Cool GTL℠ - A New Process for Conversion of Biogas or Recovered CO_2 To Liquid Fuels

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MOTIVATION

Why convert biogas to liquid fuels?

- Biogas contains large quantities of CO_2
- Conversion of biogas to liquid fuels has previously required extensive methane purification by CO_2 removal

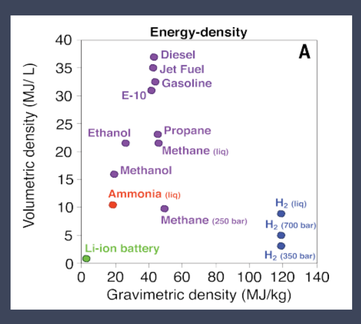
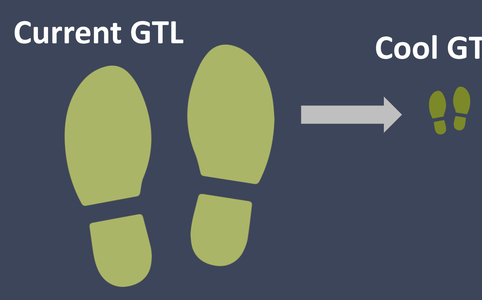


Figure. Liquid Hydrocarbon Fuels Highest Energy Density = The Perfect Energy Storage System

BENEFITS

- Modular, low-cost GTL
- Small footprint
- Great economics
- Distributed plant locations

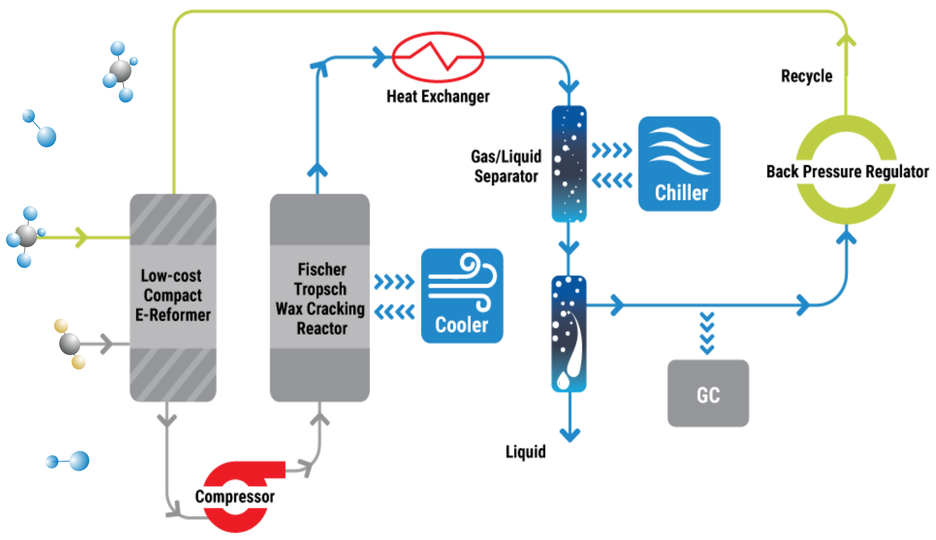


OBJECTIVES

- Produce 100 US gallons of biogenic aviation fuel
- 24/7 operation of integrated Cool GTL® pilot facility
- Conduct technoeconomic analysis (TEA) and lifecycle analysis (LCA)

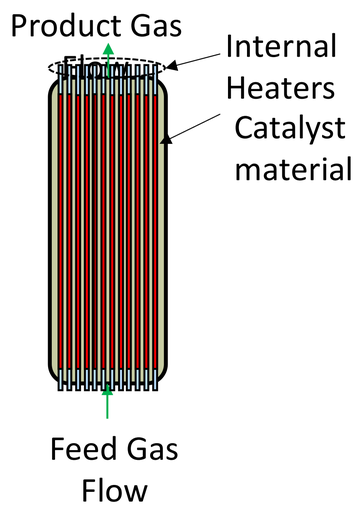
Two applications
1. IH2® gas (yield boost)
2. Anaerobic digestion biogas to liquid fuel (low cost solution)

COOL GTL PRODUCES DROP IN FUEL



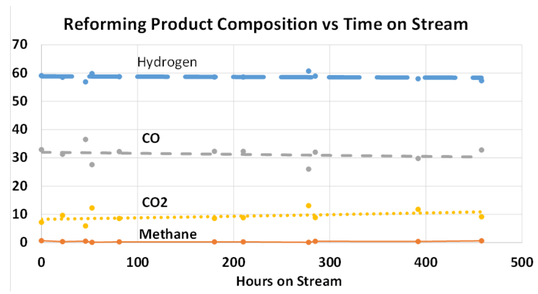
KEY DESIGN FEATURES

ELECTRIC REFORMER



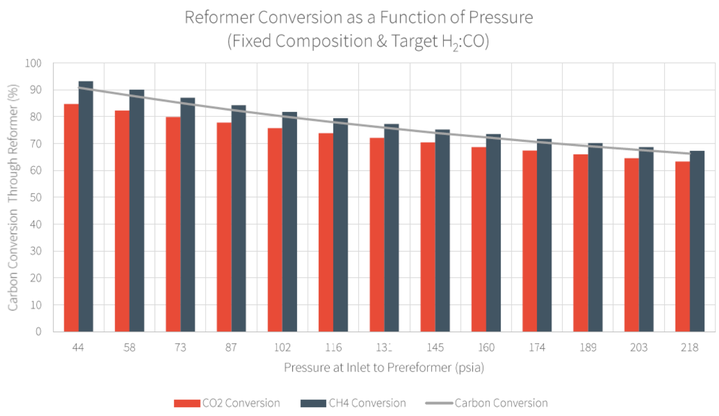
INTEGRATED PILOT FACILITY

- 2 US Gallons liquid fuel/day
- Integrated with IH² pilot at GTI
- Multiple use synthesis (CO_2+H2)
- Currently being shaken down



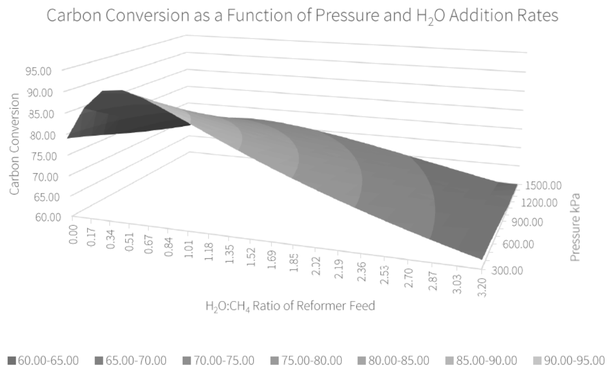
RESULTS SO FAR

BI-REFORMER OPTIMIZATION – IH²



Parameter	Case 1	Case 2	Δ From Base Case
Total Production	654.4 bpd	630.5 bpd	↓ 3.7%
Process Efficiency	10,700 scf/bbl	10,900 scf/bbl	↓ 1.9%
Next Efficiency	11,300 scf/bbl	10,900 scf/bbl	↑ 3.5%
% of Feed to FG Header	5.0%	0%	↓ 100%
Total Carbon Conversion Eff	57.5%	59.9%	↑ 4.2%
Overall CO Conversion Through FT	86.0%	86.0%	-
FT-Tail Gas Recycle Rate	0%	19.5%	-
Power Import	~1,200 kW	~900 kW	(↓ 27%)
Steam Turbine Duty	~5,050 hp	~3,400 hp	(↓ 33%)
AUX Boiler Process Duty	9.03 MMBtu/hr	0 MMBtu/hr	(↓ 100%)
Fuel Gas Duty	108.5 MMBtu/hr	93.1 MMBtu/hr	(↓ 14%)

BI-REFORMER OPTIMIZATION – BIOGAS



EARLY RESULTS

Cool Reforming (lab)

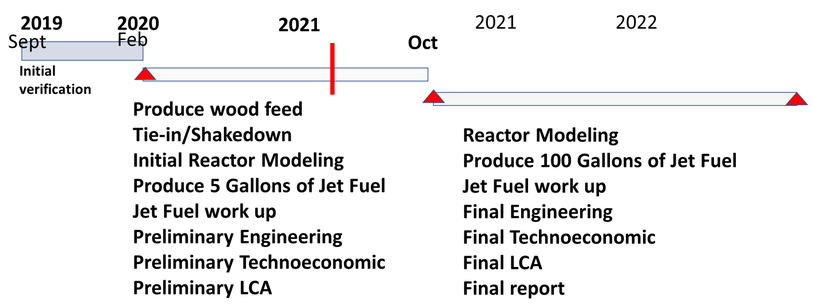
- Robust bi-reforming catalyst
- Directly makes 2:1 H_2/CO synthesis gas

Fischer-Tropsch

- No wax produced
- Drop in gasoline, diesel and jet
- High conversion per pass

Low cost, simplified version of an old process with new catalysts

PROJECT TIMELINE



WHERE TO FROM HERE?

- Pilot tests
- New applications:
  - Bio CO_2 + H_2 from electrolysis
  - DAC CO2 + H_2

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