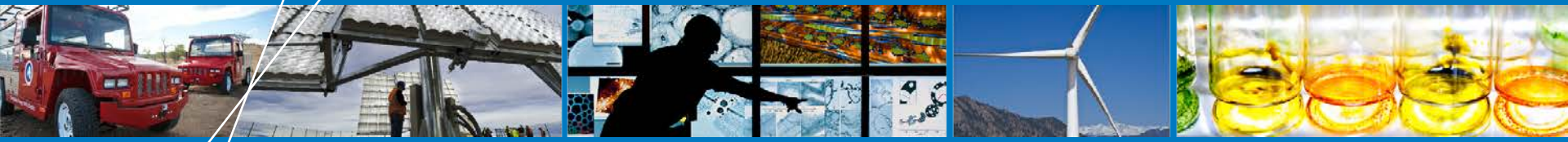
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Stationary Fuel Cell Evaluation



2012 DOE Annual Merit Review

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National Renewable Energy Laboratory

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

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Overview

Timeline	Barriers
Project start date: October 2011 Project end date: September 2012* Percent complete: On-going	Performance validation and reporting of stationary fuel cell systems under real-world operating conditions
Budget	**Partners**
Total project funding DOE share: $65k Contractor share: $0 Planned funding in FY12: $65k	In the process of establishing partnerships

*Project continuation and direction determined annually by DOE

Objectives - Relevance

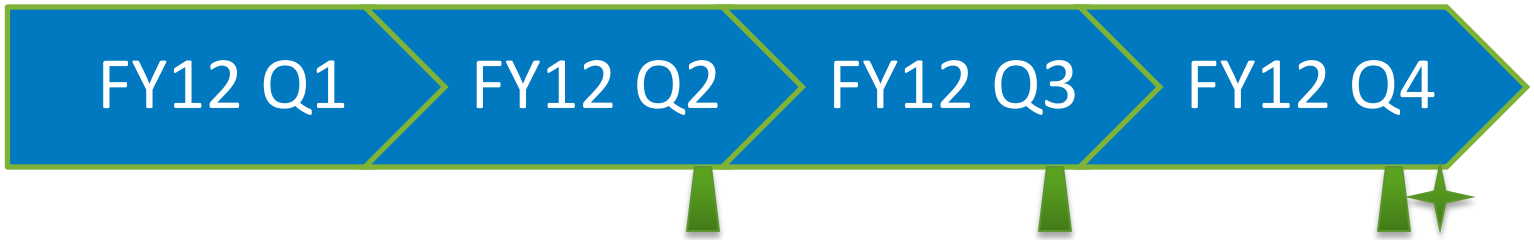
- **Independent assessment, validation, and reporting of operation targets and system performance under realistic operating conditions.**

HSDC

NREL's Hydrogen Secure Data Center

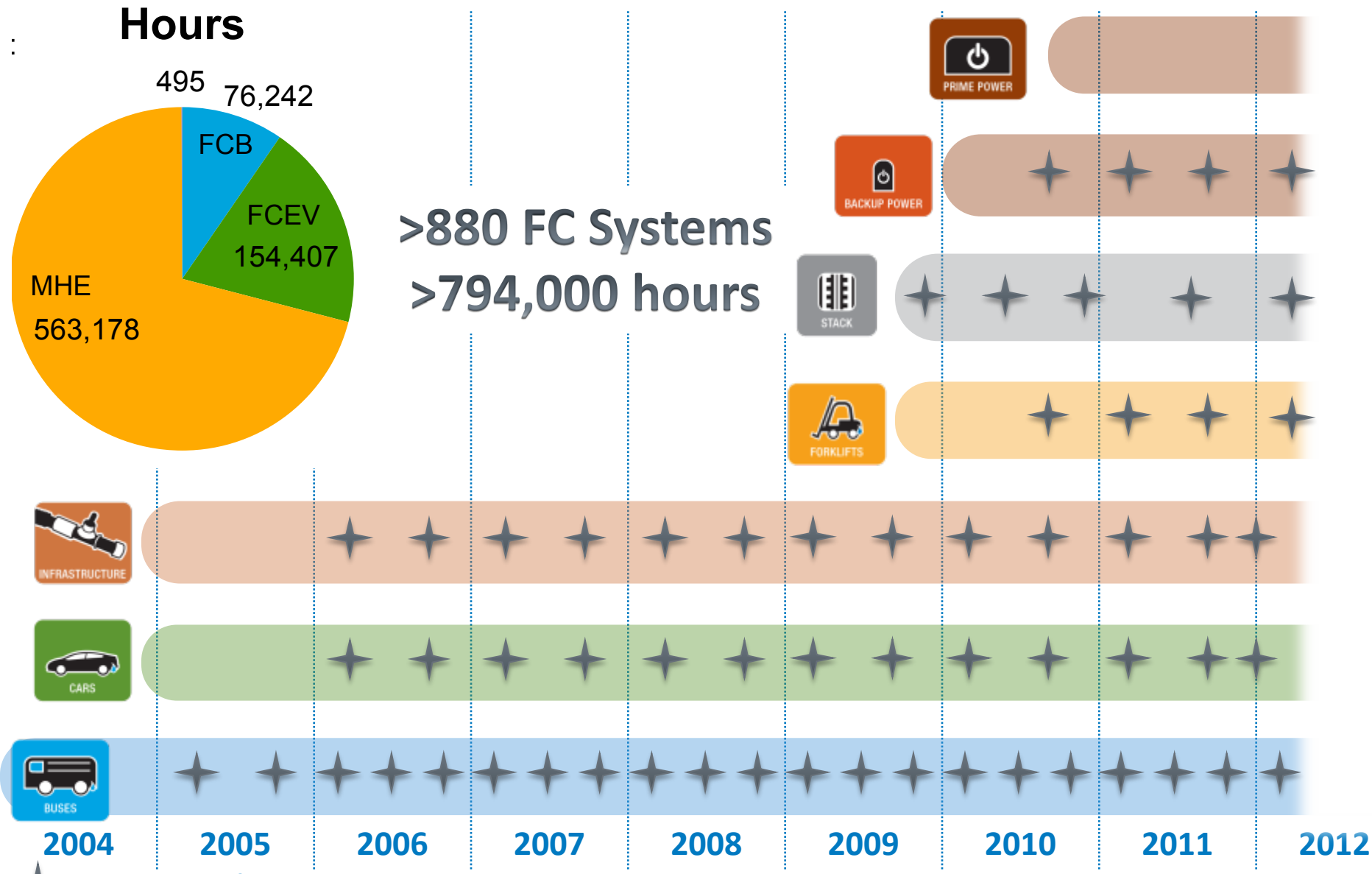
- ✓ ***Real World Operation Data*** from the field and state-of-the-art lab
- ✓ ***Collection***
- ✓ ***Analysis*** for independent technology validation
- ✓ ***Collaboration*** with industry and end users operating stationary fuel cell systems
- ✓ ***Reporting*** on technology status, progress, and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

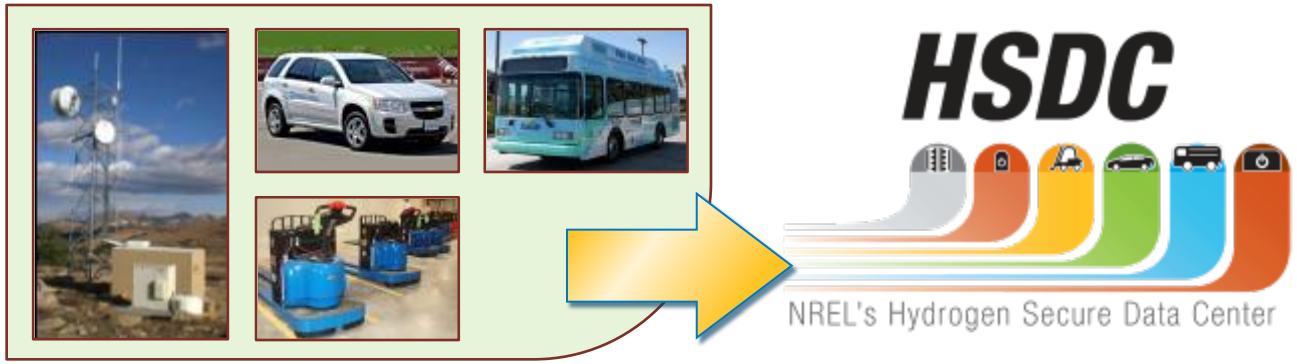


Published performance reports

Hydrogen Secure Data Center *Data Collection* - Approach

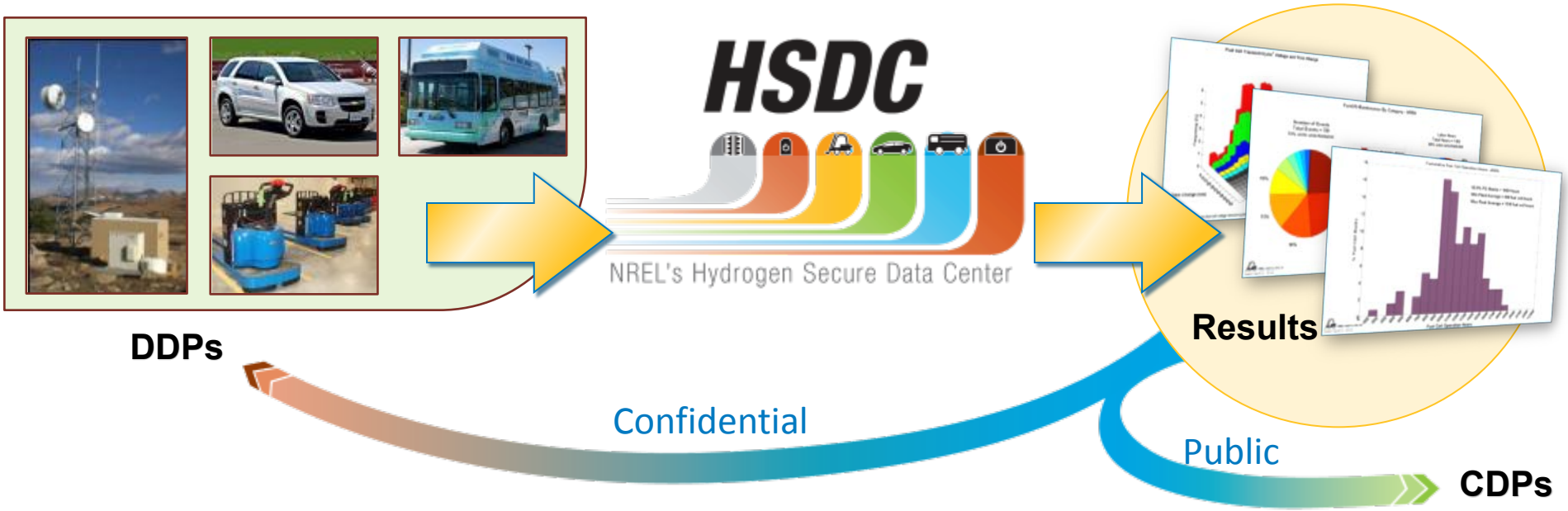
Bundled data (operation, maintenance, safety, & cost) delivered securely to NREL quarterly

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 months[1]

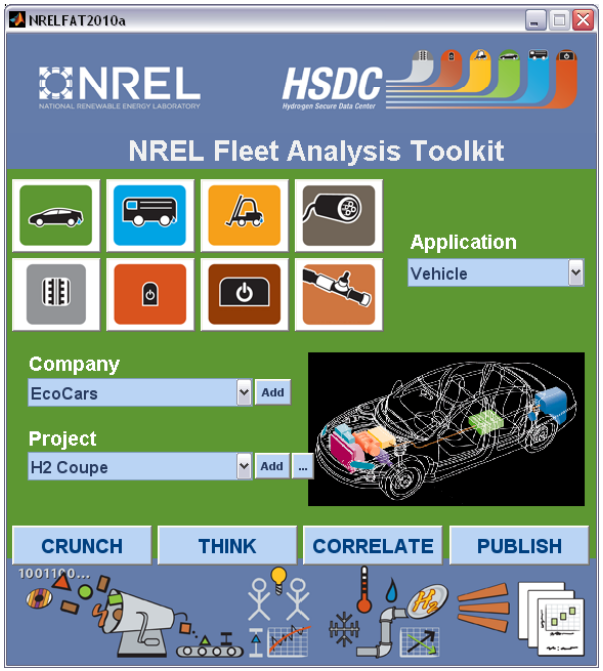
Composite Data Products (CDPs)
- Aggregated data across multiple systems, sites, and teams
- Publish analysis results without revealing proprietary data every 6 months[2]

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

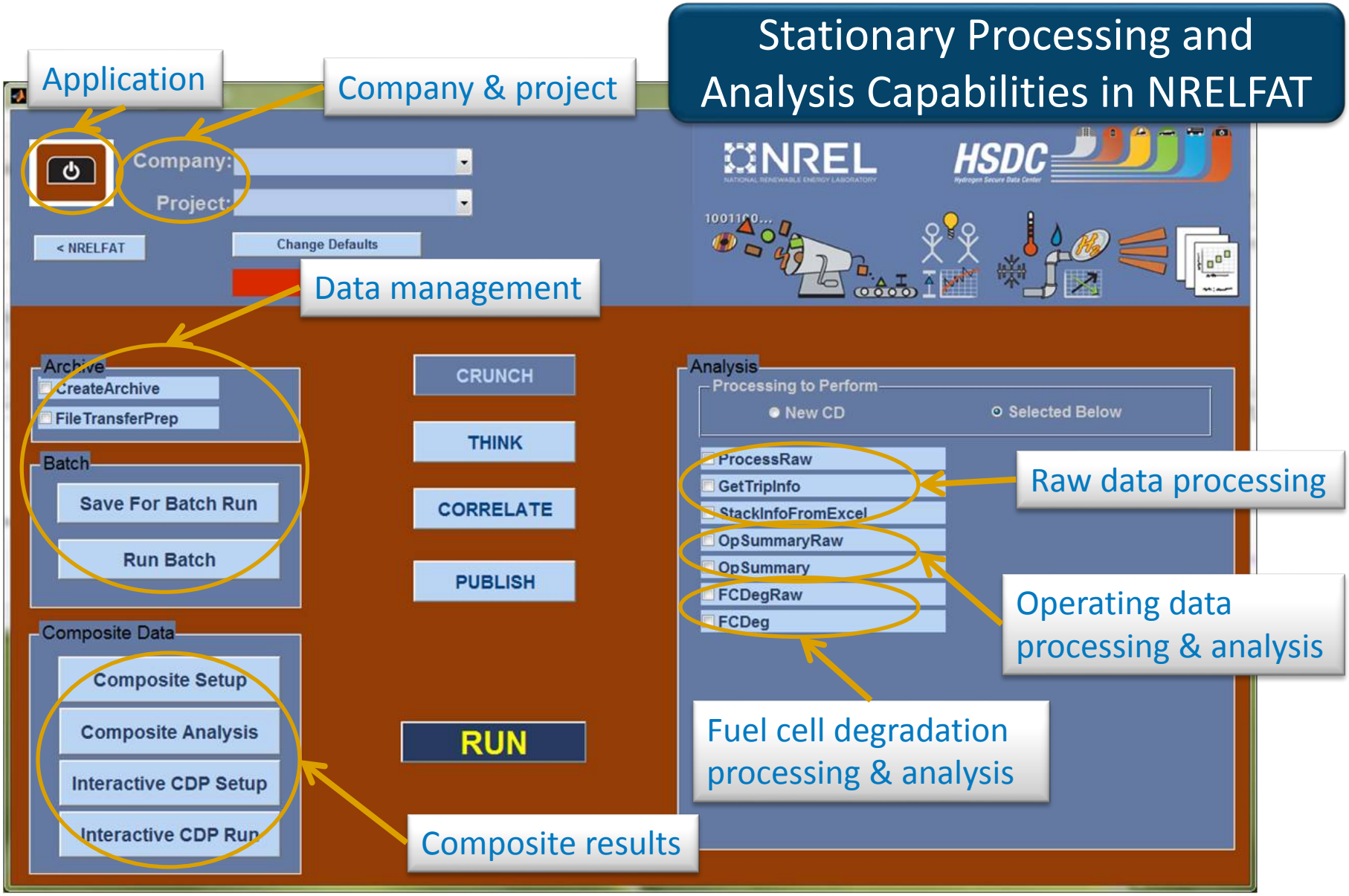
- Includes systems providing prime, continuous, or regular power to a site
- Includes multiple fuel cell types - proton exchange membrane (high and low temperature), solid oxide, phosphoric acid, and molten carbonate
- Small, kilowatt-scale to large, megawatt-scale

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 FC Data Templates - Accomplishments

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

Site Overview

Should contain fluid & energy streams from feedstock through dispensing.
-Also include a dimensioned layout of the station with components clearly marked.

Maintenance

Maintenance Date	Failure Mode[1] (Includes Preventative	Associated with	System Down	Description
8/4/2005				blower replaced. In-stock item. Site out ce for 20 hours.

Operation

(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.

All OEM Site Operation

Component	OEM	insert name of OEM
Measurement	Date updated	Unique Site	Commission	Decommission	Still in	Comments
Units	mm/dd/yyy					--

Safety

INSTRUCTIONS:
1) Scroll over headings for definitions of each category

Report Date	insert date of report
Energy Provider	insert name of energy provider

SAFETY CATEGORIES: (Choose from dropdown 'pick lists')

Date of Event	EQUIPMENT/ SUBSYSTEM INVOLVED	PRIMARY FACTOR	DAMAGES AND INJURIES
8/4/2001	H2 storage (LH2, CGH2)	Operator/Personnel Error	Property Damage - significant >$10,000)

Site Operation Summary

Calendar Quarter (ex. 2011Q2)	insert calendar quarter
Site Name	insert site name

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

NFCRC
NATIONAL FUEL CELL RESEARCH CENTER
UNIVERSITY of CALIFORNIA · IRVINE

CaSFCC
California Stationary Fuel Cell Collaborative

- **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.