VI.0 Manufacturing R&D Sub-Program Overview

Introduction

The Manufacturing R&D (research and development) sub-program supports research and development needed to reduce the cost of manufacturing hydrogen and fuel cell (FC) systems and components. The manufacturing R&D effort will enable the mass production of components (in parallel with technology development) and will foster a strong domestic supplier base. Activities will address the challenges of moving today's laboratory-produced technologies to high-volume, pre-commercial manufacturing to drive down the cost of hydrogen and FC systems.

In Fiscal Year (FY) 2010, manufacturing projects continued in the following areas: novel electrode deposition processes for membrane electrode assembly (MEA) fabrication, high-volume FC leak-test processes, novel assembly processes for low-cost MEAs, gas diffusion layer cost reductions, and fabrication technologies for high-pressure composite storage tanks.

Goal

Research and develop technologies and processes that reduce the cost of manufacturing FCs and related systems.

Objectives

- **Fuel Cells** – Presently, FC stacks are fabricated in very small quantities, and the cost of these stacks for non-automotive applications is approximately $3,000/kW (at volumes of tens of units),[1] which is more than 20 times the projected cost of about $140/kW[2] for stacks in 2010 at low volume (1,000 stacks/year) and over 60 times the cost of $25/kW[3] at high volume (500,000 stacks/year) for automotive applications. The projected high-volume cost includes labor, materials, and related expenditures, but does not account for manufacturing R&D investment. The objective of manufacturing R&D is to enable cost reduction in fuel cell stacks for stationary and transportation power systems.
- **Hydrogen Storage** – The objective of hydrogen storage manufacturing R&D is to reduce the cost of making high-pressure carbon composite hydrogen storage tanks by a factor of 10 from 2010 costs, to be in line with the Hydrogen Storage sub-program's cost targets.[4]

FY 2010 Technology Status

This sub-program focuses on the manufacture of component and FC technologies that will be needed in the early stages of commercialization. Research investments are focused on reducing the cost of components currently used (or planned for use) in existing technologies, as well as reducing the cycle times of the processes being developed. Progress toward attaining the manufacturing R&D goals is measured in terms of the ability of funded research to reduce the cost of producing FCs, and to increase manufacturing processing rates and annual manufacturing capacity.

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[1] David L. Green and K. G. Duleep, "Bootstrapping a Sustainable North American PEM Fuel Cell Industry: Could a Federal Acquisition Program Make a Difference?", Oak Ridge National Laboratory, October 2008, www.osti.gov/bridge/servlets/purl/969964-Nr6ayI/969964.pdf

[2] James et al., "Mass-production Cost Estimation for Automotive Fuel Cell Systems," DOE Hydrogen Program 2010 Annual Merit Review Proceedings, slide 23, www.hydrogen.energy.gov/pdfs/review10/fc018_james_2010_o_web.pdf.

[3] Ibid.

[4] DOE Hydrogen Program Record #9017, "On-Board Hydrogen Storage Systems – Projected Performance and Cost Parameters," R.C. Bowman and N.T. Stetson, U.S. Department of Energy, August 2010, http://hydrogen.energy.gov/pdfs/9017_storage_performance.pdf; and "Hydrogen Storage," *Multi-Year Research, Development and Demonstration Plan: Planned Program Activities for 2005-2015*, DOE Fuel Cell Technologies Program, April 2009, www1.eere.energy.gov/hydrogenandfuelcells/mypp/pdfs/storage.pdf.

The current costs for hydrogen and FC technologies are about $20/kWh for a 700-bar gas-phase hydrogen storage system[5] (projected to high volume) and about $3,000/kW for polymer electrolyte membrane FC stacks fabricated at very low volume.

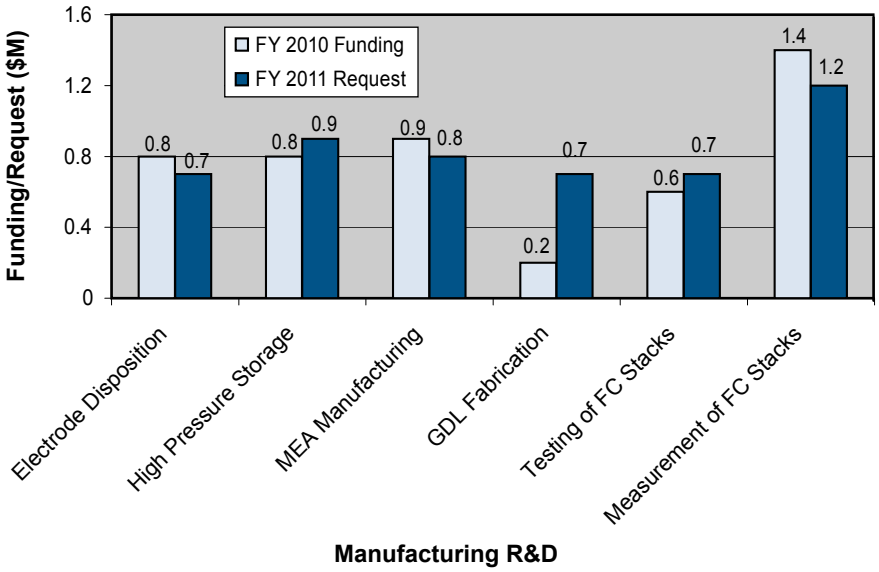
FY 2010 Accomplishments

FY 2010 saw a number of advancements in manufacturing of FCs and storage systems:

- **Gas Diffusion Layer (GDL) Fabrication:** Ballard developed a process model for controlling GDL coating conditions, resulting in significant improvement in quality yields and GDL cost reduction of 53%.
- **Electrode Deposition:** W.L. Gore demonstrated–using their cost model–that a new three-layer MEA process has the potential to reduce MEA cost by 25%.
- **High Pressure Storage:** Quantum and Boeing demonstrated advanced filament winding and fiber placement processes that reduce storage system costs by 10%.
- **MEA Manufacturing:** BASF developed a predictive model and evaluated electrode variation and defect impacts on MEA performance using their new on-line X-ray fluorescence (XRF) technique.
- **Stack Testing:** UltraCell constructed and tested their leak-test and conditioning stand.
- **Component and Stack Measurement:** The National Renewable Energy Laboratory developed and tested an internal resistance-based test stand for detection of multiple defects such as pinholes, electrical shorts, and electrode thickness variations.
- **Sensors:** The National Institute for Science and Technology developed and tested non-contact sensors for bipolar plate process control.

Budget

The President's FY 2011 budget request for the Fuel Cell Technologies Program includes $5 million for Manufacturing R&D.



[5] DOE Hydrogen Program Record #9017, "On-Board Hydrogen Storage Systems – Projected Performance and Cost Parameters," R.C. Bowman and N.T. Stetson, U.S. Department of Energy, August 2010, http://hydrogen.energy.gov/pdfs/9017_storage_performance.pdf.

FY 2011 Plans

In FY 2011, activities in the Manufacturing R&D sub-program will reduce MEA cost by 25%, reduce storage system costs by 10%, demonstrate impact on MEA performance through use of on-line XRF techniques, further reduce GDL costs beyond the 53% reduction already achieved, further develop stack leak testing, and further develop NREL's component and stack measurement capabilities. The Program plans to initiate a solicitation for manufacturing process improvement for high-temperature stationary-power FC systems and will complete a process model for high-temperature stationary FC manufacturing.

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