Flexible Co-Production of Renewable Hydrogen and Electricity

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FuelCell Energy
(NasdaqNM:FCEL)

Overview

- Hydrogen Infrastructure: Challenges and Opportunities
- DoD Hydrogen and Fuel Cell Initiatives
- On-site Renewable Hydrogen Co-production
- Co-production Technology Update
- Summary

Hydrogen Infrastructure: Challenges and Opportunities

- Challenges:

  - Transition Strategy, Stranded Assets

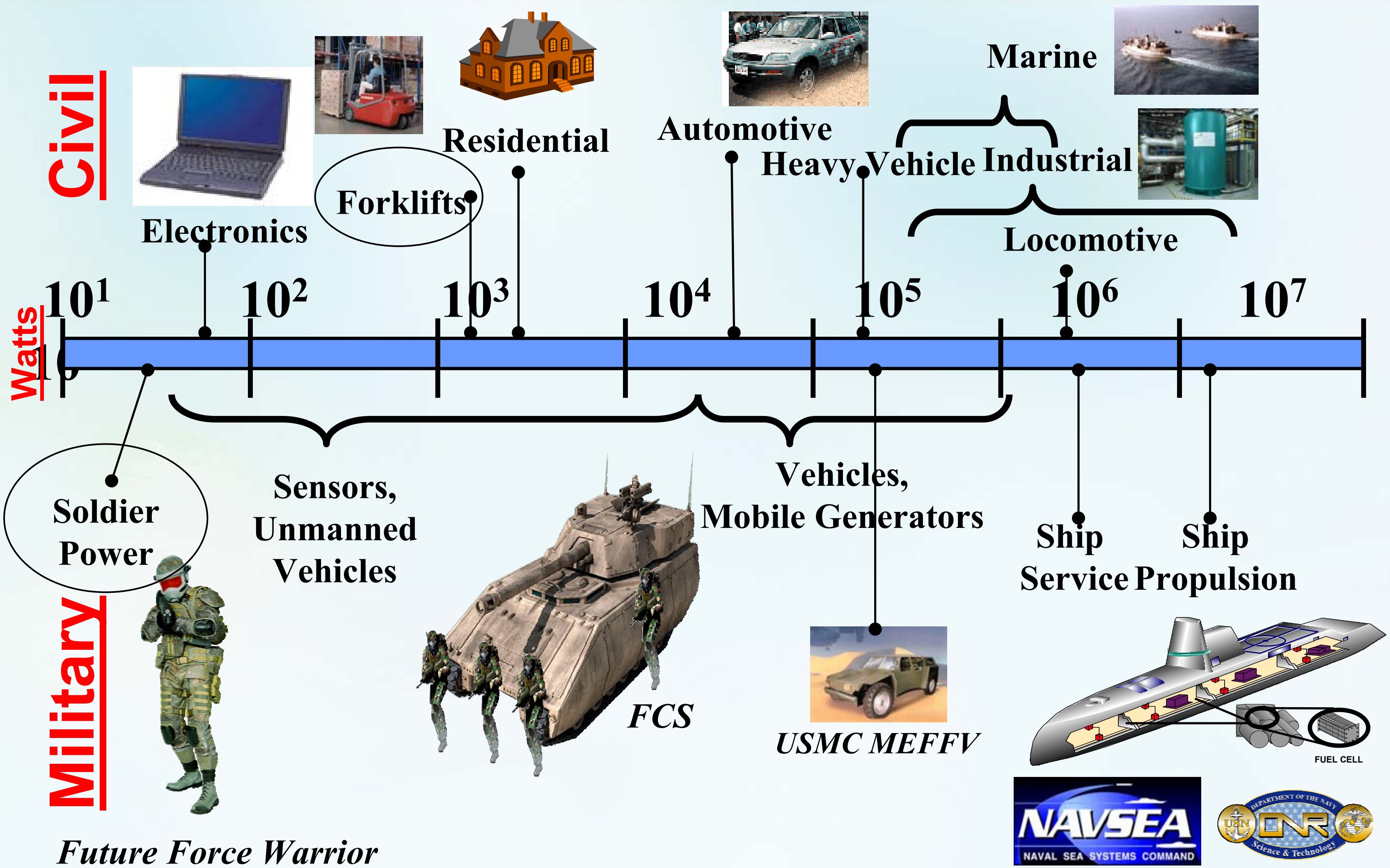
- Opportunities:

  - Flexible Value Proposition, Multi-purpose Solution

  - Dual Use (Industrial Use → Transportation Use)

- Overall, cost of the delivered hydrogen must be cost-competitive, and meet all the regulatory requirements

Leveraging Civil/Military Power Requirements



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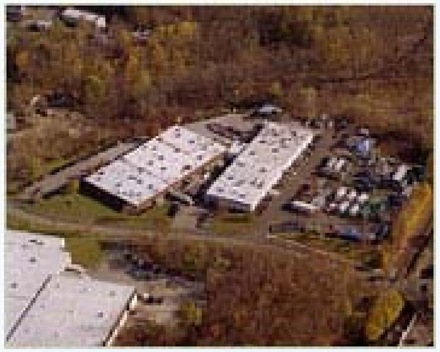
Company Overview

- Premier developer of stationary fuel cell technology
  with more than $530 million invested in R&D
- More than 30 years of experience
- Delivering Ultra-Clean Direct FuelCell power plants
  to institutional, commercial and industrial customers
- Headquarters in Danbury, CT (USA), with 65,000 square foot manufacturing facility in

Torrington, CT



Danbury, CT

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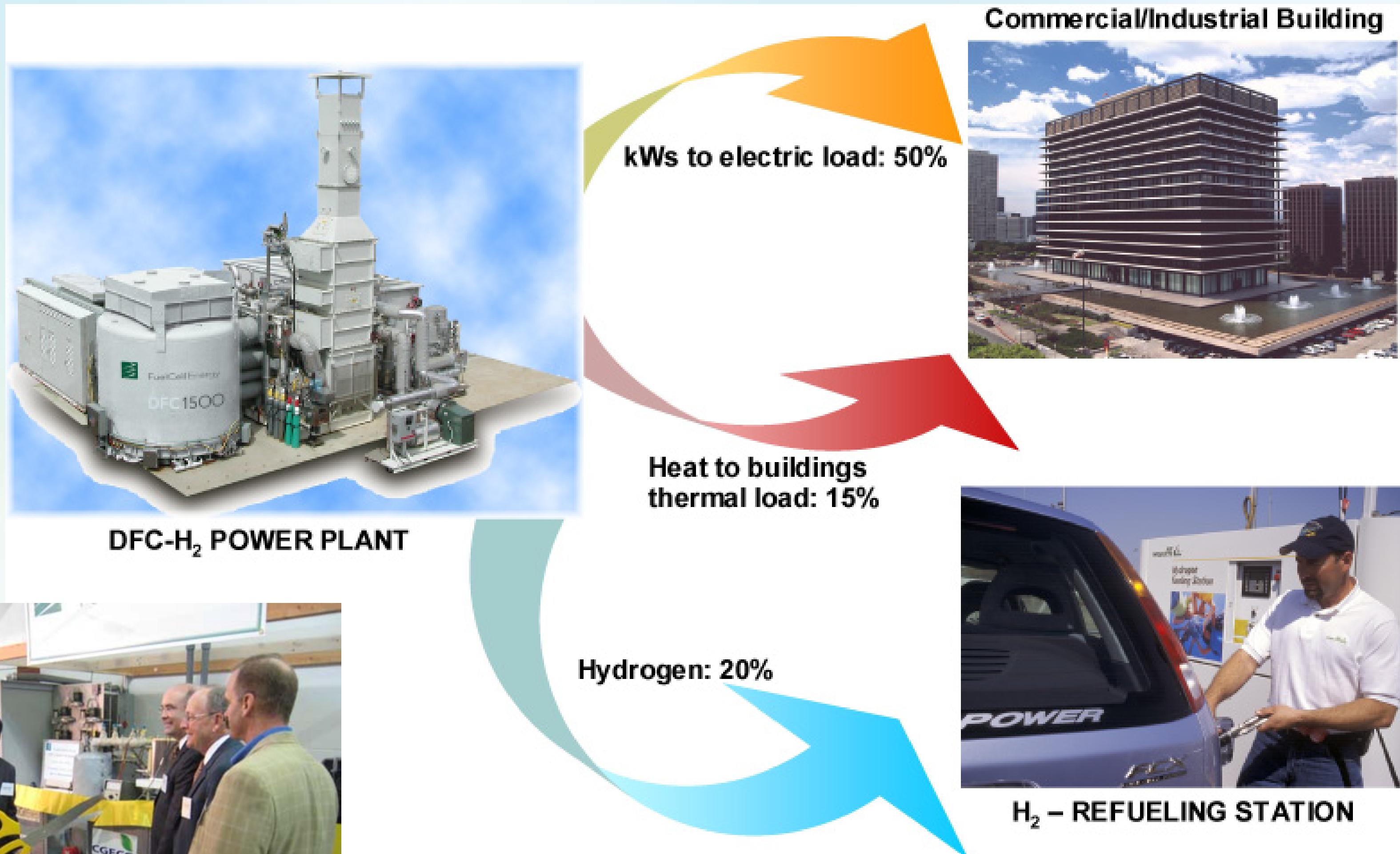
DFC-H2 Power Plant



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Target Feedstock Readiness for H_2 Co-production

Fuel	*Technology Status*
Natural Gas	**Commercial**
Digester Gas	**Commercial**
Propane	**Commercial Demo**
EPA Diesel	**Lab Demo**
JP-8	**Lab Demo**
Ethanol	**Lab Demo**
Wastes, MSW, Grasses and Grains	**Gasification Demos not integrated with DFC**

Examples of Digester Gas Fed DFC® Plants

Wastewater Treatment, Santa Barbara,CA

Kirin Brewery, Japan

Sierra Nevada Brewery, California

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DFC Units Operating on Digester Gas

Unit name	In service	Capacity
King County	6/2004	1 MW
Kirin	9/2003	250 kW
Fukuoka	1/2004	250 kW
Palmdale	8/2005	250 kW
Santa Barbara	1/2005	500 kW
Tancheon	4/2006	250 kW
Super Eco Town	6/2006	250 kW
Sierra Nevada	5/2005	500 kW
KEEP	1/2006	250 kW
Tulare	Planned	750 kW
San Ramon	Planned	600 kW

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Reduction in NO_x and SO_x Emissions

	NO_x (lb/MWh)	SO_x (lb/MWh)	CO_2 (lb/MWh)
Average US Fossil Fuel Plant	4.200	9.21	2,017
Microturbine (60 kW)	0.490	0	1,862
Small Gas Turbine (250 kW)	0.467	0	1,244
DFC Fuel Cell 47% efficiency	**0.016**	**0**	**967**
DFC Fuel Cell – CHP 80% efficiency	**0.016**	**0**	**545**

NO_x and SO_x are negligible compared to conventional technologies

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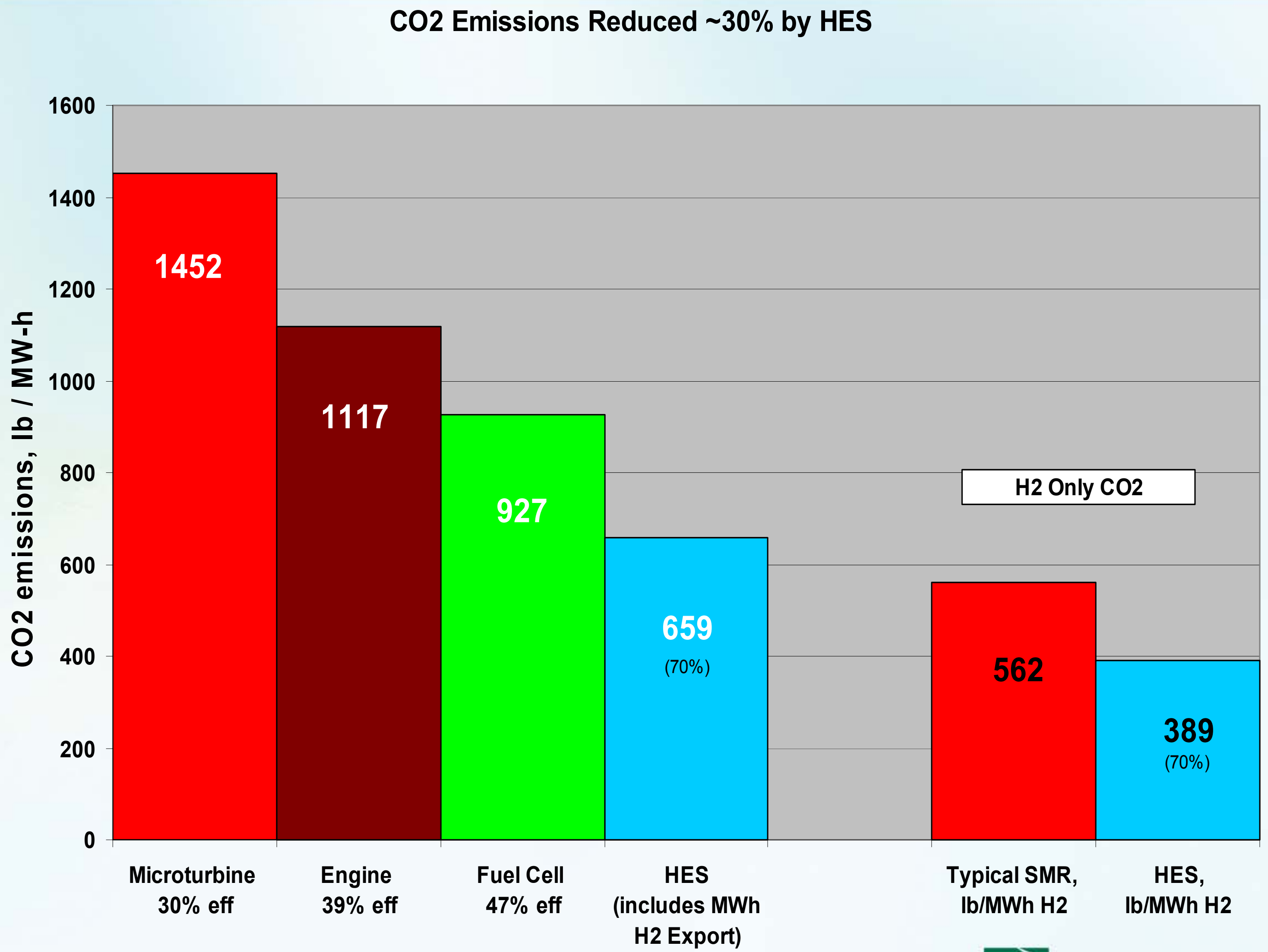
Significant Reduction in CO_2 Emissions



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Performance for DFC-300 Frame

	Units	NG	Biogas
Overall Efficiency – "Tri-Gen" (Net Power + Hydrogen + Heat) / (Fuel)	LHV	76%	70%
Overall Efficiency – H2 + Power (Net Power + Hydrogen Product) / (Fuel)	LHV	66%	63%
Hydrogen Product	Kg/day	~ 135	~120
Net Power	kW	~ 250	~ 240
Heat Export	kW	~ 75	~ 50

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Electrochemical Hydrogen Separation (EHS)

- **Separates H_2 rather than CO_2**
- **EHS can be based on PEM, PAFC or P-SOFC**
- **FCE's Electrochemical Hydrogen Separator offers:**
  - No moving parts
  - Lower power requirement and potentially lower cost
  - Simpler, truly continuous process (simple controls, flexible op.)
  - Versatile (can separate H_2 from a wide range of H_2-containing streams)

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EHS System Demonstration at University of CT

- The Demo Unit separates 6 lb/day H_2 – can refuel approx. one car per day
- >7000 hours of operation to date
- Reliable operation: No EHS-related shutdowns

Celebration of Successful Completion of EHS Demo Project September 2007

EHS Scale-up Stack Hardware Qualification

Successful Scale-up to 1000 cm^2 Active Area (Short Stack)

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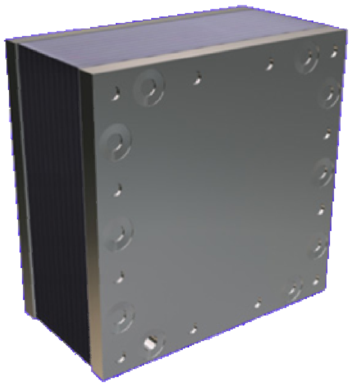
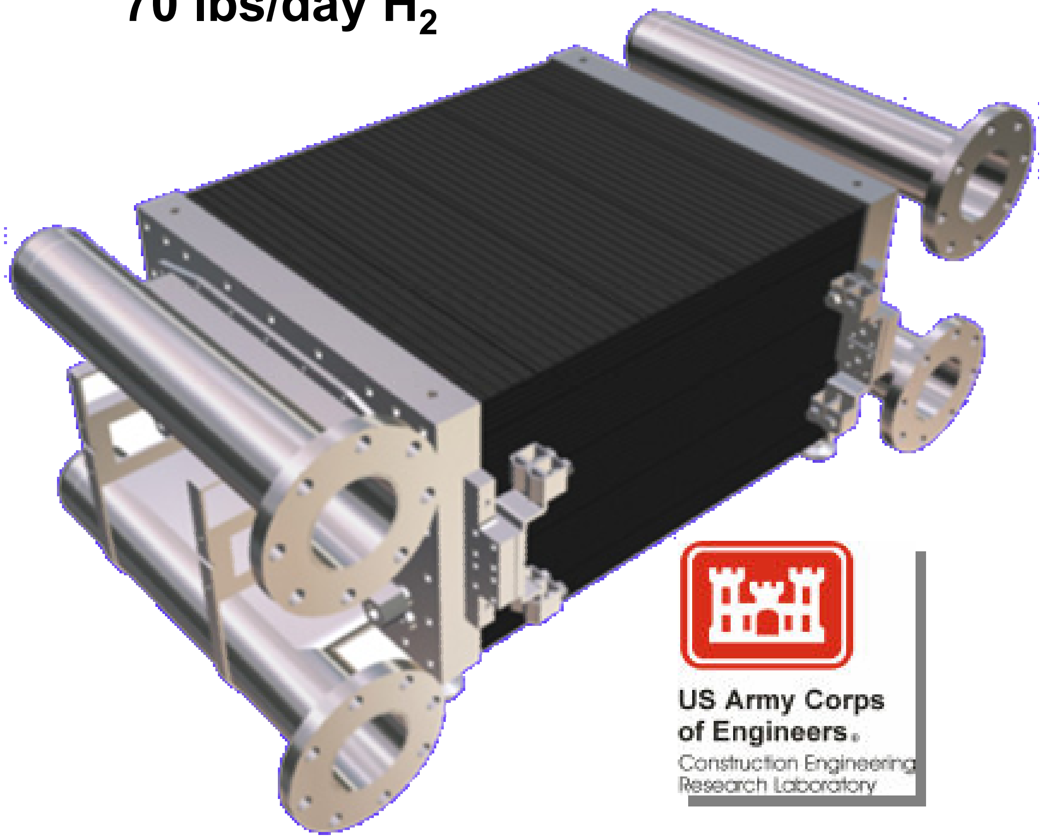
EHS Technology Scale-up: Partners

6 lbs/day H_2



Connecticut Clean Energy Fund

70 lbs/day H_2



US Army Corps of Engineers.
Construction Engineering Research Laboratory

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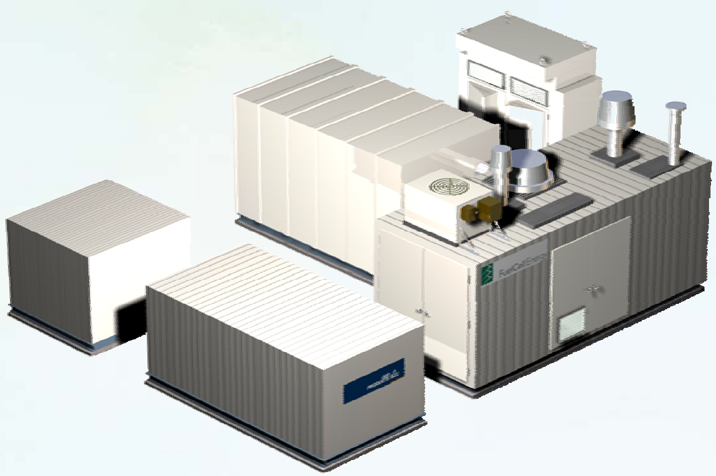
Co-Production Of Hydrogen And Electricity Using DFC Power Plants

DFC Power Plant	Electrical Output [kW]	Hydrogen Produced [lbs/Day]	Fuel Cell Fleet Vehicles Serviced [approx.] *
DFC-300	250 kW	300	~300
DFC-1500	1000 kW	1,200	~1,200

* DOE-Air Products' Study



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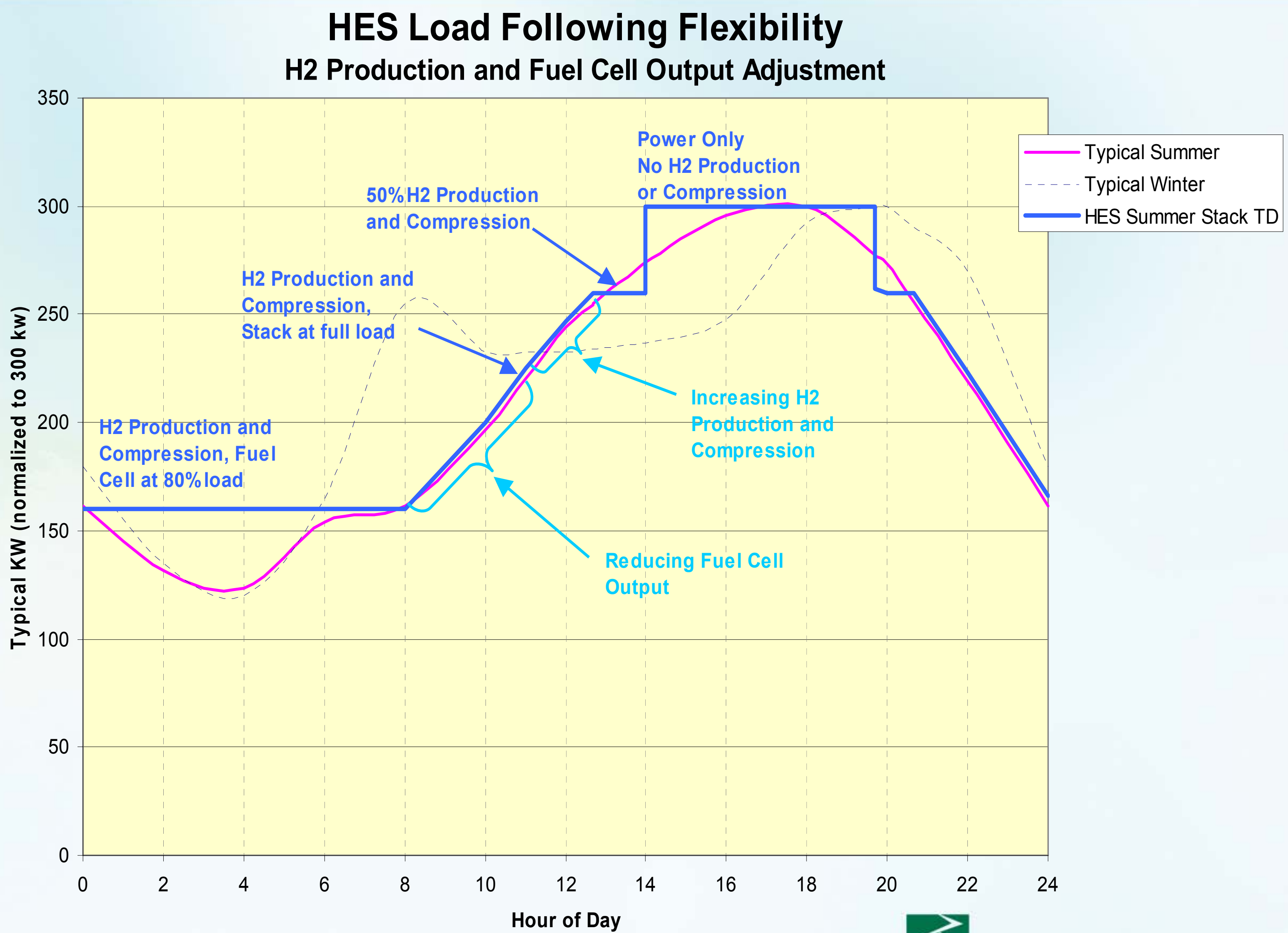
6 lbs/day H_2
Electrochemical Hydrogen Separator
70 lbs/day H_2
H_2 FUEL-UP
F-Cell

Summary

- Co-production of hydrogen and electricity offers a better value proposition
- It is an enabling technology for hydrogen infrastructure
- High temperature fuel cells such as MCFC and SOFC, provide "virtually free" source of hydrogen (you pay for separation of dilute hydrogen)
- Conventional separation processes meet technical requirements. A demonstration using Air Products' PRISM PSA system is planned.
- Initial test results using electrochemical hydrogen separation are encouraging

Flexible Co-Production: Load Following



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Defense Depot – Susquehanna, PA

Objectives:

- Explore fuel cell infrastructure and functionality with forklifts
- Develop a business case for fuel cells
- Collect and analyze operational data

Approach:

- Retrofit 40 forklifts with fuel cells
- Conduct Fly-Off between two fuel cell producers
- Set up storage & dispensing systems for delivered H_2

DOD Impacts:

- Develop knowledge of fuel cell powered fork lift capabilities, costs, limitations and benefits
- Improve MRLs and costs

Customers:

- Depot located at New Cumberland, PA

Performers: TBD

Milestones:

- Contract award – May 2007
- First Articles – Summer 2007

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Hydrogen Forklifts at Military Bases

- Delivered in May of 06 at GFARNGB
- Testing in Cold Weather Conditions
- Powered by General Hydrogen Fuel Cell Pack

General Hydrogen's Fuel Cell Pack

≥ 3 Sites

≥ 70 Fork Lifts

~5 lb/refill

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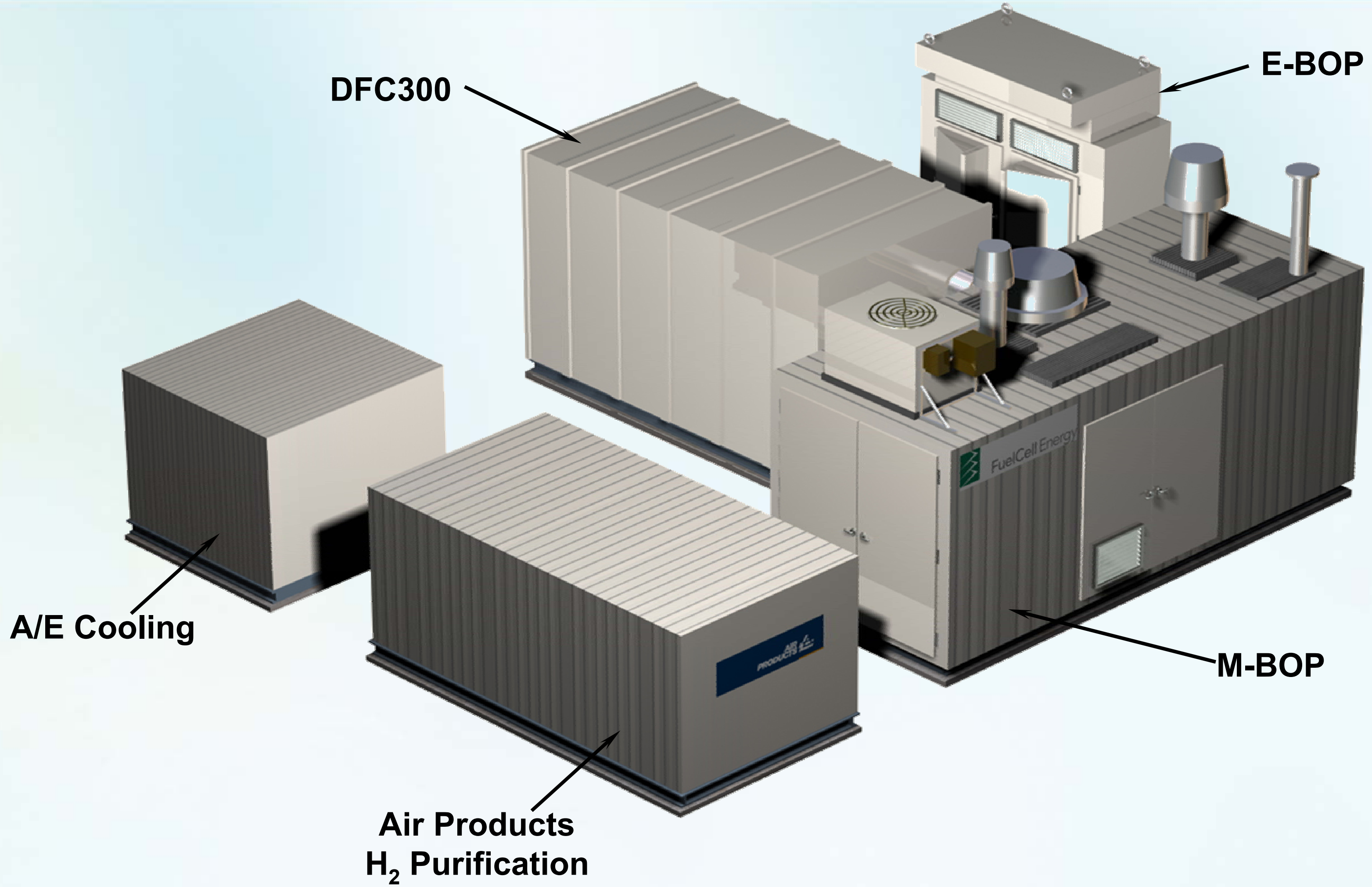
Conceptual Design of Commercial DFC-H_2 System: SubMW Unit



Demonstration Planned with Air Products in 2008/09 (DOE-EERE)