchasing power into the economy, to boost demand and stimulate confidence.

The second pillar of the plan rests on the need to direct **short-term action** to reinforce Europe's competitiveness in the long term. The emphasis is on "smart investments". Investing more in education and training will help people to retain their jobs and get back into the labour market, whilst raising productivity. Investing in infrastructure and energy-efficiency will keep people in the construction industry in work, will save energy and improve efficiency. Investing in clean cars will help protect the environment and would give Europe's companies a leading edge in a highly competitive market [2].



The European Recovery Plan is implemented by means of three Private-Public-Partnerships (PPPs):

1. "Factories of the Future" initiative for the manufacturing sector (€1.2 billion for R&D)
2. "Energy-efficient Buildings" initiative for the construction sector (€1 billion for R&D)
3. "Green Cars" initiative for the automotive sector worth a total of €5 billion, of which €1 billion is for R&D.

Their common objective is to promote the convergence of **public interest** with **industrial commitment and leadership** in determining **strategic** research activities. Thus, the PPPs represent a powerful means of boosting research efforts in three large industrial sectors - automotive, construction and manufacturing - which have been particularly affected by the economic downturn and where innovation can significantly contribute towards a greener and more sustainable economy.

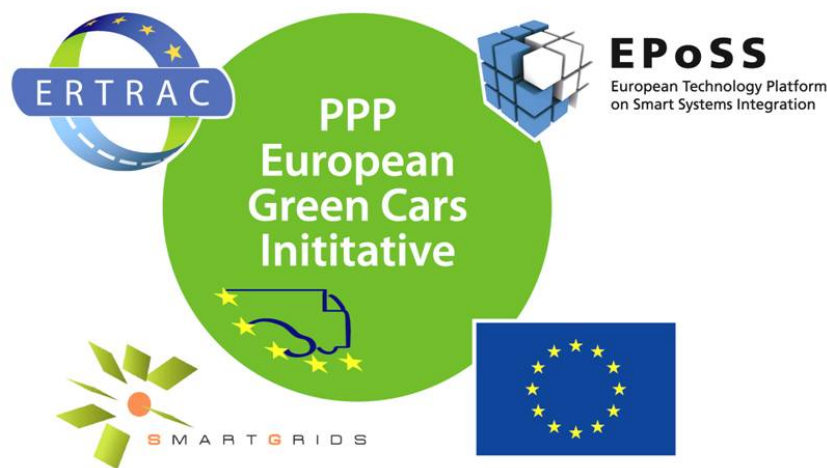
In the PPP approach, the Commission and the representatives of industrial stakeholders have identified the following advantages^[3]:

1. a leading role for industry in the definition of the strategic priorities and the implementation of the research;
2. a multi-annual integrated work programme with a pre-defined budget, ensuring continuity and allowing industry to make long-term investment plans;
3. a cross-thematic approach going from basic and applied research through to validation and large-scale demonstration, with an increased emphasis on impact and exploitation; and
4. increased opportunities to support innovation in SMEs.

1.2 The “Green Cars” Initiative PPP

The objective of the “Green Cars” initiative PPP is to support R&D on technologies and infrastructures that are essential for achieving breakthroughs in the use of renewable and non-polluting energy sources, safety and traffic fluidity.

Despite its name, the “Green Cars” Initiative is not for passenger cars only. It includes research on fully electric vehicles, long-distance trucks and logistics. However, the main focus lies 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 programmes of the European Union and the industry. These financial support measures will be supplemented by demand-side measures, involving regulatory actions by the Member States and the EU, such as the reduction of car

registration taxes on low-CO₂-vehicles to stimulate the purchase of cars by the citizens.

For a rapid implementation of the PPP European Green Cars Initiative, the instruments of the 7th Framework Programme were chosen, and an Ad-Hoc Industrial Advisory Group was established as a high-level forum for a strategic dialogue between the European Commission and the involved industrial sectors [4].

Two rounds of cross-thematic calls for proposals with a total indicative budget of **€ 197 million** were published in **July 2009 and July 2010**. **50 projects** were selected for funding involving the following programmes:

- Sustainable Surface Transport (SST),
- Information and Communication Technologies (ICT),
- Nanosciences, Nanotechnologies, Materials & New Production Technologies (NMP),
- Environment (ENV) and
- Energy.

Their focus is on **electric vehicle technologies, the integration of electric vehicles into smart electricity grids and in particular on highly energy-efficient ICT components and solutions for fully electric vehicles and sustainable automotive electrochemical storage applications.**

The **15 selected projects from the ICT programme** have already been or are currently being launched and are presented in Chapter 4 of this brochure.

The Automotive Working Group of the European Technology Platform on Smart Systems Integration (EPoSS)^[5] is intensively involved, along with DG INFSO, in the implementation of the "Green Cars" Initiative PPP. Thus, several joint workshops and events on electric vehicle technologies have been organised. Their major outcome can be summarised by the joint recommendations of ERTRAC/EPoSS/SmartGrids (Figure 2) on how and when electrification research needs should be met by the objectives of the future work programmes. They represent the link between industrial priorities and EC policies.

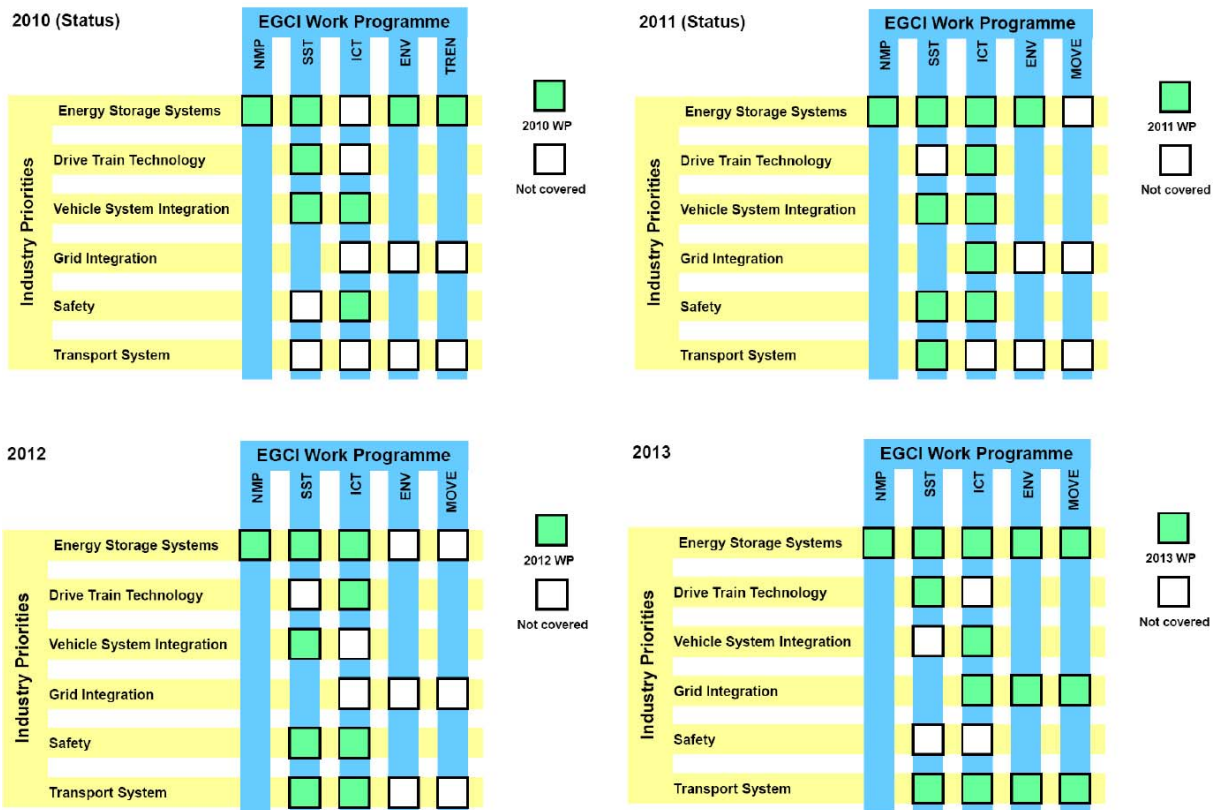


Figure 2 - Suggested coverage of R&D topics in the FP7 work programmes of the "Green Cars" initiative [6]

1.3 Standardisation

In order to promote the development of the internal market for electric vehicles and avoid the creation of market barriers, it is imperative that plugs, chargers and electric vehicles be inter-operable. This will allow users to use the same charging infrastructure for a range of electric vehicles whether in their own Member State or across borders. It will also facilitate charging at public access points and promote the concerted roll-out of the necessary charging infrastructures across the EU.



The European Commission has given a mandate to the standardisation organisations CEN, CENELEC and ETSI on 29th July, 2010 in order to:

- a) Ensure interoperability and connectivity between the electricity supply point and the chargers of all types of electric vehicles, including the chargers for removable batteries and off-board chargers.
- b) Appropriately consider any smart-charging issue with respect to the charging of electric vehicles.
- c) Appropriately consider safety, risk and electromagnetic compatibility of the charger of electric vehicles in the field of Directive 2006/95/EC (LVD) and Directive 2004/108/EC (EMC).

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2. The Fully Electric Vehicle

Dr. Pietro Perlo

Centro Ricerche Fiat, Torino, Italy

The text of this section expresses the personal views of the author and does not constitute, under any circumstances, a formal/official position of the European Commission

2.1 Benefits

a) Primary Energy Savings

Due to the EU's growing dependency on primary energy sources this parameter is very likely the most motivating one. In the EU-27, 73% of all oil (and about 30% of all primary energy) is consumed by the transport sector ^[1].

Neither first generation bio-fuels, nor third generation ones (algae), have proved to have a life cycle positive energy balance and appear to be inadequate solutions to the challenges posed by oil. At the same time, cellulosic bio-ethanol (second generation bio-fuels), although having a rather positive energy return, needs to be further developed before it can meet cost parity with petroleum based fuels ^[19,20,21,22].

Further improvements of Internal Combustion Engines (ICEs) are possible, but some 5% improvement in the peak efficiency will not meet the challenge posed by liquid fuels of which world demand is supposed to grow on average 1.3%/year until 2035 ^[2].

On the contrary, petroleum contributes less and less to the EU electricity generation mix with a rapidly decreasing share currently at around 3.0%^[3]. Electrical mobility alleviates the ever increasing EU critical imports of petroleum as well as the use of bio fuels whose production cost, until the net energy balance remains low, will for many years be strictly related to the price of oil.

On the basis of the current state of-the-art, the comparison of the overall primary energy consumption of Fully Electric Vehicles (FEVs) and ICEVs may lead to opposing conclusions in relation to the vehicle type and its mission (speed, range, use..). A comparison in a 5 to 15 years perspective can still be made, with a good degree of confidence, depending on the applied rate of change on technological evolution, including the mix of energy sources and the specific energy of batteries.

The choice of a reference mid size car with a mass of 1300kg, with batteries allowing a range of 150km with a single charge in a New European Driving Cycle NEDC (max speed 120km/h) is largely justified because it represents the vast majority of cases. For vehicles of this class, the operation of a full electric power train with the



current state of-the-art of automotive battery packs close to 180Wh/kg, the primary energy savings is in the order of 25% [4], reflecting a radical reduction of the petroleum used.

Extending the analysis to vehicle manufacturing, amongst the total 85-90 GigaJoules of primary energy needed to manufacture a mid-sized ICEV^[5], about 35-38 GigaJoules are required to produce the power train system (engine-transmission-exhaust systems). Battery cells having a specific energy above 200Wh/kg can be estimated to require 1200-1000MJ of energy per kWh of battery cell capacity [6]. The total energy needed to manufacture an electrical power train including a 30kWh battery pack and a 25kW nominal power motor is then equivalent to that necessary for the conventional ICEV power train.

In this regard it should be noted that battery technology is evolving very rapidly, for instance the specific energy of commercial Li-ion batteries has increased 8% a year CAGR for the last five years [7] while since the commercial advent of the Li-ion battery the energy needed to produce 1kWh of capacity can be estimated to have been reduced to 1/10th [6,8,9,10]. The speed of a state of-the-art production line of large soft prismatic Li-ion cells has doubled only during the last two years [11].

By 2020, with battery cells expected to more than double the current specific energies, at already above 250Wh/kg, the manufacture of FEVs will lead to considerable energy savings. In a 15 year term, FEVs are expected to meet both ranges and speeds of larger size ICEVs but their manufacturing requirements will use as much as 25-30% less energy than that required by equivalent Plug in Hybrids.

b) Reduction of Greenhouse Gas (GHG) Emissions

Clearly the convergence of renewable energies (RE) and electrified mobility appears the most appealing. The EU-27 is paving the way for RE to soon achieve over **70%** of new power installations^[12] with the goal that new installations of RE could reach 90% before 2020. In the EU, the transport sector causes 26% of all GHG emissions due to human activities ^[1,13]. Furthermore, the transport sector is the fastest growing source of greenhouse gases, and of the total from transport, over 85% are due to CO₂ emissions from road vehicles. Therefore, they are considered a major sector to target for a limitation of GHG emissions ^[13].



The differences between conventional mobility based on internal combustion engines (ICE) and EV in terms of CO₂ emissions reflects the EU mix of electricity generation. With fossils generating about 50% of the total electricity produced, renewable energy at 23% and nuclear at 27%, the European average CO₂ emission of electricity produced is in the range of 340-360g/KWh ^[14]. As a consequence, including the accumulated losses in line transmission, power inverters and battery charge, for the typical mid size FEV vehicle of reference, the total CO₂ emission is just half of the equivalent ICEVs. In a 2020 perspective with a likely EU share of renewable electricity at 40%, the total CO₂ emission of FEVs will continue to be half of the planned 2020 target at 95g/km ^[15].

c) Reduction of noxious emissions (raising public health)

Road transport remains the main source of many local noxious emissions including benzene, 1,3-butadiene, carbon monoxide (CO), nitrogen oxides (NO_x) and particulate matter (PM). Within urban areas, as much as 80% of noxious emissions are attributed to road transport. There is a growing body of evidence linking vehicle pollutants to severe health problems such as respiratory and cardio-pulmonary diseases and lung cancer. In general, according to the World Health Organisation, the emissions from car exhausts are responsible for more deaths than road accidents^[16,17].

EVs can contribute to the elimination of the side effects which are due to the local hydrocarbon combustion in conventional vehicles. The PM₁₀, SO₂ and NO_x emissions occurring during power generation are being continuously reduced because of the increased share of both natural gas and Renewable Energy with respect to coal.

2.2 Challenges

a) Range and Speed

A mid-sized EV in use for urban mobility will be designed such that it can be operated for most of the day by a single charge. However, on a highway, or more generally at velocities higher than 120km/h, the energy consumption depends mostly on the speed rather than on the distance covered. As a consequence, the combination of high speeds and long ranges in a single charge constrains the use of hybrid architectures until the next generation of much more advanced battery technology becomes available. However it is suggested to keep the R&D focus on small and mid size FEVs for the following reasons:

- Speed up applications for the dominating and growing size of urban mobility by focusing on critical technologies,
- The 2020 perspective for much higher specific energy of battery cells is expected to assure affordable FEVs capable of covering ranges well above 300km, even at high speeds,

- The ICT related R&D technological development made for FEVs will anyhow be beneficial for all kinds of hybrids.

b) Cost of Technology and Constraints on Raw Materials

The cost and supply constraints of the battery pack are acknowledged to be the most limiting factors for the wide scale introduction of electric vehicles. A detailed analysis of the raw materials used in the current state of the art Li-ion technology indicates that their selling price may be expected to reach affordable values at below 200€/kWh in the mid term^[4]. Learning effects due to large scale productions and further optimisation of the cell structure would very likely lead to more desirable price levels in a few years time, nevertheless, the user of the automobile is asking for much more than just lower costs. Progress has been dynamic in terms of design of lightweight chassis, powerful and efficient drive trains, aerodynamic shapes, and sophisticated computer controllers. However, the same statement cannot be made for battery technology.

Substantial reservations remain about the long-term performance of Li-ion batteries under the extreme heat, cold, humidity and vibration conditions that automobiles have to endure on a daily basis (if compensated for by appropriate protection measures). For instance the lifetime of a battery is halved for every 15 degree increase in



temperature, which requires complex and costly temperature conditioning, including either expensive liquid or forced air cooling of the overall battery compartment.

OEMs and suppliers will accelerate their efforts to build demonstration fleets of high value products using insufficiently proven Li-ion battery systems. But production volumes will remain small until enough hard performance data are gathered to justify the widespread commercialization of the technology. As a consequence, large format Li-ion battery supplies will be constrained for several years by inadequate manufacturing capacity which in its turn influences the rate of cost reduction.

Considering the size of the plants recently announced to specifically produce batteries for electrified vehicles, it can be deduced that the European production will not be sufficient to cover the expected demand by the automotive industry.

Batteries will not be available in adequate quantities during the regulatory compliance period and even insufficiently proven Li-ion batteries will be subject to daunting cost and supply constraints. In a nutshell, cost and supply constraints will leave the booming HEV, EV markets in a critical state of flux for several years.

The second large source of uncertainty is related to the availability of reliable and diversified supplies of metals, e.g. copper and permanent magnets that are necessary to ensure high efficiency and high power density (compact) electrical motors. At a fixed range, every 1% increase in the efficiency of the electrical motor is reflected in a typical 1,5% decrease in weight of the battery pack. An increased cost for a more efficient motor is therefore amply balanced by the reduction in weight and cost of the overall power train. While at a research level several solutions are pursued, it seems there will be no viable industrial alternative to NdFeB for at least another decade. The move from scant and critical sources of oil to a likely even more critical single source of permanent magnets should urgently address the development of both new high efficiency motors using limited weight of permanent magnets and completely new



motor designs. Like for the batteries, the production of low cost, efficient and compact motors using permanent magnet technology will not be available in adequate amounts and will be subjected to supply constraints for several years. Several manufacturers use rare earth magnets in their synchronous motors, but there are

other options which work rather well. The induction motor does not require rare earth metals. It is also possible to use a Variable Switched Reluctance (VSR) motor that does not use rare earth metals. Although VSR motors do have problems, they can be resolved. Moreover, VSR motors do not have the temperature limitations that are caused by rare earth metals. Also, rare earth metals are mechanically weak thereby

limiting speed and power. So actually, by running them much faster, VSR motors could be made smaller and lighter than motors using rare earth metals.

The issues of batteries, motors, and the scarcity of crucial materials, severely threaten the large scale introduction of electrified vehicles as they are hampering the enormous and crucial economic and environmental benefits that EVs can provide.

Europe should consider its own way of focussing on the areas (ICT) that would allow its industry to compete with or without a minimum use of exotic critical materials.

2.3 Vision, Milestones and Roadmap

The recent electrification roadmap^[4] published jointly by the ETPs EPoSS, ERTRAC, and SmartGrids is being adopted for conventionally sized cars.

However it is worthwhile noting that the demand for new forms of mobility is spreading all over the world, reflecting peoples' awareness of the ever increasing problems of providing primary energy and raw materials, of climate change and of the impact of noxious emissions on health. Rather than offering forms of mobility based on ever increasing prices, the industry is now faced with satisfying a rational demand for mobility. Not only clean, safe and low energy consumption and vehicles, but vehicles which require less energy to be produced, and use recyclable and eventually self disposable materials systems.



In the year 2000, Light Electrical Vehicles (LEVs) (i.e. bicycles, scooters, tricycles, mopeds and quad-cycles) accounted for a global production in the order of 100.000 per year, while in the 2010's they are expected to be produced in several tens of millions per year. To support these developments there is an ongoing replacement of lead-acid batteries with much more efficient and cleaner Li-ion ones. China and Japan are rolling out large scale production, addressing manufacturing cost issues. The European sales of e-bikes are expected to reach about 1.5Millions/year,

representing an incredible growth from the 2009 sales ^[18]. LEVs are now evolving to micro cars and conventional mid-sized cars. Electrification of conventional cars will follow a step by step approach starting with the smaller ones while covering at most urban mobility. Electrical mobility in an urban environment offers new solutions to the difficulties encountered by thermal engines (Clean ICEV requires costly and complex catalytic architectures and their radical downsizing implies a reduced overall efficiency. As a consequence, it is difficult to design new clean, safe and low cost small vehicles).

European companies will then be exposed to a **novel vertically organized supply chain** supported by large nations where regulations are made by fast acting Governmental Institutions. This is having, and will have, an ever increasing impact on the relations amongst Tier1-2 suppliers and OEMs, which is likely to be reflected in heavy industrial restructuring. European industries are then faced with managing the effects caused by this radical change to the supply chain, adopting quickly and properly sized competing instruments that could avoid the move of the European production to the new high tech countries.

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3. The Enabling Role of ICT for Fully Electric Vehicles

Dr. Gereon Meyer

VDI/VDE Innovation + Technik GmbH, Berlin, Germany

The text of this section expresses the personal views of the author and does not constitute, under any circumstances, a formal/official position of the European Commission

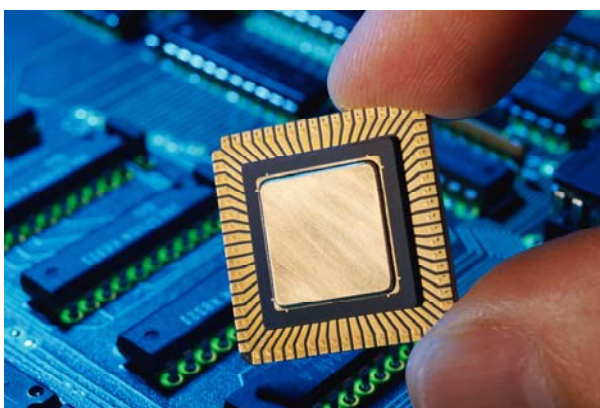
The electric power train, consisting basically of an electric machine and a battery, is as old as the concept of the automobile itself: Ferdinand Porsche, better known as the inventor of the Volkswagen Beetle, in the late 19th century first designed an electric car using wheel motors and an 80Ah lead acid battery providing 50km range. This invention was much praised at the 1900 Great Exhibition in Paris for not needing any sophisticated mechanical means of power transmission. However, electric vehicles equipped with heavy batteries and needing long recharging times could not compete with the unlimited range of cars with fuel powered internal combustion engines.

When the zero emission vehicle standards introduced in California in 1990 required 2% of all passenger cars to be emission free by 1998, the fully electric vehicle (FEV) had one of its short revivals in the 1996 General Motors EV1. A highly efficient passenger car with an energy consumption of about 100Wh/km using a 53Ah/312V lead acid battery that provided a range of 100km in an urban drive cycle (in 1999 with a 85Ah/343V NiMH battery: 200 km). The programme was stopped after about 1000 units had been built because the vehicle was considered unprofitable and demand was expected to be low. Thus, all vehicles were scrapped.

The recent political debate about energy security and climate change is again causing the public to ask for the alternatives provided by fully electric vehicles. Obviously, using electricity as the energy carrier provides a multitude of options for the primary source of energy, including wind and solar power, which would enable an enormous

cut of CO₂ emissions. Furthermore, the electric power train alone is more efficient than the internal combustion engine, even when considering the full chain of energy transfer from the primary source to the wheel (well-to-wheel analysis). In addition, it offers the opportunity to recover part of the kinetic energy lost during braking and reuse it for acceleration. At the same time, recent advancements in the performance of Li-ion batteries caused energy densities to rise by a factor of two as compared to NiMH with the perspective of another factor of three in the next ten years. Hence, several vehicle manufacturers announced the market introduction of electric vehicles recently.

However, due to high cost and weight, the available range of most fully electric vehicles will be restricted to about 200 km for the short to mid-term. Moreover, they will require several hours to recharge. Even though a range of 200kms is completely sufficient for almost all driving needs of a regular user, particularly in urban areas in Europe, the range restriction is considered a psychological barrier (“range anxiety”) that may hinder early market adoption. Two different approaches are now under discussion for tackling this issue, (a) the use of an internal combustion engine as a range extender (like in the electric drive mode of the Chevrolet Volt) and, (b) the application of Information and Communication Technologies (ICT), both internally for enhancing the energy efficiency and thus the range of the vehicle, and externally for prediction and making the driver aware of the available range (e.g. in the Nissan Leaf).



The second approach is particularly interesting from the perspective of ICT. It is aimed at reducing complexity and thus weight and at the same time increasing the energy efficiency by integrating a higher degree of electronic control, adaptive capabilities and intelligence to the system.

The role of ICT solutions and smart systems integration can be summarized as enabling the full electric vehicle

- by providing aware, caring and robust means of power and energy routing between accumulator cells, battery packs, motors and grids,

- by applying adaptive control and power electronic converters to electric motors and wheels,
- by actively enhancing the safety of road transport based on batteries and lightweight vehicles,
- by making the driver aware of the availability of energy and power and of the resulting restrictions in terms of range and comfort, and
- by guiding the driver to the next recharging station in case the car runs out of battery power.

Thus, smart systems will add synergy and harmonic interplay to the building blocks of the electric vehicle such that the drawbacks of today's batteries, e.g. the lack of energy density, lifetime and affordability, can be compensated.

3.1 ICT for Fully Electric Vehicles in the Context of the European "Green Cars" Initiative

The topic of ICT, components and systems as key technologies of the Fully Electric Vehicle was first brought onto the European agenda in summer 2008, when the Automotive working group of the European Technology Platform on Smart Systems Integration (EPoSS) and the European Commission's Directorate-General Information Society and Media (DG INFSO) jointly held an expert workshop on "Smart Systems for the Full Electric Vehicle". The results of the discussions were presented in a short strategy paper including a very first approach to a road map focussed on "Smart Systems for the Fully Electric Vehicle".

The EPoSS initiative may be considered a seed activity for making the European Green Cars Initiative one of the three Public Private Partnerships (PPPs) of the European Economic Recovery plan in late 2008. The European Technology Platforms EPoSS, European Road



Transport Research Advisory Council (ERTRAC) and Smart Grids constitute the private side of this PPP. Selected companies from the membership of the European Technology Platforms and representatives of all involved DGs of the European

Commission are part of a dedicated Ad-Hoc Industrial Advisory Group which is lead by Prof. Wolfgang Steiger (Volkswagen). That group was established for the purpose of making joint recommendations on what R&D priorities should be covered in the calls of the European Green Cars Initiative..

In October 2009, a ten-year roadmap on electrification was published. It quantifies the impact of the FEV on energy efficiency and climate protection and considers R&D needs in a broad spectrum of technology fields, emphasizing again the enabling role of ICT, components and systems: energy storage systems, drive train technologies, vehicle integration, safety, grid integration and integration into the transport system. This roadmap is continuously being reviewed and will soon be complemented by roadmaps on long distance transport as well as logistics and co-modality. First calls for proposals were launched and they closed in November 2009 and January 2010 respectively. A second round followed in July 2010. Positively evaluated projects from the first round started in May/June 2010.

Recently, the European Union substantiated the PPP European Green Cars Initiative by publishing a “European Strategy on Clean and Energy Efficient Vehicles” which complements R&D policies with regulatory and standardization frameworks.

The central web portal of the "Green Cars" Initiative is www.green-cars-initiative.eu.

4. ICT for FEV: DG INFSO's Participation in the "Green Cars" Initiative PPP

DG INFSO's participation in the "Green Cars" PPP is focused on **ICT for Fully Electric Vehicles**¹.

4.1 The 1st Call - Objective ICT-2010-10.3

The first call for proposals was published on 30th July, 2009 as Objective ICT-2010-10.3 and closed on 3rd November, 2009. As a result of the evaluation, small and medium scale focused research projects (STREPs) were selected. They encompassed the following research priorities for "Highly energy-efficient ICT components and solutions for Fully Electric Vehicles (FEVs)":

- (1) New solutions for overall efficiency gains in the electric vehicle,
- (2) Safe and robust sub-systems, and
- (3) Advanced failsafe systems and electrical architectures, new concepts for vehicle-to-road infrastructure integration.

Furthermore, a Coordination and Support Action (CSA) was selected. It targets the coordination of FEV research activities aiming at identifying and reviewing the needs in terms of research, components, systems integration and standardisation, including editing and regularly updating a European FEV roadmap.

4.2 Project Portfolio 2010

The following portfolio provides an overview of collaborative research projects launched in 2010 as a result of the first call for proposals. They have a strong industrial participation.

¹ The presented calls for proposals are part of the ICT Work Programme 2010-2011: ftp://ftp.cordis.europa.eu/pub/fp7/docs/wp/cooperation/ict/c-wp-201101_en.pdf

CASTOR

Car Multi Propulsion Integrated Power Train

VISION & AIM

The main objective of **CASTOR** is to integrate an innovative distributed propulsion system on fully electrical vehicles. Future electrical propulsion concepts demand more efficiency and less complexity with great functionality, high robustness and light weight and need to run in a wide ambient temperature range.

CASTOR is aimed at:

- Energy saving of 10 - 20% with respect to present propulsion systems.
- Cost reduction of about 25% (TBD) with respect to present propulsion systems.
- Increasing the safety due to traction properties and improved integrability into drive applications.
- Mileage improvement of 15 -20% due to higher efficiency and less weight.

How these goals will be achieved:

- Advancements in efficiency and safety by implementing a multi propulsion power train enabling novel driving functionalities based on the holistic understanding of propulsion and related energy conversion needs.
- Integration of the energy storage with the propulsion unit advancing the current state-of-the-art.
- Novel conversion topologies like direct power conversion and battery to motor phase alignments reducing the amount of active switching elements.
- Application of high efficiency control structures and modules in automotive technology ensuring robustness, reliability, drastically reduced maintenance and architectural simplicity.
- Distribution and delocalization of distributed propulsion systems in order to minimize energy consumption assuring the maximum safety of the vehicle.
- Development of smart electric system controls in order to improve propulsion and energy management and create an intelligent network on-board vehicle.
- Simplification of production chain for distributed propulsion systems through a drastic simplification of system architecture.
- The research need is not only based on the integration of the component functionalities but also considering a holistic approach for the thermal management especially related to the restricted operation temp. of Li-Ion batteries.

CASTOR PROJECT NUMBER: 260176

CONTACT: Reiner John, Infineon

WEBSITE: tbd

TIMELINE: 01/06/2010 – 30/05/2013

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 5,315,615 €
EC Funding : 3,400,000 €



PROJECT PARTNERS:

1. INFINEON TECHNOLOGIES AG, Germany
2. STIFTELSEN SINTEF, Norway
3. CENTRO RICERCHE FIAT SCPA, Italy
4. VOLKSWAGEN AG, Germany
5. FICOMIRRORS SA, Spain
6. THE UNIVERSITY OF SHEFFIELD, United Kingdom
7. Magnomatics Limited, United Kingdom



EcoGem

Cooperative Advanced Driver Assistance System for Green Cars

VISION & AIM

EcoGem aims at providing efficient ICT-based solutions to this great issue, by designing and developing a FEV-oriented highly-innovative Advanced Driver Assistance System (ADAS), equipped with suitable monitoring, learning, reasoning and management capabilities that will help increase the FEV's autonomy and energy efficiency.



EcoGem will base its approach on rendering the FEV:

- capable of reaching the desired destinations through the most energy efficient routes possible;
- fully aware of surrounding recharging points/stations while on move.

To achieve its goals, EcoGem will develop and employ novel techniques:

- on-going learning-based traffic prediction;
- optimised route planning;
- interactive and inter-operative traffic, fleet and recharging management via V2V and V2I interfaces and communication.

EcoGem's key objective is to infuse intelligence and learning functionalities to on-board systems, enabling autonomous as well as interactive learning through V2X interfacing. EcoGem vehicles will learn over time to predict (and thus avoid) congested routes, based on experience that they gather. This learning process will eventually render each EcoGem FEV capable of autonomously classifying routes according to their degree of congestion, enabling energy-driven route planning optimisation. The EcoGem ADAS will additionally cater for the complete planning of the vehicle's recharging strategy. This optimisation process will typically include automated battery monitoring and various levels of proactiveness, optimised scheduling according to several parameters (battery levels, energy consumption rate, desired destination, present location, daytime, traffic, user agenda, etc.), and real-time booking of recharging points.

EcoGem PROJECT NUMBER: 260097

CONTACT: Kerem Kürklü, TEMSA

WEBSITE: www.ecogem.eu

TIMELINE: 01/09/2010 – 30/08/2013

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 3,157,978 €
EC Funding : 2,043,922 €

PROJECT PARTNERS:

1. TEMSA AR-GE ve Teknoloji A.S., Turkey
2. PININFARINA S.p.A., Italy
3. Planung Transport Verkehr AG, Germany
4. European Virtual Engineering, Spain
5. HI-IBERIA Ingenieria Y Proyectos, Spain
6. University of Bradford, United Kingdom
7. Motor Transport Institute, Poland
8. Institute of Communication and Computer Systems, Greece
9. COSMOTE Mobile Telecommunications SA, Greece
10. SOFTECO Sismat S.p.A., Italy
11. NAVTEQ B.V., The Netherlands



eFuture

Safe and Efficient Electrical Vehicle

VISION & AIM

The idea of intelligent vehicles that cope with safety requirements and adapt their energy needs is a long-term strategy. We have started our work with successive European research projects in the last years by starting with the development of a drive-by-wire platform, but the combustion engine is still a drawback. **eFuture** wants to prepare the next generation of electric vehicle based on our first prototype by creating a platform which minimises its energy needs but can still optimise dynamically its decision between safety and energy efficiency.



Our key issues will be the optimisation of this energy usage and its influence on the vehicle/driver. We have already seen that optimising each component separately is not enough, an overall concept is mandatory to look at the interactions between the components. The strategies to control the actuators will be integrated for safety issues, comfort driving and energy efficiency and the management of the transitions between these controllers. Second ADAS functions will be re-worked to manage these different aspects and a decision unit will base on the proposed time horizon to pre-compensate the transition between modes for energy optimisation. Beside the technical developments, a major aim of the project is to look at the driver who will be confronted with dynamical properties as this energy management will have a high impact on driving.

At the end **eFuture** will be ready with a static (right configuration of components) and a dynamic (software based synchronization of command and execution layer) optimisations. Transitions between different vehicle behaviours (safety, performance, efficiency) will be designed and a strategy set for the priorities in terms of energy needs during requests collision will be developed. In addition the acceptance of the driver to this dynamical behaviour will be investigated robustness.

eFuture PROJECT NUMBER: 258133

CONTACT: Pascal Dégardins, Intedis

WEBSITE: www.efuture-eu.org

TIMELINE: 01/09/2010 – 31/08/2013

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 6,962,428 €
EC Funding: 3,952,407 €

PROJECT PARTNERS:

1. INTEDIS GMBH & CO KG INT Germany
2. Tata Motors European technical Centre PLC, United Kingdom
3. MILJØBIL GRENLAND AS , Norway
4. Hella KGaA Hueck & Co., Germany
5. Institut Français des Sciences et Technologies des Transports, de L'aménagement et des Réseaux, France
6. WIVW WÜRZBURGER INSTITUT FÜR VERKEHRSWISSENSCHAFTEN GMBH , Germany



ICT4FEV

Information and Communication Technologies for the Full Electric Vehicle

VISION & AIM

The proposed coordination action addresses enabling technologies of full electric vehicles (FEV). The focus of the initiative is set on ICT which open new technology paths towards energy efficiency, functionality and usability and are complementary to future advances in performance of battery cell technology. To fight climate change, cut emissions and secure energy supply, transport based on FEVs will soon be strongly demanded by public and private stakeholders worldwide. It can be foreseen that early technology leadership will be determinant for the global competitiveness of major European industries such as the automotive, energy and ICT sector.



ICT4FEV is aiming at building a R&D community, creating a European roadmap and recommending standards, regulations, business cases and R&D priorities for the FEV. In its core consortium it will therefore bring together for the first time major industrial partners to start a dialogue on a common understanding about impact, R&D priorities, infrastructure needs and requirements. Opportunities of technology transfer, e.g. between electric road vehicles and aircrafts, shall be taken into account and foresighted recommendations shall be made.

To broaden the view of its work, **ICT4FEV** will involve more than 15 key stakeholders representing both academia and the involved industry sectors from across Europe. Particularly involved will be vehicle manufacturers and suppliers, companies from the energy sector focussing on the vehicle-to-grid interface (V2G) and companies from the electronics and semiconductor sector dealing with components and systems. Furthermore, representatives of European and international public authorities shall take part in the dialogue. The outcome of **ICT4FEV** will serve as guideline for setting strategic priorities on a European level and by presenting the European FEV strategy at international events it will help to demonstrate the innovation strength of Europe in the field of FEV. At the same time, ICT4FEV shall serve as a platform for public information and network building in Europe.

ICT4FEV PROJECT NUMBER: 260116

CONTACT: Gereon Meyer, VDI/VDE-IT

WEBSITE: www.ict4fev.eu

TIMELINE: 01/05/2010 – 30/04/2012

BUDGET AND FUNDING SCHEME:

Coordination and Support Action (CSA)

Overall Cost: 1,394,165 €

EC Funding: 999,474 €

PROJECT PARTNERS:

1. VDI/VDE INNOVATION + TECHNIK GMBH, Germany
2. CENTRO RICERCHE FIAT SCPA, Italy
3. SIEMENS AG, Germany
4. AVL LIST GMBH, Austria
5. NXP SEMICONDUCTORS NETHERLANDS BV, Netherlands
6. EUROPEAN AERONAUTIC DEFENCE AND SPACE COMPANY EADS FRANCE SAS, France



ID4EV

Intelligent Dynamics for Fully Electric Vehicles

VISION & AIM

The objective of the **ID4EV** project is to develop energy efficient and safe brake and chassis systems for the needs of fully electric vehicles and the improvement of active safety and comfort for a faster introduction of fully electric vehicles. These systems will be optimized to the requirements for FEVs. Beside the development and optimization of the most relevant sub-systems of a vehicle with regard to active safety and comfort, the brake and the chassis system, optimization on vehicle level will be done with a new approach of a network system as well as new HMI concepts for FEVs.



Electrified auxiliaries like the brake systems and the chassis will lead to new possibilities to vehicle control and a better cooperative interaction between these distributed systems. For a fast introduction of fully electric vehicles these systems have to be safe and must have a defined fail safe concept. The aim is to provide absolute safe electrified brake and chassis systems that lead to a high user/customer acceptance. To reach this safety approach the target is to adapt existing systems to the requirements of fully electric vehicles.

The project will concentrate on the topics of energy efficiency, safety and the interaction between the vehicle, the optimized systems and the driver.

To address both possibilities of drivetrain concepts of fully electric vehicles, both concepts will take into account and their impact of the adapted systems will be analysed and solutions presented.

To reach a significant breakthrough of fully electric vehicles the adapted systems will be tested on test benches and under real world conditions in demonstrator vehicles to ensure the functionality and to prove the safety.

ID4EV PROJECT NUMBER: 260070

CONTACT: Roger Bauer, Continental

WEBSITE: www.id4ev.eu

TIMELINE: 01/06/2010 – 31/07/2012

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)

Overall Cost: 6,716,536 €

EC Funding: 3,799,402 €

PROJECT PARTNERS:

1. Continental Engineering Services GmbH, Germany
2. fka Forschungsgesellschaft Kraftfahrwesen mbH Aachen, Germany
3. RENAULT s.a.s. represented by GIE REGIENOV, France
4. ZF FRIEDRICHSHAFEN AG, Germany
5. IDIADA AUTOMOTIVE TECHNOLOGY SA, Spain
6. CHALMERS TEKNISKA HOEGSKOLA AB, Sweden
7. NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK – TNO, Netherlands
8. CONSORZIO INTERUNIVERSITARIO PER L'OTTIMIZZAZIONE E LA RICERCA OPERATIVA – ICOOR, Italy



MAENAD

Model-based Analysis & Engineering of Novel Architectures for Dependable Electric Vehicles

VISION & AIM

Fully Electric Vehicles (FEV) promise clear benefits to society. At the same time, the engineering of FEV introduces significant new challenges. FEV will be highly integrated and increasingly dependent on software and electronics. FEV systems will have more authority, share common components and rely less on mechanical backups. New complex power management and optimization algorithms are needed to ensure high performance, range of travel and low energy consumption.

MAENAD

We argue that the challenges faced in the engineering of FEV are already partly met by EAST-ADL2, an emerging automotive architecture description language (ADL) compliant with AUTOSAR, and that EAST-ADL2 is the appropriate vehicle for fully meeting these challenges. **MAENAD** will extend EAST-ADL2 with advanced capabilities to facilitate development of dependable, efficient and affordable FEV. The project will achieve language and tool support for:

- Support for the ISO 26262 automotive safety standard, including a novel approach for automatic allocation of safety requirements to components of an evolving architecture
- Effective model-based prediction of quality attributes of FEV such as the dependability and performance, via use of advanced, scalable, automated techniques.
- Automated exploration of potentially huge design spaces to achieve better or optimal trade-offs among dependability, performance and cost.

The scope of the modelling language and analysis focuses on the system structure and dynamics, in terms of physical, computational and communication components, their composition and interactions. To achieve those objectives, **MAENAD** will exploit and further develop the present state of the art in model-based design, assessment and optimization technologies. In addition, **MAENAD** will propose an overall design methodology for FEV and evaluate its application via a realistic case study on an innovative FEV system which represents a current design challenge.

Maenad PROJECT NUMBER: 260057

CONTACT: Ramin Tavakoli, Volvo

WEBSITE: www.maenad.eu

TIMELINE: 01/09/2010-31/08/2013

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)

Overall Cost: 4,047,589 €

EC Funding: 2,467,593 €

PROJECT PARTNERS:

1. VOLVO TECHNOLOGY AB, Sweden.
2. CENTRO RICERCA FIAT SCPA , Italy
3. Continental Automotive GmbH, Germany
4. MECEL AB MEC ,Sweden
5. 4S-SISTEMI SICURI E SOSTENIBILI SRL - 4S SRL, Italy
6. Metacase Consulting Oy, Finland
7. Pulse-AR S.A.R.L, France
8. SYSTEMITE AB, Sweden
9. COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES, France
10. KUNGLIGA TEKNISKA HOEGSKOLAN, Sweden
11. TECHNISCHE UNIVERSITAT BERLIN, Germany
12. UNIVERSITY OF HULL, United Kingdom



P-MOB

Integrated Enabling Technologies for Efficient Electrical Personal Mobility

VISION & AIM

The **P-MOB** project is aiming at breaking the link between the growth in transport capacity and increased fatalities, congestion and pollution. Transport is responsible for 73% of total oil consumption in EU, it is a major source of pollution and greenhouse gas emissions and the chief sector driving future growth in world oil demand. Most continents have an increasing dependence from primary energy. The demand on increased safety, reduced noxious and green house emissions has the following expectations: less than 30.000 fatalities in EU in the 2010, radical reduction of both CO2 and NOx aiming at zero local emissions.



Transport will be faced to the followings: People and good will increase their need of mobility some 35% per decade for at least 3-4 decades - The number of megalopolis is increasing and most of the traffic will be urban - Urban centres are more and more congested and closed to traffic; 1% of our GDP is wasted in congestion - Mobility is related to invariants such as: people move 1 hour a day - The average speed, since it has measured the first time in 1923, is stable in the range 35-40km/h - people tend to relate mobility to a mental freedom and as many as 90% of km are run with a single occupant - In EU 1 more million cars are on the road every 50 days and globally the number of vehicles is projected to 2200 millions in the 2050. The emerging markets require at most low cost and environment compatible vehicles. **P-MOB** addresses the above challenges proposing: a novel concept of fully electrical personal mobility, reduction of system complexity concentrating on the essentials, advanced systems integration including solar cells, e-motor and magnetic torque control of the wheel, power-energy management, distributed pack of accumulators, technologies to sell-buy electricity by adaptable vehicle to grid connections. On an average day in South EU the propose vehicle is aiming at 20 km/day by using solar energy only.

P-Mob PROJECT NUMBER: 260087

**CONTACT: Pietro Perlo,
Centro Ricerche Fiat**

WEBSITE: <http://eeepro.shef.ac.uk/p-mob>

TIMELINE: 01/05/2010 – 30/04/2013

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 4,352,595 €
EC Funding: 2,788,000 €

PROJECT PARTNERS:

1. CENTRO RICERCHE FIAT SCPA CENTRO, Italy
2. Mazel Ingenieros, SOCIEDAD ANONIMA, Spain
3. INTEGRA RENEWABLE ENERGIES SRL, Italy
4. THE UNIVERSITY OF SHEFFIELD. United Kingdom
5. SIEMENS AG, Germany
6. POLI MODEL SRL, Italy
7. Magnomatics Limited MGM United Kingdom



ELVIRE

ELectric Vehicle communication to Infrastructure, Road services and Electricity supply

This project was launched as result of the call "ICT for Safety and Energy Efficiency in Mobility" (ICT-2009.6.1 Theme).

VISION & AIM

Based on typical missions of an E.V. as use cases, it is the project's purpose to develop an effective system, which is able to neutralize the driver's "range anxiety" and encourage the customers to embark the fully electric road transport, focused on:

- an on-board E-energy communication, combined with its respective in-vehicle E-service layer,
- a customer oriented, open external service platform needed for the optimal interaction between the user/vehicle, the data processing & service provision layer and an intelligent electricity infrastructure,
- the seamless and reliable interdependent functioning of all relevant systems under real operating conditions.
- a consideration of complementary items, such as the protection of privacy, e.g. with "electricity-googling", & data authenticity.



All ELVIRE functionalities to be taken into account will be scrutinized, if existing or emerging cooperative system technologies can be used or extended. Great emphasis is placed on the "openness of the E(lectricity)-service platform", applicable to all brands and granting access to multiple players maintaining the customers' choice.

ELVIRE PROJECT NUMBER: 249105

PROJECT PARTNERS:

CONTACT: Hannes Lüttringhaus, Continental

WEBSITE: www.elvire-project.org

TIMELINE: 01/01/2010 – 01/01/2013

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 9,241,682 €
EC Funding: 5,192,783 €

1. Continental Automotive GmbH, Germany
2. RENAULT, France
3. Better Place Labs Israel LTD, Israel
4. Volkswagen AG
5. Commissariat a l'Energie Atomique, France
6. SAP AG, Germany
7. ERPC GmbH, Germany
8. Lindholmen Science Park Aktiebolag, Sweden
9. Institut für Angewandte systemtechnik Bremen GmbH, Germany
10. Endesa Network Factory SL, Spain
11. Erasmus Hogeschool Brussel, Belgium



4.3 The 2nd Call - Objective GC-ICT-2011-6.8

Eight projects were retained as a result of the second call for proposals within the objective “ICT for Fully Electric Vehicles”. The call was published on 20th July 2010 and closed on 2nd December 2010. At the time of publication of this brochure, these projects were in the final negotiation phase and were planned to be launched in summer 2011. They encompass the following target outcomes and priorities:

- a) Energy/Power Storage Systems
- b) Architectures for Energy, Communication and Thermal Management
- c) Vehicle-to-grid Interface (V2G)
- d) Vehicle Stability Control

4.4 Project Portfolio 2011

The following portfolio provides an overview of the eight selected projects with a strong industrial participation.

ESTRELIA

Energy Storage with lowered cost and improved Safety and Reliability for electrical vehicles

VISION & AIM

High costs together with concerns for driving range, reliability and safety are still the main hindrance for market adaption of full electrical vehicles (FEVs). ESTRELIA aims to provide building blocks with enhanced reliability and safety at lowered costs for smart energy storage for FEVs. This is accomplished by proposing a modular approach with ultracapacitor powerpacks with higher density with 50% energy advantage developed by Corning and evaluated by Valeo and Austrian Battery Research Lab. This will be enabled by BMS ICs based on a new concept in the HV-technology from austriamicrosystems enhancing also the modularity of Li-Ion batteries as energy packs. It will for the first time provide a flexible active cell balancing chip set also suited for the high accuracy demanding monitoring of Li-Ion batteries.



The BMS ICs and architecture proposed from FHG will be verified on prototypes built by E4V. Tests with new HV test equipment developed by Active Technologies will proof test isolation protections in the environment of several 100's V as present in FEVs. The new BMS IC concept will enable higher efficiency by lower energy loss and improved long term reliability and lower the electronic component costs for BMS of Li-Ion energy packs by 1/3rd. ESTRELIA will also develop new safety sensors which are based on silicon based MEMS approaches delivering enhanced safety functions at lowered cost compared to existing solutions. While the gas sensor will allow detection of very low levels of volatile organic compounds as emitted in thermal overruns of battery packs, the new spark detector concept will enable general safety functions by flame detection from all hazardous events in a FEV. Finally the development of new actuators as low cost power antifuse by FhG together with the new energy management HW (BMS IC) and SW will enable dynamic reconfigurable topologies for the energy storage unit, thus still enabling the functionality of the FEV despite single failing cells.

ESTRELIA PROJECT NUMBER: 285739

**CONTACT: Ewald Wachmann,
Austriamicrosystems AG**

WEBSITE: tbd

TIMELINE: 01/05/2011-30/04/2014

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 6,885,559 €
EC Funding: 4,359,989 €

PROJECT PARTNERS:

1. Austriamicrosystems AG, Austria
2. Valeo Electrical Systems, France
3. Fraunhofer IIB, Germany
4. Corning SAS, France
5. Austrian Battery Research Laboratory GmbH, Austria
6. Applied Sensors GmbH, Germany
7. CEA LETI, France
8. Active Technologies S.R.L., Italy
9. E4V, France



PowerUp

Specification, Implementation, Testing, and Standardisation of Vehicle-2-Grid Interface

VISION & AIM

PowerUp aims to develop the Vehicle-2-Grid (V2G) interface, involving a full development cycle of physical/link-layer specification, charging control protocol design, prototyping, conformance testing, field trials, and standardisation. Its results will ensure that FEVs smoothly integrate into emerging smart-grid networks. Thereby the efficiencies resulting from robust grid operation may be achieved; V2G capabilities will smoothen the daily fluctuation of electricity demand and will enable FEVs to act as emergency energy supplies.



To achieve these desired results, it is essential that any electric vehicle type would be compatible with any European smart-grid network. V2G technology will be developed in liaison with the ongoing ISO/IEC standardisation of the V2G interface, and it will extend existing smart-metering standards and ETSI ITS standards for vehicular communications. On the grid side, smart electric meters will be enhanced for V2G capability and V2G-specific demand balancing control algorithms will be researched. The specification phase will synthesise requirements of both vehicle manufacturers and utility operators. The produced V2G adapter prototypes will undergo conformance testing and field trials. The testing part will also cover safety and security aspects. The field trial activities will demonstrate end-to-end integration with the chain of smart-grid control systems. These trials will be furthermore complemented by simulations of larger V2G uptake rates, which assess V2G impact on grid stability and robustness. The validated PowerUp results will be contributed into standardisation, completing the overall R&D cycle. We aim to ensure industrial consensus on V2G interface, and carefully trial V2G implementations in a realistic integrated environment. PowerUp partners are capable of follow-up project results deployment; its impact will facilitate reaching FEVs' full potential economic and environmental benefits.

POWERUP PROJECT NUMBER: 285739

CONTACT: Andras Kovacs, Broadbit

WEBSITE: www.power-up.org

TIMELINE: 01/07/2011-30/06/2013

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)

Overall Cost: 3,722,078 €

EC Funding: 2,413,515 €

PROJECT PARTNERS:

1. BroadBit Slovakia
2. Centro Ricerche Fiat, Italy
3. Corinex, Slovakia
4. DENSO AUTOMOTIVE Deutschland GmbH, Germany
5. ETSI, France
6. Institute of Communications and Computer Systems, Greece
7. iTron, France
8. Systema, Greece
9. Technolution, Netherlands
10. Volvo Technology VTEC, Sweden
11. Public Power Corporation of Greece PPC, Greece



E-VECTOORC

Electric-vehicle control of individual wheel torque for on- and off-road conditions

VISION & AIM

The E-VECTOORC project brings together 11 complementary partners from industrial and research backgrounds to address the individual control of the electric motor torques of fully electric vehicles to enhance safety, comfort and fun-to-drive in both on- and off-road driving conditions. The key objectives of the proposal are:

- Development and demonstration of yaw rate and sideslip angle control algorithms based on the combination of front/rear and left/right torque vectoring to improve overall vehicle dynamic performance.
- Development and demonstration of novel strategies for the modulation of the torque output of the individual electric motors to enhance brake energy recuperation, Anti lock Brake function and Traction Control function.



The benefits of these strategies include reductions in: i) vehicle energy consumption, ii) stopping distance, and iii) acceleration times. All developed algorithms will include failsafe strategies and controlled shutdown procedures. The overall control strategy will employ a modular control architecture to allow an easy implementation for different vehicle layouts (e.g., the number of individually controlled motors), vehicle sizes and vehicle applications (from small city cars to sports cars and SUVs). The activity will be carried out using vehicle dynamics simulations and Hardware-In-the-Loop testing of vehicle components and subsystems, which will be complemented by full scale experimental testing of the entire system using a highly versatile vehicle demonstrator that can represent drivetrain architectures with 2, 3 or 4 electric motors. Experimental testing will provide comprehensive information for quantifying the benefits of the proposed control system in both on-road and off-road driving conditions. Hence, in line with the ICT Work Programme for FEVs, the potential of electric drive architectures for improving vehicle stability control will be more fully exploited and measured through the E-VECTOORC control approach.

E-VECTOORC PROJECT NUMBER: 284708

CONTACT: Arnold Sorniotti, University of Surrey

WEBSITE: tbd

TIMELINE: planned start - summer 2011
duration – 3 years

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 4,763,986 €
EC Funding: 3,094,997 €

PROJECT PARTNERS:

1. University of Surrey, UK
2. Technische Universität Ilmenau, Germany
3. Jaguar Cars Ltd., UK
4. Land Rover, UK
5. Flanders DRIVE, Belgium
6. Inverto, Belgium
7. Fundacion CIDAUT, Spain
8. Instituto Tecnológico de Aragón, Spain
9. Škoda Auto A.S., Czech Republic
10. Kompetenzzentrum - Das virtuelle Fahrzeug, Forschungsgesellschaft mbH, Austria
11. TRW Automotive Lucas Varity GmbH, Germany



SMARTV2G

Smart Vehicle to Grid Interface

VISION & AIM

In a context of an obliged continuous optimisation of the energy consumption rates in developed societies, embedded systems and solutions can perform a significant role in the transition process towards a Sustainable Urban Life concept in European countries. One of the main and most promising technological areas that are expected to be able to contribute in a most relevant way to that overall target is the one constituted by the electric vehicles. In that sense, the main objective targeted by the SMARTV2G Project aims at connecting the electric vehicle to the grid by enabling controlled flow of energy and power through safe, secure, energy efficient and convenient transfer of electricity and data.

This will entail, among other specific objectives, the development of a new generation of technologies allowing the seamless and user-friendly energy load of electric vehicles in urban environments in the frame of an intelligent energy supply network managed by an embedded control system.

In order to be able to achieve the exposed objectives, the project Consortium is comprised of a well-balanced group of 7 partners from 4 European countries with complementary skills and expertise, including



all the necessary profiles to deal with the scheduled project work plan. Furthermore, key industrial companies in the field of electromobility have shown their interest and commitment to the project. This interdisciplinary group of the energy industry, alternative energy components developers, software & embedded systems developers, and technological R&D centres are strongly committed to efficiently coordinate their resources over the 36 months duration of the project in order to be able to reach all expected project outcomes.

SMARTV2G PROJECT NUMBER: 284953

CONTACT: Sixto Santonja, Instituto Tecnológico de la Energía

WEBSITE: tbd

TIMELINE: 01/06/2011-31/05/2014

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 3,274,370 €
EC Funding: 2,520,000 €

PROJECT PARTNERS:

1. Instituto Tecnológico de la Energía, Spain
2. Fraunhofer Gesellschaft – Institut für Integrierte Systeme und Bauelementetechnologie, Germany
3. Etrek, Slovenia
4. CIT Development, S.L., Spain
5. Sapienza Università di Roma SAPIENZA, Italy
6. Technomar, Germany
7. Elektro Ljubljana, Slovenia



e-DASH

Electricity Demand and Supply Harmonization for EVs

VISION & AIM

The e-DASH project aims at the harmonization of electricity demand in Smart Grids for sustainable integration of electric vehicles. This is addressed by an intelligent charging system supported with real-time exchange of charge related data between EVs and the grid. Adopting the e-DASH approach allows high current fast-charging for large numbers of EVs in a brand-independent way and price-adaptive charging/reverse-charging at optimum price for the customer leading to increased desirability of EVs. In order to prevent damages of costly EV batteries, sophisticated charge control is inevitable. Moreover e-DASH also focuses on real-time grid balancing for unpredictable demand/supply situations according to spatially and temporally changing energy requirements (e.g. temporally connected EVs and regenerative energy sources). These objectives are enabled by the development of a V2G (Vehicle-to-Grid) front-end covering FEV Charging (V2G) and FEV Support (V2OEM Back-End Interface). Furthermore, the project



addresses an E-Mobility Hub for authentication and billing and the development of an OEM Back-End for enabling V2G Brokering. Together with the Demand Clearing House and the respective EV demand & supply management, the e-DASH proposal targets intelligent infrastructure harmonization and delivers unique and innovative selling propositions for new V2G businesses and services. The technological developments are surrounded by cross-cutting activities like contributions to the ISO/IEC standardization and system integration and validation.

e-DASH PROJECT NUMBER: 285586

CONTACT: Adrian Zarcula, Volkswagen

WEBSITE: tbd

TIMELINE: 01/09/2011-31/08/2014

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)

Overall Cost: 8,543,424 €

EC Funding: 5,300,000 €

PROJECT PARTNERS:

1. Volkswagen, Germany
2. Renault, France
3. Centro Ricerche Fiat S.C.p.A. Italy
4. RWE, Germany
5. ENDESA, Spain
6. CEA List, France
7. ERPC GmbH, Germany
8. Atos Origin, Spain
9. TRIALOG, France
10. TU Dortmund, Germany
11. Knowledge Inside, France
12. Eurisco, Denmark
13. ATB Bremen, Germany
14. Broadbit, Slovakia



Smart-LIC

Smart and Compact Battery Management System Module for Integration into Lithium-Ion Cell for Fully Electric Vehicles

VISION & AIM

Smart-LIC addresses the development of a Battery Management System concept aiming at:

- Lower system complexity by a radical reduction of wiring and connectors cause of EMF emissions and major source of malfunctions
- Higher efficiency of the battery packs because of the local control
- Increased overall reliability such that failures would be determined by battery cells rather than by electronics and wiring connectors
- Increased flexibility of the overall energy-power routing such to assure that all cells could perform at their maximum rating independently from the rating of the others
- Radical overall cost reduction of the overall BMS because of reduced cabling and connectors as well as simplification of the electronics
- Increased precision in determining the states of charge, of health, and of function of the individual cells and of the entire battery by applying a new cell / battery model based on electrochemical impedance spectroscopy (EIS)
- Reduced maintenance of the battery packs assured by the monitoring of the single cell



(macrocell) with the possibility to switch it off from the rest of the pack

- Reduced cost of ownership for the end user due a significant increase in battery lifetime caused by the improved management on cell level

The ambitious objectives are obtained by realizing the BMS module as a system-in-package (SiP) directly integrated into the lithium-ion cell for fully electric vehicles by using advanced packaging technologies. Early demonstration of the technology will be made by preparing specific battery packs to be installed both on a commercially electrified van vehicle for in the city delivery services and on a FEV of new concepts for urban mobility.

Smart-LIC PROJECT NUMBER: 284879

**CONTACT: Jochen Langheim,
STMicroelectronics**

WEBSITE: tbd

TIMELINE: planned start - summer 2011
duration - 3 years

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 5,761,203 €
EC Funding: 3,476,318 €

PROJECT PARTNERS:

1. STMicroelectronics France, Italy, Germany
2. Berliner Nanotest und Design GmbH, Germany
3. CRFiat, Italy
4. TU Chemnitz, Germany
5. Fraunhofer ENAS, Germany
6. Arcotronics Industries, Italy
7. Micro-Vett, Italy
8. Continental, Germany



OpEneR

Optimal Energy Consumption and Recovery for Fully Electric Vehicles

VISION & AIM

Today's Fully Electric Vehicles (FEV) has limited driving ranges. Customer surveys prove an adequately long and dependable driving range is more important than the cost of ownership. Therefore considerable efforts are being made to meet this challenge, e.g. higher capacity batteries and powertrain efficiencies. The **OpEneR** project (**Optimal Energy consumption and Recovery**) addresses this fundamental FEV weakness. OpEneR aims to unlock the FEV market by increasing the driving range, not by enhancing battery technologies, but by the development of an intelligent energy management and recovery system, integrating existing subsystems with on-board and off-board sensors. The objective is a new energy manager coordinating control strategies to maximise real world energy saving. The system provides advanced driver support based on a networked architecture comprising battery management, emachine, regenerative braking, satellite navigation, dashboard displays, whilst integration of the vehicle stability controller and environmental sensing care also for safety issues. OpEneR considers the dynamic boundary conditions electric braking, i.e. traction limits, system



temperatures, battery charge. The driver is assisted to maximise energy recovery, avoiding unnecessary disc braking. Driver support includes estimated braking distance, recuperation capability visualization and braking tips based on traffic flow / navigation data. This requires a new integrated approach where all available information is used to generate safe and efficient predictions. Currently little data is exchanged between the diverse subsystems and no overall HMI concept exists. OpEneR addresses these issues to maximise efficiency and recuperation to significantly extend FEV range. The final project goal is to demonstrate the benefits of OpEneR strategies with 2 fully operational FEV tested in real world conditions.

OpEneR PROJECT NUMBER: 285526

CONTACT: Kosmas Knödler, Robert Bosch GmbH

WEBSITE: tbd

TIMELINE: 01/05/2011-30/04/2014

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
EC Funding: 7,741,705 €
Overall Cost: 4,400,000 €

PROJECT PARTNERS:

1. Robert Bosch GmbH, Germany
2. Peugeot Citroën Automobiles SA, France
3. Robert Bosch Car Multimedia GmbH, Germany
4. AVL List GmbH, Austria
5. Centro Tecnológico de Automoción de Galicia, Spain
6. Forschungszentrum Informatik Karlsruhe, Germany



SuperLIB

Smart Battery Control System based on a Charge-equalization Circuit for an advanced Dual-Cell Battery for Electric Vehicles

VISION & AIM

The STREP project “Smart Battery Control System based on a Charge-equalization Circuit for an advanced Dual-Cell Battery for Electric Vehicles” (SuperLIB) addresses the objectives of the call “ICT for fully electric vehicles”, targeting the energy storage system. SuperLIB focuses on smart control system solutions for batteries. To enhance the overall performance, the battery consists of high-power and high-energy cells. This combination of two different types of cells together with a smart control strategy and a highly integrated package significantly improves the lifetime, the reliability and the cost/performance ratio of the battery system, by also adding the possibility of fast charging without degrading its lifetime. The control strategy is based on accurate model-based estimators, which are mandatory for precise monitoring of the battery state. The electronic architecture required for the connection of the high-power and high-energy cells enables an efficient management of the current and charge distribution inside the package. The architecture will include electronic circuits for charge equalization and DC-DC converters



utilizing advanced techniques of zero-current and zero-voltage switching for higher efficiencies and lower electromagnetic interferences. Safety and control system relevant temperature sensors will be developed for an improved thermal management of the package, thus a potential thermal runaway of a single battery cell can be avoided through early detection of local overheating. In addition this will increase the accuracy of the battery state estimation, which allows the utilization of a wide range of the battery state-of-charge. Thus, the battery can be sized smaller and kept cheaper with still providing the required usable energy content and power performance.

SuperLIB PROJECT NUMBER: 285224

CONTACT: Volker Hennige, AVL List GmbH

WEBSITE: tbd

TIMELINE: 02/05/2011-01/05/2014

BUDGET AND FUNDING SCHEME:

Collaborative Project (CP)
Overall Cost: 6,484,238 €
EC Funding: 4,179,979 €

PROJECT PARTNERS:

1. AVL List GmbH, Austria
2. Robert-Bosch-GmbH, Germany
3. Centre Ricerche Fiat S.p.A., Italy
4. European Batteries Oy, Finland
5. Fraunhofer-Gesellschaft e.V., Germany
6. Energies nouvelles, France
7. Valeo Equipments Electriques Moteur SAS, France
8. Volvo Technology AB, Göteborg Sweden
9. Vrije Universiteit Brussel, Belgium
10. K&S GmbH Projektmanagement, Germany



4.5 The 3rd Call - Objective FP7-2012-ICT-GC

This section presents the indicative planning of the third call for proposals within the objective "ICT for Fully Electric Vehicles". The call is to be published in July 2011.

“Fully Electric Vehicles” (FEVs) means electrically propelled vehicles that provide significant driving range on pure battery based power. It includes vehicles having an on-board fuel based electrical generator (Range Extender based on Internal Combustion Engine or fuel cells).

Target Outcomes

e) Electric Drive and Electronic Components

Partitioned and highly efficient power electronics devices, converter and inverter and electrical interconnects that simplify packaging and cooling, EMI-EMC designs, the management of high voltages, currents and temperatures and hardware-in-the-loop technology for algorithm and component testing. Projects should target the level of integration between the drive and the motor while maximising the efficiency of the drive over a wide range of operation of the motor as well as in relation to temperature excursions and voltage variability and fail safe tested components.

f) Integration of the FEV in the cooperative transport infrastructure

ICT-based interaction between the driver, the vehicle and the transport and energy infrastructures, for FEV trip planning and optimization, including energy use and charging. In order to compensate for the limited autonomy range, gains in energy efficiency, charging strategies and route optimisation by means of traffic information, are needed to turn the FEV into a mass market product. Adaptive strategies, algorithms and operation modes are needed for the charge and discharge management of the FEV's that balance, predict the range and adapt to the energy needs of the user with regard to the properties of the vehicle's battery and the grid. Research should also address opportunities for improving energy efficiency provided by automated driving and driver training.

g) Functional Safety and Durability of the FEV

Electrical and electronic components affect vehicle dynamics, safety and durability. Fail-safe concepts are an essential element of the system. Requirements and standards related to electromagnetic compatibility and health impacts of electromagnetic fields should be developed. Continuous improvements are expected against low frequency electromagnetic fields, as well as on local sensing of currents and electromagnetic fields, on safe and robust components and subsystems. Research will also address adaptation and improvement of in-vehicle active safety for FEVs, integrated driver-vehicle – infrastructure safety, protection of vulnerable road users, and FEV emergency handling procedures. Moreover, test methods will be required.

h) Coordination and Support Action “FEV made in Europe”

One action for the coordination of a FEV Strategic Research Agenda for ICT, components and systems, for the clustering of R&D projects in the field, and for training, education and dissemination activities. The agenda should also investigate new usages for the FEV (e.g. last mile delivery and mobility for the elderly and disabled); it should cover standardisation measures; it should propose measures for harmonisation of national research policy measures and programmes, and also propose actions for international collaboration. The action should involve relevant electrical vehicle stakeholders.

Expected impact:

- Improved energy efficiency and extended driving range of the FEV
- Reduced costs of the electronic components and the overall FEV at increased performance
- Mitigated constraints for the user of the FEV versus the Internal Combustion Engine vehicle
- The FEV seamlessly implemented in the smart grids and existing infrastructure
- Significant improvement of FEV's safety, comfort and new information and comfort services for FEV users.

- Strengthened global competitiveness of the European automobile, ICT and battery sectors. Market penetration of key components of FEVs.

Funding Schemes:

- e), f), g) STREP
- h) CSA

Indicative budget distribution:

- Estimated budget: EUR 30 million
- e), f), g) EUR 29 million
- h) EUR 1 million

Call:

To be published on July 30th, 2011; deadline for submission of proposals: December 1st, 2011. These dates are subject to change - please consult CORDIS.

5. Other ICT for FEV Related Projects

5.1 The Joint Undertakings ENIAC and ARTEMIS



In addition to the outcome of the “Green Car” Initiative, the Joint Undertakings (JUs) ENIAC¹ and ARTEMIS² launched several large-scale research projects with high relevance to the European ICT and automotive sector. The funding is shared between the EU, the project partners and the following national governments and agencies:

Germany	Austria	Belgium	Norway	Italy	France	Spain	Finland	Ireland	Czech Republic	Nederland	UK	Romania
The German Federal Ministry of Education and Research (BMBF)	The Austrian Research Promotion Agency (FFG)	The Institute for the Promotion of Innovation by Science and Technology in Flanders (IWT-Flanders)	The Research Council of Norway	The Italian Ministero Istruzione Università Ricerca; APRE Agenzia per la Promozione della Ricerca Europea	The French Ministère de l'Économie, de l'Industrie et de l'Emploi; Direction générale de la compétitivité, de l'industrie et des services (DGCIS)	Ministerio de Educación y Ciencia (ENIAC) Ministerio de Industria, Turismo y Comercio (ARTEMIS)	The Finnish Funding Agency for Technology and Innovation (TEKES)	Enterprise Ireland	The Research and Development Council in cooperation with the Ministry of Education, Youth and Sports (R&D)	The Dutch SenterNovem	Technology Strategy Board (TSB)	National Authority for Scientific Research (ANCS)

The following sections provide details on the objectives and key facts of the four major projects E³Car³, POLLUX⁴, MotorBrain and IoE⁵.

¹ www.eniac.eu/web/JU/local_index.php

² www.artemis.eu

³ E³Car is co-funded by all member states depicted above excepting UK and Romania.

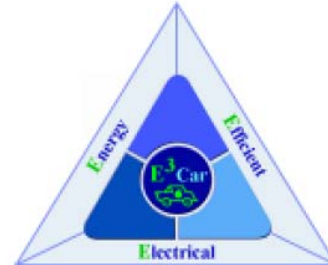
⁴ POLLUX is co-funded by all member states depicted above excepting Finland and Ireland and Romania.

⁵ The member states co-funding MotorBrain and IoE are listed in the fact sheets on page 51 and 53 respectively.

Nanoelectronics for an Energy Efficient Electrical Car

Objectives:

Research and development of **nanoelectronics technologies, devices, circuit architectures and modules** to build **energy efficient components** for Electrical Vehicles (EVs) and demonstrations in the final systems.



Vision:

- Build a solid nanoelectronics technology base for e-mobility in Europe.
- Establish standard designs and platforms for electrical/hybrid vehicles with a significant industrial, economic, innovation and societal impact to enable the path to the all electrical vehicle.
- Develop efficient and smart semiconductor components for the first industrial generation of energy efficient electrical vehicles.

Key facts:

- 11 European countries involved
- 22 Deliverables as Prototypes or Demonstrators
- 33 Project partners
- 44 Millions € Budget
- 28 Design/Supply chains
- Timeline: 01/03/2009 - 29/02/2012

The project partners are covering the whole value chain:

Research		Semiconductor				Tier1	OEM
				 Germany WP Lead 8	 Austria WP Lead 3	 WP Lead 2	
				 Italy	 France	 WP Lead 4	 WP Lead 5
					 France Germany		
			 AMS	 ON SEMI	 WP Lead 7		 FIAT WP Lead 1,6

Project website: www.e3car.eu

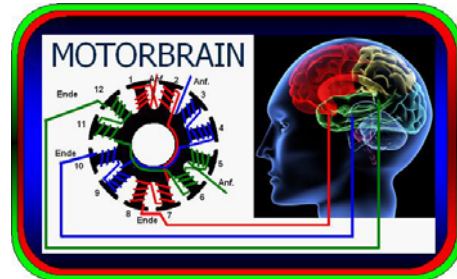
Project Coordinator: Reiner John, Infineon Technologies AG, Germany

MotorBrain



Nanoelectronics for electric vehicle intelligent failsafe powertrain

The overall objective is to develop sustainable drive train technologies and control concepts/platforms for inherently safe electric vehicle powertrains.



Target activities include:

- 1) Development of an intrinsic fail safe and fault tolerant highly efficient propulsion system based on electrical motor, novel power electronic packaging and advanced control systems;
- 2) Development of fail safe and fault tolerant components and electronic (sub-) systems as a cross functional priority, which applies to all existing car electronics, and to all technologies to be developed in the above mentioned topics;
- 3) Power and high voltage electronics and smart miniaturized systems for electrical cars.

Key facts:

- 9 European countries involved
- 29 Project partners
- 36.6Millions € Budget
- Timeline: 01/04/2011 - 31/03/2014

Vision:

MotorBrain expects to achieve three advantages over the state of the art in electric vehicle drive-trains:

- Cost reduction by as much as 25%;
- Increasing operating range by 15 to 20% through improved efficiency and weight reduction; and
- Increased security due to a distributed drive-train and improved integration.

The consortium:

Austria – Germany – Spain – UK – Italy – Czech Republic – The Netherlands – Romania – Sweden

Project website: tbd

Project Coordinator: Reiner John, Infineon Technologies AG, Germany

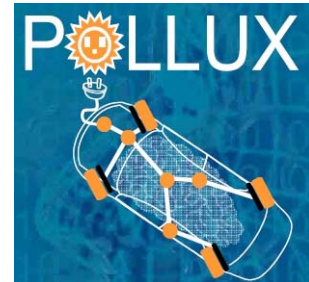
POLLUX



Process Oriented eLectronic controL Units for Electric Vehicles Developed on a Multi-System Real-Time Embedded Platform

Objectives:

To develop a **distributed real time embedded systems platform** for next generation electric vehicles, by using a component and programming-based design methodology. **Reference designs and embedded systems architectures** for high efficiency innovative mechatronics systems will be addressed with regard to requirements on composability, networking, security, robustness, diagnosis, maintenance, integrated resource management, evolvability and self-organization.



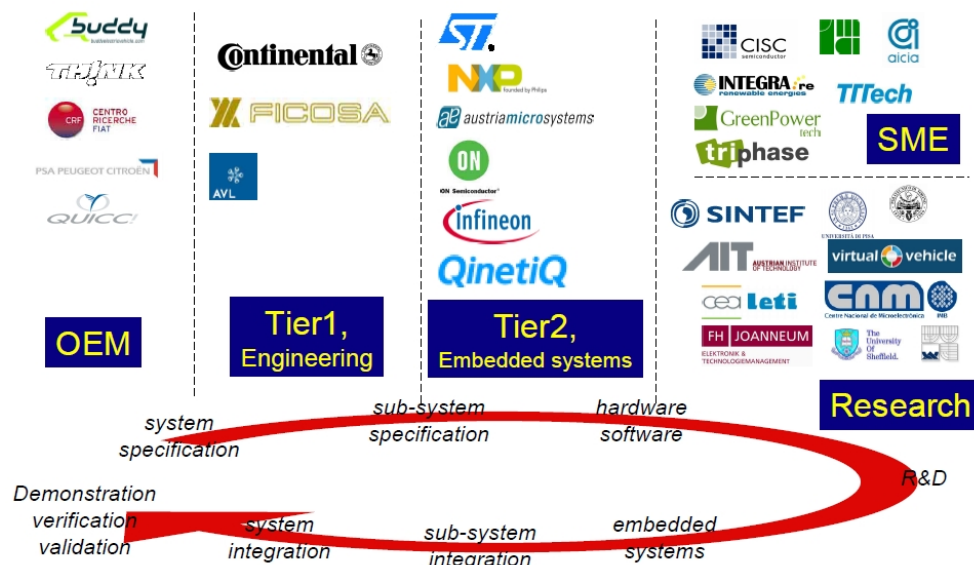
Key facts:

- 10 European countries involved
- 87 Deliverables
- 35 Project partners
- 33 Millions € Budget
- 21 Supply Chains
- Timeline: 01/03/2010 - 28/02/2013

Vision:

- Reference platform(s) (Hard and Soft) for the next generation of EVs
- Develop the underlying embedded systems (distributed and centralised control units)
- Investigate the functional safety, security and health constraints
- Make the developments functional on vehicle demonstrator in synergy with the other projects
- Standardisation

The Consortium:



Project website: www.artemis-pollux.eu

Project Coordinator: Marco Otella, Centro Ricerche Fiat, Italy

IoE

Internet of Energy for Electric Mobility

Objectives:

To **develop hardware, software and middleware for seamless, secure connectivity and interoperability** achieved by **connecting the Internet with the energy grids**. The application of the IoE will be the infrastructure for the electric mobility. The underlying architecture is of **distributed Embedded Systems (ESs)**, combining power electronics, integrated circuits, sensors, processing units, storage technologies, algorithms, and software. Reference designs and ESs architectures for high efficiency innovative smart network systems will be addressed with regard to requirements of compatibility,



networking, security, robustness, diagnosis, maintenance, integrated resource management, and self-organization. The future smart grid will converge with the Internet based on standard interfaces, and a physical infrastructure to support electric mobility and the efficient distribution of power and information.










































Key facts:

- 10 European countries involved
- 80 Deliverables
- 42 Project partners
- 45.5 Million € budget
- 3914 Person Months
- Timeline: 01/05/2011 - 30/04/2014

Vision:

- Implement the real time interface between the power network/smart grid and the internet
- Develop the underlying embedded systems
- Creation of value added services using both wired and wireless devices with access to the Internet.
- Standardisation

The consortium:

									
									
									
									
									
									
Norway	Germany	Italy	Netherlands	UK	Spain	Austria	Czech Republic	Belgium	Finland

Project website: www.artemis-internet-of-energy.eu; www.artemis-ioe.eu;
Project Coordinator: Ovidiu Vermesan, Sintef, Norway

5.2 The "Green eMotion" Project

This integrated EU demonstration project on electromobility was launched as result of the call "GC.SST.2010.7-8. Green Cars" of the Directorate-General Mobility and Transport (DG MOVE).



Green eMotion will connect ongoing regional and national electro-mobility initiatives leveraging on the results and comparing the different technology approaches to ensure the best solutions prevail for the European market. A virtual marketplace will be created to enable the different actors to interact and to allow for new high-value transportation services as well as EV-user convenience in billing (EU Clearing House).

In addition, the Green eMotion project will demonstrate the integration of electromobility into electrical networks and contribute to the improvement and development of new and existing standards for electro mobility interfaces, as the acceptance of electromobility requires international harmonization and depends to a large extent on: the ability to recharge batteries safely, anytime and anywhere, an interface that makes recharging as easy as pumping fuel, e.g. with rapid AC and DC charging technologies, inductive and battery swapping infrastructures, a telecommunications infrastructure that enables billing and recharging anywhere in Europe or for short: standards for interoperability in Europe.

To prove the interoperability of the framework, Green eMotion will demonstrate the elaborate technical solutions in some of the participating demonstration regions.

Key facts:

- 42 Project partners
- 41.8 Million € budget
- 24.2 Million € EC contribution
- Timeline: 01/03/2011 - 28/02/2015

Project Vision:

- to develop and to demonstrate a commonly accepted and user-friendly framework consisting of interoperable and scalable technical solutions in connection with a sustainable business platform

The consortium:



Project website: www.greenemotion-project.eu

Project Coordinator: Heike Barlag, Siemens, Germany

6. Conclusions and Outlook

The European Economic Recovery Plan and the European "Green Cars" Initiative

The investment in research on green automotive technologies and transport systems has long been a priority for the European Union. Within the European Economic Recovery Plan¹, the financing instruments - i.e. FP7 research grants and the European Investment Bank's preferential loans - were used under the **European "Green Cars" Initiative**. This became the key instrument to facilitate the industry's recovery from the crisis and improve its long-term competitiveness for energy efficient vehicles.

The first research projects have already been launched

As a result of the **first round of calls for proposals** (with a total indicative budget of **€ 108 millions**) published in **July 2009**, **30 projects** were selected for funding involving sustainable surface transport (SST), Information Communication Technologies (ICT), Nanosciences, Nanotechnologies, Materials & New Production Technologies (NMP), Environment and Energy programmes.

Industry, research and policy makers get together

The current projects are the living proof of a prompt implementation of the priorities set by the European Recovery Plan and the substantial set-up of the European "Green Cars" Initiative Advisory Group. The "Green Cars" Initiative PPP has rapidly brought **industrial research and policy makers together**. Its results will contribute to a

¹ COM(2008) 800 final

more sustainable mobility in Europe decreasing the CO₂ emissions and the dependency on oil, thus increasing the quality of citizens' life.

The Automotive Working Group of EPoSS² is intensively involved along with DG INFSo in the implementation of the "Green Cars" Initiative PPP³. Thus, several joint workshops and events on electric vehicle technologies have been organised and strategy papers as well as a comprehensive roadmap have been produced.

Other ICT for FEV related programmes

ICT for electro-mobility is also being funded through the Joint Undertakings ENIAC and ARTEMIS⁴. Further funds for trials and market take-up will be shortly provided by means of the Competitive and Innovation Programme (CIP)⁵.

The Green Car and the Member States

An overview of electro-mobility programmes on a national level was provided by the European Support Action EAGAR⁶. In addition, the upcoming ERA-Net+ coordination action will address the alignment of research between the Member States.

The EIB supports the automotive industry during and after the crisis

The European Investment Bank (EIB) is contributing to the Commission's "Green Cars" Initiative. The main tool is the European Clean Transport Facility (ECTF). Beyond the **support of investments in research, development and innovation for more fuel-efficient and environmentally friendly cars**, ECTF has been equally open for projects from the aircraft, rail and ship sectors. Since the start of ECTF in December 2008 until July 2010, loans amounting to **€ 6.7 billion** have been approved for the automotive industry.

² European Technology Platform on Smart Systems Integration

³ www.green-cars-initiative.eu, www.smart-systems-integration.org

⁴ 2nd Workshop on Research Projects for the FEV: <http://www.ict4fev.eu/public/documents/dg-infso-cluster-event-2010>

⁵ CIP Work Programme (WP) 2011 - Objective "Smart connected Electro-mobility". The WP was approved by the CIP ICT Management Committee on 17/12/2010. It remains subject to the formal Commission decision.

⁶ www.eagar.eu.

Demand-side measures can stimulate the deployment of "green" technologies

While research funding is a significant support on the supply side of the market, the increased market penetration of the “green” vehicles can be also stimulated by the **consumer “pull”**. Thus, several Member States have already introduced **various financial incentives encouraging the purchase of “green” vehicles**. By the end of 2010, the Commission will present guidelines on financial incentives for consumers to buy “green” vehicles encouraging the coordination of demand-side measures adopted in the Member States, promoting the most economically performing measures and ensuring that State Aid rules are respected.

Electric Vehicles will have to be smart, connected, efficient, clean and safe

Today, the current focus of the electric vehicle research is mainly on making the vehicle more affordable, mitigating constraints for the user versus the Internal Combustion Engine Vehicles (ICEV) and connecting the vehicle to the internet, the smart grid and to other vehicles. This connectivity can grant access to reserved lanes and parking spaces, that together with features like reconfiguration, upgrade and personalisation, can raise the interest of the customer. Last but not least, safety is a vitally important issue. The dynamic safety of the FEV, together with the control of harmful electromagnetic radiation, is among the key priorities in this field and the combination of ICT with sensors and actuators can offer the envisaged solutions. Additionally, light and small city cars need to share the same roads as heavy SUVs and trucks and special measures need to be taken to guarantee their safety.

However, future research should not focus only on the continuation and improvement of personal cars, but also on commercial vehicles, e.g. for the last-mile delivery or light electric vehicles. These need to be connected to the surrounding real-time environment to profit from traffic management and charging point information, time and energy efficient routes, internet applications etc.

Electric vehicles will only noticeably reduce green house gas emissions provided that the electricity production is based on renewable energy sources. Future developments

need to integrate renewable sources, such as photovoltaic cells, into the car or the parking lots.

A dilemma: Battery Electric Vehicles (BEV) or Plug-in Hybrid Electric Vehicles (PHEV)

In 2011 and 2012 the first mass-produced Electric Vehicles will be available on the market. Currently, supporters of battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV) are intensively engaged in discussions. From a technical perspective, the range required for most daily trips can be already reached today by small-city BEVs and in the medium-term also by larger cars. Nevertheless, range anxiety, purchase costs versus life cycle costs, business cases like leasing the car or some of the components and further psychological reasoning of the end user needs to be taken well into account by each of the two parties.

Coordination and Support Actions

Conferences and workshops will be one of the main tools to exchange information on research results. Two support measures, ICT4FEV⁷ and CAPIRE, will facilitate these activities.

Standards are essential for EVs moving across Europe

In order to promote the development of the internal market for electric vehicles and avoid the creation of market barriers, it is imperative that plugs, chargers and electric vehicles be inter-operable. This will allow users to use the same charging infrastructure whether in their own Member State or across borders for a range of electric vehicles.

The European Commission has given a mandate to the standardisation organisations CEN, CENELEC and ETSI on 29th July, 2010.

⁷ <http://www.ict4fev.eu/public/>

CARS21 - a revived initiative for the automotive industry

Last but not least, the electric vehicle related research is complemented by the revival of the **CARS21** initiative⁸, which focuses on the European industrial policy for the automotive sector. CARS21 will develop an action plan and a vision for "a competitive EU automotive industry and sustainable mobility and growth in 2020 and beyond." It will contribute to the EU 2020 strategy for smart, sustainable and inclusive growth, to the flagship initiatives on resource efficiency and industrial policy and to the EU strategy for clean and energy efficient vehicles.

⁸ http://ec.europa.eu/enterprise/sectors/automotive/competitiveness-cars21/cars21/index_en.htm

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For further information:

European Commission

Directorate-General Information Society and Media

Unit G2 – Microsystems

Unit G4 – ICT for Transport

B-1049 Brussels



http://cordis.europa.eu/fp7/ict/micro-nanosystems/ict-for-green-cars_en.html

www.ec.europa.eu/esafety

www.green-cars-initiative.eu

A great deal of additional information on the European Union is available on the Internet. It can be accessed through the Europa server (<http://europa.eu>).

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