



**National Laboratory
of the Rockies**

Status of Biomass Gasification in the USA

IEA Task 33

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April 2026



Coast to Coast

The 17 National Laboratories have served as the leading institutions for scientific innovation in the United States for more than 90 years.

Synthetic Aviation Fuel

Fulcrum's Sierra Biofuels

Red Rock Bio

DG Fuels

USA BioEnergy

Red Rock Bio

Red Rock Bio, Lakeview, OR (15MM GPY SAF)



- 1) Gasification + Fischer-Tropsch
- 2) Technology providers
 - a) Gasification: TCG Global
 - b) FT technology: Velocys and Emerging Fuels Technology
 - Parallel FT trains
 - c) Hydroprocessing: Haldor Topsøe
- 3) Feedstock: forest residue (166,000 dry tons per year)
- 4) Products: SAF, diesel, and naphtha
- 5) Offtakes: Southwest Airlines, FedEx
- 6) Status: anticipated construction completion; Q4 2022; project cancelled 12/2022

Red Rock Biofuels Construction Progress Late 2022

Project Cancelled, December 2022



Fulcrum – Sierra Biofuels



Fulcrum Bioenergy/Sierra Biofuels, Reno NV: (11M GPY nameplate)

- 1) Feedstock: MSW from MRF operational since 2016 at landfill 10 miles from biorefinery
 - a) 350,000 tons per year raw MSW => 175,000 tons per year prepared MSW
 - b) 120 TPH throughput
- 2) Gasification/FT
 - a) MSW feedstock/TRI indirectly heated fluid bed steam reforming gasifier
 - b) Johnson Matthey DAVY™/BP fixed-bed FT (CANS reactor)
- 3) Phase I is for Fischer-Tropsch wax
 - a) Wax to be refined by Marathon
 - b) Other offtakers include United and Cathay Pacific, BP Air, World Fuels
 - c) FT jet fuel capability to be added in Phase II
- 4) Plant is 'full scale'; scale up (3X) planned with parallel trains
- 5) Status: First gallon of product in December, 2022; project cancelled 5/2024

Fulcrum BioEnergy/Sierra Biofuels

Plant Construction Activities, Late 2020

Project Cancelled May 2024



DG Fuels



- Products: SAF, renewable diesel, naphtha
- Feedstocks: woody biomass and agricultural residues
- Technology: Gasification/FT – MyReChem gasification (NextChem, Italy)
- Projects and Status
 - 13,566 BPD renewable fuels (2,713 BPD e-SAF) project in St. James Parish Louisiana
 - Status: awaiting FID
 - 13,566 BPD renewable fuels (SAF + e-SAF) project in Moorhead Minnesota
 - Status: under development
 - 13,566 BPD renewable fuels (SAF + e-SAF) project in Phelps County Nebraska
 - Status: under development
- Low CI products with extensive renewable hydrogen (and oxygen) utilization and carbon management (CO2 sequestration)
- Partners: NextChem, Johnson Matthey, British Petroleum, Delta, AirFrance-KLM, Airbus, Baker-Hughes, Linde, Honeywell/UOP

USA BioEnergy



- Products: SAF, renewable diesel, naphtha
- Feedstocks: woody biomass (1M TPY)
- Gasification Technology: gasification technology provider unknown
- Projects and Status
 - 34M GPY renewable fuels facility optimized for SAF in Bon Wier, Texas
 - Status: FEL-2/3; awaiting FID
- Partners: UOP/Honeywell, Johnson Matthey, Applied Atomics, Citigroup, Southwest Airlines

Gasoline & Hydrogen

Frontline Bioenergy

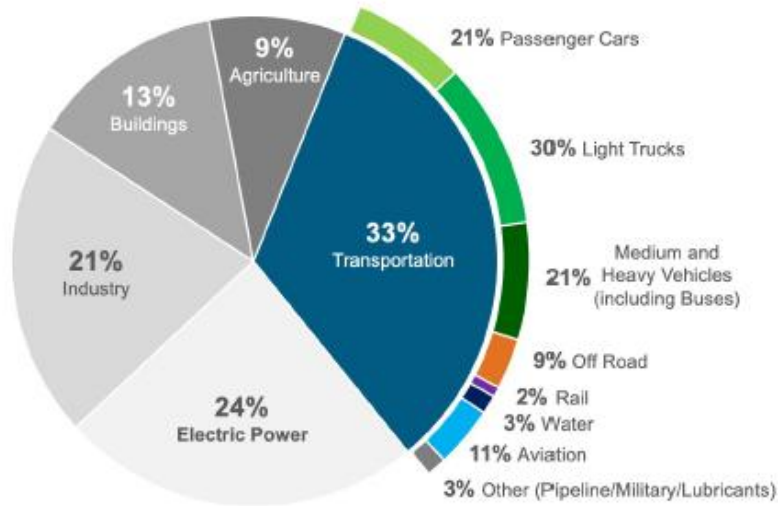
SGH2 Energy

Frontline Bioenergy

- Products: renewable gasoline (from methanol)
- Feedstocks: agricultural residues
- Gasification Technology: Pressurized (20 bar) fluid bed steam/oxygen gasification (TarFreeGas® advanced gasification) + proprietary gas cleaning and conditioning platform
- Projects and Status
 - 80 TPD biomass to methanol to high-octane gasoline facility in Iowa
 - Status: FEL-1

An Opportunity Missed?

US GHG Emissions



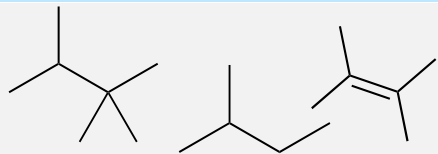
- Decarbonization of transportation sector essential
- Lots of effort on decarbonizing 11% of this sector (SAF)
- BEV currently ~7% of total US fleet (January 2025) and not growing as fast as predicted
- Outside of 1-G ethanol, little effort on the other roughly 50% that represents gasoline-powered vehicles
 - Corn ethanol ~40% GHG reduction
 - Replacing 1-G ethanol with 2-G (cellulosic) ethanol and increasing blend limits
 - Carbon-negative gasoline needed to achieve CDR

Conclusion => renewable low-carbon gasoline from lignocellulosics represents an untapped opportunity

- 1) Gasoline will remain an important transportation fuel for many years to come (in US)
- 2) Feedstock constraints for lignocellulosics not as severe as others (e.g., FOGs)
- 3) Low- and negative-carbon gasoline is needed to support global decarbonization & CDR efforts

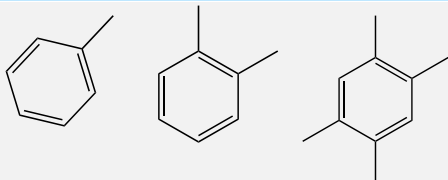
NLR's HOG Pathway: An Alternative Methanol-to-Gasoline

HOG Pathway



Branched Products

MTG Pathway



Aromatic Products

Key Differentiators of HOG versus MTG

- HOG pathway yields **branched alkanes, not aromatics**
- Higher octane (102 vs 87), higher value fuel product
- Lower severity conditions for HOG vs MTG
 - **Higher yield (18% relative), higher C-efficiency**
- Modeled **costs** for MeOH-to-HOG of \$0.49–0.66/GGE compare favorably against other alcohol conv tech.

TEA => L. Tao *et al.*, *Green Chem.* 2017, 19, 1082; D. Ruddy *et al.*, *Nat. Catal.* 2019, 2, 638

...and the HOG pathway provides a route to a jet fuel product

SGH2 Energy

- Product: hydrogen
- Feedstocks: feedstock flexible => biomass; wastes of all types (MSW, tires, textiles, etc.)
- Gasification Technology: proprietary plasma-enhanced catalytic gasification to make hydrogen-rich and tar-free product; conventional gas conditioning (PSA) to produce high-purity hydrogen
- Projects and Status
 - Lancaster CA project; 3.8M kg/y hydrogen from paper waste
 - Status: awaiting FID
- Partners: Allan Company (feedstock supply)

Bio-Methanol

SunGas Renewables

Frontline Bioenergy

SunGas Renewables

- Product: methanol
- Feedstock: woody biomass
- Gasification Technology: pressurized fluidized bed oxygen-blown gasification + POX gas cleaning
- Projects and Status
 - Beaver Lake LA; 500,000 MTA methanol
 - Status: FEED started May, 2025
- C2X LTD has, through its subsidiary Beaver Lake Renewable Energy LLC, signed a long-term agreement with Microsoft for the sale and purchase of carbon removal units (CRUs) from its Beaver Lake project to deliver 3.6 million CRUs to Microsoft over a 12-year period
- Partners: Johnson Matthey, GTI Energy, Linde, Merichem, C2X (Maersk, ENEOS), Jacobs, Kiewit Engineering

Frontline Bioenergy

- Products: RNG and bio-methanol
- Feedstocks: agricultural residues and MSW/RDF
- Gasification Technology: Pressurized (20 bar) fluid bed steam/oxygen gasification (TarFreeGas® advanced gasification) + proprietary gas cleaning and conditioning platform
- Projects and Status
 - Southern Energy Renewables; bio-methanol project in Louisiana; 500 TPD
 - Status: FEED

Where is gasification going?

Potential Opportunities

- Renewable Gasoline
 - MTG; NLR's HOG pathway
- Chemicals
 - Syngas to oxo-chemicals
 - Syngas-to-olefins => circular plastics

Headwinds: General impression in US is that gasification-based technologies are unproven and too risky



Thank You!

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