

Fuel Cell Technologies Program: Technology Validation

Hydrogen and fuel cells offer great promise for our energy future. Fuel cell vehicles are not yet commercially available, however, and the infrastructure to fuel them is limited. Research is making progress, but most hydrogen, fuel cell, and infrastructure technologies still require testing in real-world conditions before they will be ready to enter the commercial marketplace.

That's where technology validation comes in — once a technology achieves its targets in the laboratory, it must be evaluated as an integrated system, such as a hydrogen fueling station or hydrogen fuel cell vehicle. Technology validation does not certify marketability, but rather, it helps to manage research and development activities and refocus efforts as needed. The data collected also helps to develop statistical confidence that the systems meet customer expectations for cost, reliability, and durability.

Technology Validation on a Large Scale: The National Hydrogen Learning Demonstration

The U.S. Department of Energy (DOE) National Hydrogen Learning Demonstration is a unique collaboration of automobile and energy industry partners, their suppliers, and the Federal Government to evaluate hydrogen fuel cell



Generation 2 fuel cell vehicles from the National Hydrogen Learning Demonstration. Clockwise, from top left: Daimler F-Cell, Ford Edge, Hyundai-Kia FCEV, GM/Chevrolet Equinox. The demonstration has collected data on 152 vehicles at 24 stations across the country.

vehicle and infrastructure technologies together in real-world conditions and assess progress toward technology readiness for the commercial market.

The learning demonstration has been collecting data over the last four years to evaluate hydrogen fuel cell technology against targets for fuel cell durability and efficiency, vehicle range, and hydrogen fuel cost. The effort complements DOE's significant exploratory 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 and help ensure seamless integration of vehicle and infrastructure interfaces.

Vehicle Learning Demonstration Projects

The National Hydrogen Learning Demonstration projects involved the

work of the following four teams employing fuel cell vehicles and hydrogen fueling stations to collect data both in controlled test conditions and on the open road in a variety of geographic areas and climates.

- General Motors Corporation (GM) is testing vehicles with its own fuel cell technology. Currently, advanced vehicle technologies are being evaluated in the demonstration program.
- Daimler is testing vehicles with Ballard Power System's fuel cells; the vehicles 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 has testing vehicles with Ballard fuel cells; the vehicles refueled at hydrogen stations built by project partner BP in northern California and Michigan, as well as Florida.

Combined Heat and Hydrogen Power Demonstration

To address the challenge of early hydrogen infrastructure deployment, DOE is exploring combined heat and hydrogen power (CHHP) systems as a way to provide fuel for early commercial fuel cell vehicles. These stationary fuel cell systems are able to draw on a variety of resources, including the existing natural gas infrastructure and waste bio-gas from municipal landfills, agricultural sites, wastewater treatment plants, and food/beverage processing plants to serve a multitude of purposes—generate electricity and heat for facility operations, provide electricity for charging electric vehicles (EVs) or plug-in hybrid electric vehicles (PHEVs), and provide fuel for hydrogen fuel cell vehicles and fuel cell material handling equipment.

DOE is working with the California Air Resources Board (CARB) and the South Coast Air Quality Management District (SCAQMD) to demonstrate and validate the economic and technical viability of CHHP at the Orange County Sanitation District Municipal Wastewater Treatment in Fountain Valley, CA. This facility will use wastewater to produce electricity and heat for the building in addition to hydrogen fuel for local demonstration fuel cell vehicles. As advanced vehicles begin to enter the commercial market, these CHHP systems can serve as transition infrastructure by providing

hydrogen and electricity for fuel cell and plug-in hybrid electric vehicles while using proven stationary fuel cell technology.

How far have we come?

The demonstration has operated 152 vehicles at 24 stations across the country. Since the start of the project, the vehicles have traveled over 8 million miles and the stations have produced and dispensed 130,000 kg of hydrogen. Analysis has shown that the vehicles operate at up to 59% efficiency (greater than two times higher than gasoline engines), have a driving range of up to 254 miles, and a fuel cell system durability of approximately 2,500 hours or 75,000 miles.

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

Technology Validation leads the effort in data collection for these vehicle and stationary demonstrations in addition to DOE and Recovery Act-supported early market fuel cell deployments. 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 supports business case development to encourage continued adoption of fuel cell technologies.

The component data gathered is obtained from an integrated system under real operating conditions so stakeholders will have the information needed to validate DOE economic, energy, and environmental models/analyses, as well as technology status important to public benefit. 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 fuel cell technologies and how hydrogen can fit into our nation's portfolio of energy choices.

For More Information

More information on the Fuel Cell Technologies Program is available at <http://www.hydrogenandfuelcells.energy.gov>.