Technology Validation

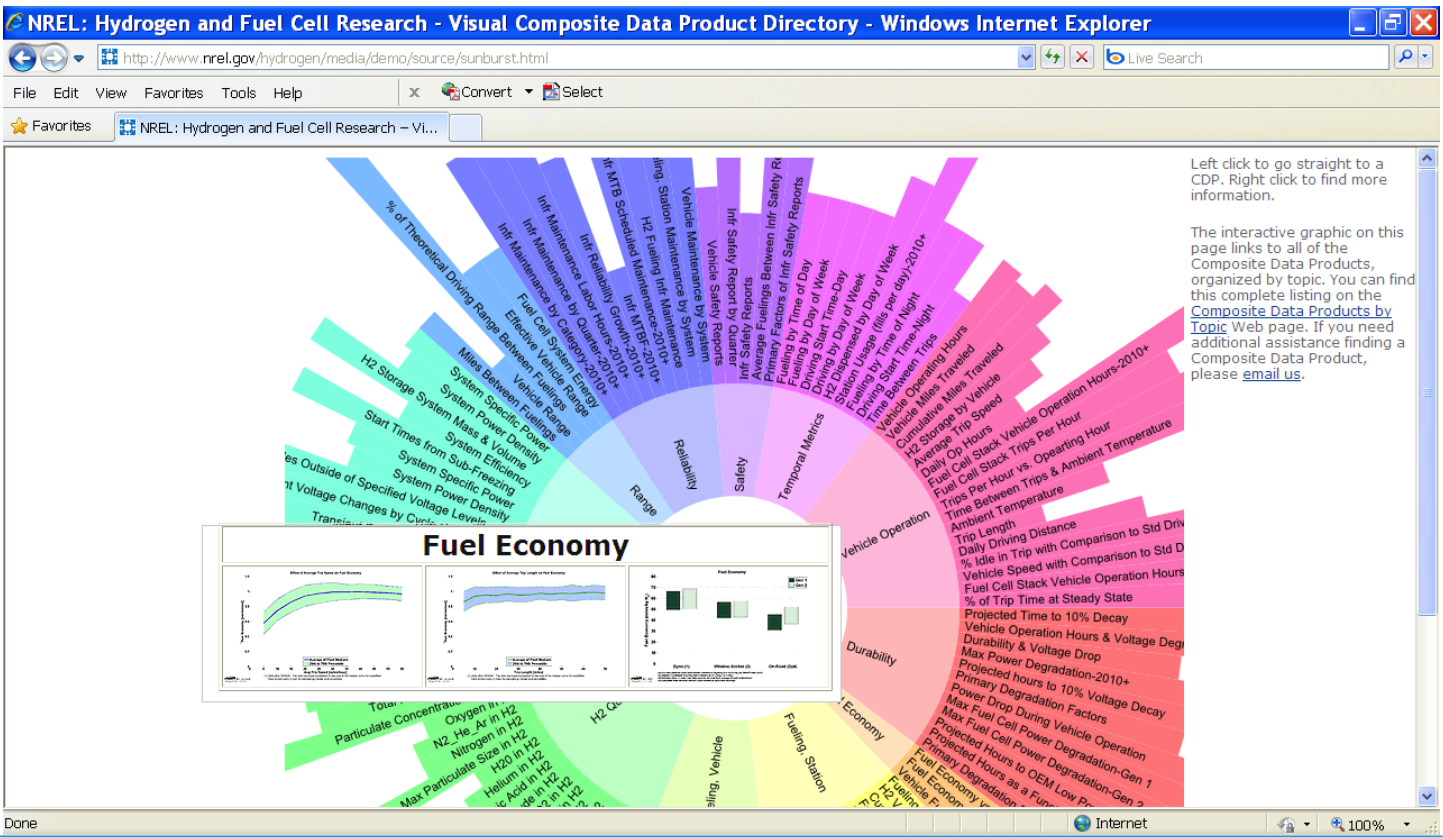
Hydrogen and fuel cells are a critical part of the Energy Department's balanced portfolio of research and development activities and its "all-of-the-above" energy strategy. The Fuel Cell Technologies (FCT) Office, through its Technology Validation program, provides a crucial step in the transition of a technology from the lab to commercialization. Once a technology achieves its targets in the laboratory, it must be evaluated as an integrated system, such as in a hydrogen fueling station or hydrogen fuel cell electric vehicles (FCEV). Technology validation does not certify marketability, but rather, real world demonstration and data collection helps to document commercial viability and to identify barriers for future R&D efforts. The data collected also helps to develop statistical confidence that the systems meet customer expectations for performance, reliability, and durability as well as meeting design requirements, specifications, and regulations.

Technology Validation on a Large Scale: The National Fuel Cell Electric Vehicle Learning Demonstration

The Energy Department's National Fuel Cell Electric Vehicle Learning Demonstration was a unique collaboration of automobile and energy industry partners, their suppliers, and the Federal Government that worked to evaluate FCEVs and hydrogen infrastructure technologies together in real-world conditions and to assess progress toward technology readiness for the commercial market.

The learning demonstration collected data from 2005 to 2012 and evaluated hydrogen and fuel cell technologies against targets such as fuel cell durability and efficiency, vehicle range, and hydrogen fuel cost. The effort complemented and informed DOE's significant research and development efforts at universities, National Laboratories, and with industry to address the hydrogen production, delivery, storage, and fuel cell technology challenges to commercialization. The final report is available on the FCT Office web site.

The learning demonstration projects involved the work of the following four teams using FCEVs and hydrogen fueling stations to collect data, both in controlled



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test conditions and on the open road in a variety of geographic areas and climates:

- General Motors tested vehicles with its own fuel cell technology.
- Mercedes North America tested vehicles with Ballard Power System's fuel cells. The vehicles are refueled at hydrogen stations built by project partner BP in northern and southern California and in Michigan.
- Chevron built hydrogen fueling stations in northern and southern California and in Michigan; Hyundai-Kia Motor Company worked in partnership with Chevron to test vehicles with fuel cells manufactured by United Technologies Corporation.
- Ford Motor Company also tested vehicles with Ballard Power System's fuel cells; the vehicles refueled at hydrogen stations built by project partner BP in northern California, Michigan, and Florida.

How far have we come?

The learning demonstration deployed 183 FCEVs and 25 hydrogen fueling stations across the country. The vehicles traveled 3.6 million miles in more than 500,000 trips; more than 33,000 refuelings were completed; and more than 152,000 kg of hydrogen were produced or dispensed (some of this hydrogen was used by vehicles that were not part of the learning demonstration). These demonstrations validated the status of several key technologies in integrated systems operating under real-world conditions. Key results include demonstrating fuel cell system efficiency of up to 59% (double the efficiency of gasoline internal combustion engines), fuel cell system durability of 2,500 hours (about 75,000 miles), and a driving range of more than 250 miles between refueling. The program also validated one vehicle outside of the original learning demonstration to be capable of achieving up to 430 miles on a single fill.[1]

Tri-generation - Combined Heat, Hydrogen, and Power Demonstration

The Fountain Valley energy station, supported in part by a $2.2 million grant from the Energy Department, is the world's first tri-generation hydrogen energy and electrical power station to provide both transportation fuel to the public and electric power and heat to an industrial facility. Located at the Orange County Sanitation District's wastewater treatment plant in Fountain Valley, California, the tri-generation station is a combined heat, hydrogen, and power (CHHP) system that can co-produce hydrogen in addition to electricity and heat.

The hydrogen, heat, and power are produced using anaerobically digested biogas from the municipal wastewater treatment plant in a high temperature molten carbonate fuel cell. The hydrogen is then sent to a hydrogen fueling station that is open to the public and can support between 25 and 50 FCEV fills per day. 250 kW of power is produced for use by the wastewater treatment plant, with nearly zero criteria pollutant emissions. In addition, since the power is made from a renewable waste stream, greenhouse gas emissions are substantially reduced.

The project was developed as a partnership between the Energy Department, the California Air Resources Board, the Orange County Sanitation District, academia, and private industry. The project is managed by Air Products and additional partners include FuelCell Energy, Inc., the South Coast Air Quality Management District, and the National Fuel Cell Research Center of the University of California, Irvine. Early market projects, like this tri-generation system, are addressing many of the logistical and other real-world challenges that confront fueling stations. Tri-gen can provide supplemental revenue to markets where additional investment would be needed to produce hydrogen.

Data Collection: Guiding RD&D and Building the Case for Fuel Cells

The Technology Validation team leads the effort in data collection for both vehicle and stationary demonstrations. Data collected from demonstrations helps DOE guide its hydrogen and fuel cell component and materials research and may also uncover new technical and institutional challenges that have not yet been considered. Data collected from early market deployments support business case development to encourage continued adoption of fuel cell technologies.

The component data gathered is obtained from an integrated system under real world operating conditions so stakeholders will have the information needed to validate DOE economic, energy, and environmental models and analyses. As the demonstrations and deployments proceed, DOE officials will be able to communicate progress, benefits, and risk to the public and Congress, and educate local communities and others about hydrogen and fuel cell technologies and how they can fit into our Nation's portfolio of energy choices.

References

1 National Fuel Cell Electric Vehicle Learning Demonstration Final Report, National Renewable Energy Laboratory, July 2012, *http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/learning_demo_final_report.pdf*

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