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HYDROGEN POWER GENERATION WITH PRE-COMBUSTION CARBON CAPTURE

A photograph of an industrial facility, likely a hydrogen production plant, featuring large, silver, insulated pipes and tall, cylindrical towers against a blue sky with scattered white clouds. A thick green diagonal line runs from the top left corner towards the center of the image.

GTI is a leading research, development, and training organization addressing global energy and environmental challenges. We're applying energy and aerospace experience to lower energy costs and provide cleaner sources of fuel and power.

HYDROGEN POWER GENERATION

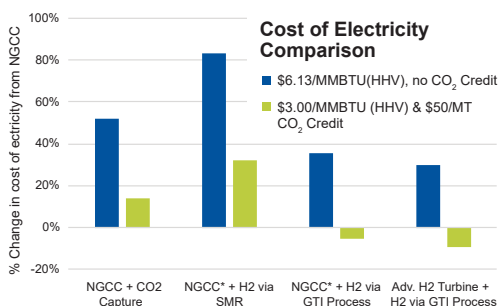
Cost-competitive H₂ generation with pre-combustion carbon capture

GTI has piloted a hydrogen production process with an inherent capability for carbon dioxide (CO₂) separation. The process is a cost-competitive, steam-neutral alternative to traditional steam methane reforming (SMR). It also produces a higher-quality hydrogen stream (>90%, which can be upgraded further) while eliminating the need for a water gas shift reactor. Furthermore, it inherently captures the CO₂ in solid phase. This eliminates the associated capital expenditure and operating expenses of amine-based systems required for CO₂ capture from SMR and natural gas combined cycle (NGCC)-based power systems.

The concept for a 5MMSCFD (12,050 kg/day) modular demonstration plant has been defined and costs estimated for its construction and operation. The design is scalable to very large H₂ production rates (e.g., 100MMSCFD [241,000 kg/day]) with the attendant economies of scale, with single or multiple modules.

Because the process has a byproduct of essentially pure CO₂, it offers a cost-effective approach for pre-combustion carbon capture for a combined cycle power plant. GTI performed a preliminary evaluation of a commercial power plant using H₂ from GTI's process compared to a NGCC plant with carbon capture.

GTI's H₂ process provides the lowest cost of electricity for reduced carbon



*NGCC: Natural Gas Combined Cycle Assumes F-Class turbine modified for H₂ use



applications. Further reductions are achieved when an advanced H₂ turbine is utilized.

STATUS: GTI has completed pilot testing (under DOE funding), which verified catalyst stability and successfully demonstrated SER chemistry and process operation. H₂ purity and yield were at or above expected levels for the limited sorbent feed rates. The next step is to upgrade the pilot using an indirectly fired calciner, and demonstrate operations. In addition, GTI has completed a hydrogen-to-power study for U.S. DOE with major OEM support, confirming the cost advantage of the GTI technology.

KEY FEATURES

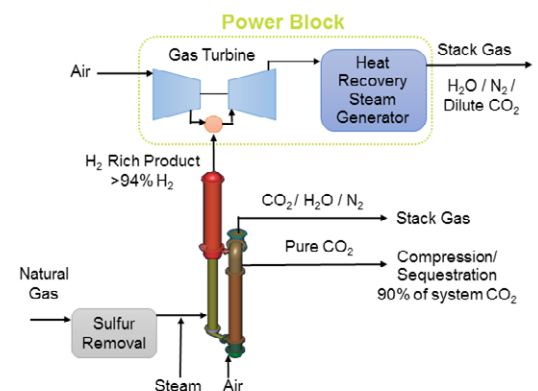
- H₂ produced in one step
- Inherent CO₂ separation
- 90% size reduction vs SMR
- 20–30% lower capital cost vs SMR
- 10–20% increased H₂ production efficiency
- Steam neutral

APPLICATIONS

- Power generation with CO₂ capture, and load-following if storage is included
- Hydrogen for:
 - Refineries and biorefineries
 - Infrastructure
 - Fertilizers (ammonia, urea)

BENEFITS

- Lowest-cost CO₂ capture option
- Excess H₂ may be stored for peak load use or sold
- Eliminate amine system



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