Highlights from U.S. Department of Energy's Fuel Cell Recovery Act Projects

The American Recovery and Reinvestment Act of 2009 (Recovery Act) was signed into law by President Obama on February 17, 2009. The Recovery Act was an unprecedented effort to jumpstart our economy, create or save millions of jobs, and put a down payment on addressing long-neglected challenges so our country can thrive in the twenty-first century. On April 15, 2009, the Energy Department announced $41.6 million in Recovery Act funding to accelerate the commercialization and deployment of fuel cells; and to build a robust fuel cell manufacturing industry in the United States, with accompanying jobs in fuel cell manufacturing, installation, maintenance, and support services.[1] Grants were awarded to develop and deploy a variety of fuel cell technologies including polymer electrolyte, solid oxide and direct-methanol fuel cells in stationary, portable, and specialty vehicle applications (i.e., lift trucks). This funding has supported the deployment of over 1,300 fuel cell systems, exceeding the original target of 1,000. These efforts are accelerating the potential of fuel cells to provide power in stationary, portable, and specialty vehicle applications; and to cut carbon emissions, create jobs, and broaden our nation's clean energy technology portfolio.

Back-up Power

Three projects were awarded $18.5M in Recovery Act funding for fuel cell deployments in backup power – ReliOn, Inc.; Sprint Nextel; and Plug Power, Inc. ReliOn (with fuel cell deployments at AT&T and Pacific Gas & Electric sites) and Sprint are demonstrating the technical and economic viability of deploying 1 kW to 10 kW polymer electrolyte membrane (PEM) fuel cells with 72 hours of on-site fuel storage to provide backup power for critical cell phone tower sites and utility networks. As of October 2013, almost 820 fuel cells have been installed and are operational nationwide. Data collected from the National Renewable Energy Laboratory (NREL) has already shown over 99.6% reliability of the fuel cells. Since the beginning of the projects, the maximum continuous grid outage the fuel cells have had the opportunity to support was 65 hours, which they did successfully. Recovery Act funding has also facilitated further market transformation. For example, as a result of Recovery Act deployments, Air Products, with no DOE funding, developed a short-truck bulk hydrogen refueler. This delivery

Recovery Act and Market Transformation Activities

As of October 2013, over 91% of Recovery Act funds have been spent, resulting in over 1,300 fuel cells deployed and over 1.4 million hours of operation.

Successful DOE deployments of fuel cells (including deployments from ARRA funding as well as Market Transformation projects) have led to industry orders of almost 5,000 fuel cell forklifts and almost 3,500 fuel cell backup power systems, with no additional DOE funding. In addition, EERE's investment of $50M in specific hydrogen and fuel cell projects led to more than $300M in revenue and investments of approximately $14M in specific projects led to a nearly $130M in additional private investment.[3]

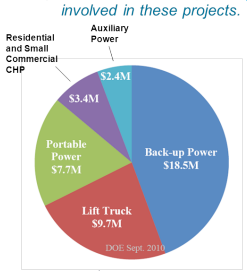
These projects support domestic fuel cell manufacturers—helping to create high-tech manufacturing jobs, and keep these jobs in the U.S.

Preliminary results indicate that nearly 700 jobs were created or retained in 2013 as a result of Recovery Act funding.[4]

National Renewable Energy's (NREL) Hydrogen Secure Data Center (HSDC) has established data reporting protocols with each of the project teams. Composite Data Products (CDPs) and Detailed Data Products (DDPs) showing progress to-date have been prepared. The CDPs are available on the NREL HSDC website.[2]

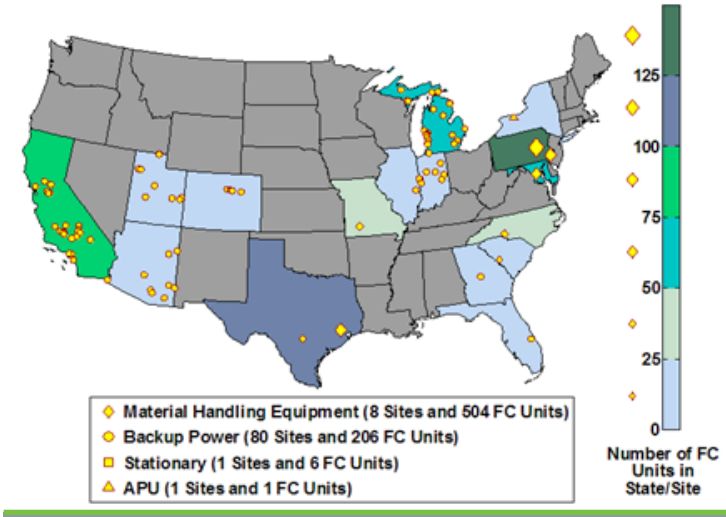
FROM the LABORATORY to DEPLOYMENT:

DOE funding has supported R&D by all of the fuel cell suppliers involved in these projects.



Approximately $54 million in cost-share funding from industry participants—for a total of about $96 million.

COMPANY	AWARD	APPLICATION
Plug Power (7A)	$2.7 M	Backup Power
ReliOn, Inc.	$8.5 M	Backup Power
Sprint Nextel	$7.3 M	Backup Power
FedEx Freight East	$1.3 M	Lift Truck
GENCO	$6.1 M	Lift Truck
Nuvera Fuel Cells	$1.1 M	Lift Truck
Sysco Houston	$1.2 M	Lift Truck
Acumentrics	$2.2 M	Backup Power
MTI MicroFuel Cells	$3.0 M	Portable
Univ. of N. Florida	$2.5 M	Portable
Plug Power (6A)	$3.4 M	CHP
Delphi Automotive	$2.4 M	Auxiliary Power



DOE Recovery Act-Funded Fuel Cell Deployment Locations. *National Renewable Energy Laboratory.*

Refueling hydrogen tanks for backup power (top right); AT&T cellular tower site with fuel cells for backup power. *ReliOn, Inc.*

Deployment Site	City, State	Operational FCs (#)
FedEx Freight East	Springfield, MO	35
Coca Cola (GENCO)	Charlotte, NC	40
Kimberly Clark (GENCO)	Graniteville, SC	25
Sysco Philadelphia (GENCO)	Philadelphia, PA	95
Wegmans (GENCO)	Pottsville, PA	136
Whole Foods Market (GENCO)	Landover, MD	61
H-E-B (Nuvera Fuel Cells)	San Antonio, TX	14
Sysco Houston	Houston, TX	98
	TOTAL	**504**

system is being used to deliver hydrogen to a wider range of sites, including the more remote backup power locations.

Plug Power is demonstrating the market viability of low temperature, 6 kW, PEM fuel cells fueled by liquid petroleum gas to provide clean and reliable primary power and 72 hours or more of emergency backup power. Ten fuel cells are currently operational at the Warner Robins Air Force Base in Warner Robins, Georgia. An additional 10 fuel cells will begin operation in 2013 at an engineering building at Fort Irwin in Barstow, California.

Material Handling Equipment (MHE)

Four projects were awarded $9.7M in Recovery Act funding to deploy fuel cell powered lift trucks, or material handling equipment (MHE), as replacements for battery and propane powered lift truck fleets. By the end of December 2011, more than 500 fuel cells for MHE were operational, bringing the Recovery Act MHE projects to full deployment. Combined, these lift trucks already have achieved over 1.4 million hours of operation and used more than 187,000 kg of hydrogen from more than 246,000 indoor hydrogen refueling events. Various end users have shown evidence of increased productivity in their warehouse operations as a result of using the fuel cells, some as much as 10%.[5] NREL analysis has shown that, for Class I and II forklifts, fuel cells could reduce the overall cost of ownership by 10% per year per lift truck and the cost of ownership of Class III forklifts (also known as pallet jacks) can be reduced by 5%, per year for each lift truck.[6]

The lessons learned from these projects, in part, have leveraged additional fuel cell deployments with no DOE funding. FedEx Freight purchased an additional five fuel cell powered lift trucks for their service center in Springfield, Missouri, bringing their total fleet to 40 fuel cell lift trucks. Sysco Foods is planning to deploy over 900 additional fuel cell lift trucks throughout seven different distribution centers nationwide.

Left: Class III fuel cell powered lift truck at Sysco Houston distribution center in Houston, TX. *Sysco Houston.* Right: Indoor refueling station for fuel cell powered lift trucks at FedEx Freight East facility in Springfield, MO. *FedEx Freight East.*

For More Information

For more information, visit http://www.hydrogenandfuelcells.energy.gov.

References and Notes

1. U.S. Department of Energy, "Secretary Chu Announces $41.9 Million to Spur Growth of Fuel Cell Markets" (April 15, 2009) http://www1.eere.energy.gov/hydrogenandfuelcells/news_detail.html?news_id=12456.
2. National Renewable Energy Laboratory, Composite Data Products http://www.nrel.gov/hydrogen/proj_fc_market_demo.html.
3. http://hydrogen.energy.gov/pdfs/13007_industry_bup_deployments.pdf and http://hydrogen.energy.gov/pdfs/13007_industry_bup_deployments.pdf.
4. 2012 Annual Progress Report: Hydrogen and Fuel Cells Program, December 2012, http://www.hydrogen.energy.gov/pdfs/progress12/i_0_satyapal_2012.pdf.
5. Nuvera Fuel Cells Inc., "H-E-B Grocery Total Power SolutionTMfor Fuel Cell Powered Material Handling Equipment" (May 2011) http://www.hydrogen.energy.gov/pdfs/review11/h2ra008_block_2011_o.pdf.
6. http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/fuel_cell_mhe_cost.pdf.

February 2014
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