

Paris, July 17, 2014

**European Research Project OpEneR presents its findings
solutions for improved mileage of fully electric vehicles**

- ▶ Collaborative research project to increase efficiency of electric and hybrid vehicles
- ▶ Eco-routing opens energy saving potential of up to 30 percent
- ▶ Optimized driving strategies reduce energy consumption up to 36 percent
- ▶ Project co-funded by the European Commission

At its final review in Vigo, Spain, on July 17 and 18, the European research project OpEneR presented collaboratively developed driving strategies and driver assistance systems that will significantly improve the efficiency and safety of both electric and hybrid vehicles in the future. This greater efficiency will help unlock the market for fully electric and hybrid vehicles: by increasing driving range without enlarging the battery. Engineers and researchers have worked to improve the electrical powertrain, the regenerative braking system, the navigation system, and the surround sensors, as well as on functions that connect these elements with each other. The two fully operational electric vehicles they have built have already demonstrated an impressive potential for making driving in real conditions more economical.

OpEneR, which stands for “optimal energy consumption and recovery based on a system network,” was launched in May 2011. The project partners are the Austrian powertrain development company AVL List GmbH, the Spanish research institute Centro Tecnológico de Automoción de Galicia (CTAG), the German research institute FZI Forschungszentrum Informatik Karlsruhe, the second largest carmaker in Europe PSA Peugeot Citroën, and the German companies Robert Bosch GmbH and Robert Bosch Car Multimedia GmbH. The project is a European research project under the Seventh Framework Program, co-funded by the European Commission – Directorate Communications Networks, Content and Technology. The total budget was 7.74 million euros, 4.4 million euros of this sum in the form of subsidies. The project was led by Bosch.

One task was the development of “eco routing”. This considers the specific needs of an electric vehicle when calculating the best route. The navigation system now continuously factors in the car’s real energy consumption behavior. Test drives demonstrated energy consumption savings of up to 30 percent in return for a longer travel time of just 14 percent. Shortcuts in inner-city traffic proved to be a particularly effective way of increasing efficiency.

Various solutions increase driving efficiency

It has long been widely accepted that a proactive driving style is the most effective way to reduce fuel consumption. The behavior of the ACC adaptive cruise control has therefore been especially adapted to an economical driving style. Additionally, enhanced map data also includes information on inclines, declines, and speed limits, while car-to-infrastructure communication provides information about traffic lights. These data create an electronic horizon that can be used to further optimize both the ACC function and the coasting function. This feature tells drivers when to lift the accelerator pedal as they approach city boundaries or speed limits. The transmission then switches to idle, making the most of the car’s momentum.

An intuitive HMI concept and an attractive cockpit based on a freely programmable TFT display also have been designed to make all the relevant information easy to read. In addition, the enhanced map data makes the calculation of the remaining mileage significantly more accurate and transparent to the driver.

A further major task was to find the ideal interaction between the electrical powertrain and the regenerative braking system. For the best possible recuperation, engineers equipped the two Peugeot 3008 e-4WD demo cars with the Bosch iBooster, an electromechanical brake booster, and an ESP® brake control system specifically adapted for electric vehicles. The powertrain concept comprises two electric motors - one per axle - that can both drive as well as recuperate. On that technical basis, the partners have developed innovative recuperation strategies, including a regenerative brake force distribution between front and rear, optimizing recuperation rates as well as vehicle stability.

To support the development process, the team used advanced co-simulation techniques, including realistic vehicle and environment interaction. A seamless approach was employed to enable fast migration of the developed functions and their simulated test cases for further development and validation on the AVL InMotion™ powertrain testbed.

As these features were incorporated into the two prototypes, numerous test drives were performed. To evaluate the efficiency gain, the simulation tools and testbeds developed by AVL, Bosch, and FZI were used, as well as the private test tracks belonging to Bosch and CTAG, and CTAG's intelligent public road corridor. In comparison to a typical sporty driver, the operation strategies finally resulted in a reduced energy consumption of 27 to 36 percent, with an increase in travel time of between 8 to 21 percent – depending on the driver's willingness to follow the recommendations. Approximately 5 percentage points of the energy consumption reduction are due to intelligent torque distribution between the front and rear electric motors, which has no influence on travel time at all.

Media contacts:

Robert Bosch GmbH: Stephan Kraus,

Telephone: +49 711 811 6286, email: stephan.kraus@de.bosch.com

PSA Peugeot Citroën, Caroline Brugier-Corbiere

Telephone: +33 140 66 5854, email: caroline.brugier-corbiere@mpsa.com

AVL List GmbH: Dr. Stephen Jones,

Telephone: +43 316 787 4484, email: stephen.jones@avl.com

Centro Tecnológico de Automoción de Galicia: Chantal Millet

Telephone: +34 986 900 300, email: chantal.millet@ctag.com

FZI Forschungszentrum Informatik Karlsruhe: Johanna Häs,

Telephone: +49 721 9654 904, email: haes@fzi.de

Company profiles:**About AVL:**

AVL is the world's largest independent company for the development of powertrain systems with internal combustion engines as well as instrumentation and test systems. AVL is acting in the following scopes of business. Development of Powertrain Systems - AVL develops and improves all kinds of powertrain systems and is a competent partner to the engine and automotive industry. Simulation - In addition AVL develops and markets the simulation methods which are necessary for the development work. Engine Instrumentation and Test Systems - The products of this business area comprise all the instruments and systems required for engine and vehicle testing.

About Bosch:

Automotive Technology is the largest Bosch Group business sector. In 2013, its sales came to 30.6 billion euros, or 66 percent of total group sales. This makes the Bosch Group one of the leading automotive suppliers (NB: Due to a change in accounting policies, the 2013 figures can only be compared to a limited extent with the 2012 figures). Automotive Technology largely operates in the following areas: injection technology for internal-combustion engines, alternative powertrain concepts, efficient and networked powertrain peripherals, systems for active and passive driving safety, assistance and comfort functions, technology for user-friendly infotainment as well as car-to-car and Car2X communication, and concepts, technology, and service for the automotive aftermarket. Additional information can be accessed at www.bosch.com, www.bosch-press.com

About CTAG:

CTAG, Automotive Technology Centre of Galicia, provides research, development and innovation to the automotive and the transport sector in general. Its 350 professionals work on different areas of the automotive cycle such as concept definition, product development, process analysis and physical validation, being able to cover different project stages, from applied research to product life.

In February 2014, CTAG inaugurated new facilities devoted to Electronics and Intelligent Transport Systems including test tracks. More than 130 specialists work nowadays on new intelligent driving technologies which aim to meet current and future needs of the automotive sector. They provide advanced skills in ADAS systems and vehicle automation, connectivity, electromobility and interior comfort, HMI, hardware and software development and validation of electronic systems.

About FZI Forschungszentrum Informatik:

Applied research in information technology with reliable knowledge and technology transfer is the core business and competence of the FZI Research Center for Information Technology at the Karlsruhe Institute of Technology. Its task is to provide businesses and public institutions with the latest research findings in information technology. It also qualifies young scientists for their career in university or business as well as self-employment. Led by professors from different faculties, research teams at FZI interdisciplinarily develop and prototype concepts, software, hardware and system solutions for their clients. As an independent and non-profit research institution, FZI works for companies and public institutions regardless of company size: from small businesses to large corporations, from local public administrations to the European Union. The FZI House of Living Labs offers a unique research environment for applied research.

More information: www.fzi.de

About PSA Peugeot Citroën

With its three world-renowned brands, Peugeot, Citroën and DS, PSA Peugeot Citroën sold 2.8 million vehicles worldwide in 2013, of which 42% outside Europe. The second largest carmaker in Europe, PSA Peugeot Citroën recorded sales and revenue of €54 billion in 2013. The Group is the European leader in low-carbon vehicles, with average emissions of 115.9 grams of CO₂ per km in 2013. PSA Peugeot Citroën has sales operations in 160 countries. It is also involved in financing activities (Banque PSA Finance) and automotive equipment (Faurecia).

For more information, please visit psa-peugeot-citroen.com.

Pictures:Picture 1: Logo OpEneR research project

OpEneR, which stands for “optimal energy consumption and recovery based on a system network”, is a European research project that was launched in May 2011. The project partners are the Austrian powertrain development company AVL List GmbH, the Spanish research institute Centro Tecnológico de Automoción de Galicia (CTAG), the German research institute Forschungszentrum Informatik Karlsruhe (FZI), the French automaker PSA Peugeot Citroën, and the German companies Robert Bosch GmbH and Robert Bosch Car Multimedia GmbH.

Picture 2: European research project OpEneR

Within the European research project OpEneR, the partners have developed driving strategies and driver assistance systems that will significantly improve the efficiency and safety of electric vehicles in the future. The project focused on improving the electrical powertrain, the regenerative braking system, the navigation system, and the surround sensors, as well as on functions that connect these elements with each other.

Picture 3: OpEneR demonstration vehicles

The partners of the European research project OpEneR have built two fully operational electric vehicles that have already demonstrated an impressive potential for making driving more economical in real conditions. The engineers and researchers have collaboratively developed driving strategies and driver assistance systems that will significantly improve the efficiency and safety of electric vehicles in the future. It is hoped that this greater efficiency will help unlock the market for fully electric vehicles by increasing driving range without enlarging the battery.



Picture 4: European research project OpEneR

Numerous test drives have been done to evaluate the newly developed driving strategies developed within the European research project OpEneR – also in winter time. These functions will significantly improve the efficiency and safety of electric vehicles in the future.



Picture 5: OpEneR vehicles on test

The two vehicles that were built as part of the European research project OpEneR were intensively tested before being driven on roads: first virtually on a hardware-in-the-loop system, and then on a real AVL InMotion™ powertrain testbed.

