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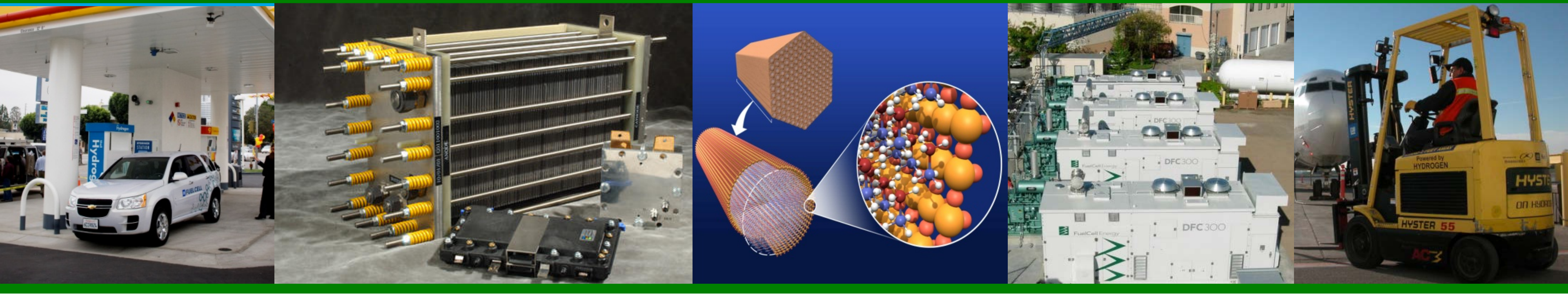
ENERGY



Hydrogen & Fuel Cells
- Program Overview -

Sunita Satyapal

2013 Annual Merit Review and Peer Evaluation Meeting
May 13, 2013

Overview
Fuel Cells – An Emerging Global Industry

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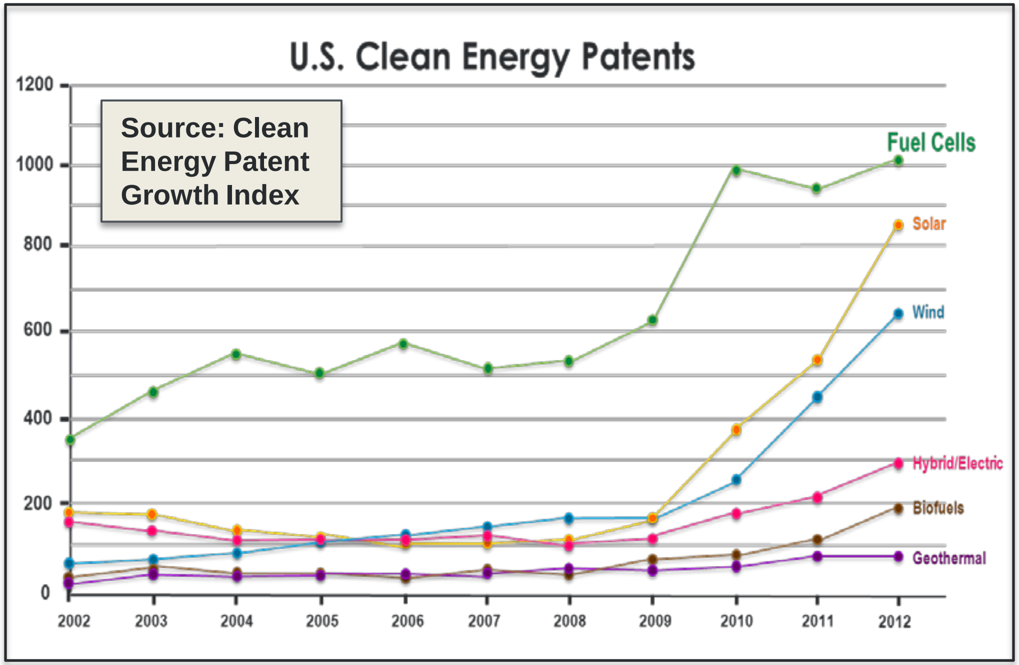
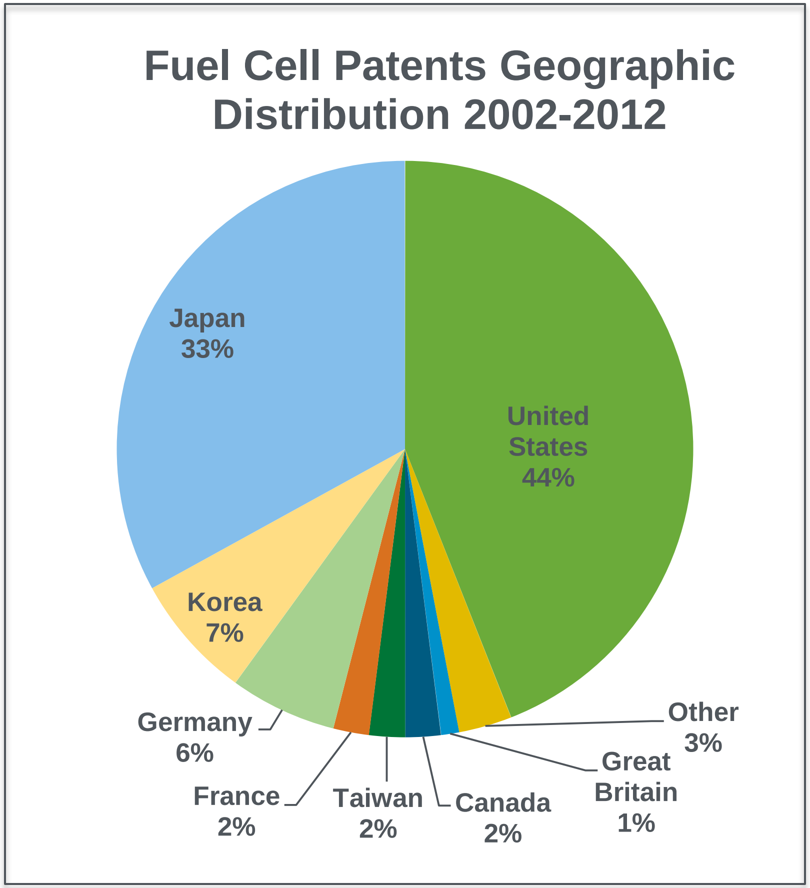


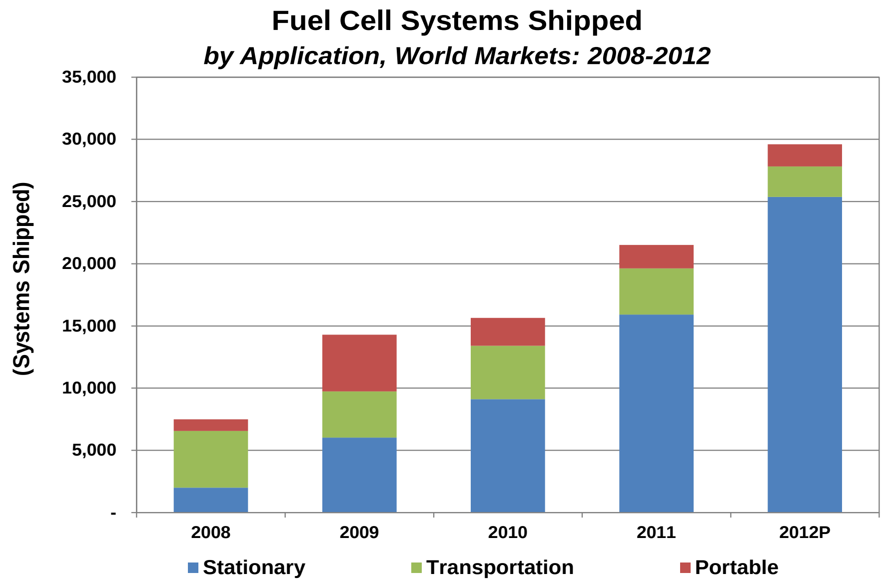


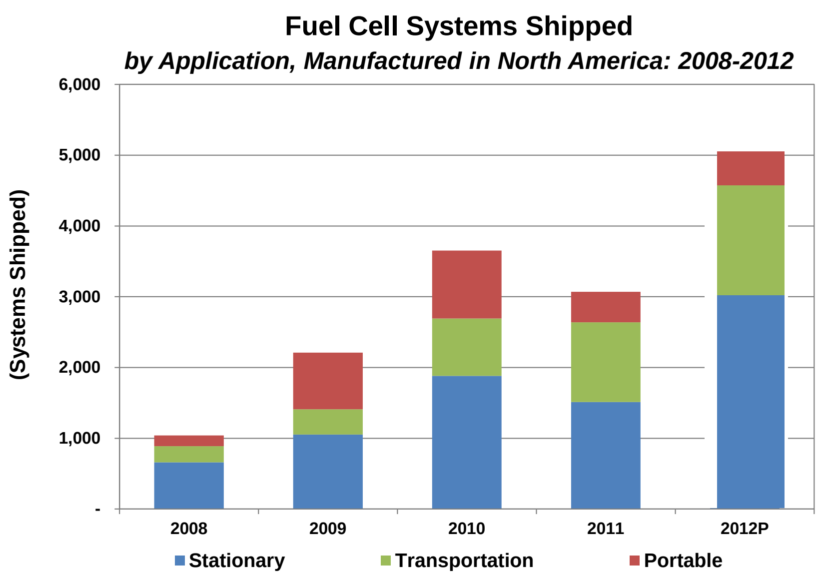
Top 10 companies for fuel cell patents: GM, Honda, Toyota, Samsung, UTC Power, Nissan, Ballard, Panasonic, Plug Power, Delphi Technologies

- **Clean Energy Patent Growth Index[1] shows growth in all clean energy technology patents**
- **More than 1,000 fuel cell patents issued in 2012**

[1] http://cepgi.typepad.com/heslin_rothenberg_farley_/2013/03/clean-energy-patent-growth-index-2011-year-in-review.html

Fuel Cell Market Overview





Source: Navigant Research

Market Growth

Fuel cell markets continue to grow

48% increase in global MWs shipped

62% increase in North American systems shipped in the last year

The Market Potential

Independent analyses show global markets could mature over the next 10–20 years, producing revenues of:

- **$14 – $31 billion/year for stationary power**
- **$11 billion/year for portable power**
- **$18 – $97 billion/year for transportation**

Several automakers have announced commercial FCEVs in the 2015-2017 timeframe.

For further details and sources see: *DOE Hydrogen and Fuel Cells Program Plan*, http://www.hydrogen.energy.gov/pdfs/program_plan2011.pdf; FuelCells 2000, Fuel Cell Today, Navigant Research

Hydrogen and Fuel Cells Program Overview

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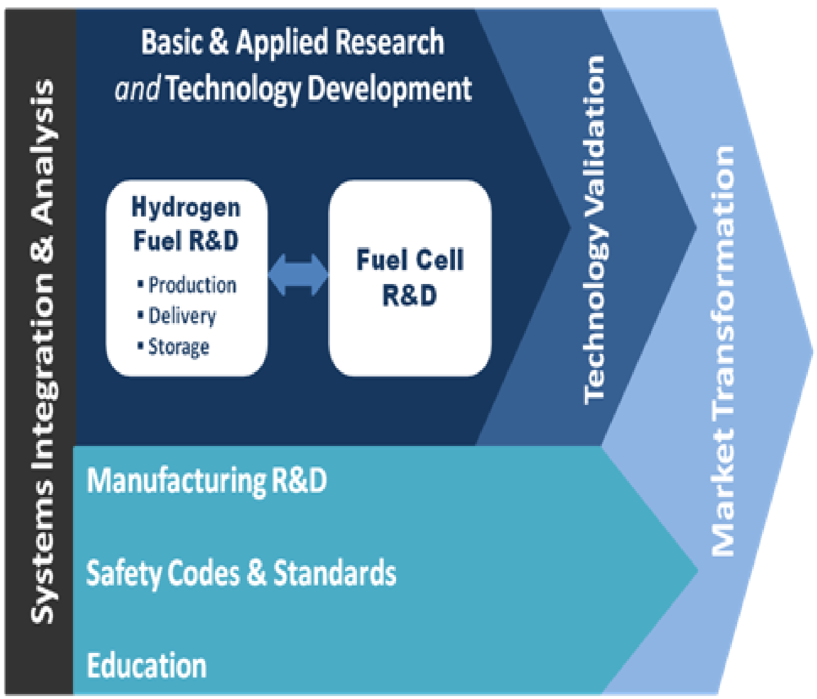
Mission: Enable widespread commercialization of a portfolio of hydrogen and fuel cell technologies through applied research, technology development and demonstration, and diverse efforts to overcome institutional and market challenges.

Key Goals : Develop hydrogen and fuel cell technologies for early markets (stationary power, lift trucks, portable power), mid-term markets (CHP, APUs, fleets and buses), and long-term markets (light duty vehicles).



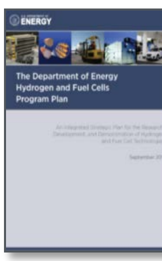
WIDESPREAD COMMERCIALIZATION ACROSS ALL SECTORS

- Transportation
- Stationary Power
- Auxiliary Power
- Backup Power
- Portable Power

Examples of Key Targets

- **Fuel Cells:**
  - **Transportation: $30/kW, 5K hours**
  - **Stationary: $1,500/kW, 60-80K hours**
- **Hydrogen: $2 to $4/gge**

DOE H_2 and Fuel Cell Program includes: EERE (Fuel Cell Technologies Office), and DOE Offices of Science, Fossil Energy and Nuclear Energy



EERE Multi-year RD&D Plan updated

Nearly 300 projects currently funded at companies, national labs, and universities/institutes

Program Plan at: http://www.hydrogen.energy.gov/pdfs/program_plan2011.pdf

Basic research conducted thru Office of Science; Applied RD&D conducted through EERE, FE, NE

Fuel Cells

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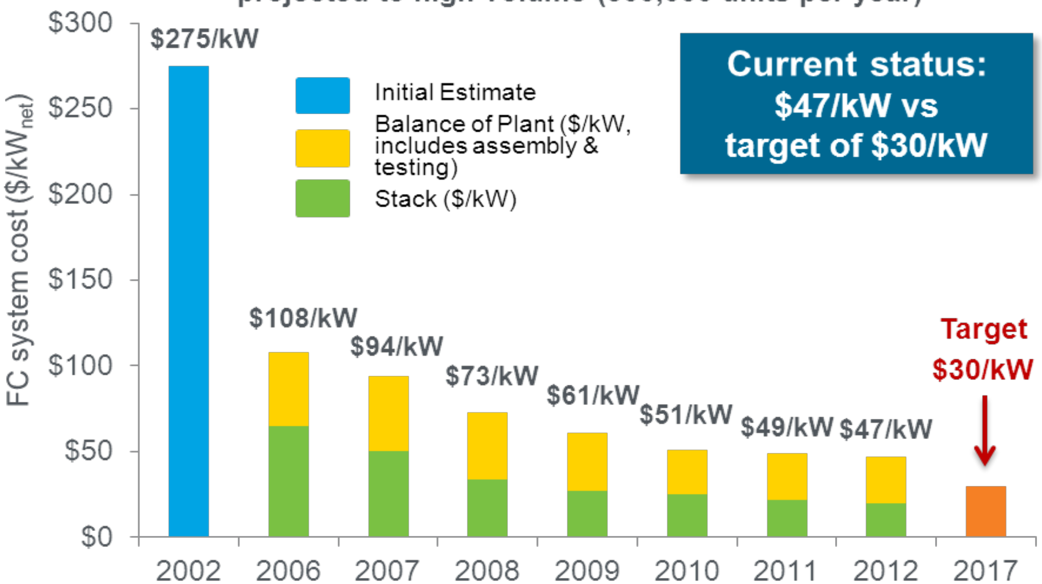
Reduced high-volume cost of automotive fuel cells to $47/kW (2012)*

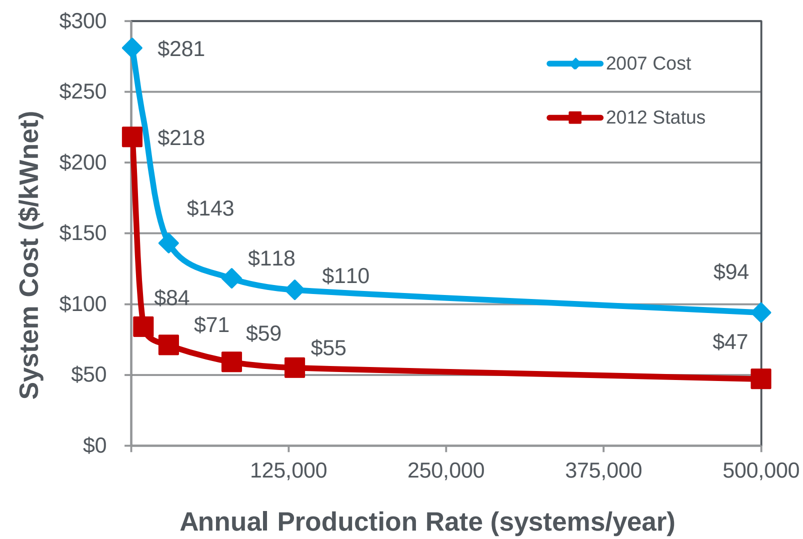
More than 35% reduction since 2008, more than 80% reduction since 2002

Projected Transportation Fuel Cell System Cost

-projected to high-volume (500,000 units per year)-



Projected Costs at Different Manufacturing Rates

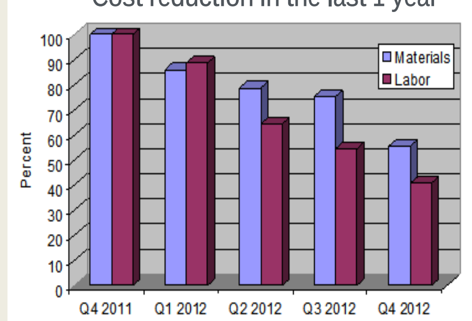


**Based on state-of-the-art lab scale technology projection to high-volume manufacturing (500,000 units/year).- Strategic Analysis*

Solid oxide fuel cell (kW-scale) R&D led to 75% weight reduction and >80% volume reduction since 2004.

Reduced cost of SOFCs 5X since 2004.

Cost reduction in the last 1 year



Systems have demonstrated over 300,000 hours

Acumentrics

Fuel Cells

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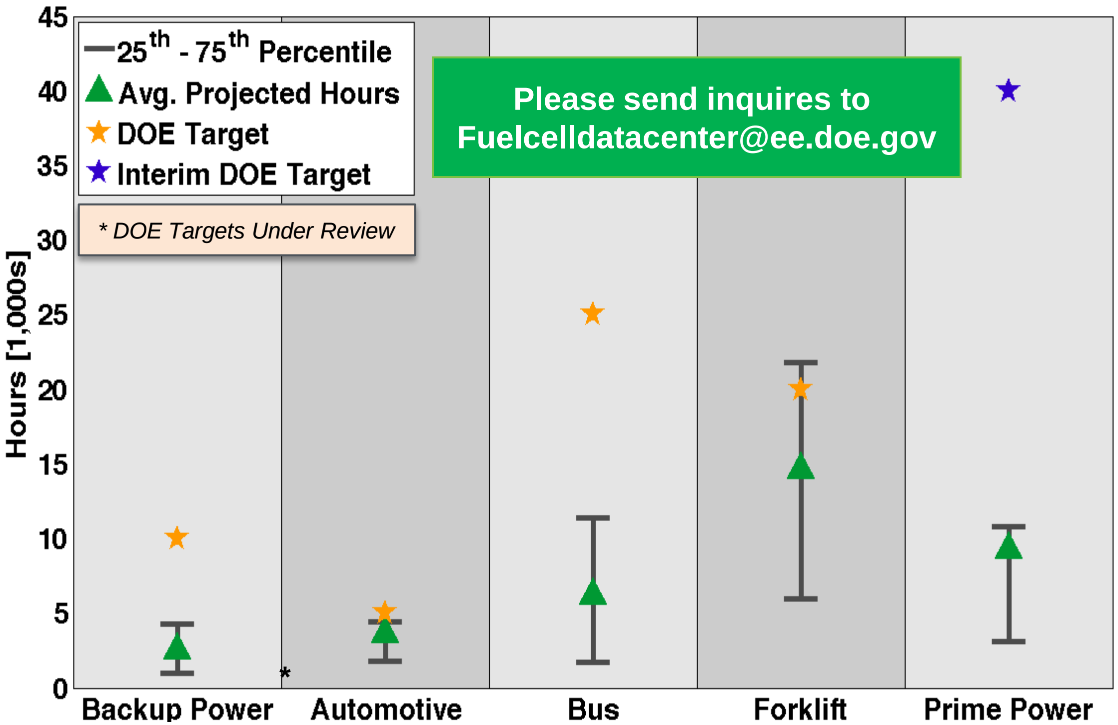
NREL- aggregated **state-of-the-art** fuel cell durability



Application	Avg Projected Time to 10% Voltage Drop	Avg Operation Hours
Backup Power	2,500	1,100
Automotive	3,600	2,200
Bus	6,200	3,800
Forklift	14,600	4,400
Prime Power	9,300	5,600

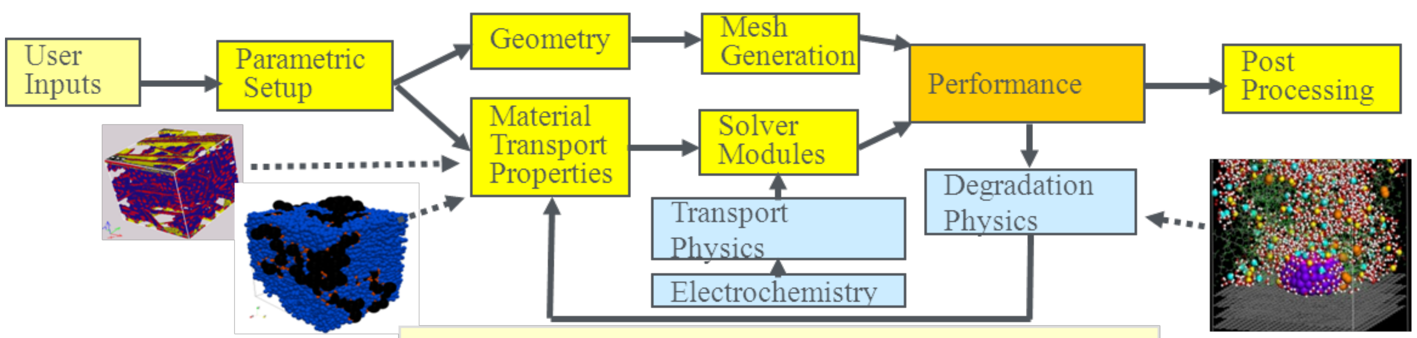
Accomplishments

- **Reduced g_{PGM}/kW for NSTF MEA from 0.20 in 2012 to 0.16 in 2013 (3M)**
- **100% increase in specific activity of PtNi thin films catalysts vs.NSTF (ANL)**

RFI on Best Practices in Catalyst Activity Measurements*

*Rotating Disk Electrode

Developed PEM fuel cell performance & durability model for public access. Can be used to assess performance and life
-Ballard



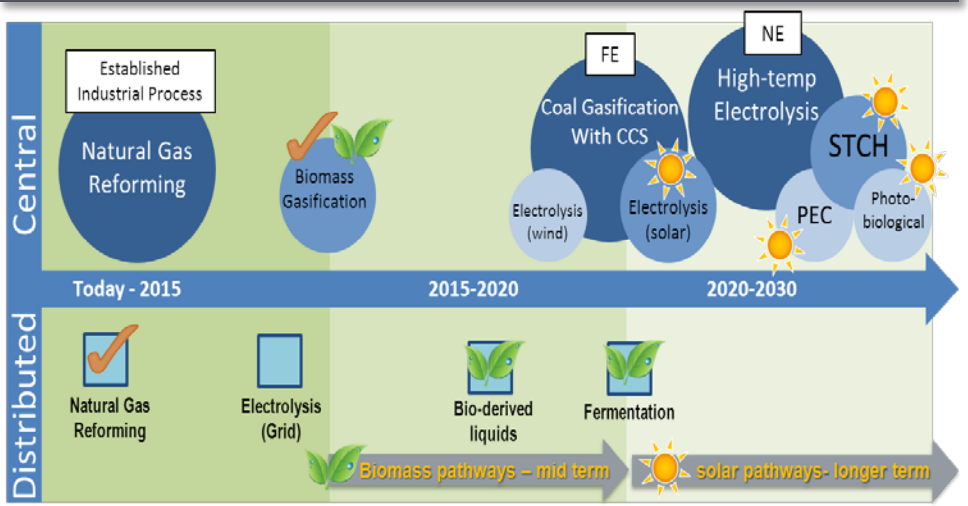
Open-source FC-PEM Package

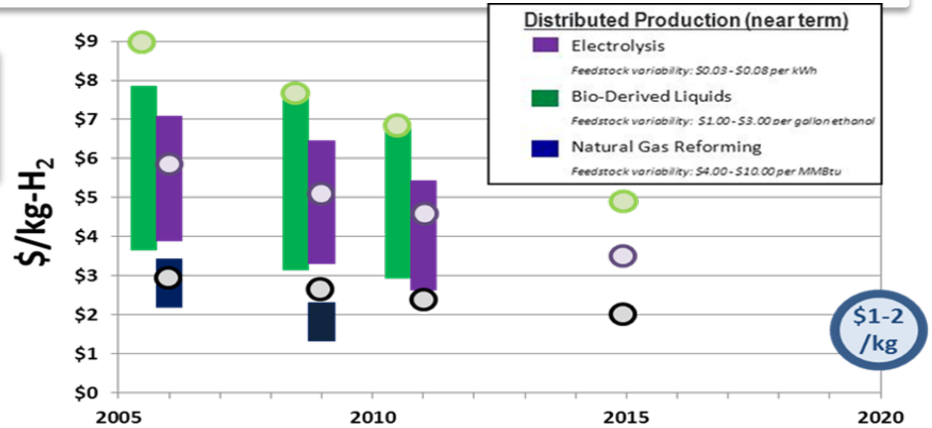
Hydrogen Production

Accomplishments

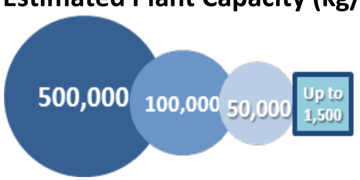
- **>550% return on investment ($48M in direct revenues) from electroylzer products**
- **Reduced stack costs by >60% to less than $400/kW since 2007 (Proton OnSite,Giner)**
- **9-fold increase in yield with novel perovsikite materials for solar thermochemical H_2 production compared to prior metal oxide material (Sandia)**
- **2 membrane separation projects selected for scale up (from 2 to up to 50 lbs/day (FE)**

- >**9M metric tons** of H_2 produced per year
- >**1,200 miles** of H_2 pipelines in use (CA, TX, LA, IL, IN)





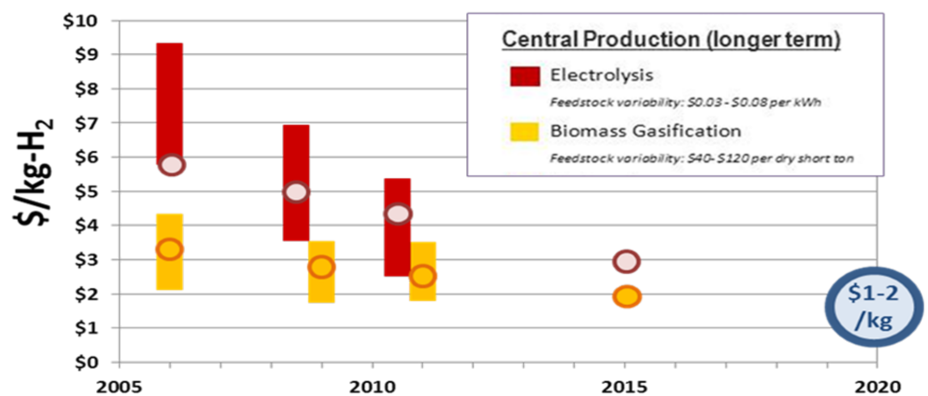
Estimated Plant Capacity (kg/day)



✓ P&D Subprogram R&D efforts successfully concluded

FE = *R&D efforts in DOE Office of Fossil Energy*

NE = *R&D efforts in DOE Office of Nuclear Energy*



http://www.hydrogen.energy.gov/pdfs/12002_h2_prod_status_cost_plots.pdf

Opportunities with low cost natural gas

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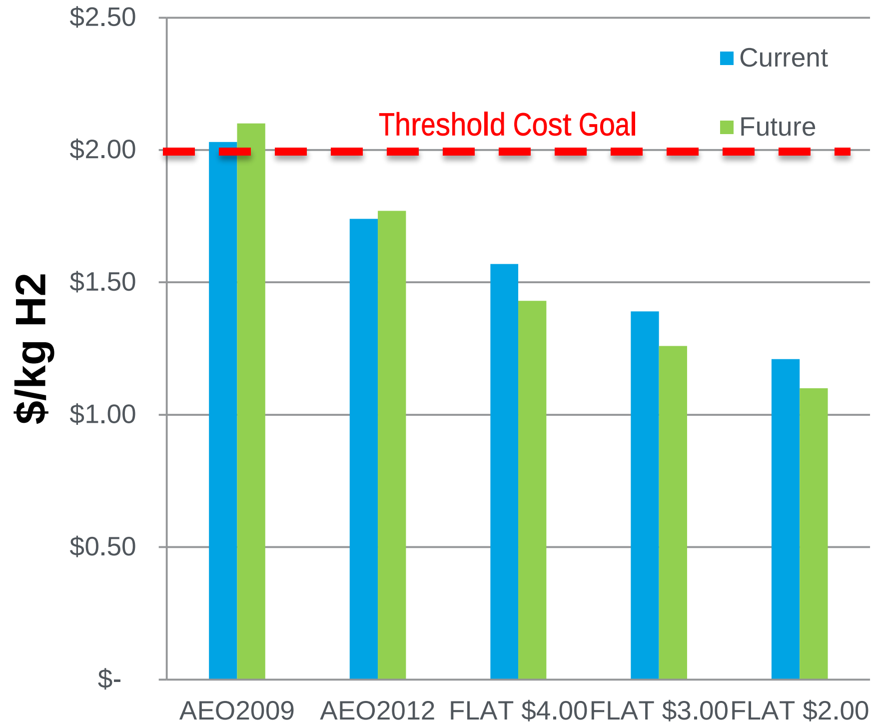
Hydrogen Production from Natural Gas: Bridge to longer-term, low-carbon pathways

- Options: Central production (high P tube trailer delivery can reduce cost of compression at station) or distributed production
- Cost of H_2 production at high volumes can be competitive with gasoline
- Cost goals can be met by a wide range of NG prices

$/kg H_2 (produced & untaxed, today's technology) for Varying Natural Gas Prices



Natural gas price basis($/MMbtu)

Existing Hydrogen Production Facilities

http://hydrogen.energy.gov/pdfs/12024_h2_production_cost_natural_gas.pdf

Excludes compression, dispensing, storage; Based on H2A v3 Case Studies @ http://www.hydrogen.energy.gov/h2a_production.html AEO2009 avg NG prices (HHV, $/MMbtu): $7.10 (Current, 2010-2030); $8.44 (Future, 2020-2040)

AEO2012 avg NG prices (HHV, $/MMBtu): $5.28 (Current, 2010-2030); $6.48 (Future, 2020-2040)

Well-to-Wheels GHG Emissions Updates

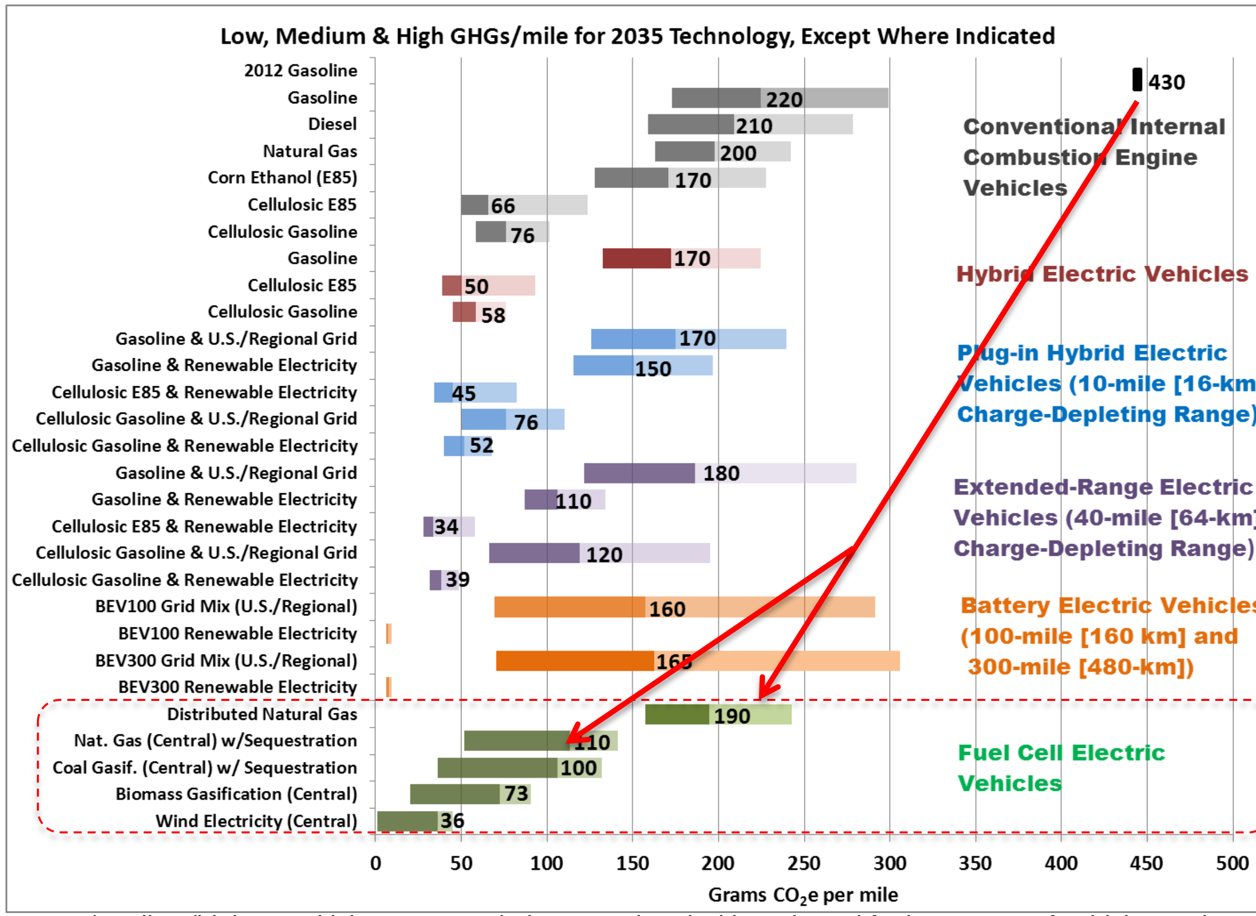
U.S. DEPARTMENT OF ENERGY

Analysis by Argonne National Lab, National Renewable Energy Lab, DOE Vehicle Technologies Office, DOE Bioenergy Technologies Office and DOE Fuel Cell Technologies Office shows benefits from a portfolio of options

- **Updated, peer-reviewed analysis (EERE multi-Office coordination)**
- **Hydrogen from natural gas can reduce GHG emissions by >50% (significantly less if centrally produced and with carbon capture)**

Well-to-Wheels Greenhouse Gases Emissions for 2035 Mid-Size Car

(Grams of CO2-equivalent per mile)



Low/medium/high: sensitivity to uncertainties associated with projected fuel economy of vehicles and selected attributes of fuels pathways, e.g., electricity credit for biofuels, electric generation mix, etc.

See reference for details: http://hydrogen.energy.gov/pdfs/13005_well_to_wheels_ghg_oil_ldvs.pdf

Hydrogen Delivery

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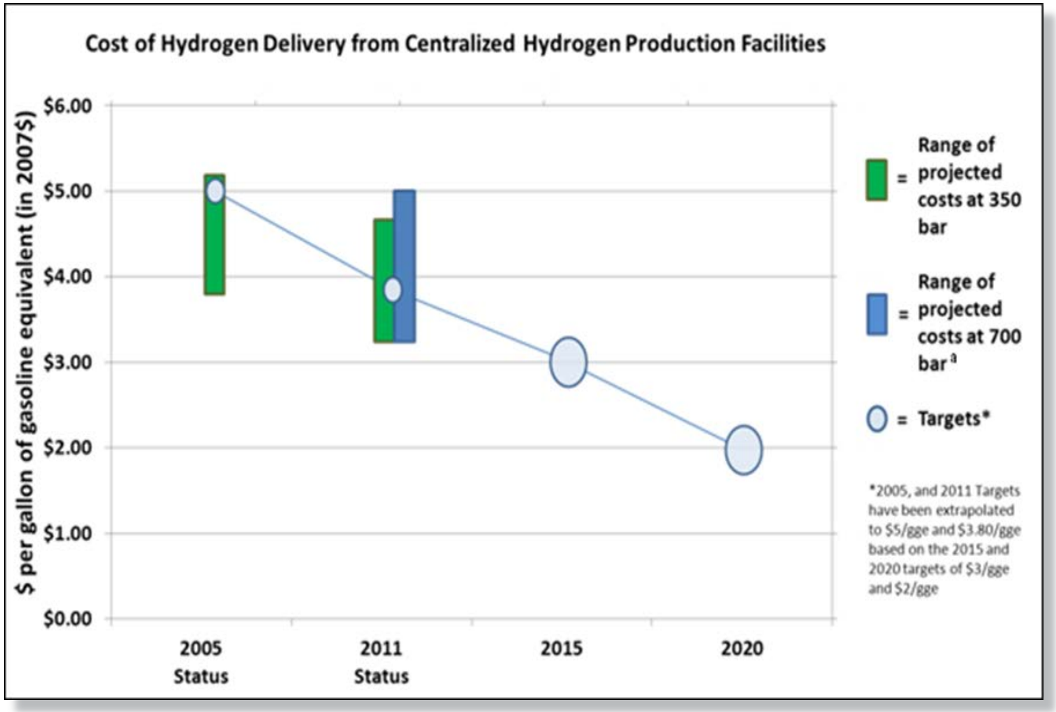
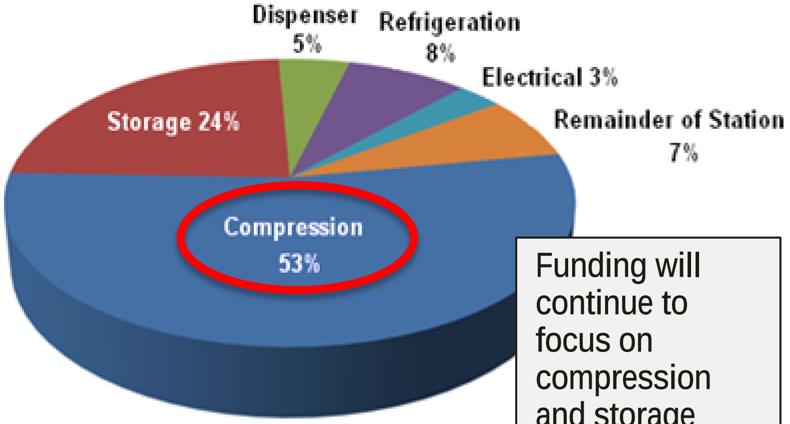


*Based on 2011 advances projected to high volume

Three methods for hydrogen delivery:

- Tube trailer transport (near-term)
- Liquid tanker transport (near-mid term)
- Pipeline transport (mid-long term)



Funding will continue to focus on compression and storage

Delivery Costs

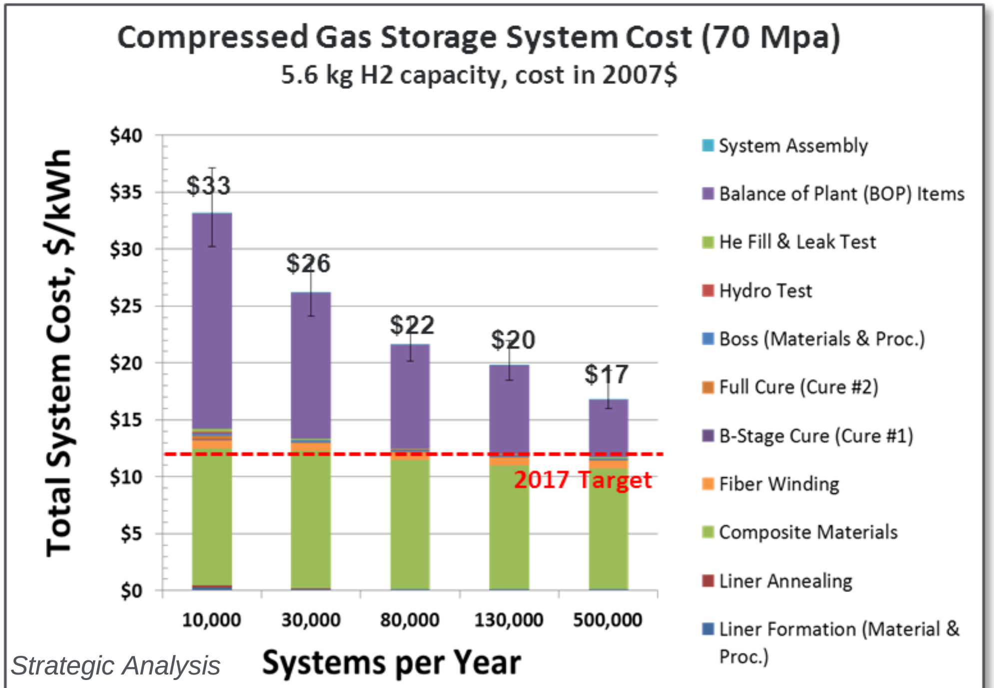
Accomplishments:

- Reduced forecourt delivery costs >40% since 2011
- >50% decrease in parts count and ~10X increase in current density for electrochemical compression since 2007(FCE)

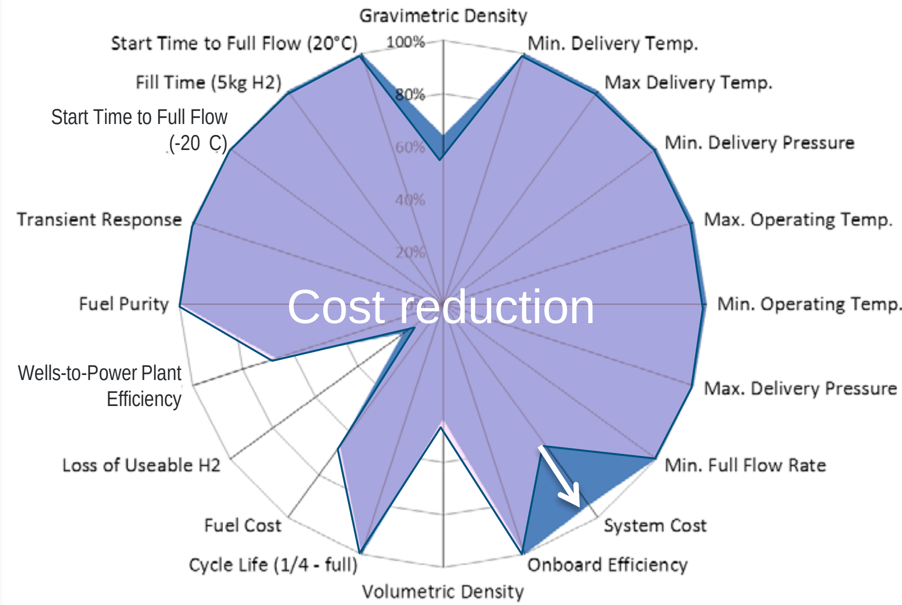
Held Compression Storage Dispensing (CSD) Workshop to Identify:

- Materials Research
- Station Optimization Analysis
- Metering, Quality & Performance Testing for Dispensing
- Data for codes and standards development

Hydrogen Storage

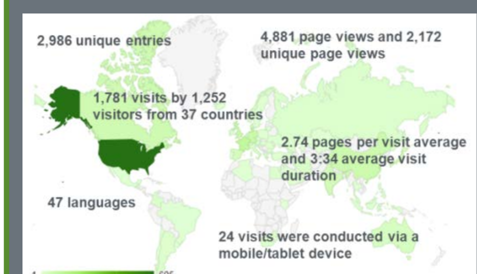


Cost Reduction for Hydrogen Adsorption Systems



Accomplishments: 3X increase in tensile strength demonstrated in C-fiber from melt-spun PAN precursor (ORNL)

- Projected ~30% cost reduction through lower pressure operation, avoiding C-fiber tanks (HSECoE)



Launched open source database* on Hydrogen Storage Materials Properties

(http://hydrogenmaterialssearch.govtools.us/)

* Included in President's Materials Genome Initiative, http://www.whitehouse.gov/mgi

Recommended Best Practices for the Characterization of Engineering Properties of Hydrogen Storage Materials

http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/best_practices_hydrogen_storage.pdf

New Clean Energy Manufacturing Initiative (CEMI) launched across EERE to increase American competitiveness in clean energy manufacturing.

- David Danielson visit to CT for CEMI CEO/CTO Roundtable and Fuel Cell Site Visits
- CEMI Regional Summit in OH – June 2013

Accomplishments

- Reduced total GDE labor costs ~75%
- Achieved 4-fold increase in throughput (exceeded goal of 3x)
- Shipped >60,000 membranes since 2009 including next generation Celtec® P1100W MEAs, released in 2012 and developed with support from FCTO.
  - Transitioned to "six sigma" product

BASF

Launched Hydrogen and Fuel Cells Technical Advisory Committee (HTAC) Manufacturing Subcommittee

Future Plans:

Collaboration with EERE Advanced Manufacturing Office

Technology Validation & Market Transformation

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Validated >500 fuel cell forklifts

Accomplishments:

>1.4M hours of operation

~250,000 hydrogen fills

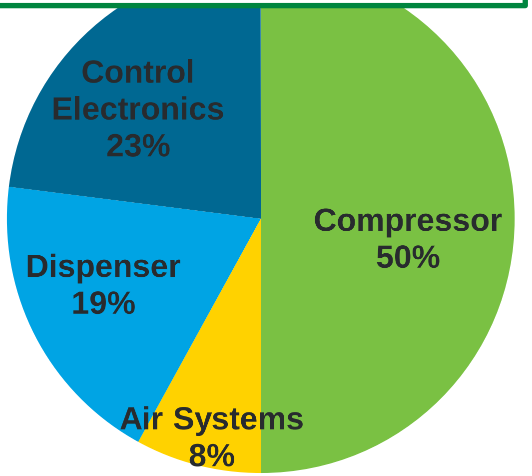
>185,000 kg hydrogen dispensed

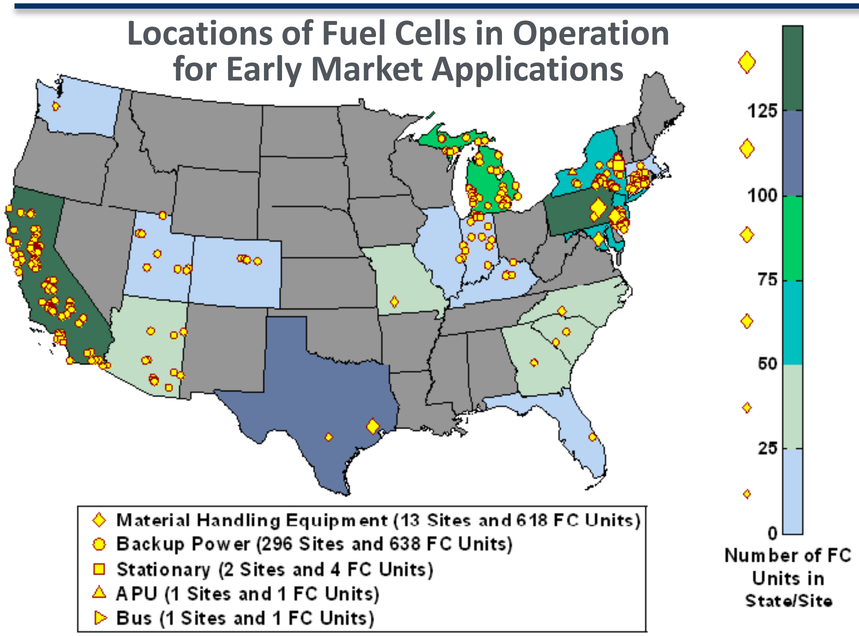
Average forklift fill of 0.6 kg in 2.3 minutes

Delivered H_2 Maintenance Count by Category
1,058 Maintenance Events, 64% unscheduled

Infrastructure consistently delivering H2 with a MTBF of 25 days or less.

Identifying areas for further effort: e.g. ~500 are compressor failures.





Exceeded DOE goal of 1,000 operating hours for back up power

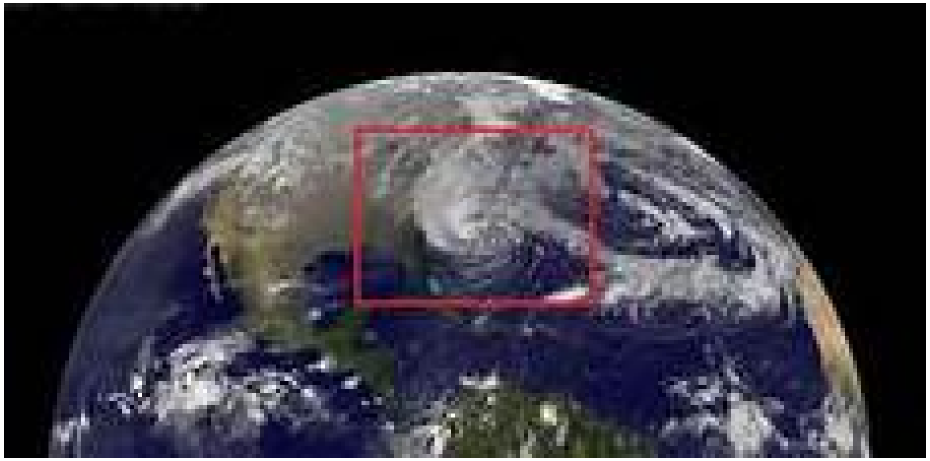
Successful operation of units in 19 states

- >800 systems in operation
- 1.86 MW installed capacity
- 99.6% successful starts

Fuel Cells for Resiliency

Hurricane Sandy was the largest Atlantic hurricane on record.

Winds spanning more than 1,100 miles



More than $60 billion in damages

- Cellphone outages reported in more than 150 counties from VA to MA
- 25% of cell towers in 10-state area stopped operating
- 8.5 million power outages reported across 21 states

NREL CDP_BU_15
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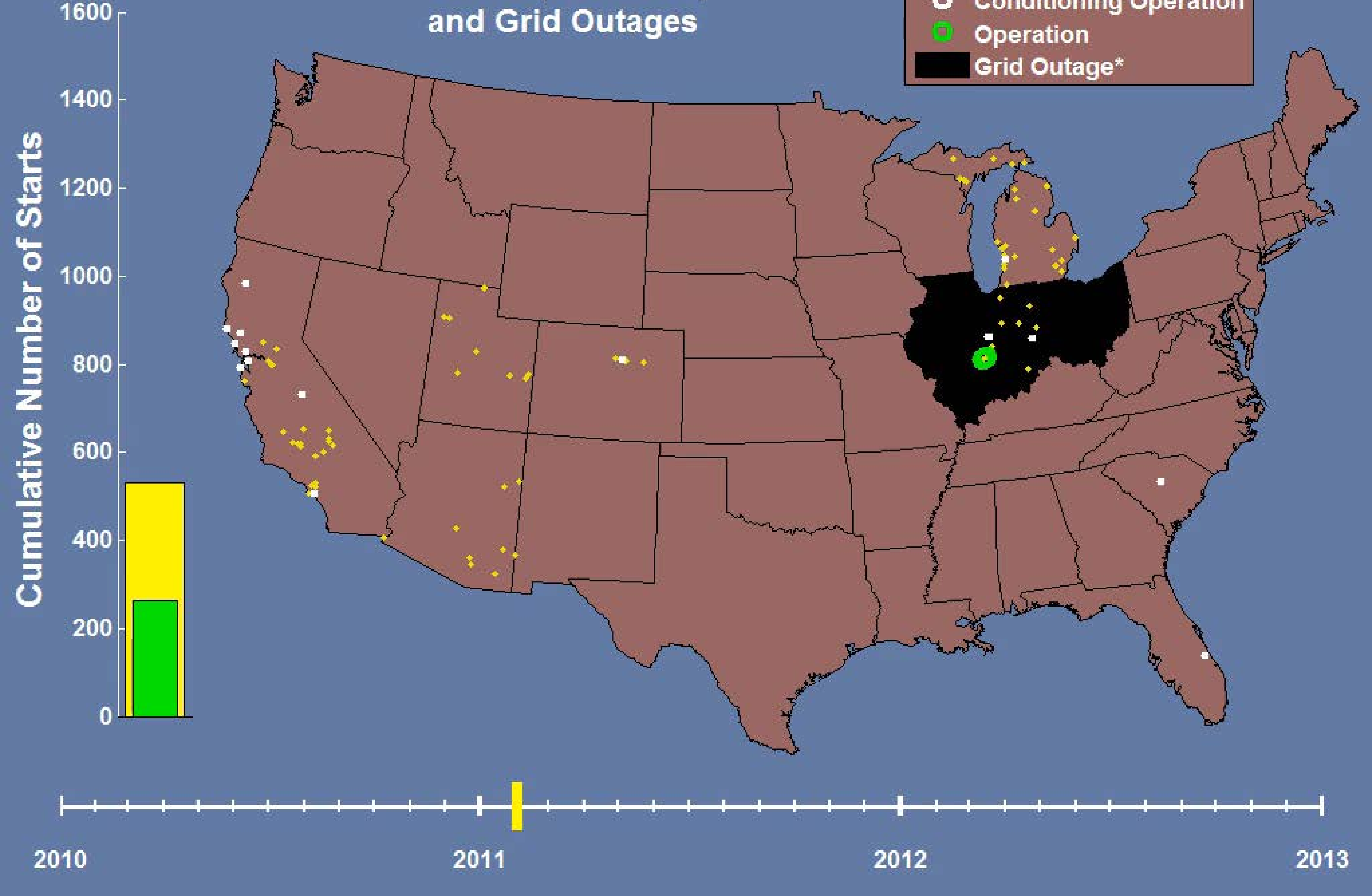
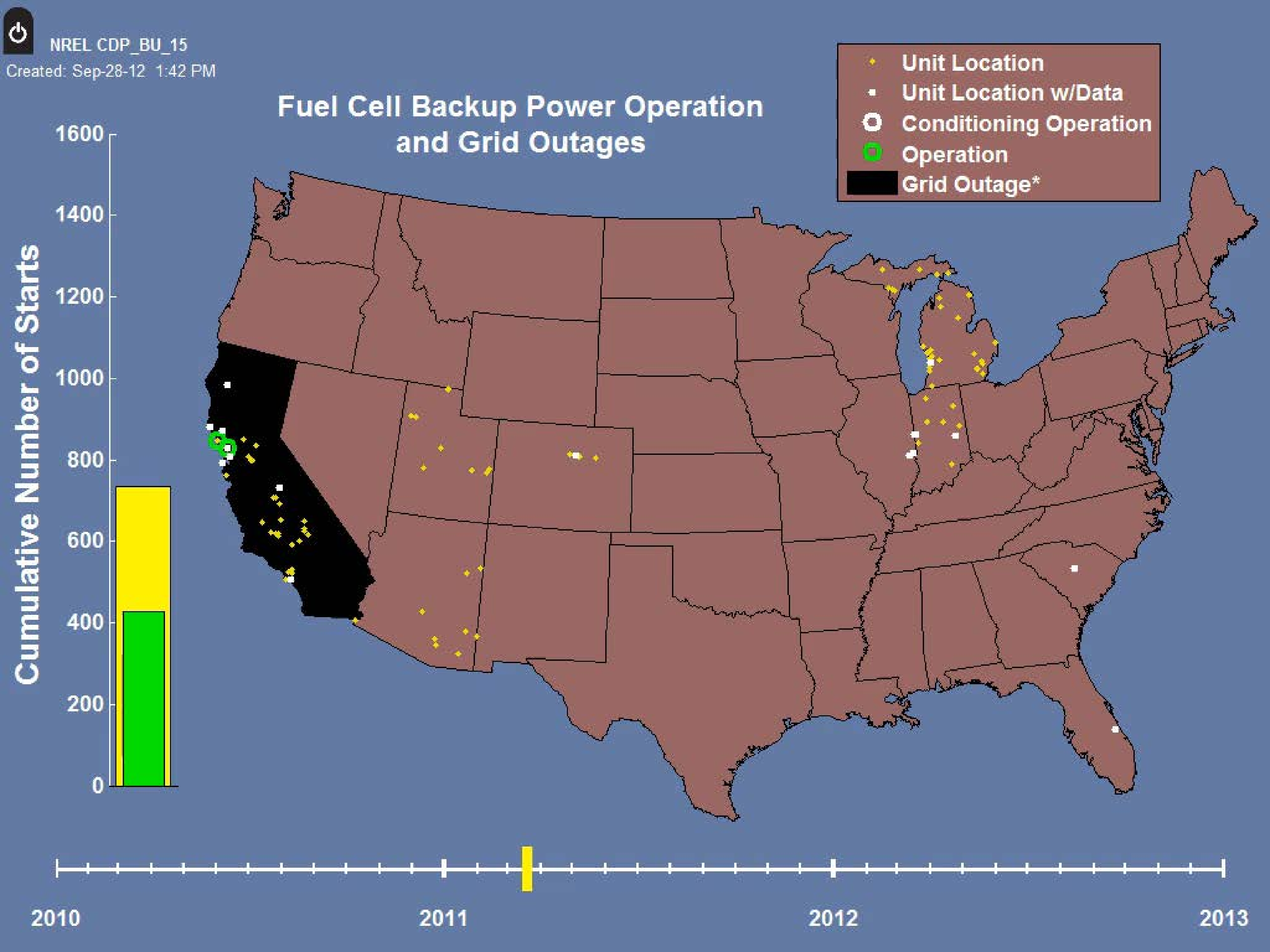
Fuel Cell Backup Power Operation and Grid Outages





NREL CDP_BU_15
Created: Sep-28-12 1:42 PM
Fuel Cell Backup Power Operation and Grid Outages
Unit Location
Unit Location w/Data
Conditioning Operation
Operation
Grid Outage*
Cumulative Number of Starts
1600
1400
1200
1000
800
600
400
200
0
2010
2011
2012
2013

NREL CDP_BU_15
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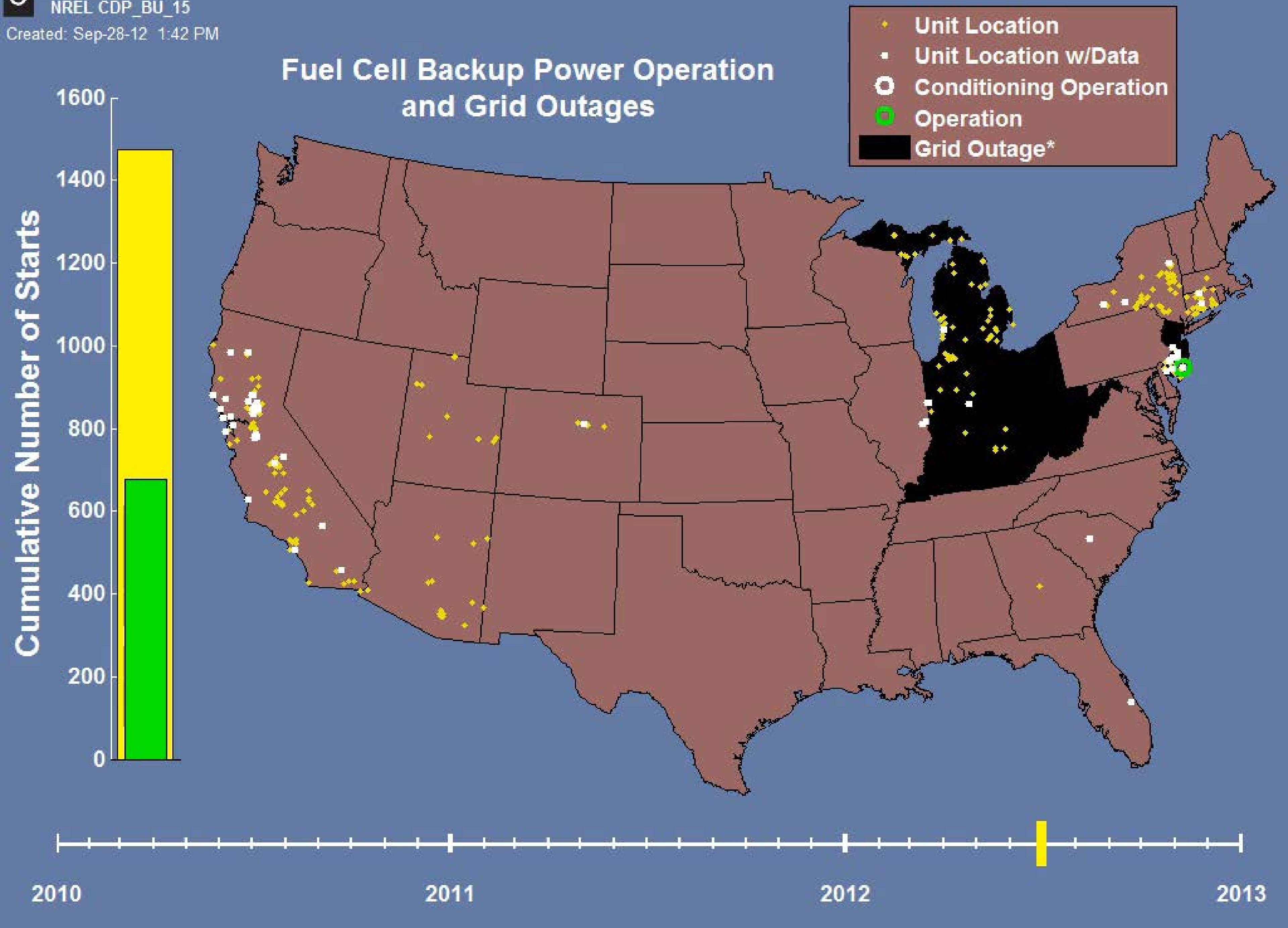
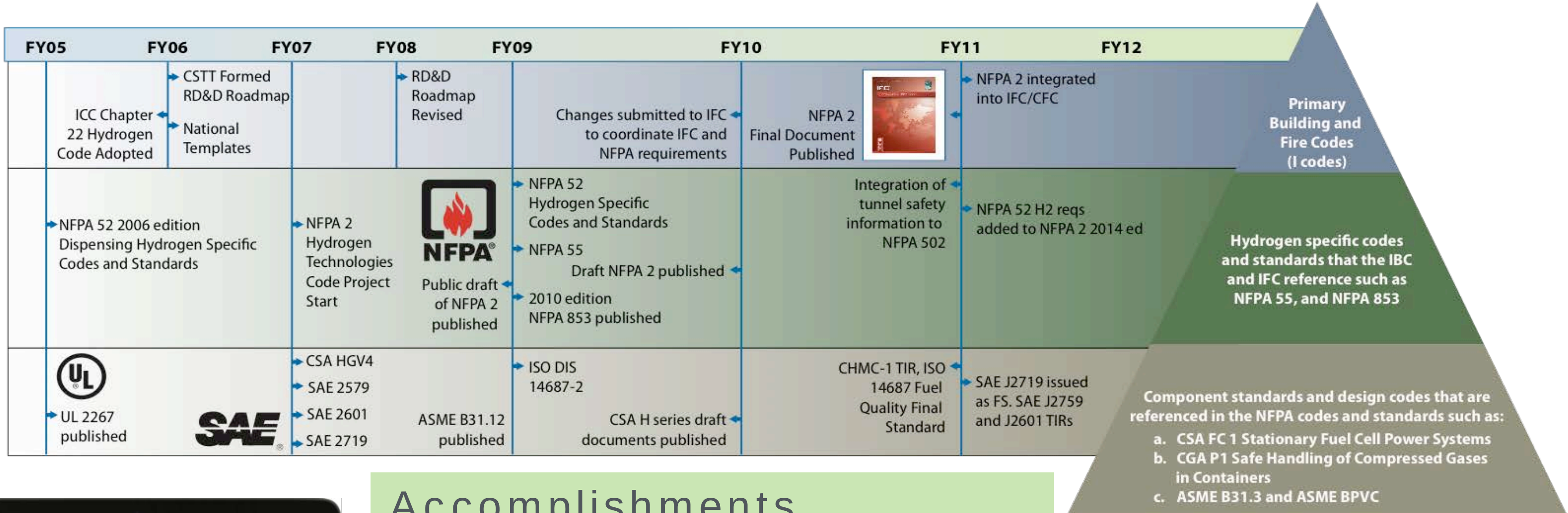
Fuel Cell Backup Power Operation and Grid Outages



Safety, Codes & Standards

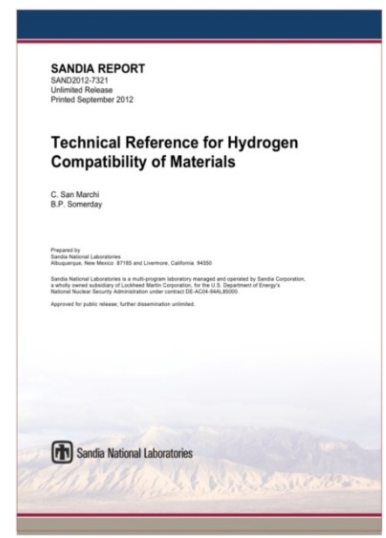


Accomplishments

First mobile app developed to accelerate H_2 and fuel cell deployments (PNNL)

- Integrates H_2incidents.org and H_2bestpractices.org into a single, searchable iPad and iPhone app

- Full acceptance of the **Global Technical Regulation** for June 2013.
- **SAE J2579** published March 2013
- Developed material & **trained > 26,000 code officials and first responders**



Information placed on OpenEI website: http://en.openei.org/wiki/Gateway:Hydrogen

Systems Analysis

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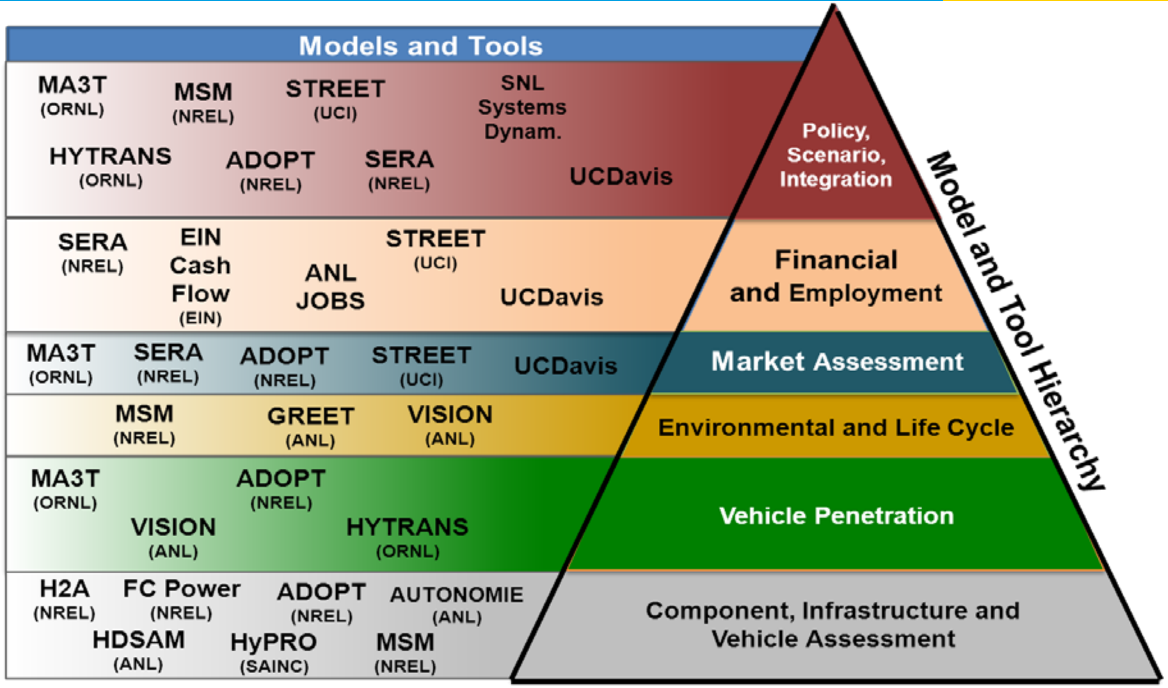


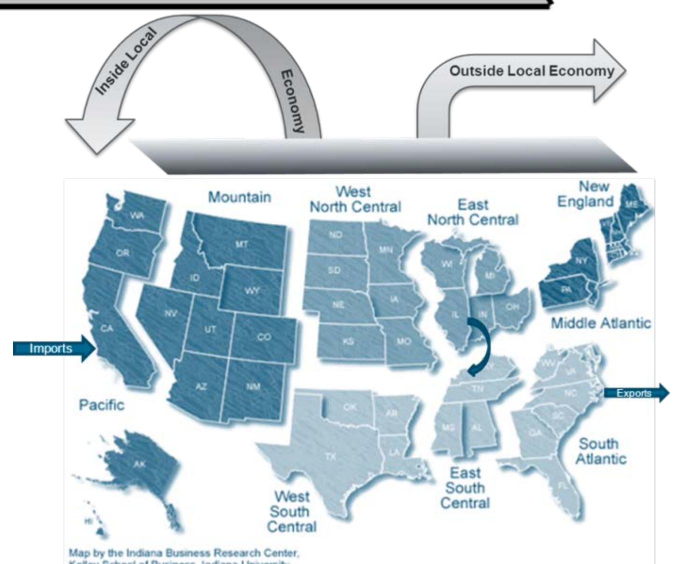
Comprehensive suite of models and tools to addresses needs and helps guide the Program, providing critical direction and focus for RD&D

Key Focus:

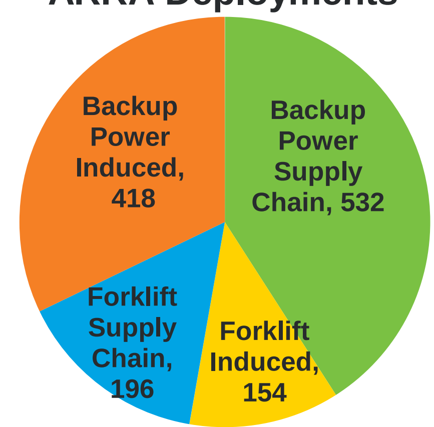
Infrastructure Analysis

JOBS FC model estimated ~1,300 job-years created/ retained as a result of Recovery Act funding in fuel cells (ANL)

http://jobsfc.es.anl.gov/main



Domestic Employment from ARRA Deployments



Assessing the Impact of DOE Funding

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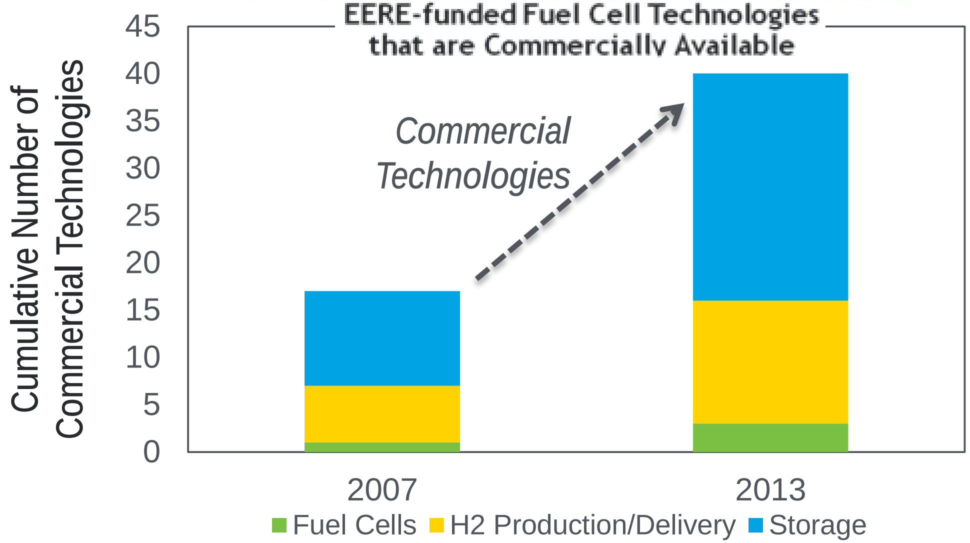
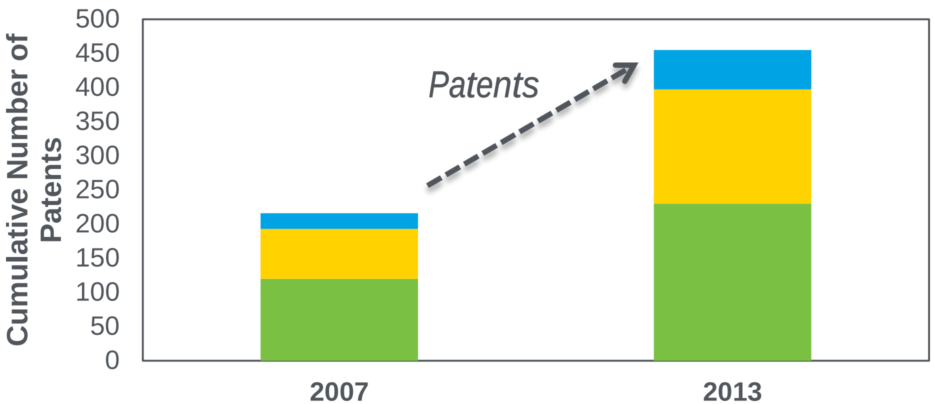
DOE funding has led to 40 commercial hydrogen and fuel cell technologies and 65 emerging technologies.

Accelerating Commercialization

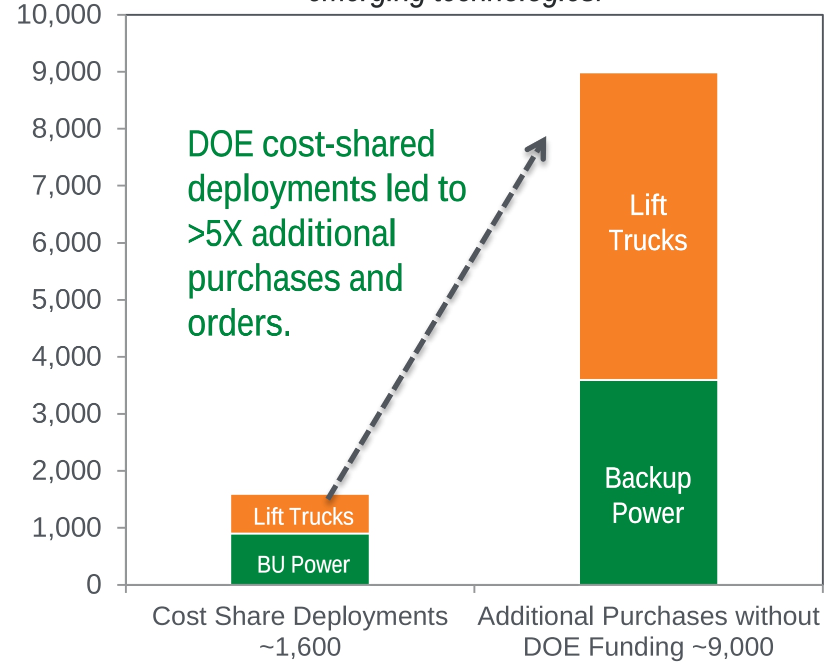


Source: Pacific Northwest National Laboratory
http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/pathways_success_hfcit.pdf



Leveraging DOE Funds:

Government as "catalyst" for market success of emerging technologies.



More than 450 PATENTS resulting from EERE-funded R&D:

- *Includes technologies for hydrogen production and delivery, hydrogen storage, and fuel cells*

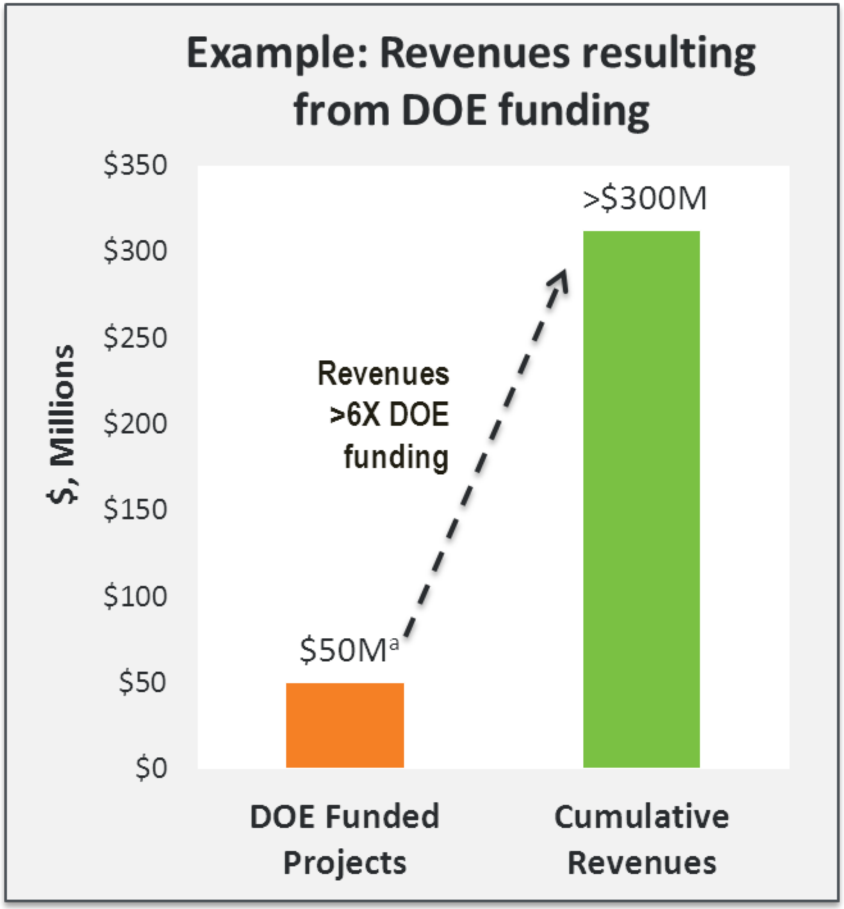
http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/pathways_2013.pdf

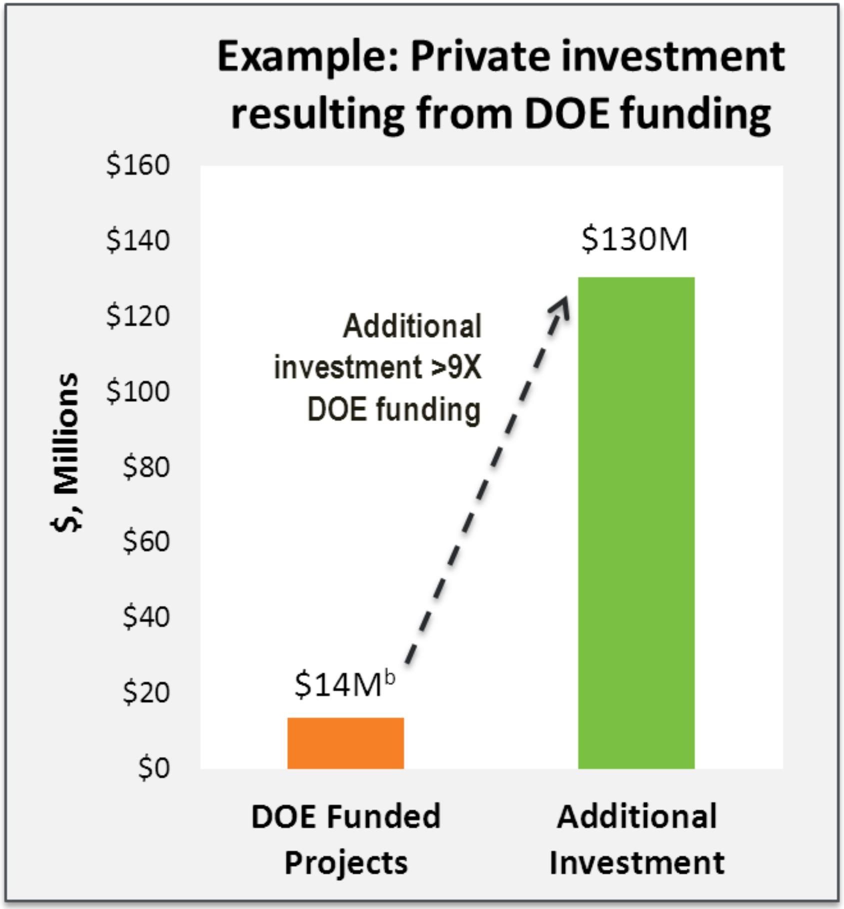
Assessing the Impact of DOE Funding

U.S. DEPARTMENT OF ENERGY

For selected projects tracked, DOE EERE funding has led to:

- Revenues valued at >6 times the DOE investment
- Additional private investment valued at >9 times the DOE investment





[a]DOE's $50M is linked to selected projects with ~$310M in revenues..

[b]DOE's $14M is linked to selected projects w/$130M additional industry investment

Budget: FCT Program Key Activities

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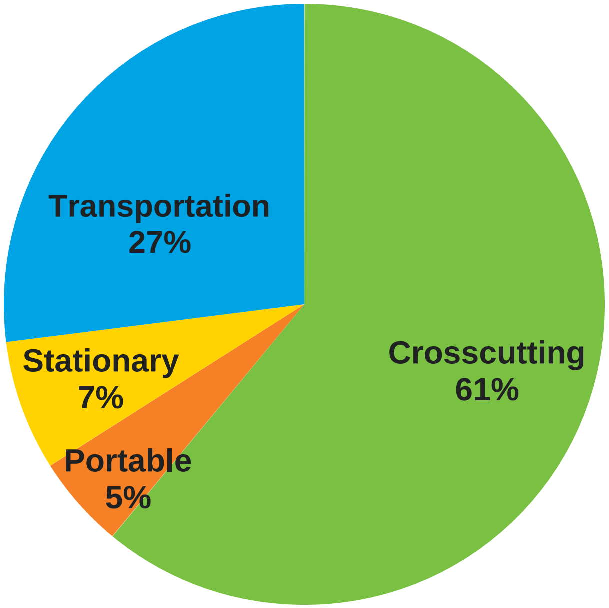
Funding *($ in thousands)*			
Key Activity	**FY 2013 Request**	**FY 2013 Planned**	**FY 2014 Request**
Fuel Cell R&D	38,000	42,400	37,500
Hydrogen Fuel R&D	27,000	33,000	38,500
Manufacturing R&D	2,000	1,900	4,000
Technology Validation	5,000	8,500	6,000
Safety, Codes and Standards	5,000	6,600	7,000
Market Transformation	0	2,800	3,000
Education	0	0	0
Systems Analysis	3,000	2,800	3,000
NREL Site-Wide Facilities Support	0	0	1,000
Total	**$80,000**	**$98,000**	**$100,000**

*Funds for the SBIR/STTR programs for FY 2013 and FY 2014 will be subtracted at later date.

Note: The FY 2012 and FY 2013 numbers shown on page 384 of the White House's FY 2014 Budget Request (www.whitehouse.gov/sites/default/files/omb/budget/fy2014/assets/doe.pdf) reflect $9.7 million that was carried over from FY 2012 to FY 2013 for obligation in FY 2013.

Future Directions:
Continue to focus on critical RD&D
Increase focus on low-carbon hydrogen pathways

Fuel Cell R&D Funding by Application (FY13 plan)



Future Directions

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Funding Opportunity Announcements (FOAs)	Funding Planned
Production & Delivery (FY14)	~$6M
Hydrogen Storage (FY14)	~$6M
Technology Validation and Market Transformation (FY13 & FY14)	~$6.5M
Manufacturing R&D (FY14)	~$3M

Notice of Intent Issued- May 2013

Technology Validation & Market Transformation

- **Demonstration & Deployment of Fuel Cell Hybrid-Electric Medium-Duty Trucks**
- **Validation of Advanced Hydrogen Refueling Components**
- **Demonstration and Case Study for Roof-top Installation of Hydrogen Fuel Cell Backup Power Systems**
- **Hydrogen Meter R&D**

Requests for Information

- RFI on Home Hydrogen Refueling Systems and Potential H-Prize Topics Issued (https://eere-exchange.energy.gov/default.aspx#FoaId2e67f6df-fd51-4da2-953c-ab515231abb0)
- Additional RFIs see: https://eere-exchange.energy.gov/

Future Directions- Global Partnerships

U.S. DEPARTMENT OF ENERGY

International Partnership for Hydrogen and Fuel Cells in the Economy

Japan - Chair 2013-2015
Germany and U.S. - Vice Chairs

- ***Representatives from 17 member countries & the European Commission***
- **Facilitates international collaboration on RD&D and education**
- **Provides a forum for advancing policies and common codes and standards**

Examples of Activities:

- Published a brochure on the status of research and commercialization of H_2 and FCs.
- IPHE Infrastructure Workshop
- Published Demonstration and Deployment Map

Website: http:www.iphe.net

International Energy Agency – Implementing Agreements

Advanced Fuel Cells Implementing Agreement: 19 member countries currently implementing six annexes

Hydrogen Implementing Agreement: 21 member countries, plus the European Commission currently implementing nine tasks

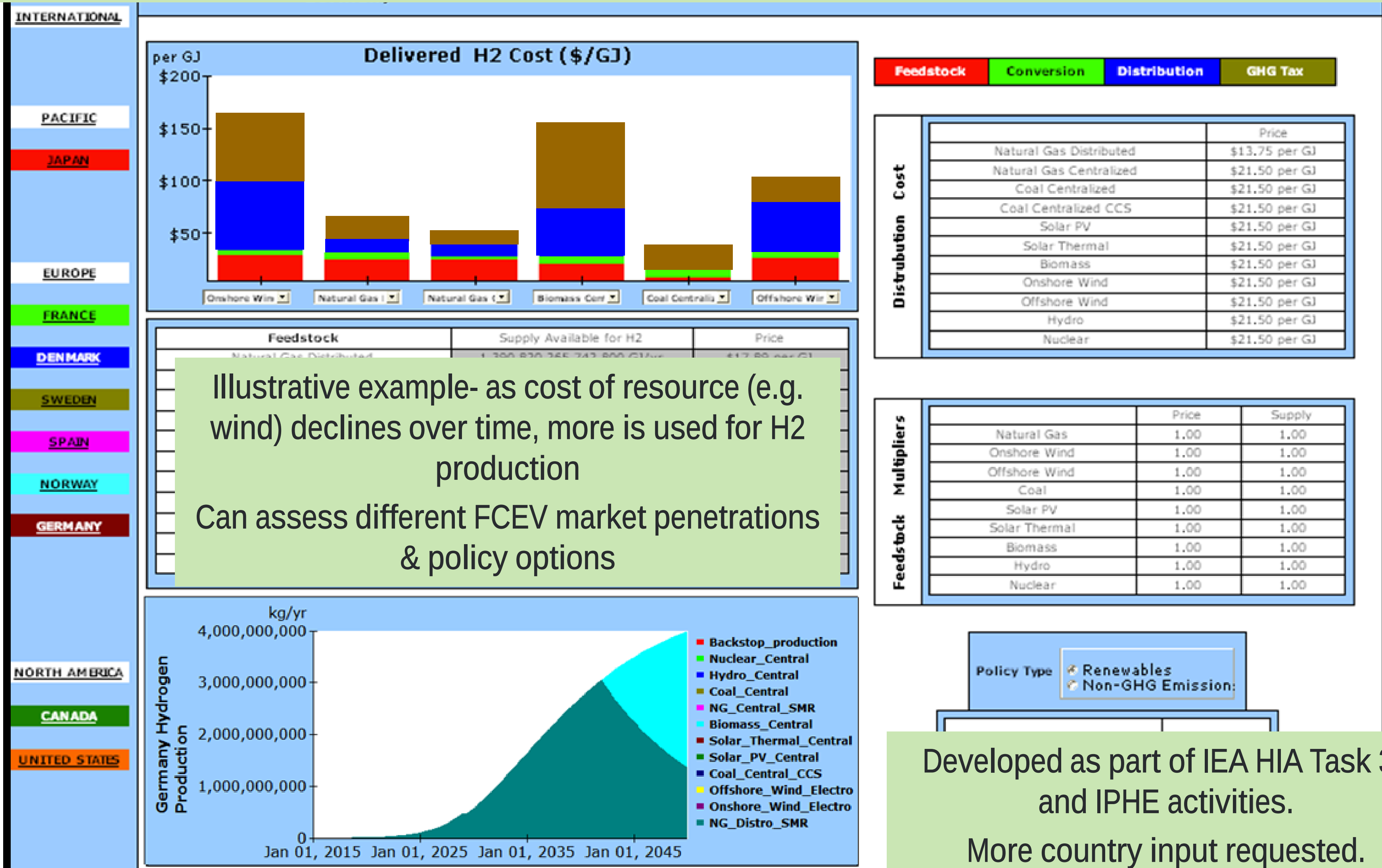
Future Areas of Collaboration:

- ***Safety Information Sharing***
- ***Data Collection***
- ***H_2 Resource Availability***

Global Hydrogen Resource Analysis Tool

U.S. DEPARTMENT OF ENERGY

Tool developed by Sandia to assess resource options for hydrogen in different countries



Illustrative example- as cost of resource (e.g. wind) declines over time, more is used for H2 production

Can assess different FCEV market penetrations & policy options

Developed as part of IEA HIA Task 30 and IPHE activities.

More country input requested.

Future Directions- Energy Systems Integration Facility (ESIF)

U.S. DEPARTMENT OF ENERGY

Future directions include increased cross-cutting activities and collaboration such as through DOE's new national asset for energy systems integration research, development, and testing

www.nrel.gov/esif

Energy Systems Integration Facility (ESIF)

U.S. DEPARTMENT OF ENERGY

DOE's new national asset for energy systems integration research, development, and testing

www.nrel.gov/esif

Communication & Outreach

Published more than 70 news articles this year (including blogs, progress alerts, DOE news alerts)

- ***Monthly Webinar Series***
  - Jobs Tool
  - Register at - http://www1.eere.energy.gov/hydrogenandfuelcells/webinars.html
- ***News Items***
- Energy Department Announces up to $2.5 Million to Deploy Fuel Cell Powered Baggage Vehicles at Commercial Airports (April 25, 2012)
- ***Monthly Newsletter***
- Visit the web site to register or to see archives (http://www1.eere.energy.gov/hydrogenandfuelcells/newsletter.html)


U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Fuel Cell Technologies Program

January 2012 Newsletter

Welcome to the inaugural issue of the Fuel Cell Technologies Program newsletter. This newsletter will be issued monthly to our Fuel Cell News subscribers and will include a recap of the previous month's news and events as well as a preview of upcoming activities.

In this issue:

- In the News
- Funding Opportunities
- Recent Blogs
- Webinars and Workshops
- Events Calendar
- Studies, Reports, and Publications

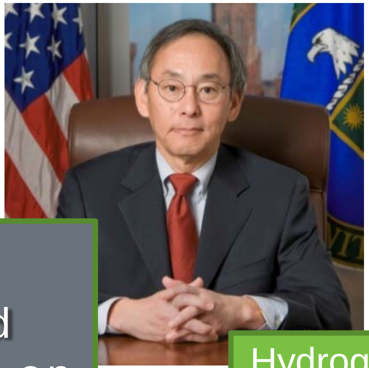
In the News

Strong Participation in Stakeholder Outreach in 2012-2013- Examples:

- Senate H_2 and Fuel Cells Caucus
  - **Blumenthal (D-CT)**
  - **Coons (D-DE)**
  - **Graham (R-SC)**
  - **Hoeven (R-ND)**
- House H_2 and Fuel Cells Caucus
  - **Dent (R-PA)**
  - **Doyle (D-PA)**
  - **Larson (D-CT)**
  - **Wilson (R-SC)**
- Fuel Cell Summit, Washington DC 2012

Hydrogen fuel cell powers lights at entertainment industry events.

Developed education materials and educated more than 9,600 teachers on H_2 and fuel cells to date.



Hydrogen fuel cell powered light tower at Space Shuttle launch

Methodology – Includes competitive review processes, peer reviews & go/no-go decisions

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Topic Selection

- **Stakeholders**
  - e.g.: RFIs, industry, HTAC, etc.
- **U.S. DRIVE**
- **Peer Reviews**
  - NAS
  - GAO
  - Others

→

- **Targets**
- **"Critical Path" needs**
- **Technology Gaps**

→

RD&D Plan and Solicitation Topics

- **Risk Analysis**
- **Technology Reviews**

↓ **RD&D Plan and Solicitation Topics**

Project & Program Review Processes

- **DOE Fuel Cell Tech Team**
- **Annual Merit Review & Peer Evaluation meetings**
- **Tech Team reviews (monthly)**
- **Other peer reviews- National Academies, GAO, etc.**
- **DOE quarterly reviews and progress reports**

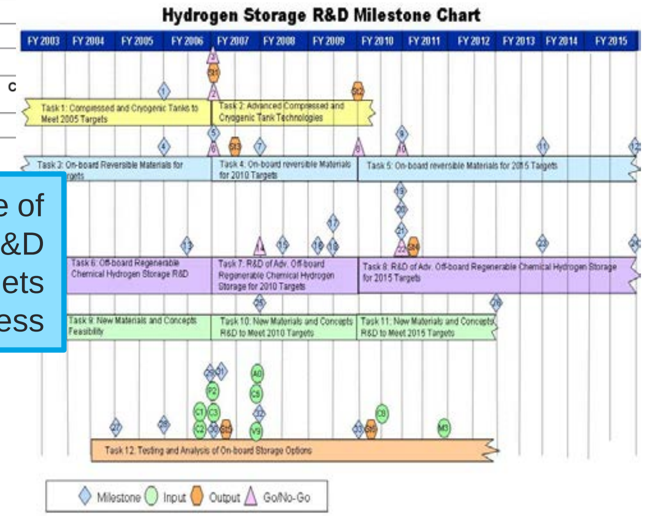
Project Number	Project Title *PI Name & Organization*	Final Score	Continue	Discontinue	Other	Summary Comment
123	New Polymer/ Inorganic Proton Conductive Composite Membranes for PEMFC	2.1		X		The project was unable to meet conductivity targets or significantly improve upon Nafion®, and the membranes developed have poor chemical stability. The project will not be continued.

Reviewer comments for projects posted online annually. Projects discontinued/ work scope altered based on performance & likelihood of meeting goals.

Example Fuel Cell Membrane Targets

Characteristic	Units	2011 status	2017 target	Nafion® NRE211
Maximum oxygen crossover	mA/cm²	<1	2	2.7
Maximum hydrogen crossover	mA/cm²	<1.8	2	2.2
Area specific resistance at:				
Max operating temp and 40 – 80 kPa water partial pressure	ohm cm²	0.023 (40 kPa) 0.012 (80 kPa)	0.02	0.186
80°C and water partial pressures from 25 - 45 kPa	ohm cm²	0.017 (25 kPa) 0.006 (44 kPa)	0.02	0.03-0.12
30°C and water partial pressures up to 4 kPa	ohm cm²	0.02 (3.8 kPa)	0.03	0.049
-20°C	ohm cm²	0.1	0.2	0.179
Operating temperature				
Minimum electrical resistance				
Cost				
Durability				
Mechanical	C			
Chemical				

Technical targets help guide go/no-go decisions.



Update of Multiyear RD&D Plan and Targets in process

>$25 million saved in the last 4 years through active project management

Project scope redirected or terminated to increase impact

Collaborations

U.S. DEPARTMENT OF ENERGY

New in 2013: H_2USA- Public-private partnership to enable the widespread commercialization of FCEVs and address the challenge of hydrogen infrastructure

Federal Agencies

- DOC
- DOD
- DOE
- DOT
- EPA
- GSA
- DOI
- DHS
- NASA
- NSF
- USDA
- USPS

− *Interagency coordination through staff-level Interagency Working Group (meets monthly)*
− *Assistant Secretary-level Interagency Task Force mandated by EPACT 2005.*

External Input

- Annual Merit Review & Peer Evaluation
- H2 & Fuel Cell Technical Advisory Committee
- National Academies, GAO, etc.

Industry Partnerships & Stakeholder Assn's.

- Tech Teams (U.S. DRIVE)
- Fuel Cell and Hydrogen Energy Association (FCHEA)
- Hydrogen Utility Group
- ~ 65 projects with 50 companies

Universities

~ 50 projects with 40 universities

DOE Hydrogen & Fuel Cells Program

International

- IEA Implementing agreements – 25 countries
- International Partnership for Hydrogen & Fuel Cells in the Economy – 17 countries & EC

State & Regional Partnerships

- California Fuel Cell Partnership
- California Stationary Fuel Cell Collaborative
- SC H_2 & Fuel Cell Alliance
- Upper Midwest Hydrogen Initiative
- Ohio Fuel Coalition
- Connecticut Center for Advanced Technology

National Laboratories

National Renewable Energy Laboratory P&D, S, FC, A, SC&S, TV, MN
Argonne A, FC, P&D, SC&S
Los Alamos S, FC, SC&S
Sandia P&D, S, SC&S
Pacific Northwest P&D, S, FC, SC&S, A
Oak Ridge P&D, S, FC, A, SC&S
Lawrence Berkeley FC, A
Lawrence Livermore P&D, S, SC&S
Savannah River S, P&D
Brookhaven S, FC
Idaho National Lab P&D

Other Federal Labs: Jet Propulsion Lab, National Institute of Standards & Technology, National Energy Technology Lab (NETL)

P&D = Production & Delivery; S = Storage; FC = Fuel Cells; A = Analysis; SC&S = Safety, Codes & Standards; TV = Technology Validation, MN = Manufacturing

World Class Researchers - Examples

Professor Thomas Jaramillo (Stanford) received a 2012 Presidential Early Career Award for Scientists & Engineers (PECASE). PECASE is the highest honor bestowed by the U.S. government on outstanding scientists and engineers who are early in their independent research careers. Jaramillo is the first ever EERE awardee.

Dr. Ian M. Robertson (Univ. of Illinois) received the American Society for Metals's 2014 Edward DeMille Campbell Memorial Lectureship Award.

Bryan Pivovar (NREL) received the Charles W. Tobias Young Investigator Award from the Electrochemical Society.

Dr. Piotr Zelenay (LANL) won the 2013 Research Award presented by the Energy Technology Division of the Electrochemical Society.

Dr. David L. Greene (ORNL) received the Transportation Research Board's 2012 Roy W. Crum Award.

Dr. Felix Paulauskis (ORNL) honored as 2012 Inventor of the Year by ORNL.

Drs. Nenad Markovic and **Vojislav Stamenkovic (ANL)** received a Distinguished Performance Award for pioneering research on the design and synthesis of multi-functional electrochemical interfaces by ANL.

Thank You

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Save the date: June 16th -20th 2014, Wardman Marriott

hydrogenandfuelcells.energy.gov