

DOE Hydrogen and Fuel Cells Program Record		
Record #: 15003	Date: 04/29/2015	
Title: Industry Deployed Fuel Cell Powered Lift Trucks		
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Item:

Table 1: Number of fuel cell deployments (shipped and on-order) for applications in material handling equipment (MHE).

	DOE Funded¹ (ARRA) as of Record Date	DOE Funded²⁻⁴ (Appropriations) as of Record Date	DOE Total	Industry-Funded Fuel Cell Shipments and Units On Order (U.S.)^{2-9, 13-17} From 2009 – Record Date	DOE and Industry Total From 2009 – Record Date
Number of MHE Deployments (current & planned)	524	189	713	8,340	9,053

The successful deployment of over 700 MHE fuel cell units with U.S. Department of Energy (DOE) funds has led to over 8,300 MHE fuel cell shipments and units on order with no DOE funding. The 9,053 MHE fuel cell shipments and units on order equate to nearly 59,000 kW of fuel cell systems.ⁱ

Data/Assumptions/Calculations:

Total DOE American Recovery and Reinvestment Act (ARRA) investment for these fuel cell powered lift trucks is about \$9.7M, with an industry cost share of \$11.8M.ⁱⁱ The DOE Fuel Cell

ⁱ Estimated total kW of fuel cell systems deployed assumes a capacity of 6.5 kW for each MHE unit. This is the average of 3 kW and 10 kW system sizes based on [NREL analysis](#) indicating that the distribution of MHE units is evenly split between Type I/II (10 kW) and Type III (3 kW) units. Information on system sizes is supported by NREL report, “An Evaluation of the Total Cost of Ownership of Fuel Cell-Powered Material Handling Equipment”:
<http://www.nrel.gov/docs/fy13osti/56408.pdf>

ⁱⁱ ARRA funding supported deployments in MHE for: FedEx Freight East; GENCO with deployments at Coca Cola, Kimberly Clark, Sysco Philadelphia, Wegmans, and Whole Foods Market; Nuvera Fuel Cells with deployments at H-E-B Grocery. Funds included units as well as other aspects of the projects such as infrastructure, training, installation, data collection, analysis, and reporting.

Technologies Office (FCTO) has estimated that the more than 700 fuel cell powered lift trucks deployed with DOE cost-share led to over 8,300 orders/deployments with no DOE funding. As industry continues to place orders and deploy units, DOE will revise its records and determine actual orders filled/units commissioned as a result of initial DOE funding (Market Transformation and ARRA projects).

The manufacturers providing the fuel cells for the deployments (installed and on order) mentioned in Table 1 are:

Hydrogenics	Oorja Protonics
Hyster-Yale / Nuvera Fuel Cells	Plug Power, Inc.

In 2011, Plug Power announced the next generation of its GenDrive® fuel cell products for electric lift trucks and committed to purchase a minimum of 3,250 fuel cell stacks by the end of 2011 from Ballard Power Systems.¹⁰ Plug Power also announced its intent to partner with Axane, an Air Liquide subsidiary, to better penetrate the European forklift market, which the company estimates to include an installed base of 2,000,000 forklifts and 325,000 annual unit sales.¹¹

In January of 2014, Plug Power launched its latest hydrogen fuel cell product, GenKey®, the company's first all-inclusive product for material handling sites. GenKey consists of three separate elements: GenDrive® fuel cell units, GenFuel® hydrogen fuel and infrastructure, and GenCare® maintenance service. By providing full integration and deployment of the entire GenKey® package, this new offering ensures a seamless transition to hydrogen fuel cell-based power for material handling operations.¹²

In December 2014, Hyster-Yale acquired Nuvera Fuel Cells and announced plans for a ground-up fuel cell MHE product. This acquisition creates a unique capability to integrate fuel cells with MHE units in order to optimize performance and energy efficiency of the combined system.¹⁸ Sales will be documented in future record updates.

As of May 2015, examples of companies that have purchased or ordered fuel cell powered lift trucks are as follows:

Ace Hardware	Golden State Foods	Stihl
Baldor Specialty Foods	IKEA	Sysco Foods
BMW Manufacturing Co.	Kimberly-Clark/GENCO	Testa Produce
Bridgestone-Firestone	Kroger Co.	Unified Grocers
Central Grocers	Lowes	United Natural Foods, Inc. (UNFI)
Coca-Cola	Martin-Brower	U.S. Foodservice

CVS	Mercedes	Walmart
EARP Distribution	Nestle Waters	Wegmans
East Penn Manufacturing	Nissan North America	Whole Foods Market
FedEx Freight	Proctor and Gamble	WinCo Foods, LLC

Based on OEM feedback, it was determined that their purchase orders for deployments were considered either directly or indirectly due to results of the DOE FCTO. This includes both Market Transformation and ARRA deployment funding. In some instances, companies increased the number of purchases beyond those with DOE funds assistance. In other instances, the OEMs were able to show the business case using data collected from DOE projects and obtained purchase orders with no DOE funding. The list only includes deployments that can be traced to DOE FCTO involvement.

Peer Review: This record was peer reviewed by the National Renewable Energy Laboratory's (NREL) National Fuel Cell Technology Evaluation Center (NFCTEC).

References:

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