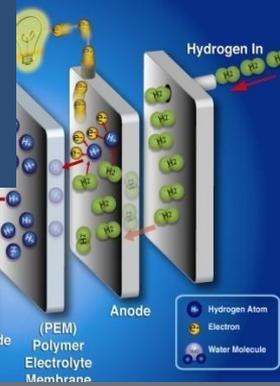




Global Policies and initiatives for hydrogen in transitioning to a low-carbon economy: the U.S. Experience



5th International Conference on Hydrogen
Safety

Brussels, Belgium

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“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

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

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.



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.

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.

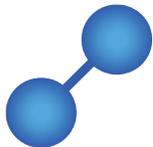
- 1) High-Impact Research, Development, and Demonstration to **Make Clean Energy as Affordable and Convenient as Traditional Forms of Energy**
- 2) **Breaking Down Barriers to Market Entry**



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

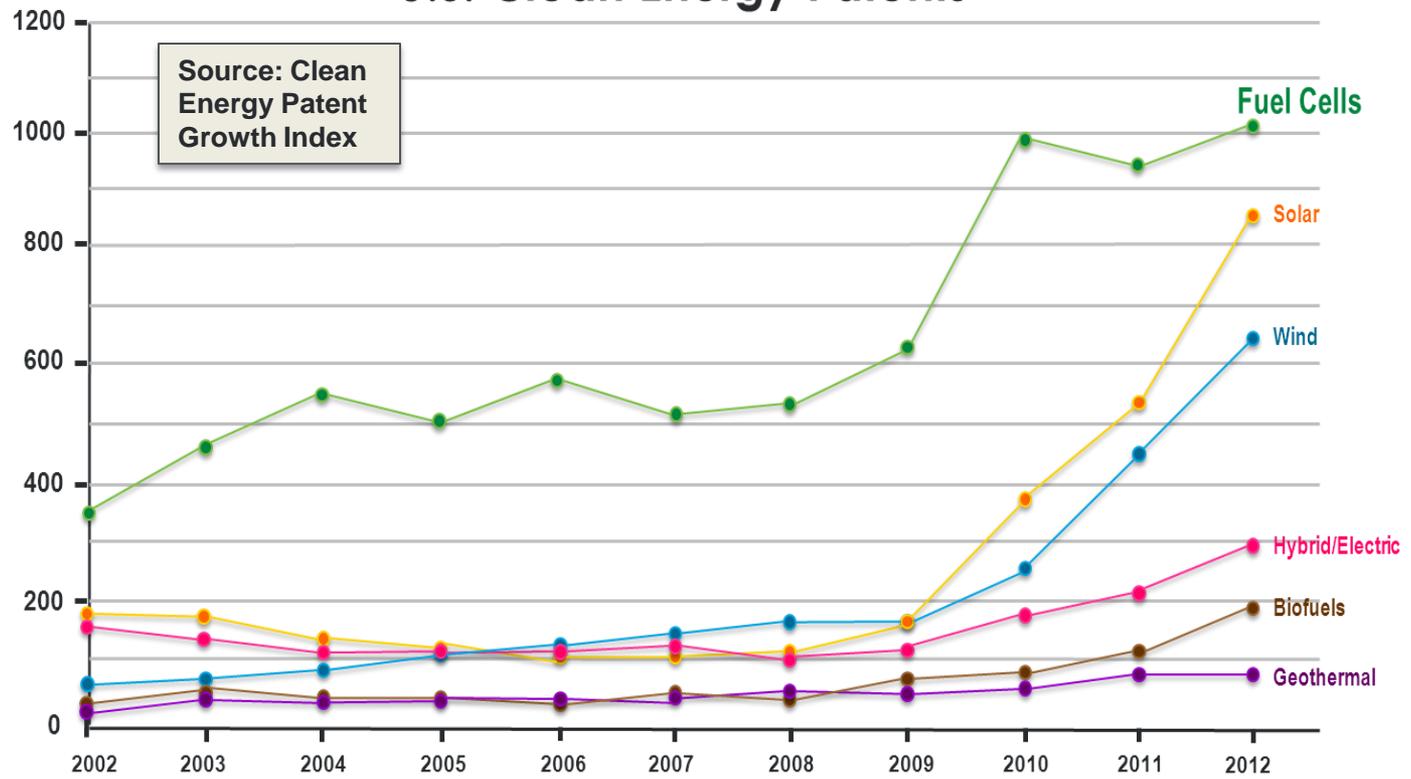


Bioenergy Technologies Office: Helps transform the nation's renewable and abundant biomass resources into cost-competitive, high-performance biofuels, bioproducts, and biopower.



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.

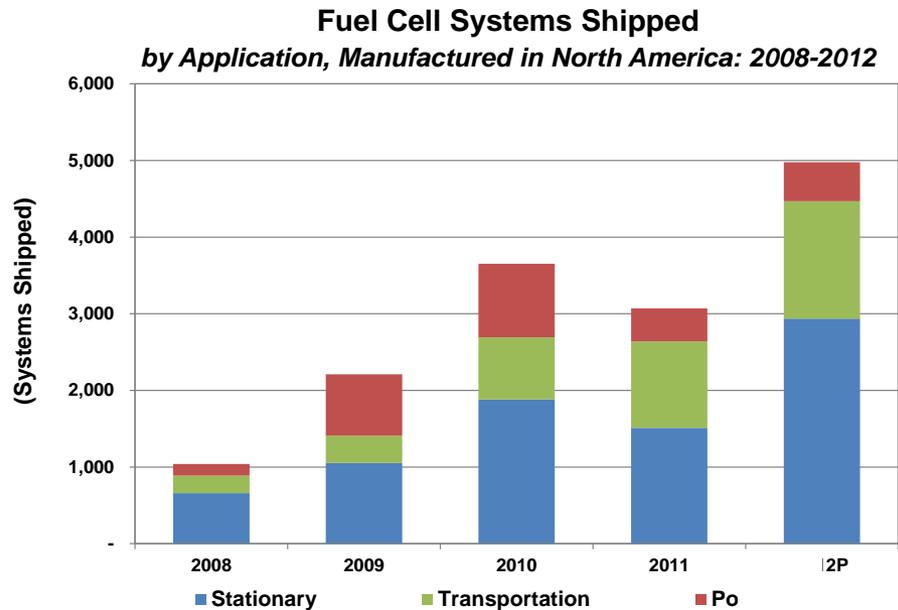
U.S. Clean Energy Patents



Source: Clean Energy Patent Growth Index

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



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**

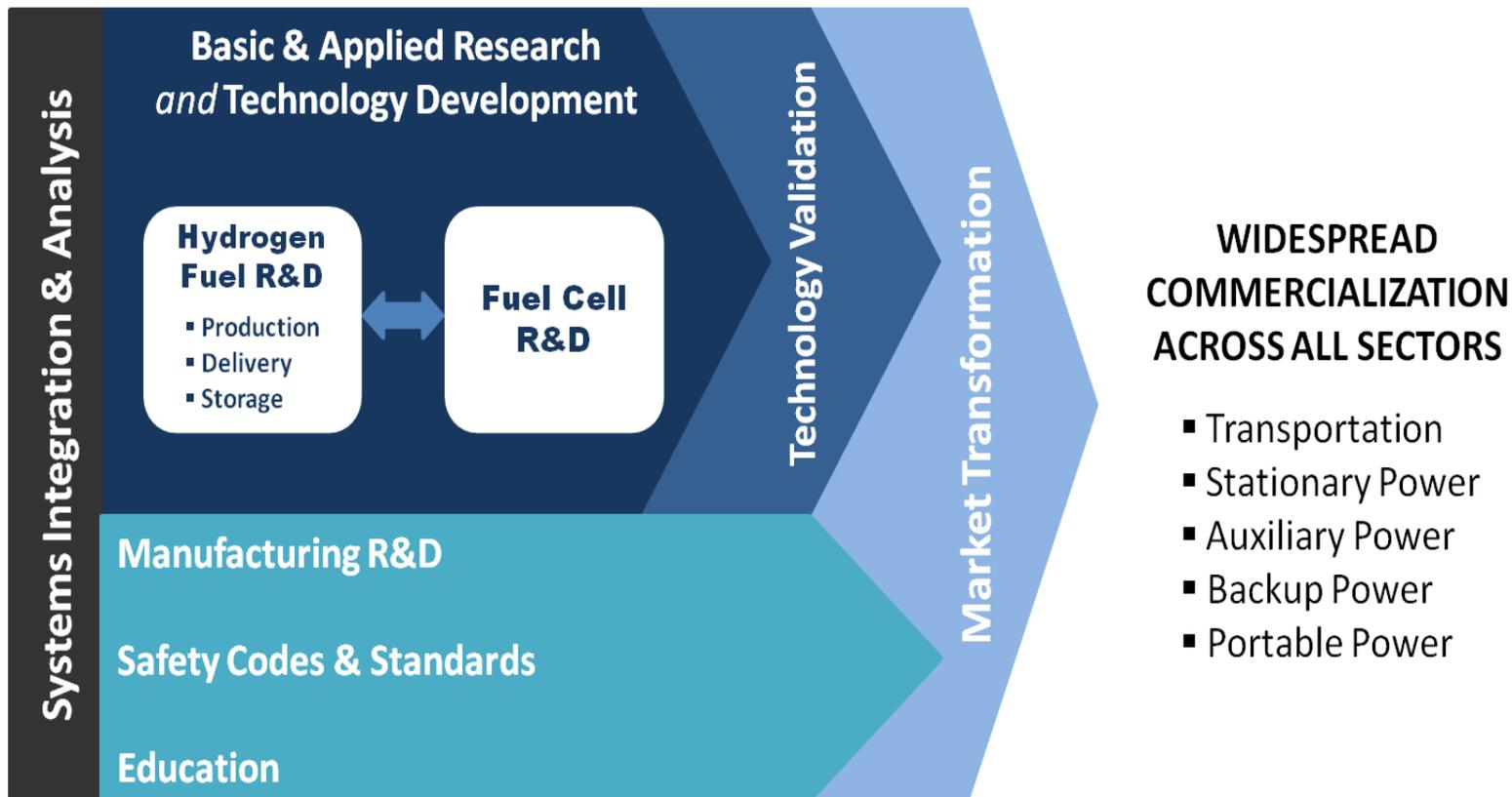
Market Potential

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

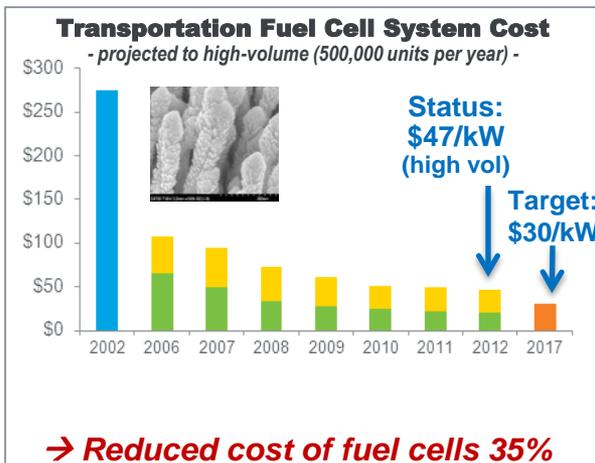
The Program is an integrated effort, structured to address all the key challenges and obstacles facing widespread commercialization.



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:

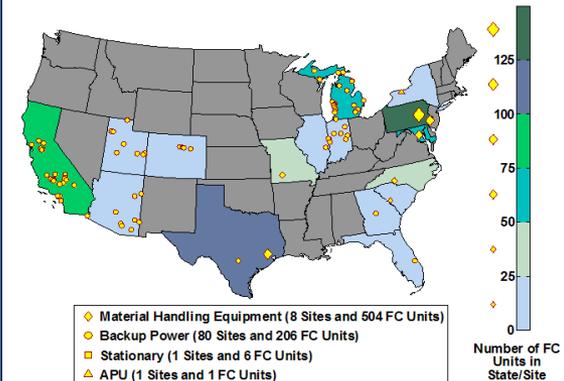
- **59% efficiency**
- **254 mile range (independently validated 430-mile range)**
- **75,000-mi durability**



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

H₂ Safety Best Practices

Welcome!

What is a best practice?
A best practice is a technique or methodology that has reliably led to a desired result. Using best practices is a commitment to utilizing available knowledge and technology to achieve success.

What is H₂BestPractices.org?
A wealth of knowledge and experience related to safe use and handling of hydrogen exists as a result of an extensive history in a wide variety of industrial and aerospace settings. Hydrogen is gaining increasing attention worldwide as a possible energy storage medium, for later conversion to electricity through fuel cells or for use as a combustion fuel. This focus has introduced many new participants to research, development, demonstration, and deployment of hydrogen technologies (e.g., fuel cell vehicles and stationary fuel cells).

The purpose of the Hydrogen Safety Best Practices online manual is to share the benefits of extensive experience by providing suggestions and recommendations pertaining to the safe handling and use of hydrogen. Best Practices have been compiled from a variety of resources, many of which are in the public domain and can be downloaded directly from the References section. Many others can be obtained via reference links found at various places within the manual.

Best Practices are organized under a number of hierarchical categories in this online manual, beginning with those displayed down the left-hand column. Because of the interdependence of the topical areas, however, individual pages are often accessible via multiple internal links. A web-based electronic document format lends itself well to this type of overlapping content.

Website features

Please notice the **mouse-over feature** on this website. When a word in the text appears in **blue font**, you can see its definition by placing your cursor over the word. All the definitions are compiled into a **Glossary** that can be accessed from the References section of every page. There is also an **Acronyms** list and a **Bibliography** that can be accessed from every page. When you click on the link to the Bibliography, it will take you to the alphabetized list of references for the particular section from which you accessed it. Please contact us if you notice any definitions, acronyms, or references that should be in these lists but aren't.

A word about safety

No information resource can provide 100% assurance of safety. Personnel with applicable expertise should always be consulted in designing and implementing any system carrying a potential safety risk.

This online manual is directly linked to a companion website, H2checklists.org, to provide unambiguous illustration of the importance of following safe practices and procedures when working with and around hydrogen. Like virtually all energy forms, hydrogen can be used safely when proper procedures are followed, but its use still involves a degree of risk that must be respected. The importance of avoiding complacency and/or haste in the safe conduct and performance of projects involving hydrogen cannot be overstated.

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hydrogen.energy.gov

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Hydrogen Safety Bibliographic Database

The [Hydrogen Safety Bibliographic Database](#) provides references to reports, articles, books, and other resources for information on hydrogen safety as it relates to production, storage, distribution, and use. The database includes references related to the following topics:

- Hydrogen properties and behavior
- Safe operating and handling procedures
- Leaks, dispersion, and flammable vapor cloud formation
- Embrittlement and other effects on material properties
- Fuel cells and other energy conversion technologies
- Sensors, tracers, and leak detection technologies
- Accidents and incidents involving hydrogen

In addition to bibliographic references, the database provides select full text documents or links to other Web sites that offer these documents. To obtain full text documents that aren't included in the database, contact your local library.

Looking for a safety-related bibliographic reference that isn't currently available in this database? We welcome your [suggested additions](#).

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Home > Codes and Standards > Introduction to Hydrogen for Code Officials

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Introduction to Hydrogen for Code Officials

The Department of Energy's [Introduction to Hydrogen for Code Officials](#) online training course provides an overview of hydrogen and fuel cell technologies, how these technologies are used in real-world applications, and references for related codes and standards.

The course consists of four modules:

- Hydrogen and fuel cell technology basics
- Hydrogen and fuel cell applications
- Hydrogen fueling stations
- Fuel cell facilities

A short quiz is offered at the end of each module. At the end of the course, you may print a "certificate of completion" that tallies your quiz score.

In addition, the course features a Library section with supplementary information including publications, related links, and a glossary of terms used in the course.

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Permitting Hydrogen Facilities

The objective of this U.S. Department of Energy Hydrogen Permitting Web site is to help local permitting officials deal with proposed hydrogen fueling stations, fuel cell installations for telecommunications backup power, and other hydrogen projects.

Resources for local permitting officials who are looking to address project proposals include [current citations for hydrogen fueling stations](#) and a listing of [setback requirements](#) on the Alternative Fuels & Advanced Vehicle Data Center Web site. In addition, this overview of [telecommunications fuel cell use](#) and an animation that demonstrates [telecommunications site layout](#) using hydrogen fuel cells for backup power should provide helpful information for local permitting officials to address project proposals. You can also view current [Stationary and Portable Fuel Cell Systems Codes and Standards Citations](#).

If you have any suggestions for making this site more useful, please [let us know](#).

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H₂ 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:



Mercedes-Benz





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

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