

## XII.11 GENCO Fuel Cell-Powered Lift Truck Fleet Deployment

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Contract Number: DE-EE0000483

### Subcontractors:

- Plug Power Inc., Latham, NY
- Air Products, Allentown, PA
- Linde North America, Murray Hill, NJ

Project Start Date: October 1, 2009

Project End Date: September 30, 2013

- Creating jobs at Plug Power to design, build and commission the fuel cell power units.
- Creating jobs at Air Products and Linde to design, install and commission hydrogen storage and fueling equipment.
- Creating jobs at Air Products and Linde to deliver hydrogen to GENCO facilities.
- Training lift truck operators in hydrogen safety, fueling procedures and fuel cell operation.
- Training lift truck maintenance personnel to service fuel cells.
- Improving the overall economic efficiency of material handling operations.

This project advances the DOE Fuel Cell Technologies' ARRA project goals of accelerating the commercialization and deployment of fuel cells and fuel cell manufacturing, installation, maintenance, and support services by demonstrating:

- Safe and reliable operation of hydrogen storage and fueling equipment and fuel delivery.
- Reliable and efficient operation of hydrogen fuel cells.
- Economic and environmental advantages of fuel cells over batteries.
- Practical operation and maintenance of fuel cells.

### Objectives

The objectives of this project are to:

- Convert 357 electric-drive fork lift trucks from batteries to fuel cell power units in five large distribution centers and manufacturing facilities.
- Demonstrate the safe and reliable operation of hydrogen-fueled material handling equipment (MHE).
- Demonstrate the economic benefits of conversion to hydrogen fuel cell-powered MHE.
- Demonstrate operator acceptance of hydrogen fuel cell-powered MHE.
- Provide a cost-effective and reliable hydrogen fuel supply.
- Spur further lift truck fleet conversions to hydrogen fuel cells.
- Establish a proving ground for hydrogen fuel cell-powered MHE.

### Relevance to the American Recovery and Reinvestment Act (ARRA) of 2009 Goals

This project advances the goals of the American Recovery and Reinvestment Act (ARRA) of 2009 to create new jobs, save existing jobs, and spur economic activity and investment in long-term economic growth by:

### Technical Barriers

This project addresses the following technical barriers to the use of fuel cell-powered lift trucks:

- Represents a change in technology, which is often met with reluctance.
- Uncertain power unit reliability due to lack of widespread performance data.
- Safety and expense of hydrogen and fueling equipment.
- Difficulty in obtaining permits and approvals for hydrogen fueling stations.

### Technical Targets and Milestones

The class and number of power units and the hydrogen supplier for each GENCO location are shown in Table 1.

The status of project milestones for deploying fuel cell power units and hydrogen storage and fueling equipment are shown in Table 2.

**TABLE 1.** Power Unit Distribution and Hydrogen Suppliers

Power Unit	Wegmans Pottsville PA	Whole Foods Landover MD	Coca-Cola Charlotte NC	Sysco Philadelphia PA	Kimberly-Clark Graniteville SC	Total
Class-1	0	45	40	0	25	<b>110</b>
Class-2	36	14	0	25	0	<b>75</b>
Class-3	100	2	0	70	0	<b>172</b>
Total	<b>136</b>	<b>61</b>	<b>40</b>	<b>95</b>	<b>25</b>	<b>357</b>
Hydrogen Supplier	Air Products	Linde	Linde	Air Products	Air Products	

**TABLE 2.** Project Milestones (June 2011)

Milestone	Wegmans	Whole Foods	Coca-Cola	Sysco Philadelphia	Kimberly-Clark
Hydrogen storage and fueling equipment commissioned	Completed Jan 2010	Completed Jan 2011	Completed May 2011	Completed Apr 2011	Completed Dec 2010
Power units commissioned	49 of 136 completed Jan 2010, balance by Dec 2010	Completed Sep 2010	Completed Jan 2011	36 of 95 completed Mar 2011, balance by Apr 2012	Completed Dec 2010
Facility operational	Started Jan 2010	Started Jan 2011	Started May 2011	Started May 2011	Started Dec 2010
Project completed	Sep 2013	Sep 2013	Sep 2013	Sep 2013	Sep 2013

## Accomplishments

The accomplishments of this project include:

- Commissioning hydrogen storage and fueling equipment at all sites (see Table 2 for completion dates).
- Commissioning power units at all sites (see Table 2 for completion dates).
- Completing fueling, operation and maintenance training at all sites.
- Operating power units at all sites (see Table 2 for starting dates).
- Some power units at Wegmans have accumulated over 5,000 hours of operation.



## Introduction

The purpose of this project is to demonstrate that hydrogen fuel cells are a safe and economical alternative to lead-acid batteries for powering electric-drive lift trucks. The primary barriers to widespread use of hydrogen fuel cells for material handling equipment are concerns about the safety of hydrogen storage and fueling equipment, operating costs for fuel and maintenance, and the long-term reliability of fuel cells.

## Approach

This project will evaluate the safety and economics of using hydrogen fuel cells to power over 350 lift trucks at five GENCO facilities. GENCO will supply the lift trucks, Plug Power will supply the GenDrive fuel cell power units, Air Products and Linde will supply the hydrogen storage and fueling equipment and the hydrogen fuel. The equipment will be maintained by GENCO personnel with assistance from Plug Power, Air Products and Linde personnel when necessary.

GENCO and the subcontractors will monitor the operation and maintenance of the power units and the hydrogen storage and fueling equipment over the duration of the project. This information will be reported to the DOE and National Renewable Energy Laboratory quarterly and summarized annually.

## Results

This project has successfully demonstrated the safe and economical operation of 300 class 1, 2 and 3 fuel cell power units and associated hydrogen storage and fueling equipment at five GENCO facilities. An additional 57 power units will be added at the Sysco Philadelphia facility by April 2012.

Some of the fuel cell power units at the Wegmans facility have accumulated over 5,000 hours of operation. GENCO and Plug Power have been monitoring the type and

frequency of repairs on these power units. Figure 1 shows the repair frequency of these power units and Figure 2 shows the types of power unit repairs.

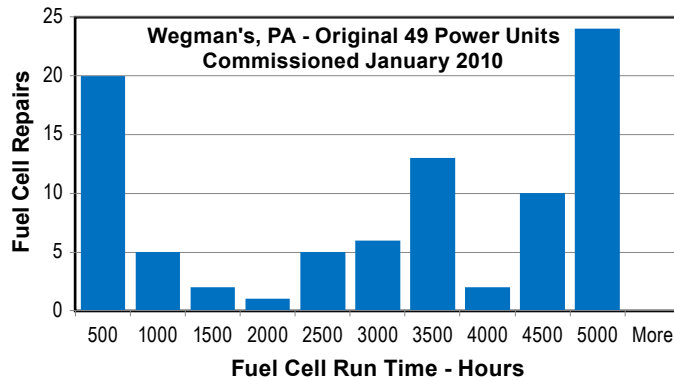


FIGURE 1. Fuel Cell Repair Frequency

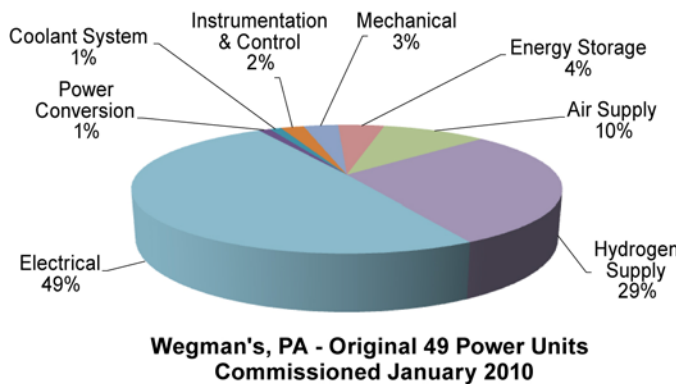


FIGURE 2. Types of Fuel Cell Repairs

### Conclusions and Future Directions

Based on the proven reliability and safety of current hydrogen fuel cell operations at GENCO facilities to date, future directions include:

- Ongoing operational and maintenance support for power units and hydrogen storage and fueling equipment.
- Ongoing data collection from power units and hydrogen storage and fueling equipment.
- Helping to reduce the overall costs of fuel cell power units and hydrogen fuel by supporting the conversion to fuel cells at other locations.

### Fiscal Year 2011 Publications/Presentations

1. Key federal and state government officials, leaders in sustainable energy solutions and executives from Kimberly-Clark, GENCO ATC, Plug Power and Air Products attended a ribbon-cutting ceremony and technology demonstration at the Kimberly-Clark site on February 11, 2011.
2. GENCO delivered an American Recovery and Reinvestment Act merit review presentation in Washington, DC in May 2011.