

RESILIENT



POWER

A Project of **Clean Energy Group**

Fuel Cells for Electric Supply and Grid Support

Wednesday, July 15, 2015

Val Stori
Project Director
Clean Energy Group



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.

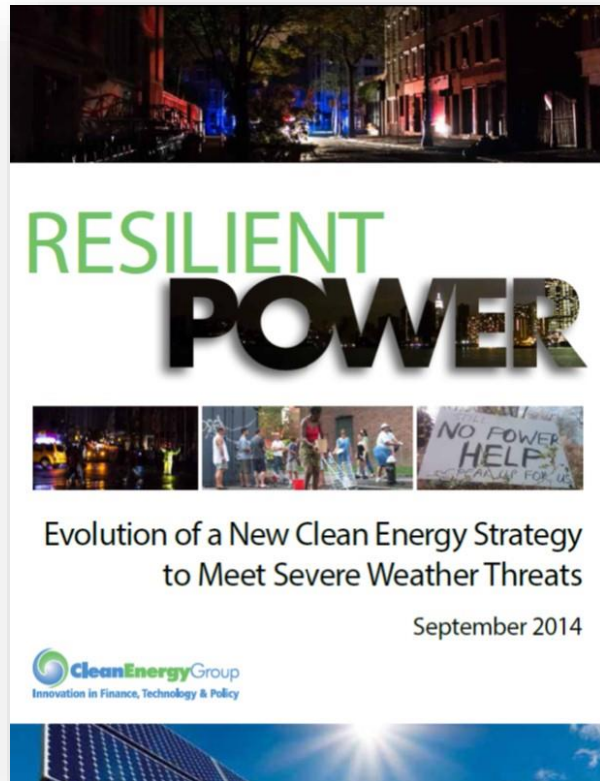
You will find a recording of this webinar, as well as previous Resilient Power Project webinars, online at:

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

and at

vimeo.com/channels/resilientpower

Who We Are



www.cleangroup.org



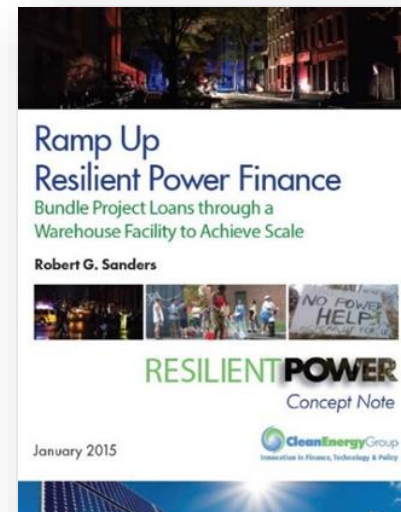
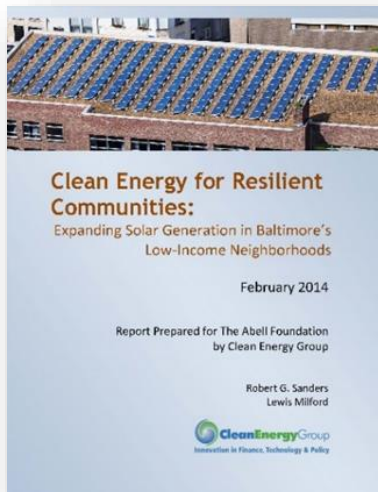
SURDNA FOUNDATION
Fostering sustainable communities in the United States

RESILIENT POWER

www.resilient-power.org

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 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



FuelCell Energy

Ultra-Clean, Efficient, Reliable Power



Fuel Cell &
Hydrogen Energy
Association



FuelCell Energy

Ultra-Clean, Efficient, Reliable Power



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



Direct Sales & Sell via Partners

Installations/orders in 9 countries



Project Development, Engineering & Construction

Over 300 megawatts installed and in backlog



- Ultra-Clean, Efficient and Reliable Power
 - **Continuous and secure baseload power**
 - **Complements intermittent wind and solar**
 - **Does not require transmission grid**
- Near-zero NO_x, SO_x 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**



1.4 MW power plant

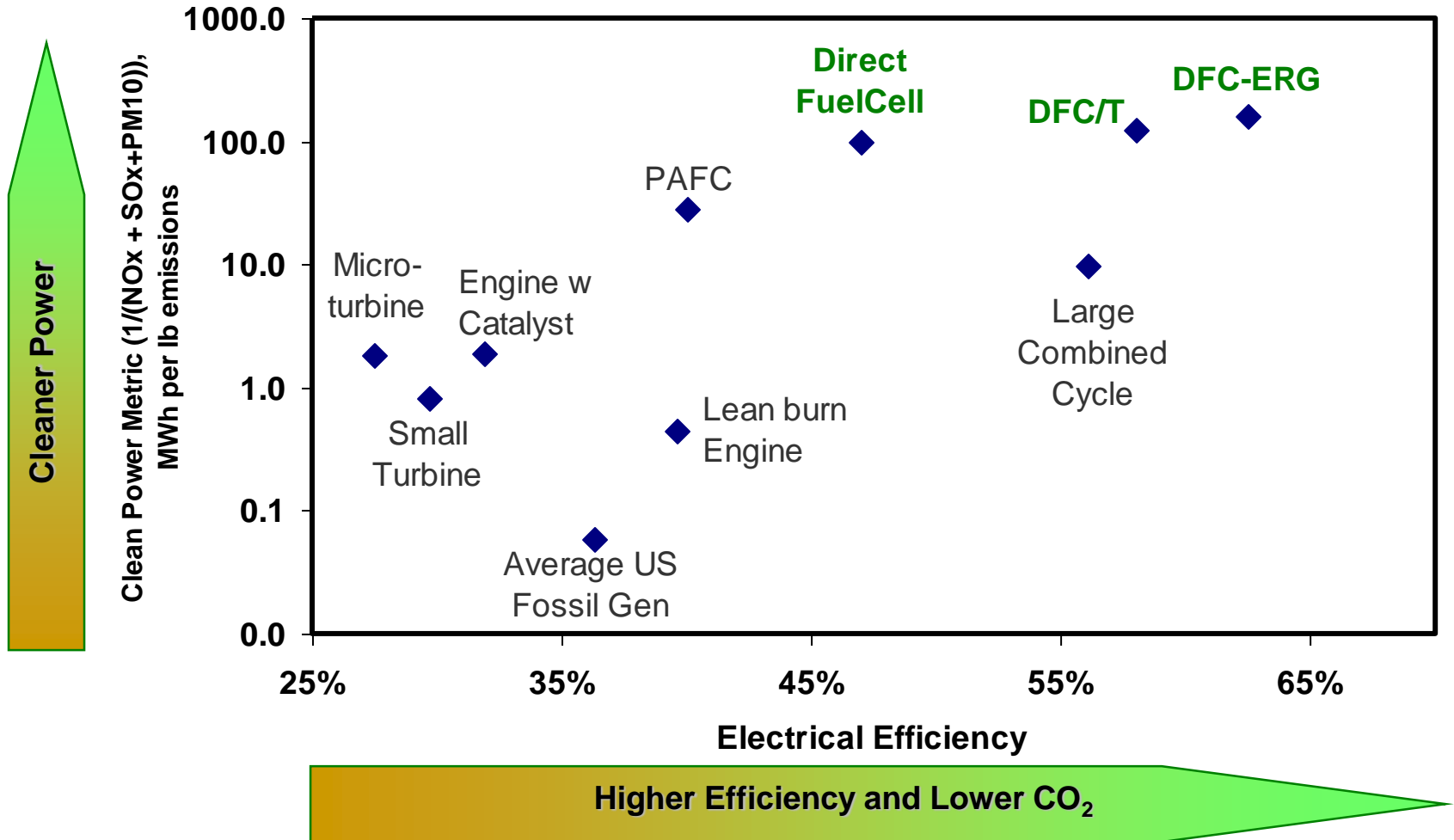


2.8 MW power plant






































11.2 MW power plant

The Cleanest Power at the Highest Efficiency



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

		 Good Solution  Possible or Partial Solution  Poor Solution	Capacity Factor	24/7 Power	Peaking Power	Central Generation	DG or On-Site Power	SOX, NOX Particulate Matter	CO2 Reduction	Avoid Siting, NIMBY Issues
Conventional Combustion			Up to 95%							
Wind			20-35%							
Solar			15-25%							
Fuel Cells			Up to 95%							

Fuel cells offer an economically compelling balance of attributes

Case Study: Ultra-Clean Power

CENTRAL CONNECTICUT STATE UNIVERSITY

ULTRA-CLEAN BASELOAD DISTRIBUTED
GENERATION FOR A UNIVERSITY.



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

- 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.



*DFC1500MA 1.2 MW
Fuel Cell Power System*

Thank You

Andrew J. Skok

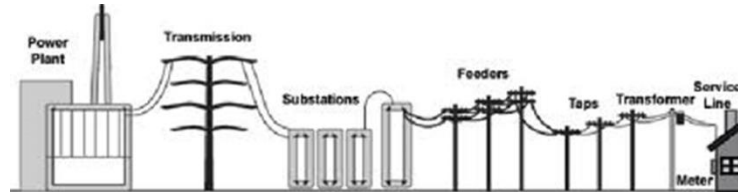
Senior Director
FuelCell Energy, Inc.
3 Great Pasture Road
Danbury, CT 06813
Office: 203-825-6068
askok@fce.com

www.fuelcellenergy.com





FuelCell Energy



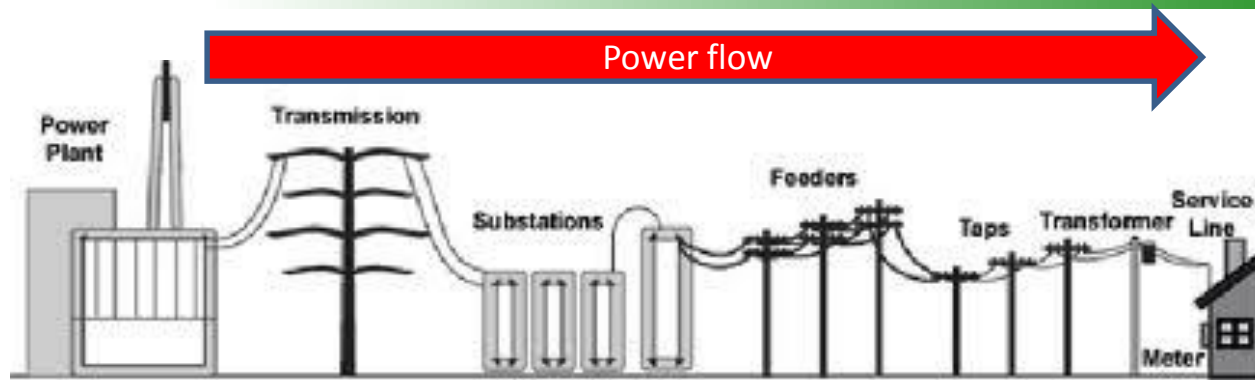
Electrical Grid Interconnection of Distributed Generation

Status, Benefits, Trends



George Berntsen
Director, Electrical & Controls Engineering

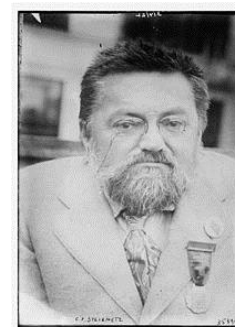
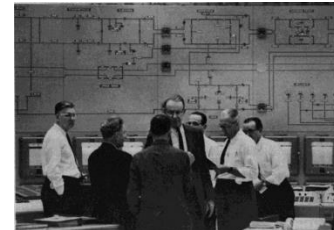
Ultra-Clean, Efficient, Reliable Power



20th Century Grid

- ❖ Greatest Engineering Achievement of the 20th 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)



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



Fuel Cell &
Hydrogen Energy
Association

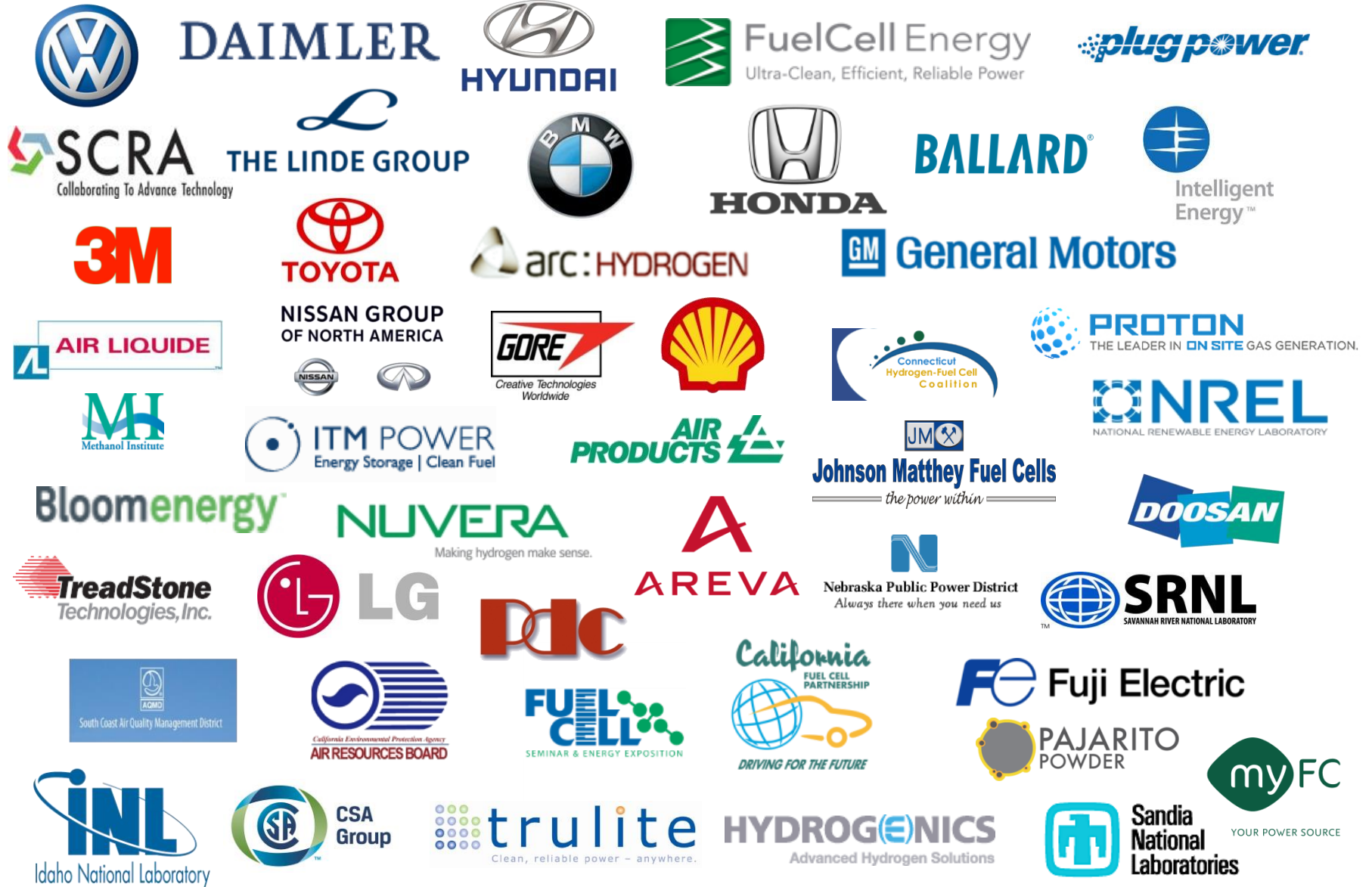
About FCHEA

- 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



Fuel Cell &
Hydrogen Energy
Association

Our Members



FCHEA Government Affairs Committee

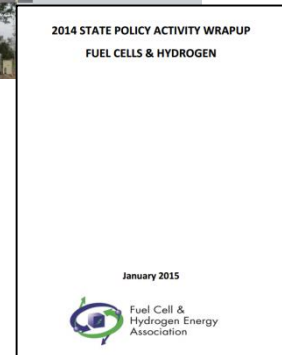
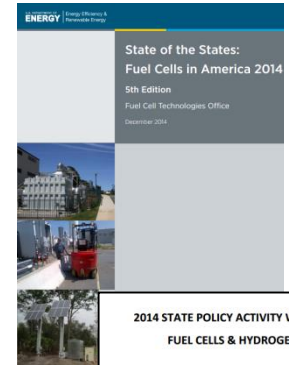
The mission of the Government Affairs Committee is to educate key decision makers and opinion leaders on key federal and state policy initiatives, and to promote the establishment and implementation of policies, regulations and legislation that advance fuel cell technology, systems and supporting fuel 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.



Fuel Cell &
Hydrogen Energy
Association

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?**



RESILIENT POWER

A Project of Clean Energy Group

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More information about the Resilient Power Project, its reports, webinar recordings, and other resources can be found at www.resilient-power.org.

Contact Info

Val Stori
Project Director
Clean Energy Group
Email: val@cleanegroup.org
Phone: (802) 223-2554



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www.resilient-power.org



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