Housekeeping

All participants are in “Listen-Only” mode. Select “Use Mic & Speakers” to avoid toll charges and use your computer’s VOIP capabilities. Or select “Use Telephone” and enter your PIN onto your phone key pad.

Submit your questions at any time by typing in the Question Box and hitting Send.

This webinar is being recorded.

You will find a recording of this webinar, as well as previous Resilient Power Project webinars, online at:

www.cleanegroup.org/ceg-projects/resilient-power-project/webinars/

and at

vimeo.com/channels/resilientpower
Resilient Power Project

- Increase public/private investment in clean, resilient power systems
- Engage city officials to develop resilient power policies/programs
- Protect low-income and vulnerable communities
- Focus on affordable housing and critical public facilities
- Advocate for state and federal supportive policies and programs
- Technical assistance for pre-development costs to help agencies/project developers get deals done
- See [www.resilient-power.org](http://www.resilient-power.org) for reports, newsletters, webinar recordings
Northeast Electrochemical Energy Storage Cluster (NEESC)

NEESC is a network of industry, academic, government and non-governmental leaders working together to help businesses provide energy storage solutions.

www.neesc.org
Today’s Guest Speakers

• Andy Skok, Senior Director, Fuel Cell Energy, Inc.

• George Berntsen, Director of Electrical and Controls Engineering, Fuel Cell Energy, Inc.

• Bud DeFlaviis, Director of Government Affairs, Fuel Cell & Hydrogen Energy Association
Fuel Cells for Electric Supply and Grid Support

Ultra-Clean | Efficient | Reliable Power
Integrated Fuel Cell Company

Design & Manufacture
Megawatt-class power generation solutions

Services
Over 100 DFC® plants operating at more than 50 sites – two billion kWh ultra-clean power produced

Project Development, Engineering & Construction
Over 300 megawatts installed and in backlog

Direct Sales & Sell via Partners
Installations/orders in 9 countries
• Ultra-Clean, Efficient and Reliable Power
  ➢ Continuous and secure baseload power
  ➢ Complements intermittent wind and solar
  ➢ Does not require transmission grid
• Near-zero NOx, SOx and particulate matter emissions
  ➢ Allows siting in congested/urban areas
• Higher electrical efficiency than competing technologies
  ➢ 47% to 70% electrical efficiency, up to 90% with combined heat & power (CHP)
  ➢ Efficiency drives economics
• Distributed generation - power where needed
  ➢ Enables smart grid
  ➢ Enhances Critical Infrastructure Support
The Cleanest Power at the Highest Efficiency

Clean Power Metric (1/(NOx + SOx+PM10)), MWh per lb emissions

Higher Efficiency and Lower CO₂

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

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<tr>
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<th>Capacity Factor</th>
<th>24/7 Power</th>
<th>Peaking Power</th>
<th>Central Generation</th>
<th>DG or On-Site Power</th>
<th>SOX, NOX Particulate Matter</th>
<th>CO2 Reduction</th>
<th>Avoid Siting, NIMBY Issues</th>
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</thead>
<tbody>
<tr>
<td>Conventional Combustion</td>
<td>Up to 95%</td>
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<td></td>
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<tr>
<td>Wind</td>
<td>20-35%</td>
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<tr>
<td>Solar</td>
<td>15-25%</td>
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</tr>
<tr>
<td>Fuel Cells</td>
<td>Up to 95%</td>
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*Fuel cells offer an economically compelling balance of attributes*
CENTRAL CONNECTICUT STATE UNIVERSITY
ULTRA-CLEAN BASELOAD DISTRIBUTED GENERATION FOR A UNIVERSITY.

Case Study: Ultra-Clean Power

BENEFITS
The campus and University System benefit with favorable economics that generate an estimated $100,000/year in savings, reliable on-site power that supports the University micro-grid strategy, and environmentally friendly power generation that advances the sustainability goals of the University.

SOLUTION
FuelCell Energy, Inc. installed an ultra-clean, efficient and reliable 1.4 megawatt Direct FuelCell® power plant that meets approximately 35 percent of the campus power needs. On-site power generation supports the University micro-grid, which ensures continuous power availability to critical campus buildings in the event of a disruption of the electric grid.

“This fuel cell power plant represents a significant step towards CCSU achieving its aggressive goals for greenhouse gas reduction and improving energy efficiency,” said Jack Miller, President, Central Connecticut State University, whose Sustainability Initiative was responsible, in part, for the University’s selection as an “exemplary Green institution” by the Princeton Review. “By providing both electricity and steam in such a clean and efficient manner, the fuel cell plant decreases our carbon emissions.”
Case Study: Hospital MicroGrid

1.4 MW DFC 1500 Fuel Cell Plant supporting Hospital MicroGrid and Operating as CHP Plant during Normal Operation

- Ultra-Clean, Efficient and Reliable Power
  - Continuous and secure power, with or without Grid
  - Generates Steam for Hospital Operations
  - Near-zero emissions; Reduces Carbon Footprint
- CHP Operation when Grid is present; MicroGrid Operation when Grid is not available
15 MW Plant in Bridgeport CT

- Installed in ~1 Year; No Emissions Permitting Required
- Powers the Utility side of the Substation for the Port of Bridgeport
- Heat used to generate additional Power for Utility (ORC Bottoming Cycle, ~55% electric Efficiency)
- Supplies power in Dense, Urban I-95 Corridor near Port on Remediated ~1.5 Acre Brownfield site
- Could keep some circuits Powered during Grid Disturbances
Key Advantages of Fuel Cell CHP

• Baseload clean power
• MicroGrid / Critical Infrastructure Support
• High electrical efficiency, Competitive Energy Cost
• Near Zero emissions; Low Noise
• Easy to site and Permit
• High quality waste heat for co-generation (CHP)
  ➢ Steam
  ➢ Hot water
  ➢ Absorption Chilling
Fuel cell energy is ultra-clean. That means we give off negligible NOx and SOx emissions, and fit neatly and quietly in a variety of locations.

Fuel cells are also green. They run on biofuels – gases from wastewater treatment, food processing, and landfills – in addition to natural gas. Plus they're efficient. They generate more electricity per unit of fuel than any other energy source, and make efficient use of residual heat.

Most important, stationary fuel cells are the only 24/7 ultra-clean distributed power source available. That's because fuel cells do not depend on wind or sunshine, and reduce your reliance on the power grid. You can build one, literally, anywhere and depend on it around the clock.

Protect your facility from power interruptions, and deal a serious blow to carbon emissions.

*Fuel cells exceed all 2007 California Air Resources Board (CARB) requirements.*
Electrical Grid Interconnection of Distributed Generation
Status, Benefits, Trends

George Berntsen
Director, Electrical & Controls Engineering
20\textsuperscript{th} Century Grid

- Greatest Engineering Achievement of the 20\textsuperscript{th} Century*
- One-way Power Flow
- Minimal communication, instrumentation, automation
- Large central power stations

* National Academy of Engineering
Increasing Penetration of Distributed Generation
- Promotes sustainability, energy efficiency, security, etc.
- Lessens transmission system, substation loads and losses.

Challenges of Intermittent (solar, wind) DG
- Electric System engineering must assume worse case of minimum and maximum output. Limits “hosting capacity” of system.
- Generation/Load Balance becomes increasingly difficult. Requires more use of peaking units.

Baseload nature of fuel cells:
- 90% capacity factor (similar to nuclear units)
- Facilitates Grid Generation/Load Balance
- Allows for deferring capacity addition plans.
Pilot Program Allowing UI and Eversource to procure 10MW of renewable distributed generation.

- Recognition of the benefits distributed generation can have on utility planning, system load relief and power quality.
- Promotes collaborative relationship between utility and DG providers.
- 7.8 MW of Fuel Cells selected by UI
  - New Haven (operating)
  - Bridgeport Seaside Park (under construction)
  - Woodbridge (contract pending)
DG Interconnection Trends

Code Revisions in process to address increasing levels of DG penetration

Major change in philosophy:

- Originally:
  - If grid goes abnormal, GET OFF and stay off until everything is stable
  - Thou shalt NOT regulate voltage

- New:
  - If grid goes abnormal, stay connected and help stabilize it. (Ride-Through)
  - You MUST be able to regulate voltage (4 different modes)

Effectivity

- Europe: Now
- California: 2016
- U.S. National Standard IEEE-1547 undergoing revision.
Fuel Cells for Electric Supply and Grid Support

Policy Discussion

Bud DeFlaviis
Director of Government Affairs
About FCHEA

• FCHEA is a trade association dedicated to the commercialization of fuel cells and hydrogen energy technologies

• Fuel cells and hydrogen technologies deliver clean, resilient, reliable energy solutions

• FCHEA represents the full global supply chain
Our Members
The mission of the Government Affairs Committee is to educate key decision makers and opinion leaders on key federal and state policy initiatives, and to promote the establishment and implementation of policies, regulations and legislation that advance fuel cell technology, systems and supporting fuel infrastructure for the public good. The goal is to be the voice of the industry regarding these matters, with a focus on U.S. federal and state activities.
Tracking State Activities

- **State of the States: Fuel Cells in America 2014**
  - Comprehensive report on fuel cell activities in the states

- **2014 State Policy Report:**
  - Specific breakdown of state-level legislation, policies, and incentives for fuel cells and hydrogen during calendar year 2014

- **Coming soon…. 2015 State Policy Report and State of the States** – Fall/Winter
Top States – Attributes

- State economic development agencies
- State energy and environmental agencies
- State lawmakers and governors
- Researchers at state universities and laboratories
- Businesses
- Coalitions or partnerships comprised of government, industry, and academia
- Willing customers
Findings – Beneficial state policies

• California
  – Self-Generation Incentive Program (SGIP) - SGIP provides rebates for qualifying distributed energy systems installed on the customer's side of the utility meter. Fuel cells are eligible for an incentive of $1.65/watt up to 3 megawatts (MW).

• Connecticut
  – Low-emission renewable energy credits (LRECs) – long term program to promote, fund and expand customer-side renewable generation.
Findings – Beneficial state policies (cont.)

• New York
  – Customer Sited Tier Fuel Cell Program – Managed by NYSERDA, provides ongoing incentives for both large fuel cells (>25 kW) and small fuel cells (≤25 kW), with funding available on a first-come, first-served basis.

• New Jersey
  – Clean Energy Fund
  – Energy Resilience Bank (ERB) November 2014
Comments

FCHEA has and continues to comment on various state policies

- SGIP
- NY Reforming the Energy Vision (REV)
- NJ Clean Energy Program
Beneficial Federal Incentive

• Investment Tax Credit (ITC)
  – Part of the Energy Policy Act of 2005
  – Fuel cells were added to the list of qualifying property for the 30% or $3,000 kW.
  – Extended a number of times, set to expire in December 2016.
Tax Policy on the Hill

• Reform
  – Lawmakers in both chambers have examined tax reform

• Extenders
  – Clock is ticking, and extenders are looking more likely
  – FCHEA is making the case that credits should be extended
Making the case

• Answers to frequently asked questions...
  – What is the current status of the stationary, backup, and fuel cell material handling market in the U.S.?
  – The ITC does not expire until 2016. Why is there a sense of urgency?
  – What has been the historical cost of the ITC credit for fuel cells?
  – How does the ITC for fuel cells differ from other technologies under section 48?
  – What is the footprint for a sizable stationary fuel cell system?

More information about the Resilient Power Project, its reports, webinar recordings, and other resources can be found at www.resilient-power.org.
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Clean Energy Group
Innovation in Finance, Technology & Policy

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