Fuel Cell Capabilities

Robert Rose
US Fuel Cell Council

Interagency Task Force
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Fuel Cells - Defined

Fuel (H₂) + O₂ / Catalyst $\rightarrow$ (H₂)O + Heat

Fuel cells combine hydrogen & electrochemically to produce electricity, water and useful heat.
Unmatched combination of benefits

- Electrochemistry, not combustion
- Low / Zero Emissions
- High Efficiency $\rightarrow$ Low CO$_2$
- 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 for consumer electronics and specialty applications
- Education kits
What’s available

54 products on USFCC voluntary list

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product Name</th>
<th>Application</th>
<th>Configuration</th>
<th>Output</th>
<th>Warranty Available</th>
<th>Find more information and place an order at</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballard</td>
<td>Stack 302</td>
<td>Transportation</td>
<td>PEM</td>
<td>55 kW</td>
<td>✓</td>
<td><a href="http://www.ballard.com">www.ballard.com</a></td>
</tr>
<tr>
<td></td>
<td>Stack 255L</td>
<td>Light Mobility</td>
<td>PEM</td>
<td>4.4 - 19.3 kW</td>
<td>✓</td>
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<tr>
<td></td>
<td>Stack 1050</td>
<td>Co-generation</td>
<td>PEM</td>
<td>1.3 kW</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

### Commercially Available Fuel Cell Products

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Product Name</th>
<th>Application</th>
<th>Configuration</th>
<th>Output</th>
<th>Warranty Available</th>
<th>Find more information and place an order at</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relion</td>
<td>T-1000</td>
<td>Backup</td>
<td>PEM</td>
<td>400-1300 V</td>
<td>✓</td>
<td><a href="http://www.reliantfuelcells.com">www.reliantfuelcells.com</a></td>
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<tr>
<td></td>
<td>T-2000</td>
<td>Backup</td>
<td>PEM</td>
<td>800 V - 28 kW</td>
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<tr>
<td></td>
<td>T-3000</td>
<td>Backup</td>
<td>PEM</td>
<td>1 kW</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T-5000</td>
<td>Backup</td>
<td>PEM</td>
<td>1 kW</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>FCEV 600</td>
<td>Mobile, Backup</td>
<td>FC/DC</td>
<td>600 V/15 kW</td>
<td>✓</td>
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<td></td>
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<tr>
<td>FCEV 1200</td>
<td>Mobile, Backup</td>
<td>FC/DC</td>
<td>1200 V/30 kW</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FCEV 1800</td>
<td>Mobile, Backup</td>
<td>FC/DC</td>
<td>1800 V/125 kW</td>
<td>✓</td>
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<td></td>
</tr>
<tr>
<td>Time Series TX</td>
<td>Generators, Industrial, Transportation</td>
<td>PEM</td>
<td>2.5 kW</td>
<td>✓</td>
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<td></td>
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<tr>
<td></td>
<td>Hydrogen Storage System</td>
<td>PEM/M, FC/DC and SGFC</td>
<td>1800 V/15 kW</td>
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<tr>
<td></td>
<td>FuelCell System</td>
<td>Stationary</td>
<td>PEM</td>
<td>200 kW</td>
<td>✓</td>
<td><a href="http://www.timefuelelectronics.com">www.timefuelelectronics.com</a></td>
</tr>
<tr>
<td>Endurance</td>
<td>FuelCell System</td>
<td>Stationary</td>
<td>PEM</td>
<td>200 kW</td>
<td>✓</td>
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</tr>
<tr>
<td></td>
<td>FuelCell System</td>
<td>Stationary</td>
<td>PEM</td>
<td>400 kW</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

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* 1 - Fuel Cell Applications: PEM, SOFC, alkaline, molten carbonate, direct hydrogen, proton exchange membrane, ion exchange membrane.
* 2 - Fuel Cell Configurations: PEM, SOFC, alkaline, molten carbonate, direct hydrogen, proton exchange membrane, ion exchange membrane.
* ✓ - Available on commercialized fuel cell products.
* || - Available as pre-commercially built-to-specified customer needs.
* * - Available as pre-commercially built-to-specified customer needs.
* ** - Available as pre-commercially built-to-specified customer needs.
* *** - Available as pre-commercially built-to-specified customer needs.
* **** - Available as pre-commercially built-to-specified customer needs.
* ***** - Available as pre-commercially built-to-specified customer needs.

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* Contact us to demonstrate commercial offering in 2007.

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* Copyright © US Fuel Cell Council 2007. 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