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## X.0 Market Transformation Sub-Program Overview

### INTRODUCTION

The Market Transformation sub-program is conducting activities to help promote and implement commercial and pre-commercial hydrogen and fuel cell systems in real-world operating environments and to provide feedback to research programs, U.S. industry manufacturers, and potential technology users. One of the sub-program's goals is to achieve sufficient manufacturing volumes in emerging commercial applications that will enable cost reductions through economies of scale, which will help address the current high cost of fuel cells (currently the capital and installation costs of fuel cells are from five to six times higher than incumbent technologies).<sup>1</sup> These early market deployments will also address other market acceptance factors, resulting in further expansion of market opportunities.

Current key objectives of the Market Transformation sub-program are to build on past successes in material handling equipment (e.g., lift trucks) and emergency backup power applications that were part of the Recovery Act, by exploring other emerging applications for market viability. Fiscal Year (FY) 2012 activities were primarily focused on completing projects using FY 2010 appropriations and preparing for a new solicitation using FY 2012 appropriations. These projects are highly leveraged, with an average of more than half of the projects' funds being provided by DOE's partners. Partners providing resources to these projects have shown a high level of interest in exploring these applications and markets, and this level of industry interest is very promising for the potential growth of the domestic fuel cell industry.

### GOALS

Market Transformation activities provide financial and technical assistance for the use of hydrogen and fuel cell systems in early market applications, with the key goals of: achieving sales volumes that will enable cost reductions through economies of scale, supporting the development of a domestic industry, and providing feedback to testing programs, manufacturers, and potential technology users.

### OBJECTIVES<sup>2</sup>

- Advance understanding of the use of fuel cells for waste-to-energy systems, shipboard auxiliary power units, and aviation applications through testing and evaluation efforts coordinated with the Technology Validation sub-program and in partnership with the Department of Defense (DOD), the Department of Agriculture, the Federal Aviation Administration, and others; evaluate design requirements for aircraft auxiliary power units by 2012 and waste-to-energy fuel cells by 2014.
- By 2014, establish baseline energy efficiency and reliability performance metrics for commercially available emergency backup power, material handling, and light commercial/residential fuel cell systems and provide feedback to component suppliers regarding cost reduction opportunities.
- By 2015, in coordination with the DOE Office of Electricity Delivery and Energy Reliability, test emerging approaches to grid management using fuel cell systems and renewably produced hydrogen.
- By 2016, develop and launch energy efficiency and reliability certification programs for fuel cells.
- By 2017, identify lessons learned from existing policies and regulations and promote the development of effective and applicable incentives for hydrogen and fuel cell technologies.

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<sup>1</sup> Catalog of CHP Technologies, U.S. Environmental Protection Agency, December 2008, [www.epa.gov/chp/basic/catalog.html](http://www.epa.gov/chp/basic/catalog.html).

<sup>2</sup> Note: Targets and milestones were recently revised; therefore, individual project progress reports may reference prior targets. Some targets are still currently under revision, with updates to be published in FY 2013.

## FY 2012 STATUS

Fuel cells have been enjoying growing success in key early markets, particularly in material handling (e.g., forklift) and backup power applications. The Program's early market deployment efforts—including Market Transformation funding and Recovery Act funding—have successfully catalyzed a significant level of market activity in these areas, which has been accompanied by substantial reductions in the price of fuel cells. The sub-program is actively pursuing additional opportunities for effective stimulation of market activity. Ongoing activities and additional areas of interest include the following:

- **Material Handling Equipment (MHE):** As a complement to the hydrogen fuel cell forklift deployments currently underway, the sub-program is investigating the use of direct methanol fuel cell (DMFC) technologies. DMFC MHE will provide the same operational benefits as hydrogen-powered fuel cell MHE, with significant additional benefits from the use of a liquid fuel, including reduced infrastructure costs, high energy density, and lower overall fueling costs.
- **Mobile Lighting:** The sub-program is exploring the potential for expanded use of fuel cells for mobile lighting, which is commonly used for road maintenance, general construction, and large outdoor events. Unlike conventional diesel-based systems, fuel cells offer the benefits of nearly silent operation, with no harmful exhaust emissions. Working with manufacturers of fuel cells and mobile lighting equipment, the Program has supported the design, construction, and testing of fuel cell power mobile lighting prototypes (Sandia National Laboratories). Demonstration and testing was conducted at a Boeing Manufacturing Plant, NASA Kennedy Space Center, Caltrans, Paramount Pictures/Saunders Electric, and the San Francisco International Airport.
- **Market Analysis and Deployment Tools:** The sub-program continues to pursue opportunities for collaboration through the DOE-DOD memorandum of understanding, including two projects that have analyzed the technical feasibility of using fuel cells for auxiliary power onboard commercial passenger airliners, addressing both low-temperature polymer electrolyte membrane fuel cells (Sandia National Laboratories), and high-temperature ceramic-type fuel cells (Pacific Northwest National Laboratory).
- **Micro-CHP (Combined Heat and Power):** To document the market viability of fuel cells for small facilities, the sub-program is working with fuel cell developers and system users to demonstrate micro-CHP systems at five commercial facilities. ClearEdge Power is providing 15 fuel cells. A key objective of this work is to obtain performance data on these systems over the course of several years.
- **Big Island of Hawaii Hydrogen Energy Storage Project:** In partnership with the Naval Research Laboratory and the University of Hawaii's Hawaii Natural Energy Institute, the sub-program is supporting the demonstration of a hydrogen energy storage system as a grid management tool. While hydrogen produced from the system could be used in a variety of value-added applications, the initial phase of the project will use the hydrogen in two fuel cell buses operated by the County of Hawaii Mass Transportation Agency.
- **South Carolina Landfill Gas Purification Project:** The sub-program is demonstrating the business case and technical viability of using landfill gas (LFG) as a source of renewable hydrogen production, using BMW's assembly plant in South Carolina as the host site. Should such a scale-up operation prove viable, it would represent a first-of-its-kind LFG-to-hydrogen production project in the nation, and it would serve as a model for future adoption of renewable biogas as a feedstock for hydrogen production.

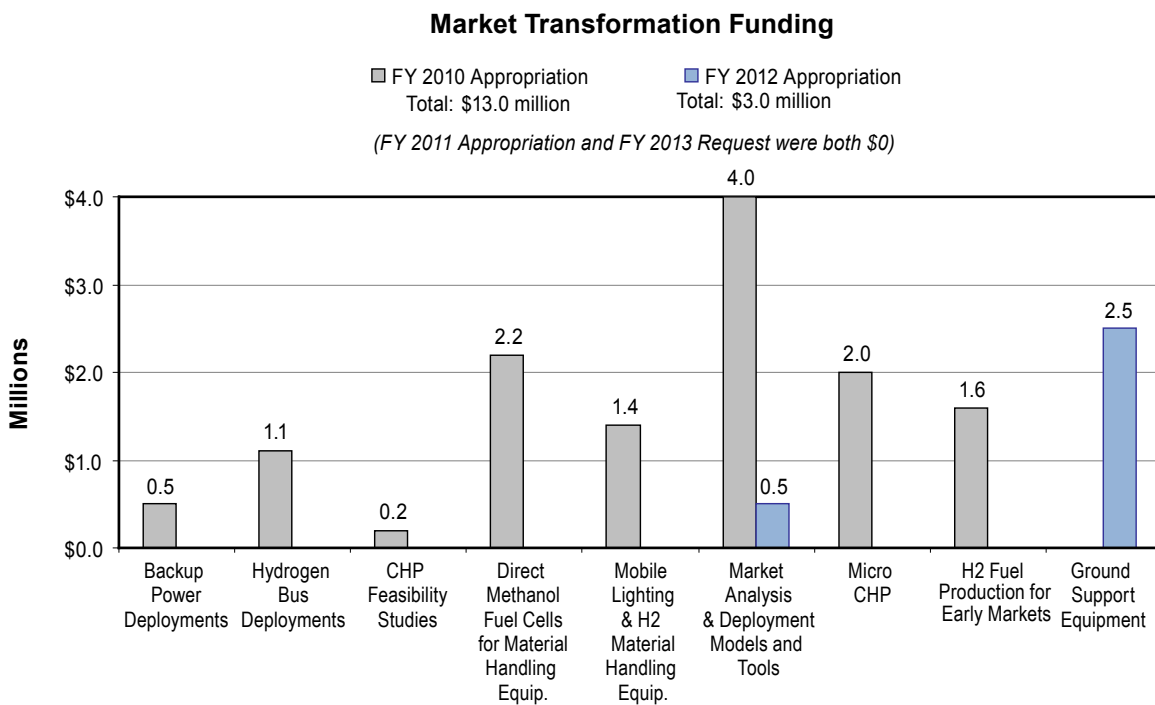
## FY 2012 KEY ACCOMPLISHMENTS

In FY 2012, the sub-program developed deployment tools and business cases for various fuel cell applications, conducted public outreach activities, and analyzed and tested potential new early markets in mobile lighting, DMFC-powered lift trucks, and auxiliary power. The following are some of the key milestones the sub-program achieved in FY 2012:

- Demonstrated and validated a fuel cell mobile lighting system that combines high-pressure (5,000-psi) hydrogen storage, efficient lighting, and a 5-kW PEM fuel cell; field tested the system at industry and government installations; and expanded public awareness of the technology by using fuel cell mobile lighting at various entertainment-industry award events, including the Oscars, the Golden Globe Awards, and the Screen Actors Guild Awards.
- Developed and published guidelines for federal facilities managers to procure energy from stationary fuel cell power systems, including the use of innovative financing mechanisms that require little or no capital investment.
- Demonstrated 75 DMFC lift trucks at four food distribution sites.
- Initiated a competitive funding opportunity to deploy fuel-cell powered ground support equipment at airports or air freight distribution centers.
- Conducted modeling and simulation for evaluating onboard fuel cell rechargers for battery-electric road vehicles.
- Initiated demonstration and deployment of fuel cell auxiliary power systems for refrigerated trucks.

### BUDGET

FY 2012 appropriation was \$3 million and no funding was requested in FY 2013.



## FY 2013 PLANS

In FY 2013, the sub-program will continue to document lessons-learned associated with previously funded projects, including the strategies developed for market entry and for risk management with respect to safety, environmental, and siting requirements. Business analysis and case studies will be initiated. Collection and evaluation of data from these projects will provide the basis for verifying the business cases for various early market fuel cell systems, as well as providing an assessment of the performance of these integrated systems. Data will be made publicly available so that more customers will become aware of the benefits of integrated hydrogen and fuel cell systems. In addition, a near-term priority will be to continue collaborating with other federal agencies—in accordance with existing interagency cooperative agreements such as the DOE-DOD memorandum of understanding—to increase the use of fuel cells in market-ready applications and to increase awareness of the benefits of these deployments. Competitive award(s) will be made and deployment of fuel cell powered ground support equipment will begin.

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