Challenges for Fossil-Based Hydrogen Production

Panel Introduction

NETL-GTI Workshop – Enabling an Accelerated & Affordable Clean Hydrogen Future – Fossil Energy Sector Role

Sept 28, 2021

John Marion – Sr. Director R&D Programs, Gas Technology Institute
Panel – Challenges for Fossil-Based Hydrogen Production

• Examine critical issues, research needs, and technology challenges for producing hydrogen from various feedstocks

  – Dan Williams, MD Wabash Valley Resources
  – Rob Hanson, CEO Monolith Materials
  – Perry Babb, KeyState to Zero, KeyState Natural Gas Synthesis and CCS Chairman and CEO

~ 10 min/each
~15 min Q/A/discussion
Clean [Blue] Hydrogen

H2 generation from fossil source with CCS/CCUS

Ways to generate blue hydrogen:

1) SMR w/ CCS [Steam Methane Reformer]
   • Fired
   • Renewable Electric
2) ATR w/ CCS [Auto-Thermal Reformer]
3) Gasification w/ CCS
4) Pyrolysis w/ CCS
5) SER w/ CCS [Sorbent Enhanced Reformer]
   • GTI CHG [GTI Compact Hydrogen Generator]
6) OSU CL [OSU Chemical Looping] w/ CCS
7) Other

Figure Ref – Friedmann – Aug’21
Clean Hydrogen production – Varying Maturities

Ref: modified from Friedmann, 2021
Blue Hydrogen Production & Power Generation R&D&D Roadmaps - CURC

- Strawman roadmaps in development for **10 technical approaches**:
  - 6 for gas & 4 for solid feedstocks
  - All with 90% CO2 capture and include potential for zero or net negative carbon emissions by co-firing biomass feedstocks
  - Each considers latest development status, time steps, costs for: Bench Scale, Engineering Studies, Small Pilots, Intermediate pilots, Commercial Scale demo’s/FOAK, and finally commercial scale with guarantees

![Diagram of hydrogen production and power generation roadmaps](www.CURC.net)

**Example only – not complete**
Curc Blue Hydrogen Roadmap - Example: SER [Sorption Enhanced Reforming]

- Current TRL = 4-5
- Estimated costs*: 20-30% cheaper H₂, 15 - 25% cheaper electricity vs alternate of SMR or ATR with CCS

**Development steps:**

- Updated pilots (USA 0.10 MMSCFD H₂ & UK 0.45 MMSCFD H₂)
- Increase bed pressure, Hot Lock hoppers, Steam assisted indirect calcination, Recycle gas - **Current Status**

- **30-40 MWe integrated power plant demo (17 MMSCFD H₂)**
  - Integrated system with GT, on-site H₂ storage, flexible operations – **Next Step**
  - Phased – H₂ production, then GT with NG/H₂ mix, then up to 100% H₂ and including plant H₂ storage
  - High pressure bed operation, bed scale up and solids distribution, full-scale solids handling loop

- **120+ MWe First large utility scale demonstration**
- **345 MWe First Commercial Plant**

* Refs – US DOE OSTI 1692380 & UK BEIS 13333-8820-RP-001 & LCOH calc tool & GTI analysis
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