

Mobile with electricity

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Electric cars are cleaner, quieter and more efficient than gasoline- or diesel-powered vehicles. Even so, they have not yet caught on. Now, however, a new era is beginning: the era of electric mobility. Experts from Fraunhofer are making important contributions to this. A selection of the research projects is being presented at the Hannover Messe trade fair.

If electric vehicles are to become an alternative to traditional vehicles there is a lot of [research and development](#) work to be done. The Fraunhofer-Gesellschaft created the "System Research for Electromobility" project back in June 2009, an initiative involving a total of 33 Fraunhofer Institutes. The research is financed with € 34.4 million in funding from the federal economic stimulus program II from the German federal ministry of education and research (BMBF). In addition, the federal economic stimulus program I provided investment in the amount of € 14 million. "It is our goal to generate knowledge and technologies along the entire value chain, and in particular at the intersections, and then to make it available to industry as we here at Fraunhofer are used to doing," said Professor Holger Hanselka, director of the Fraunhofer Institute for Structural Durability and System Reliability LBF in Darmstadt, Germany.

The research project has five focal points: vehicle concepts; power generation, distribution and conversion; energy storage technology; technical system integration; and sociopolitical questions. A few weeks ago the focus area of "Safety and Reliability" was added.

More renewable energies

"To convert our vehicles to electrical motors is not enough," emphasizes Dr. Günther Ebert, head of department at the Fraunhofer Institute for Solar Energy Systems ISE. Electrical vehicles can combat acute problems like climate change only if they are mainly powered by electricity generated through renewable sources. As long as the electricity still is being provided by large power plants fired by coal or gas, problems such as emissions of pollutants are simply transferred – to the sites of the power plants themselves. The expert explains: "In order to really utilize the advantages of electromobility we have to change the current mixture of available power more toward renewable energies." The energy concept of the German federal government envisions that in 40 years, up to 80 to 85 percent of the electricity will be provided by hydropower, sun, wind and biomass. "The goals are already there, they only have to be implemented now," says Ebert. It is only then that electrical vehicles will truly be powered by clean energy.

One decisive advantage of electrical vehicles is that they convert energy in a far more effective fashion than gasoline-powered vehicles. Professor Martin Wietschel and his team from the Fraunhofer Institute for Systems and Innovation Research ISI determined that "their calculated energy efficiency, from generating electricity to driving performance (well to wheel) is about 40 percent, if one bases these calculations on the current electricity mix." "As such the efficiency is about twice as high as that of a vehicle powered by fossil fuels. If only wind power were used to charge the batteries, the efficiency would be even at around 70 percent. In other words: [electric vehicles](#) are clearly far more economical than vehicles powered by fossil fuels.

Batteries are a key component

The undeniable advantages of electric mobility face a great challenge: supplying the vehicles with electrical energy. This requires high-performance batteries. "If the energy contents of a regular automotive tank of 12.15 gallons (46 liters) of diesel were to be stored in a lithium-ion battery, then this battery system would have to have a volume of approximately 132 gallons (500 liters) to have the same driving range, and it would weigh in excess of a ton, including the housing," says Professor Hanselka. In addition, batteries are still very expensive. The researchers at Fraunhofer are working very intensively on the development and integration of the batteries required for electric cars.

They are testing new materials, developing system efficiency further and researching how to make the systems so safe that any consumer can drive in traffic or park in an underground garage free of worries.

But the battery is not the only hindrance to transitioning to electromobility: technically, the vehicles themselves still lack a few requirements as well as permanent systems for generating electrical power. Furthermore, there is currently no reliable infrastructure for providing electrical power to cars. Moreover, very few drivers are ready to tackle the dare of an electric car. Then there is the expansive restructuring of the industrial landscape required of established suppliers and automotive manufacturers. What this would mean for Germany remains to be seen.

A once-over with a fine-toothed comb

A great many other aspects have not yet been determined: Can the systems withstand daily stresses? Are electric cars safe? Experts are investigating these questions in various Fraunhofer test facilities. For example, there they check how batteries react when subjected to intentional overstressing or to extremely high and low temperatures. These testing facilities are also available for use by automobile

manufacturers. Among other things, acoustics, crash safety and operational reliability can be tested here. Another decisive question is how to deal with the enormous energy flows that must be channeled and distributed within an electric car. The researchers at Fraunhofer invent, develop and test safe and reliable technical solutions for that.

Dr. Michael Jöckel, head of the central office for the initiative, explains: "Fraunhofer does not want to build its own car. Our researchers are working on cross-functional aspects, on the one hand, while developing individual components and systems on the other. In the technical area, these include developing and integrating wheel hub motors into the system or developing a crash-proof battery. In the societal area our work includes research into new ways of using vehicles, such as car-sharing or leasing batteries. We are also working on new structures for high-performance electronics and production processes." The interplay of all aspects is always in the foreground, since it is this interplay that will ultimately decide whether the introduction of electromobility will succeed on a large scale.

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