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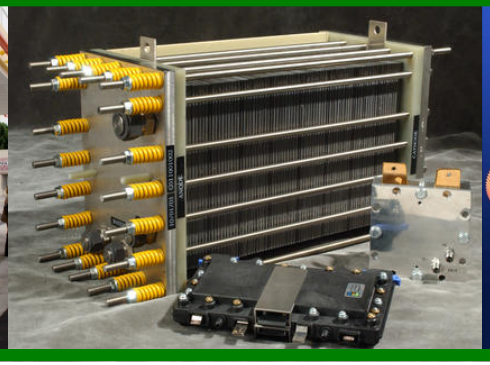
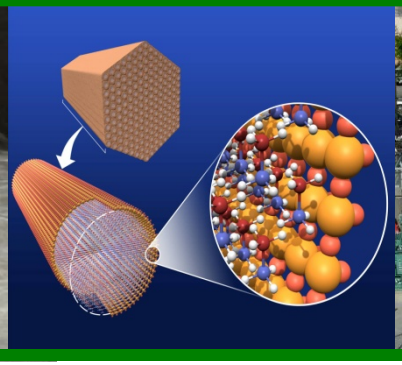

Fuel Cell Technologies ARRA Projects
- Session Introduction -

Jim Alkire

2012 Annual Merit Review and Peer Evaluation Meeting

May 16, 2012

ARRA Goals & Objective

U.S. DEPARTMENT OF ENERGY

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

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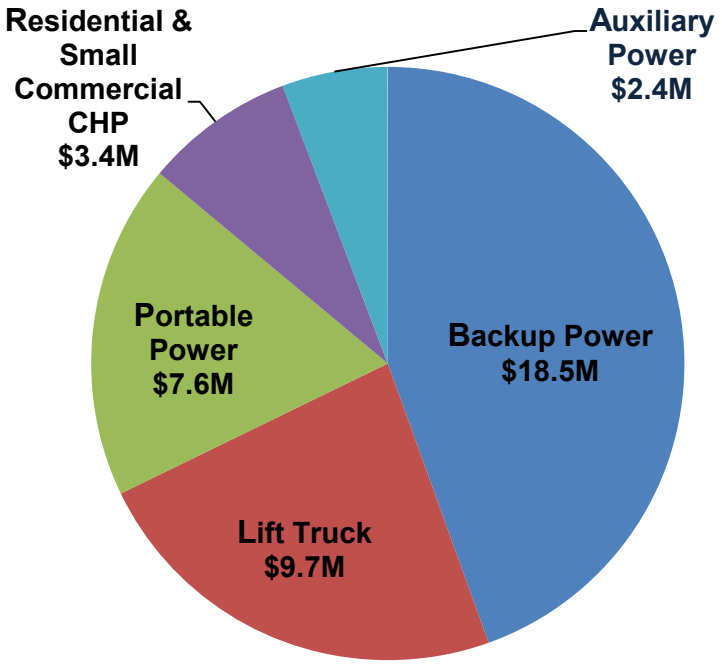
More than $41 million from the 2009 American Recovery and Reinvestment Act to fund 12 projects to deploy up to 1,000 fuel cells

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.[1]	$8.5 M	Backup Power
Sprint Nextel	$7.3 M	Backup Power
FedEx Freight East[2]	$1.3 M	Lift Truck
GENCO[2]	$6.1 M	Lift Truck
Nuvera Fuel Cells[1]	$1.1 M	Lift Truck
Sysco Houston[2]	$1.2 M	Lift Truck
Jadoo Power	$2.2 M	Portable
MTI Micro Fuel Cells[1]	$3.0 M	Portable
Univ. of N. Florida[1]	$2.4 M	Portable
Plug Power (6A)	$3.4 M	CHP
Delphi Automotive	$2.4 M	Auxiliary Power

[1] Project completed [2] Fully deployed

ARRA Fuel Cell Units in Operation

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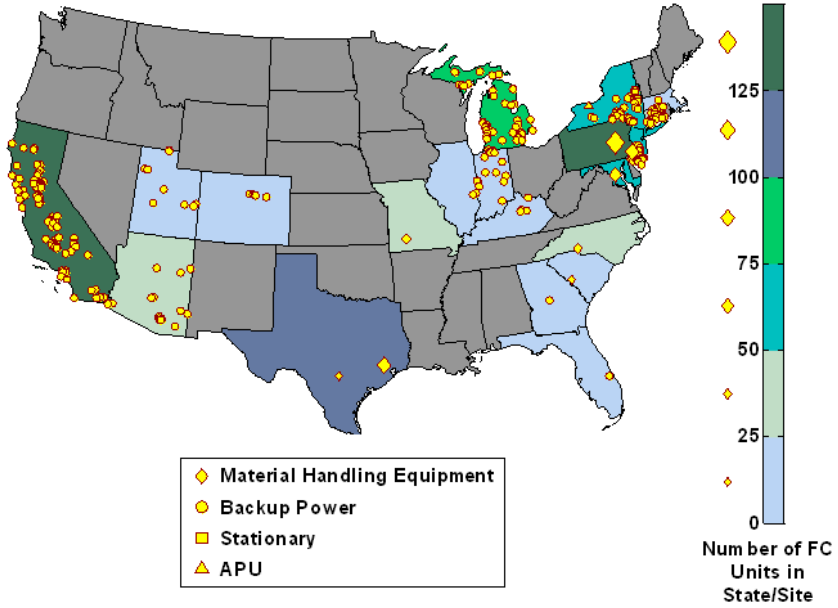
NREL estimates over 1 million operating hours and 150,000 hydrogen fills for MHE were reached in Q1 CY12.

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
Total	**1,173**	**Up to 1,000**



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

ARRA Progress & Accomplishments

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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

ARRA Progress & Accomplishments

U.S. DEPARTMENT OF ENERGY

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

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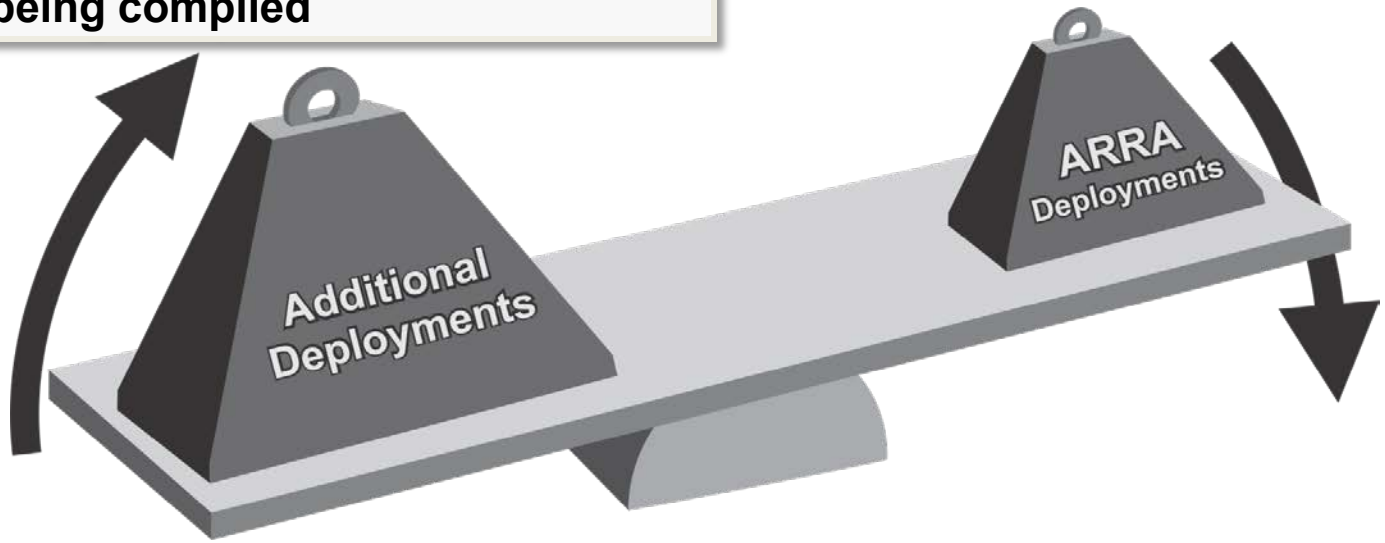
Additional fuel cell–powered lift truck deployments taking place based on ARRA experience and lessons learned!

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??



ARRA Challenges

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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)**

Sandia National Laboratory (SNL)

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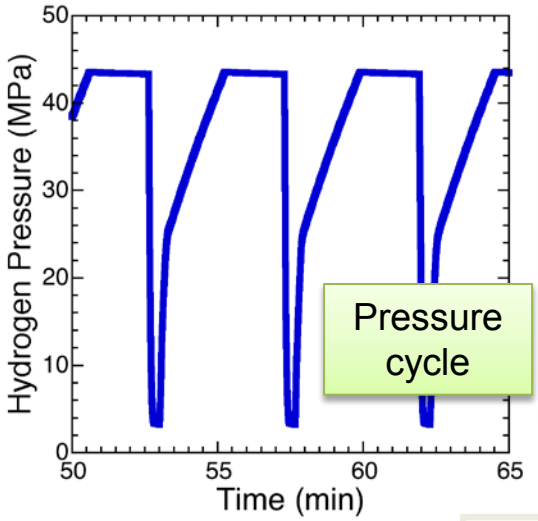
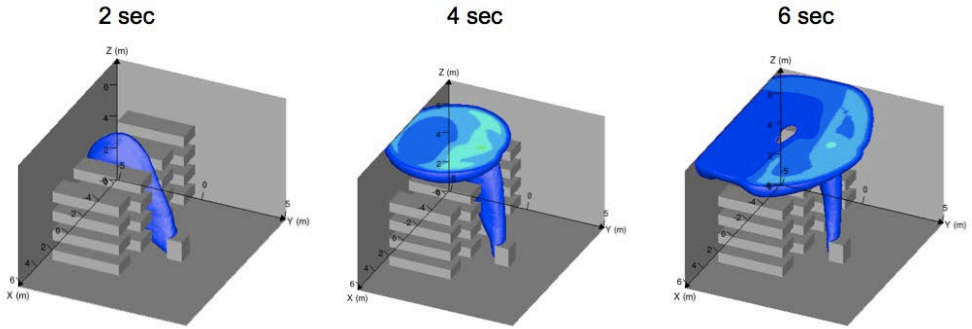
SNL developing technical basis for requirements in indoor refueling and high-cycle tank designs for material handling equipment

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

<u>Significant R&D Progress</u>**
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"

ARRA Hydrogen Fuel Cell Data

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- **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 16th at 1:45 PM

Analysis Results for ARRA Projects:

Enabling Fuel Cell Market Transformation

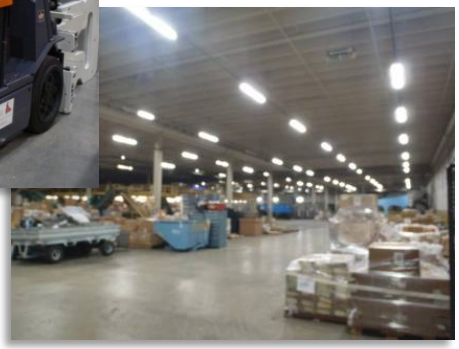
National Renewable Energy Laboratory: http://www.nrel.gov/hydrogen/news/2010/807.html

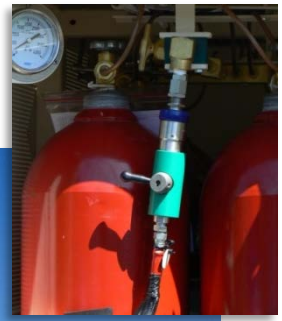
ARRA – Analysis of Impacts

U.S. DEPARTMENT OF ENERGY

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.**





ARRA Lessons Learned

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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

Summary

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Exceeded ARRA goal of 1,000 fuel cells deployed!

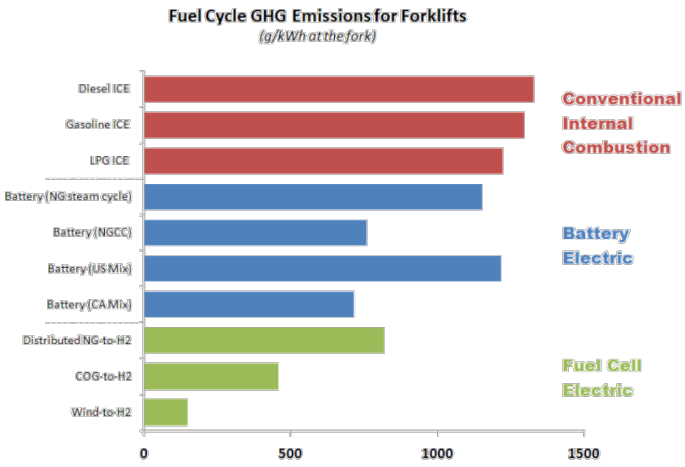
- **> 1 million hours accumulated on ARRA funded fuel cell lift trucks**
- **Backup sites showing 99.7% proven reliability for successful startups**
- **> 660 fuel cells deployed for backup power applications, with more planned**
- **> 500 fuel cell lift trucks operational; additional deployments planned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

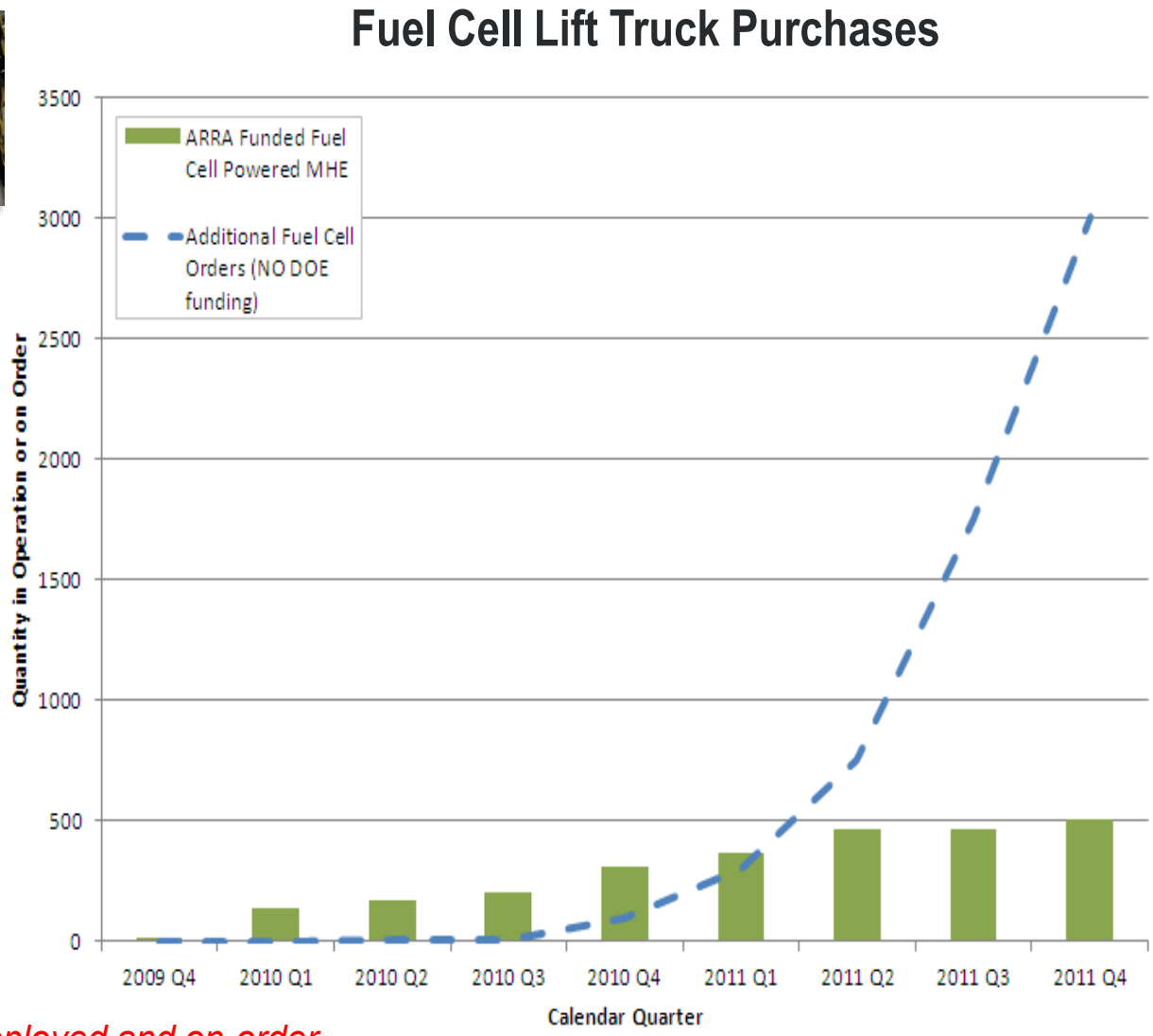
More than 1,000 fuel cells have been deployed through ARRA – exceeding the goal, and trumping DOE funded deployments at scale in the last 10 years!

ARRA as Catalyst for Deployments

U.S. DEPARTMENT OF ENERGY

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.*





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

Session Instructions

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- 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.

Reviewer Reminders

U.S. DEPARTMENT OF ENERGY

- Deadline to submit your reviews is **May 25th 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.

For More Information

U.S. DEPARTMENT OF ENERGY

ARRA Contacts

U.S. Department of Energy

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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)

Key ARRA Stakeholders

U.S. DEPARTMENT OF ENERGY

- **Data Collection & Analysis**
  - NREL
- **Fuel Cell Developers**
  - Altergy
  - 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