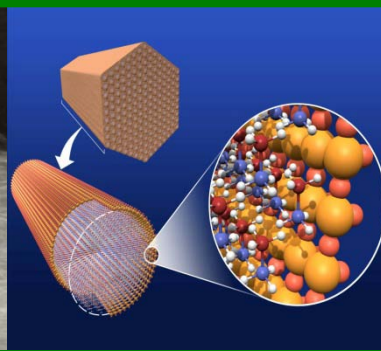




U.S. DEPARTMENT OF
ENERGY



Technology Validation Sub-program - Session Introduction -

John Garbak

*2011 Annual Merit Review and Peer Evaluation Meeting
May 13, 2011*

Goal: Validate complete systems of integrated hydrogen and fuel cell technologies for transportation, infrastructure and electricity generation applications under real-world operating conditions

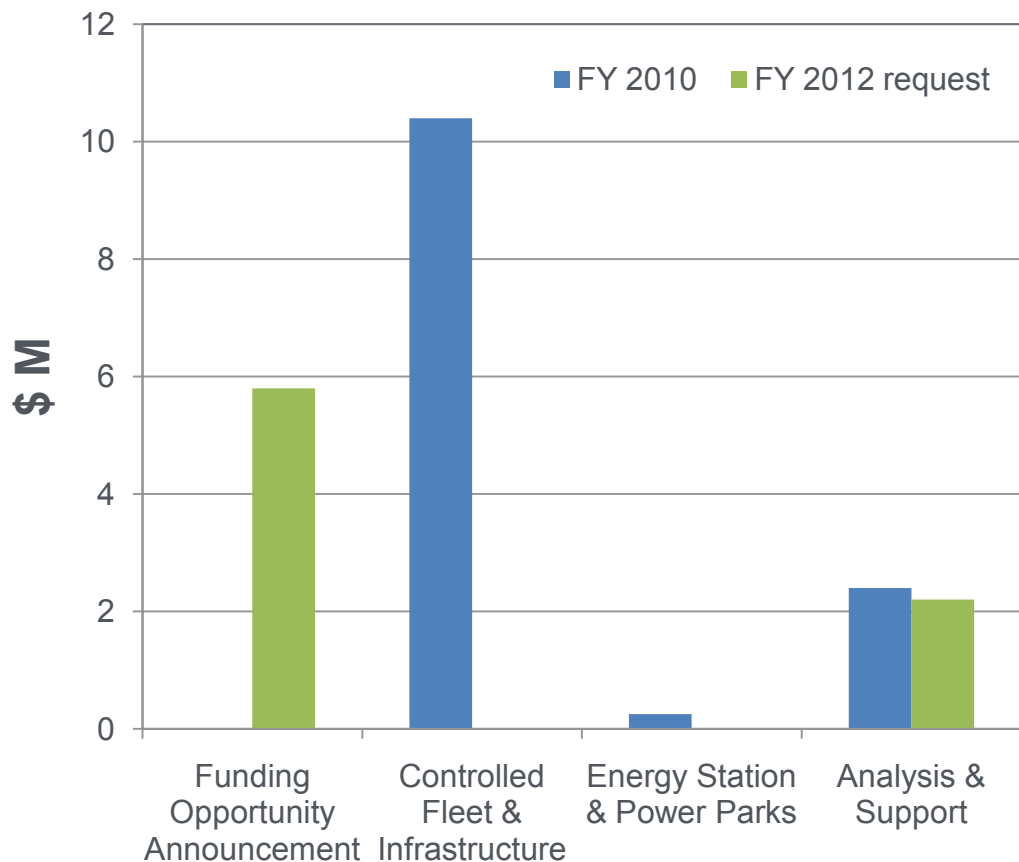
Objectives:

- Validate hydrogen and fuel cell technologies
- Identify current status of the technology
 - Assess progress toward technology readiness
 - Provide feedback to H₂ Research and Development

Key Targets

| Performance Measure | 2009 | Ultimate Target |
|----------------------------|------------|-----------------|
| Fuel Cell Stack Durability | 2000 hours | 5000 hours |
| Vehicle Range | 250+ miles | 300+ miles |
| Hydrogen Cost at Station | \$3/gge | \$2-4/gge |

FY 2012 Request = \$8.0 M
FY 2010 Appropriation = \$13.1 M



* FY 2011 Appropriations to be determined

EMPHASIS

- Data Collection Activities
 - Collect real-world data from fuel cells operating in forklifts, backup power, vehicles, and buses including projects with DOD (e.g. Hawaii).
 - Collaborate with DOT on the Fuel Cell Bus Program.
 - Support CHHP (*combined heat, hydrogen, and power*) demonstration.
- Develop Funding Opportunity Announcement*
 - RFI Issued March 31 closes June 1st
 - Innovative concepts for stationary and /or CHHP systems
 - Technology Validation projects for other markets

* Subject to appropriations

Through data collection of vehicles and buses many challenges have been met

- Lack of fuel cell electric vehicle performance and durability data
 - Learning Demo and FC Bus evaluation have generated significant quantities of fuel cell vehicle data that have been analyzed and published.
- Lack of refueling infrastructure performance and availability data for vehicles, buses, and forklifts
 - Tech Val projects have analyzed many aspects of H₂ refueling infrastructure, including refueling rates, safety, maintenance, production efficiency, and availability.
- Fuel cell vehicle and infrastructure interface issues need to be addressed
 - Communication fills (vehicle talks to station during fill) have been evaluated, and on average communication fills are 35% faster than non-communication fills

Learning Demonstration has provided valuable real-world data from fuel cell vehicles and hydrogen infrastructure



- Data has been collected on 155 fuel cell vehicles and 24 hydrogen fueling stations during the Learning Demonstration
- Fuel cell durability
 - 2,500 hours projected (nearly 75K miles)
- Range 196 -254 miles (independently validated 430 mile range)
- Over 3 million miles traveled
- Over 131K total vehicle hours driven
- Fuel cell efficiency 53-59%
- Over 140,000 kg of hydrogen produced or dispensed

NREL has collected data for DOE and FTA on 8 FCBs in service at 4 sites:

AC Transit
SunLine
CTTRANSIT
VTA

Traveled:
~ 450,000 miles

Dispensed:
>81,000 kg H₂

| NREL Hydrogen Evaluations for DOE and FTA | | | | | | | | | | | | | | | | | | | |
|---|-------|---------|------------------------------------|------------------------|---|-------------|---|-------------------|---|---|---|------------------------|---|---|---|------|---|---|---|
| Site/Locations | State | # Buses | Eval. Funding | 2010 | | | | 2011 | | | | 2012 | | | | 2013 | | | |
| | | | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| AC Transit /SF Bay Area | CA | 12 | DOE Technology Validation | ZEB A Demo | | | | | | | | | | | | | | | |
| SunLine /Thousand Palms | CA | 1 | | Advanced FCB Project | | | | | | | | | | | | | | | |
| City of Burbank/Burbank | CA | 1 | | Burbank FCB | | | | | | | | | | | | | | | |
| SunLine /Thousand Palms | CA | 1 | FTA National Fuel Cell Bus Program | | | | | American FCB Demo | | | | | | | | | | | |
| CTTRANSIT /Hartford | CT | 4 | | Nutmeg Hybrid FCB Demo | | | | | | | | | | | | | | | |
| USC, CMRTA /Columbia | SC | 1 | | Hybrid FCB | | Demo Site 2 | | | | | | | | | | | | | |
| UT, Cap Metro/Austin | TX | 1 | | MA H2 FCB Fleet | | | | | | | | | | | | | | | |
| Logan Airport/Boston | MA | 1 | | Light-wt FCB | | | | | | | | | | | | | | | |
| Albany /NY | NY | 1 | | FC APU Hybrid | | | | | | | | | | | | | | | |
| SFMTA /San Francisco | CA | 1 | | | | | | | | | | Chicago FCB | | | | | | | |
| CTA/Chicago | IL | 1 | | | | | | | | | | Birmingham FCB | | | | | | | |
| BJCTA/Birmingham | AL | 1 | | | | | | | | | | EcoSaver IV Hybrid FCB | | | | | | | |
| Ohio State/Columbus | OH | 1 | | | | | | | | | | Advanced Composite FCB | | | | | | | |
| USC, CMRTA /Columbia | SC | 1 | | | | | | | | | | | | | | | | | |

Demonstration sites color coded by geographic area:



Fuel economy results: 42% to 139% better than diesel and CNG buses

www.nrel.gov/hydrogen/proj_tech_validation.html

Estimate of data collection/evaluation - schedule subject to change based on progress of each project

Progress: Combined Heat, Hydrogen and Power (CHHP) Demonstration

Fountain Valley Station achieved 54% efficiency (hydrogen + power) of unit when operating in hydrogen co-production mode.

BACKGROUND

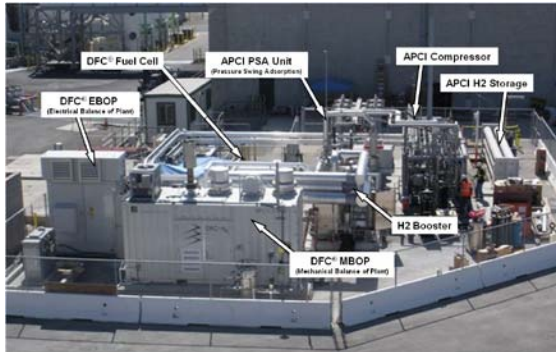
- Host site: Orange County Sanitation District
- Anaerobic digestion of municipal wastewater
- 100 kg/day hydrogen capacity (350 and 700 bar)
- Funding Partners: CARB, SCAQMD and DOE

Led and coordinated by:



ACCOMPLISHMENTS

- July 2010: Hydrogen Energy Station delivered to OCSD
- September 2010: First low-load power production from fuel cell unit
- September 2010: Fuel cell unit operated at full load on natural gas
- March 2011: Initial fills of fuel cell vehicles at hydrogen fueling station



NEXT STEP

- Hydrogen to be produced from biogas in FY 11

Issued March 31, 2011 and closes June 1, 2011

Areas of Interest

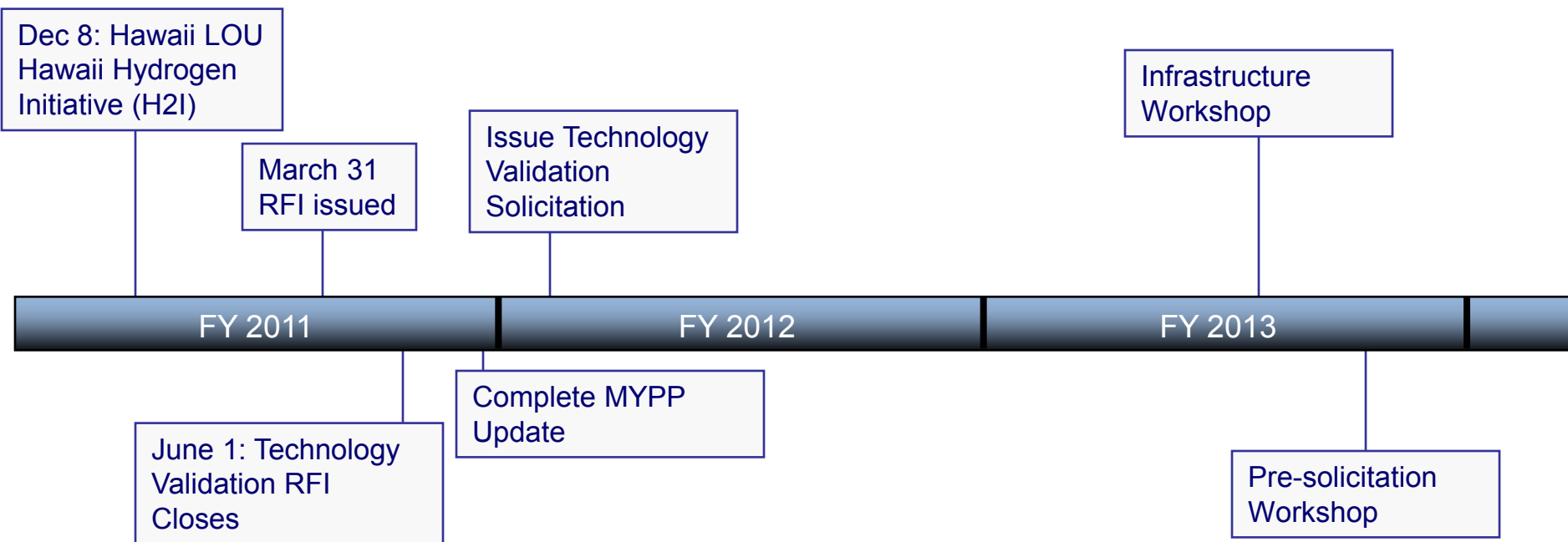
- Innovative concepts for:
 - Stationary fuel cell systems for residential and commercial applications, including combined-heat-and-power (CHP)
 - Combined-heat-hydrogen-and-power (CHHP) co-production fuel cell systems
- Technology Validation projects for other markets

For more information:

http://www1.eere.energy.gov/hydrogenandfuelcells/news_detail.html?news_id=16873

<http://www07.grants.gov/search/search.do?&mode=VIEW&oppld=84333>

Major Milestones & Future Solicitations



- 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.

- Deadline for final review form submittal is May 20th at 5:00 PM EDT.i
- ORISE personnel are available on-site for assistance. A reviewer-ready room is set up in *The Rosslyn Room* (on the lobby level) 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 Noon today, in this room.

Technology Validation

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- 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 ▶**

Technology Validation

Air Products & Chemicals, Inc.

CA Fuel Cell Partnership

General Motors Corp.

Mercedes Benz North America

NREL