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Renewable Gas 360

How Renewable Gases Can Help Decentralize the Grid: Fuel Cells and Microgrids

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Background

- **Situation**
  - **Central Resources plus Transmission are inflexible during a crisis**
    - Localized PSPS and transmission curtailments
    - Direct circuit/zonal shut-offs
  - **Diesel Alternatives are not palatable**
    - Drive to reduce emissions and GHG remains a policy factor
- **Facts**
  - **Digester gas can be fuel cell ready with less process than pipeline RNG**
    - Directed Biogas offers logistical diversity
  - **Fuel Cells with Biogas offer near zero emissions and GHG**
    - Fuel Cells configured for microgrid adds local resiliency
    - Addition of CHP offers a carbon-negative resource

FuelCell Energy: A Global Leader in Fuel Cell Technology – Operating Since 1969

COMPANY OVERVIEW

- Deliver clean and affordable fuel cell solutions for the supply, recovery and storage of energy
- SureSource fuel cell systems provide continuous baseload power and are deployed with utility, municipality, university and industrial and commercial enterprise customers
- Turn-key solutions from design and installation of a project to long-term operation and maintenance of fuel cell system

GLOBAL CUSTOMERS

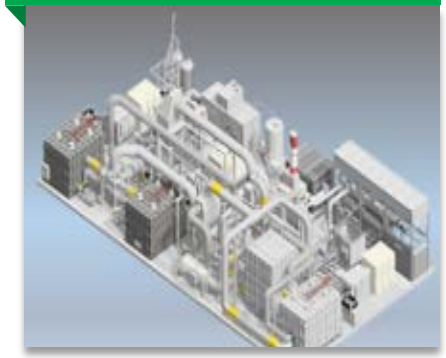
Over 10 Million MWh generated by SureSource™ plants around the world

COMPANY HIGHLIGHTS[1]

Headquarters	**Danbury, CT**
Listing: NASDAQ	**FCEL**
Employees	**~300**
Continents	**3**
Global Plant Installations	**59**
Capacity in Field	**>260 MW**

Service & License

Advanced Technologies



Generation

Product

Enable The World To Live A Life Empowered By Clean Energy

[1] As of the quarter ended April 30, 2020.

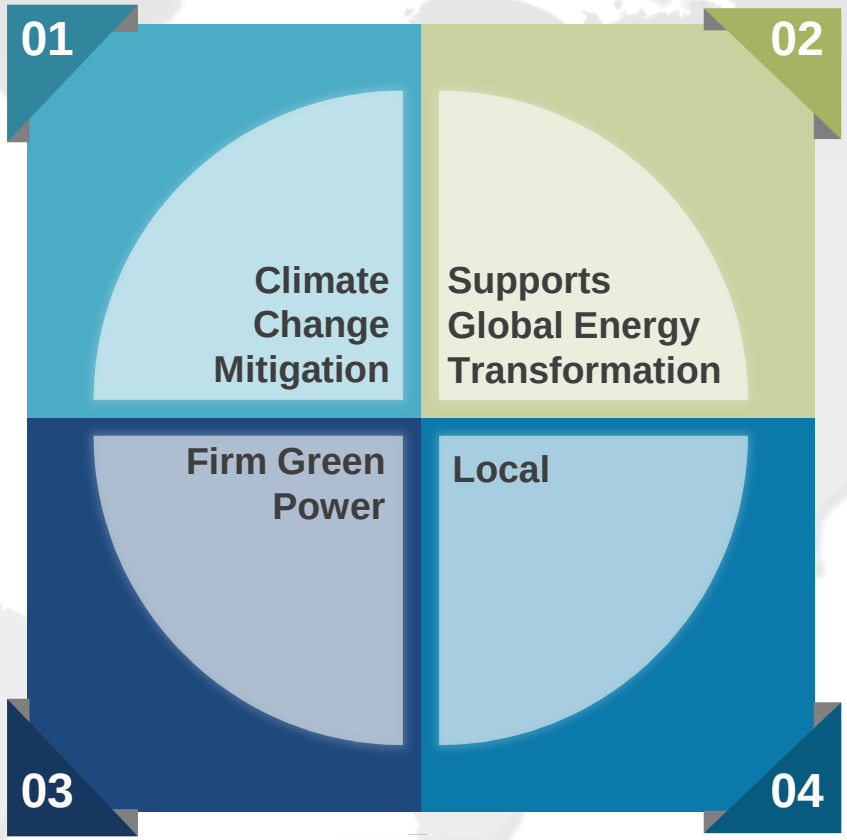
FuelCell Energy Technology: Addressing The 4 Major Energy Opportunities

Carbon Capture

- Most efficient Carbon Capture technology – Produces MW while capturing carbon
- Increases output of host plant, providing additional generation / ancillary revenue
- Power revenue stream reduces cost of CO_2 capture

Electrolysis
Hydrogen Energy Storage
Hydrogen Power Generation

- ≥ 8hr Energy Storage "**Virtual-Battery**"
- > 100% electrical efficiency when utilizing excess thermal energy
- Fully scalable energy storage (caverns, etc.)
- Provides efficient, dispatchable, zero emissions power while **avoiding** the **raw material and disposal issues of batteries**



Distributed Hydrogen

- Hydrogen production at the point of need – Avoid emissions & cost of transport
- Hydrogen co-produced with power and thermal energy
- Low carbon footprint with natural gas
- Zero carbon footprint with biogas
- Carbon (-) with H2 tradeoff of Nat Gas
- No water consumption

Distributed Generation

- Multi-Fuel
- Microgrid
- CHP
- Carbon Capture and Separation
- Sub-MW through Large MW Scale
- Grid Resiliency | Reliability
- Limited Space Requirements
- Avoid transmission upgrade and infrastructure costs

Biogas, Fuel Cells and Microgrids

Merits of Fuel Cells with Biogas

- **Effective conversion of anaerobic digester gas (ADG)**
  - *Multiple Sources available*
    - *Wastewater treatment, food or agricultural digesters*
  - *Avoids clean air permitting challenges*
  - *Requires less clean – up than conversion for pipeline RNG*
  - *Can yield carbon – negative benefit with CHP*
- **Multiple uses of power generated**
  - *Delivered to Grid via BioMAT or other available Tariff*
  - *Utilized On-Site*
  - *Generated locally and received via virtual PPA*
- **Enhances site's energy resiliency with continuous supply of power**
  - *Not dependent on weather or time of day*
  - *Can be a core resource for a local Microgrid*

Example: Fuel Cell for Compliance and CHP

City of San Bernardino, CA

- **Project with the City of San Bernardino Municipal Water Department (SBMWD)**
  - Compliance with SCAQMD requirements for alternatives to flaring
  - SBMWD receives electricity through a 20-year Power Purchase Agreement (PPA)
- **1.4 megawatt SureSource 1500™**
  - operation on anaerobic digester gas (ADG) and as needed, natural gas
  - electricity and thermal energy will support the SBMWD water reclamation plant
- **Plant will use proprietary FCE fuel conditioning system**
  - digester gas treatment
  - fuel blending
  - quality monitoring
- **Under Construction**

Example: On-Site Biogas to CHP

City of Riverside, CA

Project Description

- **1.4 MW fuel cell plant**
  - In Service in 2016
  - 20yr Power Purchase Agreement (PPA)
  - Proprietary FCE Clean-up System
- **Generates carbon-neutral power and heat for anaerobic digesters**
  - Uses two thirds of the WQCP biogas
  - Provides one third of WQCP facility's total power needs

Benefits

- *Immediate operating savings to Water Quality Control Plant (WQCP)*
- *Replaced failing internal combustion engines*
- *Avoids air permitting challenges*
- *No capital expense upfront*
- *Eliminates a waste disposal issue*
- *Complete turn-key solution*

Example: Biogas Fuel Purchase

City of Tulare, CA

Digester gas purchase agreement and site lease

- Biogas supply from City WWTF supports a 2.8 MW SureSource 3000™ fuel cell power plant.
- Largest facility under the California Bioenergy Market Adjustment Tariff (BioMAT).
- 20-year BioMAT PPA provides renewable and carbon neutral power to the Southern California Edison grid.

Allows City of Tulare to benefit from biogas revenue while focusing on core activity of WWTF operation

Enabled with an efficient sale/leaseback financing

Example: Directed Biogas to Microgrid

UC San Diego

Fuel Cell Installation

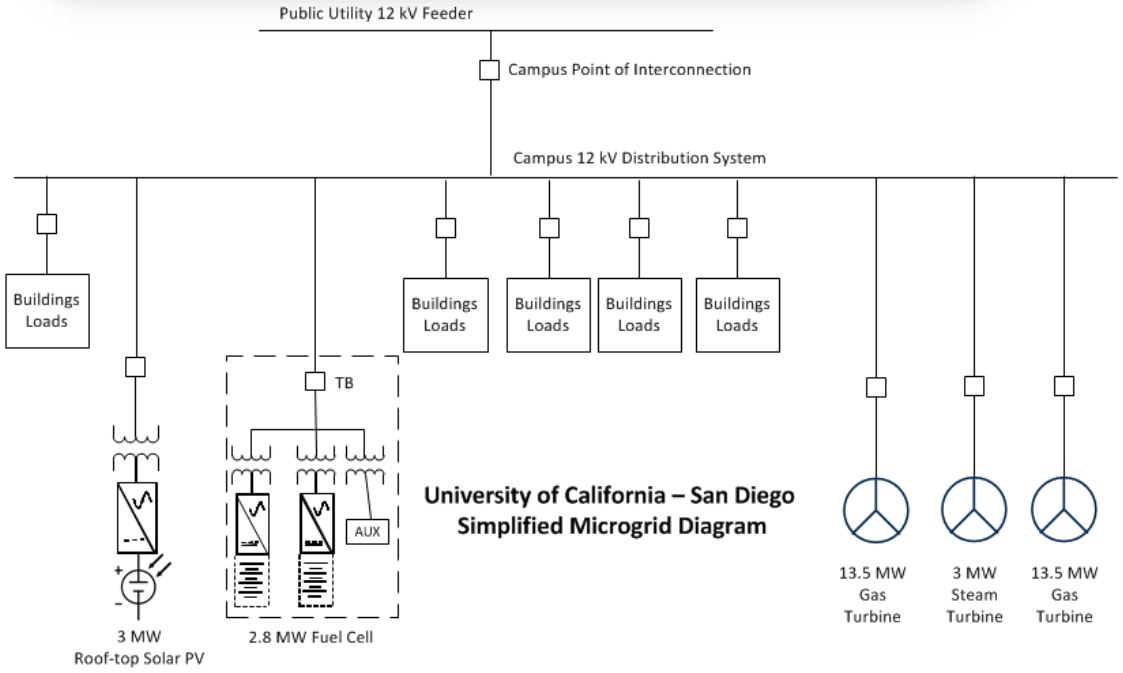
- 2.8 MW SureSource 3000
- Enabled first uses of directed biogas
- Provides electricity and chilling to campus

Benefits

- Fuel cell provides 8% of campus electricity needs
- Carbon negative when utilizing directed biogas

Microgrid

- Fuel Cell provides predictable baseload
- Operates in concert with:
  - Intermittent Solar PV
  - Peaking Battery Storage
  - Load Following 30 MW Gas Turbines



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Summary for Discussion

Biogas and FuelCell Energy Fuel Cells

- *Multiple applications on Biogas*
- *Proprietary and proven gas clean up*
- *Can deliver Negative carbon installations*
- *Microgrid experience can be applied for improved resiliency*

Policies to enable the Biogas/Fuel Cell Benefits

- *Flexible utility feed in tariffs to expand power uses*
- *Recognize Biogas for Fuel Cell Power as preferred over other uses*
- *Motivations to Enable unused Biogas Resources*

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