



## Matching Federal Government Energy Needs with Energy Efficient Fuel Cells

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### Micro & Man-Portable

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

### Portable, Backup, APU

- 100 Watts to 10 Kilowatts
- Battery replacement or charging, defense (platoon power), telecom backup, remote, auxiliary power

### Buildings & Facilities

- 5 Kilowatts to Megawatts

### Speciality vehicles & Material handling

- 1 to 50 Kilowatts
- Forklifts, airport tugs



Pittsburgh, Pennsylvania – October 1992



Stationary /  
Distributed  
Power



- Increasing Need for Reliability
- Increasing Need for Power Quality
- Energy Security
- Shift to Distributed Alternatives
- Modular Need / Flexibility of Design
- Industry Deregulation
- Carbon Dioxide Abatement

MARKETS & MARKET  
DRIVERS

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Stationary /  
Distributed  
Power

➔

Backup Power  
Remote Power  
Premium Power  
Residential / Commercial  
& Industrial Power

MARKETS & APPLICATIONS

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- Prime Movers
  - 7x24
  - CHP
  - Grid Connect and/or Grid Independent

Types of Fuels Utilized

- Natural Gas
- Propane
- Anaerobic Digester Gas

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- Federal Government
- State and Local Governments
- Large Commercial Corporations
- Colleges and Universities
- Utilities



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- Industrial
  - Factories
  - Central Power Houses
  - Waste Water Treatment Plants
- Hospitals and Nursing Homes
- Hotels, Dormitories, Barracks
- Prisons and Jails
- Fire Stations



US Postal Service – San Francisco Mail & Processing Center – 250 kWe

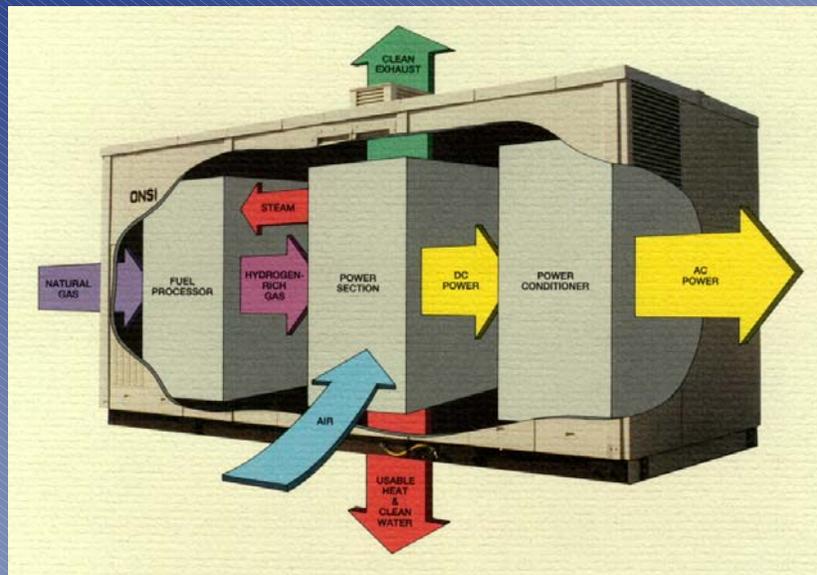


Santa Rita Correctional Facility, California – 1,000 kWe



El Estero Waste Water Treatment Plant, Santa Barbara, California  
500 kWe

## Fuel Cell System Diagram



Source: UTC Power



US Embassy  
United Kingdom



## 5kW GenSys

- Thermal Output - 22,000 BtuH 135 Deg F
- Weight - 2,200 pounds
- 32" x 68" x 84"
- Reliability > 90%
- 26% electrical efficiency



## SOFC Companies

- Ceramic Fuel Cells Limited
- Fuel Cell Technologies
- FuelCell Energy
- Acumentrics
- Rolls Royce
- Siemens Power
- UTC Fuel Cells
- ZTEK



## Phosphoric Acid Fuel Cells

- One of the few fuel cells commercially available
- U.S. and Japanese suppliers have been marketing 50 to 200 kW systems
- Over 245 units have been installed worldwide with a combined operating history of almost 5 million hours
- Cost challenges have limited commercial success



### PureCell 200 (PC25)



- > 3P/480VAC/GP/GI
- > 900,000BtuH 140-250 Deg F
- > 40,000 lbs...2000lb/kW
- > 10X10X18
- > Reliability 97%
- > 39% electrical efficiency

200kW ChevronTexaco - Houston, Texas



## PureCell 200 FUEL CELL POWER PLANT

### Specifications

• Power Output	200 kW
• Standard Output Voltage	480 V
• Standard Frequency	60 Hz
• Efficiency at ISO conditions	40 +/- 2%
• Available thermal energy	264 kWth
• Fuel gas type	Natural Gas
• Fuel consumption (935 Btu/ft <sup>3</sup> )	31.5 ft <sup>3</sup> /min
• Noise	65 dBA at 10 feet
• Emissions	NO <sub>x</sub> 0.02 lb/MWh SO <sub>x</sub> 0.001 lb/MWh CO 0.05 lb/MWh



### 600kWe Fresno, California Project 12 Story Commercial Office Building





600 kWe Fresno, California Project  
3 UTC Power PureCell 200 Power Plants



600kWe Fresno, California Project  
100 Ton Adsorption Chiller





## Molten Carbonate Fuel Cells

- Best suited for large power plants
- Japanese, European, and US firms have demonstrated systems of 250 kW to 2 MW class
- Can use natural gas directly without the need for an external fuel processor and have had some recent test successes
- Commercial products available today



## Specifications

• Power Output	300 kW	
• Standard Output Voltage	480 V	
• Standard Frequency	60 Hz	
• Efficiency at ISO conditions	47 +/- 2%	
• Available thermal energy	123 kW	
• Exhaust temperature	650 F	
• Allowable backpressure	5" WC	
• Fuel gas type	Natural Gas	
• Fuel consumption (935 Btu/ft <sup>3</sup> )	35 ft <sup>3</sup> /min	
• Average water consumption, average	2.0 gpm	
• Noise	72 dBA at 10 feet 65 dBA at 10 feet	
• Emissions	NO <sub>x</sub> 0.02 lb/MWh SO <sub>x</sub> 0.001 lb/MWh CO 0.05 lb/MWh	

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FuelCell Energy

- Overall Plot Area 29' x 33'

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### Fuel Cell Project Payback

Capital Recovery Cost	Costs	Electrical Energy Savings	Credits
Fuel Cost		Thermal Savings (CHP)	
Maintenance Cost		Tax, Renewable or Environmental Credits	
Cell Stack Replacement Cost		Government Subsidy	
	Special Situations		

Project Payback Criteria

Chart Courtesy of GenCell Corp



## Fuel Cell Costs ROM

- ❑ Capital Expenditure – Est. \$1.8MM
- ❑ Operation and Maintenance – Est. \$0.038/kWH
- ❑ Fuel Costs – @ Assumed \$7.00/MMBtu...\$0.07/kWH



LOGANEnergy Corporation

*The Power of Fuel Cells*

**Thank You !**

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