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# VIII. TECHNOLOGY VALIDATION

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## VIII.0 Technology Validation Sub-Program Overview

### Introduction

The Technology Validation Sub-Program has been focused on conducting learning demonstrations that emphasize co-development and integration of hydrogen infrastructure with hydrogen fuel cell-powered vehicles to permit industry to assess progress towards technology readiness. Technology Validation tests, demonstrates and validates hydrogen fuel cell vehicles and infrastructure and uses the results to provide feedback to the Hydrogen R&D Program.

### Goal

Validate the status of meeting Program targets for integrated hydrogen and fuel cell technologies for transportation, infrastructure and electric generation under real-world operating conditions for both the transition and mature market periods.

### Objectives

- By 2008, validate that hydrogen vehicles have greater than 250-mile range without impacting passenger or cargo compartments.
- By 2009, validate 2,000-hour fuel cell durability in vehicles and hydrogen infrastructure that results in a hydrogen production cost of less than \$3.00/gasoline gallon equivalent (gge) (untaxed and dispensed) and allows for safe and convenient refueling by drivers (with training).
- By 2014, validate \$1.60/gge (at the plant gate) hydrogen cost from biomass gasification and \$3.10/gge for central wind-based electrolysis at the plant gate.
- By 2015, validate hydrogen vehicles that have greater than 300-mile range, 5,000-hour fuel cell durability, and hydrogen infrastructure that results in a hydrogen production cost of \$2.50/gge (untaxed) and allows for safe and convenient refueling by drivers (with training).

### Fiscal Year 2009 Technology Status

In 2009, the National Learning Demonstration continued to provide data for evaluating the technology status with respect to fuel cell durability, driving range, and power park demonstrations. Data collected during the past four years has been analyzed. Thus far, more than 1.9 million miles have been traveled by the fuel cell vehicles in the project, and 90,000 kg of hydrogen either produced or dispensed. The fuel cell durability has reached nearly 2,000 hours, and the vehicle range has exceeded the goal of 250 miles. Fuel cell system efficiency data at ~25% net power is 53–58% which is close to the DOE target of 60%.

High-pressure gas storage is approaching adequate refueling times and rates for consumers. Twenty-four percent of the vehicles have experienced flow rates >1 kg/m (DOE's near-term target).

### FY 2009 Accomplishments

#### National Learning Demonstration

- Generation 1 and 2 vehicles continued to be operated by customers, hydrogen refueling stations were installed and operated, and data were provided to the Hydrogen Secure Data Center at the National Renewable Energy Laboratory.
- All Generation 2 vehicles have been placed into service, bringing the total number of Generation 1 and 2 vehicles in the project to 140.
- A total of 20 hydrogen fueling stations are currently in operation, located in Northern and Southern California; Orlando, FL; Washington D.C.; Detroit, MI; and the New York City area.



Learning Demonstration Project Teams and Their Two Generations of Vehicles<sup>1</sup>

### Hawaii Hydrogen Power Parks

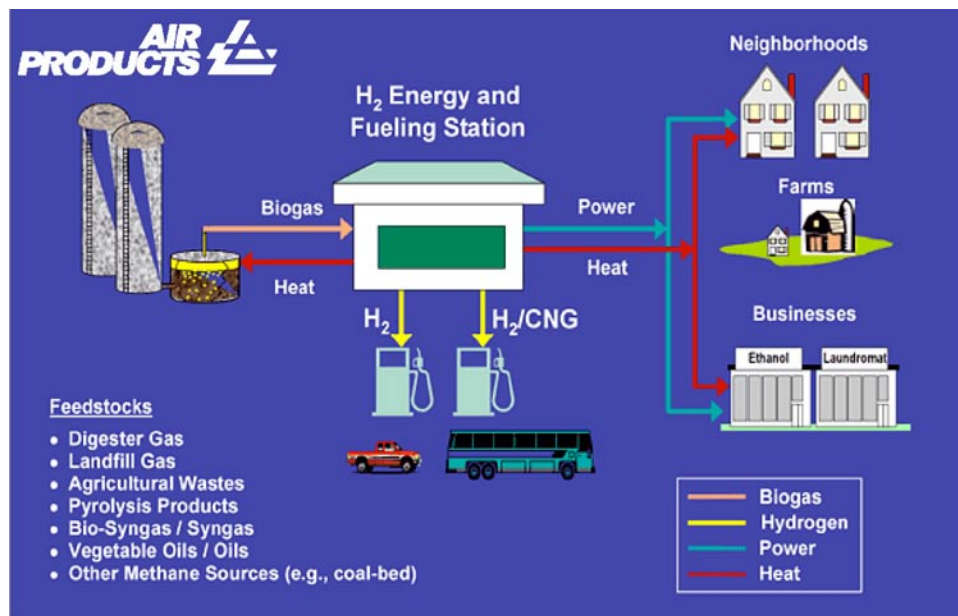
- Issued a Request for Proposal for the “turn-key” supply of the hydrogen production/fueling system - selection to be completed by September 30, 2009.
- Worked with the Hawaii Volcanoes National Park and the Hawaii Center for Advanced Transportation Technologies to develop a specification for the shuttle buses, and obtained quotes from suppliers.

### Energy Station at Fountain Valley<sup>2</sup>

- Air Products and FuelCell Energy completed the initial phase of validation testing of the Hydrogen Energy Station at FuelCell Energy’s facilities in Danbury, CT. The system has operated at up to 50% load, and has met expectations for hydrogen production, purity and recovery, and for net power production.
- Air Products executed an agreement with the California Air Resources Board (CARB) to support the existing DOE program and to add a new 100 kilogram per day fueling station to provide

<sup>1</sup> U.S. Fuel Cell Vehicle Learning Demonstration: Status Update and Early Second-Generation Vehicle Results, Keith Wipke et al, National Renewable Energy Laboratory, EVS24, Stavanger, Norway, May 13-16, 2009.

<sup>2</sup> Hydrogen Energy Station is a technology that co-produces power, heat and hydrogen. This type of system is often referred to as CHHP (Combined Heat, Power and Hydrogen). As shown in the figure, the station uses a high-temperature fuel cell to co-generate electricity, heat and hydrogen. The fuel cell can use a diversity of hydrogen-rich fuels, including digester gas, natural gas, landfill gas and syngas. This technology is expected to provide a source of cost-competitive, renewable hydrogen.



Energy Station Concept for Fountain Valley

renewable hydrogen to fuel cell vehicles. The system will be installed and operated for three years under the CARB program at Orange County Sanitation District in Fountain Valley, CA. The board of the South Coast Air Quality Management District has also approved funding for the project.

## Budget

The funding portfolio for Technology Validation addresses the need to validate integrated hydrogen and fuel cell technologies for transportation, infrastructure, and electric generation in a systems context under real-world operating conditions. The FY 2009 funding was appropriated under the Vehicle Technologies Office in the Hybrid Electric Systems Activity.

The President's FY 2010 budget request realigns the Hydrogen Program to focus on nearer term impacts to our Nation's most pressing energy needs. Therefore, funding was not requested for the Technology Validation Activity in FY 2010.

## FY 2010 Plans

In FY 2010 all of the National Learning Demonstration projects will be concluded and final reports will be prepared.

The program's validation activities also encompass fuel cell buses (FCBs). Collaboration with the Department of Transportation includes validating fuel cell and hydrogen technologies in transit bus applications in coordination with the Federal Transit Administration, and harmonizing data collection efforts with other FCB demonstrations worldwide.

Under our Market Transformation program element, DOE has collaborated with the Defense Logistics Agency (DLA) on the demonstration of fuel cell forklifts. As the main provider of fuel and supplies for the Department of Defense as well as several civilian agencies, DLA supports a vast infrastructure of distribution centers across both the United States and abroad. By introducing fuel cell forklifts into their distribution centers, DLA capitalizes on an excellent opportunity for testing fuel cells under real world conditions, and providing feedback to manufacturers. As part of this effort, NREL will collect and analyze the operations and performance data of the fork lifts.

As the program develops a more diverse portfolio of projects that include early market applications, the Technology Validation effort will be expanded to collect and analyze data from stationary fuel cells.

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