



FuelCell Energy

Ultra-Clean, Efficient, Reliable Power



Fuel Cells and Hydrogen for Greater Sustainability Using Natural Gas

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At AIChE Workshop. Washington DC October 8-9 2014

Ultra-Clean | Efficient | Reliable Power

FCE Products and Services

Design

Megawatt-class distributed power generation solutions



Manufacture

Global manufacturing footprint

- North America
- Europe
- Asia via partner



Sales

Direct & via Partners

Installations & orders in 9 countries



EPC*

Project Development and Project Finance, Engineering & Construction

Over 300 megawatts installed and in backlog

* Engineering, Procurement & Construction



Services

Operate & maintain power plants

- Over 100 DFC® plants operating at more than 50 sites globally
- Three billion kWh ultra-clean power produced



Providing turn-key distributed power generation solutions that meet both economic and sustainability goals

Scalable Solutions



Individual fuel cell
&
350 kW fuel cell stack



Four-Stack Module
1.4 megawatts



Completed module
1.4 megawatts



1.4 MW
DFC1500[®]

- Utilizes one module
- Adequate to power 1,400 homes



2.8 MW
DFC3000[®]

- Utilizes two modules
- Adequate to power 2,800 homes



59MW fuel
cell park

World's Largest Fuel Cell Park



*“The scale of this installation is contributing to the power and heating needs of an urban population and generating the electricity in a **highly efficient and ultra-low emission** profile that supports our National renewable portfolio standard,”*

*Tae-Ho Lee
Chief Executive Officer
Gyeonggi Green Energy*

- **Scalable consisting of 21 DFC3000® power plants**
 - Only ~ 5.2 acres for 59 MW
- **Supplying electric grid and district heating system**
- **Constructed in only 14 months**
- **Adequate to power ~ 140,000 S. Korean homes**



Industrial Hydrogen Use
Existing market



Vehicle Fueling
Emerging market



Orange County Sanitation District
Renewable Hydrogen for Vehicle fueling

Ongoing Projects:

- Orange County Sanitation District, CA – Hydrogen from wastewater treatment digester gas for vehicle fueling
- Village Farms, Vancouver Canada - Hydrogen from landfill gas for vehicle fueling
- Torrington DFC Manufacturing Plant – Hydrogen for industrial heat treating

Zero or low-carbon H₂ economically produced near end users

What Can We Do With By-Product Hydrogen?

DFC300®



DFC1500®



DFC3000®



Co-product

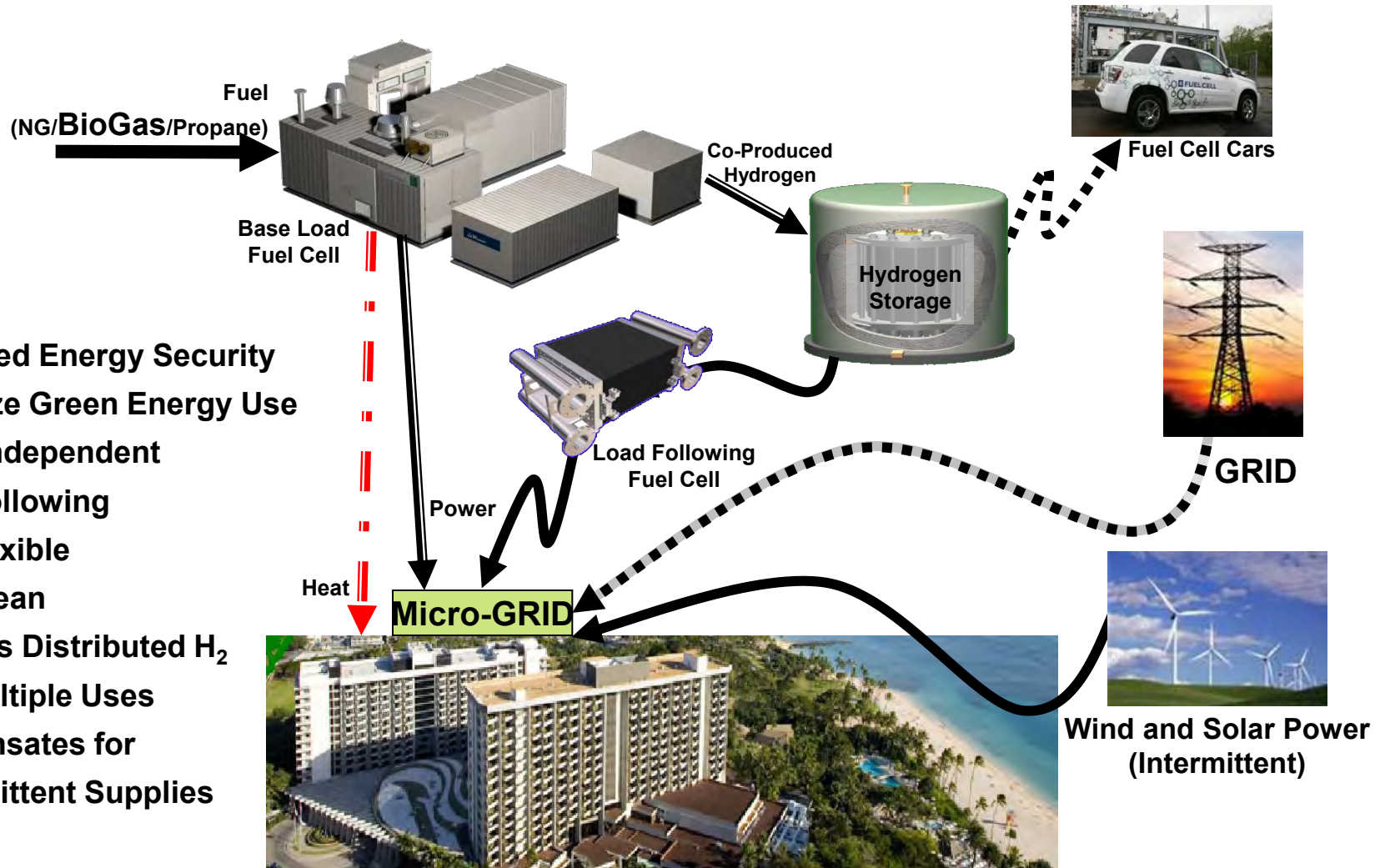
Power, kW	250	1,150	2,300
Hydrogen, kg/day	125	700	1,400
Heat, mmBtu/hr	0.5	2.0	4.0

Refueling Capacity

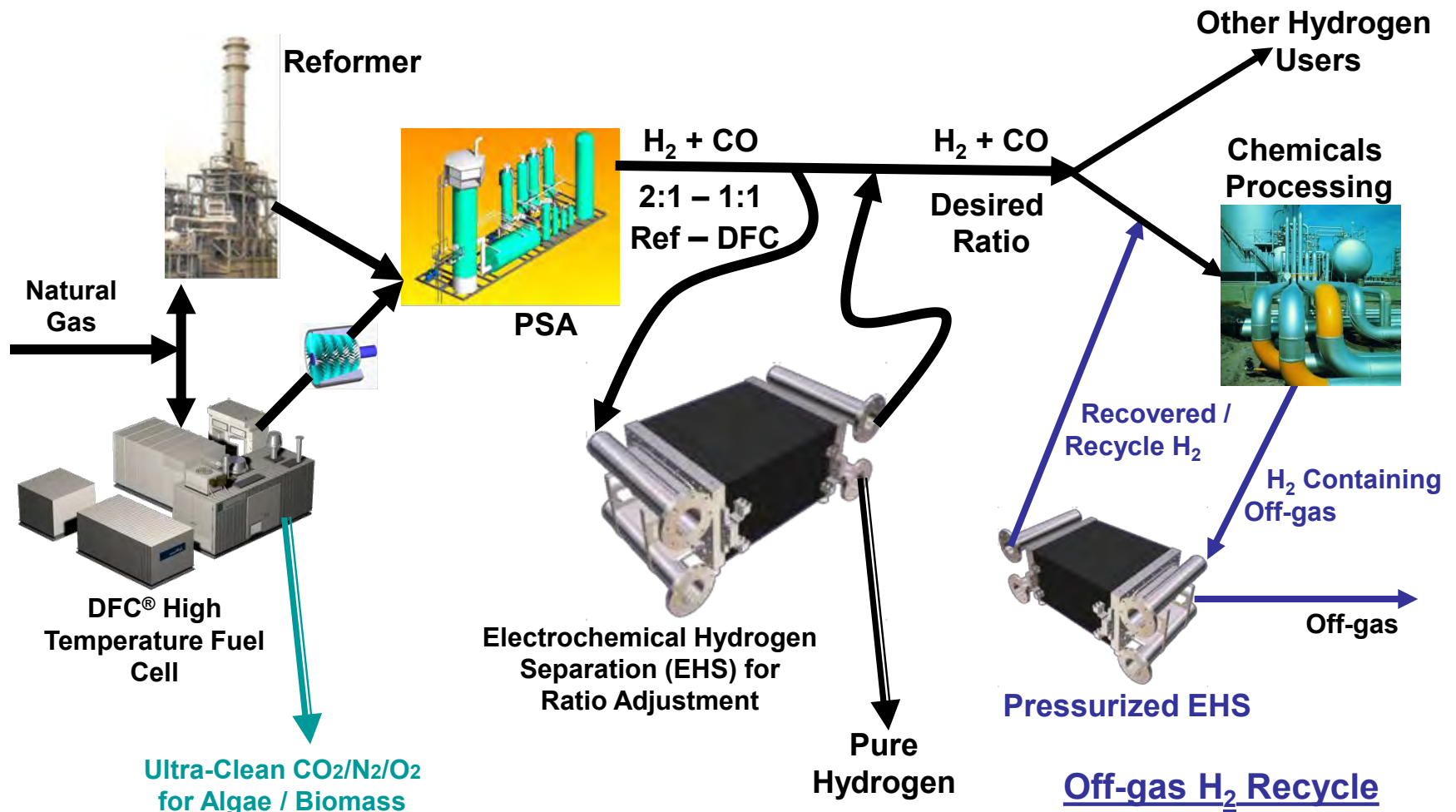
Cars, 4.2 kg/day	30	140	280
Buses, 25 kg/day	5	24	48
Fork Lifts, 2.1 kg/day	60	280	560
Plug-in Battery Hybrid, 12 kWh/day	500	2,400	4,800

Enabling Renewable Energy Use for Grid Independent Operation

- Enhanced Energy Security
- Maximize Green Energy Use
- Water Independent
- Load Following
- Fuel Flexible
- Ultra Clean
- Provides Distributed H₂ for Multiple Uses
- Compensates for Intermittent Supplies



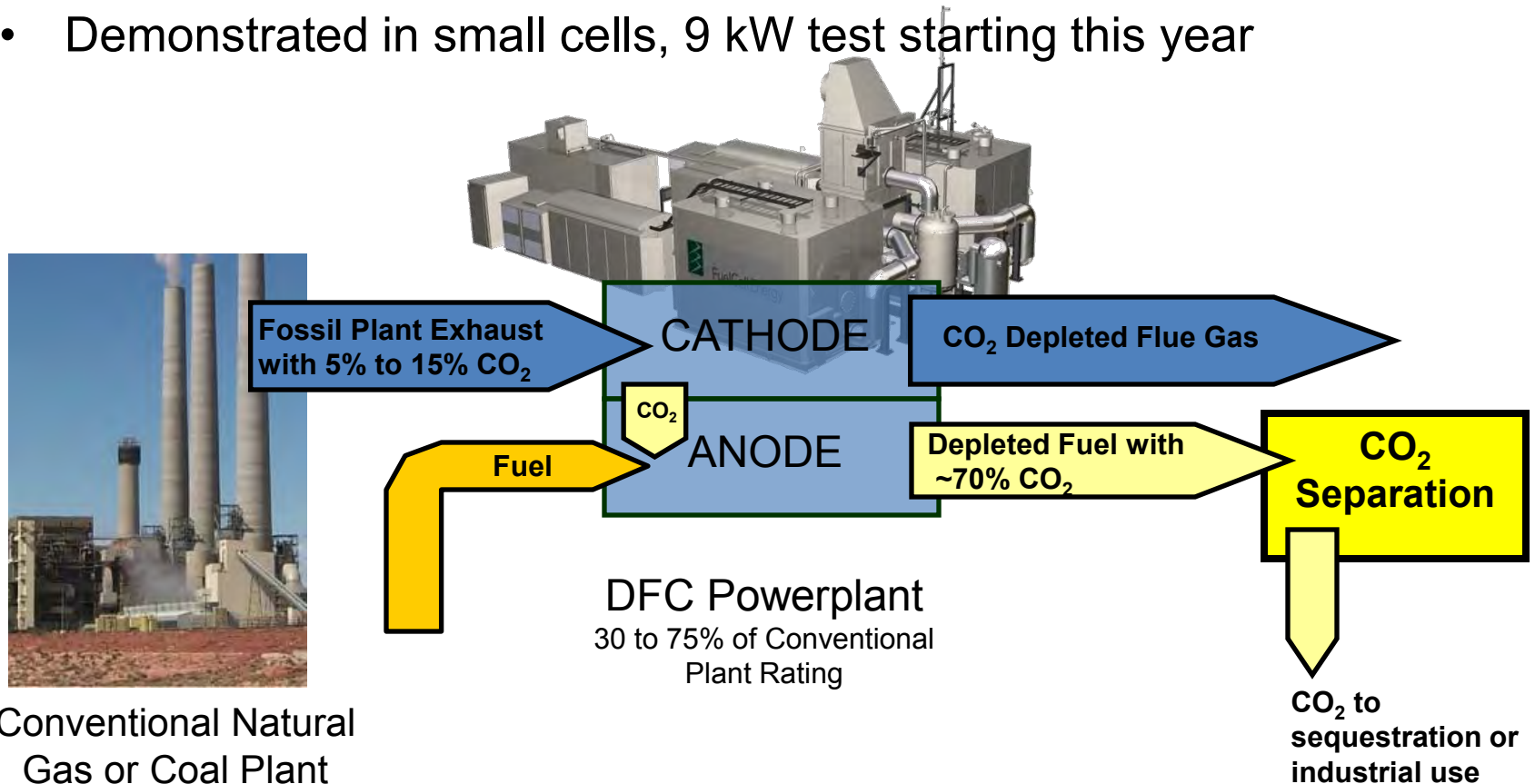
Chemical Integration / Hydrogen Recycle



Chemical integration opportunities include H₂ to CO ratio adjustment, H₂ recycle from processing off-gas and CO₂ for other uses

Carbon Capture with DFC Powerplants

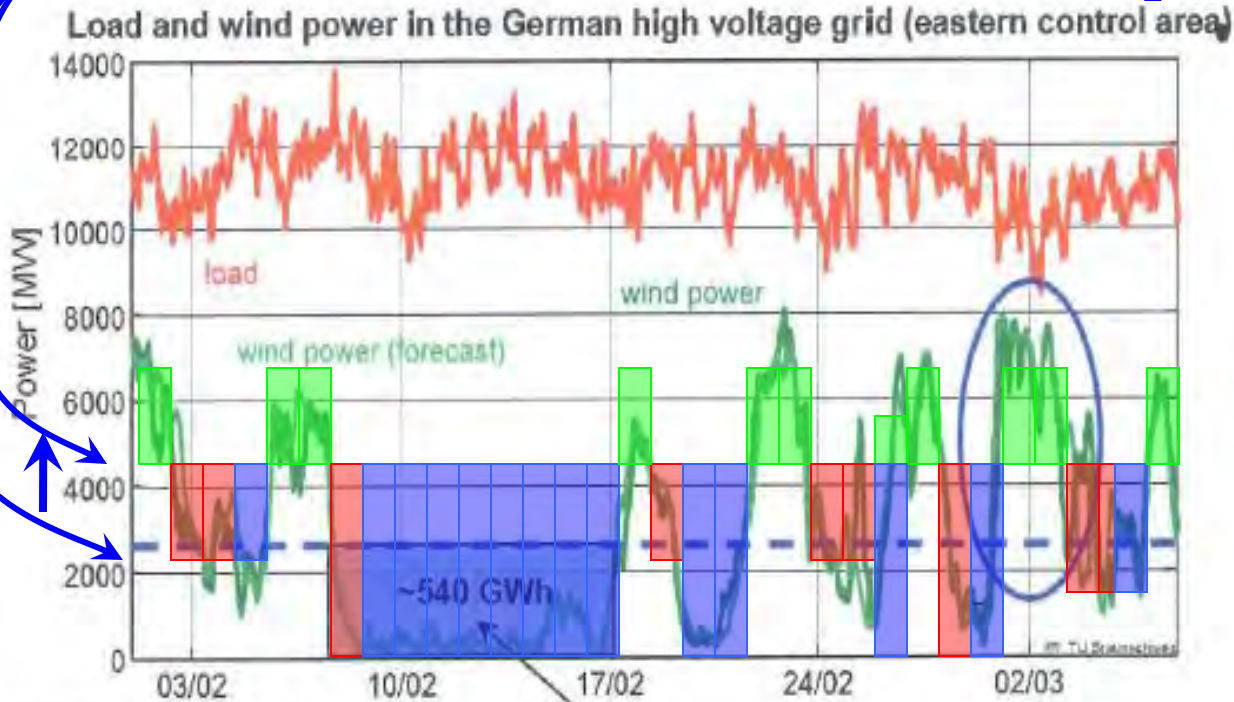
- Carbonate electrochemical process transfers CO₂ from Air Electrode (Cathode) to Fuel Electrode (Anode)
- CO₂ is easily separated from Fuel Electrode exhaust gas because it is no longer diluted with air
- Demonstrated in small cells, 9 kW test starting this year



Back-up slides

Wind Power is Soft Energy

Hydrogen can also reduce size of battery storage needed by increasing average wind + battery + H₂ output



Source: IIR / TU Braunschweig

Necessary storage capacity for continuous supply of average power

- Battery charge
- Battery discharge
- Hydrogen power

Hydrogen converts soft to hard, reliable power

Megawatt-class distributed power generation solutions

- **Highly Efficient**
 - High electrical efficiency
 - Combined heat & power supports economics and sustainability
- **Ultra-clean**
 - Virtual lack of pollutants eliminates future clean air compliance concerns
 - Low carbon footprint / net-zero carbon using renewable biogas
- **Enhances grid resiliency**
 - Continuous power close to the point of use

On-site Power



Electric Grid Support



Commercialization Roadmap

Present

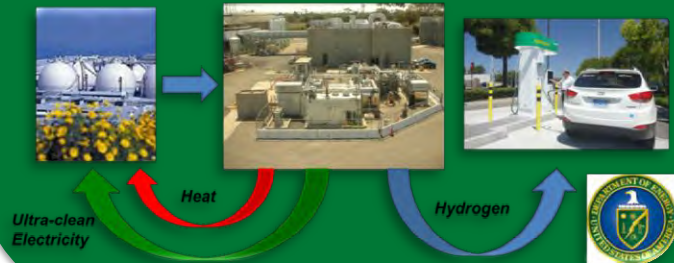
Multi-MW fuel cell parks



MW-class On-site & Biogas



Sub-MW Distributed H₂ Generation

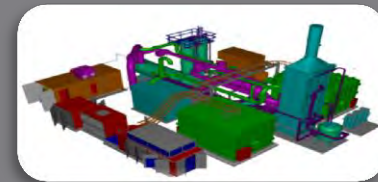


New Markets

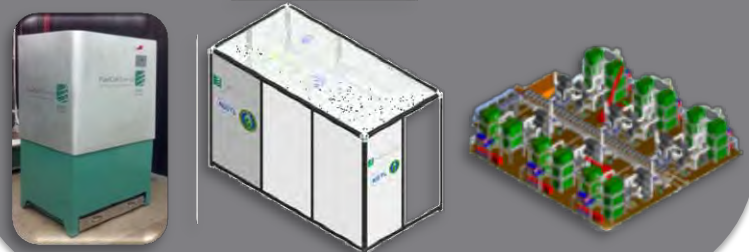
MW Distributed H₂ Generation



High Efficiency DFC



SOFC | Storage | Carbon Capture

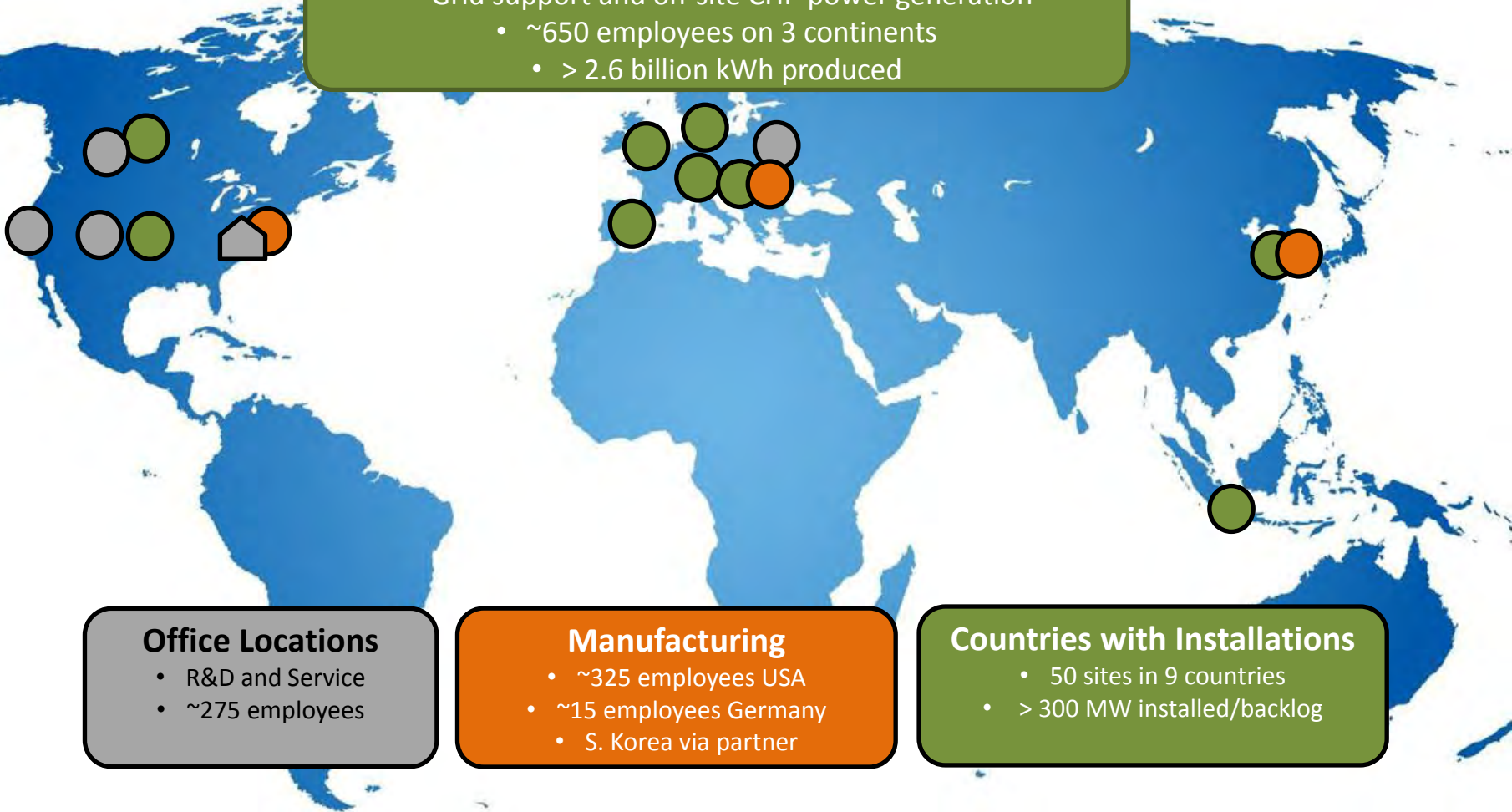


Global Relationships

<p>Partners:</p>	<p>North America</p>	<p>Europe</p>	<p>Asia</p>	
	<p>Customers: Electric Utilities and IPP's</p>			
	<p>On-site Power:</p>			

MW-class distributed generation solutions

- Grid support and on-site CHP power generation
 - ~650 employees on 3 continents
 - > 2.6 billion kWh produced



Office Locations

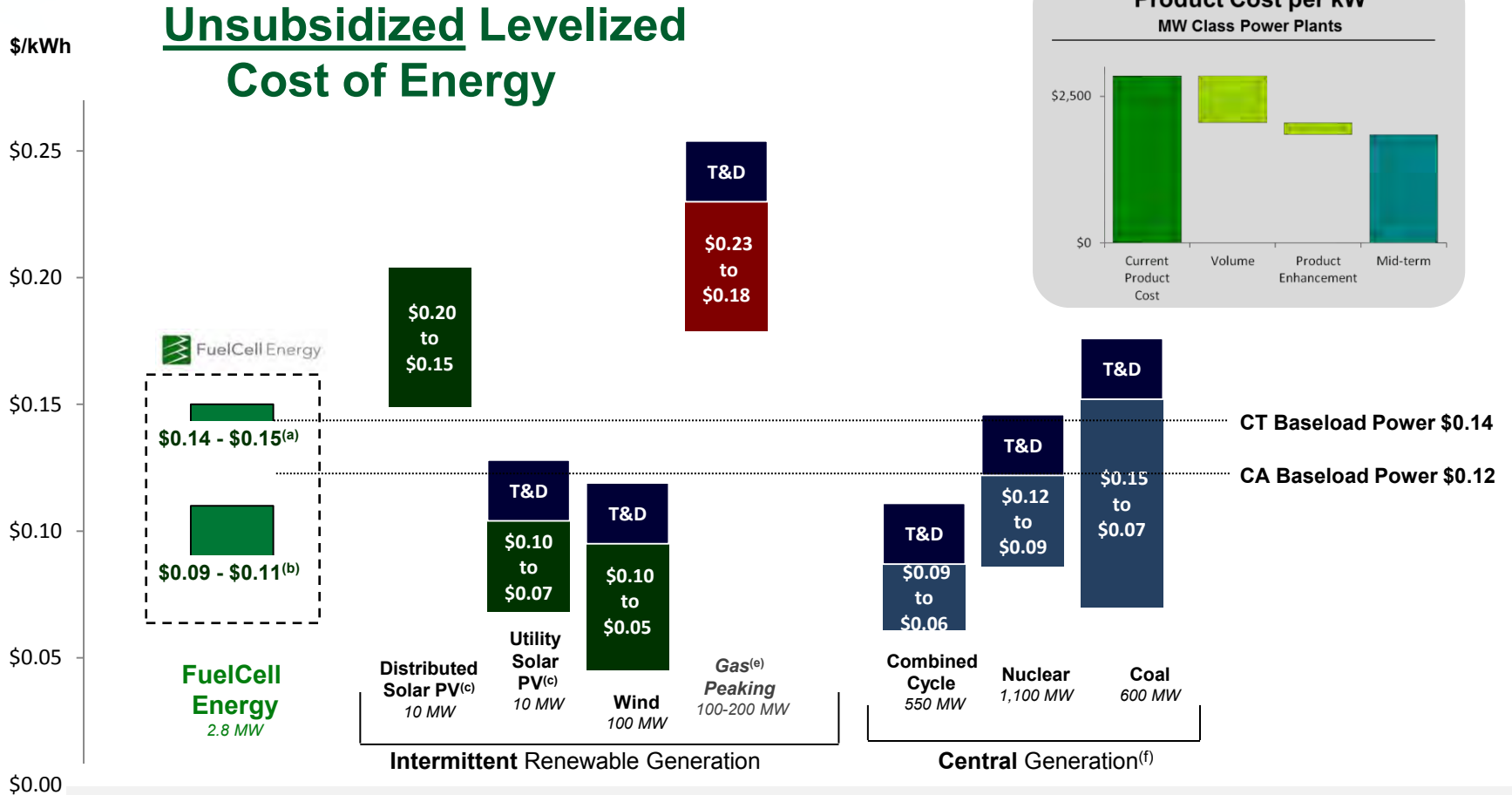
- R&D and Service
- ~275 employees

Manufacturing

- ~325 employees USA
- ~15 employees Germany
- S. Korea via partner

Countries with Installations

- 50 sites in 9 countries
- > 300 MW installed/backlog



- (a) LCOE of \$0.15/kWh with natural gas at \$8/mmBtu or \$0.14/kWh at \$6/mmBtu; each \$2/mmBtu change equates to about \$0.01/kWh.
- (b) Mid-term LCOE target of \$0.09-\$0.11/kWh based on global production volume of approximately 210 MW annually.
- (c) Distributed solar based on rooftop installation in SW USA with 20-23% capacity factor; Utility solar based on tracking technology and 27-28% capacity.
- (d) Installation and maintenance cost of Transmission & Distribution (T&D) is estimated to add up to \$0.024/kWh.
- (e) Gas peaking addresses intermittency of solar and wind when power is required but sun not shining/wind not blowing.
- (f) Does not include waste disposal costs, incremental emission clean-up costs or nuclear-related security costs.

Source: Company estimates, Lazard's Levelized Cost of Energy Analysis—Version 7.0, U.S. Energy Information Administration (EIA) & Oak Ridge National Lab.

Project Overview

1.4 MW combined heat & power fuel cell plant located at Central Connecticut State University

- Providing ~1/3 of campus power needs



1.4 MW utility-owned power plant at CCSU – New Britain

Benefits

- High efficiency drives favorable economics
 - CHP for heating and absorption chilling
- Ultra-clean emission profile supports CCSU sustainability goals
- Micro-grid enhances campus energy security
- Private capital providing public benefits

“This power plant is a significant step in helping CCSU achieve our aggressive goals for reducing greenhouse gases and improving energy efficiency on campus,” said Central Connecticut State University President Jack Miller.

Project Overview

14.9 MW of ultra-clean, efficient and continuous power generation on a remediated brownfield site in Bridgeport, CT

Benefits

- Clean & quiet on ~ 1.5 acres
- Hardens electric grid by supplying 3 substations
- Tax revenue for City of Bridgeport
- Sustainable jobs for State of Connecticut
- 15 year service contract for FuelCell Energy
- Diversify power generation for utilities/consumers

Output is adequate to power approximately 15,000 homes



Dominion



The United Illuminating Company



CL&P

“The Dominion Bridgeport Fuel Cell is another important step in our efforts to identify and develop opportunities to produce clean energy that is reliable and cost effective,” said Thomas F. Farrell II, Dominion Chairman, President and Chief Executive Officer. “We are now adding fuel cell technology to our energy portfolio that already includes wind, hydro, biomass and, soon, solar. This project supports Connecticut’s clean energy goals while producing significant economic development benefits for the State and the City of Bridgeport.”

Challenge for a Water treatment facility

- Compliance with clean air regulations
- Meet ambitious sustainability goals

Solution

World's largest fuel cell power plant converting renewable biogas into electricity and heat

- adequate to power 2,800 homes

Benefits

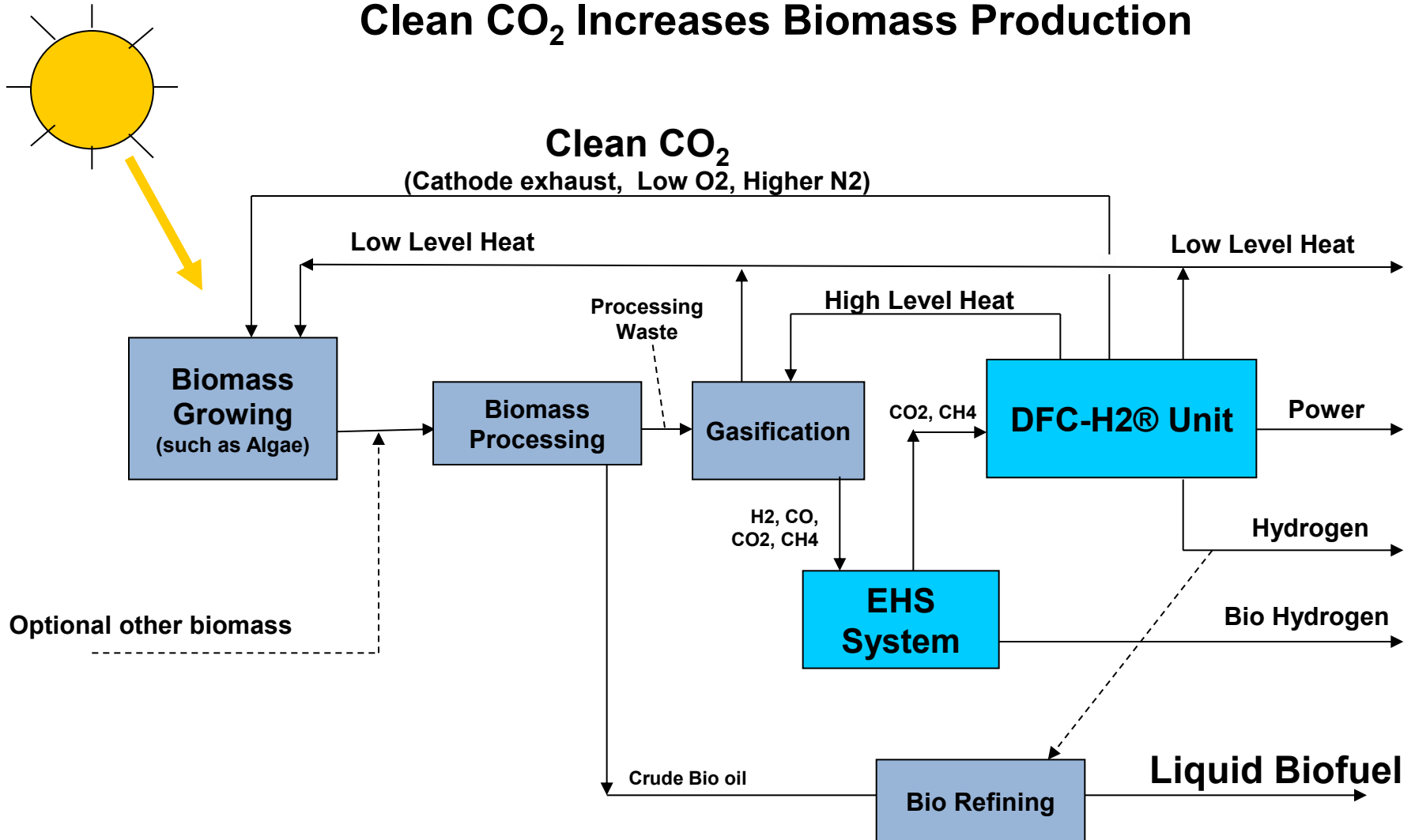
- Converts waste disposal problem into multiple value streams
- Ultra-clean power facilitates clean air permitting
- Distributed generation enhances power reliability and energy security
- High efficiency drives economics



**2.8 MW power plant at Inland Empire
municipal water treatment facility
Ontario, California**

“The clean electrical generation process and the reliable 24/7 operating nature of the fuel cell will help us attain the objectives of our strategic energy plan and position us to meet ever more stringent clean air emission requirements,” said Terry Catlin, Board President, Inland Empire Utilities Agency.

Clean CO₂ Increases Biomass Production



Low Carbon On-Site Power from Natural Gas

- 3.8MW ultra low carbon system for on-site power generation from natural gas – larger systems possible
- Captured CO₂ can be sequestered or sold commercially

