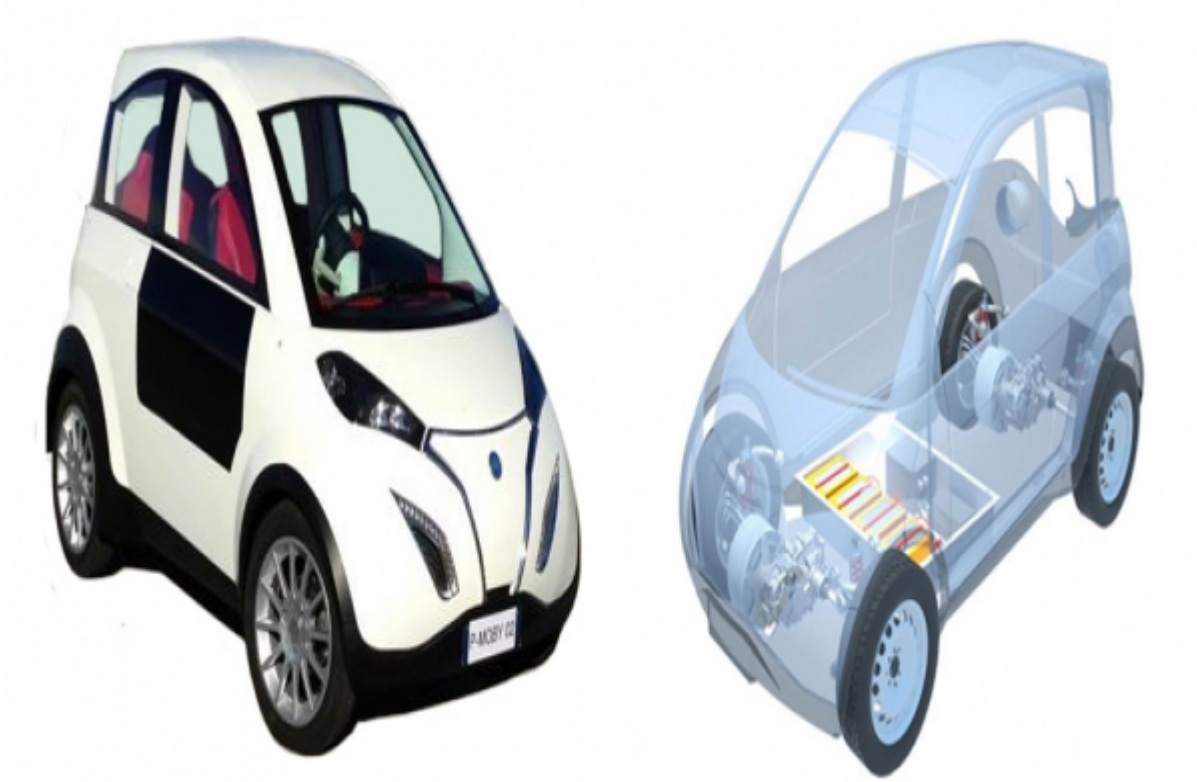
Digital Single Market

Projects news and results02/08/2013

Kick-starting Europe's electric vehicle industry

Electric vehicles (e-vehicles, or EVs) are set to play a key role in the future of urban mobility, reducing pollution, decreasing dependence on fossil fuels and saving drivers money.



Although e-vehicles make up only a tiny fraction of the European car fleet at present, sales are expected to grow exponentially over the coming years, thanks, in no small measure, to advances in e-vehicle technology being made by EU-funded researchers. Fully electric vehicle technologies that optimise safety, energy consumption and kinetic energy recovery are also major contributors to on-going improvements in the performance of hybrid vehicles.

Across the European Union transport accounts for more than 70 % of total oil consumption, the vast majority of which is imported from abroad. With more than one million additional cars going onto Europe's roads every 50 days, fuel consumption, congestion and pollution will only continue to

increase if the internal combustion engine remains the main source of automotive power. Hence, the EU, national governments and private companies are spending billions on supporting the development of e-vehicles.

'Rather than offering forms of mobility based on ever-increasing energy prices, the industry is now faced with satisfying a rational demand for mobility: clean, safe and low-energy-consumption vehicles, requiring less energy to be produced, and using recyclable and eventually self-disposable materials,' says Dr Pietro Perlo, the CEO of Interactive Fully Electrical Vehicles (IFEVS), an Italian SME dedicated to e-vehicle development.

Dr Perlo helped oversee the development of ground-breaking e-vehicle technology in the 'Integrated enabling technologies for efficient electrical personal mobility' (P-MOB) project, supported by almost EUR 2.8 million in funding from the European Commission. Involving researchers from six companies (Siemens from Germany; Mazel from Spain; IFEVS, Polimodel and Fiat from Italy; and Magnomatics from the United Kingdom), as well as the University of Sheffield in the UK, the project resulted in the development of a novel prototype electric car with a range of up to 20 kilometres (km) powered by solar power alone.

Coordinated by Centro Ricerche Fiat in Turin, Italy, the team behind P-MOB sought to break the link between increasing transport capacity and rising road deaths, congestion and pollution by developing an e-vehicle prototype that is not only clean, but extremely safe and compact. To do so, the researchers took a novel approach to advanced systems integration focusing, among other things, on solar cells, e-motor and magnetic torque control, power-energy management, distributed accumulators and technologies to enable e-vehicles to put power back into the grid when not in use.

'The design has met the highest safety ranking, a low footprint and extremely low energy consumption, making the vehicle ideal for most people's needs in cities as well as suburban roads,' Dr Perlo notes.

The prototype is a small compact vehicle - weighting less than 600 kilogrammes (kg) before the installation of the battery pack, and with a top speed of over 100 km/h - which meets new regulations on 'micro' electric vehicles. It is also able to meet the classical regulations for vehicle categories such as M1 (a car with eight passenger seats or fewer).

Aerodynamic, safe and solar-powered

A parallel project called 'Building blocks concepts for efficient and safe multiuse urban electrical vehicles' (WIDE-MOB), also involving the P-MOB partners, helped address the design and development of the basic building blocks of electric vehicles. The WIDE-MOB team worked on optimised aerodynamics to radically reduce the drag at any speed and lightweight and low-cost bodies designed for high safety in the event of a frontal or lateral crash, as well as a variety of technologies for distributed propulsion.

'Our vehicle is the first with a two-motor powertrain with one motor per axle. We have two doors on one side only ensuring a high degree of safety, better ergonomics and reduced complexity with extremely low aerodynamic drag: around 30 % lower than other vehicles of the same dimensions,' Dr Perlo explains. 'All the technologies were developed during the course of the project by the partners. Only the battery cells were produced outside Europe, though the design came from within the project.'

The project's integrated ICT-based control systems allow for the operation of two motors and two

differentials - so the vehicle's front and rear axles are independent, providing effective four-wheel drive - as well as variation of the torque ratio, depending on driving conditions, which provides a variety of important benefits. It increases vehicle control on small radius curves, improves adherence on wet and icy roads, provides the impression of faster acceleration without drawing more power and allows for fail-safe operation: if one motor fails the other will always allow you to return home. Most significantly, this in turn ensures that a single motor failure will not cause loss of control of the vehicle, particularly at high speeds.

In addition, the use of two motors combined with ICT-based smart energy management enables higher efficiency, because the two motors can individually be operated at peak performance in all driving conditions, while maximising energy recovery during braking through distributed braking on two axles combined with virtual 'anti-lock braking system' (ABS) control.

Meanwhile, smart photovoltaic panels with smart diodes and self-adapting electronics minimise loss of energy generation due to shadows or a single malfunctioning cell. Like most electric vehicles, the P-MOB prototype can be charged directly from the electricity grid. The addition of flexible high-efficiency mono-crystalline silicon solar-cell technology, however, means that it can also be powered by the sun alone and can even sell back power to the electricity grid once its batteries are full.

In trials at Fiat's testing track in Turin, the vehicle was able to travel 20 km powered solely by its solar cells - more than enough for the average European daily commuter, especially in sunnier southern Europe.

'The vehicle's performance met our expectations for the design: it showed very high stability on small radius curves and had an average energy consumption of around 80 Watt-hours per kilometre,' Dr Perlo says. 'We presented it to the public at events in Turin, Athens and Brussels and received very positive feedback.'

The prototype was designed using the first variable design platform for micro electric vehicles, also created within the P-MOB and WIDE-MOB projects, and now set to continue its evolution within the EU-MOBY R&D platform, supported by the European Commission.

'The idea of having a vehicle that with minor additions could meet both the homologation of micro electric vehicles and the classical M1 world is new and is enabling novel business approaches. All these concepts have been patented,' Dr Perlo notes.

However, he points out that batteries are at the heart of electrical vehicles and Europe's lack of a strong battery industry remains a challenge to home-grown technology. 'No doubt a new level of pan-European industrial organisation is needed to specifically address the manufacture of batteries because this will put the overall road transport industry in trouble in the next few years,' he says.

Nonetheless, electric vehicle sales in Europe are expected to increase apace, rising from 45,000 this year to 400,000 in 2015, representing around 3.5 % of new passenger car registrations. As technology improves, prices will also drop, with a small to mid-sized electric passenger car with a range of 250 km on a single charge predicted to cost EUR 15,000 within four years, down from EUR 20,000 at present.

Another incentive to switch to electric is likely to come from EU plans to progressively reduce overall passenger car fleet CO2 emissions over the coming years.

'This will likely induce a deep change in the personal mobility offer: the conventional passenger car

price will increase due to the technology to achieve the CO2 emission threshold while electric vehicles will fall in cost thanks to the optimisation of the manufacturing process and increasing sales,' Dr Perlo predicts. 'There will be a new equilibrium in the market and there will be room for new vehicle concepts such as the one developed in P-MOB.'

P-MOB received research funding under the European Union's Seventh Framework Programme (FP7).

Link to project on CORDIS:

- FP7 on CORDIS [1]
- P-MOB project factsheet on CORDIS [2]
- WIDE-MOB project factsheet on CORDIS [3]

Link to project's website:

- 'Integrated enabling technologies for efficient electrical personal mobility' project website [4]

Information Source: Dr Pietro Perlo, CEO, Interactive Fully Electrical Vehicles (IFEVS), Italy

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Links
[1] http://cordis.europa.eu/fp7/home_en.html
[2] http://cordis.europa.eu/projects/rcn/95088_en.html
[3] http://cordis.europa.eu/projects/rcn/98686_en.html
[4] http://eeepro.shef.ac.uk/p-mob/index.html