

2021 H2-PACE Virtual Meeting



Power And Control Electronics for Hydrogen Technologies

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About FuelCell Energy- 52 Years

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

Global leader in fuel cell technology since 1969

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



- Serving utilities, industrial and large municipal customers with both utility-scale and on-site power generation
- Advanced Technologies addressing needs in:
 - Local hydrogen production for transportation / industry
 - Long duration energy storage
 - Carbon capture

Global Customers



FuelCell Energy Clean Technologies Transforming 4 Major Energy Opportunities

01

Distributed Generation

Microgrid/Grid Resiliency
Combined Heat & Power (CHP)
Carbon Capture & Separation
Multi-Fuel Carbon Neutral

Distributed Hydrogen

Green H₂ With BioFuels
Hydrogen Production At Point Of Use
H₂ Co-Produced With Power & Thermal
No Water Consumption

02

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Energy
Transition

03

H₂ Energy Storage

Electrolysis 100% Efficiency¹
Carbon Free Power Generation
Unlimited Storage Opportunity
Green, Blue, Gray H₂

Carbon Capture

Capture CO₂ and Produce Power²
Climate Mitigation – Reduce 2°
Power Revenue Reduces CO₂ Capture Cost
Leverage Abundant Natural Gas

04

¹when utilizing waste heat

²Only Technology In The World That Captures Carbon and Produces Additional Power

Fuel Cells for Distributed Generation – Typical Scale

Grid Support with CHP

- Power sold to grid
- Heat sold to district heating system
- 20 MW KOSPO site built in 2018
- 6 month construction time
- Potential to easily scale larger



Grid Support / Urban Redevelopment

- Power sold to grid
- Enhance resiliency
- Brownfield revitalization
- 15 MW on 1 ½ acres
- Only 12 mo. Installation
- Owned by FuelCell Energy

Resiliency for Pharma

- 5.6 MW with steam for company campus
- Predictable power solving grid quality issues
- Immediate savings vs. grid
- Sustainability



Fuel Cell / Solar Integration

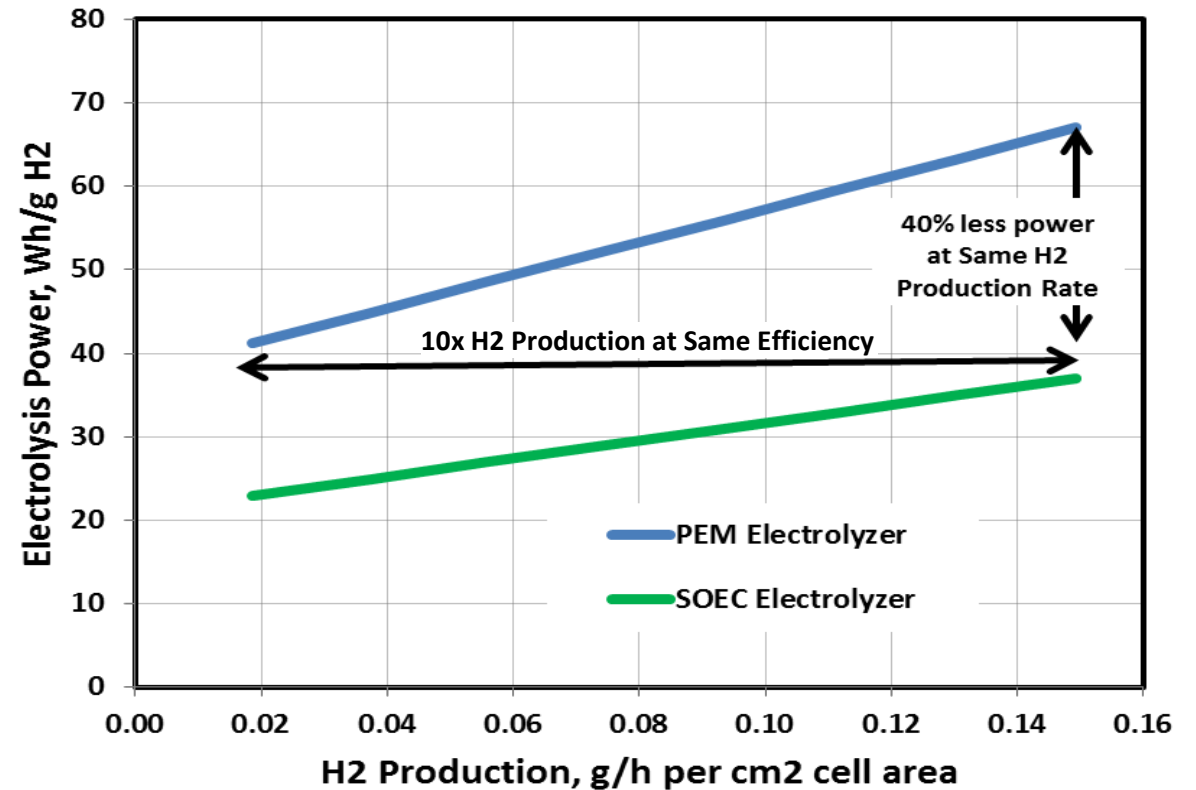
- Utility-owned, rate-based
- Enhance resiliency
- 2.8 MW fuel cell on ¼ acre - ~23,000 MWh annually
- 2.2 MW solar on ~9 acres - ~3,000 MWh annually

FCE is primarily focused on MW Scale installations – For SOEC: 1 MW to 50 MW++

High Efficiency Steam Electrolysis with SOEC

For a given Production rate:

- **High current density = Lower Capex**
 - 30 to 50% lower cost per kg for hydrogen depending on power cost
- **Low electrolysis voltage = Lower Opex**
 - Solid Oxide Electrolysis Cells (SOEC) can be operated at **more than 100% electrically efficiency**
 - Provides opportunities for **waste heat utilization in hydrogen production**



SOEC Offers Great Potential for Hydrogen Production at Scale

Intrinsic SOEC Characteristics:

- High Electrical Efficiency
- Operation near thermally neutral enables rapid load response capability
- Lower Capital Cost (Potential)
- High tolerance to electrical noise on power bus
- ~900 Vdc bus, multiples thereof for larger systems (1800 Vdc, 3600 Vdc, etc.) Somewhat tailorable.
- Modularize at different levels, e.g.: 1 MW, 5 MW, 50 MW



Desired Power Electronics Characteristics:

- High Electrical Efficiency, every % point counts
- Rapid load response increases overall value proposition
- Lower Capital Cost
- Trade lower cost for noisier / less accurate output
- Operation in kV range
- We see value in modularizing at different power levels, although not necessarily in lockstep with SOEC sizes (e.g.: It is reasonable to have one power electronics installation feeding 5 SOEC systems, or other combinations, as packaging and costing dictate).
- Primarily 1 MW and larger

Power Electronics should not give away the intrinsic SOEC advantages

Thank You

**Enable The World
To Live A Life
Empowered By
Clean Energy**



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