Munich and Singapore labs steer research toward affordable electric cars

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The Technische Universitaet Muenchen (TUM) has rolled out a comprehensive initiative to accelerate development of electric vehicles that could play at least two vital roles in the foreseeable future: as a greener means of mobility and as distributed energy storage devices networked to a "smart grid." Around fifty professors in eight faculties are engaged in relevant research projects, coordinated through the newly formed Science Center for Electromobility and strengthened by collaborations with partners in the energy and automotive industries. TUM is on track to unveil a concept car at the next Frankfurt auto show, IAA 2011, and some aspects of the electric vehicle's design and technology were presented to German media today. To further investigate how electric mobility might work in megacities, particularly in tropical regions, the university has established a one-of-a-kind facility in Singapore.

Despite increasing attention to potential advantages of electric vehicles -- reducing dependence on fossil fuels, slowing greenhouse gas emissions, turning down the noise level on city streets -- they're not yet competitive with conventional cars. After several false starts in recent decades, however, TUM Professor Markus Lienkamp asserts that "Electromobility is ripe for the market. The goal of putting a million electric automobiles on the road by the year 2020 is achievable" -- not, he says, by focusing solely on technical problems, but above all through a paradigm shift in vehicle and mobility concepts. Lienkamp, who led several research groups at Volkswagen before joining TUM as director of its Automotive Engineering Institute, heads up both the Munich-based Science Center for Electromobility and the Singapore-based TUM CREATE Center for Electromobility in Megacities.

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The TUM concept for electric vehicles encompasses the whole process chain from technical optimization -- in areas such as reducing weight, improving batteries, leveraging IT and wireless networking for energy management, and enhancing safety -- to market research, design and manufacture, and even to new modes of vehicle use, such as a "car on demand" scenario. The central differentiating feature of the TUM approach, according to Lienkamp, is that the car concept is embedded in a broader mobility concept, which from the outset is tailored to the needs and priorities of city dwellers.

The quest to realize this concept gives focus to collaborations among TUM researchers in the faculties of mechanical engineering, electrical engineering, informatics, chemistry, physics, civil engineering, architecture, and economics, as well as the interdisciplinary Munich School of Engineering. One immediate goal is to demonstrate that an affordable electric car for a large customer base could be manufactured now by uniting available and novel components in a visionary design. The proof is being built from the ground up at TUM's Garching campus, where Lienkamp and colleagues today offered the first media preview: real steps toward a subcompact electric car with competitive performance in urban settings, optimized for total lifetime cost and sustainability. Their timeline calls for prototype assembly this winter and public demonstration at the Frankfurt auto show in September 2011; a longer-term plan anticipates development that could lead to fleet trials by 2013.

Taking an even broader view, the university is spearheading research with global implications. To what extent do electromobility solutions formulated in Europe meet the needs of other regions? How can an infrastructure for electromobility best be furnished in congested cities? How will batteries developed in Germany perform in temperatures of 35 to 40 degrees C. and tropical humidity? What kinds of car designs will appeal to drivers in other parts of the world? Specifically, TUM researchers are investigating what benefits new vehicle and mobility concepts might have to offer for the world's burgeoning megacities, and what adaptations will be dictated by regional conditions -- whether by economy, culture, or climate.

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Singapore will be the home base for this effort. A contract signed last month established the TUM CREATE Research Center for Electromobility in Megacities. It will be part of the Campus for Research Excellence and Technological Enterprise (CREATE), a framework for collaboration with elite international universities set up by Singapore's National Research Foundation. TUM's primary research partner there will be the Nanyang Technological University (NTU); the two universities also are offering a joint Ph.D. program.

"Each of our countries has a highly skilled, educated workforce and a desire to pioneer clean technologies that will seed new industries," says TUM President Prof. Wolfgang Herrmann, who began building the university's presence in Singapore a decade ago. "We need to be present where technological progress is unobstructed, as in the Asian metropolitan centers." Herrmann sees this cooperation as a model for the internationalization of German research universities; a strong presence in other countries, he says, could enhance their performance and impact at home.

Scientists and engineers at the TUM CREATE Research Center will work on a full spectrum of studies. Basic research will focus on electrochemistry and new materials, energy storage systems, embedded systems, interdisciplinary development of vehicle concepts, and modeling and optimization for architectures and infrastructure. Applied research will target energy storage engineering, electric car technology, infrastructure and transportation, prototyping and testbed development. "The complex yet compact urban structure of Singapore is ideally suited to develop and test a comprehensive electric mobility system for a megacity," according to Lienkamp. He says issues such as the electric power infrastructure and the vehicle battery will not be the only decisive ones. "When you consider how much energy it can take to cool and dehumidify a car in a tropical climate, even details such as the inclination of the windshield are going to be important."

The university has announced several other related activities in recent months:

- the participation of Prof. Ann-Kristin Achleitner in an independent study commissioned by the German government, which considered the role electromobility might play in a strategy for sustainable economic growth
- the appointment of Prof. Gernot Spiegelberg, electromobility project leader for Siemens, as a Visiting Scientist at the TUM Institute for Advanced Study
- and a cooperative agreement, between TUM's Munich School of Engineering and Tsinghua University Beijing, to create a research institute focusing on Advanced Power Sources for Electric Vehicles.

President Prof. Herrmann emphasizes that electromobility is a long-established central research focus for the university. "We take an interdisciplinary approach here, because that enables us to harness the double strengths of the Technische Universitaet Muenchen -- in both the engineering sciences and the natural sciences."

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