



IEA Bioenergy
Technology Collaboration Programme



USA Country Update

IEA - T33 Meeting

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December 1, 2021

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Technology Collaboration Programme

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Updates on Commercialization Activities

- Fulcrum Sierra Biofuels
- Red Rock Bio
- Other commercialization activities
- Comments on the political environment

Fulcrum Bioenergy/Sierra Biofuels

Reno, Nevada

Fulcrum Bioenergy/Sierra Biofuels: (11MM GPY)

- 1) 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) 20 TPH throughput
- 2) Gasification/FT
 - a) MSW feedstock/TRI indirectly heated fluid bed steam reforming gasifier
 - b) Johnson Matthey DAVY™/BP fixed-bed FT
 - c) Plant now undergoing start-up operations
- 3) Recently pivoted from jet fuel to FT wax
 - a) Off-take with Marathon Oil Co., Wax to be refined by Marathon
 - i. Uncertain where as Martinez, CA is being converted to renewable diesel facility
 - 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
 - a) 12 new projects currently planned/underway

Feedstock - Sorted MSW



Fulcrum BioEnergy/Sierra Biofuels

Plant Construction Activities, Late 2020



Red Rock Bio

Lakeview, Oregon

- Pathway: gasification to Fischer-Tropsch Jet Fuel
- Technology providers
 - Gasification: TCG Global
 - FT technology: Velocys and Emerging Fuels Technology
 - Parallel FT trains
 - Hydroprocessing: Haldor Topsoe
- Feedstock: forest residue (166,000 dry tons per year)
- Products: cellulosic renewable jet, diesel, and naphtha fuels
- Offtakes: Southwest Airlines, FedEx Express
- First commercial project status
 - Capacity: 15 MGY
 - Anticipated construction completion: Q4 2022

Red Rock Biofuels Construction Progress



Other Commercialization Activities

Aries Clean Energy

- Downdraft gasifier for biochar and syngas-to-power applications
- Fluid bed gasifier for production of syngas
- Projects
 - 1) Linden, NJ; fluidized bed gasification of bio-solids (Linden Roselle Sewerage Authority)
 - Processing 430 TPD biosolids; 22 TPD biochar and power
 - **Construction completed Fall 2021**
 - 2) Holloway Bioenergy; Lost Hills, CA
 - Aries down-draft gasifier; Ag wastes from California's Central Valley
 - 165 TPD ag waste feedstock producing 86MWe/D and 5,000 TPY biochar
 - Operational Q3 2021
 - 3) Lebanon, TN
 - Aries down-draft gasifier; wood wastes and bio-solids diverted from landfill
 - 420KWe/D and biochar
 - Operational since 2017

Sierra Energy

- DoD project (Ft. Hunter Liggett, CA; Army base)
- Gasifier: FastOx technology; blast furnace design (~2,200 °C)
- 'Commercial' project underway to produce FT liquids and power
 - Basically a waste minimization project
 - 20 MTD military waste + woody biomass
 - 500 KWhe electricity
 - 1 BBL/D FT diesel fuel

Other Pre-Commercialization Activities

Frontline BioEnergy

- Pressurized fluid bed (10 Bar)
- Air or oxygen with steam (TarFreeGas[®]; PMFreeGas[®])
- Projects
 - San Joaquin Renewables; San Joaquin, CA
 - RNG from Ag wastes; 15 million gallon-equivalents of RNG
 - Engineering in progress; approvals for injection in existing pipelines received; \$165M new funding recently received

SunGas Renewables

- Spinoff from GTI
- Supplier of processes for clean syngas and renewable products based on pressurized, oxygen-blown fluidized bed gasifier
- Incorporates integrated tar reduction and syngas cleaning
- Initial projects in advanced engineering for third-party developers are focused on liquid biofuels
- Pursuing plans for utility-scale RNG production facilities

Arbor Renewable Gas

- 1,000 BPD renewable gasoline (MTG) from woody biomass in Beaumont, Texas
- Gasifier: SunGas Renewables
- MTG: Haldor Topsoe

Velocys, Natchez MS

- 35M GPY SAF from gasification of woody biomass; no other details available

The Political Climate

- DOE: Liquid transportation biofuels coming back on the table
 - Sustainability: >70% life-cycle GHG reduction
 - Very strong emphasis on waste carbon feedstocks, SAF, and marine diesel products
 - Variety of SAF pathways under development (in addition to Fulcrum and RRB)
 - gasification => LanzaJet, Vertimass
 - Pyrolysis => Alder Energy
 - Arrested anaerobic digestion (volatile fatty acids upgrading) => Alder Energy
- Infrastructure bill (\$1.2T) has large investments in hydrogen
 - Nothing specific called out for biomass
- DOE has issued a roadmap to stand up 4-5 operating biofuels demonstration plants (each at ~1M GPY) by 2030
 - 3B GPY SAF is target by 2030 (BioEnergy Technology Office)

Thanks for your attention!

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