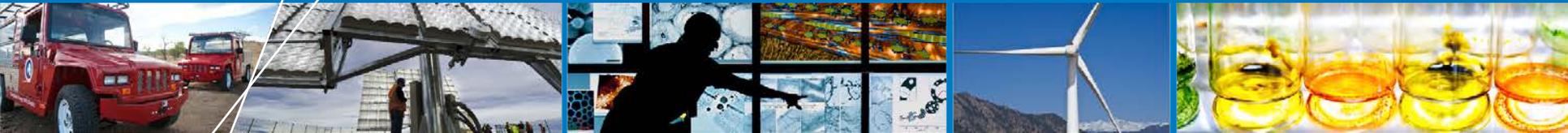


National Fuel Cell Technology Evaluation Center



HTAC

October 29, 2013

Jennifer Kurtz

NFCTEC Launch – September 12, 2013

Energy Department Launches National Fuel Cell Technology Evaluation Center to Advance Fuel Cell Technologies

Following Energy Secretary Ernest Moniz's visit to the National Renewable Energy Laboratory (NREL), the Energy Department today announced the unveiling of a one-of-its-kind national secure data center dedicated to the independent analysis of advanced hydrogen and fuel cell technologies at the Energy Department's Energy Systems Integration Facility (ESIF) located at NREL in Golden, Colorado.

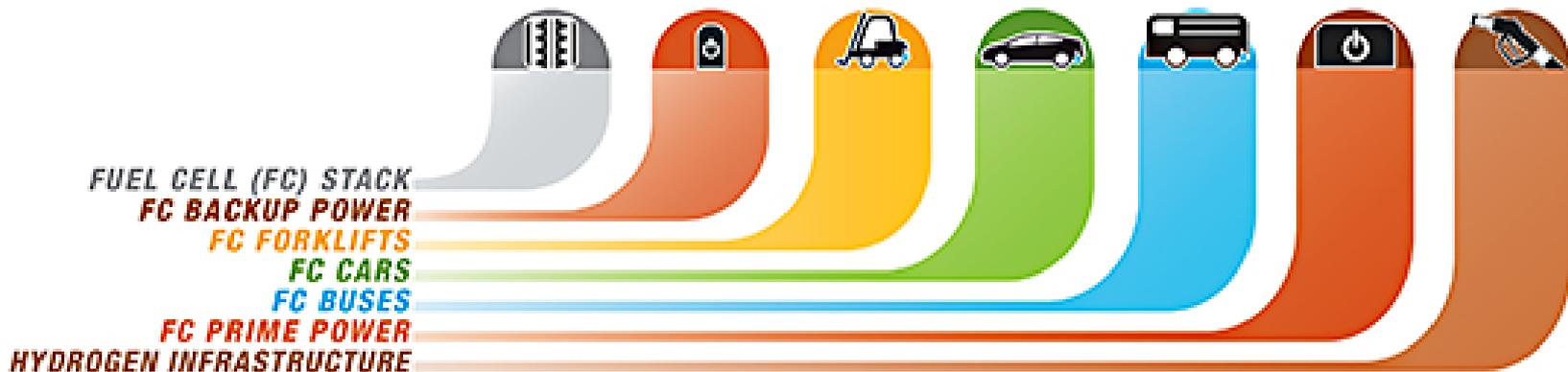
The National Fuel Cell Technology Evaluation Center (NFCTEC) allows industry, academia, and government organizations to submit and review data gathered from projects to advance cost-effective fuel cell technology. NFCTEC will also help accelerate the commercialization of fuel cell technologies by strengthening data collection from fuel cell systems and components operating under real-world conditions, and analysis of these detailed data that can be compared to technical targets. The NFCTEC is housed within an ESIF area specifically designed for the secure management, storage, and processing of proprietary data from industry and other stakeholders. Aggregated analysis results that show the status and progress of the technology, but do not identify individual companies, are available to the public.

Source: http://apps1.eere.energy.gov/news/news_detail.cfm/news_id=19607

Rebranding of HSDC to NFCTEC

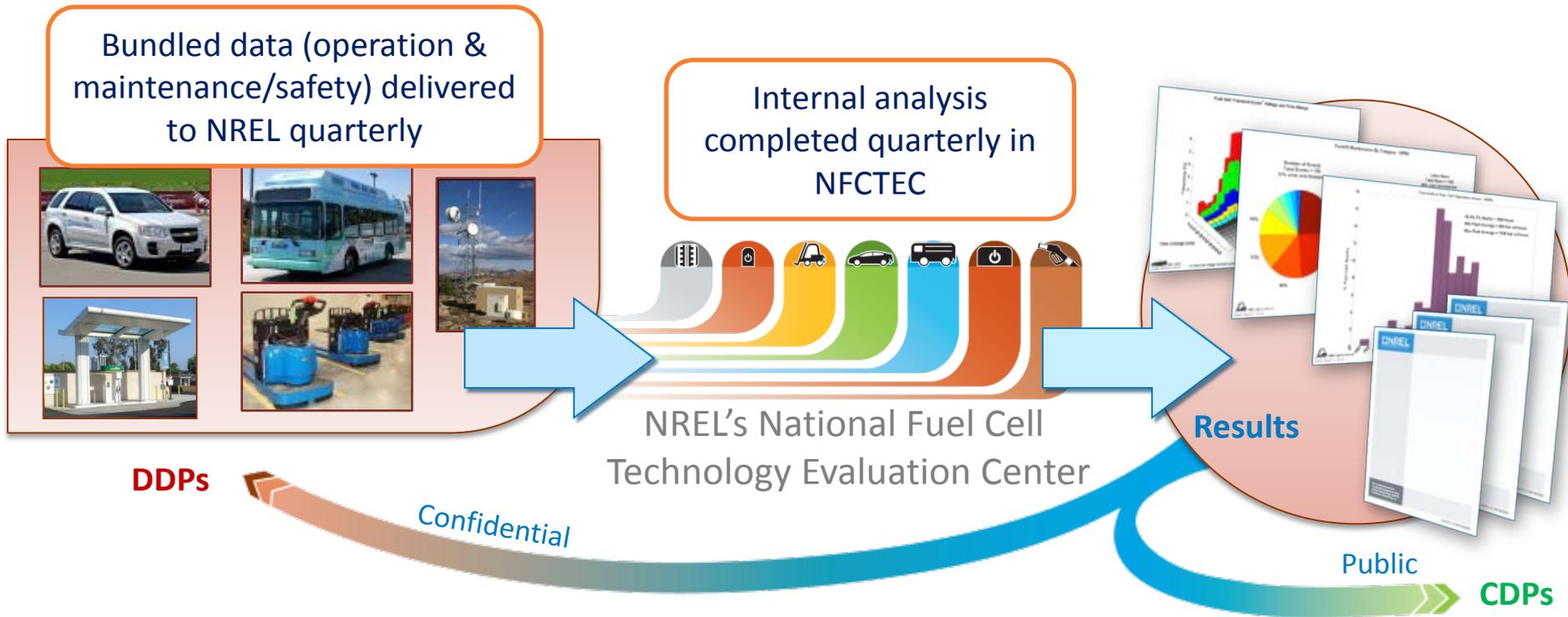


National Fuel Cell Technology Evaluation Center



a national resource for hydrogen and fuel cell stakeholders

Analysis and Reporting of Real-World Operation Data



Detailed Data Products (DDPs)

- Individual data analyses
- Identify individual contribution to CDPs
- Shared every six months only with the partner who supplied the data¹

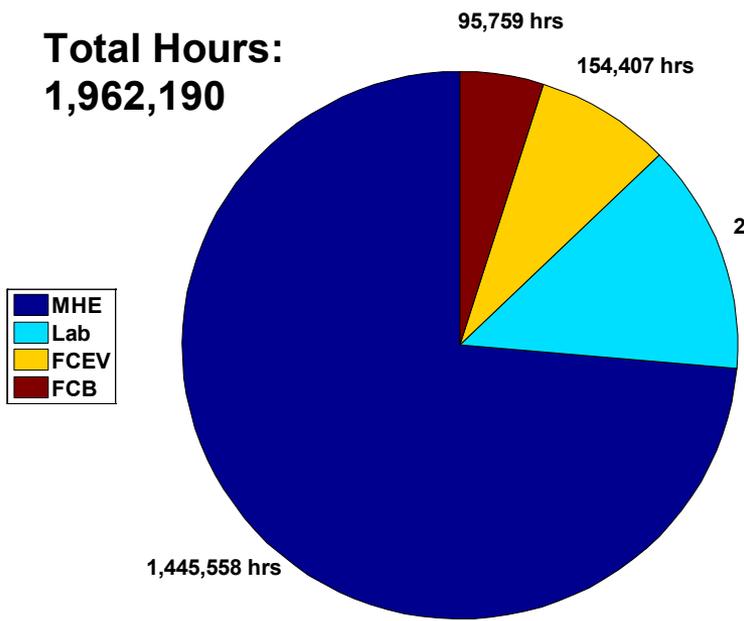
Composite Data Products (CDPs)

- Aggregated data across multiple systems, sites, and teams
- Publish analysis results every six months without revealing proprietary data²

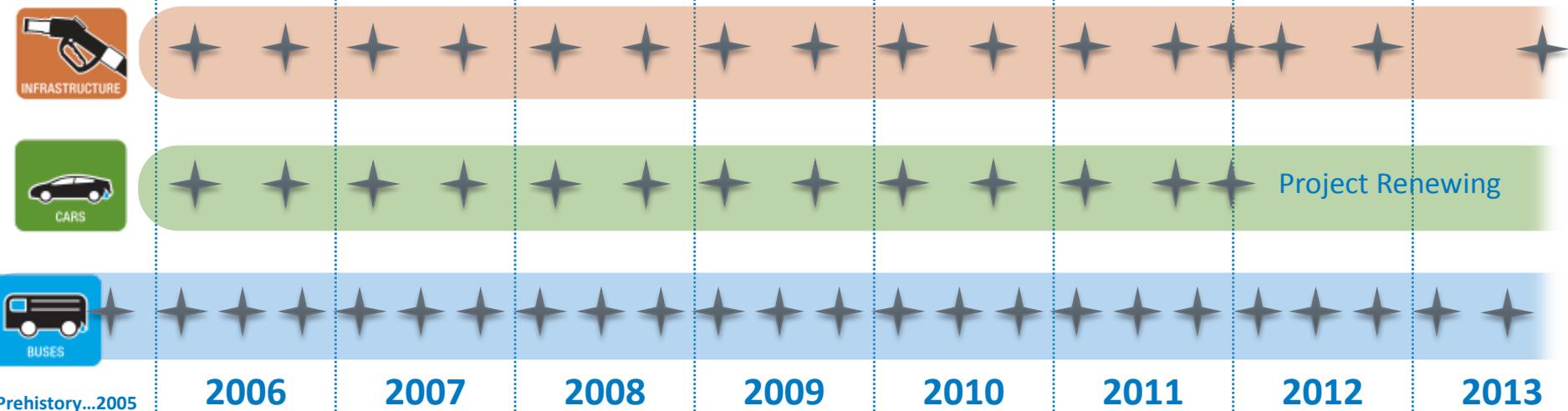
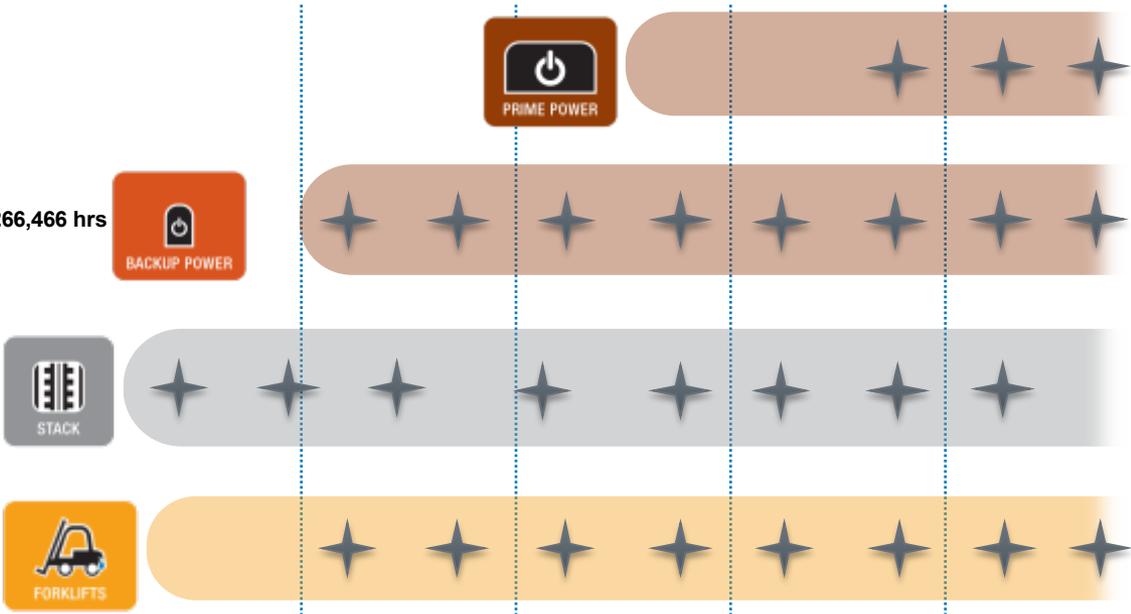
http://www.nrel.gov/hydrogen/proj_learning_demo.html

Leveraging Data Process and Analysis Capabilities Across Technology Validation Projects

Total Hours:
1,962,190



- MHE
- Lab
- FCEV
- FCB



Prehistory...2005

★ Published performance reports

Fuel Cell Electric Bus Evaluation



Three types of fuel cell dominant, FCEBs at three transit sites:

- AC Transit, Oakland, CA
 - 40-foot Van Hool buses with ClearEdge Power* FC (ZEBA)
- CTTTRANSIT, Hartford, CT
 - 40-foot Van Hool buses with ClearEdge Power FC (Nutmeg)
- SunLine, Thousand Palms, CA
 - 40-foot New Flyer bus with Ballard FC and Bluways hybrid system (AT)
 - 40-foot Eldorado bus with Ballard FC and BAE Systems Hybrid drive (AFCEB)

ACT
ZEBA



CTT
Nutmeg



SL AT



SL AFCEB



*Formerly UTC Power

Fuel Cell Electric Vehicle Evaluation

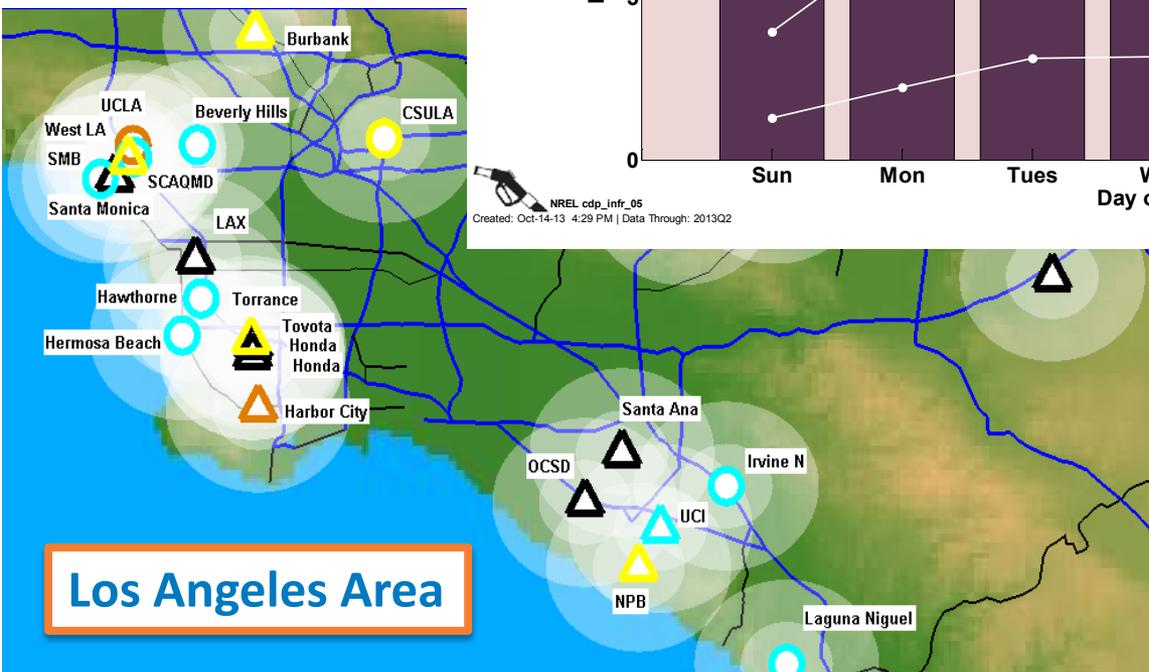
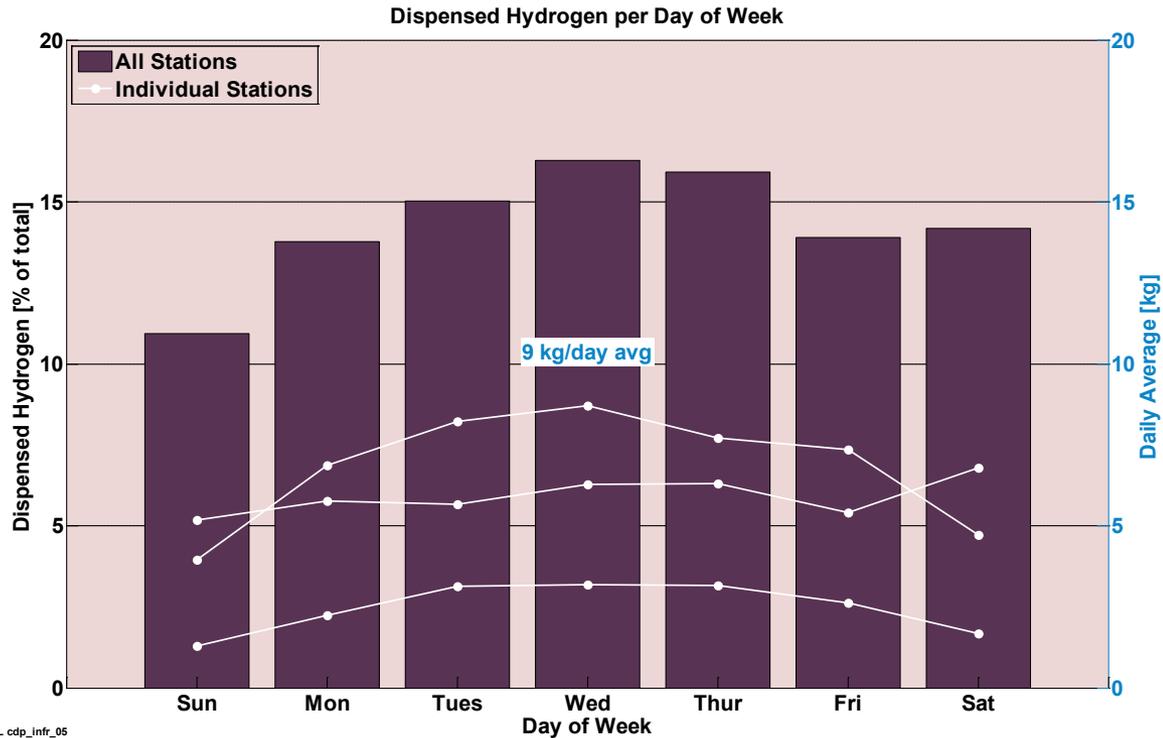


Objectively assess progress toward targets and market needs

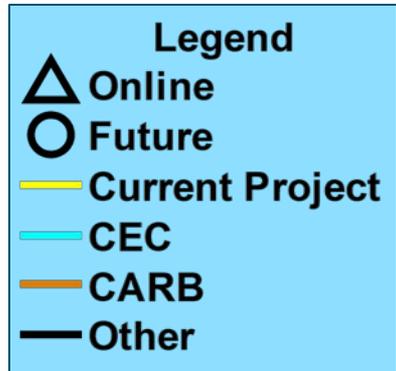
Key Targets		
Performance Measure	Status*	Ultimate (2020)
Fuel Cell Stack Durability	2,500 hours	5,000 hours
Vehicle Range	254+ miles	300+ miles
Fill Rate	0.77 kg/min	1.0 kg/min
Efficiency	59% at 25% Power	60% at 25% Power

*As reported in previous Learning Demonstration results

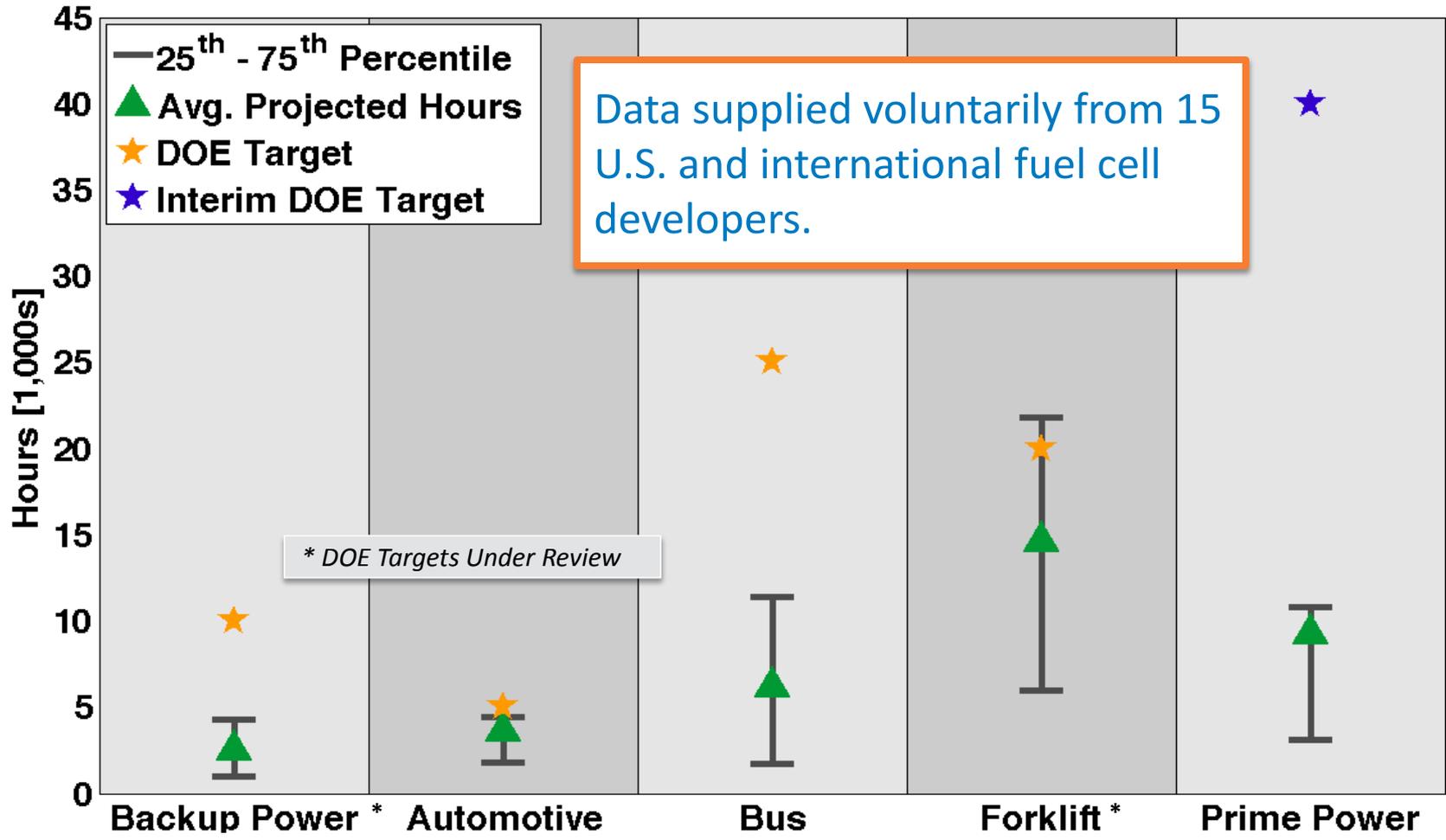
Infrastructure Evaluation



NREL cdp_infr_05
Created: Oct-14-13 4:29 PM | Data Through: 2013Q2



Fuel Cell Technology Status



Fuel Cell Material Handling Evaluation



Validation of MHE is based on real-world operation data from high-use facilities

1,859,616
Operation hours

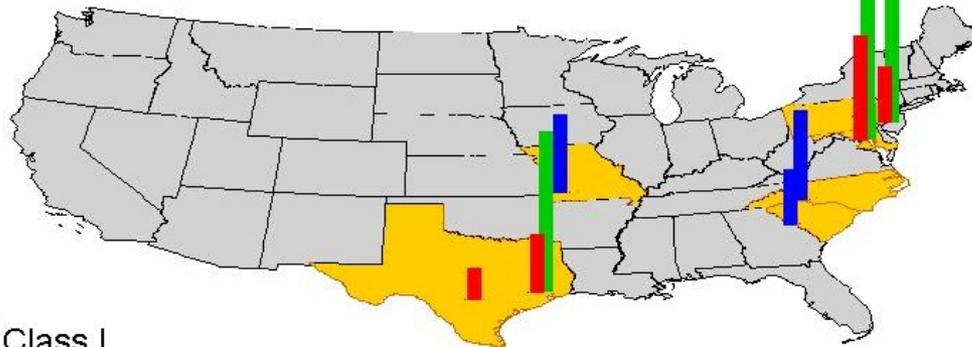
291,114
Hydrogen fills

490
Units in operation*

4.4
Average operation hours
between fills

232,551
Hydrogen dispensed
in kg

504 Units | 8 Sites



- Class I
- Class II
- Class III

Height proportional to units deployed.

0.6
Average fill amount
in kg

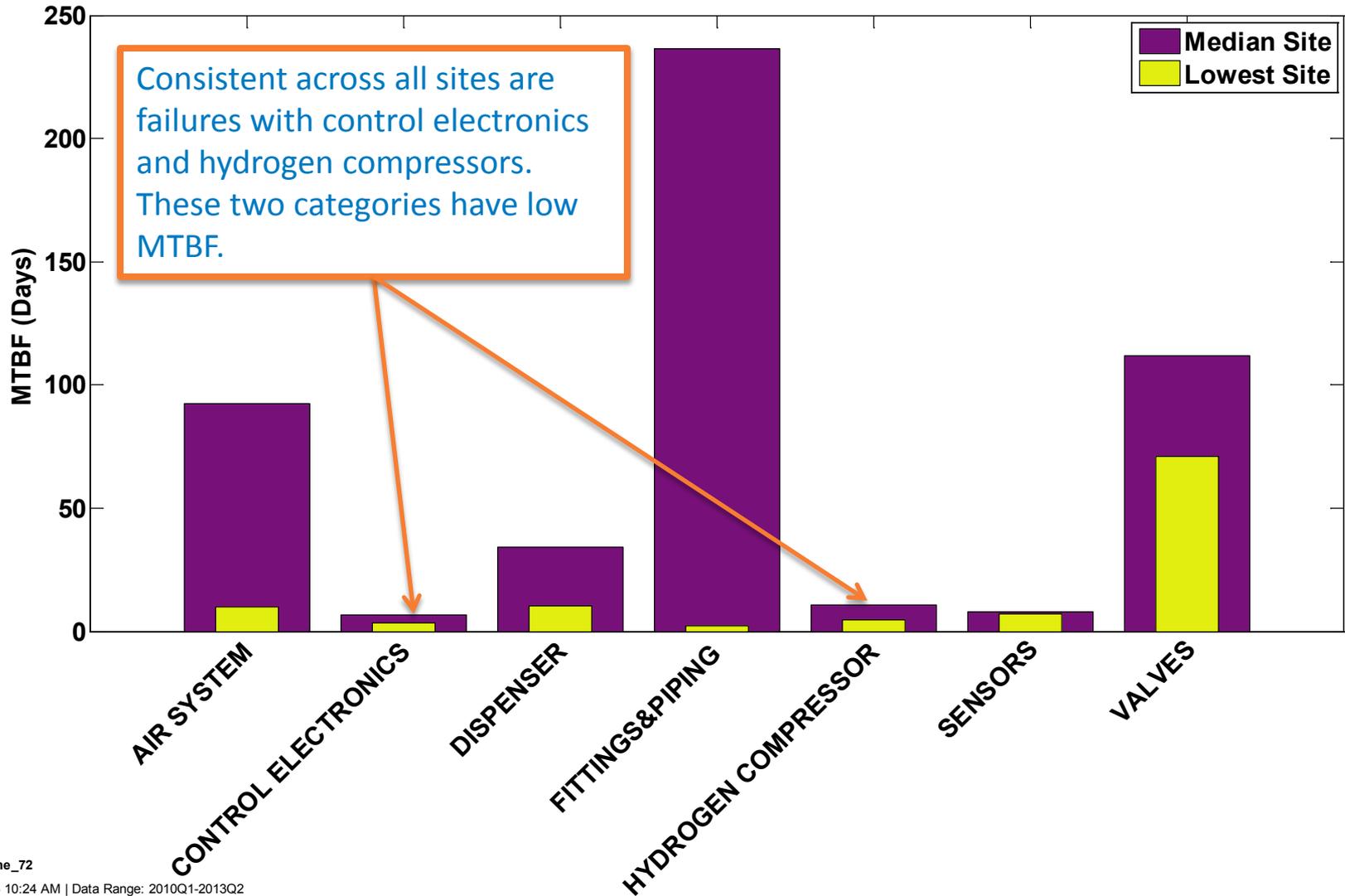
2.3
Average fill time
in minutes

*One project has completed

Breakdown of MTBF by Key Delivered Hydrogen Infrastructure Categories



MTBF by Equipment Category: Infrastructure (Delivered H₂ Only)



NREL cdparra_mhe_72

Created: Sep-26-13 10:24 AM | Data Range: 2010Q1-2013Q2

Fuel Cell Backup Power Evaluation



1.94

Installed capacity
in MW

Systems are operating reliably in 23 states. Reasons for unsuccessful starts include an e-stop signal, no fuel, and other system failures.

99.7%

Successful starts

842

Systems in operation*

4-6

Average site
capacity in kW

2,579

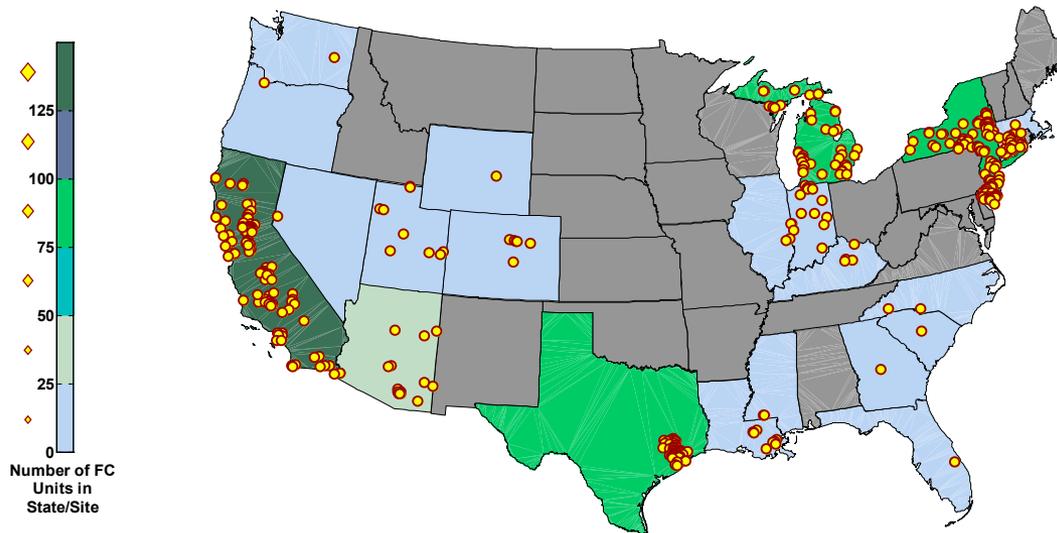
Start attempts

65

Continuous run
hours demonstrated

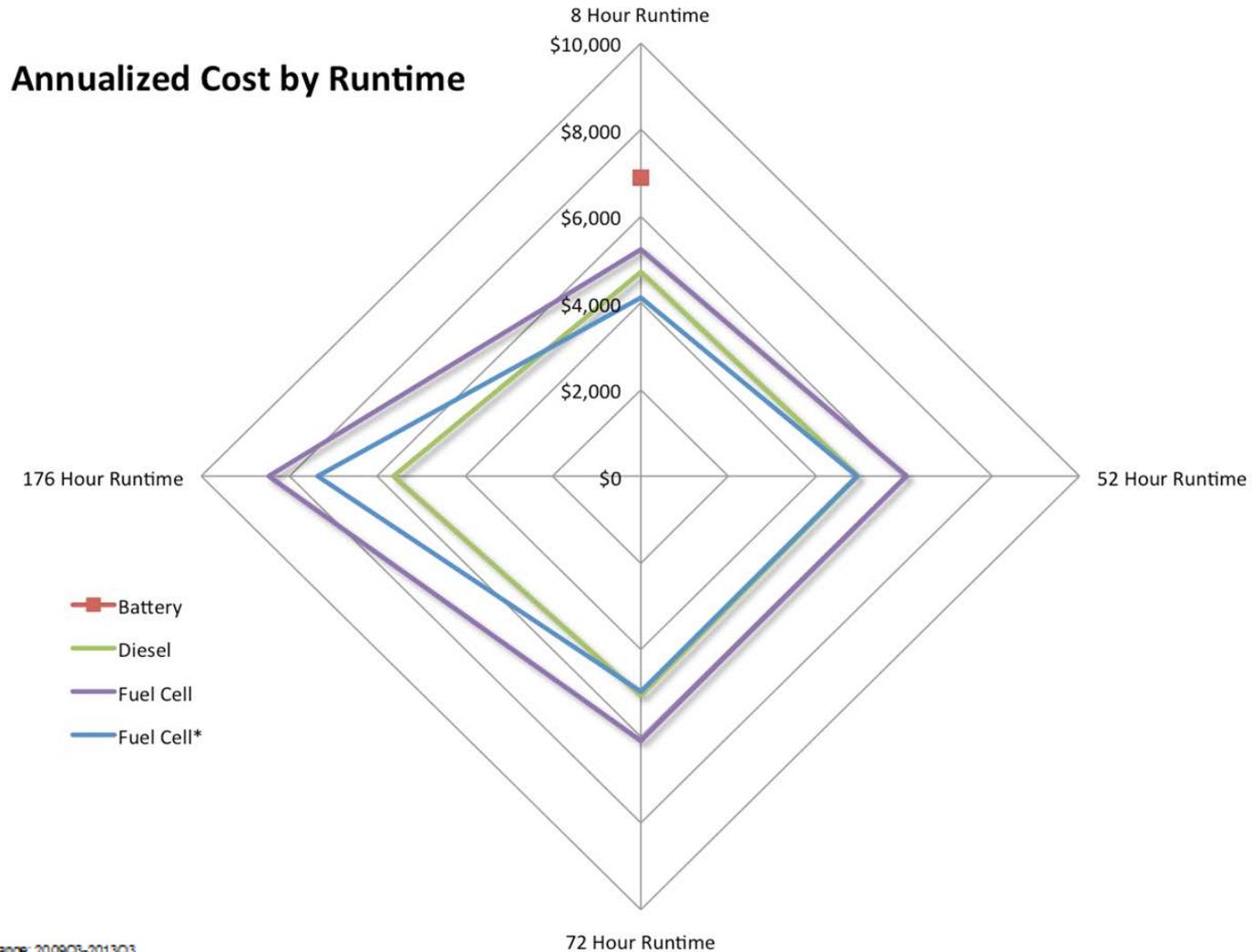
1,683

Operation hours



*Not all systems have detailed data reporting to NREL

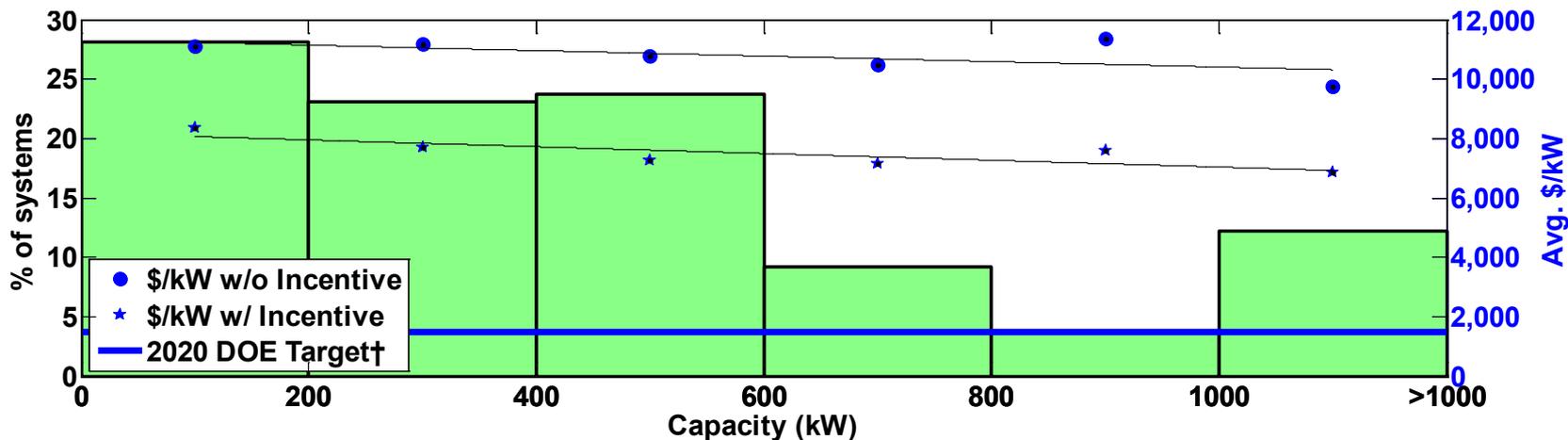
FCBP Annualized Cost by Runtime



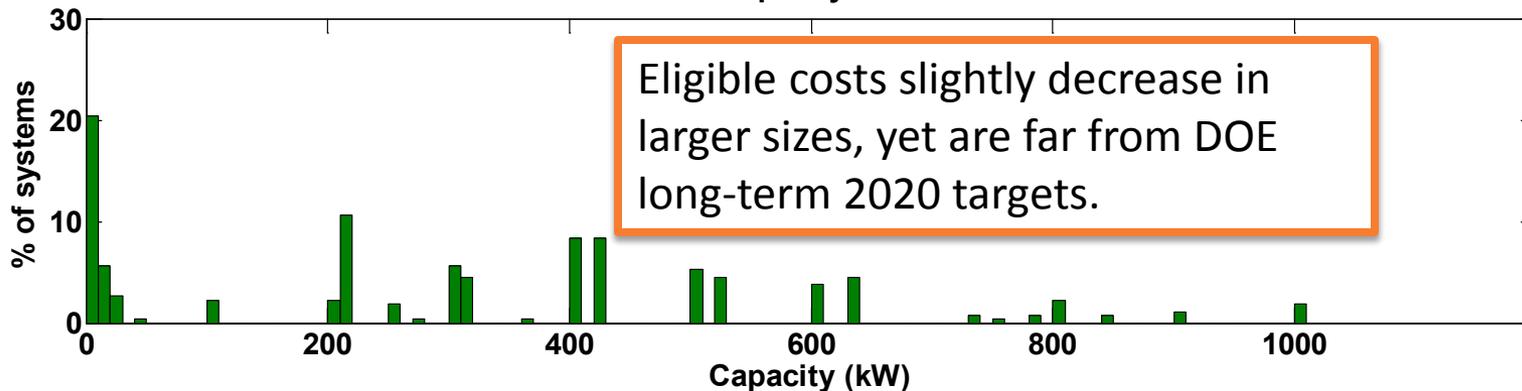
Fuel Cell Prime Stationary Power Evaluation



Fuel Cell Stationary Capacity and Average Eligible Costs Incentive Range \$3K-\$4K/kW



Detailed Capacity Distribution



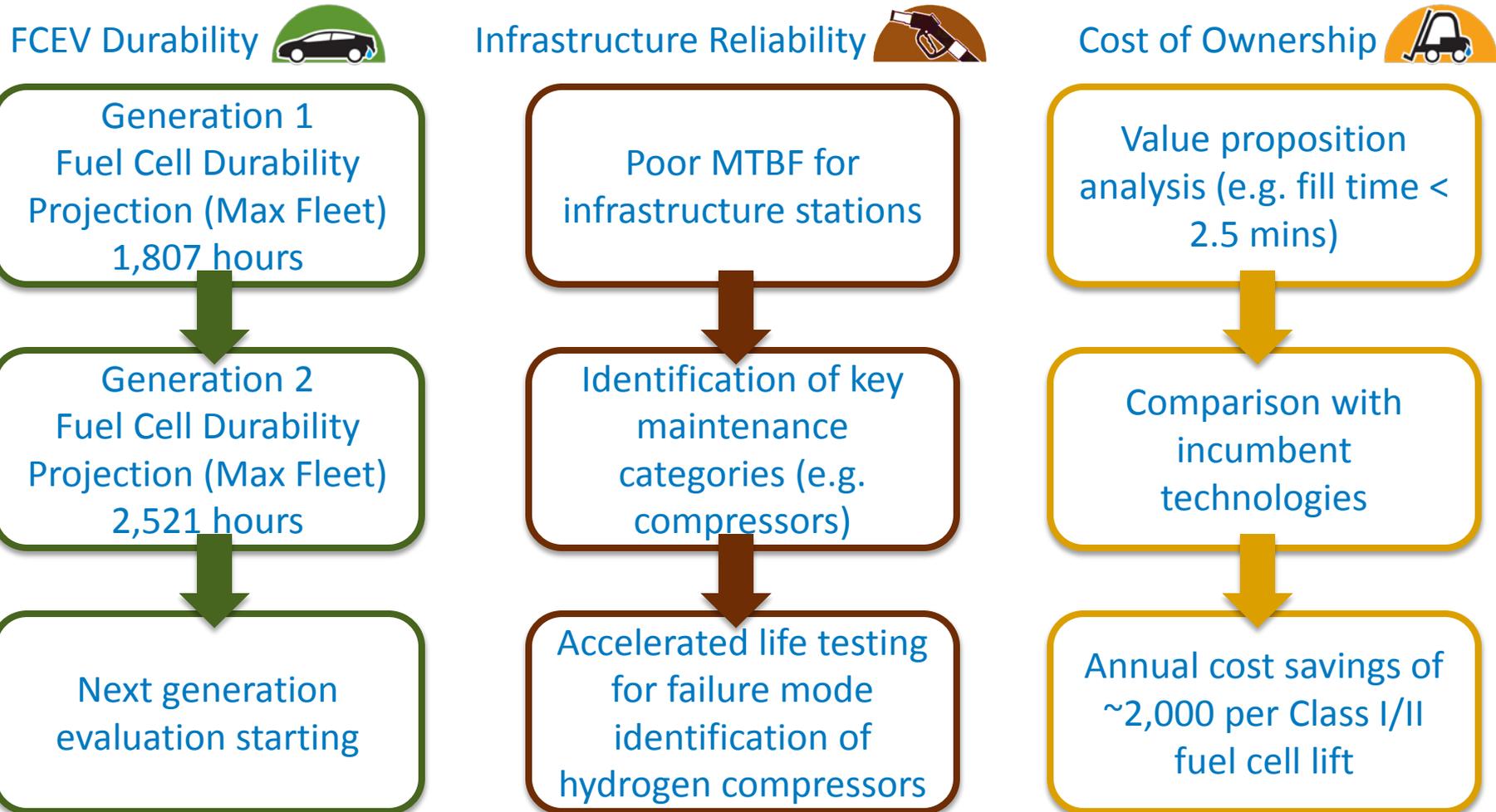
Eligible costs slightly decrease in larger sizes, yet are far from DOE long-term 2020 targets.

Eligible Costs May Include: Planning & Feasibility Study, Engineering & Design, Permitting, Self-Generation Equipment Waste Heat Recovery Costs, Construction & Installation Costs, Gas & Electric Interconnection, Warranty, Maintenance Contract Metering, Monitoring & Data Acquisition System, Emission Control Equipment Capital Gasline Installation, Fuel Gas Clean-up Equipment, Electricity Storage Devices, Bond to Certify Renewable Fuel Sales Tax, Fuel Supply (digesters, gas gathering, etc.), Thermal Load, & Other Eligible Costs

†for the year 2020, operating on natural gas.
*Data from the California SGIP.

NREL Technology Validation

Objective: Independent validation of fuel cell and hydrogen technologies in real-world operation providing status, trends, and gaps to key stakeholders.

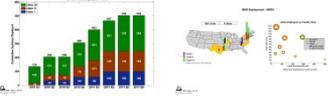


Results published via NREL technology validation website (http://www.nrel.gov/hydrogen/proj_learning_demo.html)

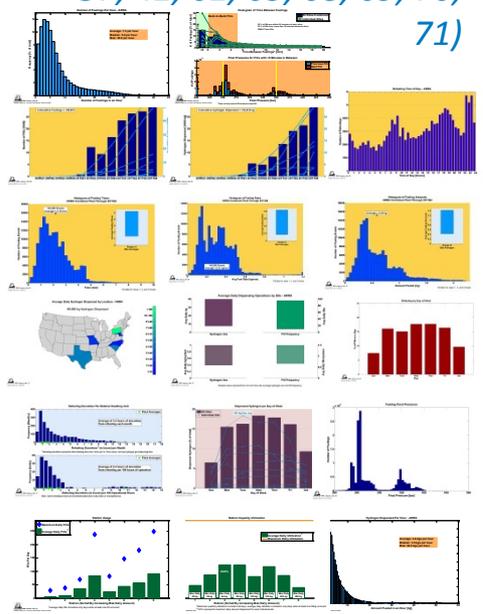
74 MHE CDPs—Count and Category



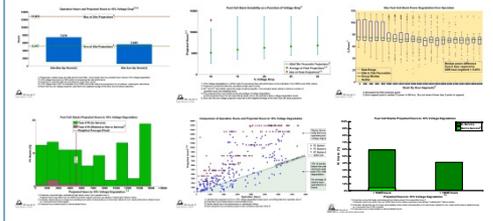
Deployment & Site Overview (1, 40)



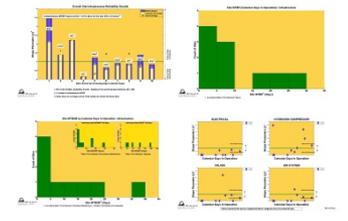
Infra. Operation (3, 4, 5, 6, 9, 10, 21, 22, 35, 37, 42, 62, 65, 68, 69, 70, 71)



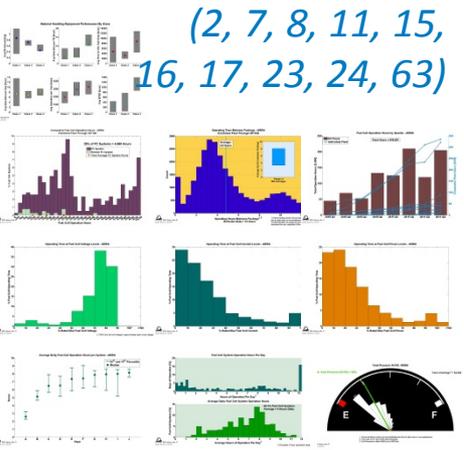
Fuel Cell Durability (32, 33, 34, 38, 39, 73)



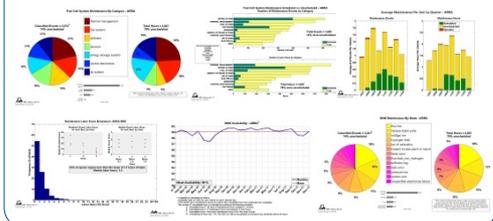
Infra. Reliability (45, 48, 49, 50)



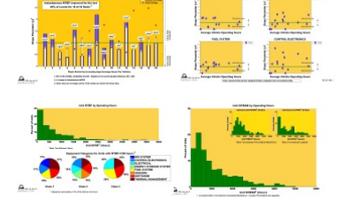
Fuel Cell Operation (2, 7, 8, 11, 15, 16, 17, 23, 24, 63)



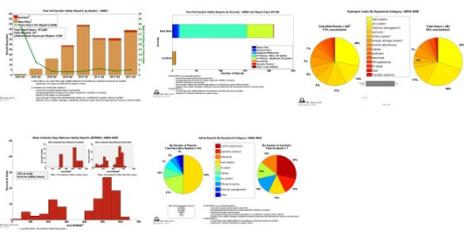
FC Maintenance (12, 13, 14, 43, 54, 61)



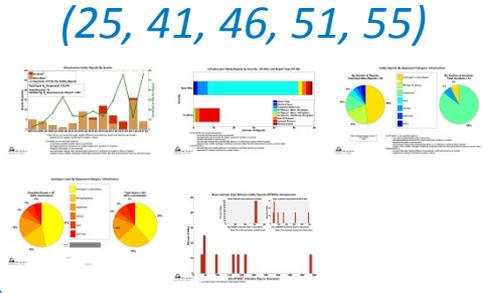
Fuel Cell Reliability (28, 29, 30, 31)



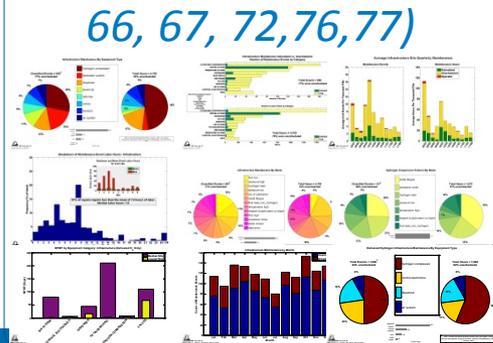
Fuel Cell Safety (26, 27, 53, 56, 57)



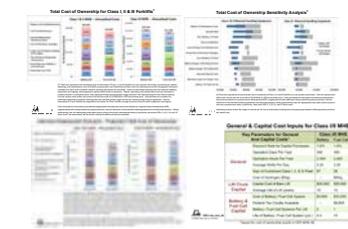
Infra. Safety (25, 41, 46, 51, 55)



Infra. Maintenance (18, 19, 20, 44, 47, 52, 66, 67, 72, 76, 77)



Cost of Ownership (58, 59, 60, 64)



NFCTEC

- Independent, secure analysis
- Industry collaboration
- Confirmation of component and system technical targets
- Technology validation
- Evaluation, optimization, and demonstration in integrated energy systems and real-world operation



Photo by Dennis Schroeder, NREL
Figures and illustrations: NREL

