

Stationary Fuel Cell Evaluation



2012 DOE Annual Merit Review

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Project ID# TV-016

This presentation does not contain any proprietary, confidential, or otherwise restricted information.

Overview

Timeline

Project start date: October 2011

Project end date: September 2012*

Percent complete: On-going

Barriers

Performance validation and reporting of stationary fuel cell systems under real-world operating conditions

Budget

Total project funding

DOE share: \$65k

Contractor share: \$0

Planned funding in FY12: \$65k

Partners

In the process of establishing partnerships

*Project continuation and direction determined annually by DOE

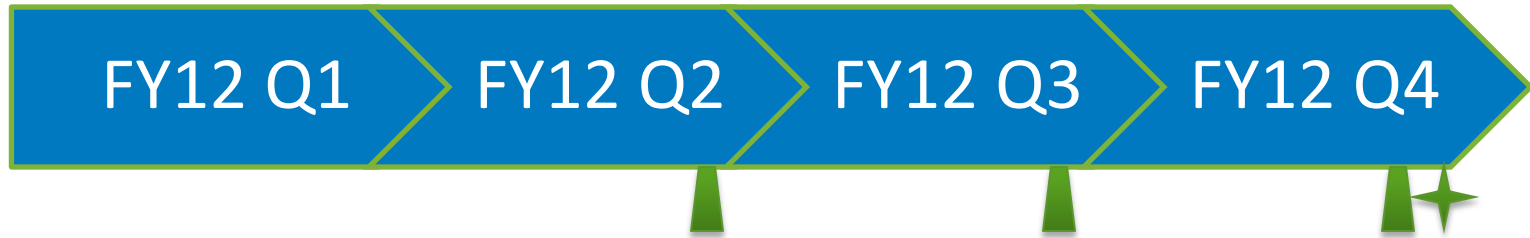
Objectives - Relevance

- Independent assessment, validation, and reporting of operation targets and system performance under realistic operating conditions.



- ✓ **Real World Operation Data** from the field and state-of-the-art lab
- ✓ **Collection**
- ✓ **Analysis** for independent technology validation
- ✓ **Collaboration** with industry and end users operating stationary fuel cell systems
- ✓ **Reporting** on technology status, progress, and technical challenges

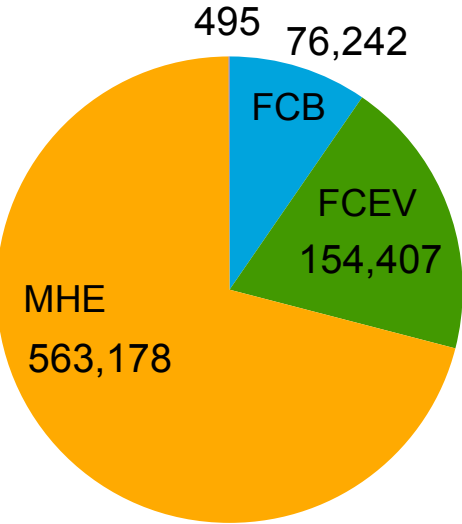
Milestones - Approach and Accomplishments



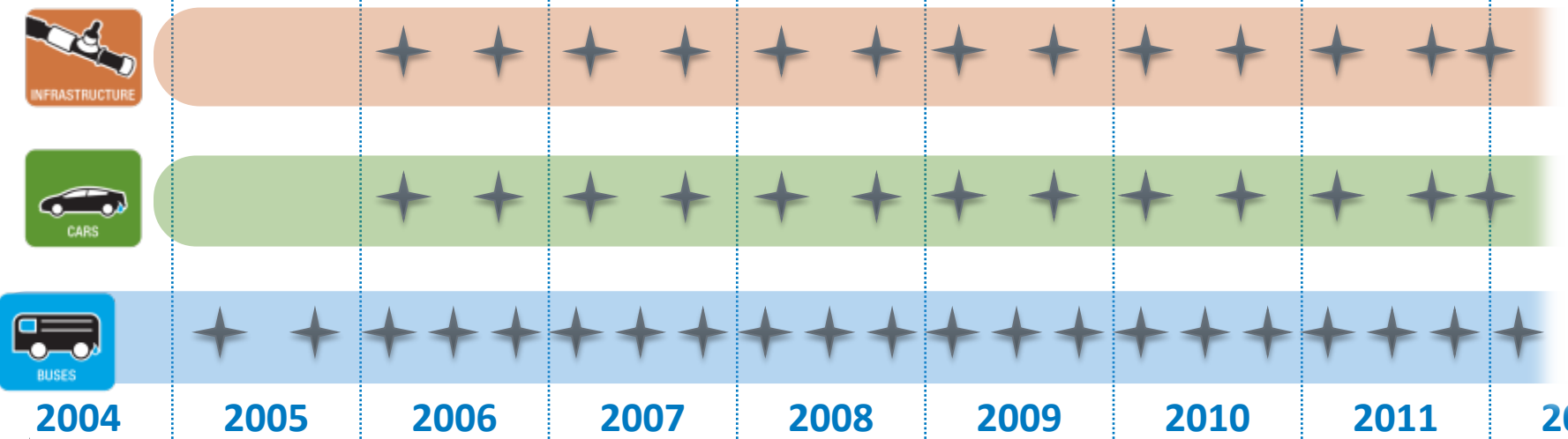
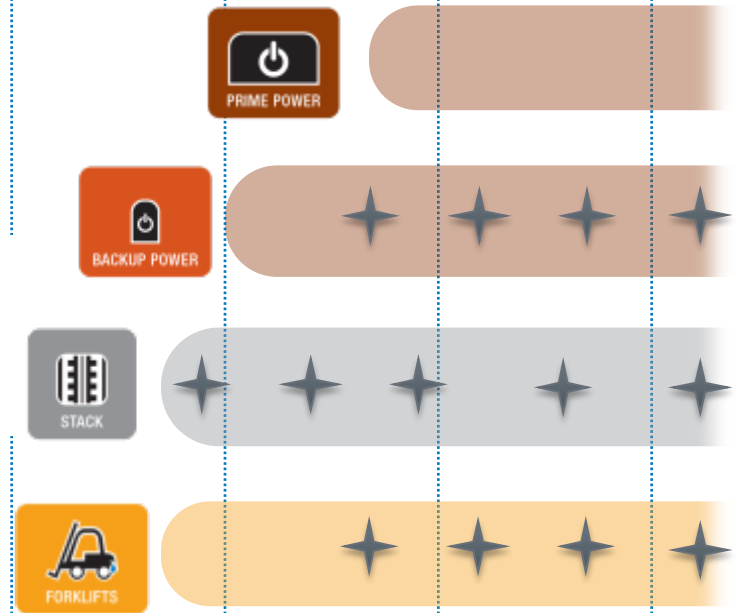
- ▲ Quarterly data analysis (based on available data)
- ★ Publication of first technical stationary fuel cell composite data products (data through June 2012)

Technology Validation Project Leveraging - Approach

Hours



>880 FC Systems
>794,000 hours



★ Published performance reports

Hydrogen Secure Data Center *Data Collection* - Approach

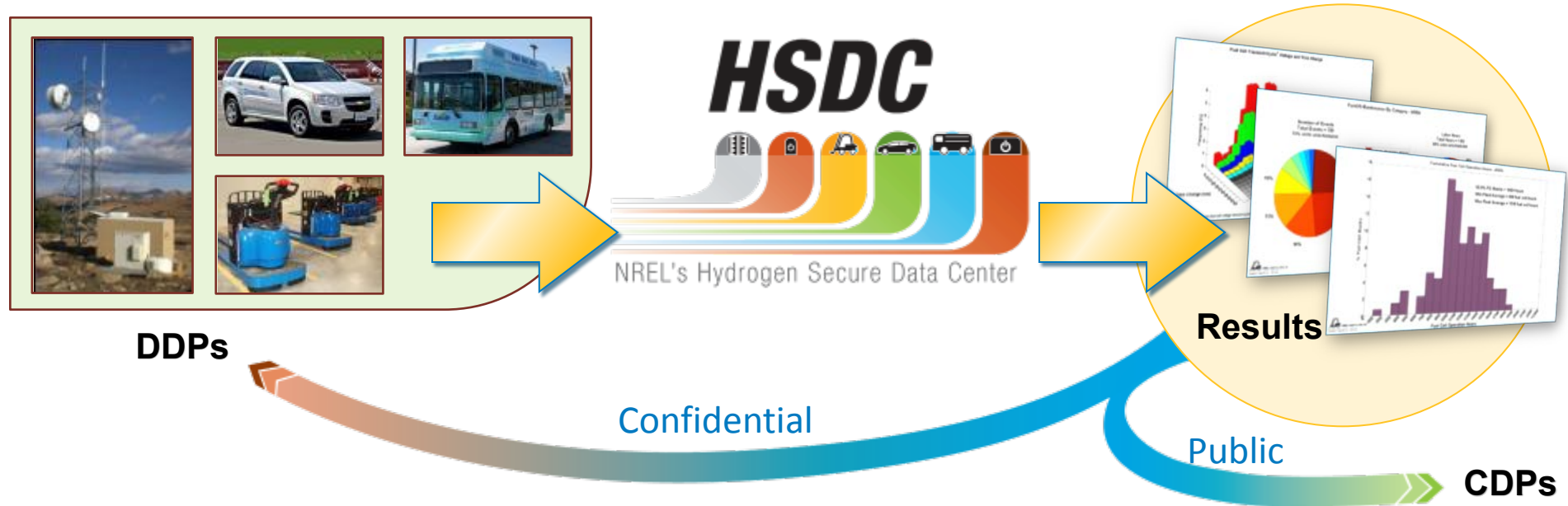
Bundled data (operation, maintenance, safety, & cost) delivered securely to NREL quarterly

Data stored, processed, and analyzed quarterly within the HSDC, which is not connected to an external network.



Access to the HSDC is limited by badge access for only NREL's technology validation team. Proprietary data is protected with aggregated public results.

Hydrogen Secure Data Center Analysis and Reporting - Approach



Detailed Data Products (DDPs)

- Individual data analyses
- Identify individual contribution to CDPs
- Only shared with partner who supplied data every 6 months¹

Composite Data Products (CDPs)

- Aggregated data across multiple systems, sites, and teams
- Publish analysis results without revealing proprietary data every 6 months²

1) Data exchange may happen more frequently based on data, analysis, and collaboration

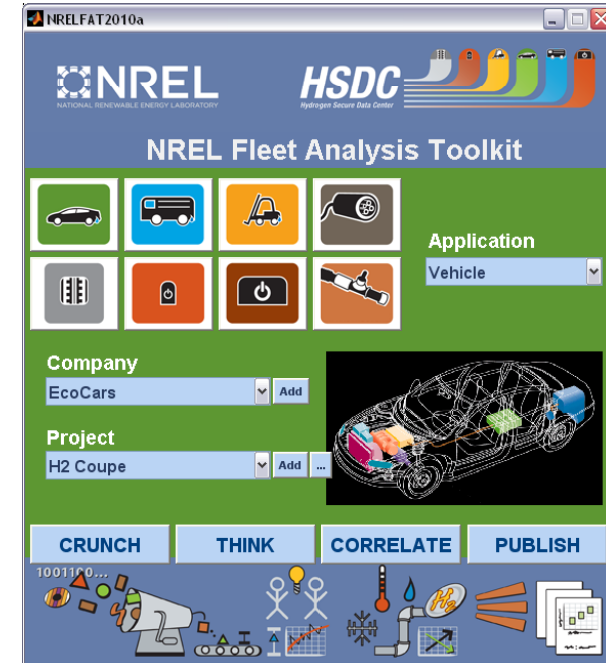
2) Results published via NREL Tech Val website, conferences, and reports

Stationary Fuel Cell Systems - Approach

- Includes systems providing prime, continuous, or regular power to a site
- Includes multiple fuel cell types - proton exchange membrane (high and low temperature), solid oxide, phosphoric acid, and molten carbonate
- Small, kilowatt-scale to large, megawatt-scale

Data Processing, Analysis, and Reporting Tools - Approach and Accomplishments

- **NREL Fleet Analysis Toolkit (NRELFAT)**
 - Developed first under fuel cell vehicle Learning Demonstration
 - Restructured architecture and interface to effectively handle new applications and projects and for flexible analysis
 - Leverage analyses already created
- **Report results**
 - Detailed and composite results
 - Target key stakeholders such as fuel cell and hydrogen developers, and end users



Stationary Fuel Cell Processing - Accomplishment

Stationary Processing and Analysis Capabilities in NRELFAT

The screenshot displays the NRELFAT software interface, which is organized into several functional areas:

- Application:** Located at the top left, it includes a power button icon and a 'Company & project' section with dropdown menus for 'Company:' and 'Project:'.
- Data management:** A central section containing several functional groups:
 - Archive:** Includes 'CreateArchive' and 'FileTransferPrep' buttons.
 - Batch:** Includes 'Save For Batch Run' and 'Run Batch' buttons.
 - Composite Data:** Includes 'Composite Setup', 'Composite Analysis', 'Interactive CDP Setup', and 'Interactive CDP Run' buttons.
 - Processing Buttons:** A vertical column of buttons labeled 'CRUNCH', 'THINK', 'CORRELATE', 'PUBLISH', and 'RUN'.
- Analysis:** A panel on the right titled 'Analysis' with a sub-section 'Processing to Perform'. It features a radio button for 'New CD' and a 'Selected Below' section containing a list of analysis tasks:
 - ProcessRaw
 - GetTriplInfo
 - StackInfoFromExcel
 - OpSummaryRaw
 - OpSummary
 - FCDegRaw
 - FCDeg

Yellow callouts and arrows highlight specific features and their corresponding descriptions:

- A callout labeled 'Application' points to the power button icon.
- A callout labeled 'Company & project' points to the dropdown menus.
- A callout labeled 'Data management' points to the 'Archive' and 'Batch' sections.
- A callout labeled 'Raw data processing' points to the 'ProcessRaw' task in the Analysis panel.
- A callout labeled 'Operating data processing & analysis' points to the 'OpSummaryRaw' and 'OpSummary' tasks.
- A callout labeled 'Fuel cell degradation processing & analysis' points to the 'FCDegRaw' and 'FCDeg' tasks.
- A callout labeled 'Composite results' points to the 'Composite Analysis' and 'Interactive CDP Run' buttons.

Stationary FC Data Templates - Accomplishments

Data templates constructed based on other technology validation projects for consistent and complete data sharing

Site Overview

Maintenance

Operation

All OEM Site Operation

Safety

Site Operation Summary

consistent with the level of detail of the energy and efficiency analysis.
Should contain fluid & energy streams from feedstock through dispensing.
Also include a dimensioned layout of the station with components clearly marked.

Maintenance	Quarterly	Report Date	OEM	insert name of automaker	Failure Mode ¹ (Includes Preventative	Associated with	System Down	Description
8/4/2005								blower replaced. In-stock item. Site out of service for 20 hours.

Maintenance	System Number	Unique System	(1) Data will be delivered to NREL's Hydrogen Secure Data Center (HSDC) and will be protected as commercially valuable data in accordance with HSDC security procedures. (2) Data must be collected at a minimum frequency that is dependent on the run conditions (i.e. run conditions with many transients data at 1 point per second or steady state could be 1 point per hour) (3) Values may be calculated rather than directly measured.					
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Component	OEM	insert name of OEM	Date updated	Unique Site	Commission	Decommission	Still in	Comments
mm/dd/yyyy			11/18/20					--

Report Date	insert date of report	Energy Provider	insert name of energy provider	SAFETY CATEGORIES: (Choose from dropdown 'pick lists')			
Date of Event	8/4/2001			DESCRIPTION	EQUIPMENT/SUBSYSTEM INVOLVED	PRIMARY FACTOR	DAMAGES AND INJURIES
				H2 storage (LH2, CGH2)		Operator/Personnel Error	Property Damage - significant >\$10,000

Data should be from reporting quarter

Monthly Data Table		Month		
Category	Units	Month1	Month2	Month3
Operation Time	hours			
Electricity to Site	kWhr			
Electricity to Grid	kWhr			
Hydrogen Produced	kg			
Operation & Maintenance Service Charge	\$			
Total Operation & Maintenance Charge for site	\$			

Collaborations

- **Partners for data delivered at the end of FY12 (~40 MW)**
 - National Fuel Cell Research Center
 - California Stationary Fuel Cell Collaboration



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- **Communicating with several organizations to establish agreements for sharing data with NREL**
 - State and regional fuel cell organizations
 - Fuel cell developers

Proposed Future Work

- **Establish partnerships with end users, state collaborations, and fuel cell developers to create data sets of stationary fuel cell systems operating in real-world conditions**
- **Receive first delivery of data from NFCRC and CaSFCC**
- **Publish first set of composite data products for stationary fuel cell operation in Fall 2012**

Summary

Relevance: Validating the performance of technologies in integrated systems, under real-world conditions supports market growth, product awareness, and technology growth.

Approach: Leverage capabilities established under other technology validation activities like NRELFAT to address a gap in performance results for stationary fuel cell systems.

Accomplishments: Data templates have been created and NRELFAT is capable of raw data processing, operation summary, and voltage degradation analyses for stationary data sets.

Collaborations and Future Work: Establish partnerships and stationary field data sets for the first set of results to be published in Fall 2012.