Electromobility: new components going for a test run

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The FreccO (Fraunhofer electric concept car, generation 0) serves as the technology base for tests on the models in order to coordinate the separate components with one another (© Ingo Daute/Fraunhofer)

The future belongs to electrical cars – that's what most experts think. Unfortunately, there are still a lot of problems that have not been solved. This is the reason why researchers at 33 Fraunhofer institutes put their heads together in the Fraunhofer System Research for Electromobility project to move electromobility one big step ahead. This two-year

project was completed on July 30, 2011, and the demonstrator vehicles they came up with were showcased at the final event in Papenburg, Germany, on September 2, 2011, on the ATP test track.

In the future, it will be whisper-quiet on road because in the long run electric cars will replace the internal combustion engine. But there are still some unanswered questions. For instance, how do you store the electricity in cars? Or what power networks do you need? And anyway, how do you pay for charging your battery? Two years ago, researchers from 33 Fraunhofer institutes joined forces to answer these and many other questions while coordinating the various components of electrical cars. The idea behind this partnership is supporting the German car and supply industry to make sure they stay on top in electromobility for a long time to come. This is why this project was funded by the German Federal Ministry of Education and Research with 34.5 million euros from its Economic Policy Program II.

Professor Ulrich Buller is the Senior Vice President for Research at Fraunhofer Gesellshaft. He describes the idea behind system research: “We take care of overarching aspects starting with generating the energy and going all the way down to business models.” Professor Holger Hanselka is the director of the Fraunhofer Institute for Structural Durability and System Reliability LBF and the project coordinator. He goes into detail: “We have defined a total of five concentrations: issues of decentralized power generation and power transport to vehicles, energy storage, vehicle engineering and system integration. We’re talking about new value-added chains and getting people to accept the idea of electromobility. We added the concentration of ‘function, reliability, testing and launch’ in 2011.”

After the project was over, the institutes involved unveiled their findings on the ATP test track in Papenburg, Germany, on September 2; researchers invited visitors for a test ride in the experimental vehicles.

This is where the first and second generation of Fraunhofer's Frecc0 developmental vehicles are ready for testing. Both of these electrical cars are based upon Artega GT, a two-seater sports car. Franz-Josef Wöstmann, division director at the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM in Bremen, Germany, says: "We installed commercially available components into the Frecc0 1.0 and concentrated on streamlining the way these components interact." This Fraunhofer Institute took on project management for building the Frecc0 demonstrator vehicle.

Frecc0 2.0 contains components recently developed by these scientists. A case in point are wheel hub motors that the researchers from IFAM conceived in teamwork with their colleagues at the Fraunhofer Institute for Integrated Systems and Device Technology IISB, the Fraunhofer Institute for Mechanics of Materials IWM and the Fraunhofer Institute for Structural Durability and System Reliability LBF. Franz-Josef Wöstmann stresses, "We engineered the motor from the onset for the European market and we selected a diameter to make sure it has room in a 15-inch wheel rim. In turn, the engine is adapted to the available construction space. This is why we had to come up with completely new components with maximum power density – starting with the power electronics through setting up the cooling right down to the design." Totally new vehicle designs are possible since the researchers moved the entire drive train – the entire engine including the center tunnel, cardan shaft and transmission – out of the car and into the wheel hubs or even eliminated them altogether. For instance, the passenger compartment on a vehicle that is about the same size as a VW Passat would be as big as an S-Class Mercedes. Another advantage is the fact that every wheel gets the performance it needs. This means greater safety for each passenger because each individual wheel cannot only be separately braked, but also accelerated. That gives the wheel hub motor torque vectoring, an advancement over today's ESP. Franz-Josef Wöstmann adds that "all components in the wheel hub motor are designed for series production."

Another innovation is the cast coil. Now, Fraunhofer researchers can cast coils with a new technique instead of winding them as previously. This has the benefit that the installation space in the drive motor is used more efficiently. In contrast to the lot fill factor of approximately 55 percent normal today, experts achieve lot fill factors in excess of 90 percent. This permits higher power density and greater efficiency with an equally large coil installation space. Much smaller coils can be used due to the higher lot fill factors, or aluminum can be used with the same dimensions if engine output is supposed to stay the same. Felix Horch from the Fraunhofer Institute for Manufacturing Technology and Advanced Materials explains: “Thanks to this new production technology, we can substantially reduce the installation space, weight and price for coils.”

Incidentally, Fraunhofer scientists were not the only ones to use the Frecc0 as a test platform. In the future, automobile manufacturers and suppliers will be able to use Frecc0 together with the Fraunhofer Institute for Manufacturing Technology and Advanced Materials for testing or advancing new components.

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