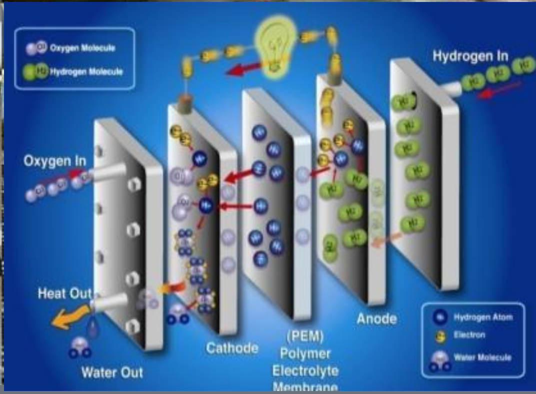
Fuel Cell Technologies Program Overview

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





IEA HIA Hydrogen Safety Stakeholder Workshop

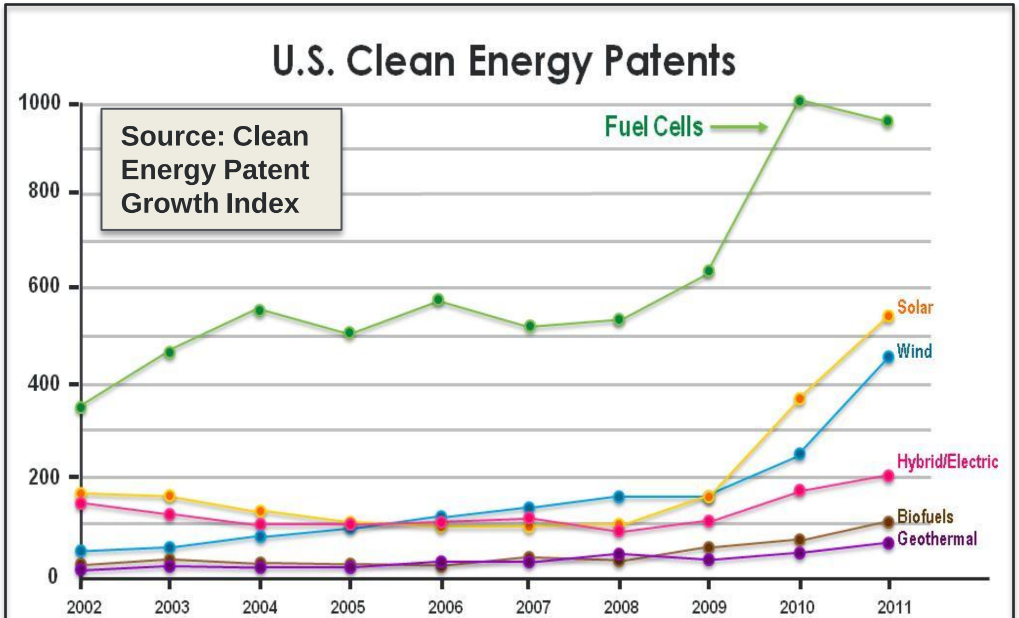
Bethesda, Maryland

10/2/2012

Dr. Sunita Satyapal

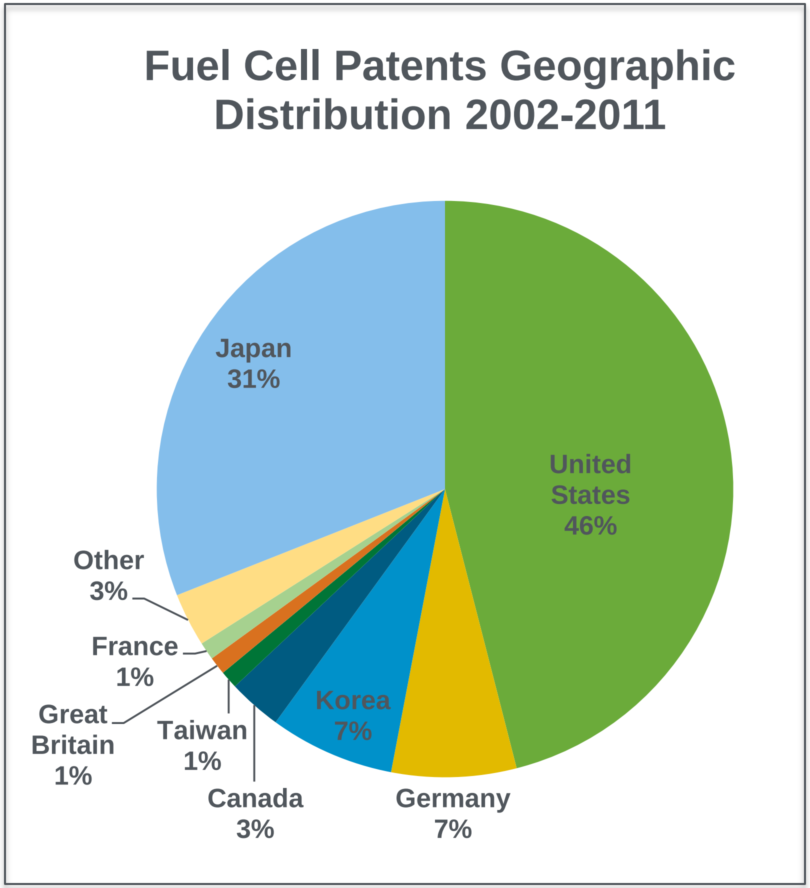
U.S. Department of Energy
Fuel Cell Technologies Program
Program Manager

Fuel Cells – An Emerging Global Industry



Clean Energy Patent Growth Index

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



Clean Energy Patent Growth Index[1] shows that fuel cell patents lead in the clean energy field with over 950 fuel cell patents issued in 2011.

- **Nearly double the second place holder, solar, which has ~540 patents.**

[1] http://cepgi.typepad.com/files/cepgi-4th-quarter-2011-1.pdf

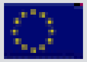
Worldwide Investment & Interest Are *Strong and Growing*

Interest in fuel cells and hydrogen is global, with more than $1 billion in public investment in RD&D annually, and 17 members of the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE).

Activity by Key Global Players

Germany: >$1.2 Billion in funding ('07 – '16); projected demand for 1,000 hydrogen stations; >22,000 small fuel cells shipped.

Japan: ~$1.0 Billion in funding ('08 – '12); plans for 2 million FCEVs and 1000 H_2 stations by 2025; 100 stations by 2015; 15,000 residential fuel cells deployed

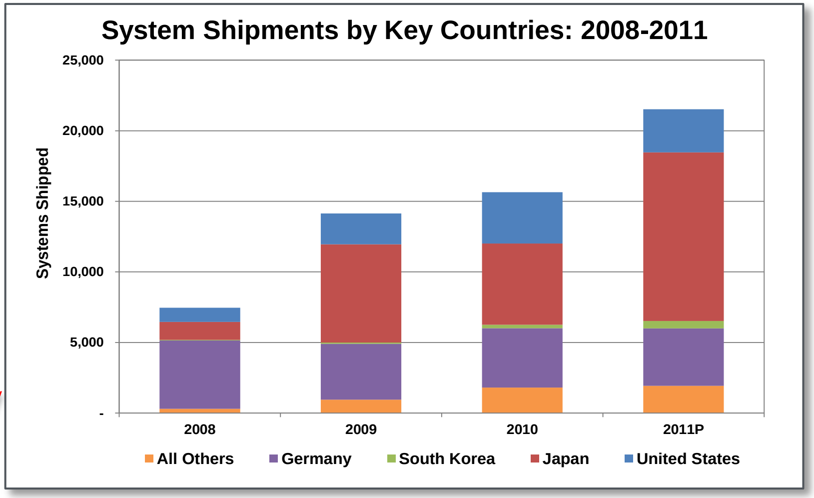


European Union: >$1.2 Billion in funding ('08–'13)

South Korea: ~$590 M ('04-'11); plans to produce 20% of world shipments and create 560,000 jobs in Korea

China: Thousands of small units deployed; 70 FCEVs, buses, 100 FC shuttles at World Expo and Olympics

Many of the world's major automakers are planning commercialization of FCEVs in the 2012 – 2015 timeframe, including Toyota, Honda, GM, Daimler, Hyundai-Kia.



Fuel cell and hydrogen markets continue to grow

- **>20,000 systems shipped in 2011 (>35% increase from 2010)**
- **>55 Mtons produced in 2011 and >70Mtons projected for 2016**

Widespread market penetration could create:

- **180,000 new jobs in the US by 2020**
- **675,000 jobs by 2035**

Projected Global Market Revenues over the next 10-20 Years

Stationary Power	Portable Power	Transportation
$14-$31B/yr	$11B/yr	$18-$97B/yr

Worldwide Commitment to FCEVs

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The world's leading automakers have committed to develop FCEVs. Germany and Japan have announced plans to expand the hydrogen infrastructure.

Major Auto Manufacturers' Activities and Plans for FCEVs

Toyota
- 2010-2013: U.S. demo fleet of 100 vehicles
- 2015: Target for large-scale commercialization
- "FCHV-adv" can achieve 431-mile range and 68 mpgge

Honda
- Clarity FCX named "World Green Car of the Year"; EPA certified 72mpgge; leasing up to 200 vehicles
- 2015: Target for large-scale commercialization

Daimler
- Small-series production of FCEVs began in 2009
- Plans for tens of thousands of FCEVs per year in 2015 – 2017 and hundreds of thousands a few years after
- In partnership with Linde to develop fueling stations.
- ***Recently moved up commercialization plans to 2014***

General Motors
- 115 vehicles in demonstration fleet
- 2012: Technology readiness goal for FC powertrain
- 2015: Target for commercialization

Hyundai-Kia
- 2012-2013: 2000 FCEVs/year
- 2015: 10,000 FCEVs/year
- "Borrego" FCEV has achieved >340-mile range.

Volkswagen
- Expanded demo fleet to 24 FCEVs in CA
- Recently reconfirmed commitment to FCEVs

SAIC (China)
- Partnering with GM to build 10 fuel cell vehicles in 2010

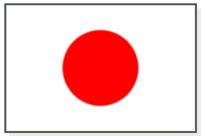
Ford
- Alan Mulally, CEO, sees 2015 as the date that fuel cell cars will go on sale.

BMW
- BMW and GM plan to collaborate on the development of fuel cell technology

Based on publicly available information during 2011

H_2Mobility - evaluate the commercialization of H_2 infrastructure and FCEVs
- Public-private partnership between NOW and 9 industry stakeholders including:
  - Daimler, Linde, OMV, Shell, Total, Vattenfall, EnBW, Air Liquide, Air Products
- FCEV commercialization by 2015.
- $40€ investment to ensure 50 hydrogen station by 2015.

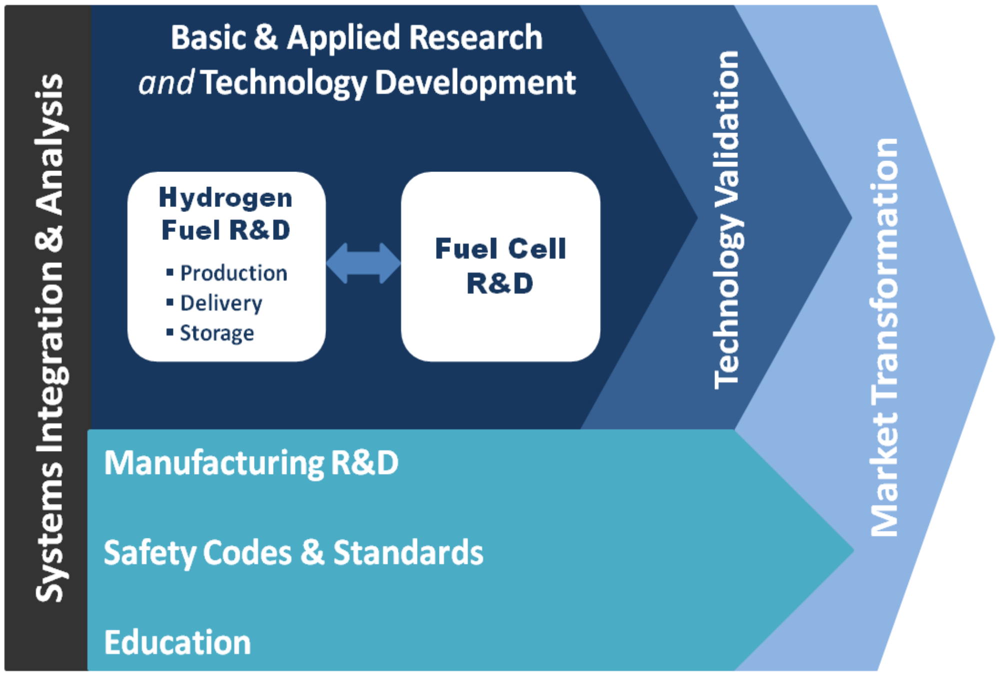
UKH_2Mobility will evaluate anticipated FCEV roll-out in 2014/2015
- 13 industry partners including:
  - Air Liquide, Air Products, Daimler, Hyundai, ITM Power , Johnson Matthew, Nissan, Scottish & Southern Energy, Tata Motors, The BOC Group, Toyota, Vauxhall Motors
- Government investment of £400 million to support development, demonstration, and deployment.



13 companies and Ministry of Transport announce plan to commercialize FCEVs by 2015
- 100 refueling stations in 4 metropolitan areas and connecting highways planned, 1,000 station in 2020, and 5,000 stations in 2030.

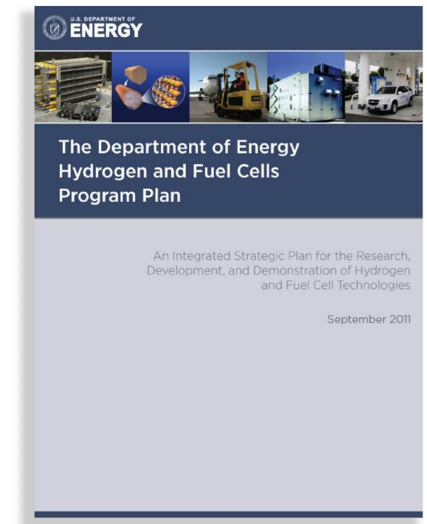
DOE Program Structure

The Program is an integrated effort, structured to address all the key challenges and obstacles facing widespread commercialization.



WIDESPREAD COMMERCIALIZATION ACROSS ALL SECTORS

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



Update to the Hydrogen Posture Plan (2006)

Released September 2011

Nearly 300 projects currently funded

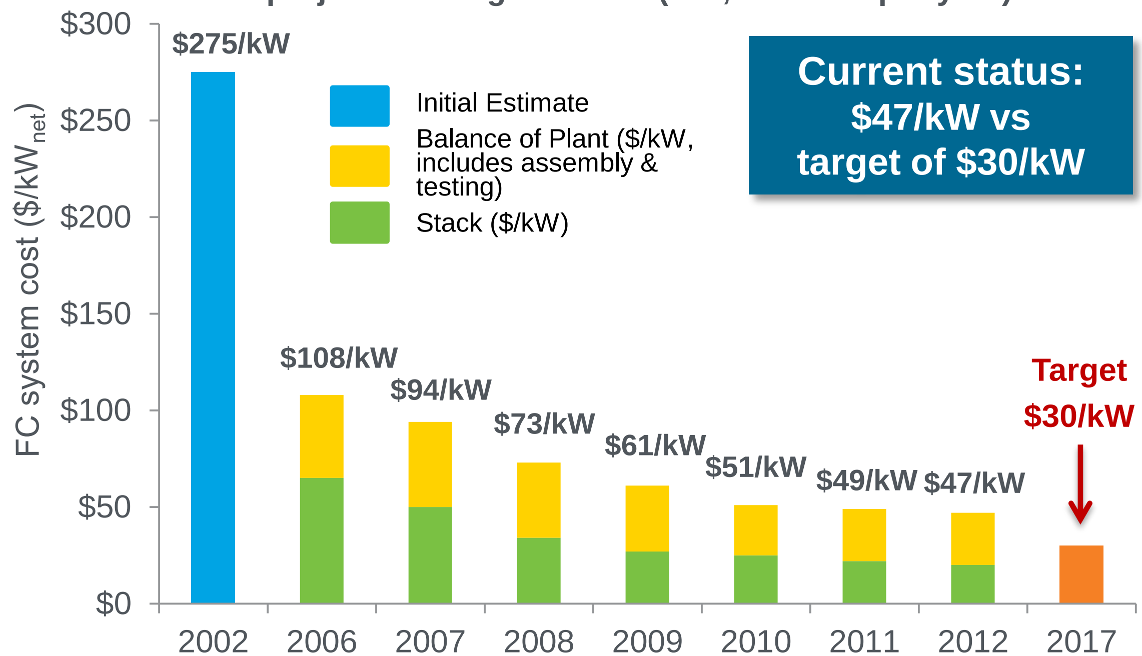
at companies, national labs, and universities/institutes

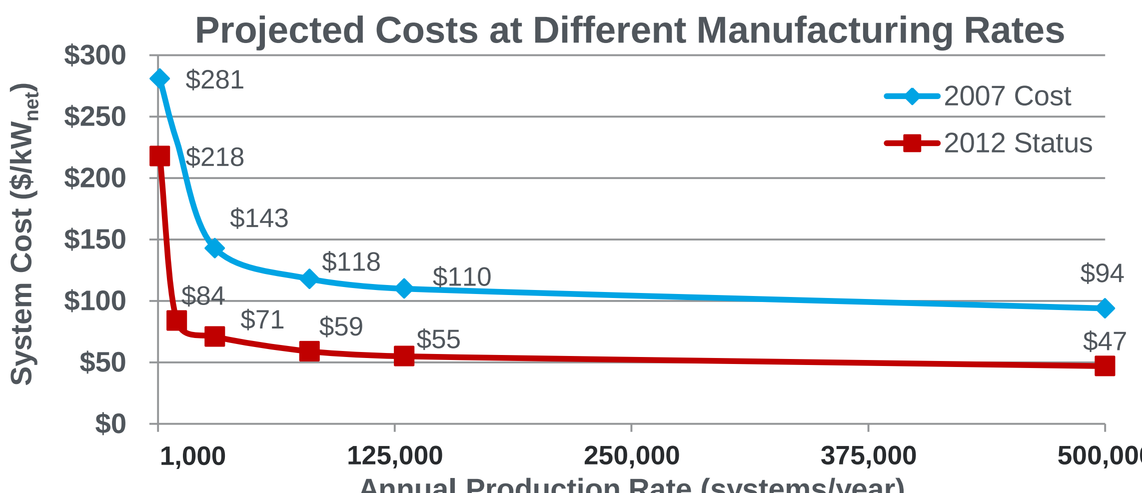
More than $1B DOE funds spent from FY 2007 to FY 2011

Progress – Fuel Cells

Projected high-volume cost of fuel cells has been reduced to $47/kW (2012)*

- ***More than 35% reduction since 2008***
- ***More than 80% reduction since 2002***





***Based on projection to high-volume manufacturing (500,000 units/year).** The projected cost status is based on an analysis of state-of-the-art components that have been developed and demonstrated through the DOE Program at the laboratory scale. Additional efforts would be needed for integration of components into a complete automotive system that meets durability requirements in real-world conditions.*

Progress: *Hydrogen Production R&D*

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The revised hydrogen threshold cost is a key driver in the assessment of Hydrogen Production and Delivery R&D priorities.

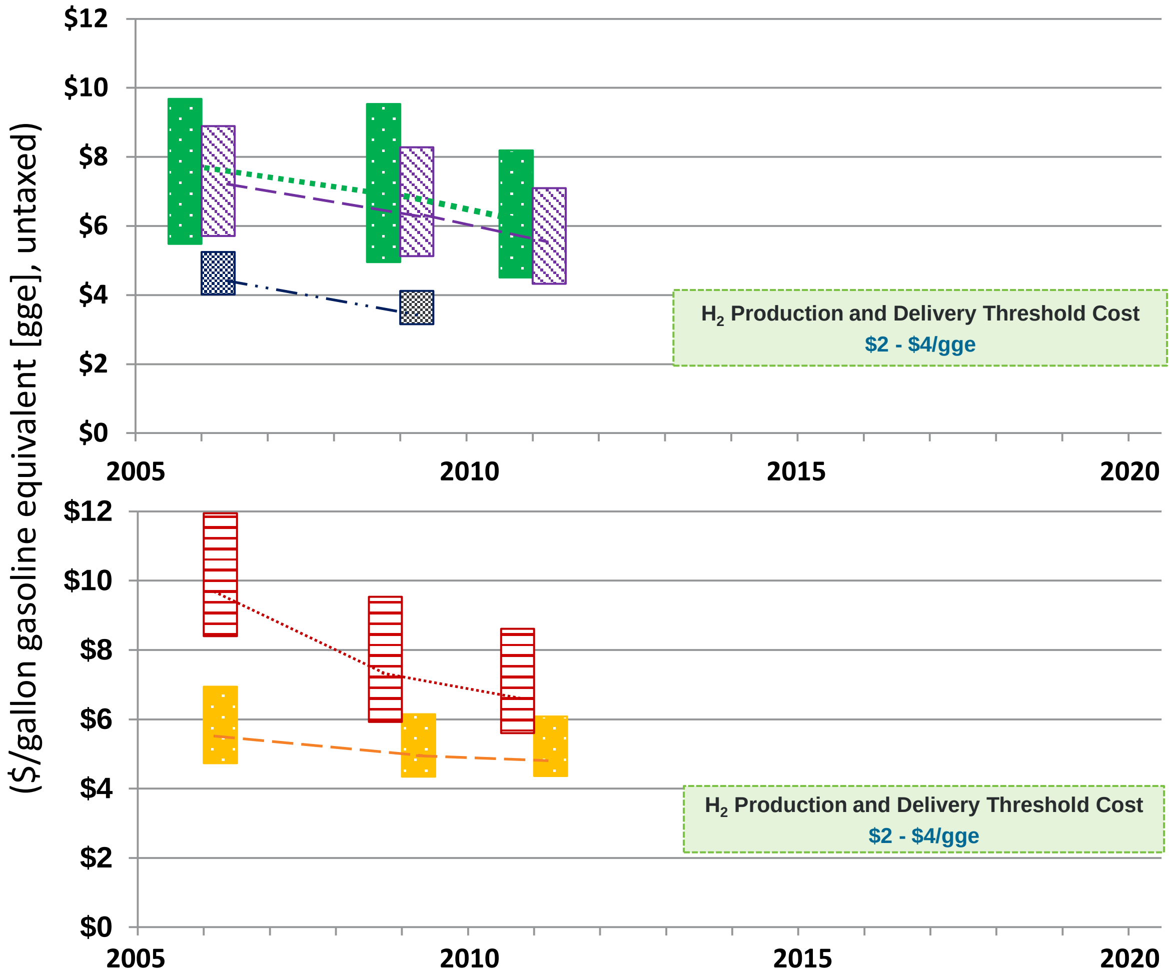
Projected High-Volume Cost of Hydrogen Production[1] (Delivered[2])—Status

Distributed Production (near term)

- Electrolysis
  Feedstock variability: $0.03 - $0.08 per kWh
- Bio-Derived Liquids
  Feedstock variability: $1.00 - $3.00 per gallon ethanol
- Natural Gas Reforming[3]
  Feedstock variability: $4.00 - $10.00 per MMBtu

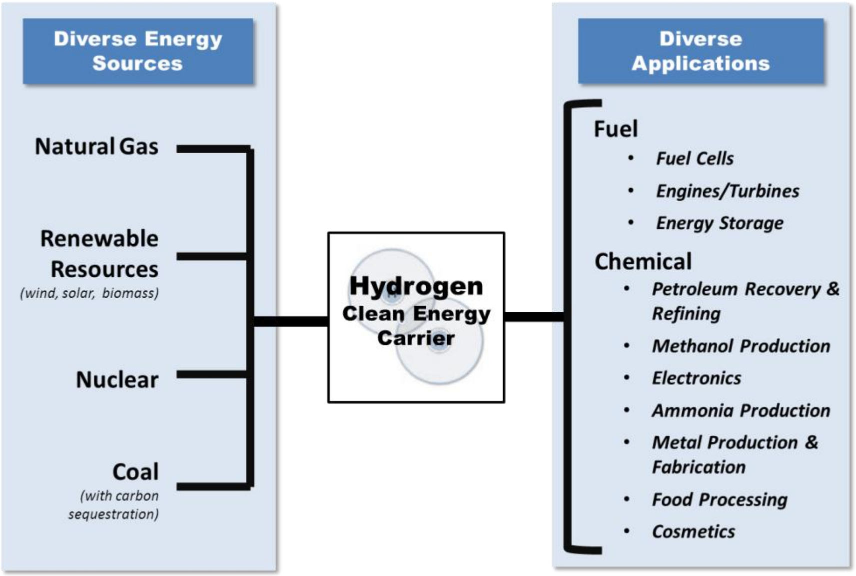
Central Production (longer term)

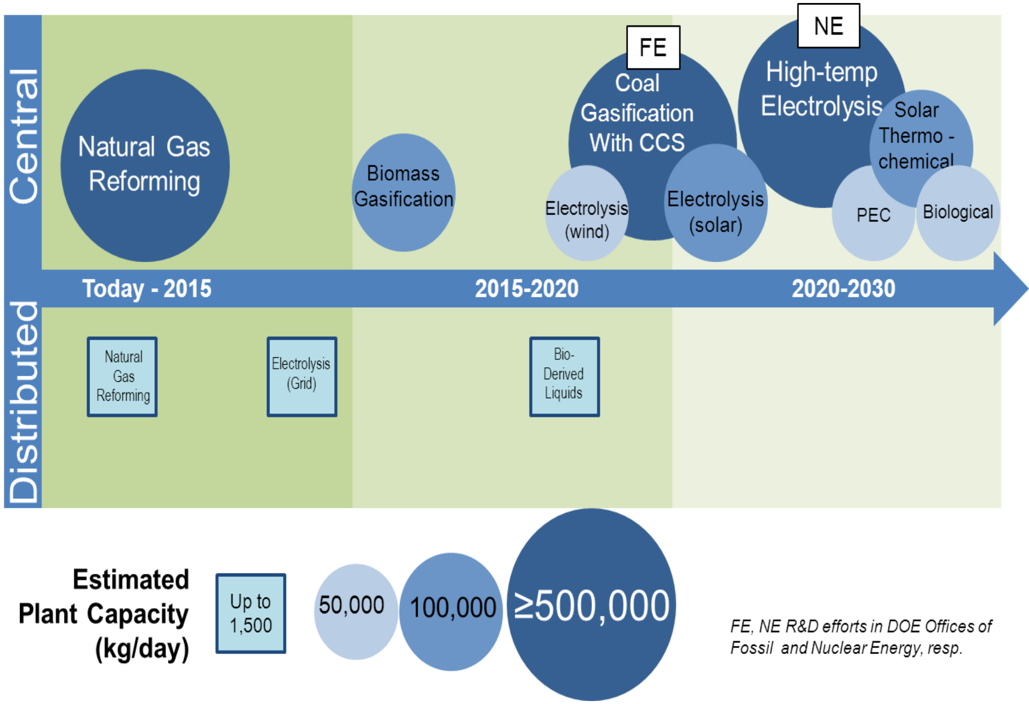
- Electrolysis
  Feedstock variability: $0.03 - $0.08 per kWh
- Biomass Gasification
  Feedstock variability: $40- $120 per dry short ton

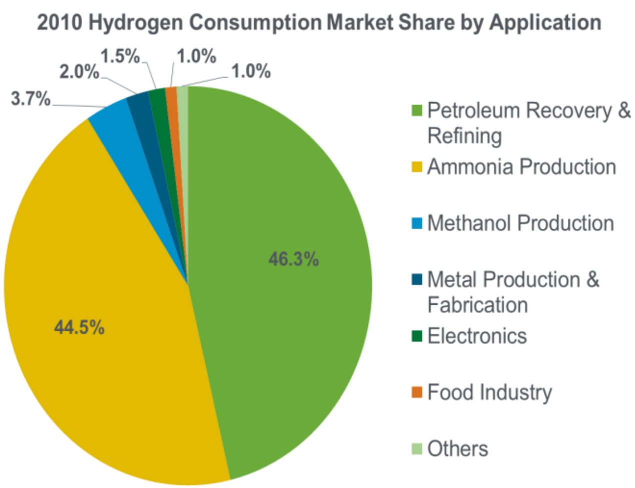


Notes:
[1] Cost ranges for each pathway are shown in 2007$ based on high-volume projections from H2A analyses, reflecting variability in major feedstock pricing and a bounded range for capital cost estimates.
[2] Costs include total cost of production and delivery (dispensed, untaxed). Forecourt compression, storage and dispensing added an additional $1.82 for distributed technologies, $2.61 was added as the price of delivery to central technologies. All delivery costs were based on the Hydrogen Pathways Technical Report (NREL, 2009).
[3] Analysis of projected costs for natural gas reforming indicated that the threshold cost can be achieved with current technologies or with incremental improvements made by industry. FCTP funding of natural gas reforming projects was completed in 2008.

Hydrogen: Sources & Applications







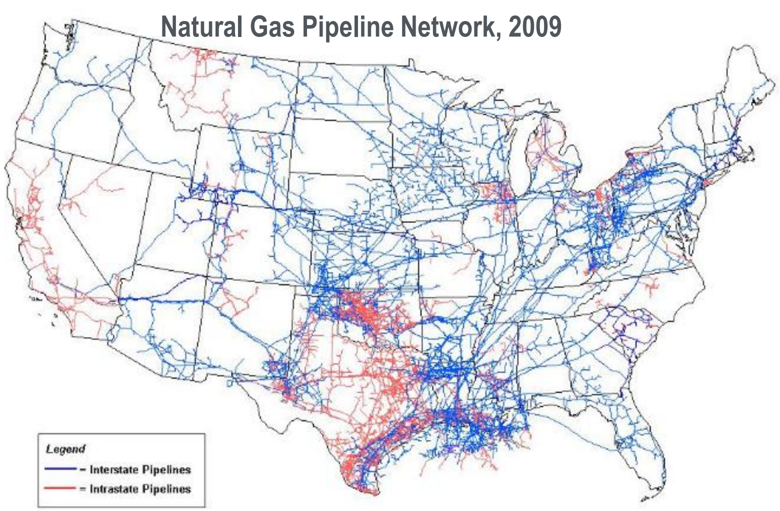
HTAC Subcommittee: H_2 Production Expert Panel Review underway to provide recommendations to DOE

Two Main Options for Low-cost Early Infrastructure

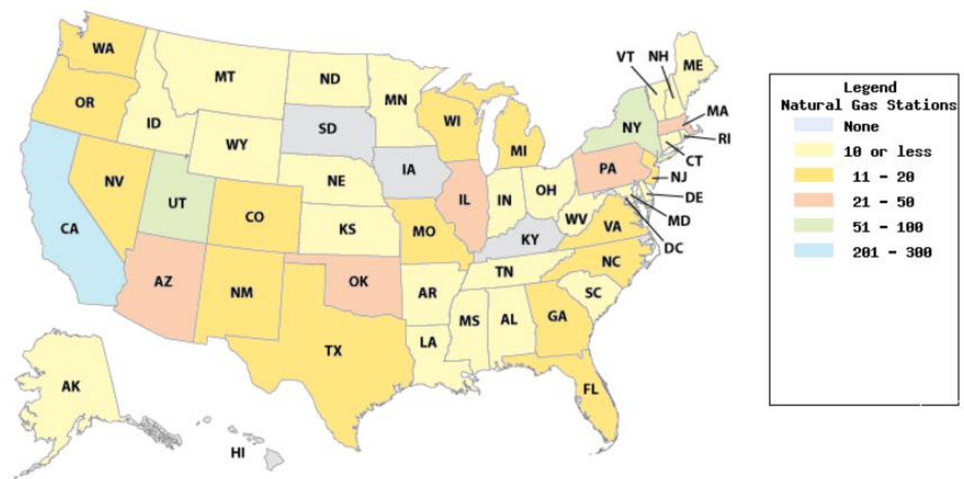
1. **Hydrogen delivered from central site**
   - Low-volume stations (~200-300 kg/day) would cost <$1M and provide hydrogen for $7/gge *(e.g., high-pressure tube trailers, with pathway to $5/gge at 400–500 kg/day- comparable to ~$2.10/gallon gasoline untaxed)*
2. **Distributed production (e.g. natural gas, electrolysis)**

Other options

1. Co-produce H_2, heat and power (tri-gen) with natural gas or biogas
2. Hydrogen from waste (industrial, wastewater, landfills)



Source: Energy Information Administration, Office of Oil & Gas, Natural Gas Division, Gas Transportation Information System



Natural gas fueling stations

Technology Validation

Completed world's largest single FCEV & H_2 Demonstration to date (50-50 DOE-Industry cost share)

- >180 fuel cell vehicles and 25 hydrogen stations
- 3.6 million miles traveled; 500,000 trips
  - ~152,000 kg of hydrogen produced or dispensed; >33,000 refuelings

Air Products UTC Power Daimler
Hyundai GM BP
Chevron Ford KIA

	Status	Project Target
Durability	~2,500	2,000
Range	196 – 254*	250*
Efficiency	53 – 59%	60%
Refueling Rate	0.77 kg/min	1 kg/min

	Status (NG Reforming)	Status (Electroylsis)	Ultimate Target
H_2 Cost at Station	\$7.70 - \$10.30/kg	\$10.00 - \$12.90/kg	\$2.00 - \$4.00/kg

Demonstrated world's first Tri-generation station

Anaerobic digestion of municipal wastewater (Orange County Sanitation District)

- Produces 100 kg/day $H_{2,}$; generates ~ 250 kW; 54% efficiency co-producing H_2 and electricity
- Nearly 1 million kWh of operation
- >4,000 kg H_2 produced

(Air Products, FuelCell Energy)

Demonstrated H_2 for Energy Storage (NREL)

- Showed PEM and alkaline electrolyzers provide grid frequency regulation, 4X faster than 'control' with no electrolyzers
- Achieved 5,500 hrs of variable electrolyzer stack operation to determine effects of wind AC power on stack degradation

*Independently validated a vehicle that can achieve a 430 mile range.

Market Transformation: Addressing Market Barriers

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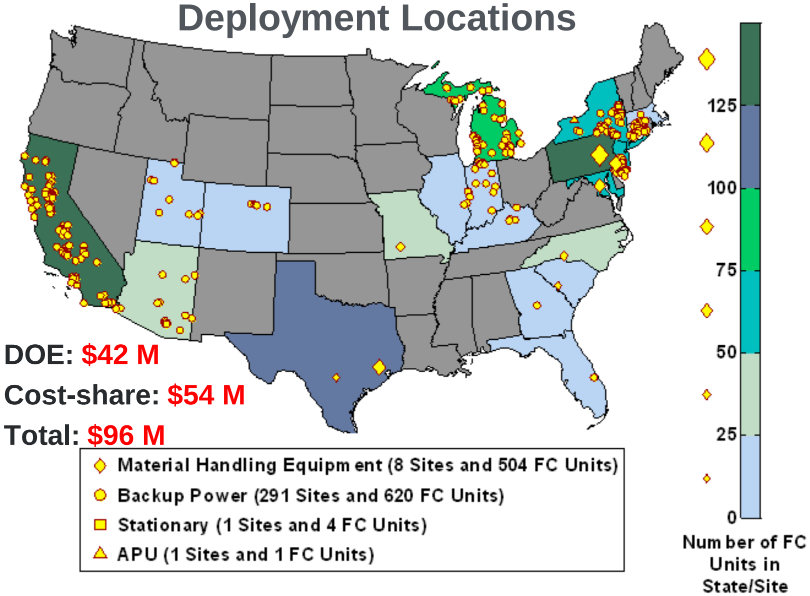
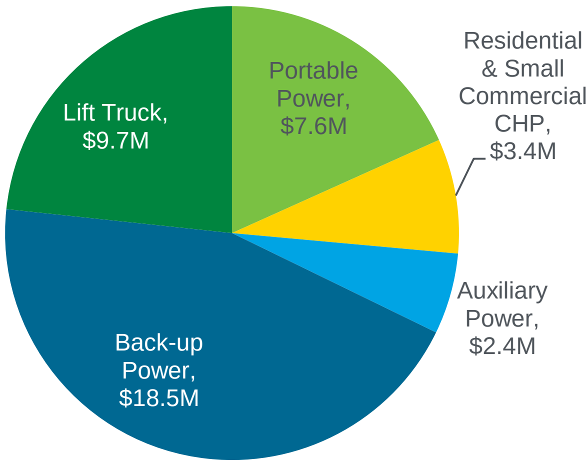
Deployments help ensure continued technology utilization growth and catalyze market penetration while providing data and lessons learned.

Deployment Locations



DOE: $42 M
Cost-share: $54 M
Total: $96 M



FedEx
Sprint
AT&T
Genco
Sysco
Wegmans

ARRA Deployment Status

Fuel Cell Application	Operational Fuel Cells	Total Fuel Cells Planned
Backup Power	668	539
Material Handling	504	504
Stationary	0	6
APU	0	3
Total	**1,172**	**> 1,000**

Coca Cola
Whole Foods
Kimberly-Clark

NREL ARRA Data Collection Snapshot

ARRA Material Handling Equipment Data	As of 12/31/2011
Hydrogen Dispensed	99,650 kg
Hydrogen Fills	>148,250
Hours Accumulated	>959,880 hrs

MORE THAN 3,500 ADDITIONAL FUEL CELL LIFT TRUCKS PLANNED OR INSTALLED **with NO DOE funding**

Market Transformation- Early Market Deployment Summary

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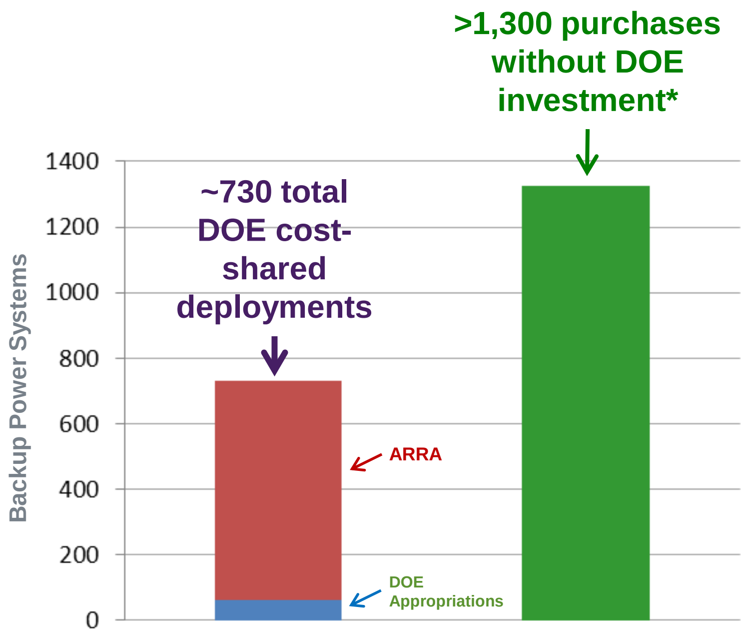
Early market deployments of approximately 1,400 fuel cells have led to more than 5,000 additional purchases by industry—with no further DOE funding.

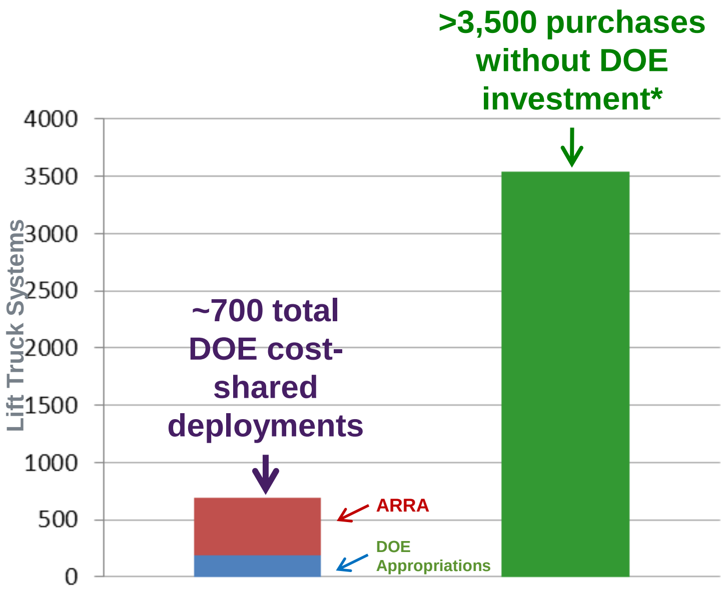
Backup Power Units



Leveraging DOE funds:

DOE deployments led to almost 2X additional purchases by industry.

Lift Truck Deployments



Leveraging DOE funds:

DOE deployments led to >5X additional purchases by industry.

Recovery Act and Market Transformation Activities – Government as "Catalyst" for market success of emerging technologies

*industry purchases include units on order

Safety, Codes & Standards Overview

Goals: Support the widespread commercialization of hydrogen and fuel cells by facilitating development of regulations, codes, and standards (C&S), and by developing and implementing practices to ensure the safe use of hydrogen and fuel cell technologies

Approach

Identify R&D needs

- Lead stakeholder workshops, develop R&D roadmaps
- Analyze existing codes and standards, safety knowledge
- Participate in technical working groups

Perform High-Priority R&D

- Understand foundational hydrogen behavior
- Quantitative Risk Assessments
- Compatible materials and components
- Develop and harmonize test protocols

Impact Codes and Standards

- Participate in and lead technical committees to develop requirements
- Publish R&D results

Harmonize Internationally

Global Technical Regulations (GTR Phase 1-SAE J2578, SAE J2579)
International Standards Development Organizations(e.g., ISO, IEC)
International Partnerships and Agreements (IPHE, IEA)

Key challenges include:

- Need to synchronize codes and standards development with technology deployment needs
- Lack of coordination of R&D with codes and standards development cycle and revision schedule
- Need to harmonize C&S domestically and internationally
- Need to standardize the permitting process for H_2 infrastructure
- Lack of sufficient hydrogen safety information (e.g., best practices and frequency data)

Progress: Safety, Codes & Standards

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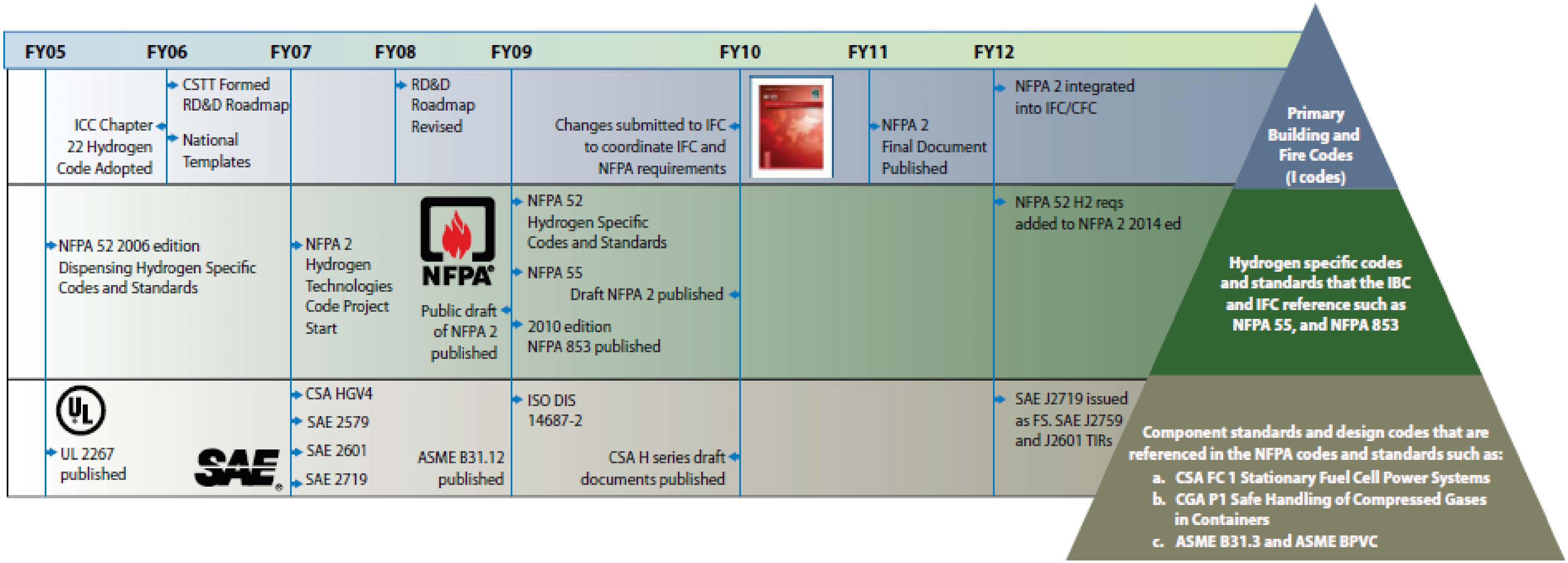
Timeline of Hydrogen Codes and Standards



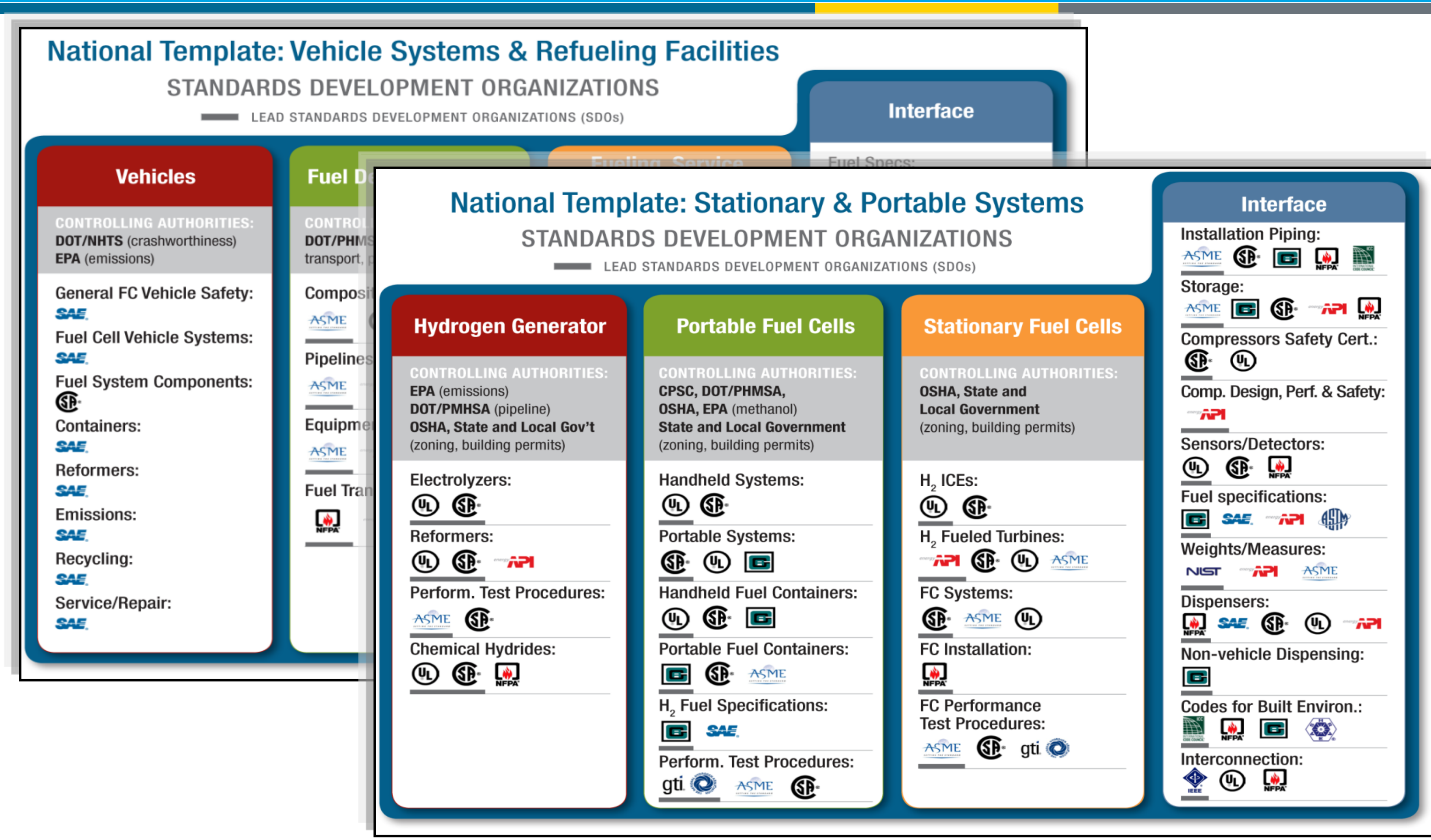
Examples of Accomplishments:

- Provided technical data and incorporated a risk-informed approach that enabled NFPA2 to update bulk gas storage separation distances
- Implemented a science-based approach to develop an ISO standard for hydrogen fuel quality (standard approved).
- Completed R&D to enable Test Method for Evaluating Materials Compatibility standard.
- Demonstrated >50,000 cycles of metals tanks for forklift applications
- Launched international round robin testing of Type IV tanks

The United States will use the GTR as the technical underpinning for the development of the U.S. Federal Motor Vehicle Safety Standard (FMVSS). Submitted to the U.N. ECE WP29 Dec. 2011, Target Acceptance Dec. 2012

Codes & Standards Progress

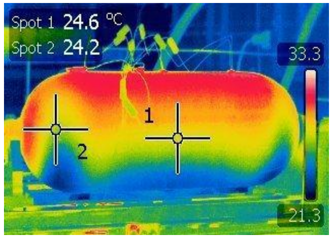
U.S. codes and standards development coordination



- *National template developed to delineate and coordinate critical roles of standards and model code development organizations*

www1.eere.energy.gov/hydrogenandfuelcells/codes/standards_organization.html

Fast-Fill Model Validation (SNL,China):



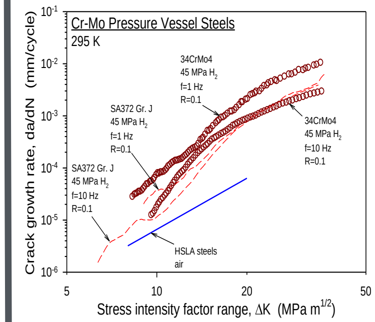
Motivation

- A variety fill models exist, some proprietary
- A generalized, validated model provides a comparative standard
- Current data may be inadequate to fully validate a model
- Current Standards (SAE 2579, GTR, EIHP)

Experimental Approach

- Perform hydrogen filling experiments at specified and relevant pressure ramp rate while the following measurements are made:
  - The transient gas pressure in the tank
  - The total enthalpy of hydrogen entering the tank
  - The transient mass flow rate of hydrogen entering the tank
  - The final uniform temperature and pressure in the tank after fill
  - The transient mass-averaged gas temperature in the tank

Materials Compatability (SNL, Japan):



- Completion of standards through committee leadership and data evaluation
  - CSA HPIT1 completed Sept. 2011
  - CSA CHMC1 (Part 1) published early 2012
  - SAE J2579 progress reported at ICHS conference Sept. 2011
  - ASME KD-10
- I[2]CNER - Sandia Participation with U. of Illinois and Kyushu University
  - Leverage 40+ years in H_2 Effects on structural materials at SNL
- Evaluate effects of load-cycle frequency on fatigue crack growth rates for 7XXX aluminum alloys in high-pressure H_2
  - Results presented at ASME PVP conference July 2011

Fuel Quality (LANL):

ISO TC 197 Working Group 12

- FDIS Draft Submitted in Nov 2011
- Fuel Quality Technical Report in draft (*Target – Dec 2012)*

SAE J2719

- Hydrogen Quality Guidelines for Fuel Cell Vehicles (Published Sept 2011)

ASTM (D7653-10)

- Determination of Trace Gaseous Contaminants in Hydrogen Fuel by Fourier Transform Infrared (FTIR) Spectroscopy

Sensors (NREL, LANL, LLNL, & EC):

- Working group participation on national and international sensor test standards
  - ISO
  - UL
  - FM
- International Collaboration (NREL/JRC-IET) MOU
  - Oxygen dependence
  - Assess improvements/degradations MEMs sensor
    - Team expanded to include Univ. of Quebec
  - Hydrogen detection via oxygen displacement

Safety, Codes & Standards Progress - Example

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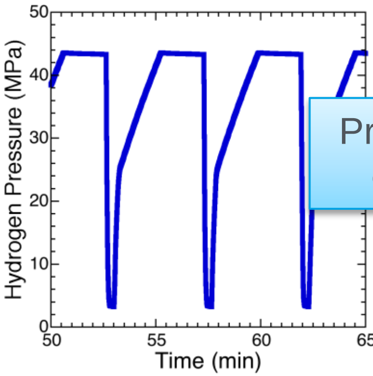
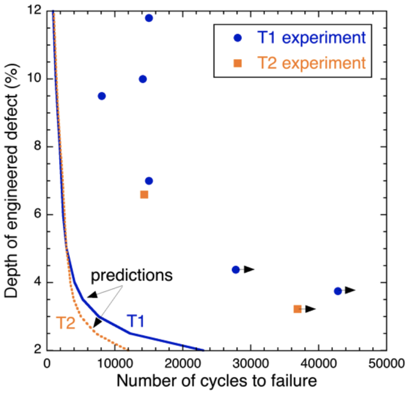
Full-scale pressure vessel testing support CSA HPIT1 standard development

- Engineered defects used to evaluate defect tolerance
- Vessels cycled to failure or up to 50,000 cycles
- Cycle-life compared to ASME design calculations for hydrogen pressure vessels
- Materials testing in gaseous hydrogen also performed
- All observed failures were leak-before-break
- Cycle-life calculations (with engineered defects) are conservative by factor of 4 or more
- Results used to justify design requirements in CSA HPIT1 standard



Pressure cycle



Proposed design requirements

- Quench and tempered Cr-Mo steels
- S_u (ultimate strength) ≤ 890 MPa
- hoop stress ≤ 0.4 S_u

Sandia National Laboratories

Progress: Safety Knowledge Tools

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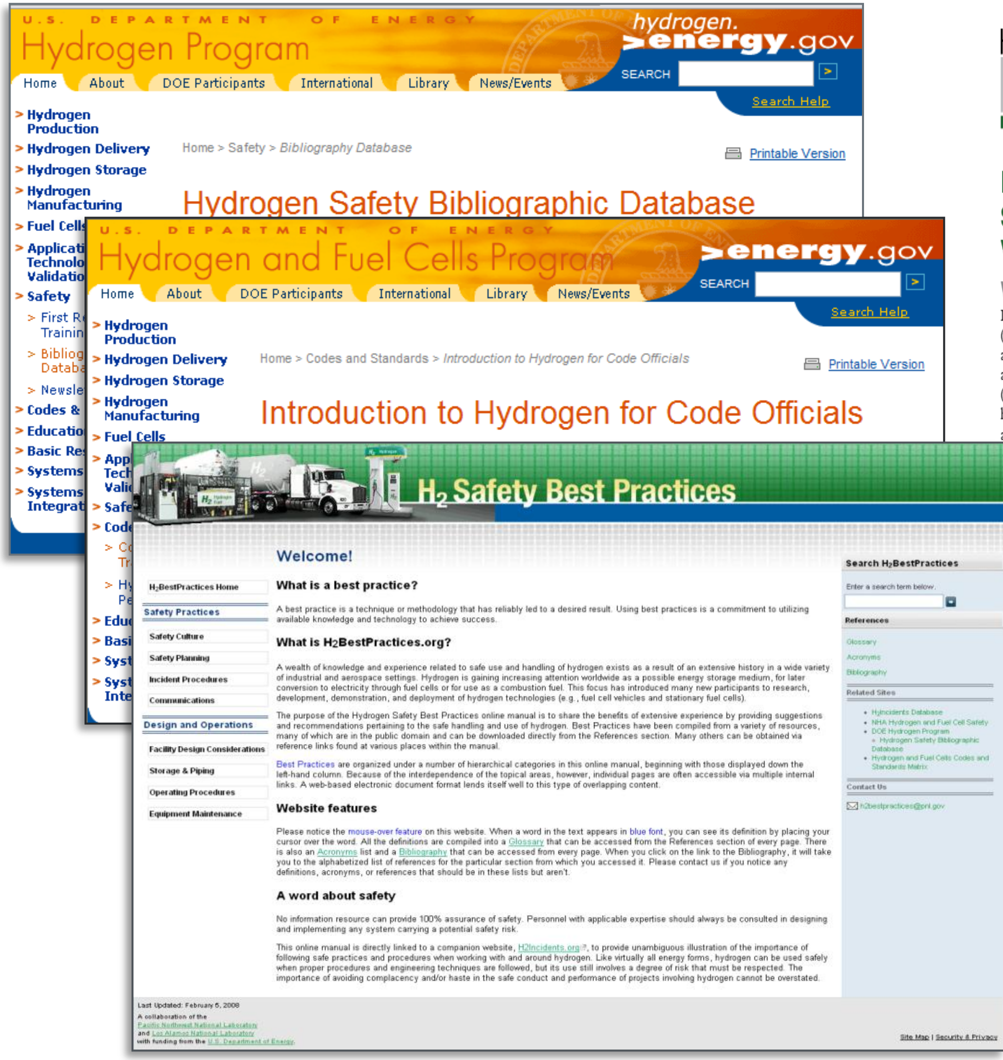
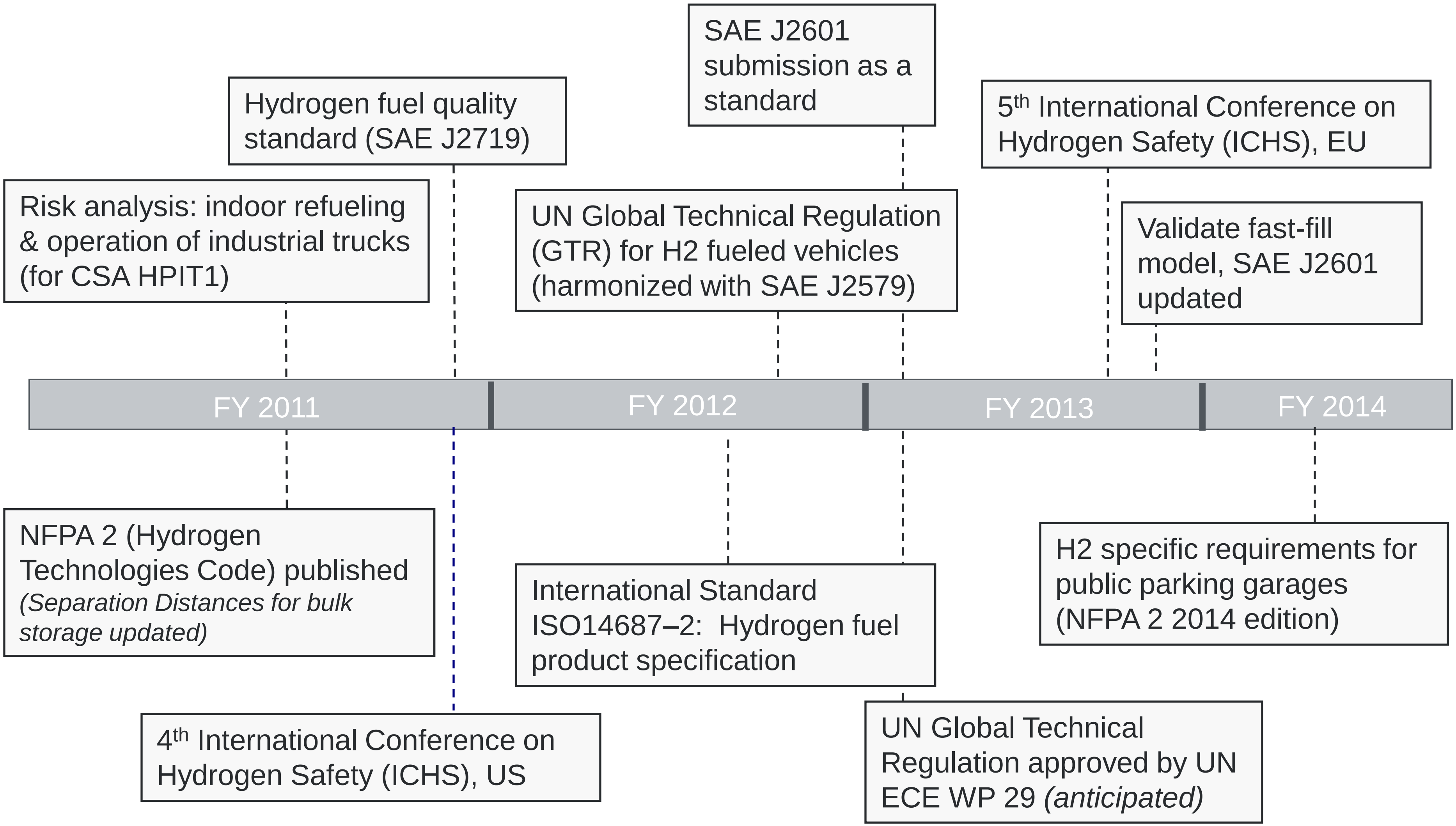


www.eere.energy.gov/hydrogenandfuelcells/codes/

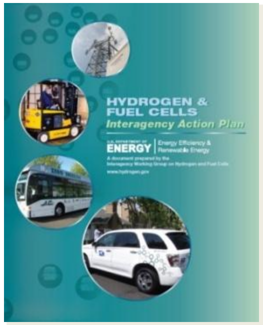
Developed training material for first responders, code officials.
Educated > 23,000 to-date (online & in-person)

- **206 Lessons Learned events in "H2Incidents.org"**
- **Approximately 750 entries in the Hydrogen Safety Bibliographic Database**

Roadmap Milestones - Examples

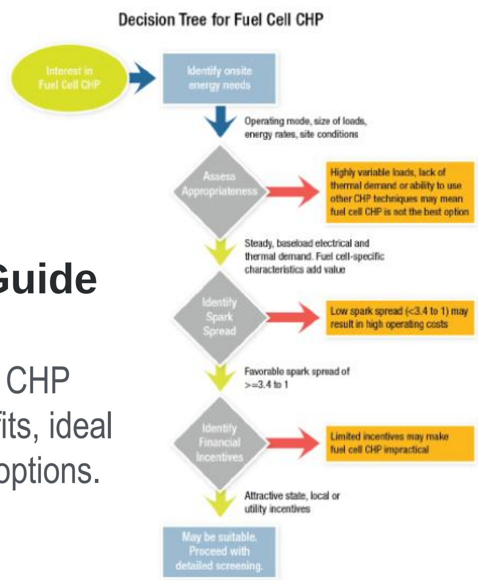


Collaborations – Federal Agencies and States



December 2011

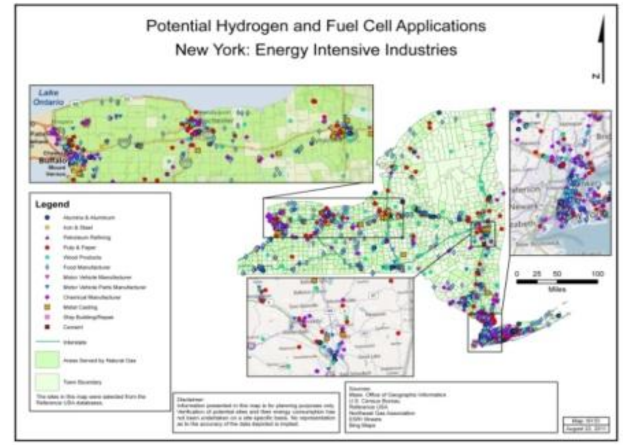
Developed Interagency Action Plan with 10 Federal Agencies (Interagency Working Group)



Developed Procurement Guide (ORNL)

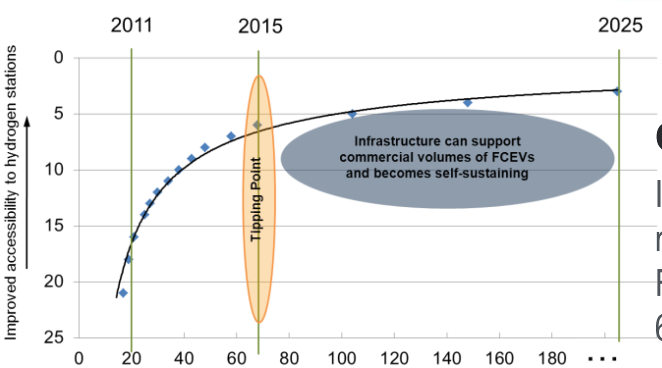
Provides guidance on CHP technology – its benefits, ideal usage, and financing options.

Published States Report (Joel M. Rinebold, et al, Connecticut Center for Advanced Technology (CCAT))



Identified numerous opportunities for fuel cells for different applications. **>1.8 GW opportunity identified.**

Developed Roadmaps for Northeastern States (CCAT)



California (CaFCP)

Identified infrastructure requirements for commercial FCEV launch ("tipping point" is 68 stations)

Hydrogen and Fuel Cell Initiatives at the State Level

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Several states—including California, Connecticut, Hawaii, Ohio, New York, and South Carolina—have major hydrogen and fuel cell programs underway.

California

FCEVs and Fuel Cell Buses

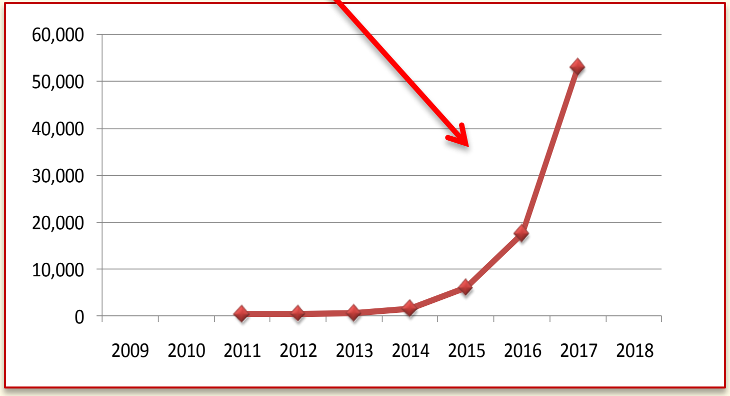
- **> 450 vehicles** in operation since 1999 — ~200 currently operating
- **~ 4.3 million miles** driven
- **> 1 million passengers** on fuel cell buses

Investment in Hydrogen Stations

- **20 stations** — including planned/funded
- **~$34M invested** *(C.A.R.B. and C.E.C.)* — with ~$23M industry cost share
- **~$18M planned** for future solicitations

Industry's Plans for FCEV Sales in CA

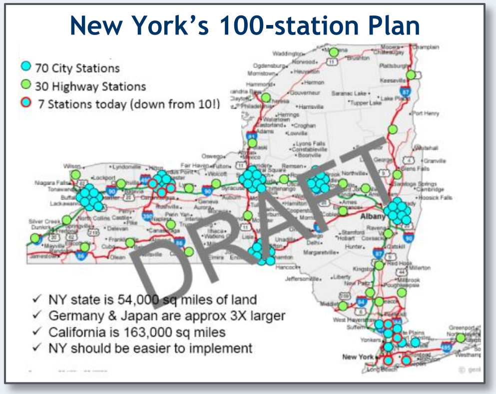
(based on 2010 survey of automakers)



New York

Plans 100 hydrogen stations (70 city, 30 highway) by 2020 to support minimum of 50,000 FCEVs — plan starts in 2015 with 1500 vehicles and 20 stations

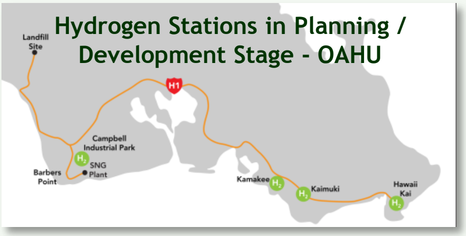
- **Industry Investment:** Six auto companies plan total investment of nearly $3.0 Billion
- **State Investment:** NY developing plans to provide $50M to support infrastructure rollout while leveraging >$165M in Federal vehicle incentives for initial FCEV commercial deployment



Hawaii

Agreement signed by 12 stakeholders—including GM, utilities, hydrogen providers, DOD, DOE—to establish hydrogen as a major part of the solution to Hawaii's energy challenges.

- **15 GM FCEVs** currently in demonstrations with military
- **Renewable hydrogen** (from geothermal and wind energy) will be used for buses
- Goals include **20-25 stations** on Oahu by 2015 to support annual sales of up to **5,000 FCEVs** in early years.



Communication & Outreach

Published more than 40 news articles so far in 2012 (including blogs, progress alerts, and DOE FCT news alerts)

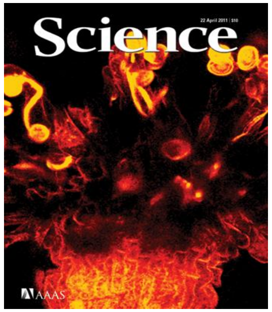
Communication and Outreach Activities include:

- Webinar Series:
  - 2012 Student Design Contest Winners
  - Storage Vessels for Fuel Cell Forklifts
  - Fuel Cells for Portable Power
  - BNL's Low-Platinum Electrocatalysts for FCEVs)
- News Items:
  - New Energy Department Report Shows Strong Growth in the Fuel Cell Market in 2011
  - DOE Issues "State of the States: Fuel Cells in America 2012"
- Monthly Newsletter

"These technologies are part of a broad portfolio that will create new American jobs, reduce carbon pollution, and increase our competitiveness in today's global clean energy economy."

Blogs and Social Media:

- Winners of Hydrogen Student Design Contest Turn Urban Waste into Energy
- Multiple DOE-EERE Facebook and Twitter posts



Progress in low and zero Pt catalysts highlighted in Science

Hydrogen power lights at the 2011 Golden Globes

Hydrogen fuel cells providing critical backup power

Collaborations

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

DOE Hydrogen & Fuel Cells Program

Universities

~ 50 projects with 40 universities

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

International Partnership for Hydrogen and Fuel Cells in the Economy

- ***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**
- **Guided by four priorities:**
  1. Accelerating market penetration and early adoption of hydrogen and fuel cell technologies and their supporting infrastructure
  2. Policy and regulatory actions to support widespread deployment
  3. Raising the profile with policy-makers and public
  4. Monitoring technology developments

Recent Activities:

- Published a brochure on the status of research and commercialization of H_2 and FCs.
- IPHE Infrastructure Workshop (Sacramento, 2010)
- Published Demonstration and Deployment Map
- Published Communiqué on the opportunities associated with using hydrogen and fuel cell technologies
- Fuel Cell Cost Analysis Comparison Published

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

Other Collaborations

Joint Technology Initiative (JTI); **MOUs** (NEDO-AIST-LANL, Hiroshima U-LANL); **Bi-lateral agreements, strong international collaboration on safety**

Future Plans - Summary

Continue to promote and strengthen R&D activities

- Hydrogen, fuel cells, safety, codes and standards, etc.

Conduct strategic, selective demonstrations of innovative technologies

- Technology validation – solicitation planned

Continue to conduct key analysis to guide RD&D and path forward

- Life cycle cost; economic & environmental analyses, etc.

Leverage activities to maximize impact

- U.S. and global partnerships

Safety, codes & standards is critical across the entire Program.

World Class Researchers - Examples

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

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. Adam Weber (LBNL) and Professor Vijay Ramani (IIT) honored as Energy Technology Division Supramaniam Srinivasan Young Investigator Award from The Electrochemical Society in Seattle.

Professor Scott Samuelsen (UC Irvine) named a White House Champion of Change for his work as Director of the Advanced Power and Energy Program and the National Fuel Cell Research Center.

Dr. Fernando Garzon (LANL) was elected President of the National Electrochemical Society (ECS).

Dr. Radoslav Adzic (BNL) honored as 2012 Inventor of the Year by the NY Intellectual Property Law Association.

Other Presidential Awardees:

- **Professor Susan Kauzlarich** – UC Davis, a 2009 recipient of the ***Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring***—and a partner of the Chemical Hydrogen Storage Center of Excellence

- **Dr. Jason Graetz** – Brookhaven National Laboratory, a 2009 recipient of the ***Presidential Early Career Award for Scientists and Engineers***—and a partner of the Metal Hydride Center of Excellence

- **Dr. Craig Brown** – NIST, a 2009 recipient of the ***Presidential Early Career Award for Scientists and Engineers***—and a Partner of the Hydrogen Sorption Center of Excellence

Thank You

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