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

Global Policies and initiatives for hydrogen in transitioning to a low-carbon economy:

the U.S. Experience

5th International Conference on Hydrogen Safety

Brussels, Belgium

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Presidential Commitment

"We've got to invest in a serious, sustained, all-of-the-above energy strategy that develops every resource available for the 21st century."

– President Barack Obama

Administration's Clean Energy Goals

Transportation

- Reduce oil imports by 1/3 by 2025

Renewable Energy and Energy Efficiency

- By 2035, generate 80% of electricity from a diverse set of clean energy sources
- Make non-residential buildings 20% more energy efficient by 2020

Environmental

- Cut green house gas emissions to 17% below 2005 levels by 2020, and 83% by 2050

Federal Leadership

- Reduce Federal Greenhouse Gas emissions by 28% by 2020

Fuel Cells part of All-of-the-Above Energy Strategy

The President's proposal will support research into a range of cost-effective technologies – like advanced vehicles that run on electricity, homegrown biofuels, **fuel cells**, and domestically produced natural gas.

the WHITE HOUSE

PRESIDENT OBAMA IS CALLING ON CONGRESS TO ESTABLISH AN

ENERGY SECURITY TRUST

HERE'S HOW IT WORKS

FUNDED WITH
REVENUE FROM PROFITABLE OIL AND GAS COMPANIES

$2 BILLION OVER TEN YEARS

Fully paid for within the President's budget. **No extra costs.**

Supports research by American scientists on **long-term projects.**

INVESTMENTS IN

CUTTING-EDGE DISCOVERIES
IN TECHNOLOGIES THAT WILL SHIFT OUR VEHICLES OFF OIL FOR GOOD

- Natural gas fuel tanks that are cheaper, lighter and stronger
- Advanced batteries for electric vehicles
- Cleaner biofuels
- Hydrogen fuel cells and breakthrough technologies

WILL CREATE

- **American Energy Sources**
- **Less Pollution**
- **New Jobs**
- **Lower Energy Costs**
- **New Technology**

The Energy Security Trust is just one piece of President Obama's All of the Above approach to create a secure energy future. The President's plan will cut our reliance on foreign oil, create jobs and help lower energy cost for middle class families.

3/15/2013 SHARE THIS IF YOU THINK IT'S A GOOD IDEA WH.GOV/ENERGY

EERE's National Mission

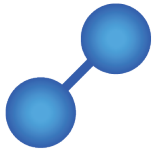
The U.S. Department of Energy's Office of Energy Efficiency & Renewable Energy (EERE) 's mission is to create American leadership in the global transition to a clean energy economy.

1) **High-Impact Research, Development, and Demonstration to Make Clean Energy as Affordable and Convenient as Traditional Forms of Energy**

2) **Breaking Down Barriers to Market Entry**

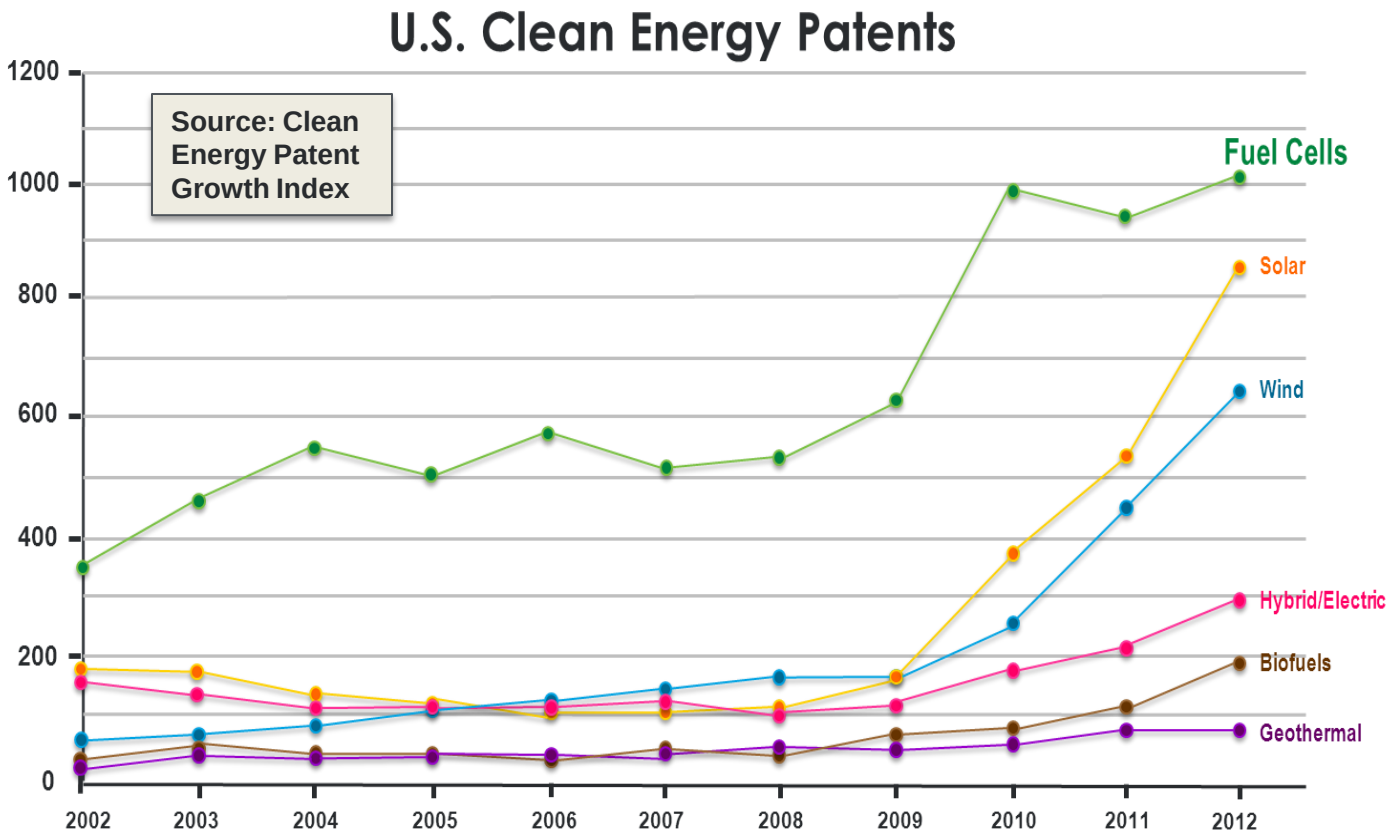
Vehicle Technologies Office: Develops more energy efficiency and environmentally friendly highway transportation technologies that will enable America to use less petroleum.

Bioenergy Technologies Office: Helps transform the nation's renewable and abundant biomass resources into cost-competitive, high-performance biofuels, bioproducts, and biopower.



Fuel Cell Technologies: Development and deployment of hydrogen and fuel cells with the ultimate goals of decreasing our dependence on oil, reducing carbon emissions, and enabling clean, reliable power generation.

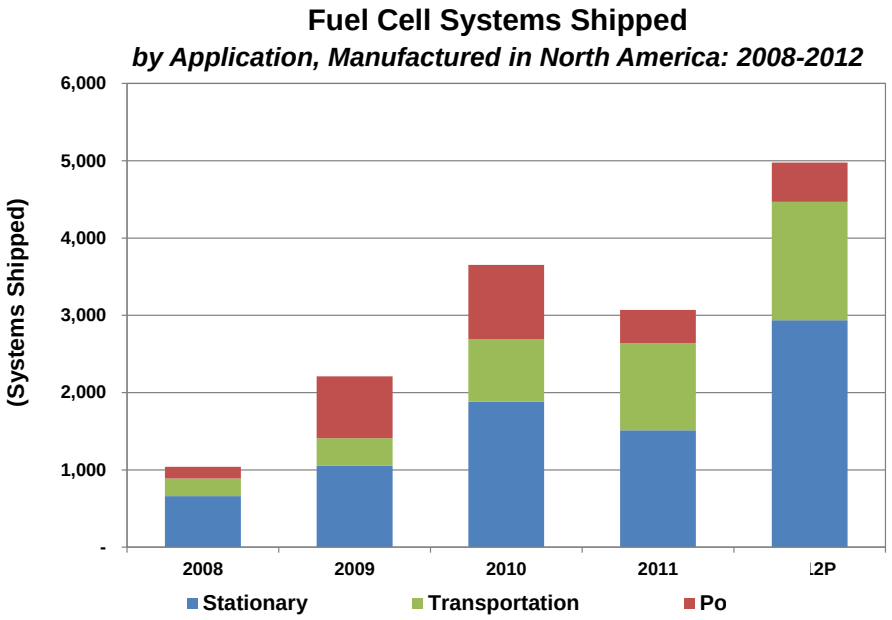
Fuel Cells – An Emerging Global Industry



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

[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

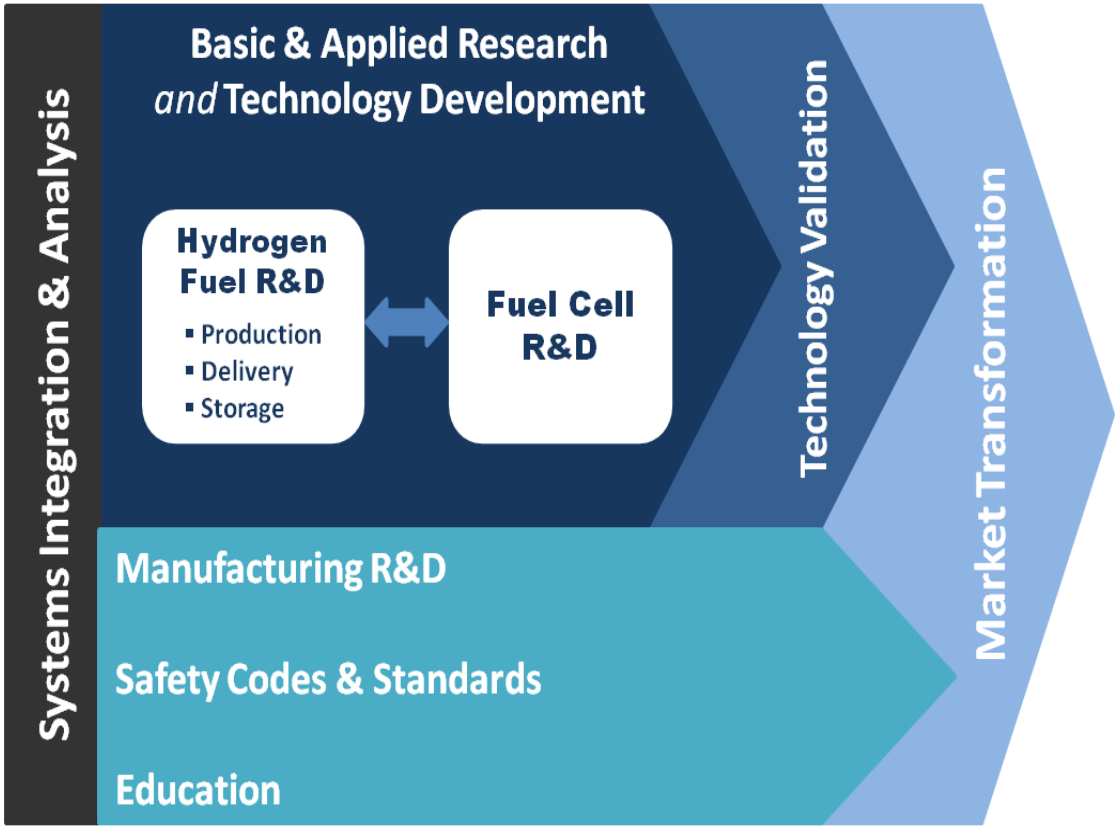
Market Potential

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

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

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



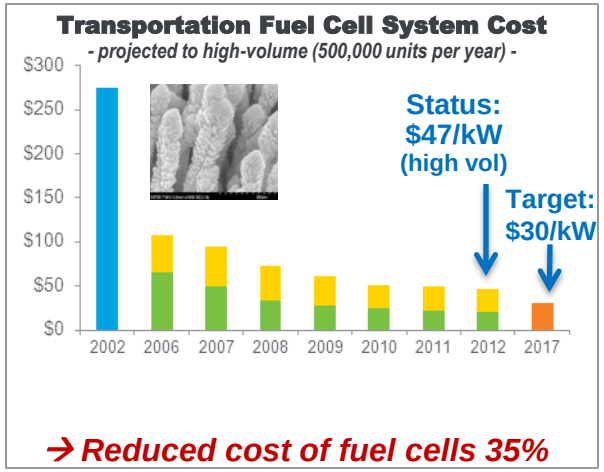
WIDESPREAD COMMERCIALIZATION ACROSS ALL SECTORS

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

DOE R&D

- *Reduces cost and improves performance*

Examples of progress:



→ Reduced cost of fuel cells 35% since 2008, 83% since 2002

DOE Demonstrations & Technology Validation

- *Validate advanced technologies under real-world conditions*
- *Feedback guides R&D*

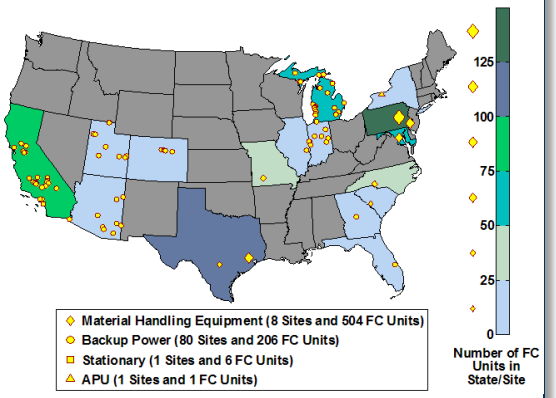
Examples—validated:

- *59% efficiency*
- *254 mile range (independently validated 430-mile range)*
- *75,000-mi durability*

Deployments

- *DOE Recovery Act and Market Transformation Projects*
- *Government Early Adoption (DoD, FAA, California, etc.)*
- *Tax Credits*

Recovery Act & Market Transformation Deployments



> 1,300 fuel cells deployed

Safety, Codes and Standards

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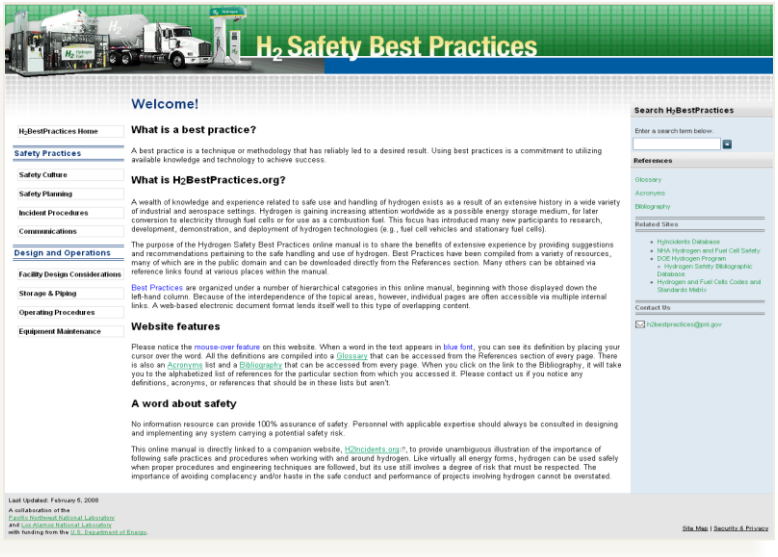

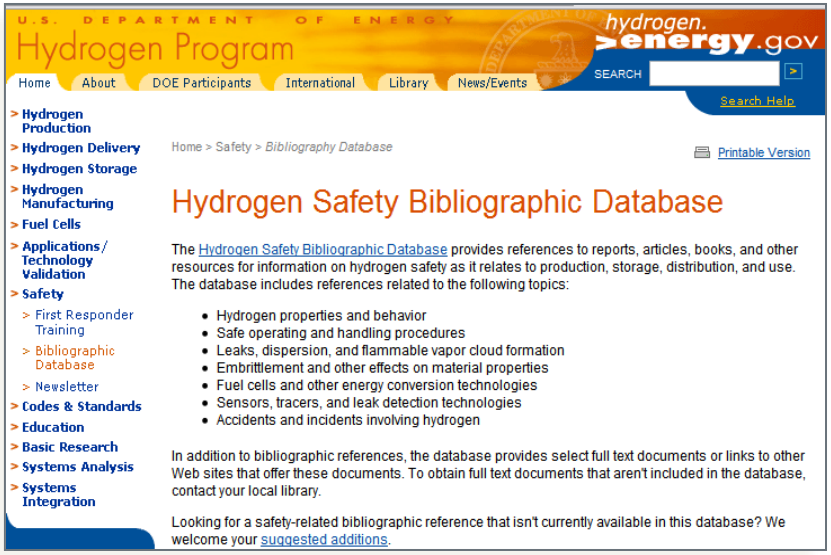

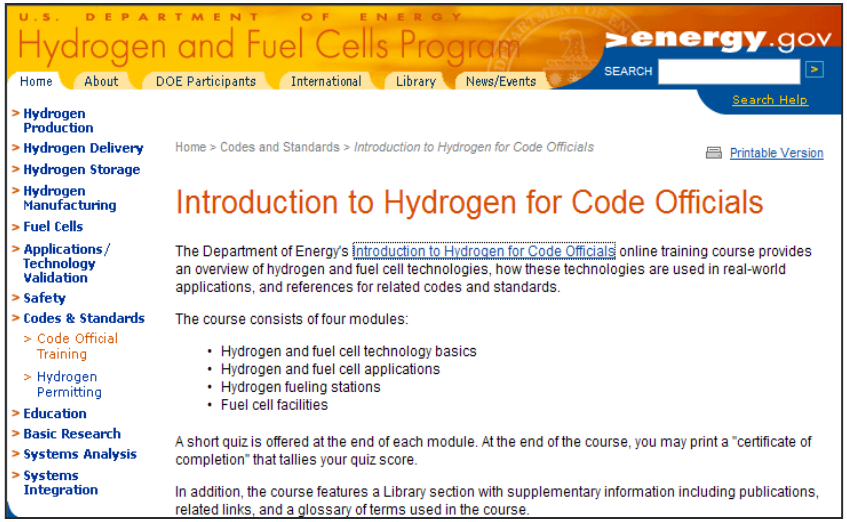

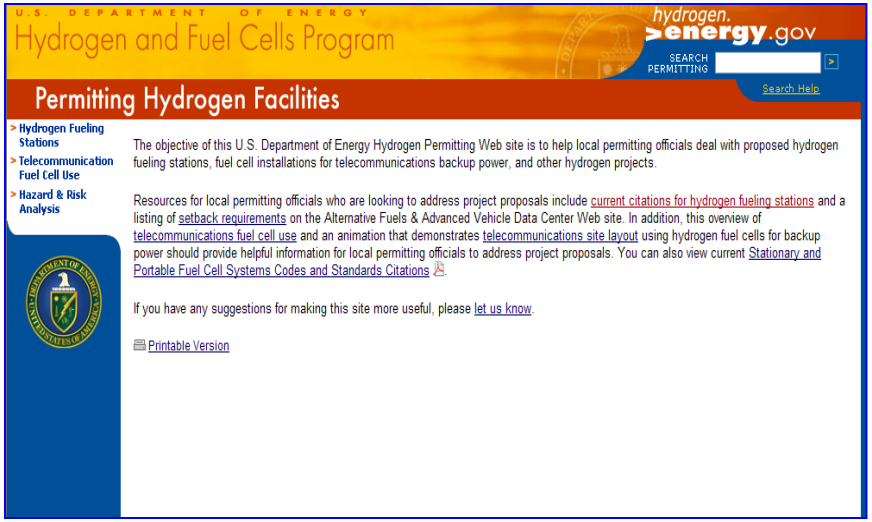

www.eere.energy.gov/hydrogenandfuelcells/codes/

H_2 USA

Mission: To promote the commercial introduction and widespread adoption of FCEVs across America through creation of a public-private partnership to overcome the hurdle of establishing hydrogen infrastructure.

Current partners include:

U.S. DEPARTMENT OF ENERGY
Fuel Cell & Hydrogen Energy Association
GlobalAutomakers
EDTA Electric Drive Transportation Association
HONDA The Power of Dreams
ITM POWER Energy Storage | Clean Fuel
NISSAN
HYUNDAI
AGA American Gas Association
GM
Mercedes-Benz
California Fuel Cell Partnership DRIVING FOR THE FUTURE
PROTON THE LEADER IN ON SITE GAS GENERATION.
plug power
Massachusetts Hydrogen Coalition
TOYOTA
NREL NATIONAL RENEWABLE ENERGY LABORATORY

International Partnerships

International Partnership for Hydrogen and Fuel Cells in the Economy

- ***Japan- Chair; U.S. and Germany-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**
- **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

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 Plans

Continue to promote and strengthen R&D activities

- Hydrogen, fuel cells, safety, manufacturing, etc.
- Cost, performance, durability need to be addressed

Conduct strategic, selective demonstrations of innovative technologies

- Industry cost share and potential to accelerate market transformation

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

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

Leverage activities to maximize impact

- U.S. and global partnerships
- H2USA: Public-Private partnership to enable widespread commercialization of hydrogen vehicles in the United States

Thank You

hydrogenandfuelcells.energy.gov