FuelCell Energy

DFC Technology Status

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reliable, efficient, ultra-clean

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Distributed Generation

DFC power plant is an enabler for broad distributed generation

- Distributed generation puts power where it's needed
- Increases power reliability
- Near zero emissions allow units to be sited almost anywhere – even polluted urban areas
- Reduces need for central generation plants
- Reduces grid congestion and need for new transmission lines
- Distributed generation enables smart grid
- Balances the grid with 24/7 power
- Meets requirements for low carbon technology
- Smaller projects enable faster permitting, financing, and execution

600 kW at M&L Commodities

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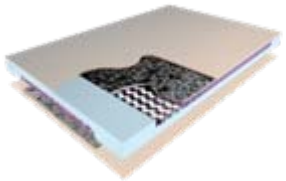
FuelCell Energy Products



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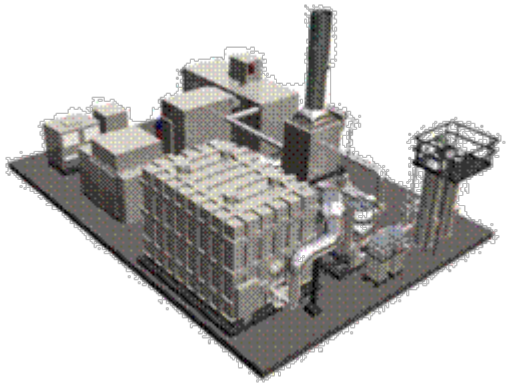
Stack

Building block approach provides scalability and a common cell/stack component across product lines

DFC300
Single Module
Power plant



DFC1500
Four Module
Power plant

DFC3000
Two 4-Stack
Modules

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DFC Typical Applications

Average-Sized Grocery Stores, 300-Bed Hotels

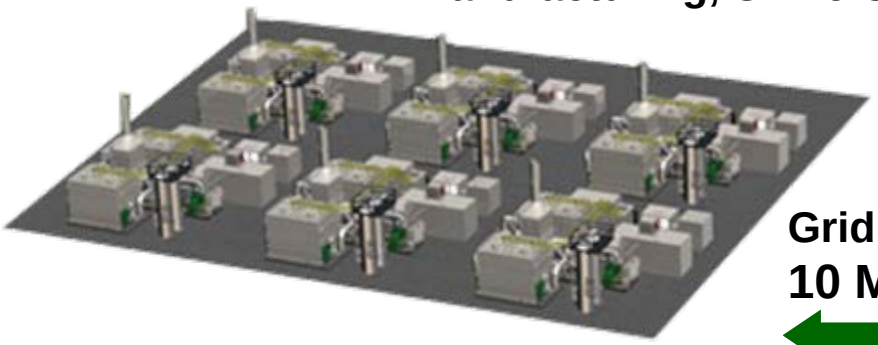
300 kW

1.4 MW

1000-Bed Hotels, Convention Centers, Wastewater Treatment, Food/Beverage

300-Bed Hospitals, Manufacturing, Universities

2.8 MW



Grid Support, RPS

10 MW +

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High Electrical Efficiency

DFC power plants offer the highest efficiency of any distributed generation technology

Fuel to Electrical Efficiency

60%

50%

40%

30%

20%

10%

Micro-turbines
25 – 30%

Small Gas Turbines
25 –35%

Natural Gas Engines
30 – 42%

Direct FuelCell (DFC)
47%

DFC-ERG
DFC/Turbine
58 – 65%

MO3262

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Direct Fuel Cell Emissions Compared to Others

	CO_2 (lb/MWh)	NO_X (lb/MWh)	SO_X (lb/MWh)	PM_{10} (lb/MWh)
Average US Fossil Fuel Plant	2031	5.06	11.6	0.27
Average US Generation	1408	3.4	7.9	0.19
Typical Small Gas Turbine	1494	1.1	0.008	0.08
DFC (Baseline products)	980	0.01	0.0001	0.00002
DFC Potential (at 65% Efficiency)	**680**	**0.007**	**0.00007**	**0.00001**

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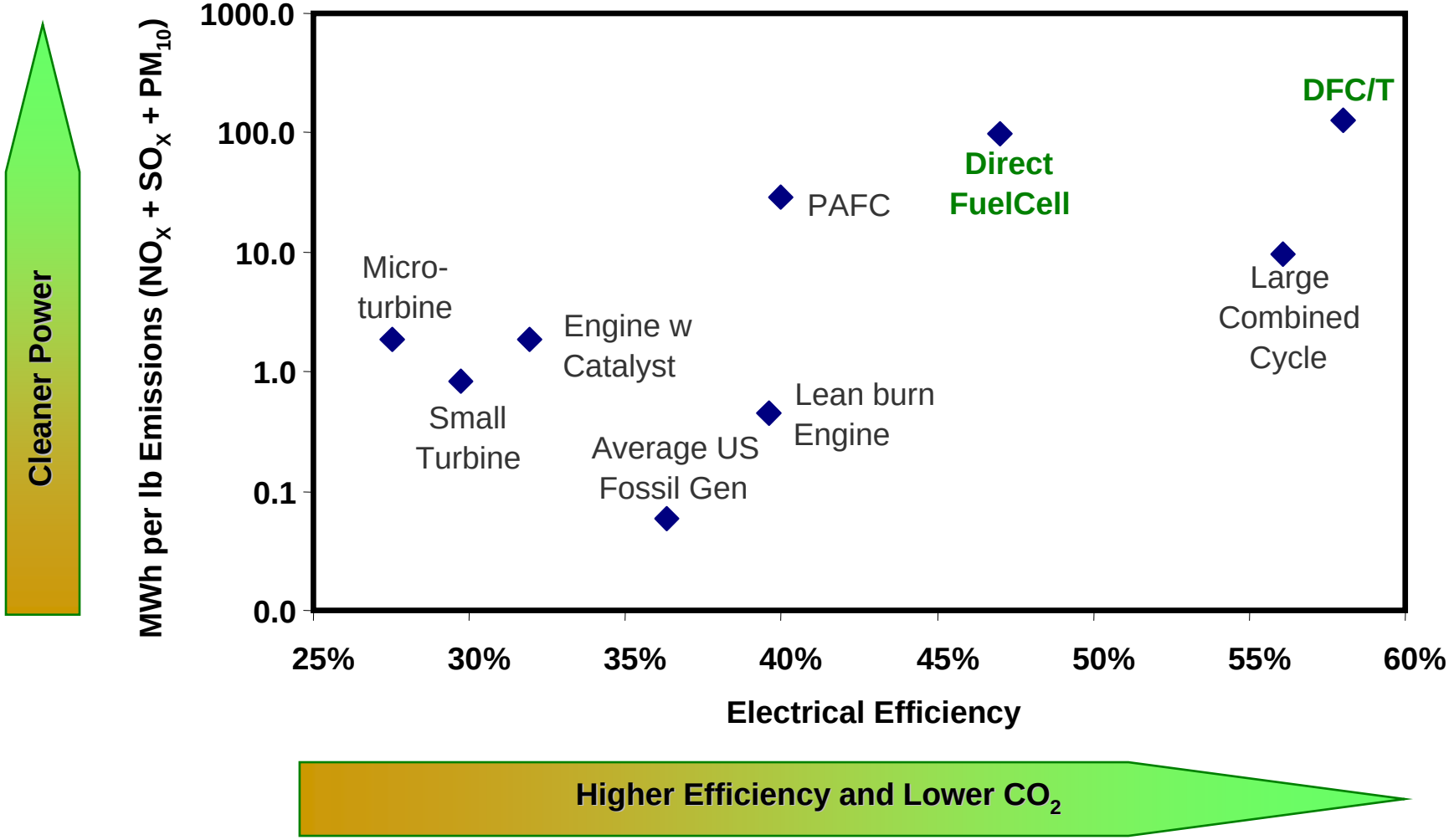
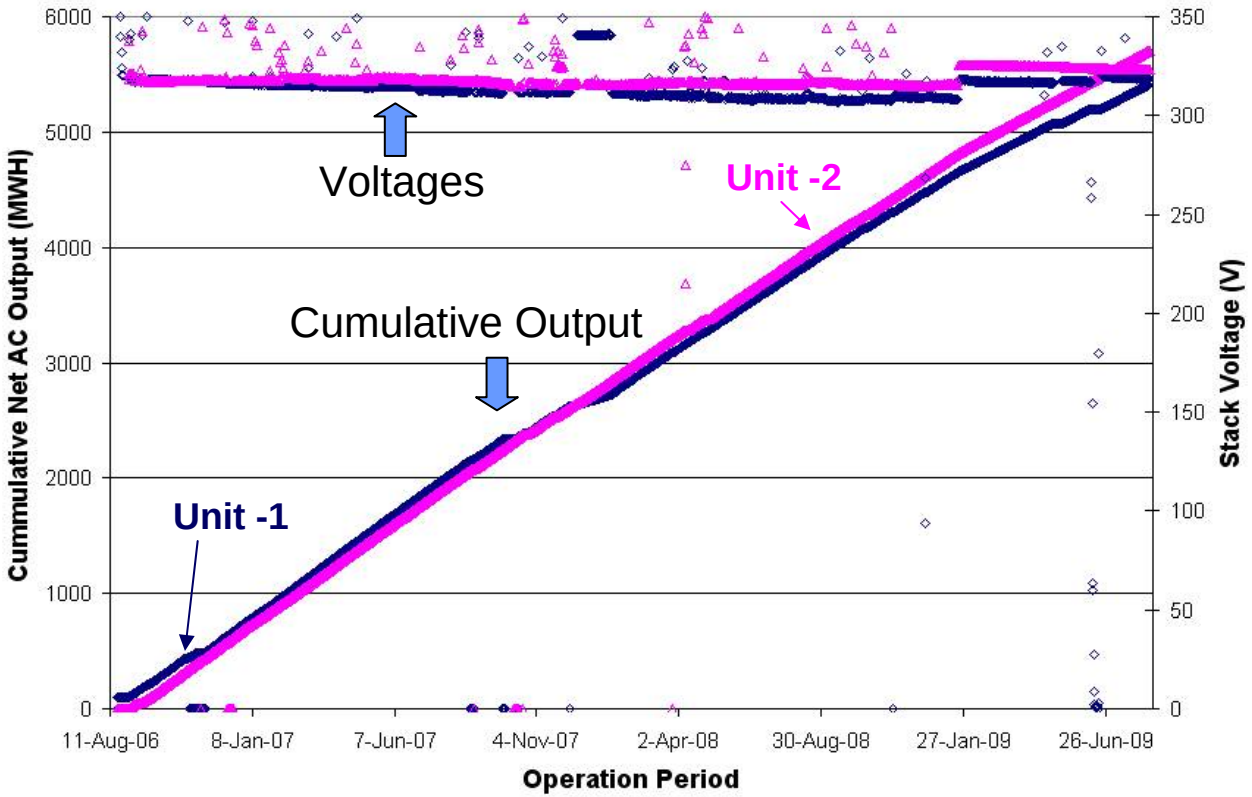
DFC: Cleanest Power at the Highest Efficiency



Source for non-DFC data: PAFC data from product brochure; Other data from "Model Regulations For The Output Of Specified Air Emissions From Smallerscale Electric Generation Resources Model Rule and Supporting Documentation", October 15, 2002; The Regulatory Assistance Project report to NREL



Both stacks at the Camp Pendleton site met life goals

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Typical Operating Point of a 2.4 MW Power Plant

DFC3000 POWER PLANT MAIN MENU 8/17/2009 8:11:27 AM

Power Plant Load Rated

	ACTUAL	ISO RATED
DC Power	2607 KW	2566 KW
Gross AC Power	2573 KW	2463 KW
BOP Load	58 KW	63 KW
Altitude Correction	0 KW	0 KW
Stack Auto Derate	0 KW	0 KW
Net AC KW Output	2415 KW	2400 KW

SYSTEM INFORMATION:

ICONICS VERSION: 11
PLC LOGIC VERSION: 55.0
MODULE A SERIAL NUMBER: B1220-013
MODULE B SERIAL NUMBER: B1220-014

POWER PLANT LOCATION:

MPC 2 - Yulchon, Republic of Korea

MODULE A	DC Voltage	DC Current
STACK AB	623 V	1046 A
STACK CD	631 V	1032 A
AVERAGE	627 V	2078 A
Runtime	1169 Hrs	

MODULE B	DC Voltage	DC Current
STACK AB	625 V	1046 A
STACK CD	625 V	1046 A
AVERAGE	625 V	2093 A
Runtime	1169 Hrs	

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Multi-MW Scale Fuel Cells

4.8 MW Fuel Cell – Pohang, Korea

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DFC Edge in Biogas Applications

- **More power for given amount of biogas**: Higher efficiency than any other generation at typical digester facility sizes
- **Good heat to power ratio for digester support:** Fuel cell makes enough heat to support digester operation
- **Avoids generation of NO_X and other pollutants** from flare or from other generation technologies

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King County Seattle

1 MW Municipal Wastewater Treatment Plant

First Site with Online Fuel Switching

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Kirin Brewery Project

First SubMW Digester Gas Project, Running on Biogas from Beer Production

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Sierra Nevada Brewery

Site with Power Generation in excess of ADG Supply

First Site with Automated Fuel Blending

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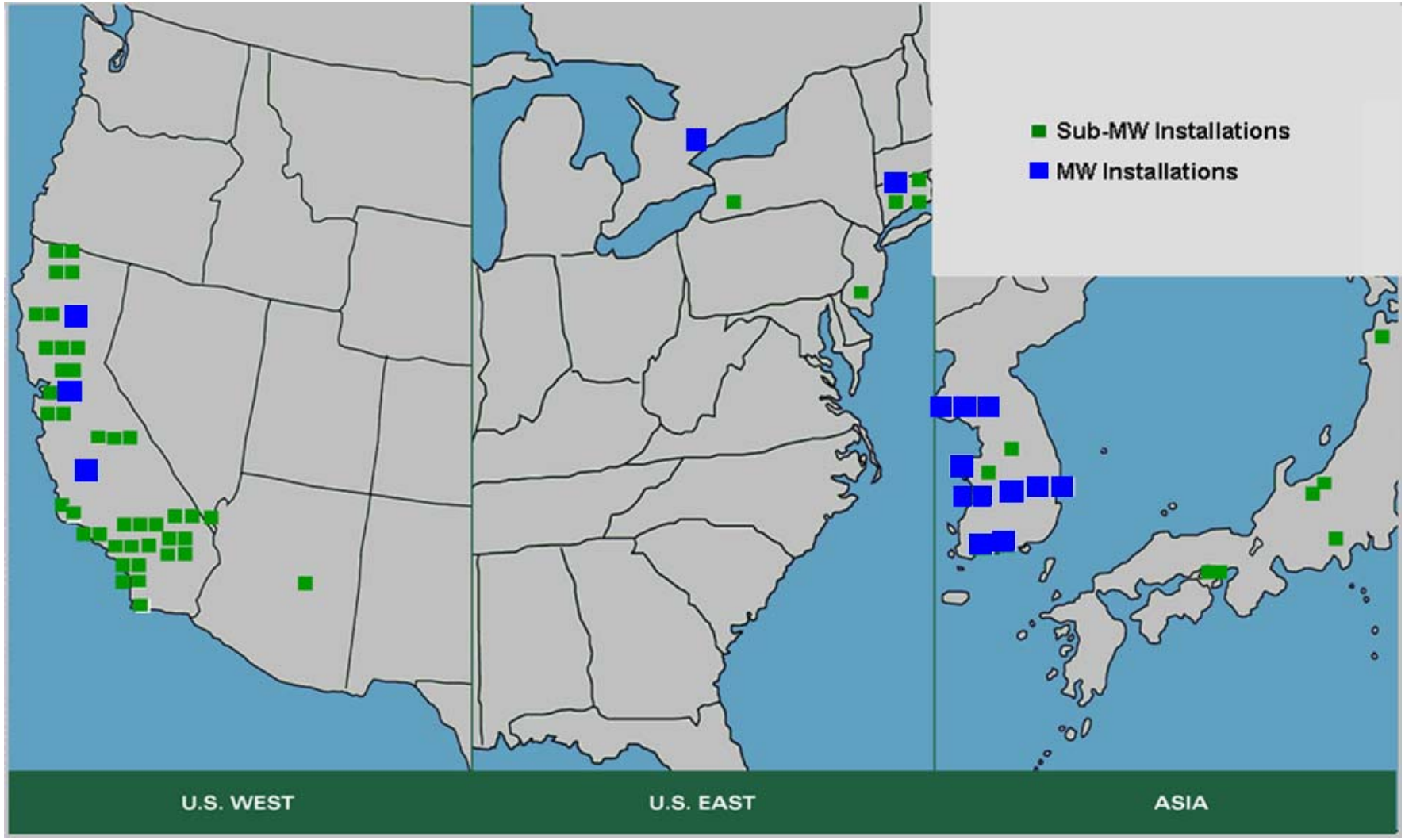
MW and Sub-MW DFC® Worldwide Installations



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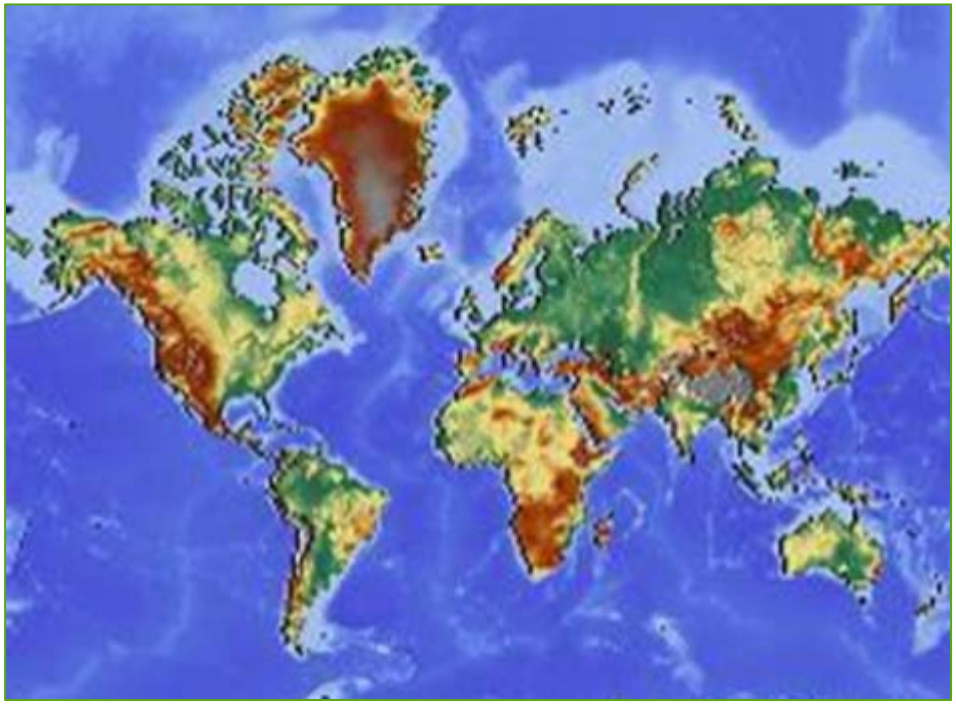
Current Market

Markets

- 95 MW installed/backlog
  - Japan/Korea: 72 MW
  - California/West Coast: 15 MW
  - Northeast/Canada: 5 MW
  - Europe: 2 MW
- Targeted applications
  - Grid Support: 69 MW
  - Renewable/Wastewater: 9 MW
  - Manufacturing: 7 MW
  - Hotels: 3 MW
  - University & Hospitals: 2 MW
  - Government: 3 MW
  - DFC-ERG: 2 MW



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DFC Production

- Production and delivery capabilities meet current demand
- State-of-the-art manufacturing in Torrington, CT
- 70 MW capacity
- Production rate of 30 MW/year
- Strong supply chain in place
- Expansion plan to achieve 150 MW capacity

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New Products: DFC ERG Status

- DFC-ERG provides heat for natural gas pipeline letdown operations
  - Byproduct heat warms gas to prevent freezing as pressure is let down from transcontinental pipelines to local lines
  - Excess electricity sold to the grid
- Improved economics and lower carbon emissions due to ~60% electrical efficiency
- First site commissioned in Toronto
- Four sites pending under Connecticut RPS program
- Market opportunity estimated at 250-350 MW in Toronto, California and the Northeast U.S.

2.2 MW DFC-ERG in Toronto

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Products Under Development:
DFC/T Fuel Cell Turbine Hybrid System

- Fuel cell waste heat drives unfired turbine
- Electrical efficiency increased from 47% to 58-60%
- Field tested in DFC300 based subMW system
- Commercial product being designed based on DFC3000, 3.4 MW rating
  - First unit approved under CT Project 100

Billings, MT field test

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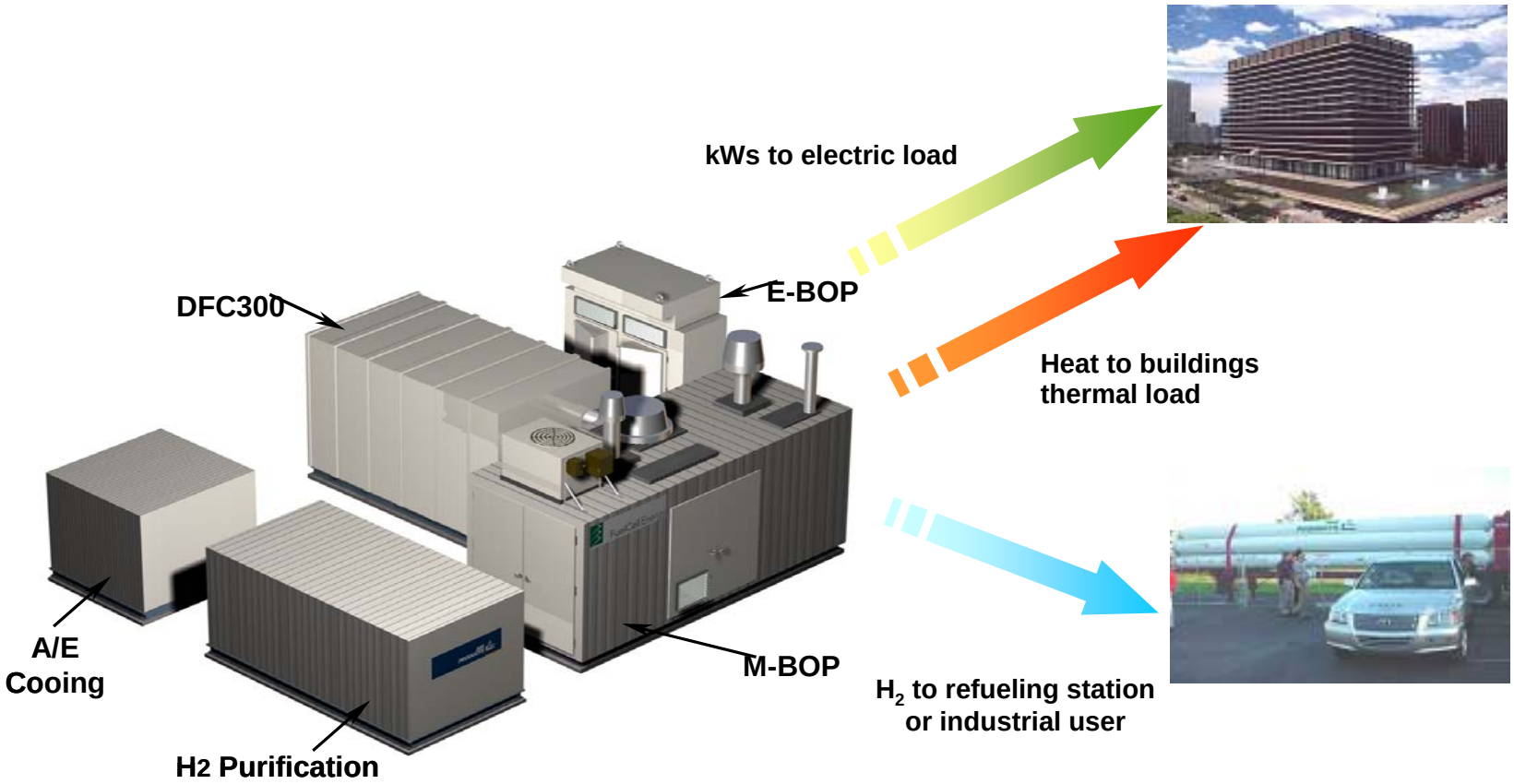
Products Under Development: Electricity and Hydrogen Co-production



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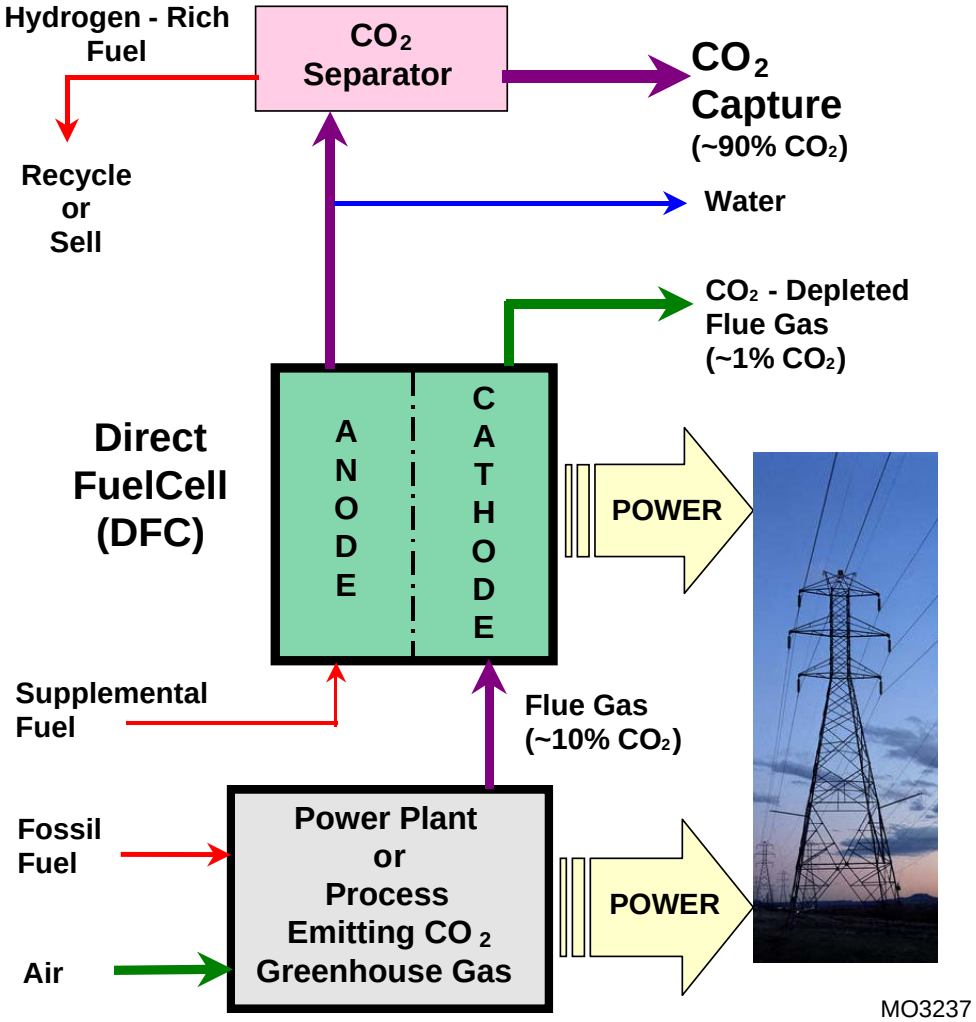
Products Under Development: Electricity Co-production and Carbon Separation

- Exhaust from fossil fuel plant used as DFC oxidant
- CO_2 from fossil fuel plant transferred and concentrated for efficient sequestration
- Produces additional power, unlike other carbon capture concepts



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DFC System Performance Summary Projection

DFC system has shown excellent performance in separation of carbon dioxide, in the study of various types of coal fueled power plants

PLANT TYPE	Net Power MW		CO2 to Environment lbs/MWhr	
	w/o DFC	with DFC	w/o DFC	with DFC
Pulverized Coal (PC) Steam Plant	200	341	1838	108
ACFB Steam Plant	200	353	1997	113
IGCC Plant	200	327	1657	101

DFC provides additional power

> 90% CO_2 separation from the greenhouse gas (per unit energy produced)

*** Preliminary results prior to input from fuel cell test results**

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DFC Status Summary

- 300 kW, 1.4 MW, and 2.8 MW size products for CHP applications
- Product performance expanding markets
- Customers/applications providing repeatable order flow – Asia, California, Connecticut
- RPS and South Korean markets creating multi-MW volume (84% of the installed and backlog volume in Asia) .
- Established manufacturing capability to meet current and future demand
- Cost reduction and volume on path to profitability

Pohang, Korea

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Direct FuelCell Attributes

- Higher electrical efficiency than competing technologies (approaching 50% in simple cycle distributed generation applications)
- Fuel flexible (NG, biogas, propane, coal-bed methane, and methanol)
- Modular
  - Easily siteable at load centers (simple connections to grid and fuel infrastructure)
  - Near-zero NO_X, SO_X and low CO_2 emissions as well as quiet operation
  - Reliable, 24/7 power
- High grade waste heat for combined heat & power (CHP; overall efficiency can achieve 90%)
- Competitive advantage on renewable biogas over other technologies
- Enabler for transformational technologies
  - High efficiency (58-65%) combined cycle systems in small size range (DFC/T)
  - Co-production of electricity and hydrogen (DFC-H_2)
  - Co-production of electricity from coal and CO_2 separation
  - High efficiency energy (>60%) recovery generation (DFC-ERG) system

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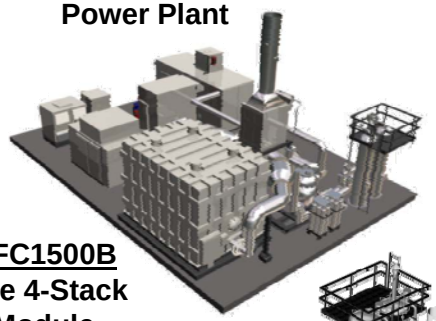
Cell Package and Stack

Single-Stack Module

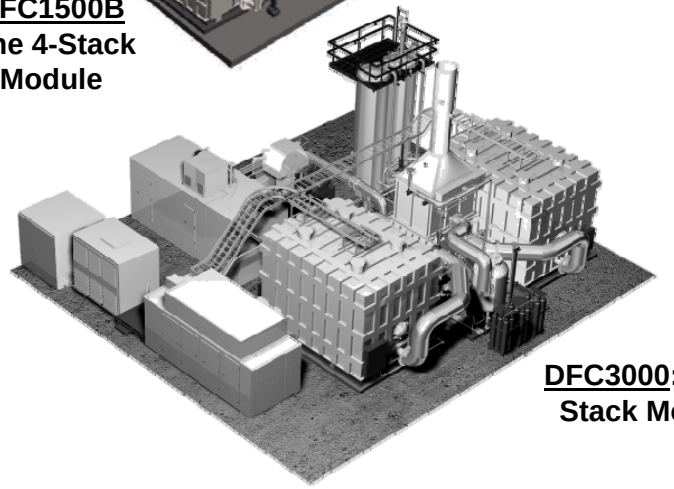
Four-Stack Module

DFC300
Single Module Power Plant

DFC1500A
Four Module Power Plant



DFC1500B
One 4-Stack Module



DFC3000: Two 4-Stack Modules

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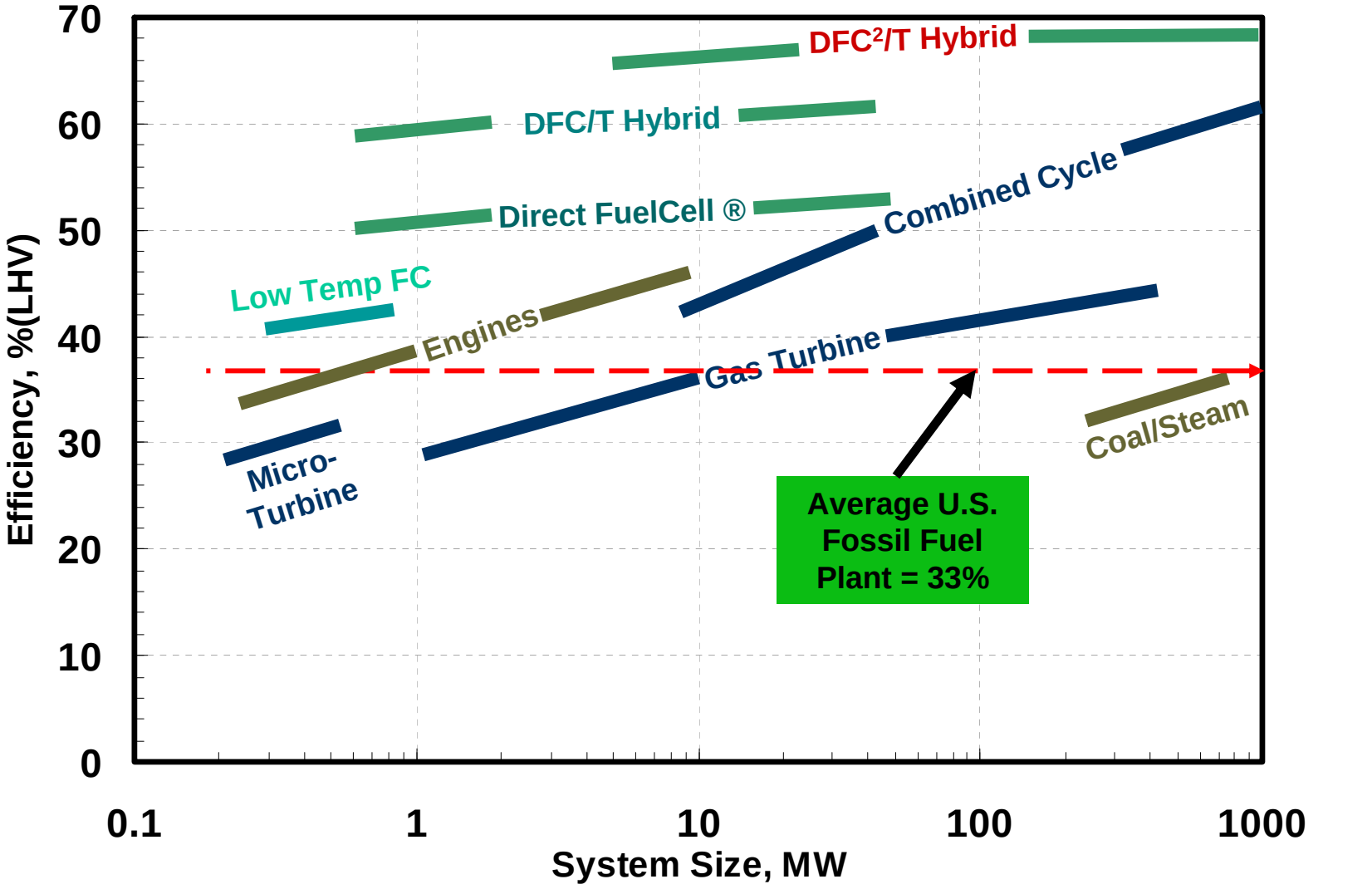
Direct Fuel Cell Efficiency Comparison with Competition



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DFC Production Readiness

- Production and delivery capabilities meet current demand
- State-of-the-art manufacturing in Torrington, CT
- 70 MW/yr capacity
  - Current production rate 30 MW/year
- Strong supply chain in place
- Expansion plan to achieve 150 MW capacity

Torrington, CT

Danbury, CT