Highest rated EU research project successfully completed:

OPTEMUS presents innovative solutions for electric vehicles

The collaborative EU research project OPTEMUS, coordinated by VIRTUAL VEHICLE has been successfully closed last week. Top experts in their corresponding fields at EU level covered the entire automotive value chain: one major OEM, three major TIER1 suppliers, leading companies in simulation, SMEs, and academia and R&D institutes.

OPTEMUS addressed the major barriers towards mass-adoption of EVs through the holistic combination of new technological developments. The introduced solutions allow reducing the energy consumption for comfort and component cooling as well as traction and thus help increasing the driving range of electric vehicles. The technologies developed have been virtually tested as well as implemented in a Fiat 500e Demonstrator Car.

Graz (A), June 30, 2020 – The limited driving range of EVs represent one of the main barriers to their large-scale adoption by the market. EV performance can highly vary due to the influence of weather conditions. Recent studies report that range of EVs is reduced by as much as 33% in extreme heat and 60% in extreme cold, a quite aggressive variation for a conventional driver accustomed to the performance of ICE (internal combustion engine) vehicles.

"This project was top-rated as best-in-class in the call for optimised and systematic energy management in electric vehicles" explains **Dr. Alois Steiner**, VIRTUAL VEHICLE's Project Leader for OPTEMUS. "After four years of development with 15 partners from five European countries, the innovative solutions developed within the OPTEMUS project help to decrease the energy consumption for passenger comfort and component conditioning and thus increasing the driving range especially in extreme weather conditions."

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OPTEMUS solutions: Reduced energy consumption, extended driving range

Prime objective of the OPTEMUS research activities was to increase the real driving range of an A-class EV (Fiat 500e) in extreme weather conditions by at least 38%. A combination of technologies has been developed and validated in order to reduce energy consumption by at least 32% for component cooling, 60% for passenger comfort and 15% for traction energy.

David Guedj, EU Project Officer overseeing OPTEMUS explains: "The project started a few years ago with the call for energy-efficiency for electric vehicles. It is nice to see that from the inception of the proposal to the project we now have a set of solutions that are quite impressive. Managing the energy budget as well as extending the range is one of the main concerns for EV's. OPTEMUS offers a number of solutions and we look forward to their next successes."

OPTEMUS Key results:

A Compact Refrigeration Unit (CRU) was developed as a core part of the heat pump system. It enables energy efficient heating and cooling of the passenger cabin, the battery and power electronics. A manufactured prototype was tested and evaluated on bench and in the demonstrator vehicle.

The concept of a **Battery as Thermal Storage** was successfully implemented, leading to a significant higher thermal capacity due to integration of phase change material (PCM). It also enables the storage of 0,9 kWh of sensible heat (between 40 and 15 °C) and 1,0 kWh of latent heat, which can be used by the heat pump system. In addition, it prevents the battery from overheating during fast charging.

An innovative **Preconditioning Functionality** ensures best comfort for passengers as well as maximum driving range due to preconditioning of the cabin and battery. It uses user information as departure time and desired cabin temperature as well as cloud information (e.g. expected weather conditions) and can be used via a smartphone app.

The **Thermal Management ECU (TMECU)** provides an optimal thermal management strategy based on a control-oriented model and mathematical optimization. It reduces energy consumption for the cold use case in the range of 7-11 % depending on the operation mode.

Peltier elements in the back and cushion as part of the **Smart Seat** enable energy efficient cooling and heating. In winter conditions the smart seat enables to lower the cabin temperature while keeping the same passenger comfort. In summer conditions the seat reduces sweating of the passengers and enables to increase the cabin temperature while keeping the same passenger comfort.

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A **3D Cabin Model including the Virtual Comfort Dummy** enabled detailed investigations of the thermal comfort in the cabin for different setups, e.g. heating and cooling conditions, different velocity fields etc. In addition, Virtual Reality (VR) glasses were used to observe result details in the passenger cabin.

Eco-Driving and Eco-Routing: Eco-Driving evaluates the driving style by means of a score and thus teaches the most energy efficient driving style for a specific journey, while Eco-Routing navigation aims to find the most energy-efficient route in a vehicular road network to travel from an origin to a destination.

The **Regenerative Shock Absorber (RSA)** enables energy harvesting by converting kinetic energy of the damper to electric energy by means of a hydraulic and electric motor. Two prototypes of the RSA were designed, manufactured and tested at the bench.

Flexible Photovoltaic Panels enable energy harvesting with the placement on different locations of the car body. A sophisticated control strategy by means of dedicated DC/DC converters with a centralized maximum power point tracking (MPPT) algorithm ensure the maximization of the harvested power.

Finally, the **OPTEMUS Fiat500e Demonstrator Vehicle** enabled the in-vehicle testing of all developed technologies. The impact on energy consumption and range of the Fiat500e **in extreme weather conditions** not only fulfilled but overachieved the ambitious project objectives.

OPTEMUS Partner Consortium

VIRTUAL VEHICLE Research Center, Austria
ESI Group, France
Fraunhofer, Germany
IFPEN, France
Centro Ricerche Fiat, Italy
Continental, Germany
Mondragon University, Spain
Magneti Marelli, Italy
University of Salerno, Italy
Bax & Willems, Spain
Scuola Superiore Sant'Anna, Italy
DENSO Thermal Systems SpA, Italy
DENSO AUTOMOTIVE Deutschland GmbH, Germany
RWTH Aachen, Germany
ESI Software, Germany

Visit the Website: http://www.optemus.eu

Watch the videos: OPTEMUS Short Summary: https://youtu.be/kO-n4zsTM_g

OPTEMUS Key Results / full: https://youtu.be/SsS8IbLtjtQ

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VIRTUAL VEHICLE – Enabling Future Vehicle Technologies

The Virtual Vehicle Research GmbH is Europe's largest R&D center for virtual vehicle technology with 300 employees. Research priority is the linking of numerical simulations and hardware testing, which leads to a powerful HW-SW whole system design and automation of testing and validation procedures. This focus on industry-related research makes VIRTUAL VEHICLE the innovation catalyst for future vehicle technologies.

The international partner network of VIRTUAL VEHICLE consists of 30 national and 50 international industrial partners (OEMs, Tier 1 and Tier 2 suppliers as well as software providers) as well as 18 national and 30 international scientific institutions.

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