U.S. Federal Agency Purchasing Managers

Fuel Cell Systems for Portable, Backup and UPS Applications

Eric Simpkins, USFCC President
Vice President, IdaTech, LLC
Washington, DC
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Definitions
Introduction
What’s Available & How Used
Typical Operation & Maintenance
Time: Order to Site Installation
Pricing
Summary
<table>
<thead>
<tr>
<th>Micro &amp; Man-Portable</th>
<th>Portable, Backup, APU</th>
</tr>
</thead>
</table>
| • Less Than 100 Watts  
  • Consumer electronics, defense (solder power), speciality applications |
| • 100 Watts to 15 Kilowatts  
  • Battery replacement or charging, defense, telecom, backup, remote, aux. power |
| Buildings & Facilities | Speciality vehicles & Material handling |
| • 100 Kilowatts to Megawatts  
  • Primary power, critical backup, cogeneration, trigeneration |
| • 1 to 50 Kilowatts  
  • Forklifts, airport tugs, et. al. |

**Definitions**

*Introduction*

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Corporate Overview

IdaTech is a leader in the development of fuel processors and integrated fuel cell systems for portable power, critical backup power and remote power applications world-wide.

- Central Oregon business, 68 Employees
- World class energy technology company focused on the commercial deployment of PEM fuel cell products
- Wide range of fuel processing capabilities to produce high purity hydrogen from a variety of fuels
- Market- and application-driven fuel cell solutions for backup, industrial remote and portable power applications
- Deploying systems worldwide with partners in North America, South America, Europe and Asia

IdaTech Expansion & Growth

- Expanded to a new, state-of-the-art facility
- Increased production and R&D capacity
- Established a European office in Herten, Germany to better serve IdaTech’s European customers and partners
- Growing employee population ~30% in 2007
- Sales offices in North Carolina, Texas, France, Germany, soon in Asia and Middle East

New German Office
Herten, Germany

New Corporate Headquarters
Bend, Oregon
Companies Represented:

Delphi Corporation (Michigan)
IdaTech, LLC (Oregon)
Millennium Cell (New Jersey)
ReliOn (Washington state)
Plug Power (New York)
UTC Power (Connecticut)

Markets Served

Delphi - APU, Defense, Portable
IdaTech - Backup, Defense, BR/BC, Portable, APU, Recreation
Millennium Cell (New Jersey) - BR, Portable
ReliOn (WA state) - Backup, Telecom, Defense
Plug Power - Telecom / Utility / Industrial UPS, Defense
UTC Power - Backup, Defense, Portable

Key: BR - battery replacement  BR/BC - battery replacement or charging
Delphi Corporation’s Solid Oxide Fuel Cell power system, currently under development, is intended for a variety of transportation and non-transportation applications

- Delphi’s SOFC is being engineered to operate using many types of fuels, including: diesel, biodiesel, natural gas, propane, gasoline, and military logistic fuels.
- Onboard reforming enables operation with low sulfur diesel fuels
- Highly integrated, compact unit
  - Up to 3.5 kW Power Output
  - Volume: 65 liters (2.3 cubic feet)
  - Weight: 80 kg (175 lbs)
ElectraGen™ Backup Power Systems

- Compact (25” x 27” x 53”)
- 3 kW and 5 kW (+/-48VDC) systems may be configured in parallel for up to 15 kW output
- Modular (Standard 19” rack mountable, OEM)
- Interchangeable capacitor or battery options
- Cold/hot climate operation (-40° to 50°C)
- Outdoor-rated (indoor compatible)
- 1-Year maintenance interval
- Remote monitoring & diagnostics with Graphical Use Interface (IP, RS-232)
- CE, ANSI/CSA FC 1 and NEBS Level 3 certified
- Standard 2 year, 1,500 hours operational warranty

Production Deliveries Initiated in 2006

ElectraGen™ XTR Module

- A liquid-fueled extended run module designed to produce hydrogen on-demand for critical and remote applications
- Provides virtually unlimited backup power run time when combined with the ElectraGen™ 3 or ElectraGen™ 5 fuel cell systems
- Ideal for remote locations where hydrogen delivery is not feasible

Production Deliveries Initiated in 2007
iGen™ Power System

- 250 Watt (100 – 500 W) compact & integration-ready system
- Light weight design, quiet operation with integration opportunity into multiple applications
- On-board fuel reformer converts methanol/water fuel to hydrogen
- IdaTech’s proprietary air-cooled stack technology
- 12 VDC, 24 VDC, or 120 VAC

Example End Markets

Solar - Fuel Cell Hybrid Power Plant

- PV
- Batteries
- Fuel container
- FCS
- Regulation system
- Customer

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### Portable Fuel Cell Activities

**Soldier Power**

<table>
<thead>
<tr>
<th>Based on 30W – 72 Hour Mission</th>
<th>Protonex &amp; MCEL Fuel Cell System</th>
<th>BA-5590 Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration for mission</td>
<td>1 Fuel Cell 3-24 hr Fuel Cartridges</td>
<td>13 Battery Packs</td>
</tr>
<tr>
<td>Weight of System</td>
<td>5.1 kg (11.2 lbs)</td>
<td>12.7 kg (28.0 lbs)</td>
</tr>
<tr>
<td>Total Cost per system</td>
<td>$793</td>
<td>$1,040</td>
</tr>
<tr>
<td>(FC amortized over 30 missions)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Status:** Originated as DUST program with AFRL in 2004
3rd generation product delivered to AFRL for field trials

**Competitive:** Field hydration, fast start-up, non-flammable fuel

**Advantage:** 20% cheaper and 60% lighter than BA5590

### Portable Fuel Cell Activities

**Special Operations Radio**

<table>
<thead>
<tr>
<th>Based on 11 day mission</th>
<th>Jadoo &amp; MCEL Fuel Cell System</th>
<th>BA-5590 Battery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration for mission</td>
<td>1 Fuel Cell 7 x 500 W-hr Fuel Cartridges</td>
<td>35 Battery Packs</td>
</tr>
<tr>
<td>Weight of System</td>
<td>11 kg (24 lbs)</td>
<td>36 kg (79 lbs)</td>
</tr>
<tr>
<td>Total Cost per system</td>
<td>&lt;$1000</td>
<td>$2625</td>
</tr>
<tr>
<td>(FC amortized over 25 missions)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Status:** First prototype demonstrated Sept. 2006
Delivery to SOCOM in Q1-07

**Competitive:** Field hydration, non-flammable fuel

**Advantage:** 66% lighter than BA5590
Portable Fuel Cell Activities  
Jadoo XRT - 100W Portable Power Generator

Core Specifications

- Utilizes Jadoo Standard Fuel Cell
- 110V Inverter (100W)
- 12V Output
- 360Whr * 6 = 2160 Whr
- Fuel gauge for all cartridges

- Targeted for military, first responder, surveillance, portable office markets

Status:  
First prototype demonstrated Sep., 2006  
Field trials in Q2-07

Competitive:  
Field hydration, infinite shelf life, non-flammable fuel

Advantage:  
Disposable, 50% lighter than metal hydrides

WHO IS PLUG POWER?

- World Leader in PEM Fuel Cell Systems
  - 650 systems delivered worldwide
- Aggressive market engagement strategy
  - Significant number of commercial orders providing back-up power on telecommunications networks around the world
  - Sale of GenCore® systems to federal and state agencies
  - Well-positioned to increase market penetration
- Prepared for commercial ramp-up
  - Established relationships with key suppliers such as 3M, Dana, and Engelhard
  - Partnerships with Honda
  - Focus on product cost reduction and lean, flexible manufacturing
  - Financially sound with $200M in cash
- Strong technology position – 147 patents issued, 171 patents pending
- Experienced and committed operations oriented management team
WHAT DO WE HAVE TO OFFER?

- **Improving system reliability**
  - Starts more reliability than gensets
  - Runs more predictably than batteries
  - Significant advantage for extended run time applications
  - Automatic monthly diagnostics
  - Remote monitoring/call in functionality

- **Reducing costs**
  - Lower first costs than generators
  - Lower maintenance costs than batteries
  - Outdoor operation eliminates costly facility modification
  - Lightweight

- **Environmentally beneficial**
  - Quiet
  - No greenhouse gas emissions
  - Reduces hazardous material handling and clean-up

Proven results operating on many networks in diverse environments

Opportunity

- Traditional back-up technologies capabilities do not meet the telecommunications, utility or industrial UPS industry needs

- Sensitive to temperature
- High cost of ownership
- Requires factory matching
- Limited diagnostic capability
- Heavy
- Lead recycling

- Combustion emissions
- High audible noise
- Maintenance dependant
- Extended run only
- Poor reliability
- Zoning/easements
ReliOn Company Profile

- Fuel Cell Solutions for critical backup power applications
  - Government
  - DoD
  - Telecom – Wireless / Wireline
  - 200 watts – 12,000 watts
- Over 850kW deployed ~ 400 sites
- Incorporated 1995
- Delivering Commercial products since 2003
- Strong R&D and intellectual property portfolio based on scalability, modularity, & core technology
- Active member - USFCC

ReliOn – Modular Cartridge Technology
Super-efficient, reliable, clean, energy-saving alternative – the future is here.

PureCell™ Model 5 Backup Power System

Marcus Rothstein
Product Manager, Hydrogen Fuel Cells
860-727-2779 marcus.rothstein@utcpower.com

Current Design Specifications

- **Net Power:** 5 kW
- **Fuel Type:** Compressed H₂ (> 200 psi)
- **Emissions:** <0.7% H₂; Water vapor
- **Output Voltage:** 48V DC (nominal)
- **Efficiency:** >41% at maximum power
- **Fuel Consumption:** ~0.1 g/s of H₂ at 5 kW net
- **Remote Communications:** Included
- **Grid Loss:** Provides instantaneous power
- **Certification:** Designed to CSA FC1
- **Design life:** 10 years
- **Physical:** Fits 19- or 23-in. rack
  - Height: 21 in. (53.3 cm)
  - Width: 17 in. (43.2 cm)
  - Length: 28 in. (70.0 cm)
  - Weight: ~220 lb (~100 kg)
### PureCell™ Model 5 Backup Power System

#### Product Attributes

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>High efficiency</td>
<td>Cost savings</td>
</tr>
<tr>
<td>Minimal moving parts</td>
<td>Increased reliability/Low maintenance</td>
</tr>
<tr>
<td>Smaller footprint</td>
<td>Less space required</td>
</tr>
<tr>
<td>Rack mountable</td>
<td>Simple compatibility</td>
</tr>
<tr>
<td>Light weight</td>
<td>No building reinforcements</td>
</tr>
<tr>
<td>Zero emissions</td>
<td>Site flexibility/Environmentally safe and sound</td>
</tr>
<tr>
<td>Remote monitoring</td>
<td>Worry free operation</td>
</tr>
<tr>
<td>Simple architecture</td>
<td>Reliability</td>
</tr>
<tr>
<td>Short lead time</td>
<td>10-week delivery</td>
</tr>
</tbody>
</table>

In Development for 2008 Production Deliveries

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- Time: Order to Site Installation
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- Summary
Typical Operation & Maintenance

Portable Fuel Cell Systems (>100 watts)

- Flexible power plants – baseload, backup (intermittent), APU
- Fuels flexible – alcohols, natural gas/propane, liquid fuels
- Minimal maintenance – typically annually, e.g. filters; pumps & blower (occasionally)

Backup Fuel Cell Systems (1 kW to 15 kW)

- Use is typically occasional, e.g. a few hours a week or month
- Fuels flexible – hydrogen, alcohols, natural gas/propane
- Minimal maintenance – typically annually, e.g. filters; pumps & blower (occasionally)

Auxiliary Power Systems (1 kW to 10 kW today; military ↑)

- Objective is to compliment a prime power source, use is typically occasional
- Fuels flexible – alcohols, natural gas/propane, liquid fuels (diesel, gas, jet)
- Minimal maintenance - typically annually, e.g. filters; pumps & blower (occasionally)
Order to Site Installation
Several Fuel Cell companies have commercial products
- available to ‘standard’ order/delivery schedule
- defined deliverables, price, warranty, maintenance
- Early examples - shipping 5 kW backup systems
  ~10 – 15 weeks from time of order

Several have near-commercial power plants
- acquisition cycle is specifically related to
  expectations (demo vs field trial validation),
  development status, quantity required, et. al.

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Fuel Cell Systems Pricing

Frequently asked, “How much is your Fuel Cell System?”
There are two realistic responses:

• Several products are listed in GSA Advantage!
  - Feature negotiated acquisition packages
  - Distribution channels, installation & maintenance are defined
  - Currently – ReliOn, Plug Power
  - Forthcoming - IdaTech, others

• Uses are application dependent:
  - How system is used & operated
  - Security, siting issues, human factors/safety
  - Certification(s) required
Summary

• Portable, backup and UPS products have a wide variety of uses, serving many point-of-use applications
• Highly flexible – power levels, configurations, fuels, siting
• Serving markets worldwide – universal interest
• Multiplicative advantages – affordable life cycle cost, quiet, efficient ... to name a few
• Portable & Backup systems available today; UPS forthcoming
  • GSA Advantage
  • Direct from Fuel Cell companies and market channels