

# Market Transformation: Fuel Cell Early Adoption

*DOE Fuel Cell  
Pre-Solicitation Workshop*  
January 23, 2008

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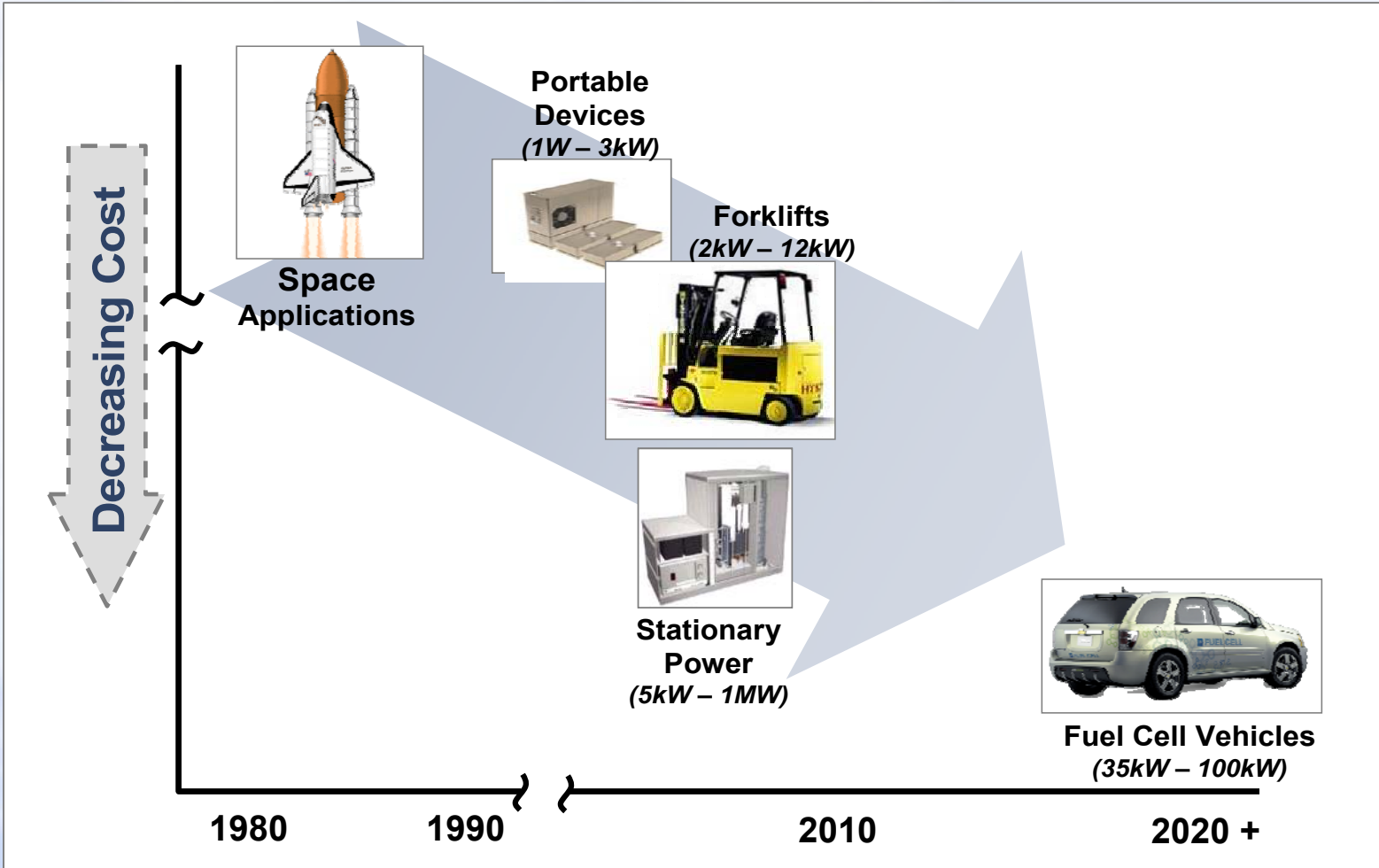
# Outline

- Market Transformation
- The Role of Federal Government
- Hydrogen and Fuel Cells In Vehicles and Equipment (HyFIVE) Action Plan
- HyFIVE Market Transformation Strategy
- Early Market Applications
- Next Steps



# Market Transformation — *From Early Markets to Fuel Cell Vehicles*

**Early markets in stationary, portable, and niche applications will lower cost and establish a supplier base—to pave the way for the commercialization of fuel cell vehicles**





# The Role of Federal Government

## **EPACT 2005– Section 782 and 783, Federal Purchase Requirements**

**Section 782:** Lease/purchase fuel cell vehicles for light or heavy duty fleets

**Section 783:** Lease/purchase stationary, portable, or micro fuel cells for electrical power



*General Hydrogen forklifts and refueling infrastructure*

## **Executive Order 13423 “Strengthening Federal Environmental, Energy, and Transportation Management” provides the framework for early adoption of hydrogen and fuel cell systems.**

Section 2 of the E.O. directs Federal agencies to implement sustainable practices for (1) energy efficiency and reductions in greenhouse gas emissions; (2) use of renewable energy; and (3) acquisition of green products and services.

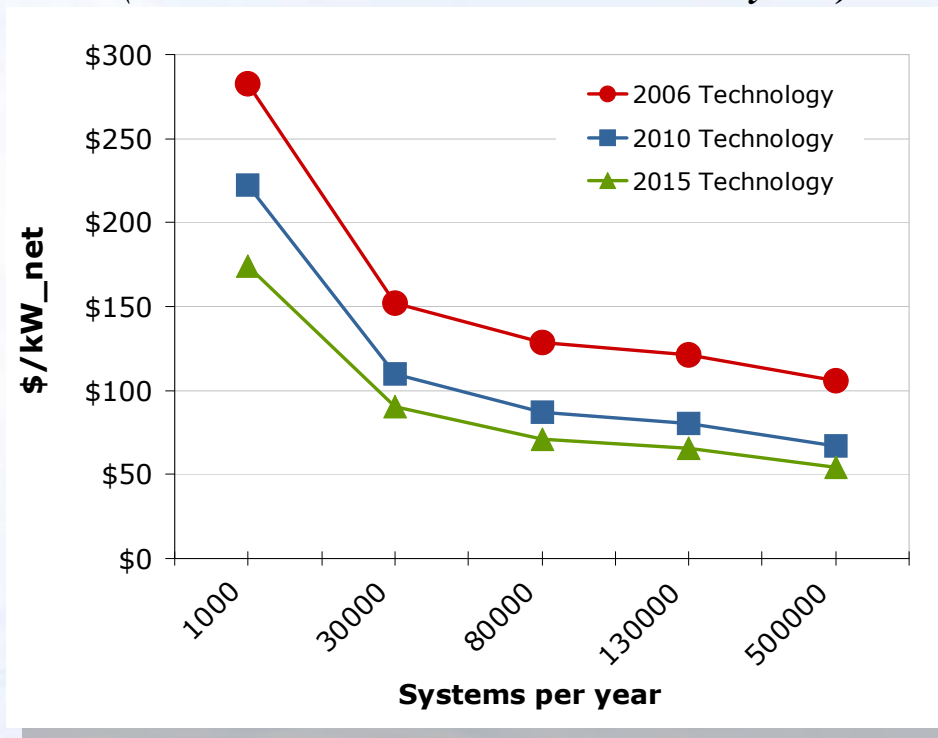


# HyFIVE Action Plan

## Achieve market transformation by increasing:

- Demand for fuel cells to achieve manufacturing economies of scale
- Domestic supplier base capability

**Fuel Cell Cost\***  
(based on 80-kW Automotive Fuel Cell System)



\* Based on DTI DFMA cost analysis. 2010 and 2015 projections assume technology meets DOE targets.



## **HyFIVE Market Transformation Strategy**

- Identify early adopter applications
- Deploy fuel cells in Federal / State governments and select industries
- Document fuel cell performance
- Develop success stories to increase public awareness
- Develop a recognition program to build customer awareness and confidence in the technologies
- Conduct education and outreach efforts to raise awareness of the technologies



# Market Transformation — *Early Markets for Material Handling Equipment*

## Fuel Cells...

- Allow for rapid refueling – quicker than changing-out or replacing batteries
- Provide constant power – without voltage drop
- Eliminate need for space for battery storage and chargers

***Fuel cell technology is  
cost-competitive today...***



Photo courtesy of Hydrogenics

	3kW PEM FUEL CELL PAIRED WITH INTEGRAL NiMH BATTERY, FOR PALLET TRUCKS*		
	BATTERY-POWERED (2 batteries per truck)	PEM FUEL CELL-POWERED, WITHOUT INCENTIVE	PEM FUEL CELL-POWERED, WITH INCENTIVE
Net Present Value of Capital Costs	\$17,654	\$23,835	\$21,004
Net Present Value of O&M Costs (including the cost of fuel)	\$127,539	\$52,241	\$52,241
Net Present Value of Total Costs of System	\$145,193	\$76,075	\$73,245

Source: Identification and Characterization of Near-term Direct Hydrogen Proton Exchange Membrane Fuel Cell Markets, Battelle Memorial Institute (April 2007)



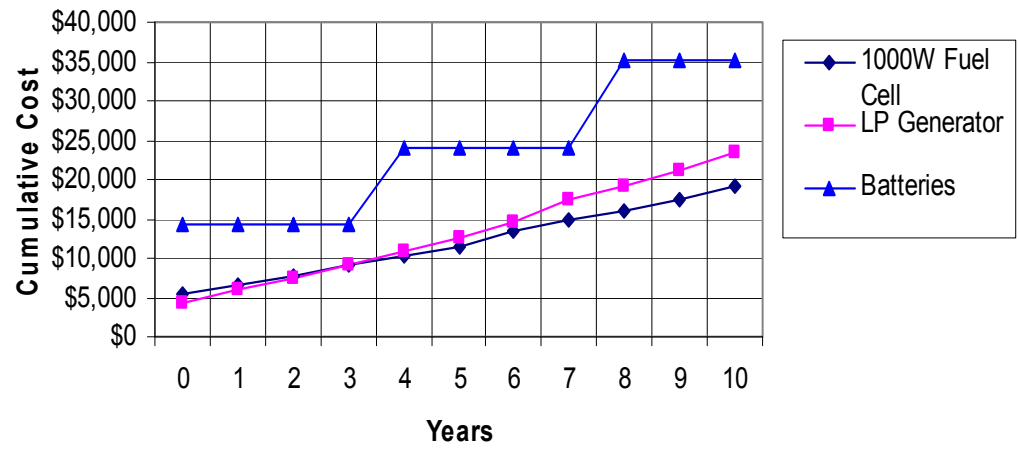
# Market Transformation — Early Markets for Backup Power

## Fuel Cells...

- Provide longer continuous run time – greater durability than batteries
- Require less maintenance than generators
- Offer cost savings over batteries and generators

**Fuel cell technology is cost-competitive today...**

1000W Fuel Cell vs. LP Generator vs. Battery  
Life Cycle Cost Comparison Cumulative Cost



	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





# Market Transformation — *Early Markets for Data Centers*

## About data centers...

- **Large Demand:** 58.7 billion kWh (U.S., 2006) = approx. 5 days of U.S. domestic electricity use.
  - growing 14% annually and will double by 2011
- **Low overall efficiency:** From the energy source, the fuel efficiency of a data center's computing operations is <15%.
- **Half of the energy consumption of data centers is used for cooling:** Power requirements are proportional to cooling requirements



## Fuel Cells for Data Centers...

- Provide high-quality, reliable, grid-independent on-site critical load power
- Improve the effectiveness of data center power use by 40% (CHP)
- Produce no emissions
- Have low O&M requirements
- Can be remotely monitored



## Next Steps

- Identify financial mechanisms to assist with deployment of fuel cells. Include models, tools, and templates.
  - Bundling of finance options
  - Power purchase agreements, i.e. NREL / WAPA PV contract
  - DOE Loan Guarantee Program
- Generate industry-supplied value proposition for fuel cell technologies.



## Next Steps, Cont'd

- Complete quantitative assessment of fuel cells addressing:
  - Current sales and projected growth
  - Effect of government intervention on commercialization and manufacturing economies of scale, i.e. moving down the cost-curve
  - Energy efficiency
  - Emissions reductions
- Evaluate ways to increase the number of fuel cell products on the GSA Schedule.



# Thank You

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