How Fuel Cells Support Resiliency, Efficiency and Sustainability of the UC San Diego Microgrid

The Campus Microgrid

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FuelCell Energy

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MICROGRID KNOWLEDGE CONFERENCE SERIES

Microgrid 2019 CONFERENCE

FuelCell Energy (FCE) at a Glance

Delivering Clean Innovative Solutions for the Global Supply, Recovery and Storage of Energy

A global leader in fuel cell technology since 1969

- Danbury, CT - Corporate, R&D
- Torrington, CT – Manufacturing, Service
- Germany – Manufacturing, Service
- South Korea – Manufacturing, Service

Global Customers

- Serving utilities, industrial and large municipal customers with both utility-scale and on-site power generation
- Fuel cells are extremely efficient, non-combustion technology that emit negligible NOx, SOx and particulate pollutants.
- Advanced Technologies addressing needs in:
  - Carbon capture
  - Local hydrogen production for transportation / industry
  - Long duration energy storage
- Unmatched experience
  - 8,491,660 Total MWH generated by SureSource™ plants *(As of January 2019)*

SureSource Fuel Cell Solutions

Solutions Serve a Range of Applications:

- SureSource™ 1500 – 1.4MW
- SureSource™ 3000 – 2.8MW
- SureSource™ 4000 – 3.7MW
- 47% to 60% electrically efficient
- Greater than 80% in combined heat and power (CHP) mode
- Scalable from 1.4MW to 20MW+

Complete Service Capabilities:

- Flexible financing and Power Purchase Agreements (PPAs)
- Manage all design engineering, permitting & utility interconnects
- Turn-Key EPC services
- Complete long-term service & maintenance programs

SureSource Value Proposition

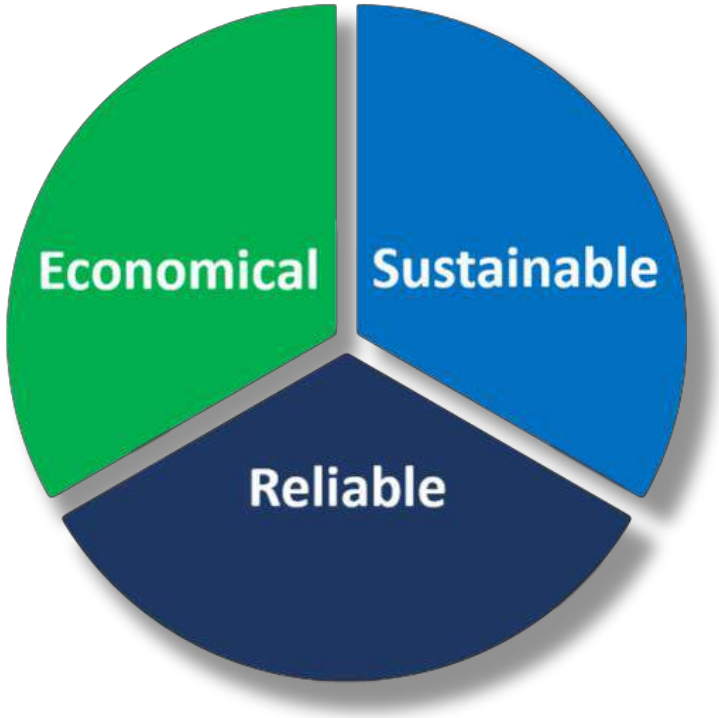
SureSource Solutions Offer:

- **Operating Savings** – lower than grid cost
- **Improved Resiliency** – capable of full grid-independent micro-grid operation
- **Environmental Goals** – near zero criteria pollutants, low CO2 footprint
- **Fuel Flexibility** – natural gas, biogas including anaerobic digester gas (ADG)
- **Combined Heat and Power** – additional benefits from heat recovery

Why Consider Fuel Cell Power?

Provide Multiple Dimensions to Energy Goals

- **Manage, Stabilize Energy Costs**
- **Achieve Carbon Reduction Goals**
- **Enable Microgrids**
- **Improve Resiliency and Reliability**
  - *Complement wind, solar, and storage assets*
  - *Augment Utility Service*
- **Replace Infrastructure**
- **Access Alternative Capital**
  - *PPA Delivery Models*
- **Introduce New Economic Value Streams**
  - *Electricity Savings*
  - *Thermal Energy Savings*
  - *Capacity Credits*
  - *RPS and APS Credits*



New Factors Driving Microgrids

Risk Factors and Expectations for Reliability in CA are Changing

- ✓ CA Utilities have authority to shut down the grid for wild fire prevention”
- ✓ In October 2018 the first-ever grid shutdown for wild fire prevention lasted three days and affected nearly 60,000 customers.
- ✓ Fuel cell systems can provide resiliency during and after natural disasters.
- ✓ Core business functions and critical infrastructure remain operational while the grid is unstable

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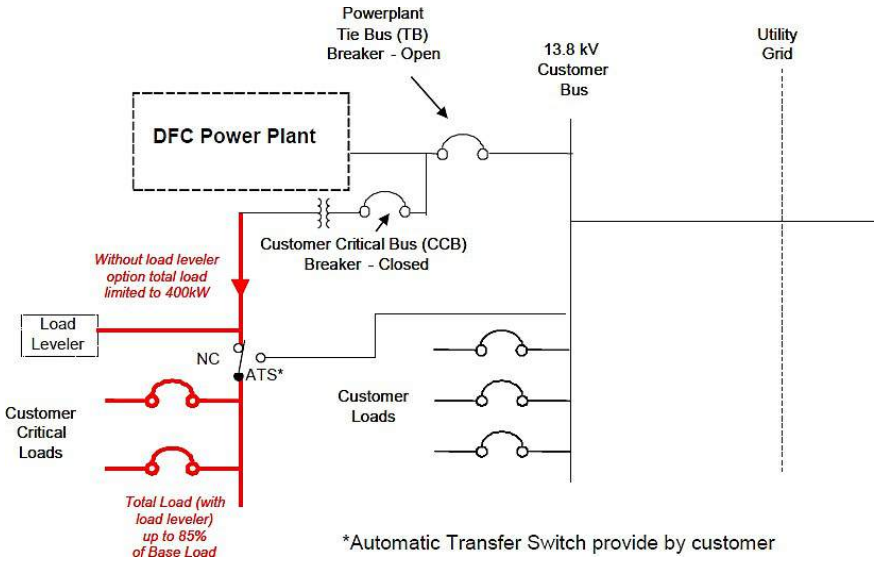
Fuel Cell Microgrid Management

- **Grid Connected mode**
  - In normal operation the fuel cell synchronizes to local utility grid and offsets part or all of the load demand of the facility, reducing power needed from the utility
- **Micro-grid mode**
  - After a grid outage, facility loads see a brief interruption, and are then reconnected in a controlled manner to the fuel cell and other on-site sources
- **Critical Supply mode**
  - Upon grid outage, disconnects from the grid and enters standby mode. Seamless backup power available to hard-wired customer critical loads up to 85% of fuel cell output



FuelCell Energy Fuel Cells in San Diego

2.8 MW at UC San Diego

0.3 MW at Point Loma WWTP
and Biogas Purification System

1.4 MW at South Bay WRP

San Diego Convention Center

UC San Diego


BioCycle energy

92% SELF-GENERATED ENERGY

SYMPHONY OF THE MICROGRID AT AN URBAN UNIVERSITY

The University of California San Diego's microgrid produces 92 percent of its annual electricity load and 95 percent of its heating and cooling load. A fuel cell powered by directed biogas is a cornerstone of the operation.

Marsha W. Johnston

Project Overview

- Grid-connected 2.8 MW Fuel Cell
- Powered by directed biogas
- Provides electricity and absorption chilling to campus

Benefits

- ✓ Cost savings during normal operations
- ✓ Fuel cell provides 7% of campus UC total energy needs, or the equivalent of powering 2,800 homes
- ✓ Carbon negative when utilizing directed biogas
- ✓ Heat byproduct used in a 300-ton absorption chiller for campus cooling

U v D ' m - grid produces 92 percent of its annual electricity load and 95 percent of its heating and cooling load.

- Marsha W. Johnston, BioCycle July 2014

Pfizer Groton

Project Overview

- Grid-connected 5.6 MW fuel cell
- Provides electricity and steam to R&D campus
- Seamless grid independent capability
- Private, Critical Facility Microgrid

Benefits

- ✓ Closes electrical generation gap with a more reliable source than the commercial grid – makes site independent year round
- ✓ PPA structure with no up-front capital cost, delivers energy cost savings to Pfizer
- ✓ Enhances site sustainability profile
- ✓ Clean profile reduces permitting hurdles

US Navy - SUBASE Groton

Naval Submarine Base New London

Home to 15 attack submarines

Employs ~9500 active duty, reserve and civilian personnel

- 7.4 MW fuel cell plant, 20-year PPA with utility, sited within Base secure perimeter on Enhanced Use Lease (EUL)
- Design interconnect compatible with Navy microgrid
- Compliance with DOD directives for resiliency, clean power, operational costs

Thank You

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