Advanced Oxygen-Free Electrolyzer for Ultra-Low-Cost H_2 Storage for Fossil Plants

Award Number: DE-FE0032023

Prime Recipient: T2M Global LLC

PI: Pinakin Patel

Sub-Recipient & Host Site: Hawaii Gas, HI

Location: Danbury, Connecticut

DOE: $500,000
Non-DOE: $125,000
Total: $625,000

AES Project Overview: Key Components

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Fossil/Coal Plants

Excess Electricity

Advanced O_2 free Electrolyzer Integrated with H_2 Storage

H_2

Hybrid Power Cycle (Engine/Fuel Cell)

Electricity-out (On-Demand)

Utility Grid and Microgrids:

Syngas Waste Streams

Coal Gas, Naptha

Flare Gas

Liquid Fuels/ GTL

Fuel Cells

SNG Refinery

Biomass Gasifier

Dilute/Waste H_2

Waste Heat

Produce higher value H_2 from dilute syngas streams
Extend the life of Fossil Plants

Objectives: Hydrogen Energy Storage

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- T2M and Hawaii Gas Team will develop Advanced Electrolyzer System (AES) technology to equip fossil plants with H_2 Energy Storage needed for **load-following capability** by using excess electricity and waste heat
  - Staged capacity increase from 1 to 10 kg/day H_2
  - Pressurization to reduce electricity consumption by up to 80%
  - Develop multifunction enclosure to reduce capital cost by 50%
- MW class AES module design: 20 MWh storage capacity (1-ton H_2 per day)

Steps essential for demonstration at Hawaii Gas by 2025

Problem Statement and Opportunity

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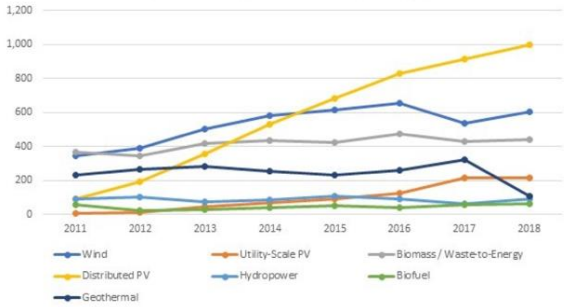
- Hawaii Gas uses naphtha feedstock to produce ~ 3 billion cubic feet/yr of SNG; up to 25% of dilute syngas is used as a fuel
- The state of Hawaii has the highest cost of electricity in the United States
- Emerging, intermittent VRE: expensive curtailment when excess generation. Very expensive electricity during peak times. No grid scale energy storage is available
- Fossil plants are baseload and cannot load-follow

Most Expensive

1. Hawaii 34.43
2. Alaska 21.99
3. Connecticut 20.8
4. Massachusetts 20.6
5. California 19.44



H_2 Storage for fossil plants increases sustainability and profitability

Advanced O_2 free Electrolyzer (AES)

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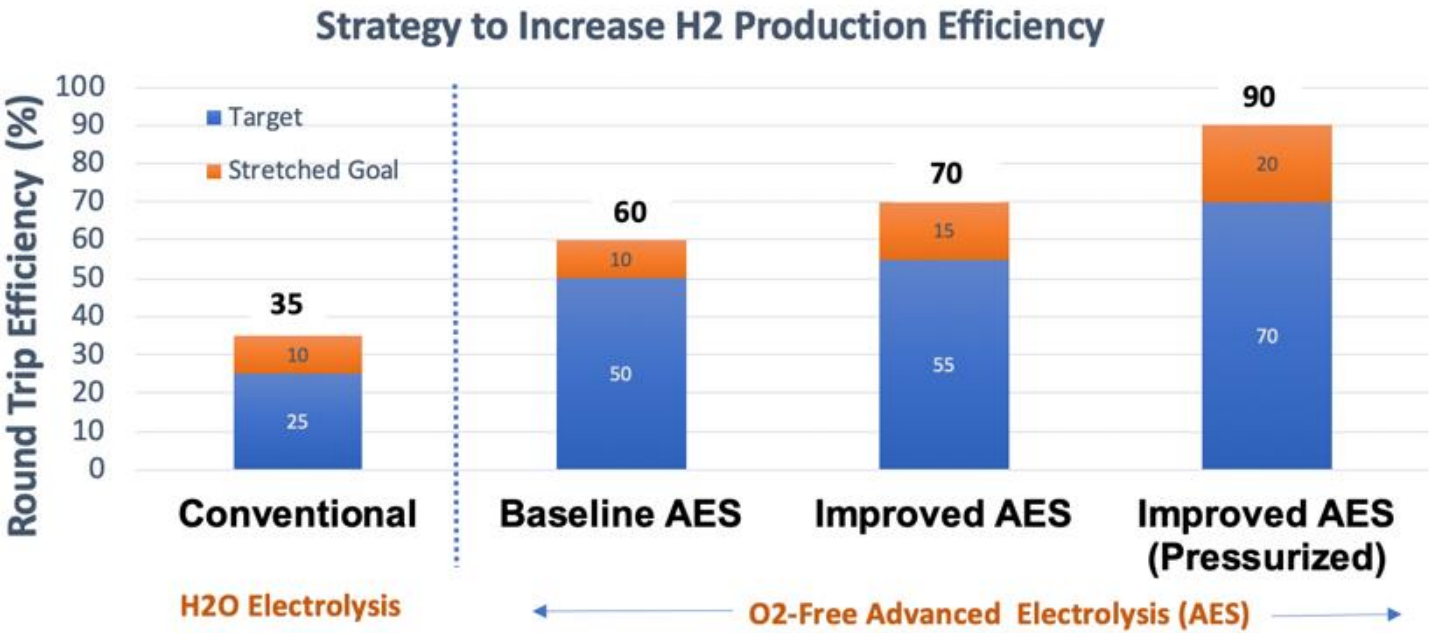
- Oxygen-free AES technology offers a modular system with the safest hydrogen production and the lowest Pt-catalyst loading
- AES validated at short stack level at atmospheric pressure



AES ideal for fossil plants: 2x increase in capacity and efficiency for H_2 production

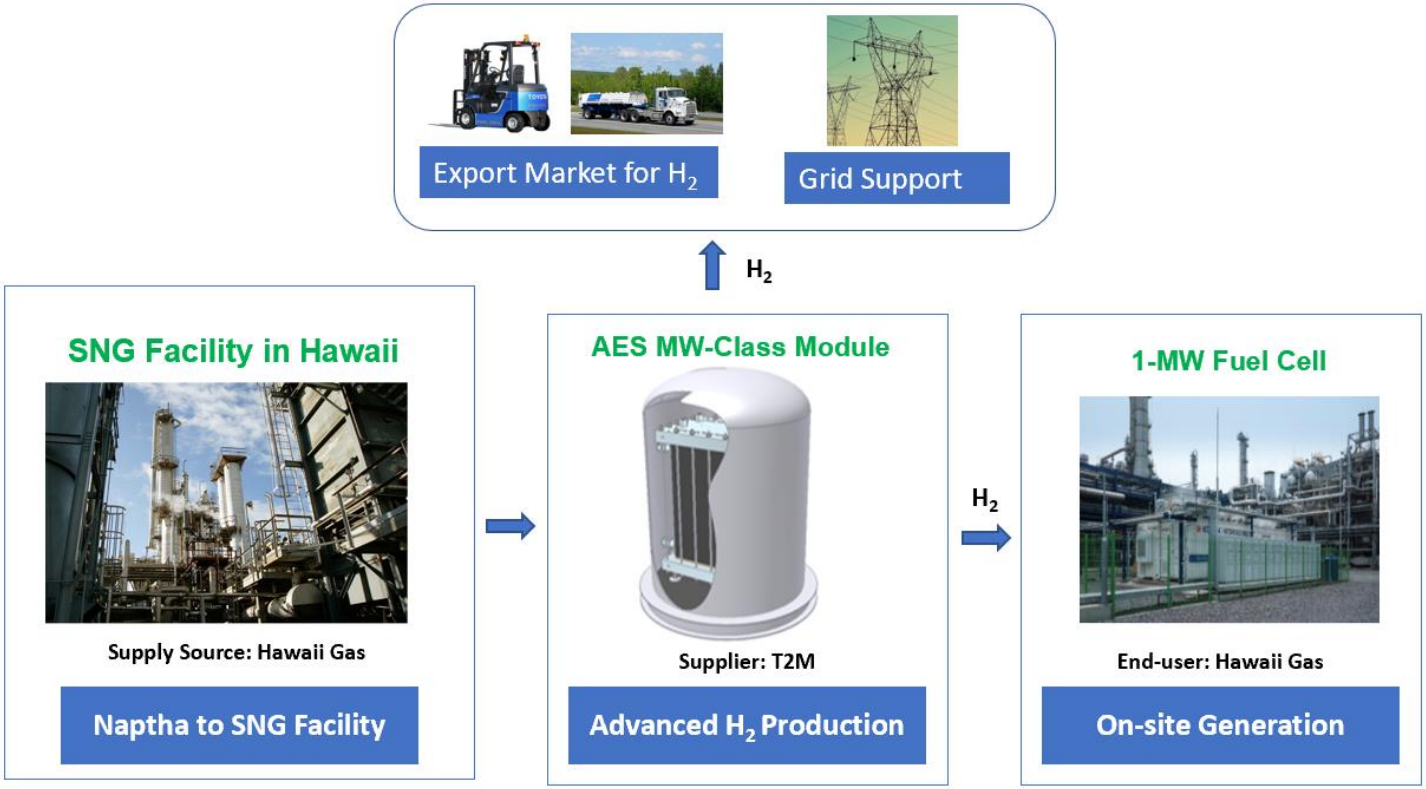
Relevance, Outcomes & Impacts

- Fossil Plants cannot load follow – H_2 Storage for new revenue
- Upgrade Excess Electricity and Waste Heat to higher value
- Feedstock Flexibility: H_2 from a variety of syngas streams like coal gasifiers, GTL plants, Naphtha crackers, Pet-coke, SMRs, etc.
- Opens new markets for Long Duration Storage for grid support
- H_2 production without any incremental GHG emissions
- Modular and water independent system: Easier to deploy

Over $10 Billion/yr US market: Target H_2 cost $4/kg

Potential Benefits to Hawaii Gas

- Additional revenue of $7.5 million/yr from the product H_2



Electricity independence from local grid, saving $2 Million/yr in purchased electricity utilizing stranded syngas

Opportunity for NETL: Excess Electricity

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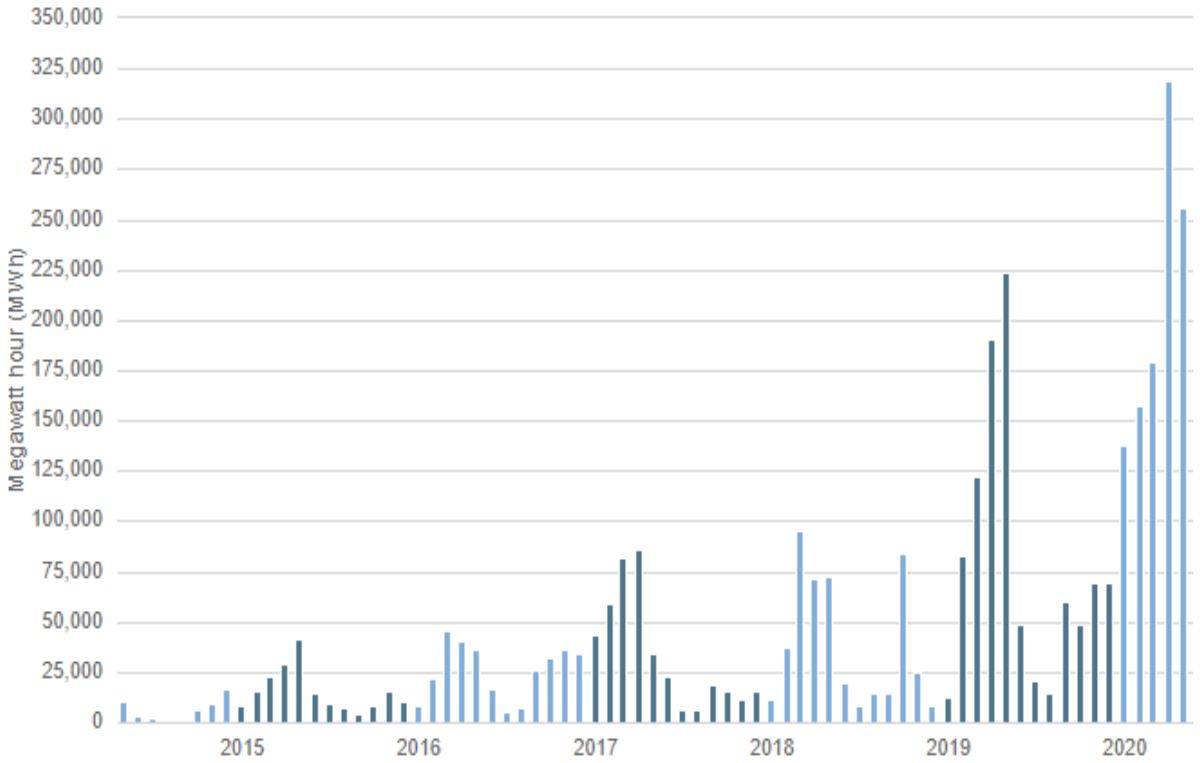
- Excess electricity causes grid instability problems: Wind and solar curtailments are growing (Cost >$100M)

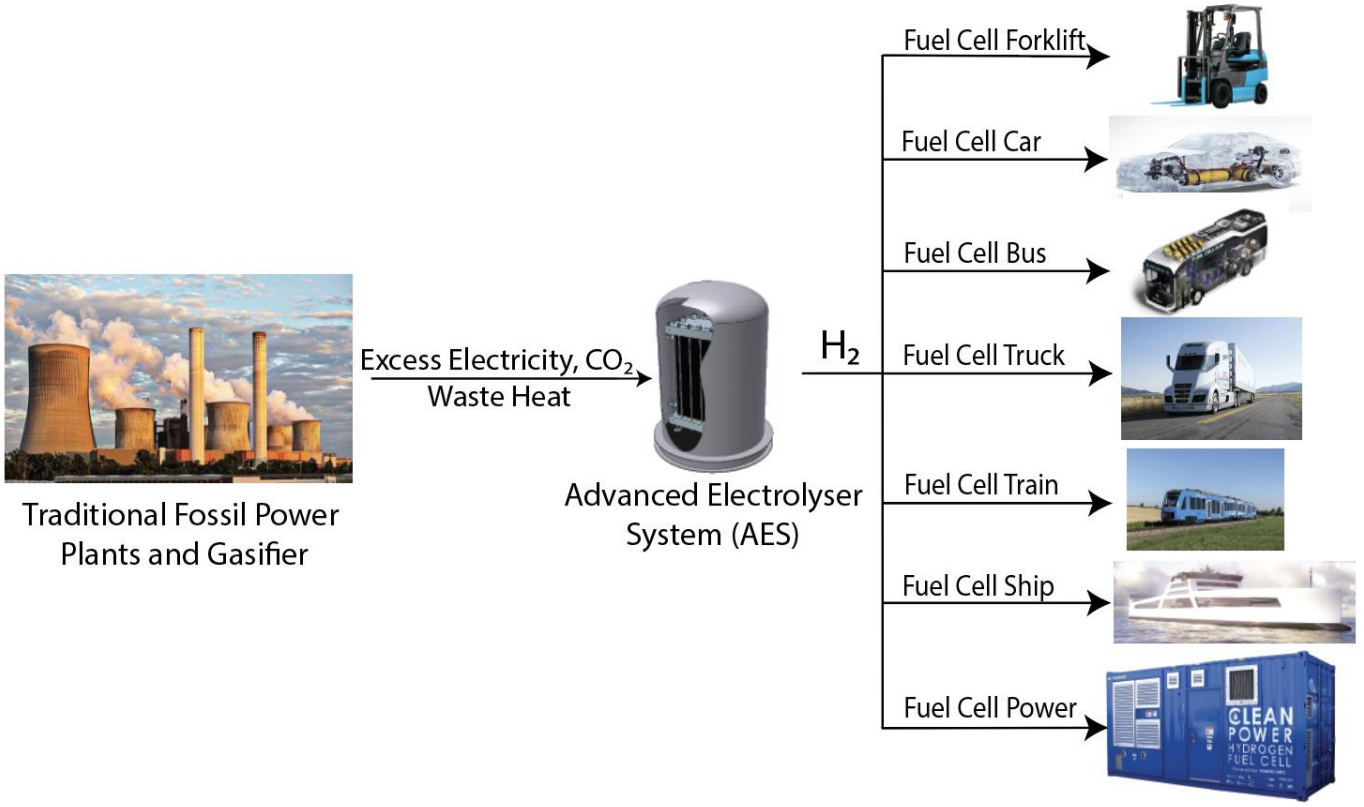


Source: CAISO

Excess electricity for lower-cost hydrogen from fossil plants: Demonstrate AES technology on different syngas sources

Fossil Plants: Fueling the H_2 Economy

- H_2 fuel cells are emerging as a multi-billion-dollar industry



Opportunity for NETL

Transition strategy for Fossil Assets: Create higher value H_2 from stranded assets - Excess Electricity, waste heat and dilute syngas

Fossil Based H_2 for Grid Support

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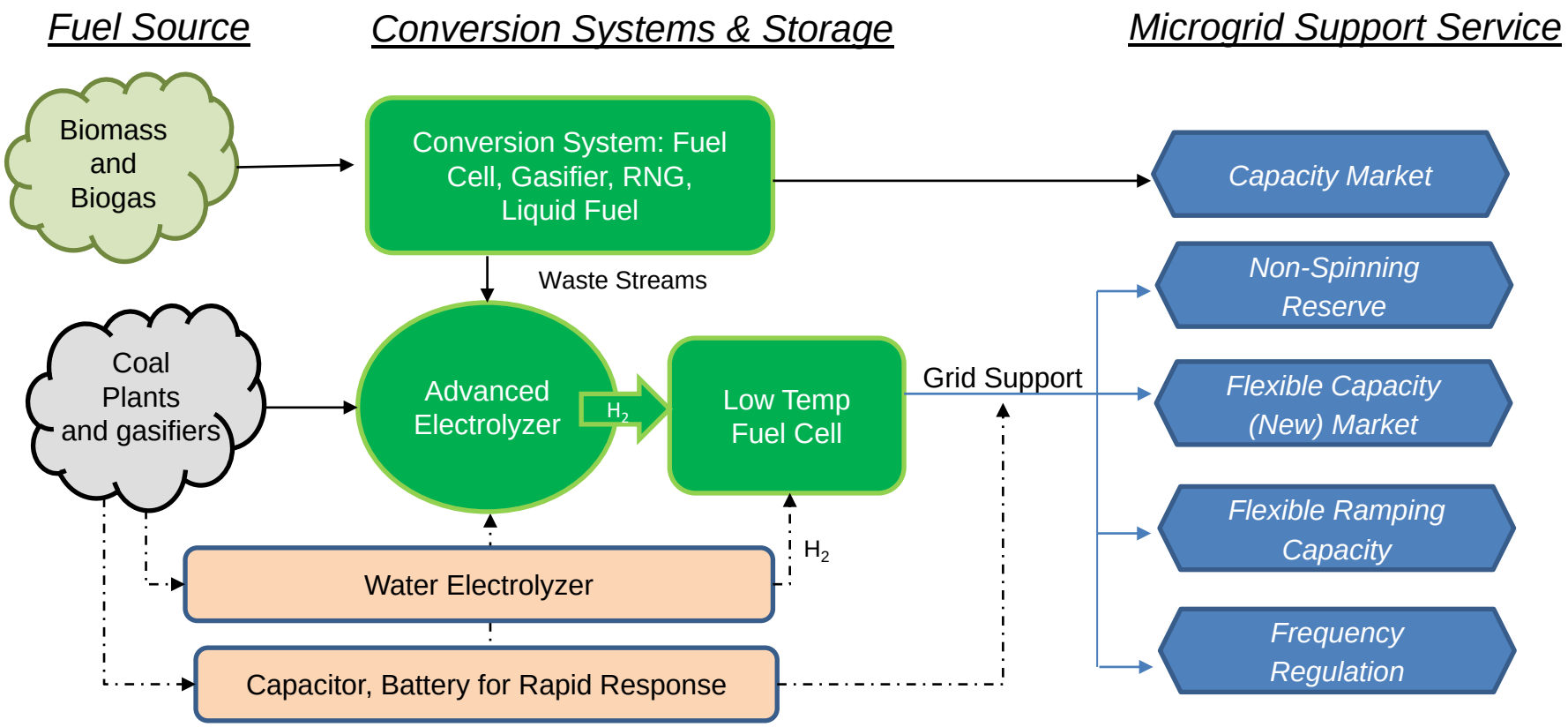

New Market for Fossil Assets: Over $4 Billion in Revenue
Multiple pilot/demonstration opportunities

Thank you!

Open for Questions

Converting Wasted Resources to Clean Energy

Pinakin Patel
www.t2mglobal.com
ppatel@t2mglobal.com