Fuel Cells for Critical Communications Backup Power

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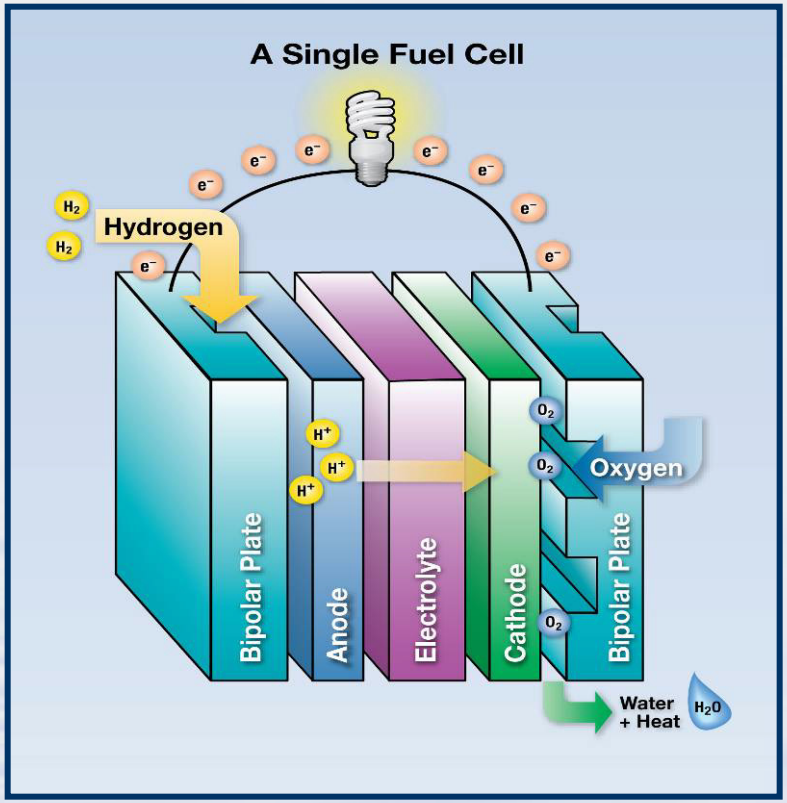
Fuel Cell Overview

Fuel cells use hydrogen to create electricity, with only water and heat as byproducts

- An individual fuel cell produces about 1 volt
- Hundreds of individual cells can comprise a fuel cell stack
- Fuel cells can be used to power a variety of applications –Bibliographic Database
  - Laptop computers (50-100 W)
  - Distributed energy stationary systems (5-250 kW)
  - Passenger vehicles (80-150 kW)
  - Central power generators (1-200 MW)



Why hydrogen?

- Diverse domestic resources
- Efficient, reliable power
- Zero/near-zero emissions

Renewable Sources:

- *Wind*
- *Biomass*
- *Solar*
- *Geothermal*
- *Hydro*
- *Ocean*

Nuclear

Natural Gas
(for transition period only)

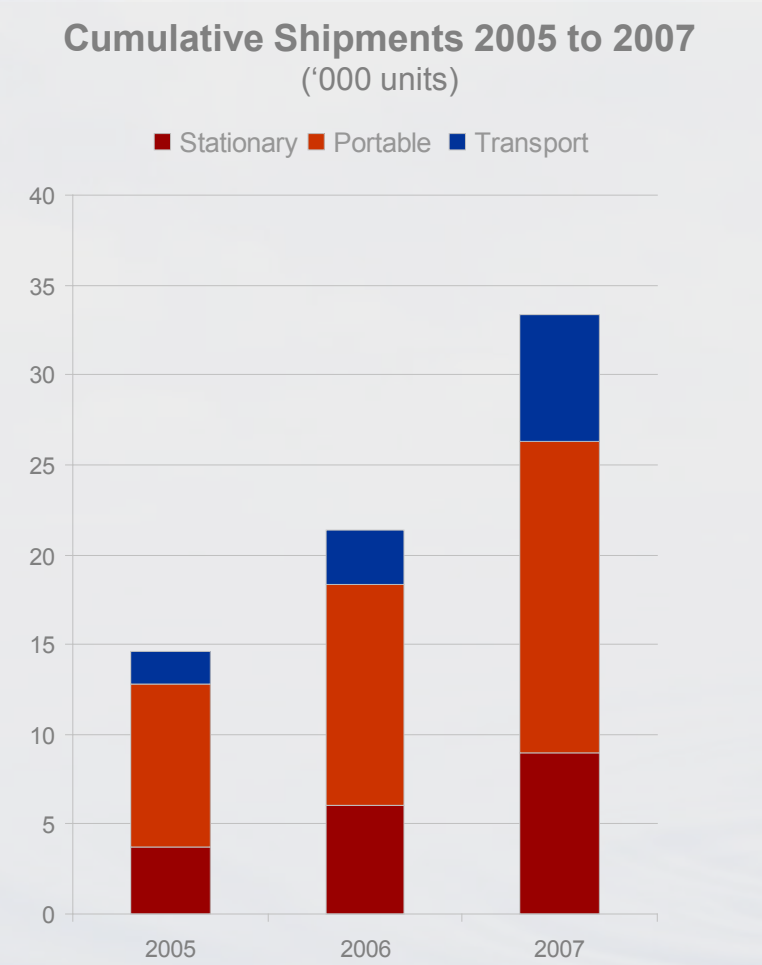
Coal
(with carbon sequestration)

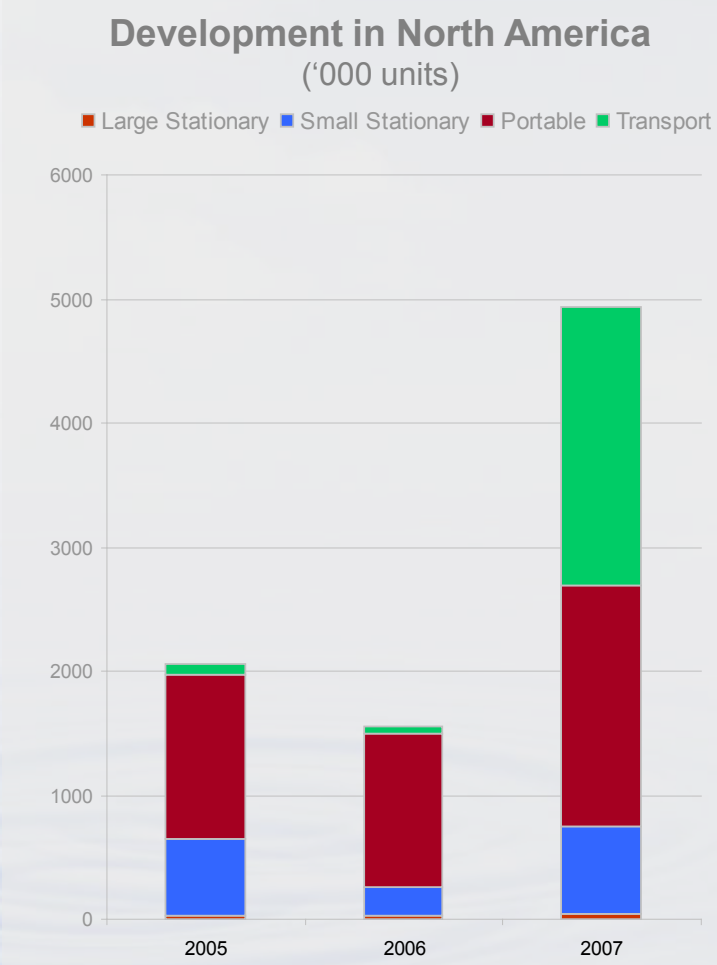
Stationary/ Backup Power

Transportation

Specialty Markets

The fuel cell industry has seen an average annual growth of 59% over the past three years. More than 12,000 new units were shipped in 2007.



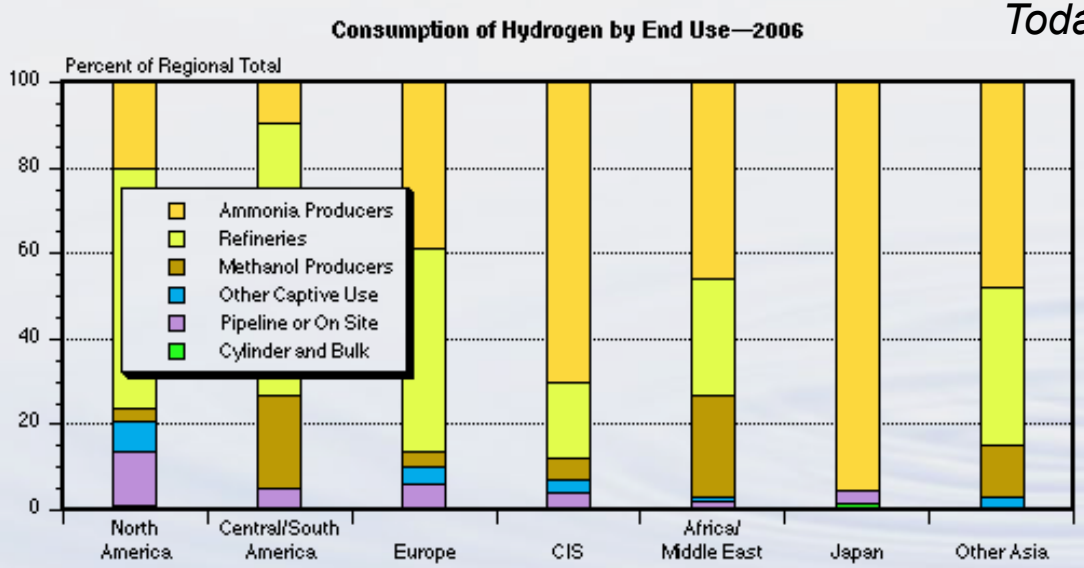


Source: Fuel Cell Today Industry Review 2008

Hydrogen refinery consumption expected to increase by 40% from 2006-2011.

Global Hydrogen Trends

- 53 million metric tons consumed 2006
- 80 million metric tons forecasted demand 2011
  - Global environmental regulations and the quality of today's sour crude feedstock will drive consumption in excess of 40% over the next five years
  - Oil-sands processing, gas-to-liquids, and coal gasification projects that are ongoing, require enormous amounts of hydrogen and will boost the size of the market



Today ~96% of all hydrogen is from fossil fuels
~49% from natural gas
~29% liquid hydrocarbons
~18% coal with and
~4% electrolysis and other sources

U.S. hydrogen production
~ 9 million metric tons

Source: http://www.sriconsulting.com/CEH/Public/Reports/743.5000/

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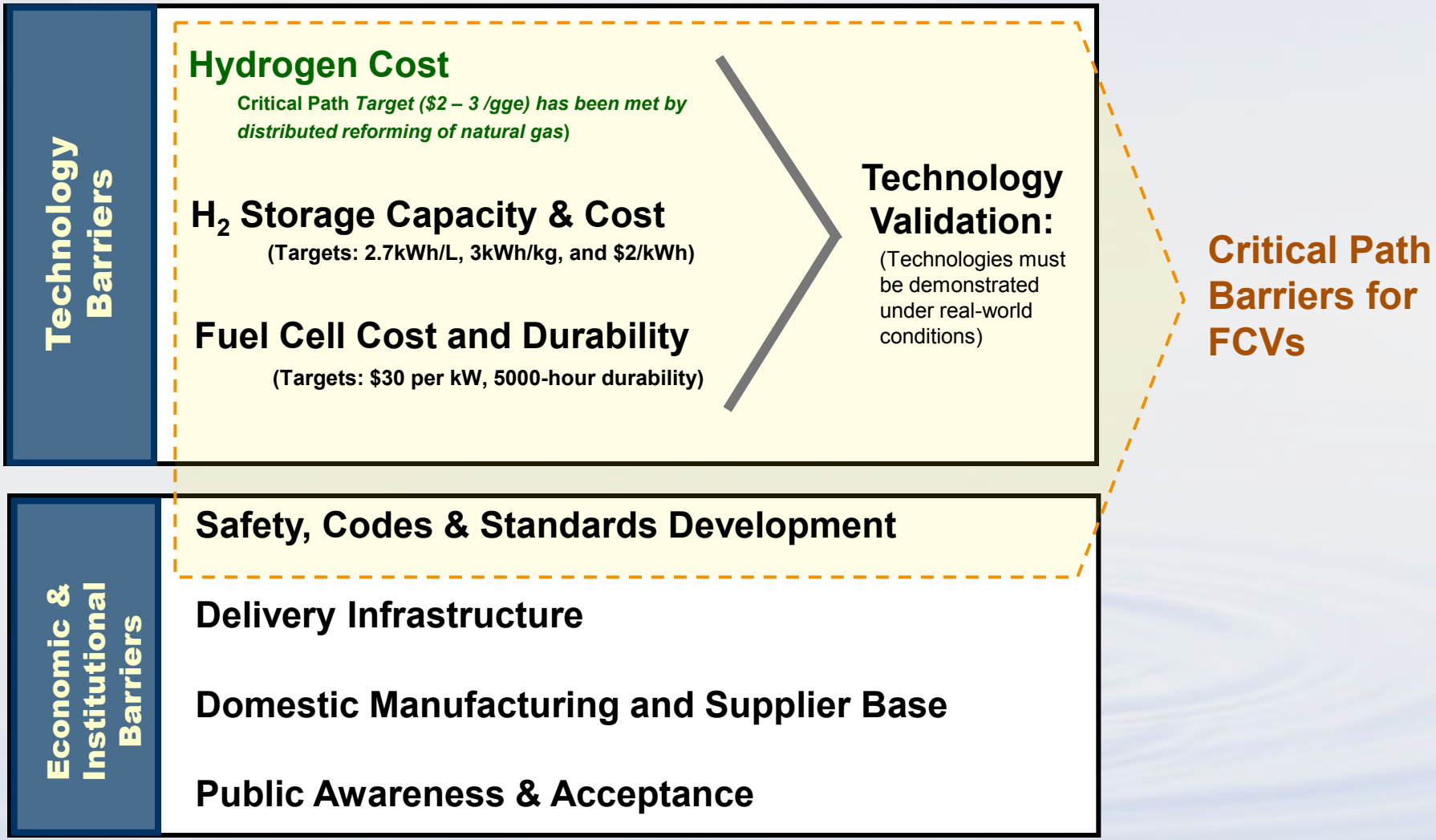
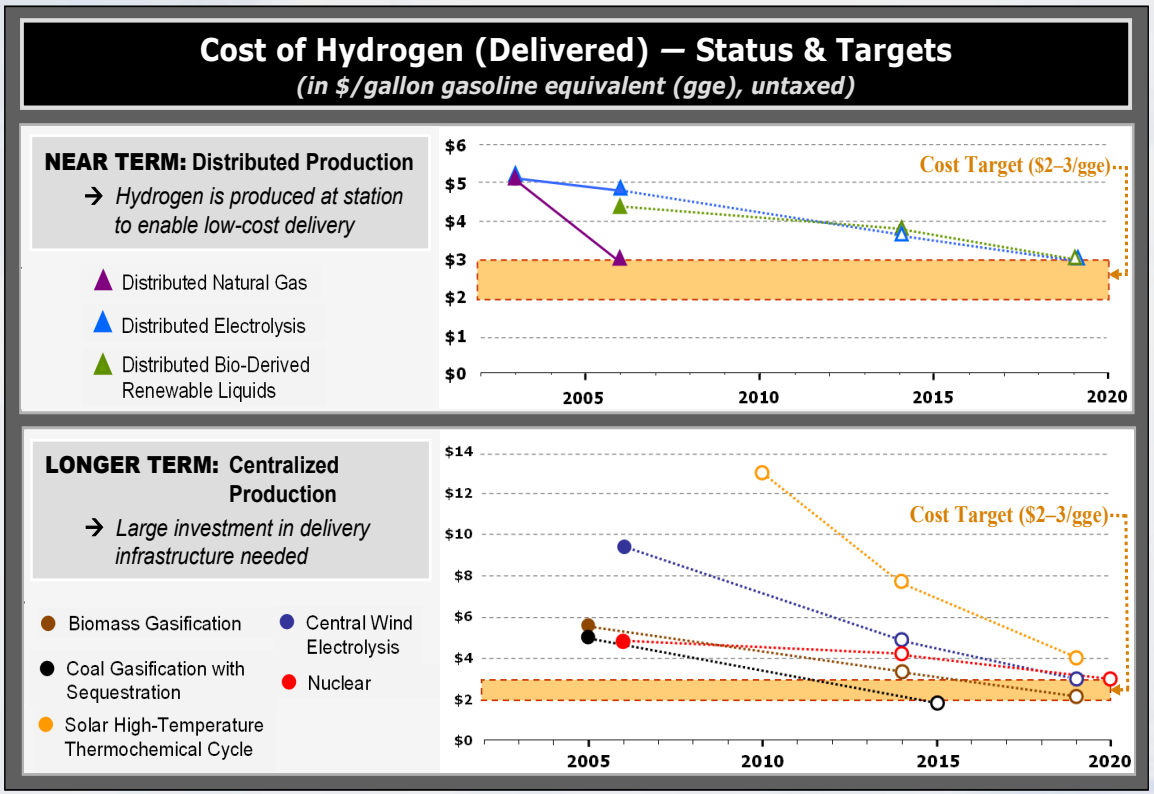
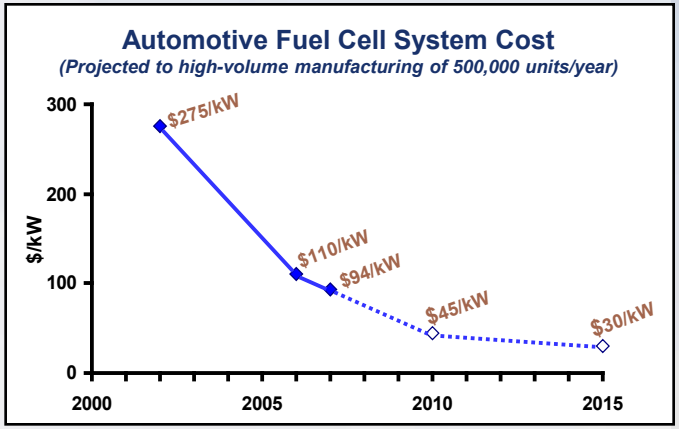
The Hydrogen Program is addressing critical barriers to enable the widespread commercialization of hydrogen and fuel cell technologies.

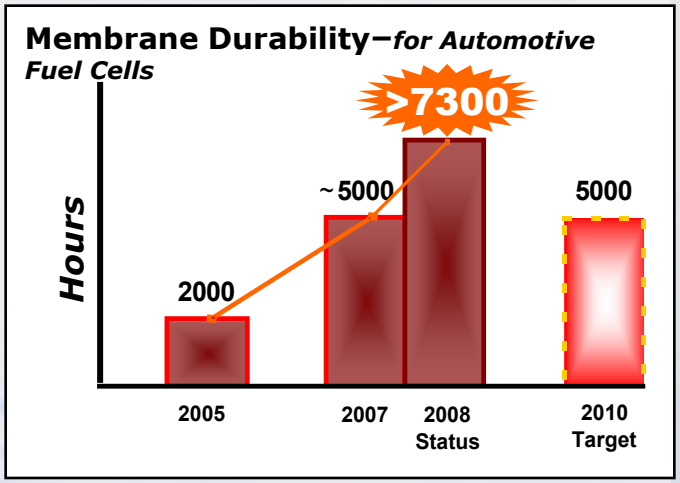


Significant progress has been made as a result of DOE funded R&D.



Open symbols for cost reduction targets subject to appropriations





- Reduced high volume automotive fuel cell cost to $94/kW (by 65%)
- Doubled automotive stack durability to 2,000 hrs
- Identified materials with > 50% improvement in storage capacity since 2004
- Demonstrated membrane durability of 7,300 hrs (exceeded 2010 target of 5,000 hrs)

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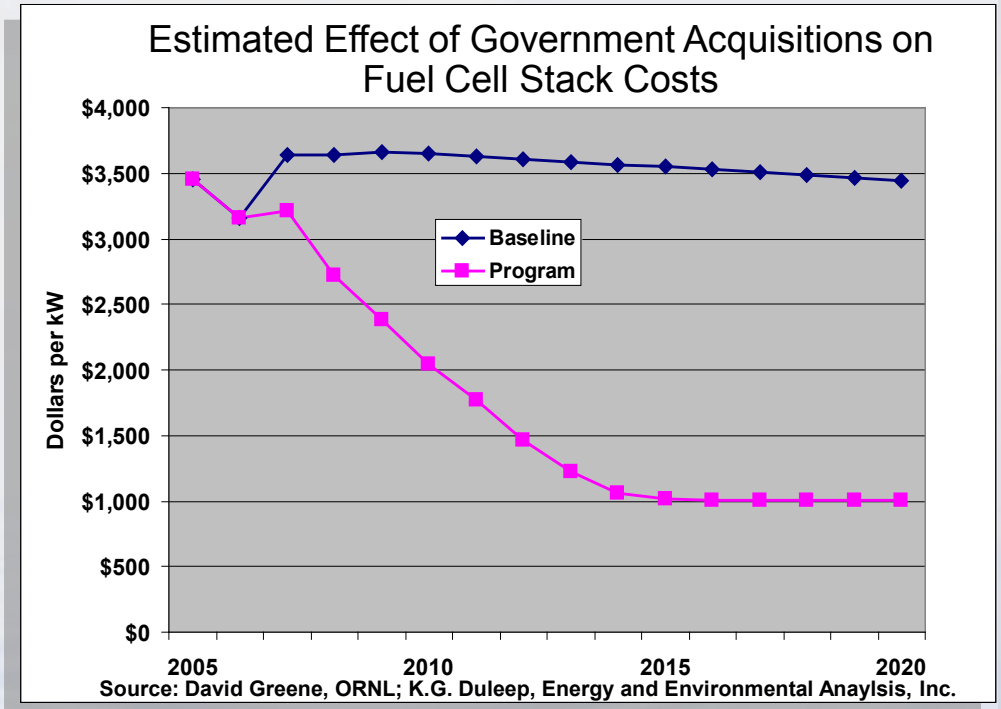
Market Transformation

The Program is working to reduce the non-technical barriers facing the commercialization of hydrogen and fuel cell technologies

Objectives

- Assist Federal agencies in using hydrogen and fuel cells to meet the requirements of:
  - EPACT 2005 Sec. 782 and 783
  - Executive Order 13423
- Increase volume of fuel cell purchases to achieve economies of scale
- Support national infrastructure and domestic supplier base development
- Improve user confidence in fuel cell reliability by collecting operations data



Government acquisition – even at a relatively modest level – appears to be enough to drive down fuel cell costs

Fuel cells for backup power

Customer Benefits

- Provide longer continuous run time, greater durability than batteries
- Offer cost savings over batteries and generators
- Small footprint
- Suitable for extended runtime applications
- Require less maintenance than generators
- Fewer moving parts resulting in increased reliability
- Remote monitoring
- Lightweight
- Quiet

A 1-kW fuel cell system has been providing power for this FAA radio tower near Chicago for more than 3 years.

Photo courtesy of ReliOn

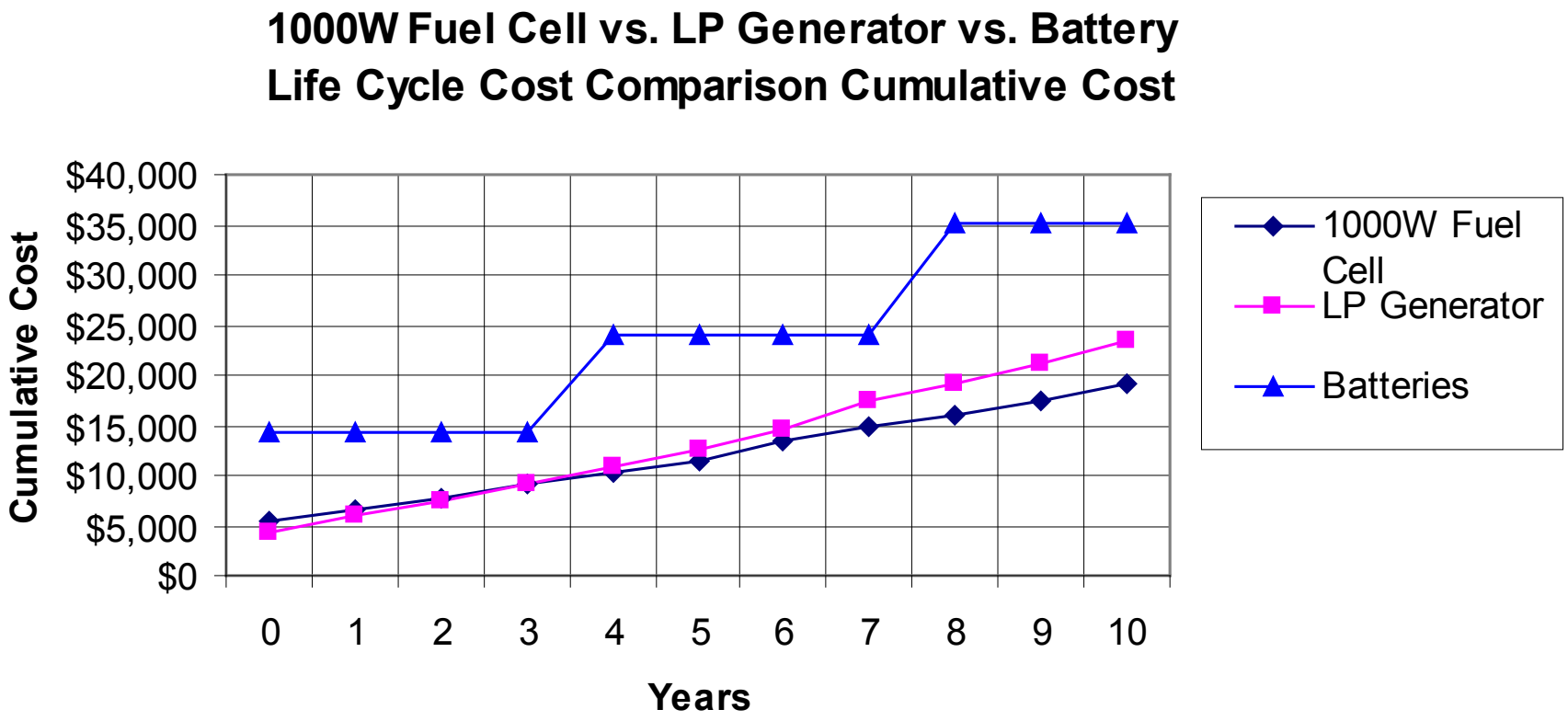
Fuel cell technology is cost-competitive today…

	OUTDOOR INSTALLATIONS		
	BATTERY/ GENERATOR	PEM FUEL CELL WITHOUT TAX INCENTIVE	PEM FUEL CELL WITH TAX INCENTIVE
8-hour run time			
52-hour run time	$61,082	$61,326	$56,609
72-hour run time	$47,318	$33,901	$32,014
176-hour run time*	$75,575	$100,209	$95,491

Source: Battelle Memorial Institute

** Additional cost for PEMFCs at 176-hour run time is due primarily to the cost of hydrogen storage*

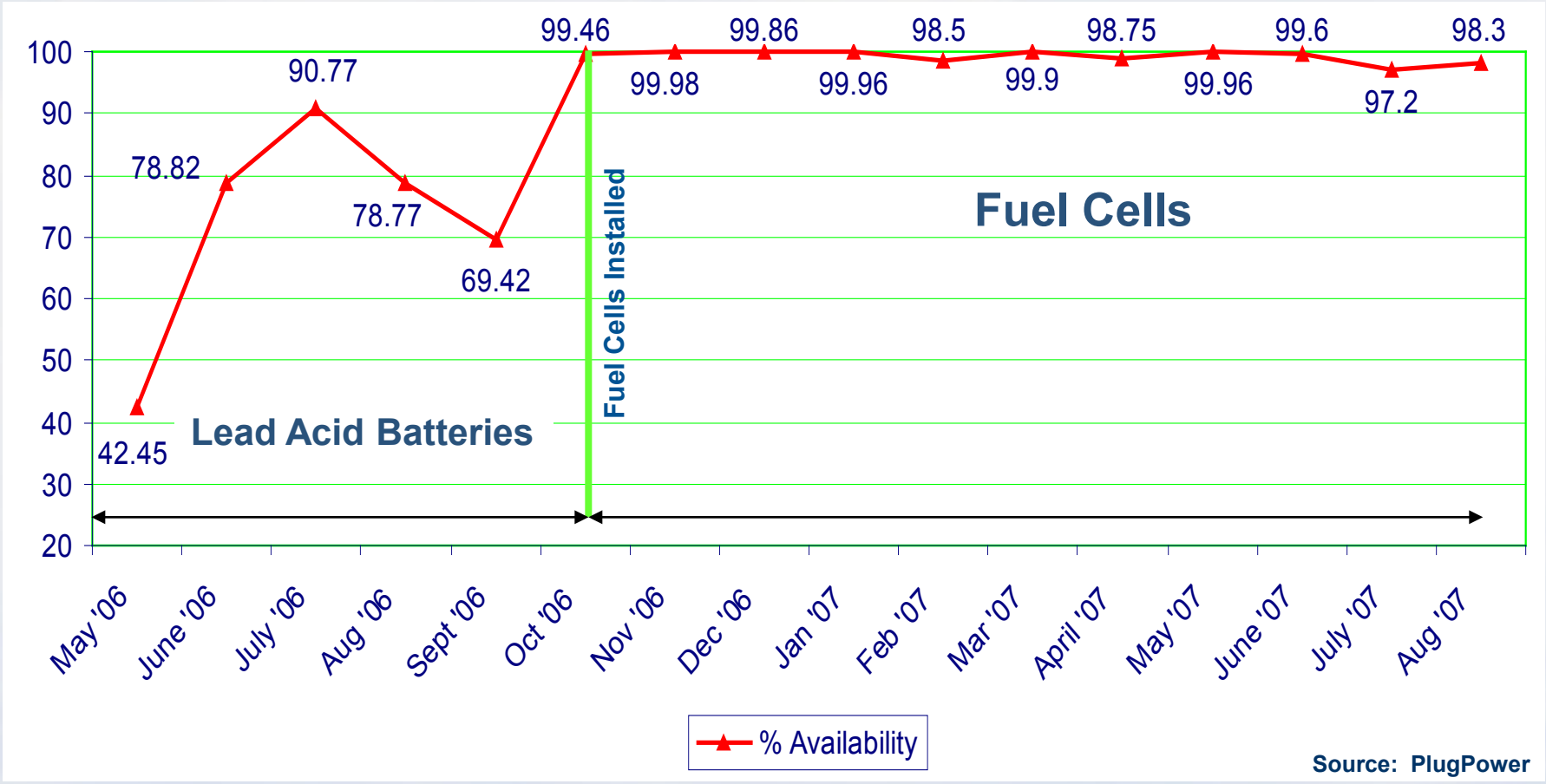
Life Cycle Cost Savings



Source: National Weather Service, www.eere.energy.gov/hydrogenandfuelcells/pdfs/fuel_cell_mtng_leonardo.pdf

Reliability

A major wireless carrier in Mexico switched to fuel cells from batteries at a critical BTS site in October 2006. Availability increased to over 99.5%.



Source: PlugPower

Examples of PEM Fuel Cell Products for Backup Power

ReliOn	Plug Power	IdaTech
1.2 kW	5 kW	3-5 kW (can be configured in parallel up to 15 kW)
24-48V DC	+/- 46-56V DC	+/- 48V DC
-40°C to 46°C	-40°C to 46°C	-40°C to 50°C
23.5"h x 12.75"w x 19"d	44"h x 26"w x 24"d	25"h x 40"w x 53"d
Compressed hydrogen	Compressed hydrogen	Compressed hydrogen
UL, CSA, CE	CE, FCC Class A, UL Listed to ANSI Z21.83, GR-63, GR-1089, GR-487, NEBS Level 3	CE, ANSI/CSA FC-1, NEBS Level 3

- **The U.S. Fuel Cell Council Commercially Available Fuel Cell Product List: http://www.usfcc.com/resources/outreachproducts.html**
- **General Services Administration (GSA) is currently in the process of creating a new 'Innovative Energy Solutions' Schedule that will make the purchase of fuel cell systems easier for Federal agencies**

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Fuel Cell Implementation Case Study

- New York Power Authority (NYPA) funded the installation of 24 Plug Power GenCore® fuel cell systems across New York State
- The systems provide backup power at public safety communications facilities
  - For example, emergency communication towers that support two-way radio transmissions
- Most systems are 5-kilowatt, 120-volt systems with a hydrogen cabinet housing six tanks, which can provide up to 12 hours of backup runtime
- Fuel cells were selected over traditional generators for backup power due to their demonstrated reliability
- A typical 5-kilowatt system cost ~ $20,000 to purchase and install
- Lessons learned? It's easy to do! Fuel cells are not difficult to install and operate, and training is easily accomplished

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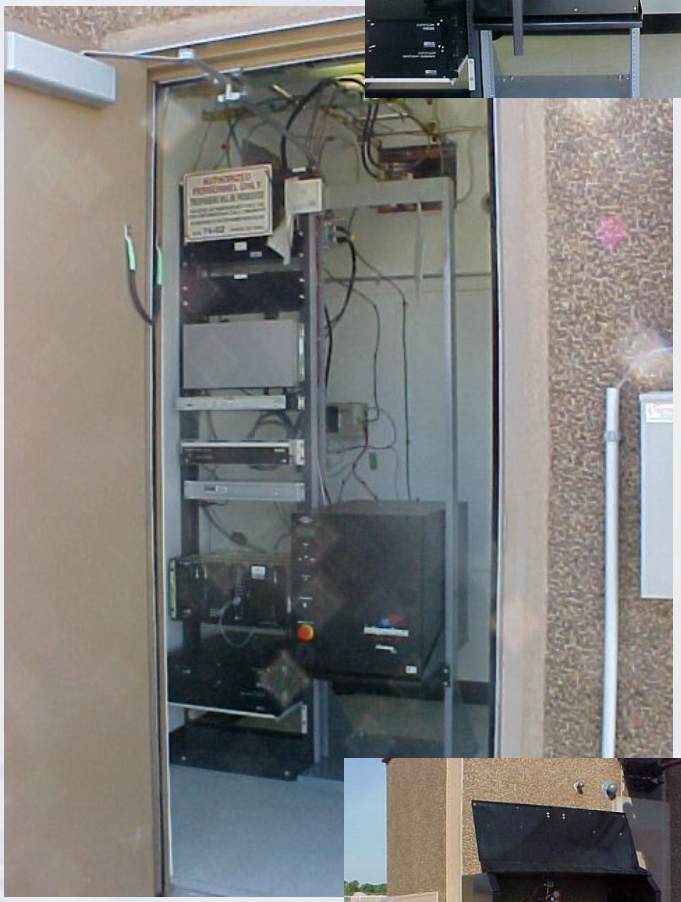
Current PEM Fuel Cell Installations – Elk Neck State Park, Maryland

- The Elk Neck Tower, a single-channel microwave repeater radio tower, supports several tenants, including the State of Maryland's E-911 Communications System.
- The state park is currently using two 1 kW ReliOn systems for extended backup to the site.
- E-911 radios are configured to run on a 48 V power system normally supplied through primary grid power. The total peak power load for this equipment configuration ranges from 200 to 450 W.
- During Hurricane Isabel and in its aftermath (September 2003), the fuel cell system enabled critical radio communications over the microwave network for Maryland State Police and emergency medical response services until primary grid power was restored.

Current PEM Fuel Cell Installations - Multi-Agency Radio Communication System (MARCS), Ohio



- MARCS provides mobile voice, data, vehicle location, and computer-aided dispatching services within a single computer system that is shared by multiple state agencies.
- PEM fuel cells installed at four microwave radio towers in early 2004. Currently, three sites are operational.
- PEM fuel cells provide backup power; replaced generators.
- Have installed 1 kW ReliOn PEM fuel cells to power the electronics and to keep the battery charged (cannot run AC or lights). Replaced a 15 kW generator.
- Backup runtime provided by PEM fuel cells is approximately 4-6 days.
- Fuel is compressed hydrogen.
- PEM fuel cell has never failed to come online when required.

Funding Opportunity

DOE Hydrogen Program
Funding Opportunity Announcement

"Research, Development, and Demonstration of Fuel Cell Technologies for Automotive, Stationary, and Portable Power Applications"

- Issued May 27, 2008
- Closes August 27, 2008
- Topic 7A: Emergency Backup Power Systems
- www.hydrogenandfuelcells.energy.gov/advanced_fc_technology.html

Education Activities

APCO 74TH ANNUAL CONFERENCE & EXPO 2008

New Projects Just Announced:

State and Local Government Outreach *– CT, OH, SC, TX, VA; Clean Energy States Alliance, Technology Transition Corporation will lead outreach efforts that are national in scope*

Early Deployment and Education *– Carolina Tractor & Equipment (forklift demonstration/end user outreach)*

University Programs *– Humboldt State University, California State University-LA, University of Central Florida, Michigan Tech, University of North Dakota*

Recent Activities & Progress

Interim Survey – Began collecting data for next survey (follows 2004 baseline, will publish in FY09)

First Responders & Code Officials

- Upgraded intro course – 6,200 users since launch
- Began development of advanced course
- "Introduction to Hydrogen for Code Officials" in draft

Local Communities --

- Radio spots, podcasts, MySpace, Orlando Magic Collaboration

End-Users – Early market fact sheets, event outreach

Students

- Completed middle school guides, reached 6,000 teachers through workshops
- New 2-week unit for high school science classes to be field tested

INCREASE YOUR H_2IQ hydrogen.energy.gov

Safety, Codes and Standards

- *DOE is working with the first responder community and others to dispel myths and provide accurate, objective information about hydrogen safety.*
- *Codes and standards have been developed and are in the process of being updated.*

Safety

First Responder Course

- Basic information for fire and law enforcement personnel
  www.hydrogen.energy.gov/firstresponders

Safety Bibliographic Database

- Contains ~400 documents related to hydrogen safety
- *www.hydrogen.energy.gov/biblio_database*

Safety Best Practices Manual

- Provides recommendations pertaining to the safe handling and use of hydrogen
- *http://h2bestpractices.org/*

Codes and Standards

Hydrogen and Fuel Cell Codes and Standards Database

- Contains status of fuel cell codes and standards activities, services, and events
- *www.fuelcellstandards.com*

Permitting Guides

- Contains information on the regulatory process and relevant codes and standards
- *www.eere.energy.gov/hydrogenandfuelcells/codes/permitting_guides.html*

Permitting Compendium for Stationary Installations *(Coming soon)*

Incentives

Federal tax credit:

Provided by the Energy Policy Act of 2005, Sections 1335 and 1336: investment tax credit for stationary fuel cells (residential and business) of $1,000/kW or 30%

State incentives:

A number of states have incentives and loan programs to encourage the use of energy efficient technologies and renewable energy systems

Learn more about incentives!

www.fuelcells.org/info/statedatabase.html

www.dsireusa.org

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DOE Information Resources

*Visit **www.hydrogen.energy.gov** or call the DOE Information Center at **877-EERE-INFO/877-337-3473** for copies of DOE hydrogen and fuel cell information resources*

Learn more –

- *Introductory fact sheets*
  - ✓ Fuel cells – technology overview, fuel cells for backup power, fuel cells for material handling equipment
  - ✓ Hydrogen production, delivery, and storage technologies
  - ✓ Hydrogen safety
- *Podcasts* – short audio files on hydrogen and fuel cell topics
- *Overview book* – includes a chapter on each technology area
- *Animations* – how fuel cells work

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Questions?

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