

# Fuel Cell Capabilities

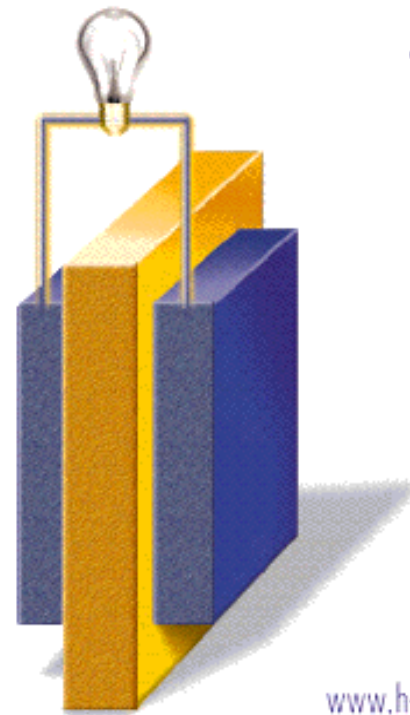
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Interagency Task Force  
18 December, 2007

# Fuel Cells - Defined



Fuel cells combine hydrogen & electrochemically to produce electricity, water and useful heat.



[www.h-tec.com](http://www.h-tec.com)

# Unmatched *combination* of benefits

- Electrochemistry, not combustion
- Low / Zero Emissions
- High Efficiency → Low CO<sub>2</sub>
- Flexible: Wide Range of Applications / Distributed Installation
- High Quality, Reliable Power (DC or AC)
- Quiet
- Fuel Flexible (incl. biogas, waste gases)

# Advance US policy goals

- Reduce smog, other environmental benefits
- Reduce carbon intensity
  - High efficiency generation
  - CHP capability
  - Peak shaving

# Advance US policy goals

- Open new energy supply pathways (fuel flexibility)
- Increase security of supply
  - distributed installation
  - Grid stability
  - Virtually 100% reliability possible
  - Long run-time backup capability
  - Portable backup capability
  - High quality for sensitive equipment

# Advance US policy goals

- Economic Benefits, strengthen industrial base
  - 500,000 jobs
- Fuel Cells open the door to hydrogen energy
- Fuel cells create a pathway for renewable transportation energy

# How we can help (available products)

- Power gen / CHP: 200 kW – 2.4 MW
- Federal buildings, off-grid capability, assured power
- Small scale power generation / backup power:
  - < 1 kW – 125 kW
  - Plug, ReliOn, Idatech (soon) on GSA schedule
  - Telecom, data centers, remote application


# How we can help (available products)

- Portable systems: up to 9 kW but generally smaller
- Power packs for diverse applications
- Forklifts and similar in several classes
  - Through forklift OEM's
- Battery chargers, continuous run-time systems consumer electronics and specialty applications
- Education kits




# What's available


54 products  
on USFCC  
voluntary  
list



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### Commercially Available Fuel Cell Products


Manufacturer	Product Name	Application <sup>1</sup>	Configuration <sup>2</sup>	Output	Warranty Available?	Find more information and place an order at:
	Mark 902	Transportation	PEM	85 kW	✓	<a href="http://www.ballard.com">www.ballard.com</a>
	Mark 9 SSL	Materials Handling / Light Mobility	PEM	4.4 - 19.3 kW	✓	
	Mark 1030	Cogeneration	PEM	1.3 kW	✓	



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### Commercially Available Fuel Cell Products

Manufacturer	Product Name	Application <sup>1</sup>	Configuration <sup>2</sup>	Output	Warranty Available?	Find more information and place an order at:
	HyPM Power Pac					
	HySTAT Hydroge Station					
		ElectraGen™ 5				
		ElectraGen™ 3				
		ElectraGen XTR				
		iGen™ ***				
		N-Cen				
		XRT				
		FillPoint				
		FillOne				
		N-Stor130				
		N-Stor360				
		Medis Power Pac				
		Moblion 30M1***				
		Moblion 1M1***				
		PowerFlow PFS-0				
		PowerFlow PFS-0				
		HDL-82				
		Forza RPM				
		HDL-82				
		GenCore® 5T				
	GenCore® 5U					



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### Commercially Available Fuel Cell Products

Manufacturer	Product Name	Application <sup>1</sup>	Configuration <sup>2</sup>	Output	Warranty Available?	Find more information and place an order at:
	T-1000	Backup	PEM	600 -1200 W	✓	<a href="http://www.relion-inc.com">www.relion-inc.com</a>
	T-2000	Backup	PEM	600 W - 2kW	✓	
	I-1000	Backup	PEM	1 kW	✓	
SFC Smart Fuel Cell	EFOY 600	Mobile / Backup	DMFC	600 WH/day	✓	Non Member
	EFOY 1200	Mobile / Backup	DMFC	1,200 WH/day	✓	
	EFOY 1600	Mobile / Backup	DMFC	1,600 WH/day	✓	
	Titan Series H <sub>2</sub> Generators	Industrial, Transportation	Alkaline Electrolysis	2 - 60 Nm <sup>3</sup> /hr	✓	<a href="http://www.teledyneenergysystems.com">www.teledyneenergysystems.com</a>
	Teledyne PEM Fuel Cells	Aerospace / Defense	PEM	100 - 15 kW	None presently	
	Medusa Fuel Cell Test Stations	PENFC, DMFC and SOFC Testing	PEM, DMFC, SOFC	Watts to 15 kW	✓	<a href="http://www.utcpower.com">www.utcpower.com</a>
	PureCell™ System Model 200	Stationary	PAFC	200 kW	✓	
	PureMotion™ 120 System	Transportation	PEM	120 kW	✓	
	PureCell™ System Model 5****	Backup	PEM	5 kW	✓	

**1 - Fuel Cell Applications**

- Micro - Battery Replacement
- Portable - Mobile Electric Generation
- Backup - Emergency Power, Grid Parallel
- Stationary - Primary Power and Peak Shaving
- APU - Auxiliary Power Unit
- Transportation - Bus & light duty vehicle propulsion

**2 - Fuel Cell Configurations**

- PEM - Proton Exchange Membrane Fuel Cell
- PAFC - Phosphoric Acid Fuel Cell
- MCFC - Molten Carbonate Fuel Cell
- SOFC - Solid Oxide Fuel Cell
- AFC - Alkaline Fuel Cell
- DMFC - Direct Methanol Fuel Cell
- FFC - Formira Fuel Cell
- SBFC - Sodium Borohydride Fuel Cell

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\*\*\* - Available on precommercial basis to qualified customers

\*\*\*\* - Current use in demonstrators; commercial offering in 2007.

\*\*\* - Product is undergoing field testing

\*\*\*\* - Current use in demonstrators; commercial offering in 2007.

\*\*\* - Pre-production late 2007; production modules mid-2008.

For a detailed product listing, including product descriptions and efficiencies, visit [www.USFCC.com](http://www.USFCC.com)

# Commercial Definition

The USFCC considers a fuel cell power commercial if it meets the following three criteria:

- Offered for sale to the public
- Offered with a written warranty, supported by service capability
- Meets approved industry standards or is certified by an established industry body.

# Vehicles – 2010 and Beyond

- EPACT 2005, Section 782, requires agencies to lease or purchase fuel cell vehicles starting January 1, 2010 financial support from DOE sufficient to cover any cost premium (subject to congressional funding)
- Buses
  - Need supportive policy
  - Need bulk purchases

# Power Generation – 2010 and Beyond

- High efficiency baseload power and hybrid systems (turbines)
- Lower cost systems
- Systems optimized to more markets

# How you can help

- Buy units – where they provide value
  - Best applications fully value fuel cell benefits
- Open your building efficiency programs to recognize CHP, high efficiency generation
  - EO 113423
- Explore ESCO-type financing to take advantage of federal investment tax credit
- Partner with states

# How you can help

- Prepare for fleet purchases in 2010
- Make land / support available for hydrogen infrastructure
- Educate your work force
- Reward your work force
- Participate in development programs for that meet special Agency needs
- Include FC's in your thinking (e.g. digester gas)
- Challenge the industry – offer to buy “if”

# Supplemental Slides

# Vehicles – 2010 and Beyond

- Auto companies are promising again (2008-2012)
- Leases! in 2008 (Honda)
  - \$600/month
  - Southern California
- 780 km range (468 miles) (Toyota)
  - 2300 mile road trip, Alaska-California
- 100-vehicle consumer demonstration (GM)
  - CA, NY, DC
  - 1000 vehicles by 2010-2012
- 83 mpg estimated (Daimler)



200+ mph land speed record (with zero emissions!)



# Mobility – Markets

- Goods movement/fork lifts



- DoD buying 100 units (PA, VA, CA, WA)
- Tests under way or planned: grocery stores, “big box” stores, package services

- California

- 2500 light duty ZEVs by 2012 seems secure

# “CHP/””Large Scale” Power Generation

- Forward pricing of next generation PAFC unit
- (UTC: ½ price, 2x durability and output)
- Expansion of manufacturing capability in to marketplace interest (FCE)
  - Federal tax credit + support for renewable generation = significant California market
  - CT major purchaser of fuel cell power
- Achievement of SECA program goals
  - Managers still touting \$400/kw cost target, value of SOFC as enabling clean coal use
- Work on biofuels, military fuels

# Power Generation

- Excellent performance in backup power off-grid power applications
- Hundreds of units sold
  - Substantial fuel savings reported
- 8-hour telecom backup requirement (FCC) should spur demand

# Micro

- Improvements in efficiency, size and weight
- Novel designs, SOFC + PEM + DMFC + metal air
- Expanding list of candidate fuels
- Product announcements beyond battery
- Safety emerging as a sales point
- Major company interest/activity (Motorola in US)
- *Market pull* – military, device manufacturers

# Hydrogen

- First public 700 bar Station (UC Irvine)



- ~ 40 more stations needed by 2010-2011
- DOE has done a commendable scenario  
DOD actively working on deployment

Needs: Sites for stations, co-financing, fleet purchases