

Electric vehicles are eco-friendly, quiet and economical. However, their future depends on efficient battery technology. For these vehicles to finally break through, their battery systems must offer higher performance than up to now – i.e., their charging times and weight must be reduced. To master these challenges, Ricardo has opened a battery development center for the comprehensive development of battery systems – with the help of a dSPACE simulator.

Improving Battery Technology for a Greener World

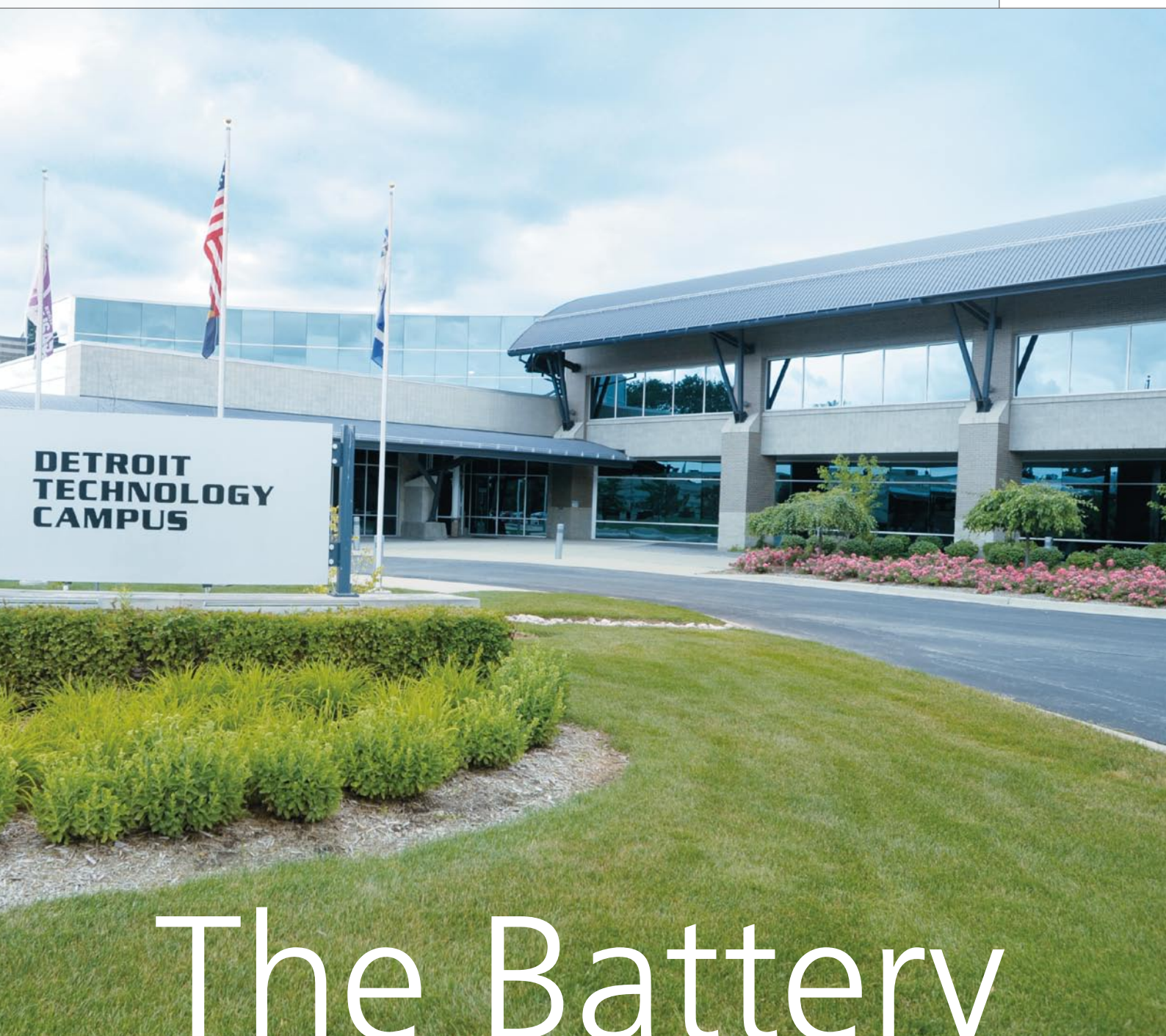
The development of new vehicle technologies has enormous potential to reduce harmful emissions and improve fuel efficiency. Hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs) are among the most promising candidates for “greener” transportation technologies. To be fully accepted, these advanced vehicles must provide the same reliability and robustness as conventional ones. One major component in their success will be their high-voltage batteries.

Ricardo Inc., a leading provider of technology and consulting for the automotive industry, is at the helm of this technological revolution with the opening of its new Battery Systems Development Center in Detroit, Michigan, USA.

“While there has been a great deal of theoretical discussion on renewable energy, Ricardo is applying the technology by taking it off the whiteboard and into the real world,” said Ricardo Inc. President Kent Niederhofer. “In 2008 we launched TVFE™ as a total vehicle fuel economy solution, and in 2009 we opened the Battery Systems Development

Located in Detroit, Michigan, USA, the new Battery Systems Development Center offers turnkey engineering and development of complete high-voltage battery-packs.





**DETROIT
TECHNOLOGY
CAMPUS**

The Battery Eldorado

Integrated development facility for hybrid and electric vehicle battery systems

Center, which is among the industry's most complete battery development facilities, working with many customers from cell suppliers to the Tier 1s and OEMs on battery systems for hybrid and electric vehicles."

Tackling Battery System Challenges

The center brings engineering design and evaluation experts and resources together to engineer fully integrated, turnkey battery systems and their electronic management systems. "The Center is a state-of-the-art, benchmark facility that enables Ricardo to evaluate and optimize batteries throughout the development cycle, from the early stages to battery pack production and integration into the vehicle," said Karina Morley, Ricardo's global vice president of controls and electronics. "The center is unique in terms of the



The test chambers are equipped with robust safety and filtration systems – ideal for working with cells and packs using unvalidated support systems.

breadth of services it provides. For instance, we can work with cell suppliers to develop complete battery packs. We can also conduct pack evaluations and pack subsystem design for battery pack OEMs. Our virtual vehicle development environment allows vehicle OEMs and battery pack OEMs to evaluate the pack in a simulated vehicle. We also have the ability to evaluate the perfor-

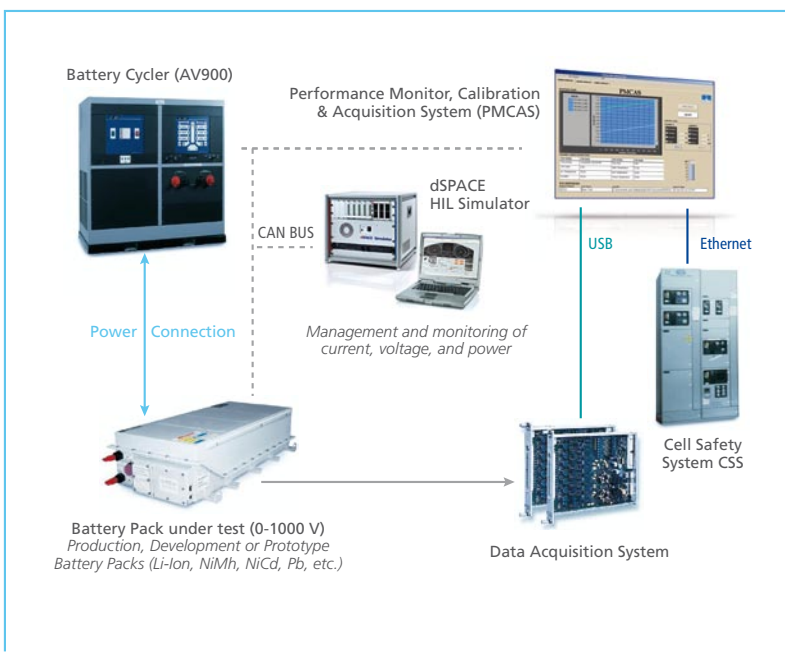
mance of packs connected to a hybrid powertrain on our dynamometers." Additionally, the center has a large garage facility where battery packs can be integrated into vehicles for further evaluation. While the center is being touted for its battery development capability in the area of hybrid and electric vehicles, its services are equally applicable to non-automotive industries that can benefit from advanced battery pack development. These include applications such as agricultural equipment, defense and off-road vehicles.

"We use dSPACE simulators on many projects and are pleased with their performance."

Karina Morley, Ricardo Inc.

Virtual Vehicle Development Using dSPACE HIL Simulator

One of the most unique aspects of the Battery Systems Development Center is its virtual vehicle development capability, which allows fully simulated vehicle integration to be conducted in a safe, controlled and repeatable environment. "This environment incorporates a dSPACE HIL simulator that is programmed to act as the virtual vehicle to verify the operation of battery systems," said Morley. "A vehicle, or portion thereof, is modeled and simulated on the dSPACE HIL system.



The setup for testing battery packs. The dSPACE HIL Simulator is the heart of the virtual vehicle, and simulates all vehicle components necessary for the tests.



Integration of a battery pack into a car.

Glossary

PHEV – Plug-in hybrid electric vehicle – a hybrid vehicle with batteries that can be recharged by an external electric power source

TVFE™ – A customized Ricardo solution to provide maximum efficiencies and minimum energy losses, and decrease loads on vehicles.

A typical use scenario for the dSPACE HIL Simulator is examining the effect of frequent charging and discharging on the battery pack, as typically occurs in everyday road traffic.

To emulate this effect, the battery packs are connected to the battery cyclers. Of special interest are the consequences for the batteries' life span. Other aspects are heat development in the battery, its mechanical robustness, and so on.

"We have used dSPACE Simulators on many projects in the past and have been pleased with their performance," Morley said. "The simulator meets our expectations and is performing well. Its unmatched test

capabilities allow us to test a wide range of virtual vehicle configurations at minimal cost, because we can avoid the high cost of integrating real components such as powertrains, engines or chassis dynamometers. Some tests wouldn't be possible at all without the HIL simulator."

High-Safety Test Chambers for Advanced Battery Tests

Up to now, the center houses three test chambers equipped with robust safety and filtration systems. "The level of chamber safety that exists is another major factor that distinguishes us from other test sites,"

said Morley. "This allows us to work with cells and packs using unvalidated support systems in a safe manner. There are battery test centers out there that specialize in pack testing, but our center is truly a resource for battery systems development, not repetitive testing," Morley continued. "With our test center, we are also prepared for future tasks in other business areas that Ricardo is involved in. This would include the test and development of battery systems or ultra-capacitor systems for applications such as wind turbine and solar cell systems, military systems, and potentially even aerospace applications." ■

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About Ricardo Inc.

Ricardo Inc. is a leading independent technology provider and strategic consultant to the world's transportation sector industries. The company's activities range from vehicle systems integration, controls, electronics and software development, to the latest driveline and transmission systems and gasoline, diesel, hybrid and fuel cell powertrain technologies. Its customers include the world's major vehicle, engine and transmission manufacturers, Tier 1 suppliers and leading motorsport teams.