

Fuel Cell Energy Services

Rebuild HI
Consortium

19 July 2005

LOGANEnergy Corp.

Clean

Quiet

Reliable

LOGANEnergy

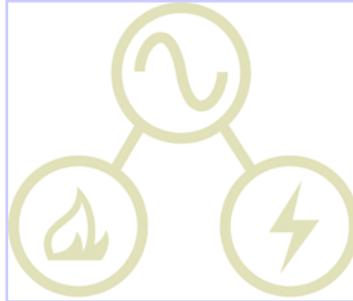
www.loganenergy.com

Steve Butala

Discussion Points



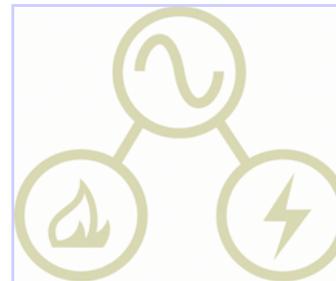
Introducing LOGAN



Product Catalog



Fuel Cell Benefits



2005 Initiatives

LOGANEnergy Executive Summary

Market
Leader

Proven
Success

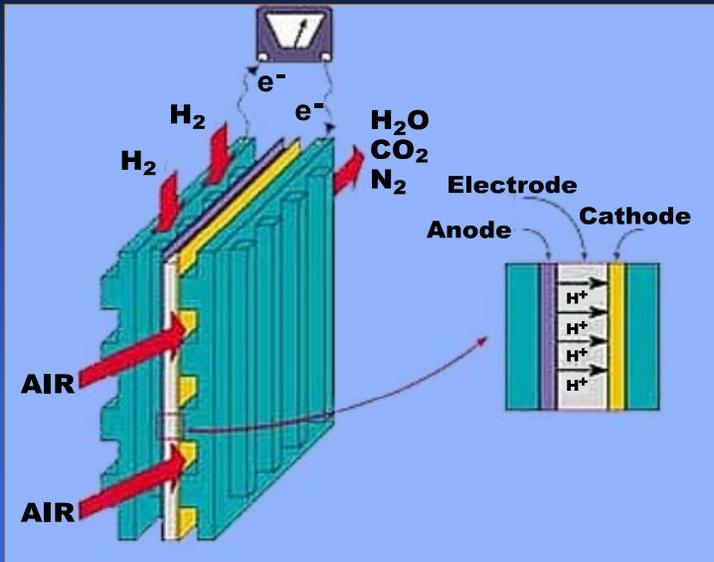
Profitable
Company

- Fuel Cell Energy Services Company – founded 1994
- Project portfolio experience >7MW ~ 12% worldwide capacity.
- Specialize in fuel cell planning, installation, & maintenance
- Customers - DoD/CERL, utilities, banks, universities, real estate developers & other business centers.
- Assist manufacturers with their product commercialization strategies.
- Product catalog - PEM, PAFC and Molten Carbonate. 5kW to 1MW in capacity
- Target residential, commercial and industrial applications.

LOGAN Energy Operations 1994-2004



A Fuel Cell Primer



- Similar to battery, but supplied by external fuel
- Generally use hydrogen from a reformer converting:
 - Natural Gas (Best)
 - Propane (Good)
 - Methanol (OK)
- Products are:
 - DC Power (More Amps = Less Volts)
 - Heat
 - Water
- Named by their electrolyte
 - PEM = Proton Exchange Membrane

Anode:



Electrolyte Membrane

Wire

Cathode:



** A catalyst like Platinum is needed to make these reactions go!

Reformer and Shift Converter:



At 1600/450 °F in catalyst beds.

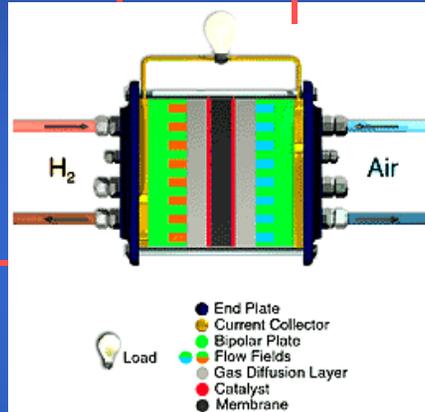
Key Points

- ❑ High conversion efficiency of fuel to power and heat; CHP >75%.
- ❑ Electrochemical conversion process, few moving parts, low maintenance.
- ❑ Fuel Cell System can be sized to accommodate different capacity needs. Flexible siting.
- ❑ May operate either Grid Parallel or Grid Independent.
- ❑ Environmentally attractive energy service due to low emissions.
- ❑ Reliable, clean, and quiet. "Green Signature"

Qualifications 1994-2004

- ❑ LOGAN Team Installed 60 FC Sites HI to FL >7MW Capacity.
- ❑ Support 24/7 O&M Service Response.
- ❑ Standardization of Installation Techniques.
- ❑ Standardization of Safe Grid Interconnect Methods.
- ❑ Standardization of Service/Maintenance Procedures.
- ❑ Support Community Awareness Programs.
- ❑ Transfer Know-how to Commercial Sector Projects.
- ❑ 2004 closed with 30 projects at 21 locations in 18 states.
- ❑ 2005 15 new projects 5kW-1MW, US, UK, Puerto Rico, Iceland.

The Future is Now !









Distributed Generation Benefits

Fuel Cells are DG Resources that:

1. Are More efficient than conventional... CHP
2. Reduce Pollution...**Green Signature**
3. Reduce Dependency on Oil Imports
4. Reduce transmission load loss
5. Create new high tech jobs
6. Use a variety of fuels
7. Lower carbon intensity of energy production

Product Catalog



FuelCell Energy

Megawatt Class Systems



Residential & Light Commercial Products



UTC Power

A United Technologies Company

Commercial Systems



FuelCell Energy

DFC 1500 Fuel Cell Power Plant



Kings County WWTP, Seattle, WA

DFC 1500 Fuel Cell Power Plant

Applications

Sitability Ultra Low Emissions Low Noise	Ultra low emissions of NO _x and SO _x allow the DFC® products to be placed in areas where emissions restrictions prohibit traditional generation technologies.
Efficiency Nominal 49% Electric Efficiency Combined Heat & Power (CHP) Efficiencies ~ 80%	At efficiencies approaching 50% and higher, the DFC® products far exceed traditional power generation efficiencies leading to significantly lower fuel costs.
Applicability Low Profile Matched Modular Design	The DFC® products have been designed for installation at a wide variety of sites including industrial, commercial and institutional areas. The modular design allows for multiple units to be combined, providing incremental capacities.

Direct FuelCell® Applications

End Users

- Low cost on-site power generation
- Cogeneration / Combined Heat and Power (CHP)
- Solution for premium power needs
- Environmental compliance

Utilities

- Transmission & distribution grid support
- Grid congestion relief
- Environmental compliance

Cogeneration/Combined Heat & Power (CHP)

- Steam, high temperature hot water and absorption cooling

Alternative Fuels

- Wastewater treatment / Anaerobic Digester Gas (ADG)
- Hydrogen-rich off-gas

Specifications

Dimensions Height Width Length	25 feet 49.5 feet 39 feet
Power Output Net Power at Plant Rating Voltage	1000 kW up to 1700 kVA 480 VAC 50 or 60 Hz
Net Efficiency At Rated Output Heat Rate	49% LHV 6,965 Btu/kWh LHV
Fuel Consumption (natural gas) At Rated Output	125 scfm @ 933 Btu/cf LHV
Water Use Water Uptake Water Discharge	153 gph 65 gph
Available Heat Exhaust Temperature Exhaust Flow Exhaust Back Pressure	Approx. 1.4 MMBtu/hr >700 °F 13,800 lb/hr <5 in. water column
Noise	<75 dB(A) @10 ft.
Emissions NO _x SO _x CO NMOC	0.3 ppmv 0.01 ppmv 10 ppmv 10 ppmv



UTC Power

A United Technologies Company

600kW Commercial Project



May, 2004

The Adsorption chiller installed in Fresno Federal Guarantee Saving Build. (Fresno City, CA . USA)



Adsorption chiller
NADAC-120US
X 1 unit
Ref. capacity
109 ~ 130USTR



Cooling Tower for AD & Fuel Cells



Fuel Cell
made by
International Fuel Cells
200Kw * 3units





UTC Power

A United Technologies Company

Single Fuel Cell Power Plant



Chevron Texaco Plant, Houston, TX

Specifications

- 200 kWe/235kVA...
- 480Vac...3 Phase... 60 Hz
- Natural Gas...2Mcf/H
- Grid Parallel/Independent
- Thermal Recovery... .9MMbtu/H
- 18'X10'X10'...40,000 lbs



Ft McPherson, GA... Oct. 2003

Plug Power 5kW GenSys

- 1P/110/208 VAC/GP/GI
- 22,000 BtuH 135 Deg F
- 2,200 lbs...440lb/kW
- 32" x 68" X 84"
- Reliability > 90%
- 26% electrical efficiency

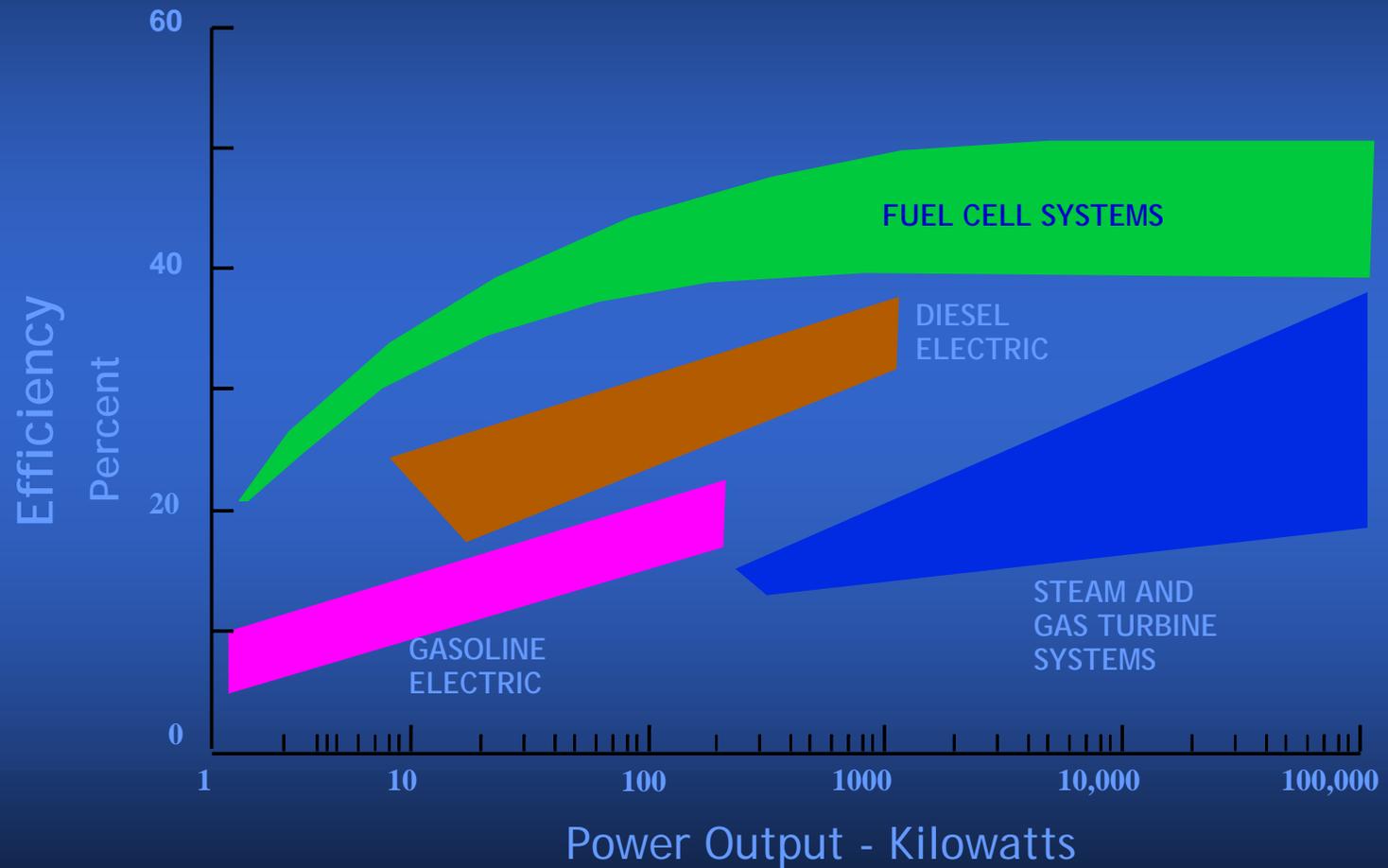


WCI Communities Golf Course
Sarasota, FL... Oct. 2004

Product Applications Summary

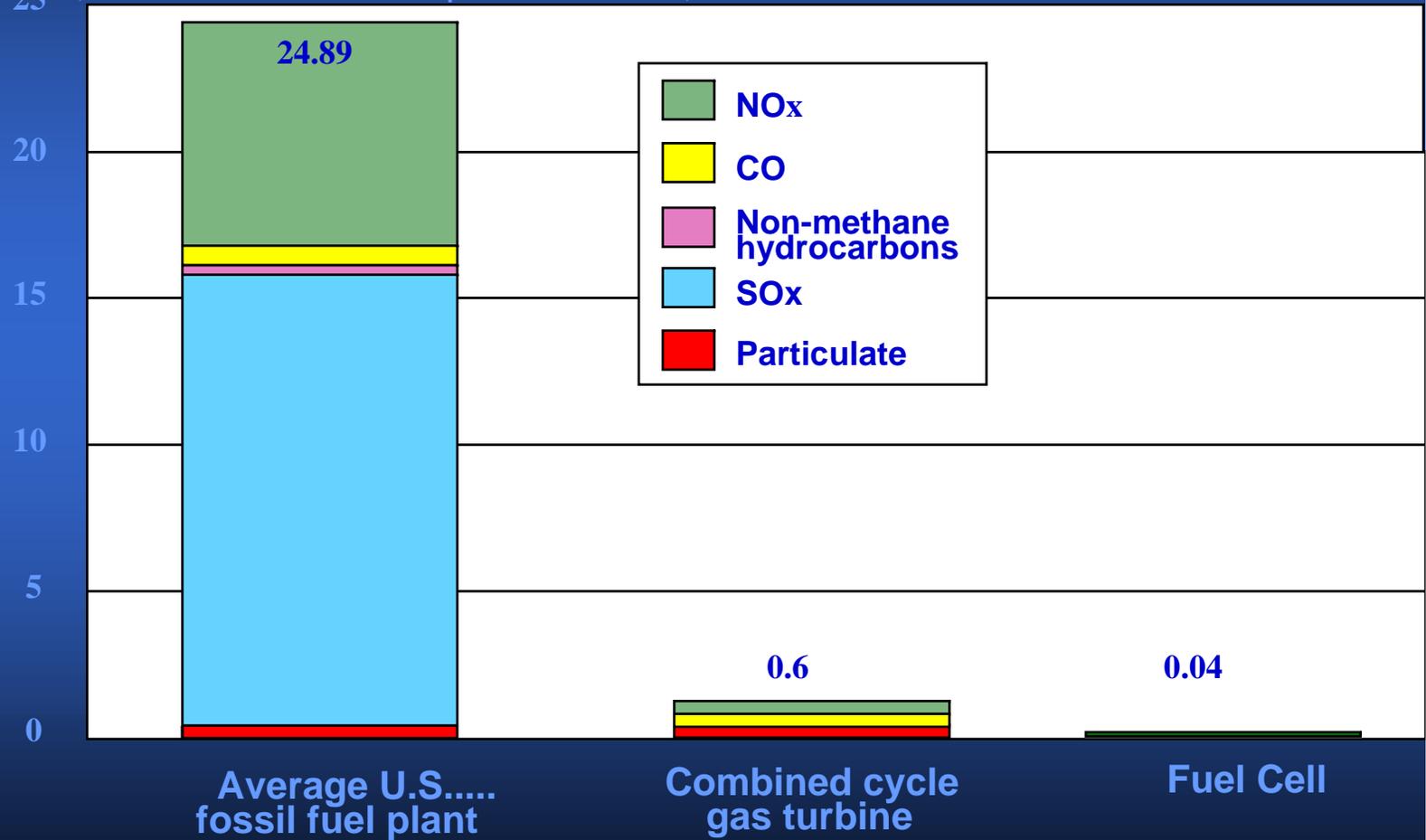
Manufacturer	Product	Scale	Markets	Applications
Plug Power	GenSys	5 kW	Residential	Base Load
(PEM)	GenCor	5 kW	Lt. Commercial	Standby
UTC Power	PureCell 200	200 kW	Commercial	Base Load
(PAFC)				Reliable Power
				Premium Power
Fuel Cell Energy	DFC300	250 kW	Commercial	Base Load
(MCFC)	DFC1500	1000 kW	Industrial	Sub station
	DFC3000	2000 kW	Industrial	Grid Enhancement

Benefits: Comparative Efficiencies



Benefits: Clean Emissions

(Pounds of emissions per 1000 kWh)



Fuel Cell Technology

2005 Initiatives

Plug Power ~ 30 Units

DOD ~ 4 Projects

Brownfield Devel ~ 3MW

Renewables ~ 1MW

Other Commercial ~
400kW

It's Your World...
Power it Wisely!

It's Your Power...
Choose it Wisely!

Next Steps

It's Your World...
Power it Wisely!

Ne

New Site Assessment

Energy Services LOI

Detailed Analysis

Project Agreement

Design/Engineering

Project Installation
Customer Service
Ops & Maintenance

It's Your Power...
Choose it Wisely!





Thank You !

LOGANEnergy

The Wise Power Choice

GOODBYE TO ALL THAT OIL

Steve Butala
Logan Energy

Aloha

- Steve Butala, Logan Energy Fuel Cell Technician
- Logan Energy specializes in fuel cell planning, installation, and service.
- My personal views on the looming energy crisis and where fuel cells fit in.

Topics of Discussion

- When will oil run out?
- Will life without oil equal the apocalypse?
- What will replace oil?
- Where do fuel cells fit in?

When will oil run out?

- It is predicted that somewhere between now and 2037, oil will start to run out.
- Knowing the exact year doesn't matter.
- Crash mitigation for the end of oil will take 20 years. Add 10 years for political action just to get started.

The Apocalypse

- Hawaii's in deep kimchee
- How will we get tourists here?
- How will we get our food here?
- How will we power our buildings?
- How will we fuel our cars?

What will replace oil?

- Hawaii, with proper planning, will outrun the four horsemen of the Apocolypse
- Photovoltaic on every house and building
- Windmills on the peaks or in the ocean
- Wave energy
- Garbage to energy
- Biomass
- Nuclear?

No place like home

- Solar hot water
- No clothes dryer, super efficient refrigerator, no A/C
- Photovoltaic for remaining electrical requirements
- Excess PV will produce hydrogen for use in fuel cell car and fuel cell backup generator.

What This Means

- Renewables are the answer, but they still won't be enough
- We are an incredibly wasteful society, we must learn to consume less energy
- Quality of life doesn't have to diminish, in fact logically, being more efficient pays off

Hybrid Prius vs. Murano

- $10,000 \text{ miles} \times \text{gal}/50 \times \$2.45 = \$490$
- $10,000 \text{ miles} \times \text{gal}/16 \times \$2.65 = \$1,656$
- $\$1,656 - \$490 = \$1,166$
- $\$1,166 \text{ for } 10 \text{ years at } 7\% = \$16,105$
- $\$7,000 \text{ for } 10 \text{ years at } 7\% = \$13,769$
- Total savings = \$29,874

Next Steps

- We need strong leadership
- There has been a total lack of political debate on how we will handle the impact of no oil
- Continue doing what your doing: Rebuild HI Consortium, push renewable projects and energy conservation, get the word out and set an example
- <http://www.fraw.org.uk/rangers/>
- Support fuel cell projects!