

## **OxEon Energy, LLC**

### U.S. Department of Energy High-Temperature Electrolysis (HTE) Manufacturing Workshop



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### **OxEon Energy, LLC**



#### North Salt Lake, Utah Manufacturing, R&D Facility

- New 24,000 ft<sup>2</sup> office, laboratory, and manufacturing facility
- NASA, DOE, DOD and Commercial Projects
- Tape casting, electrode synthesis, cell and stack production, and testing
- End-to-end power to synfuels pilot plant in operation
- New entity created in 2017 to continue team's prior 30-years of progress





#### Solid Oxide Fuel Cell and Electrolysis Stacks

- Longest running solid oxide fuel cell & electrolysis group in world
- Only NASA flight qualified, TRL 9 SOEC unit in history
- 30kW/10kW reversible system test program in process

#### **Fuel Reformation and Generation**

- Plasma Reformer H<sub>2</sub> and Syngas for flare curtailment
- Fischer-Tropsch Reactors Modular design for transportation fuel production from  $H_2$  and Syngas

## **Company Technology Focus**





- Equipment Limiting Capacity
  - Tape casting 20 MW/year
  - Cell fab: 500 kW/year
  - Stack fab: 1 MW/year
  - Expansion bay available for 5x increase in furnace capacity
- FT Pilot: 5 gpd liquid

## **How Big Is The Current Need?**

- Fossil Quads By End-Use Sector
  - 21 Industrial
  - 23 Transportation
  - 8 Residential
  - 6 Commercial
- Electric contribution
  - 21 Electric in
  - 6 Electric out

1 Dollar





- Electrofuels & Chemicals
  - (Too) Energy Intensive?
  - Displacing 52 Fossil Quads is intense!
  - 3.8x 458 GW annual average grid load
  - <u>1,740 GW electrolysis</u> at η=100%
  - Mega-Tons/d of Hydrogen, 0.45GT/y
- How will we store, distribute, and use it?
  - Fossil fuel replacements



## **Approach to 1:1:1 Success**



\$0.32/kg H<sub>2</sub> remaining in current operation for CapEx – **BREAKTHROUGH OPPORTUNITY** 

#### • Technical Focus:

- **Performance:** Power density improvements for CAPEX reduction. Lifetime enhancement.
- **Design and BOP**: Number of stacks required to displace fossil a driver for footprint and power density

#### Grant/Loan Funding

- Stack Manufacturing: Production capacity & costs
- **Demonstrations at scale** to drive manufacturing and create industrial acceptance establishing supply chain
- $\circ$  Policy:
  - Incentives to level competitive markets with last century incumbents (fossil resources)



Source: SOEC Stack Mfg Cost Analysis, Strategic Analysis, Apr21





### **Manufacturing Process Scale Up**



- Scale up of current processes Equipment and Automation
- Process development for advanced manufacturing methods for cost reduction
- TEA for plant sizing based on expected market growths (do not want to be undersized in 5 years from build)
- Plant site selection Socio-economic and technical impacts
  - Underserved communities
  - Replace coal/oil/gas facilities

### **Workforce Development**



- Training opportunities
- Replacement of displaced jobs from coal/oil/gas Transition Programs
- Strategic locations for in-person positions
  - Facility location in under-represented communities
  - Facility locations for displaced coal, oil and gas jobs
- Implement learnings from COVID staffing hardships



### **Critical Supply Chain Development**



- US Manufacturing base is low in
  - Cells
  - Interconnects
  - Glass
  - Specialty Powders/Chemicals
- Avoid Single Sourced Suppliers Risk Reduction
- Capacity for multiple SOEC manufacturers
  - Assist in min-buy ordering (prior example was 441 mill-run purchase)
  - Prioritization on DOE contracts for production purposes
- COVID learning application on supply chain shortages

# **Supply Chain**



- Global supply chain unavoidable for some materials
  - Zirconia, glass, elements for high temperature alloys
- US Manufacture of components, assemblies, & system
  - Fab electrolyte, electrodes, cells, stacks, modules, BOP
  - Avoid scenarios like offshore chip fab on auto/truck manufacturers, PCs
- Need multiple suppliers, multiple consumers
  - Single point supply chain weakens industry ecosystem
  - Dominant producer offshoring can/has driven US suppliers out of market
- There must be economic incentive up and down the chain

## **Demonstration Project Scale**



- Step-wise demonstration scale increase with support for manufacturing scale up throughout the supply chain
  - Drive industry acceptance and infrastructure growth
  - Rapid increase in industry capacity through predictable growth
  - Scale up of manufacturing capabilities for supply chain and SOEC manufacturing facilities
  - Multiple projects at each level





# **Thank You**

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**Beyond Current Potential**