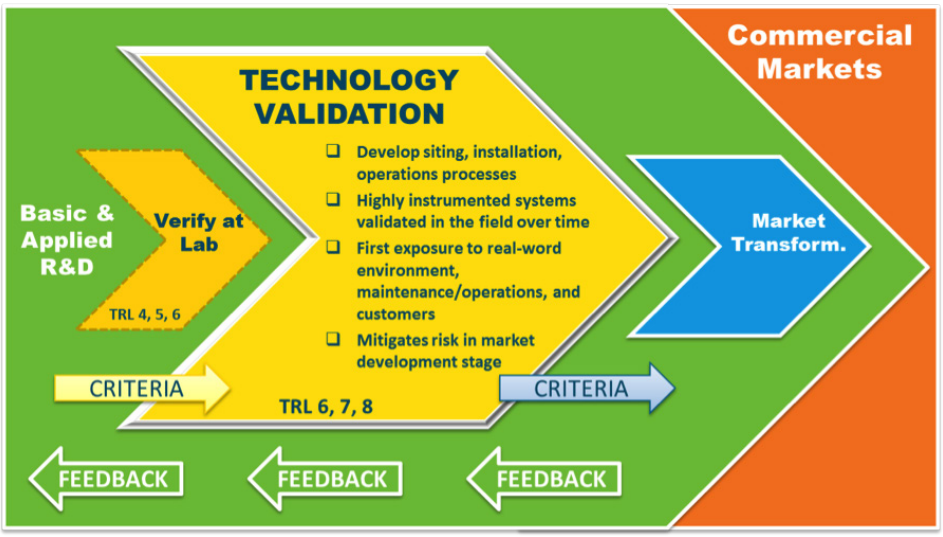
Technology Validation

The Technology Validation (Tech Val) program of the Department of Energy's Fuel Cell Technologies Office (FCTO) provides an essential function in the transition of hydrogen and fuel cell technologies from the lab to commercialization. Hydrogen and fuel cell technologies are validated through real-world demonstration and data collection to determine whether these technologies meet the anticipated requirements of the market. Tech Val projects are typically 50/50 cost-shared between the government and partners, such as fuel cell system manufacturers, automobile manufacturers, energy companies, suppliers, universities, state governments, and end-users.

Strategy

In the development path of a technology—from initial conceptualization to laboratory-scale testing, proof-of-concept, demonstration, and on to widespread commercialization—technical and performance criteria need to be met before advancing to the next stage. Components are initially verified in the laboratory, where adjustments may be made under controlled conditions, and risks related to the next stage (validation) are mitigated. Technologies are then incorporated into complete, "integrated" systems for further testing. This is the ***Technology Validation phase***, where systems are validated over time, in the field, through exposure to real environmental conditions. The technology is in the customer's hands at this point and is exposed to everyday operations and related maintenance situations. The Tech Val program is first to develop siting, construction, installation and operations processes, and to acquire/develop facilities for field maintenance and operations. Performance of the technologies against cost targets and various technical targets (such as durability, reliability, and availability) are evaluated, while potential risks related to market development are mitigated. The Market Transformation program of FCTO then takes the technology that has been field-validated and encourages potential end-users to gain experience with the technology and develop economies of scale needed to meet cost requirements of a viable value proposition.

The Tech Val program meets its objectives through extensive data collection and evaluation for a variety of hydrogen and fuel cell applications. Data are collected to determine whether performance and cost targets have been met under realistic operating conditions, to provide feedback on progress, and to efficiently manage the research elements of the program while providing redirection as needed. Detailed evaluation results are catalogued by the National Renewable Energy Laboratory (NREL) in the form of composite data products (CDPs).[1] Raw data are protected by NREL and analysis results are aggregated into CDPs, which are published every six months, allowing for the sharing of learning without revealing proprietary company data.



Vehicles

Fuel Cell Electric Vehicles (FCEVs)

Six major automakers (General Motors, Honda, Hyundai, Mercedes-Benz, Nissan, and Toyota) demonstrated light-duty FCEV performance by providing real-world vehicle data from over 220 vehicles totaling more than 6 million miles as part of the Tech Val program. Advanced FCEVs are validated against technical targets to gauge technology readiness, and to determine the status and trends of criteria such as durability, fuel economy, and range. Analysis of these FCEV performance data reveal that steady progress has been demonstrated over the past 10 years.

Fuel Cell Medium-Duty Trucks

The objective of projects in this category is to develop fuel cell hybrid electric parcel delivery trucks, which will introduce fuel cells into delivery vehicles to provide fuel and emissions savings. Storing energy as hydrogen can significantly increase the range of larger electric-drive vehicles. Two concurrent projects, led by FedEx and the Center for Transportation and the Environment, are designing and deploying fuel cell hybrid electric trucks to evaluate their performance and validate the technology through real-world operation.

Fuel Cell Electric Buses (FCEBs)

The Tech Val program collaborates with the Department of Transportation's Federal Transit Administration through the National Fuel Cell Bus Program, by providing third-party assessment of FCEBs once they are placed into service. A variety of data relating to the operation, maintenance, cost, and reliability of the FCEBs are collected, evaluated, and compared to data from conventional (diesel or compressed natural gas) buses to determine the status of FCEB fuel cell systems and aid fleets with the implementation of next-generation FCEBs.

Hydrogen Infrastructure

Hydrogen Fueling Station Data

Data from state-of-the-art hydrogen fueling facilities, such as those operated by California State University—Los Angeles (CSULA), Proton OnSite, and Gas Technology Institute (GTI), are collected and evaluated to provide valuable feedback related to hydrogen infrastructure. CSULA operates an electrolyzer-based station running on renewable hydrogen, and it was the first station in the United States to receive a seal of approval for sale of hydrogen on a per kilogram basis (as of January 2015). Proton OnSite is evaluating a high-pressure (57 bar) advanced electrolyzer system at its station in Connecticut, and GTI is collaborating with Linde to deploy several hydrogen stations throughout California, using liquid hydrogen and 900 bar ionic compression technology.

With the Department of Interior (DOI), the Department of Energy (DOE) officially opened a new hydrogen fueling demonstration station in Washington, D.C. on July 11, 2016. The event also marked the delivery of newly available commercial FCEVs to DOE and DOI fleets. This collaboration between DOE and DOI will demonstrate cutting edge hydrogen generation technology and provide an opportunity to showcase commercial FCEVs at federal agencies and the surrounding region. Though not a public station, advances demonstrated through this project will enable public retail stations of the future.

Infrastructure Support

DOE is also working with national laboratories and other partners on several projects that aim to deploy and test advanced technologies and innovative approaches that support the developing hydrogen infrastructure.

Compressors account for one-third of maintenance hours at hydrogen stations. NREL is evaluating the performance of compressors by way of accelerated testing to reproduce component failures, which are then correlated to real-world usage with statistical methods. In addition, various contaminants are being analyzed to reveal their nature and help identify solutions.

Liquid hydrogen pumps have the potential to increase hydrogen storage density (and thus vehicle driving range) by up to 30 percent, while enabling five-minute refueling and minimizing delivery costs. Lawrence Livermore National Laboratory is investigating and validating the use of high-pressure liquid hydrogen pumps, measuring criteria such as fill density, electricity consumption, and refueling time.

Work is also being conducted on tools and approaches that will enable a smoother and quicker transition to hydrogen infrastructure. The California Fuel Cell Partnership is developing the **Station Operational Status System**, which is a platform designed to collect, store, and distribute data about the operational status of hydrogen stations. Efforts are underway to increase the frequency and quality of data and to improve user interface, thereby improving customer satisfaction and station demand. Sandia National Laboratories developed a prototype device—the **Hydrogen Station Equipment Performance (HySteP) device**—to measure hydrogen dispenser performance and the ability to meet the standard fueling protocol, SAE J2601. HySteP is now being used on new stations in California, helping accelerate commercial hydrogen station acceptance.

Early Markets

Early market applications of fuel cell technologies are assessed to identify opportunities to optimize components and systems and accelerate commercialization in key early markets.

Stationary Fuel Cells

The deployment and performance of stationary fuel cell systems (combined-heat-and-power and electric only) operating under real-world conditions is tracked and evaluated, focusing on factors such as cost, capacity, deployment count, and fuel source.

Grid Integration/Energy Storage

To demonstrate how hydrogen and fuel cell technologies can be part of a broader clean energy system, DOE is evaluating the use of electrolyzers as a controllable electrical load that can provide real-time grid services. An electrolyzer stack test bed was designed, built, commissioned, and is in operation. The first of its kind real time digital simulator (RTDS)-to-RTDS communications network between labs was established for hardware-in-the-loop simulations with electrolyzer hardware at NREL and grid simulation at Idaho National Laboratory.

References

1 National Renewable Energy Laboratory, Hydrogen and Fuel Cell Composite Data Products, available at: http://www.nrel.gov/hydrogen/cdp_topic.html

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