



## U.S. Federal Agency Purchasing Managers

### Fuel Cell Systems for Portable, Backup and UPS Applications

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Vice President, IdaTech, LLC  
Washington, DC  
April 26, 2007



### *Definitions*

### Introduction

### What's Available & How Used

### Typical Operation & Maintenance

### Time: Order to Site Installation

### Pricing

### Summary



#### Micro & Man-Portable

- Less Than 100 Watts
- Consumer electronics, defense (soldier power), speciality applications

#### Portable, Backup, APU

- 100 Watts to 15 Kilowatts
- Battery replacement or charging, defense, telecom backup, remote, aux. power

#### Buildings & Facilities

- 100 Kilowatts to Megawatts
- Primary power, critical backup, cogeneration, trigeneration

#### Speciality vehicles & Material handling

- 1 to 50 Kilowatts
- Forklifts, airport tugs, et. al.



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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

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## IdaTech Expansion & Growth



*New Corporate Headquarters  
Bend, Oregon*

- 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*



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## 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

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## Delphi Corporation Solid Oxide Fuel Cell

***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)



**DELPHI**

## 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

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## 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

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# iGen™ Power System



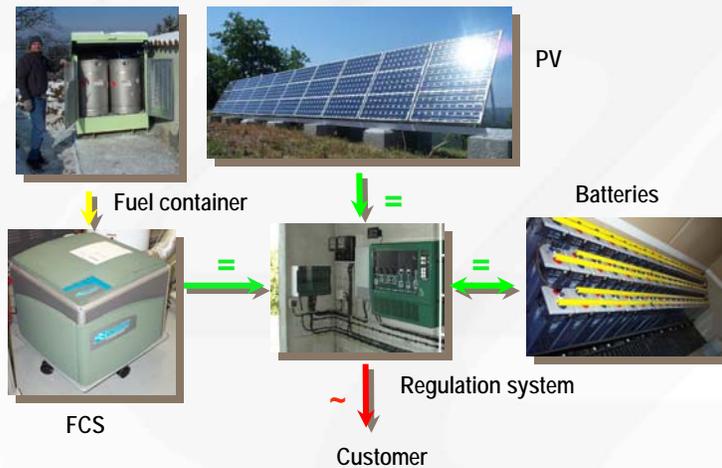
- 250 Watt (100 – 500 W) compact & integration-ready system
- Light weight design, quiet operation with integration opportunity into multiple applications
- On-board fuel reformer converts methanol/water fuel to hydrogen
- IdaTech's proprietary air-cooled stack technology
- 12 VDC, 24 VDC, or 120 VAC

## Example End Markets



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# Solar - Fuel Cell Hybrid Power Plant



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## Portable Fuel Cell Activities *Soldier Power*



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



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

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## Portable Fuel Cell Activities *Special Operations Radio*



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



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

GenCore.



GenCore® 5T Fuel Cell System with Hydrogen Storage Module (HSM)

**Proven results operating on many networks in diverse environments**

## Opportunity

GenCore.

### ❖ 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



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- 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

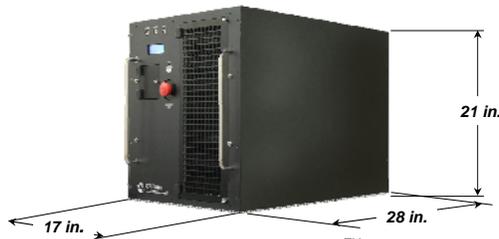


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Super-efficient, reliable, clean, energy-saving alternative – the future is here.



**PureCell™**

PureCell™ Model 5 Backup Power System



Marcus Rothstein  
Product Manager, Hydrogen Fuel Cells  
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In Development  
for  
2008 Production  
Deliveries

4/19/07 M.Rothstein/E.Strayer  
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## PureCell™ Model 5 Backup Power System



### Current Design Specifications

<b>Net Power:</b>	5 kW
<b>Fuel Type:</b>	Compressed H <sub>2</sub> (> 200 psi)
<b>Emissions:</b>	<0.7% H <sub>2</sub> ; Water vapor
<b>Output Voltage:</b>	48V DC (nominal)
<b>Efficiency:</b>	>41% at maximum power
<b>Fuel Consumption:</b>	~0.1 g/s of H <sub>2</sub> at 5 kW net
<b>Remote Communications:</b>	Included
<b>Grid Loss:</b>	Provides instantaneous power
<b>Certification:</b>	Designed to CSA FC1
<b>Design life:</b>	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™**

In Development  
for  
2008 Production  
Deliveries

4/19/07 M.Rothstein/E.Strayer

# PureCell™ Model 5 Backup Power System



## Product Attributes

### Features

- High efficiency
- Minimal moving parts
- Smaller footprint
- Rack mountable
- Light weight
- Zero emissions
- Remote monitoring
- Simple architecture
- Short lead time

### Benefits

- Cost savings
- Increased reliability/Low maintenance
- Less space required
- Simple compatibility
- No building reinforcements
- Site flexibility/Environmentally safe and sound
- Worry free operation
- Reliability
- 10-week delivery

In Development  
for  
2008 Production  
Deliveries



4/19/07 M.Rothstein/E.Strayer



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## 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)



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## 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



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- 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