Climate change is a significant threat to the planet. Hydrogen (H₂) as a substitute to existing energy sources is one valuable solution to combat climate change. Steam methane reform (SMR) is currently the dominant H₂ production process. However, there is an opportunity to make this process more efficient and profitable. During production, approximately 25% (2.5 MT/year) H₂ goes into the waste stream representing ~$25B in lost annual revenue. The process also emits 95M tons of uncaptured CO₂ representing further missed revenue potential.

H₂RECO²VERY was developed with this exact problem. This advanced membrane can recover almost all the H₂ currently lost, increasing profits for producers. It can also capture close to all of CO₂ currently emitted, which can be sequestered or to sold to meet industrial demand. In short, H₂RECO²VERY makes H₂ manufacturing more efficient and profitable. Los Alamos has a prototype which recovers H₂ and removes CO₂ efficiently at lab scale and is seeking an industrial partner for pilot-scale demonstration.

**OVERVIEW**

Climate change is a significant threat to the planet. Hydrogen (H₂) as a substitute to existing energy sources is one valuable solution to combat climate change. Steam methane reform (SMR) is currently the dominant H₂ production process. However, there is an opportunity to make this process more efficient and profitable. During production, approximately 25% (2.5 MT/year) H₂ goes into the waste stream representing ~$25B in lost annual revenue. The process also emits 95M tons of uncaptured CO₂ representing further missed revenue potential.

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**ADVANTAGES**

- Recovers nearly 100% of H₂ from lost/waste H₂ stream
- Recovers close to all of CO₂ emissions
- Modular retrofit to existing SMR Process
- Significant potential to scale up
- Tunable structural and physical properties allow the process to impact H₂ production from Methane Pyrolysis

**TECHNOLOGY SNAPSHOT**

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**APPLICATION AREA**

- **Sector:** Climate and Energy Transition
- **Area:** Hydrogen Futures
- **Industry:** Oil and Gas
- **Market:** Steam methane reform (SMR)

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TECHNOLOGY DESCRIPTION

The advanced membrane technology developed at Los alamos is comprised of carbon molecular sieve hollow fiber membranes which feature a highly tunable structural and physical properties that can efficiently recover H₂ and CO₂ from tail (or waste) streams from the dominant hydrogen process – SMR. As H₂ and CO₂ pass through the membrane, the membrane construct allows H₂ only to pass through to be filtered on one side. CO₂ is collected on the other side. The unique carbon membranes can significantly increase H₂ production and decrease CO₂ pollution.

MARKET APPLICATIONS

This technology is ideal for energy companies currently producing hydrogen via SMR. The membranes are encased into modules and the module system is retrofit into the waste stream of existing SMR processes. The global hydrogen generation market size is expected to surpass $219.2 billion (USD) by 2030 and the carbon capture market is projected to reach US $35 billion by 2032.

Existing SMR plants are the initial target for H₂RECO₂VERY; however, with major government and private investment in hydrogen technologies this is just the beginning. This membrane technology can be fine-tuned to support next generation hydrogen production processes - methane pyrolysis - among other applications including biomass and waste gasification, green hydrogen geological storage, H₂ recovery plants and carbon capture at hydrogen plants.

NEXT STEPS

This technology has been evaluated in the lab under simulated process-relevant conditions. Los Alamos has an MVP which efficiently recovers H₂ and removes CO₂ at lab scale. Los Alamos is seeking commercial partners to further develop various process prototypes from pre-pilot to full pilot scale development and implementation.

SELECTED PUBLICATIONS
