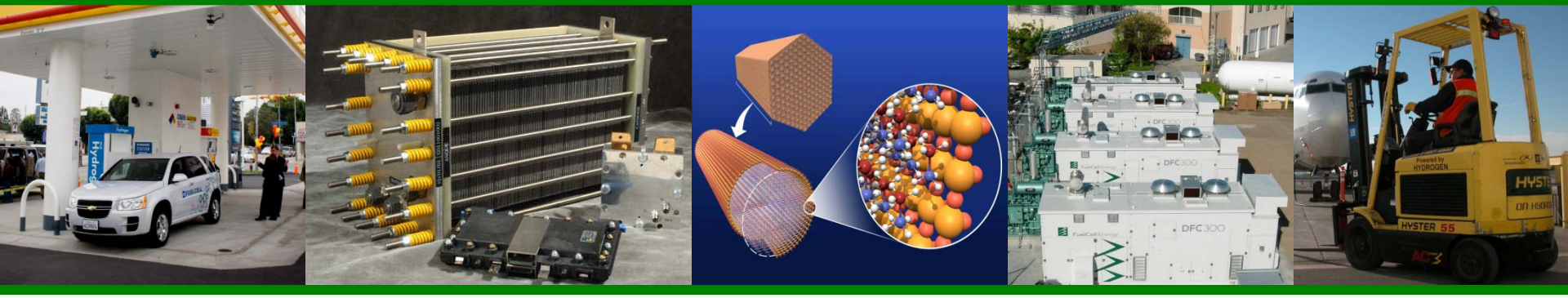
U.S. DEPARTMENT OF ENERGY



Fuel Cell Technologies ARRA Projects
- Session Introduction -

Sara Dillich

2011 Annual Merit Review and Peer Evaluation Meeting

May 12, 2011

ARRA Goals & Objective

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American Recovery & Reinvestment Act (ARRA) of 2009

ARRA Goals:

- **Create new jobs as well as 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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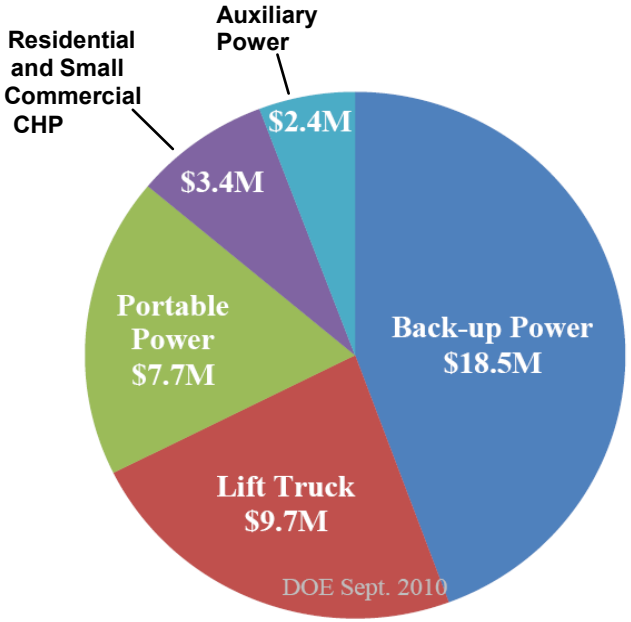
More than $41 million from the 2009 American Recovery and Reinvestment Act to fund 12 projects to deploy up to 1,000 fuel cells

FROM 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
Delphi Automotive	$2.4 M	Auxiliary Power
FedEx Freight East	$1.3 M	Specialty Vehicle
GENCO	$6.1 M	Specialty Vehicle
Jadoo Power	$2.2 M	Backup Power
MTI MicroFuel Cells	$3.0 M	Portable
Nuvera Fuel Cells	$1.1 M	Specialty Vehicle
Plug Power, Inc.	$3.4 M	CHP
Plug Power, Inc.	$2.7 M	Backup Power
Univ. of N. Florida	$2.5 M	Portable
ReliOn, Inc.	$8.5 M	Backup Power
Sprint - Nextel	$7.3 M	Backup Power
Sysco Houston	$1.2 M	Specialty Vehicle

* Orange = fully deployed; Yellow = project completed

ARRA Fuel Cell Units in Operation

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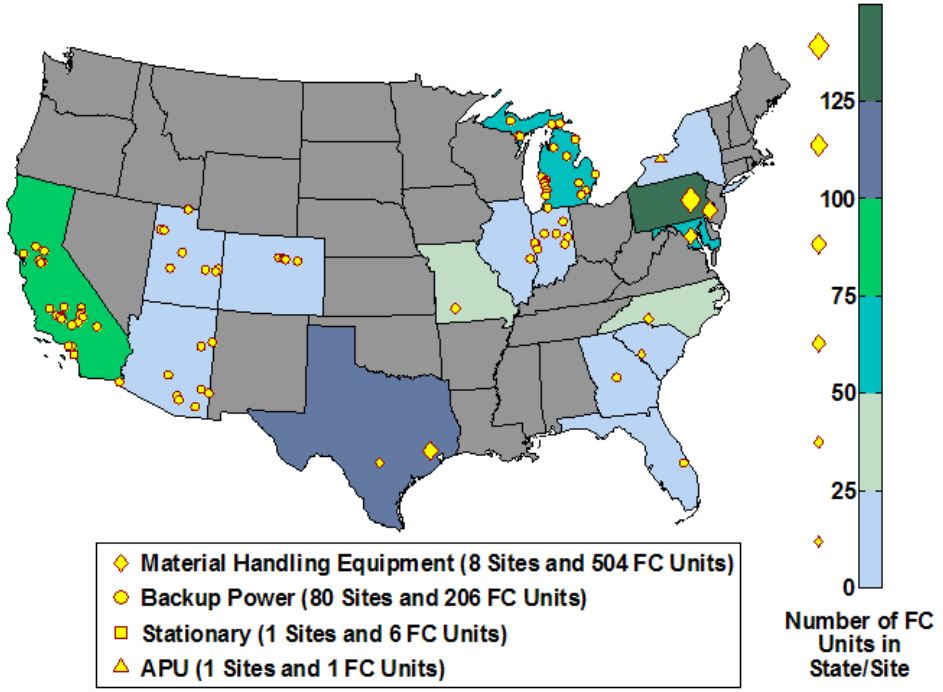
Deployment Status – April 2011

Fuel Cell Application	Operational Fuel Cells	Total Fuel Cells Planned
APU	0	3
Backup Power	267	539
Material Handling	369	504
Stationary	0	6
Total	**636**	**> 1,000**

NREL ARRA Data Collection Snapshot

ARRA Material Handling Equipment Data	As of 12/31/2010
Hydrogen Dispensed	> 18,500 kg
Hydrogen Fills	> 38,800
Hours Accumulated	> 307,400 hrs



ARRA Progress & Accomplishments

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Over 400 fuel cell powered lift trucks fully deployed as of end of CY2011

CURRENT STATUS

- **12 project grants still active**
- **Over 360 fuel cell lift trucks deployed**
- **More than 260 fuel cell backup systems operational**
- **48 jobs created or retained**
- **Over 69% of funds have been spent**
- **Siting and permitting activities are continuing**
- **Safety Plans developed for all projects**
- **Site visits by Hydrogen Safety Panel have been completed, with more planned in 2011**

Status as of April, 2011

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**

Leveraging Even More Fuel Cells

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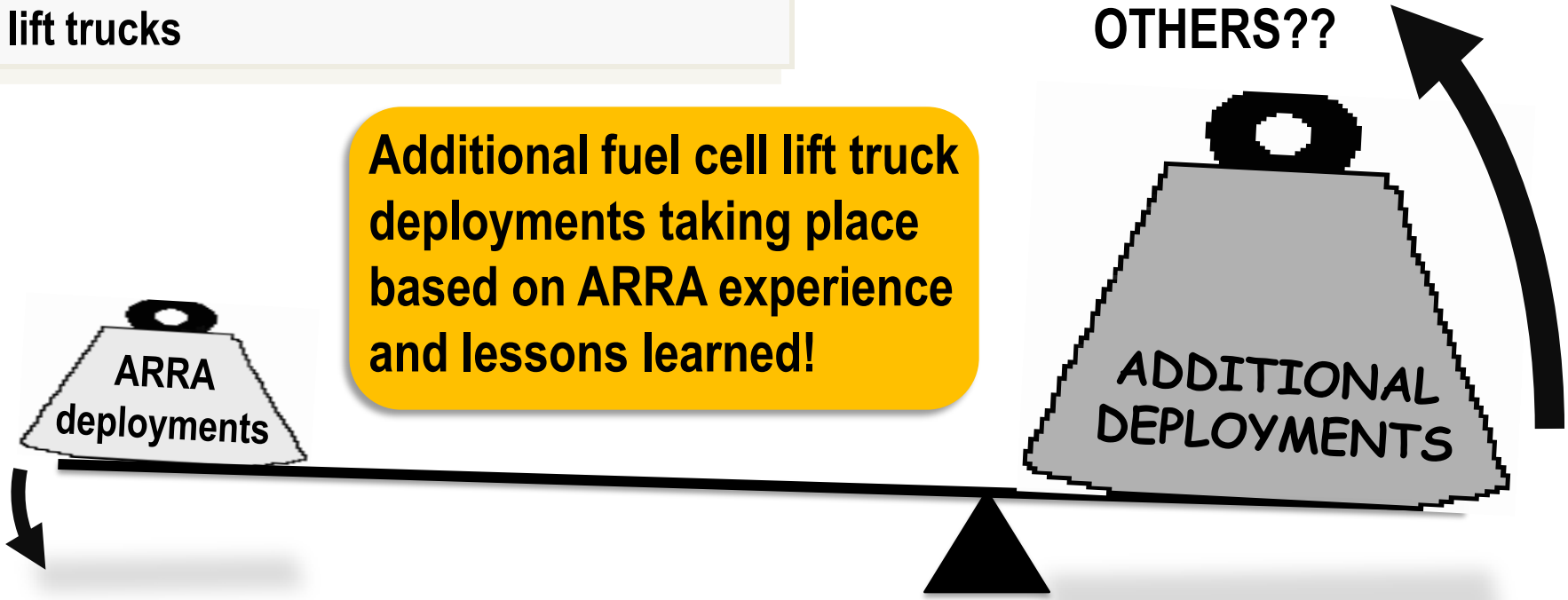
LEVERAGING ADDITIONAL FUEL CELL DEPLOYMENTS

- Sysco (Corporation) plans to convert an additional 500+ battery powered lift trucks to fuel cell power
- H-E-B Grocery, with Nuvera Fuel Cells, plans to expand their current fleet of fuel cell powered lift trucks by 28 additional lift trucks

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



ARRA Challenges

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Risk management strategies are in place

Risk Mitigation Strategies

- **NEPA reviews completed for 10 projects, 2 in progress**
- **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 (planned)**
  - **Warner Robins AFB, GA (planned)**
- **Tracking metrics identified to evaluate the performance of projects (NREL)**
- **Costing schedule updated to account for delays (siting & permitting, NEPA)**

Tank Testing

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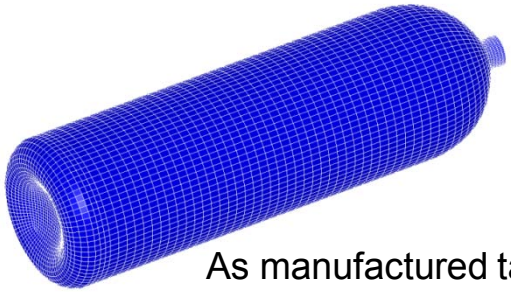
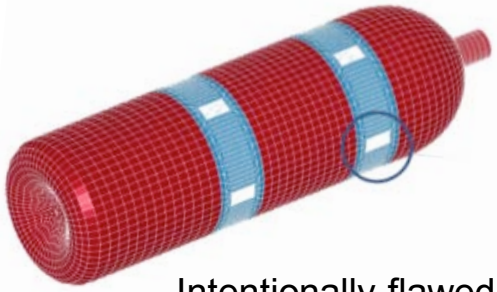
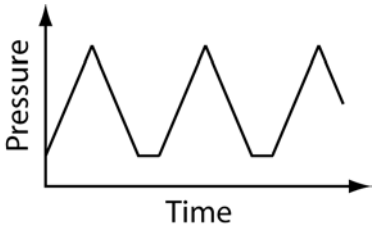
Safety, Codes & Standards subprogram: funding SNL lifecycle analysis of high-cycle tanks for MHE



As manufactured tank



Intentionally flawed tank



Cyclic H_2 Pressure Loading

Addressing cyclic fatigue of steel tanks to provide technical basis for code language for tanks (CSA HPIT1, SAE J2579)

- **Quantifiable data for crack initiation, crack growth, leak before-burst**
- **Developing unified design methodologies for high cycle-life tanks**

FY10 Results:

- **"As manufactured" tanks subjected to >34,000 cycles**
- **Intentionally flawed tank cycle-life exceeds predictions for crack growth**
- **New appendix proposed for SAE J2579**

More information in AMR progress report: "SCS012, San Marchi, SNL: Forklift Tank Testing and Analysis"

Indoor Hydrogen Refueling

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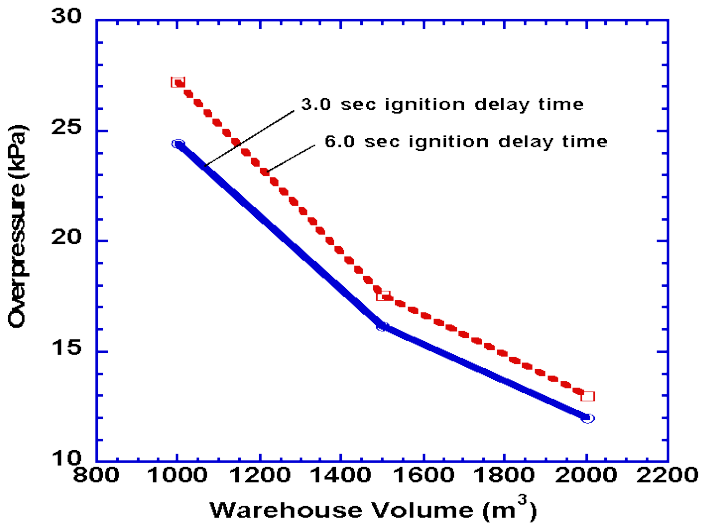
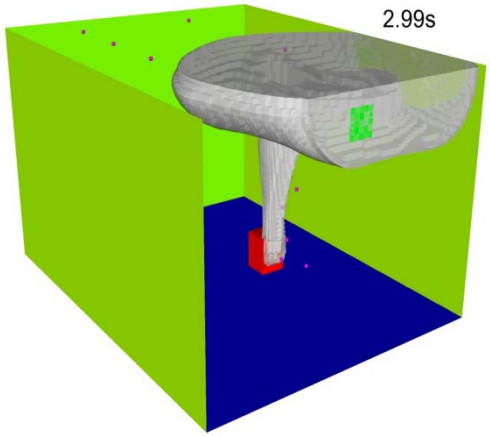
SNL developing technical basis for refueling requirements





Developing the science-basis for indoor refueling requirements in NFPA 55/2

- **Unintended release model development**
- **Experimental validation**
- **Participation in requirements development**

FY10 Results:

- **Dispersion and over-pressure model validated with 1/2.8 scale experiments**
- **Data obtained for realistic leak scenarios (input from tank testing)**
- **NFPA 2 Task Group formed to establish indoor refueling requirements**

More information in AMR progress report: “SCS010, Dedrick, SNL: Research and Development Program for Safety, Codes & Standards”

ARRA Hydrogen Fuel Cell Data

U.S. DEPARTMENT OF ENERGY

- NREL Data Collection: Operation & maintenance data now available for MHE
- Fuel Cell & Infrastructure Data to NREL's Hydrogen Secure Data Center
- Data includes operation, maintenance, safety, and hydrogen production

See talk by Jen Kurtz (NREL) in track F – Today, May 12th at 5:15 pm
Analysis Support 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

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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**

  AMR presentation – Track II: May 10th at 8:30 AM at Crystal City Marriott Hotel

- **Fuel Cells Market Effects Evaluation**

  Study of initial impacts of ARRA fuel cell projects, initiated FY2011 by EERE Office of Planning, Budget & Analysis

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

- Have back-up strategies in place
  - Project terminations
  - Partner changes
  - Business and financial uncertainties

Summary

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Over halfway to ARRA goal!

- Over 307,400 hours have been accumulated on ARRA funded fuel cell lift trucks as of Dec 2010
- Over 260 fuel cells for backup power in communication towers have been deployed, with a total of 500 or more planned
- Over 360 fuel cell lift trucks are operational, with a total of 500 planned
- 75 portable fuel cells for recharging consumer electronics have been field tested by end-users
- 16 states have operational fuel cells funded through ARRA (up to 21 states will have fuel cells)

Plan to exceed goal of 1,000 fuel cells deployed in commercial scale applications due to ARRA funds – trumping DOE funded deployments at scale in the last 10 years!

Session Instructions

U.S. DEPARTMENT OF ENERGY

- This is a review, not a conference.
- Presentations will begin precisely at the 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, BlackBerries, etc.
- Photography and audio and video recording are not permitted.

Reviewer Reminders

U.S. DEPARTMENT OF ENERGY

- Deadline for final review form submittal is May 20th at 5:00 PM EDT.
- ORISE personnel are available on-site for assistance. A reviewer-ready room is set up in *The Boardroom* (next to Salon A) and will be open Tuesday –Thursday from 7:30 AM to 6:00 PM and Friday 7:30 AM to 2:00 PM.
- Reviewers are invited to a brief feedback session – at 12:00 Noon on Friday, in this room.

For More Information

U.S. DEPARTMENT OF ENERGY

ARRA Contacts

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NREL Data Collection and Analysis:

Jennifer Kurtz

EERE Fellowship Program

U.S. DEPARTMENT OF ENERGY

- Fuel Cell Technologies Program Opportunities Available
  - Conduct applied research at universities, national laboratories, and other research facilities
  - Up to five positions are available in the areas of hydrogen production, hydrogen delivery, hydrogen storage, and fuel cells

❑Applications are due June 30, 2011
❑Winners will be announced mid-August
❑Fellows will begin in mid-November 2011

eere.energy.gov/education/postdoctoral_fellowships/

Postdoctoral fellowships in hydrogen and fuel cell research ▸

Key ARRA Stakeholders

U.S. DEPARTMENT OF ENERGY

- **Data Collection & Analysis**
  - NREL
- **Fuel Cell Developers**
  - Altergy
  - Delphi
  - Jadoo Power
  - MTI MicroFuel Cells
  - Nuvera Fuel Cells
  - Plug Power, Inc.
  - ReliOn, Inc.
  - University of North Florida
- **Fuel Cell End Users**
  - AT&T
  - City of Folsom, CA
  - Coca Cola
  - 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
- **Hydrogen Providers**
  - Air Products & Chemicals, Inc.
  - Linde
  - Nuvera Fuel Cells
    (via on-site NG reformer)