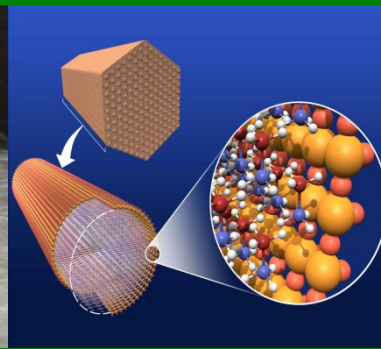




U.S. DEPARTMENT OF  
**ENERGY**



# Fuel Cell Technologies ARRA Projects - Session Introduction -

*Jim Alkire*

*2012 Annual Merit Review and Peer Evaluation Meeting  
May 16, 2012*

## *American Recovery & Reinvestment Act (ARRA) of 2009*

### **ARRA Goals:**

- **Create new jobs and save existing ones**
- **Spur economic activity**
- **Invest in long-term economic growth**

### **EERE Fuel Cell ARRA Project Goal:**

- **Accelerate the commercialization and deployment of fuel cells and fuel cell manufacturing, installation, maintenance, and support services**

### **Objective:**

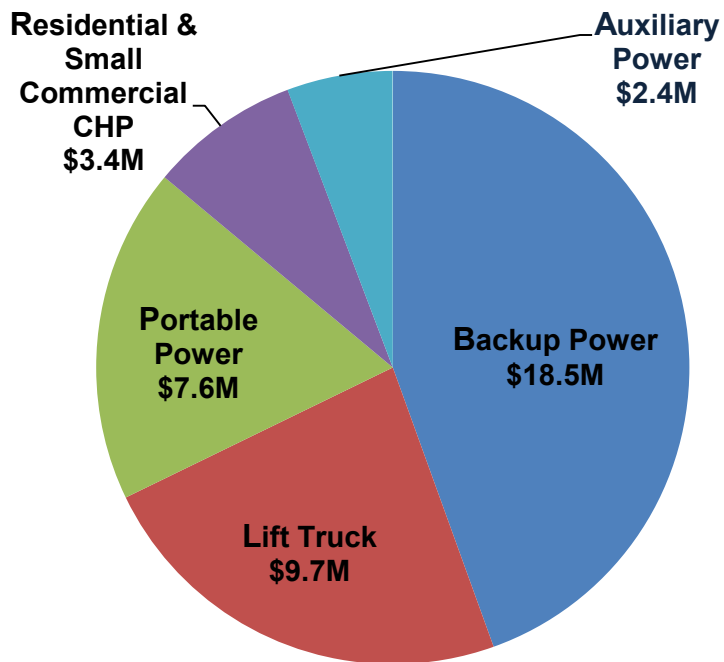
- **Deploy up to 1,000 fuel cells for early market applications**

# ARRA Fuel Cell Funding & Budget

*More than \$41 million from the 2009 American Recovery and Reinvestment Act to fund 12 projects to deploy up to 1,000 fuel cells*

## From lab to deployment:

*DOE has supported R&D by all fuel cell developers involved in these projects.*



Industry participants provide approximately **\$54 million** in cost-shared funding—for a total of **~ \$96 million**.

Company	Award	Application
Plug Power (7A)	\$2.7 M	Backup Power
ReliOn, Inc. <sup>1</sup>	\$8.5 M	Backup Power
Sprint Nextel	\$7.3 M	Backup Power
FedEx Freight East <sup>2</sup>	\$1.3 M	Lift Truck
GENCO <sup>2</sup>	\$6.1 M	Lift Truck
Nuvera Fuel Cells <sup>1</sup>	\$1.1 M	Lift Truck
Sysco Houston <sup>2</sup>	\$1.2 M	Lift Truck
Jadoo Power	\$2.2 M	Portable
MTI Micro Fuel Cells <sup>1</sup>	\$3.0 M	Portable
Univ. of N. Florida <sup>1</sup>	\$2.4 M	Portable
Plug Power (6A)	\$3.4 M	CHP
Delphi Automotive	\$2.4 M	Auxiliary Power

<sup>1</sup> Project completed

<sup>2</sup> Fully deployed

# ARRA Fuel Cell Units in Operation

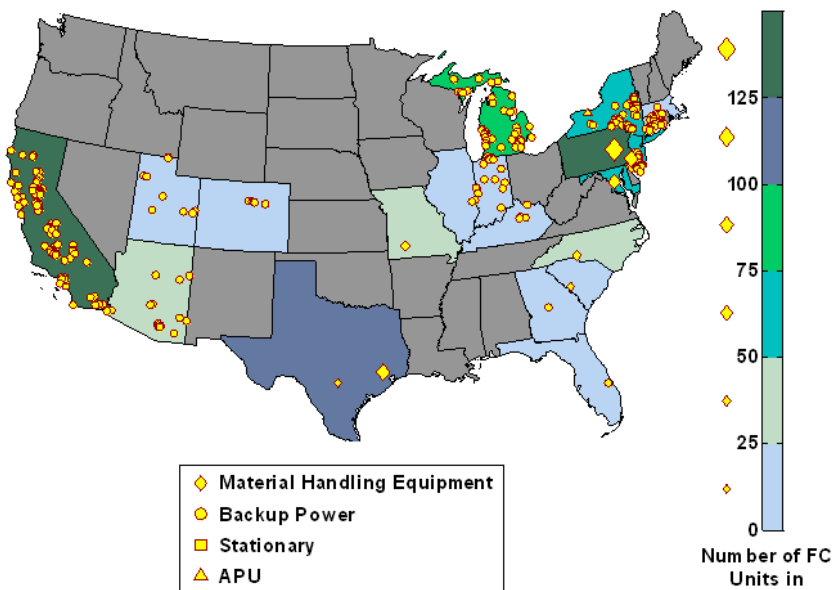
*NREL estimates over 1 million operating hours and 150,000 hydrogen fills for MHE were reached in Q1 CY12.*

## Fuel Cell Deployment Status – April 2012

Application	Currently Operational (#)	Originally Planned (#)
APU	1	1
Backup Power	668	539
Material Handling	504	504
Stationary	0	6
<b>Total</b>	<b>1,173</b>	<b>Up to 1,000</b>

## NREL ARRA Data Collection Snapshot

ARRA Material Handling Equipment Data	As of 12/31/2011
Hydrogen Dispensed	99,650 kg
Hydrogen Fills	> 148,250
Hours Accumulated	> 959,880 hrs



*Fuel cell–powered lift trucks fully deployed as of end of CY2011*

## **CURRENT STATUS**

- **12 project grants awarded (4 ended; 8 to remain active through CY13)**
- **Over 500 fuel cell lift trucks deployed**
- **More than 660 fuel cell backup systems operational**
- **22-71 jobs created or retained per quarter as reported on Recovery.gov**
- **More than 86% of funds have been paid out**
- **Siting and permitting activities posed major challenges, but are nearly complete**
- **Safety plans developed for all projects**
- **Hydrogen Safety Panel has reviewed and provided feedback on all project safety plans and has completed site visits to selected projects (3 MHE & 1 backup site)**

Status as of April 2012



## *Completed multiple outreach and media events*

### ■ Media Events

- **Sysco Houston (TX)**
  - 98 lift trucks operational
- **FedEx Freight East (MO)**
  - 35 lift trucks operational
- **GENCO**
  - Kimberly Clark site (SC)
  - 25 lift trucks operational

### ■ Major Presentations

- **Fuel Cell Seminar & Exposition**
  - October 2010
  - November 2011



# Leveraged Fuel Cell Deployments

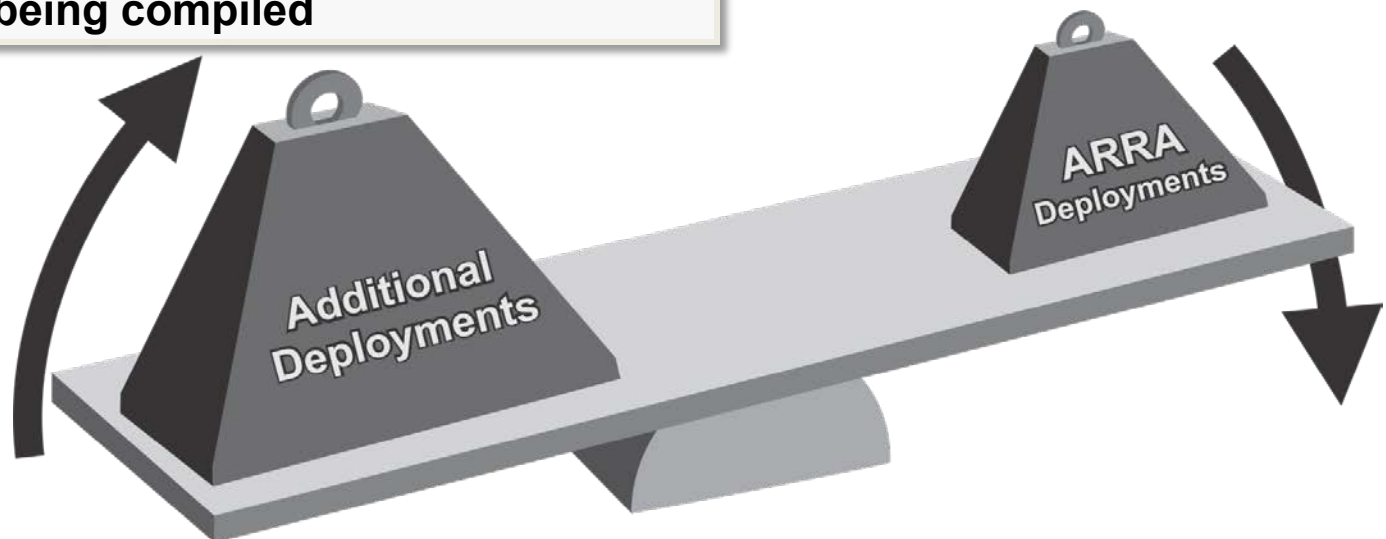
*Additional fuel cell–powered lift truck deployments taking place based on ARRA experience and lessons learned!*

## Examples of Leveraged and Future Deployments:

- Sysco (Corporation) plans to convert an additional 900+ battery powered lift trucks to fuel cell power over the next 24 months at seven sites nationwide
- By June 2012, Sysco will complete fuel cell fleet conversions at four of the seven sites
- FedEx Freight East purchased an additional 5 fuel cell powered lift trucks to bring their fleet to a total of 40 lift trucks
- Other examples being compiled



**OTHERS??**



*Risk-management strategies are in place.*

## Risk Mitigation Strategies

- **NEPA reviews completed for all 12 projects**
- **Routine safety plans and reviews completed for all projects. Site visits:**
  - Sysco Houston – Houston, TX
  - H-E-B – San Antonio, TX
  - Coca Cola – Charlotte, NC
  - Warner Robins AFB, GA
- **Tracking metrics identified to evaluate the performance of projects (NREL)**
- **Costing schedule updated to account for delays (siting & permitting, NEPA)**

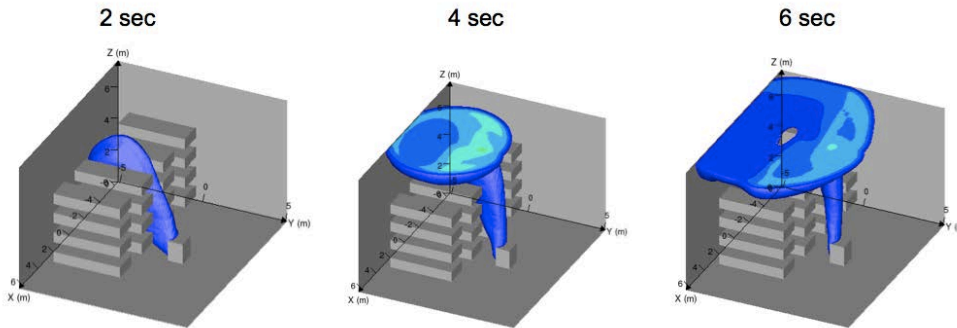
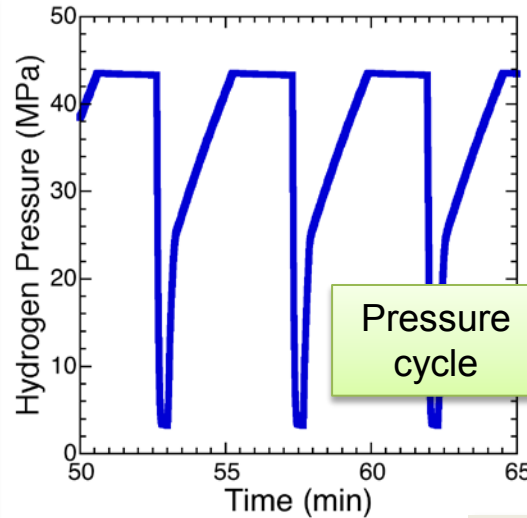




## *SNL developing technical basis for requirements in indoor refueling and high-cycle tank designs for material handling equipment*

**SNL is performing tests to simulate service in fuel-cell applications\*:**

- **Vessels cycled to up to 50,000 cycles**
- **All observed failures were leak-before-burst**
- **Results used to justify design requirements in CSA HPIT1 standard**



Hydrogen release volume as a function of time for 6.35mm leak

### **Significant R&D Progress\*\***

**Results are being incorporated into:**

- **A fault-tree model of indoor refueling systems**
- **Indoor refueling requirements NFPA 2 2014 revision**

\*AMR progress report: "SCS005, Somerday, SNL: R&D for Safety Codes and Standards: Materials and Components Compatibility"

\*\*AMR progress report: "SCS011, Dedrick, SNL: R&D for Safety Codes and Standards: Risk Assessments"

# **HSDC**

NREL's Hydrogen Secure Data Center

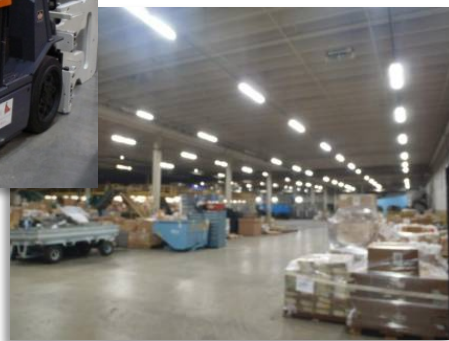


- **National Renewable Energy Laboratory (NREL) Data Collection: Operation & maintenance data now available for MHE & backup power**
- **Fuel cell & infrastructure data to NREL's Hydrogen Secure Data Center**
- **Data includes operation, maintenance, safety, and hydrogen production**

**Talk by Jen Kurtz (NREL) in Track F – Today, May 16<sup>th</sup> at 1:45 PM**  
***Analysis Results for ARRA Projects:***  
***Enabling Fuel Cell Market Transformation***

## DOE-EERE

- **“Status and Outlook for the U.S. Non-Automotive Fuel Cell Industry: Impacts of Government Policies and Assessment of Future Opportunities” David Greene, ORNL, 2011**
- **“Evaluation of U.S. DOE Energy Recovery Act Fuel Cells Initiative” William Ernst, Strategic Analysis, Inc.**



## **Siting and Permitting**

- **Tackle NEPA requirements first**
- **Facilitate national guidelines for siting and permitting**

## **Codes and Standards**

- **Identify and address concerns that may impact commercial acceptance of fuel cell systems**
- **Provide technical basis for codes and standards**

## **Unanticipated Events**

- **Prepare back-up strategies in advance**
  - **Project terminations**
  - **Partner changes**
  - **Business and financial uncertainties**

## *Exceeded ARRA goal of 1,000 fuel cells deployed!*

- **> 1 million hours accumulated on ARRA funded fuel cell lift trucks**
- **Backup sites showing 99.7% proven reliability for successful startups**
- **> 660 fuel cells deployed for backup power applications, with more planned**
- **> 500 fuel cell lift trucks operational; additional deployments planned without DOE funding**
- **20 states have operational fuel cells funded through ARRA (up to 21 states will have fuel cells)**



**More than 1,000 fuel cells have been deployed through ARRA – exceeding the goal, and trumping DOE funded deployments at scale in the last 10 years!**

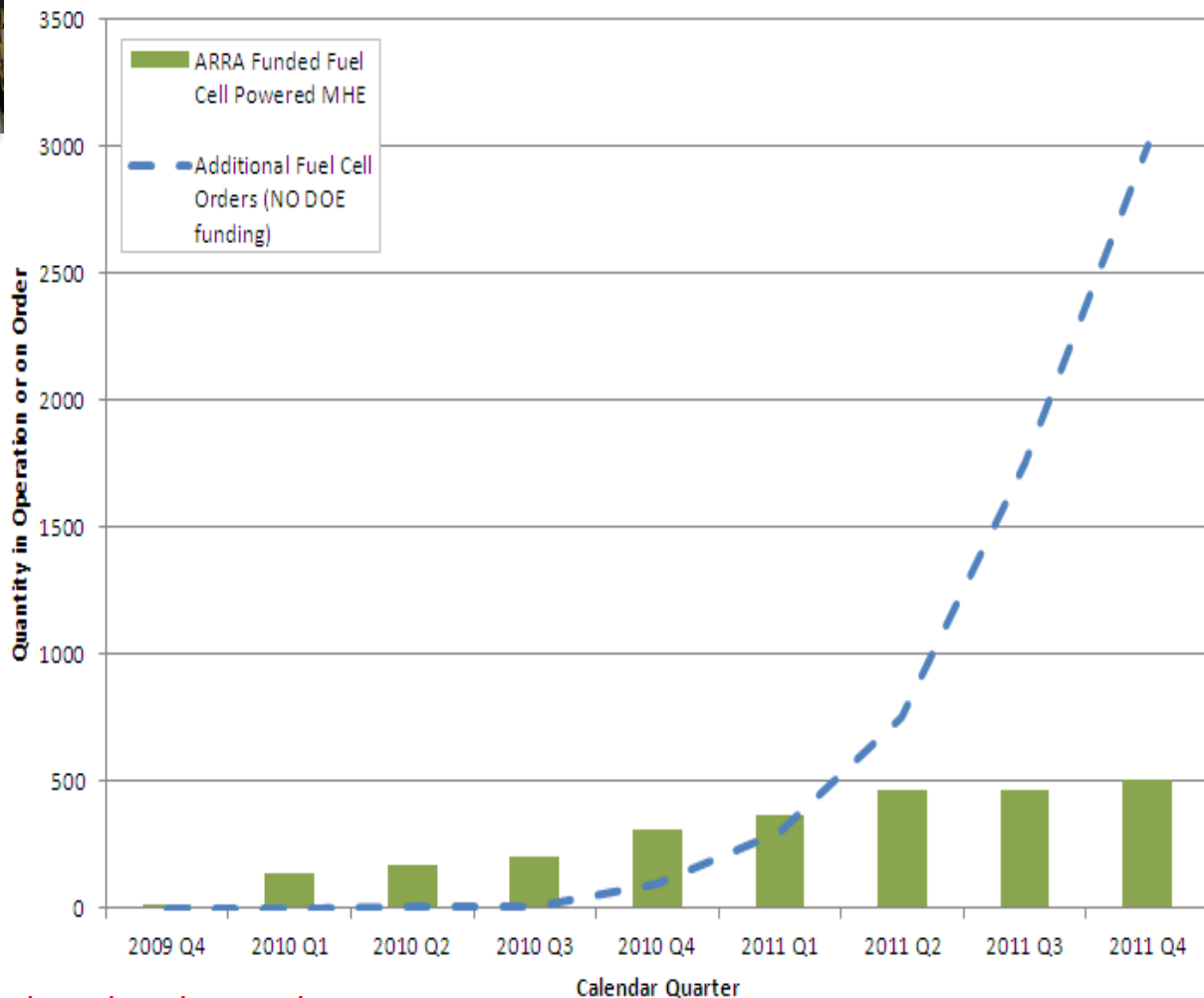


# ARRA as Catalyst for Deployments

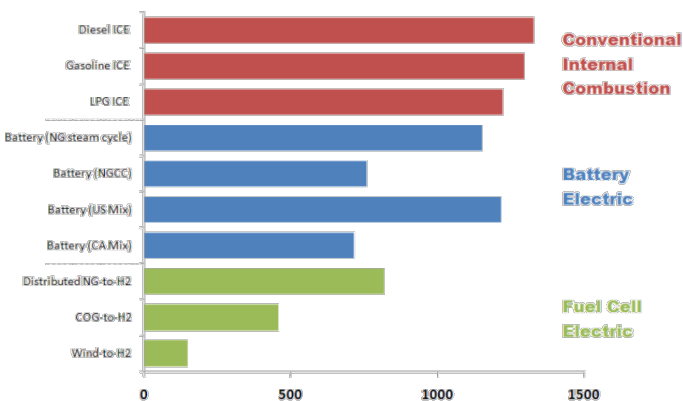
*ARRA and MT deployments of fuel cells for lift trucks led to industry purchases of an estimated 3,000 additional fuel cell lift trucks with NO DOE funding.\**



## Fuel Cell Lift Truck Purchases



Fuel Cycle GHG Emissions for Forklifts  
(g/kWh at the fork)



*\*Preliminary analysis—includes units deployed and on-order.*

- This is a review, not a conference.
- Presentations will begin precisely at scheduled times.
- Talks will be 20 minutes and Q&A 10 minutes.
- Reviewers have priority for questions over the general audience.
- Reviewers should be seated in front of the room for convenient access by the microphone attendants during the Q&A.
- Please mute all cell phones and other portable devices.
- Photography and audio and video recording are not permitted.

- Deadline to submit your reviews is **May 25<sup>th</sup> at 5:00 pm EDT.**
- ORISE personnel are available on-site for assistance.
  - **Reviewer Lab Hours:** Tuesday – Thursday, 7:30 am – 8:30 pm; Friday 7:30 am – 1:00 pm.
  - **Reviewer Lab Locations:**
    - Crystal Gateway Hotel—Rosslyn Room (downstairs, on Lobby level)
    - Crystal City Hotel—the Roosevelt Boardroom (next to Salon A)
- Reviewers are invited to a brief feedback session – at 6:15 pm today, in this room.

## **ARRA Contacts**

### **U.S. Department of Energy**

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*Donna Lee Ho*

*Gregory Kleen*

*Jason Marcinkoski*

*Dimitrios Papageorgopoulos*

*David Peterson*

*Katie Randolph*

*Ned Stetson*

*Reginald Tyler*

### **Technical Support**

*Shaun Onorato*  
*(Cas-Navarro Joint Venture LLC)*

*Matthew Simon*  
*(Energetics, Inc.)*

### **Data Collection & Analysis:**

*Jennifer Kurtz (National Renewable Energy Laboratory)*

- **Data Collection & Analysis**

- NREL

- **Fuel Cell Developers**

- Alteryx
- Delphi Automotive
- Jadoo Power
- MTI Micro Fuel Cells
- Nuvera Fuel Cells
- Plug Power, Inc.
- ReliOn, Inc.
- University of North Florida

- **Hydrogen Providers**

- Air Products & Chemicals, Inc.
- Linde
- Nuvera Fuel Cells  
(via on-site NG reformer)

- **Fuel Cell End Users**

- AT&T
- City of Folsom, CA
- Coca Cola
- FedEx Freight East
- Fort Irwin
- GENCO
- H-E-B
- Kimberly Clark
- NASCAR
- PG&E
- Sempra Energy customers
- Sprint Nextel
- Sysco Houston
- Sysco Philadelphia
- University of California - Irvine
- Warner Robins Air Force Base
- Wegmans
- Whole Foods Market