• Company Experience
• Case Studies & Lessons Learned
• Renewable Hydrogen
• Near Term Opportunities
Providing turn-key distributed power generation solutions

NASDAQ: FCEL
Scalable Solutions

Global platform – scale enhances economics

Individual fuel cell & 350 kW fuel cell stack

Completed module 1.4 megawatts

Four-Stack Module 1.4 megawatts

59 MW fuel cell park
- Utilizes 21 DFC3000 plants

2.8 MW DFC3000®
- Utilizes two modules
- Adequate to power 2,800 homes

1.4 MW DFC1500®
- Utilizes one module
- Adequate to power 1,400 homes
Why Fuel Cells?

• Clean, Quiet & Efficient
• Energy Cost Savings
• Financeable, Low-Risk
• Improved Reliability & Resiliency

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Efficiency (§LHV)</th>
<th>NOx (lb/MWh)</th>
<th>SOx (lb/MWh)</th>
<th>PM₁₀ (lb/MWh)</th>
<th>CO₂ (lb/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average U.S. Grid</td>
<td>33%</td>
<td>3.43</td>
<td>7.9</td>
<td>0.19</td>
<td>1,408</td>
</tr>
<tr>
<td>Average U.S. Fossil Fuel Plant</td>
<td>36%</td>
<td>5.06</td>
<td>11.6</td>
<td>0.27</td>
<td>2,031</td>
</tr>
<tr>
<td>DFC® Fuel Cell on Nat Gas</td>
<td>47%</td>
<td>0.01</td>
<td>0.0001</td>
<td>0.00002</td>
<td>940</td>
</tr>
<tr>
<td>DFC® Fuel Cell on Nat Gas (CHP)</td>
<td>80%</td>
<td>0.006</td>
<td>0.00006</td>
<td>0.00001</td>
<td>550</td>
</tr>
<tr>
<td>DFC® Fuel Cell on Biogas (CHP)</td>
<td>80%</td>
<td>0.006</td>
<td>0.00006</td>
<td>0.00001</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: The Regulatory Assistance Project report to NREL, October 15, 2002
## Natural Gas & Renewable Markets

### Natural Gas
- Electric Utilities & IPPs
- Education & Healthcare
- Gas Transmission
- Industrial
- Commercial, Data Centers
- Government
- Oil Production & Refining

### Renewable Biogas
- Wastewater
- Food & Beverage Processing
- Agriculture
- Landfill Gas
Energy Cost Savings

Levelized Cost of Energy - unsubsidized

FuelCell Energy: $0.12
Central generation: $0.06 - $0.15 + T&D
Solar PV: NE-USA: $0.10 - $0.22 + peaking + T&D
Solar PV: SW-USA: $0.08 - $0.17 + peaking + T&D
Gas Peaking Power: $0.18 - $0.23 + T&D
WIND: SE-USA: $0.08 - $0.12 + peaking + T&D
Wind: MW-USA: $0.04 - $0.06 + peaking + T&D
Transmission (T&D): $0.02

Based on $4.50 mmBtu gas cost; Each $2/mmBtu change equates to one penny for FCE LCOE
Source: Company estimates, Lazard LCOE v. 8.0, EIA, Oak Ridge National Lab
**Presence in California**

**Continuous presence and growth in California since 2003**

- Currently 16 California residents based full-time supporting FCE’s operations:
  - 14 Technicians – build, operate and maintain fuel cells
  - 12 with 5+ years tenure

- Significant Company milestones in CA:
  - First MW class MCFC site in Santa Clara late 90s
  - Largest fleet of renewable bio gas units, and world’s largest on-site bio gas fuel cell
  - First Renewable H₂ Refueling station – OCSD
  - First food & beverage, agricultural applications

- 13 MW of systems operating on bio-gas at 10 sites

- More than half of FCE California installations
Fuel Requirements

Fuel Composition
- Output, Efficiency constant to 55% CH₄
- More dilute compositions can be tolerated with derating
- Fuel blending capability installed for process interruptions
- Delivery pressure 15 psig

Fuel Quantity
- 1.4 MW: 310 CFM, 240 MMBtu/day, ~400K population
- 2.8 MW: 620 CFM, 480 MMBtu/day, ~800K population

Fuel Quality
- Total Sulfur <10 ppmv, individual species lower
- Siloxanes <100 ppbv
- Total Metals <1 ppmv, individual metals lower
- Moisture: gas delivered at 15 °F above dewpoint

<table>
<thead>
<tr>
<th>Source</th>
<th>Gas production per head (cubic feet/day)</th>
<th>Energy content (Btu/h)</th>
<th>Energy content Watts</th>
<th>Electrical output Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>1</td>
<td>25</td>
<td>7.32</td>
<td>3.44</td>
</tr>
<tr>
<td>Swine</td>
<td>4</td>
<td>100</td>
<td>29.30</td>
<td>13.77</td>
</tr>
<tr>
<td>Beef</td>
<td>46</td>
<td>1150</td>
<td>336.95</td>
<td>158.37</td>
</tr>
<tr>
<td>Dairy</td>
<td>28</td>
<td>700</td>
<td>205.10</td>
<td>96.40</td>
</tr>
<tr>
<td>Poultry</td>
<td>0.29</td>
<td>7.25</td>
<td>2.12</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Inland Empire Utilities Agency

Municipal water treatment facility facing biogas disposal issues, strict air permitting regulations, and ambitious sustainability goals

Benefits

• Renewable baseload power solves waste disposal problem and provides continuous clean power

• Ultra-clean power facilitates clean air permitting

• Distributed generation enhances power reliability and energy security

• High efficiency drives economics

“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. Nov 8, 2010

2.8 MW power plant at Inland Empire municipal water treatment facility
**Tulare Wastewater Treatment Facility**

**Tulare CA Waste Water Treatment Plant**
- 2.7 MW electric load
- 11.5 million gallons per day of wastewater from domestic and industrial sources
- Large agricultural community - dairy facilities contributing high organic loads
- 500,000 cubic feet of biogas per day
- Severe emissions non-attainment restrictions throughout California's San Joaquin Valley

**Fuel Cell Plant:**
- 1.2 MW, commissioned 2007 & 2011
- Reduces reliance on electric grid
- Avoids 6,200 tons CO2 emissions per year
- Average availability 95% in 2014

*Tulare was named to the EPA Top 20 List of facilities generating the most green power on-site*
Microsoft Data Center Project

• Converting renewable biogas into ultra-clean power for the data plant

• Location is a wastewater treatment plant in Cheyenne, Wyoming

• Data center load is Microsoft ITPAC module (IT Pre-Assembled Components), modular data center package

• Combines fuel cell critical power capabilities with unique ability to use on-site biogas from anaerobic digestion
Grid-connected 2.8 MW fuel cell powered by Directed Biogas providing electricity and absorption chilling to campus grid

Benefits

- Fuel cell under PPA – no up-front capital
- ITC monetized, savings passed to UCSD
- UC carbon neutrality by 2025
- Full 42 MW system saves $800K per month

Features

- 42 MW total from gas turbine, fuel cell, PV and energy storage – provides 92% of campus electric load and 95% of heating and cooling load
- Fuel cell operates at 68% overall efficiency
- Directed biogas from Point Loma wastewater treatment plant
- In operation since 2012
Renewable Hydrogen

Orange County Sanitation District, Fountain Valley CA

- Co-production of hydrogen with power and heat from clean fuel cell systems: tri-generation
- Produces 250 lb/day of renewable hydrogen from Anaerobic Digester Gas
- Supports fleet of 30 fuel cell vehicles in Southern California
### 2.3MW Tri-generation System

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Output, kW</th>
<th>Hydrogen Production, kg/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Configuration</td>
<td>2,800</td>
<td>1,270</td>
</tr>
<tr>
<td>DFC-H2 Configuration</td>
<td>2,350</td>
<td></td>
</tr>
</tbody>
</table>

#### Possible H₂ Uses

- **Cars/day, 4.2 kg each**
  - 300

- **Buses/day, 25 kg each**
  - 50

- **Fork Lifts/day, 2.1 kg each**
  - 600

*Plant layout is ~100’ x 100’, with flexibility for equipment location*

*Since cars are not fueled daily, the fleet served by a station would be ~10 times the number of cars visiting the station on a given day*
San Francisco Bay Area Facilities

More than 20MW renewable power and 9,000 kg/day renewable hydrogen generation potential in San Francisco area from wastewater treatment plants alone (enough for ~12,000 cars). Landfill gas could more than double potential.

Source: [http://maps.nrel.gov/biomass](http://maps.nrel.gov/biomass), and EPA water treatment facility database
Filling Station Data from California Fuel Cell Partnership: [http://cafcp.org/stationmap](http://cafcp.org/stationmap)
More than 70MW renewable power and 30,000 kg/day renewable hydrogen generation potential in LA area from wastewater treatment plants alone (enough for ~40,000 cars). Landfill gas could more than double potential.

Source: http://maps.nrel.gov/biomass, and EPA water treatment facility database
Filling Station Data from California Fuel Cell Partnership: http://cafcp.org/stationmap
Real World Experience

Integrated Approach Builds on Experience

• 15 MW of bio gas powered fuel cell plants in 23 locations since 2007
• Highly reliable when fuel quality and quantity are within spec
• Take-away: Bring all fuel clean-up engineering, design & operations in-house
  o Extensive in house engineering & technology capability
  o Pre-qualified, integrated supplier base
  o Well trained, experienced Construction & Service teams
• Maintenance services:
  o 15 to 20 year term, same as fuel cell plant
  o Timely and correct preventive maintenance, including gas sampling
  o Standardized procedures, consumables, and parts across the fleet
  o Maintenance intervals synchronized with fuel cell plant maintenance
• Seamless integration with fuel cell plant control & monitoring system

Bottom line – higher uptime, increased savings, all technology risk removed from Client
Project Finance Options

• Comprehensive Engineering, Procurement, and Construction services – leverages FCE strength and experience, lowers risk and distractions to Client

• PPA, Lease, Debt Financing

• PPA, Operating lease enable 30% ITC at Universities, Hospitals, Non-Profits

• $40M revolving fuel cell project finance fund with NRG

• Comprehensive Service Agreements with guarantees of fuel cell performance

No up-front capital, energy cost savings, low risk
# 2015 CA SGIP Level of Incentives

<table>
<thead>
<tr>
<th>Non-Renewable</th>
<th>Renewable and Waste Energy Recovery</th>
<th>Emerging Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 MW (Base)</td>
<td>1-2 MW</td>
<td>2-3 MW</td>
</tr>
<tr>
<td>$0.44/W</td>
<td>$0.22/W</td>
<td>$0.11/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- **Internal Combustion Engine**: Micro-turbine, Gas turbine, Steam turbine, Biogas Adder\(^1\), California Supplier Adder\(^2\)
- **Wind Turbine**: Waste Heat to Power Pressure Reduction Turbine, California Supplier Adder\(^2\)
- **Fuel Cells\(^*\)**: Biogas Adder\(^1\), California Supplier Adder\(^2\)

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\(^1\) The biogas Adder of $1.46/W may be used in conjunction with fuel cells or any conventional CHP technology.
Fuel Cells for Biogas

- Clean, Quiet, advanced power generation
- Great fit for Waste Water Plants
- Proven technology, financing available
- Incentives Available for projects

On-site Power

Electric Grid Support
Thank you!

Ken Wicker
Director - Business Development, Northern CA
Cell: 408.455.6978 | KWicker@fce.com
The DFC®1500 stationary fuel cell power plant from FuelCell Energy provides high-quality, Ultra-Clean electrical power with 47% efficiency, and high quality exhaust heat suitable for hot water, steam, or absorption chilling applications, around the clock. Designed for commercial and industrial applications, the system offers easy transport, quiet and reliable operation, and simple site planning and regulatory approval. The DFC1500 is ideal for wastewater treatment plants, manufacturing, food and beverage processing, universities and office campuses.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Power @ Plant Rating</td>
<td>Exhaust Temperature</td>
<td>NOx</td>
<td>CO₂</td>
</tr>
<tr>
<td>1,400 kW</td>
<td>700 +/- 50 °F</td>
<td>0.01 lb/MWh</td>
<td>980 lb/MWh</td>
</tr>
<tr>
<td>Standard Output AC voltage</td>
<td>Exhaust Flow</td>
<td>SOx</td>
<td>CO₂ (with waste heat recovery)</td>
</tr>
<tr>
<td>480 V</td>
<td>18,300 lb/h</td>
<td>0.0001 lb/MWh</td>
<td>520-680 lb/MWh</td>
</tr>
<tr>
<td>Standard Frequency</td>
<td>Allowable Backpressure</td>
<td>PM10</td>
<td></td>
</tr>
<tr>
<td>60 Hz</td>
<td>5 iwc</td>
<td>0.00002 lb/MWh</td>
<td></td>
</tr>
<tr>
<td>Optional Output AC Voltages</td>
<td>Heat Energy Available for Recovery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>By Request</td>
<td>(to 250 °F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional Output Frequency</td>
<td>(to 120 °F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 Hz</td>
<td>2,216,000 Btu/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3,730,000 Btu/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LHV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47 +/- 2 %</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FuelCell Energy’s DFC3000™ system is the largest of the Direct FuelCell® (DFC®) power plant fleet, capable of providing high-quality baseload power with 47% electric power generation efficiency around-the-clock. Scalable for Multi-Megawatt Fuel Cell Parks, the system is especially suitable for applications with larger load requirements such as universities, manufacturing facilities, wastewater treatment plants, and utility/grid support.

### Cross Power Output

<table>
<thead>
<tr>
<th>Rating</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power @ Plant Rating</td>
<td>2,800 kW</td>
</tr>
<tr>
<td>Standard Output AC Voltage</td>
<td>13.800 V</td>
</tr>
<tr>
<td>Standard Frequency</td>
<td>60 Hz</td>
</tr>
<tr>
<td>Optional Output AC Voltages</td>
<td>By Request</td>
</tr>
<tr>
<td>Optional Output Frequency</td>
<td>50 Hz</td>
</tr>
</tbody>
</table>

### Available Heat

<table>
<thead>
<tr>
<th>Condition</th>
<th>Energy Available for Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>(to 250°F)</td>
<td>4,433,000 Btu/h</td>
</tr>
<tr>
<td>(to 120°F)</td>
<td>7,460,000 Btu/h</td>
</tr>
</tbody>
</table>

### Pollutant Emissions

<table>
<thead>
<tr>
<th>Emission</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>0.01 lb/MWh</td>
</tr>
<tr>
<td>SOx</td>
<td>0.0001 lb/MWh</td>
</tr>
<tr>
<td>PM10</td>
<td>0.000002 lb/MWh</td>
</tr>
</tbody>
</table>

### Greenhouse Gas Emissions

<table>
<thead>
<tr>
<th>Emission</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>980 lb/MWh</td>
</tr>
<tr>
<td>CO2 (w/ waste heat recovery)</td>
<td>520-680 lb/MWh</td>
</tr>
</tbody>
</table>

**DFC®3000 Fuel Cell Power Plant**