
IX.0 Market Transformation Program Overview

INTRODUCTION

The Market Transformation program is conducting activities to help promote and implement commercial and pre-commercial hydrogen and fuel cell systems in real-world operating environments to provide feedback to research programs, U.S. industry manufacturers, and potential technology users. One of the program's goals is to achieve sufficient manufacturing volumes in emerging commercial applications to enable cost reductions through economies of scale, which will help address the current high cost of fuel cells. These early fuel cell deployments will also address other market acceptance factors, which will result in further expansion of market opportunities.

Current key objectives of the Market Transformation program are to build on past successes in material handling equipment (MHE) (e.g., lift trucks) and emergency backup power applications that were part of the American Reinvestment and Recovery Act of 2009 (Recovery Act), by exploring other emerging applications for market viability. Fiscal Year (FY) 2013 activities were primarily focused on completing projects using FY 2010 appropriations, launching a new project to demonstrate commercial viability of fuel cell-powered airport ground support baggage tractors, and preparing and issuing a new solicitation using FY 2013 appropriations to demonstrate fuel cell-powered electric medium-duty hybrid trucks for parcel delivery applications. 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.

OBJECTIVES¹

The program's key objectives include:

- Conduct market transformation deployment projects to enable life cycle cost and performance of fuel cell-powered lift trucks and emergency backup power systems to be on par with conventional technologies by 2020.
- Establish baseline energy efficiency and reliability performance metrics for commercially available emergency backup power systems, MHE, and light commercial/residential power systems and provide feedback to component suppliers regarding cost reduction opportunities by 2013.
- Test emerging approaches to grid management using renewable hydrogen storage and fuel cell systems in coordination with the DOE's Office of Electricity Delivery and Energy Reliability by 2014.
- Advance the knowledge and expertise of waste-to-energy stationary fuel cells, shipboard auxiliary power unit (APU) applications, and aviation applications through targeted testing and evaluation efforts in coordination with technology validation activities and in partnership with the U.S. Department of Defense, the U.S. Navy, the U.S. Army, and civilian agencies such as the U.S. Department of Agriculture and the Federal Aviation Administration by conducting design requirements planning for aircraft APUs by 2012, shipboard APUs by 2013, and waste-to-energy fuel cells by 2014.
- Identify lessons learned from promulgated policies and regulations and promote the development of the most effective and applicable incentives for hydrogen and fuel cell technologies by 2016.

¹Note: Targets and milestones were recently revised; therefore, individual project progress reports may reference prior targets.

FY 2013 STATUS

Fuel cells have been enjoying growing success in key early markets, particularly MHE and backup power applications. The Fuel Cell Technologies Office'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 Office is actively pursuing additional opportunities for effective stimulation of market activity. Ongoing activities and additional areas of interest include the following:

- **MHE Project:** As a complement to the hydrogen fuel cell lift truck deployments currently underway, the program continues to investigate the market viability of using direct methanol fuel cell (DMFC) technologies. The DMFC MHE project is now being completed and operational benefits and reduced infrastructure costs are being verified.
- **Micro-CHP (combined heat and power) Project:** To document the market viability of fuel cells for small facilities, the program is working with fuel cell developers and system users to monitor the long-term performance and evaluate the engineering, economic, and environmental impacts of micro-CHP systems at five commercial facilities. Clear Edge Power has provided 15 fuel cells.
- **Hydrogen Energy Storage Project:** In partnership with the Naval Research Laboratory and the State of Hawaii, the 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, during the initial phase of the project, the hydrogen will be used in fuel cell buses operated by the County of Hawaii Mass Transportation Agency and the National Park Service.
- **South Carolina Landfill Gas Purification Project:** The program is demonstrating the business case and technical viability of using landfill gas (LFG) as a source of renewable hydrogen production, with BMW's assembly plant in South Carolina as the host site. This project represents a first-of-its-kind LFG-to-hydrogen production plant in the nation and is expected to serve as a model for future adoption of renewable biogas as a feedstock for hydrogen production.
- **Ground Support Equipment (GSE) Demonstration Project:** This project is demonstrating the value proposition of using fuel cell-powered tow tractors as a cost-competitive and more energy-efficient solution when compared to incumbent internal combustion engine-powered vehicles. This effort will address concerns regarding the weatherproofing of fuel cell-powered GSE and enable end-users at FedEx's busiest airport to accomplish their daily tasks while reducing consumption of gasoline and diesel fuels. This project was kicked off in Latham, New York in March 2013.
- **Cost-Benefit Analysis of Fuel Cells in Hybrid Electric Vehicles Project:** The program is demonstrating the cost-benefit tradeoffs of adding a fuel cell APU to double the range of existing battery electric vehicles and aims to quantify the cost-benefit of using a fuel cell APU for different vehicle classes based on the levelized cost of driving.

FY 2013 KEY ACCOMPLISHMENTS

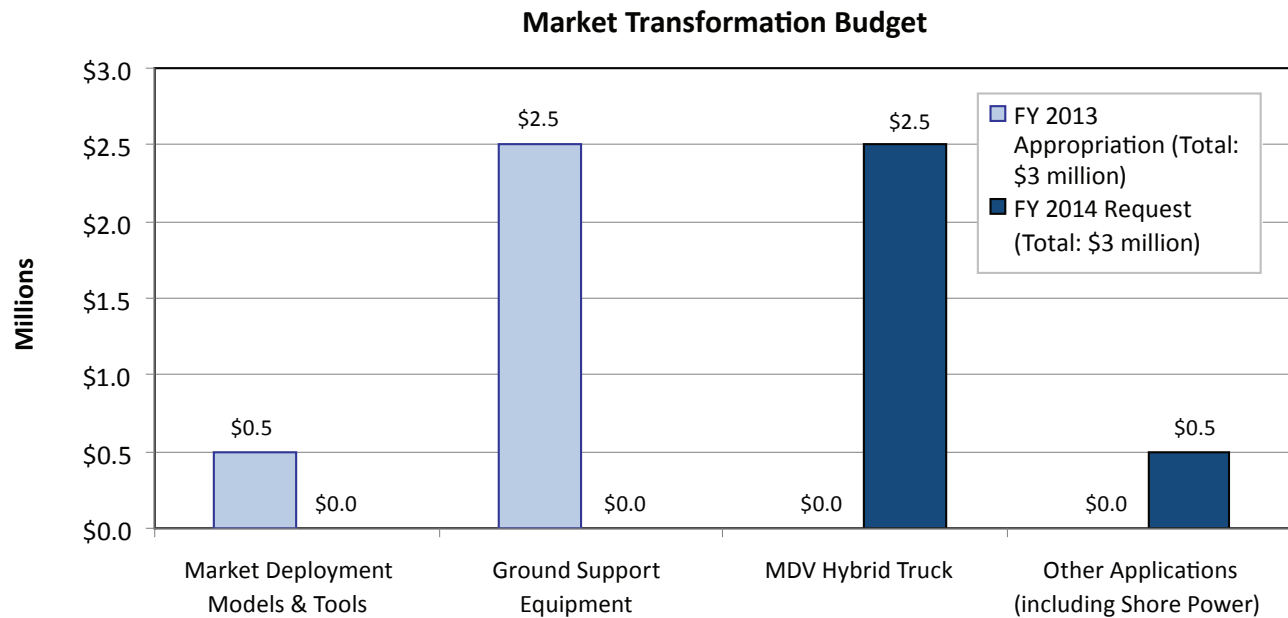
In FY 2013, the program developed deployment tools and business cases for various fuel cell applications, conducted public outreach activities, and analyzed and tested potential new early markets in mobile lighting, DMFC-powered lift trucks, and auxiliary power. The following are some of the key milestones the program achieved in FY 2013:

- In FY 2013, this project analyzed 251,000 hours of operational data from 131 DMFC lift trucks operating at five food distribution sites. Durability analysis and operation analysis of the DMFC units has been completed. The estimated median time of DMFC unit operation was 1,391 hours.
- Performance data for 15 micro-CHP fuel cells were collected and analyzed indicating an average of over 11,000 hours per system. The project team also made recommendations and adjustments to the fuel cell operation that improved fuel cell power output stability.
- In 2013, as part of a demonstration of a hydrogen energy storage system as a grid management tool, a fuel cost analysis based on project equipment in fuel cell bus applications resulted in fuel cost estimates that are competitive (~\$8/kg) with conventional fuels on a cents per mile basis.

- Awarded two projects and began design development of fuel cell APUs for refrigerated trucks.
- By the end of FY 2013, the LFG-to-hydrogen project team completed development of an LFG clean-up system, conducted startup and troubleshooting activities, and demonstrated, using project equipment, that the fuel cost estimate is competitive (~5.50/kg) with off-site commercial vendors. This project—the world’s first demonstration of LFG-to-hydrogen fuel for fuel cell powered lift trucks—is continuing at the BMW plant in Greer, South Carolina, home to the world’s largest fuel cell-powered lift truck fleet (over 300 MHE units).
- In FY 2013, the GSE demonstration project was kicked off in Latham, New York and the project team completed system modeling, tracked and shared data with the baggage tow tractor manufacturer, coordinated with FedEx Express sites for hydrogen permits, and signed a hydrogen supply agreement.
- At the end of FY 2013, the project team developed a vehicle-level energy management system to properly evaluate benefits of using fuel cell system power and onboard hydrogen storage, quantified the trade-off between energy consumption and cost on the Urban Dynamometer Driving Schedule, and demonstrated benefits of using fuel cell systems to double the range of current battery electric vehicles for medium-duty vehicle applications.

BUDGET

FY 2013 appropriation was \$3 million and \$3 million was requested in FY 2014.



FY 2014 PLANS

In FY 2014, the 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 potential 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-Department of Defense 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 design and deployment of fuel cell-powered medium-duty trucks for parcel delivery will begin.

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