



**IEA Bioenergy**  
Technology Collaboration Programme



## USA Country Update

### IEA - T33 Meeting

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**Technology Collaboration Programme**

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# Updates on Commercialization Activities

- Fulcrum Sierra Biofuels
- Red Rock Bio
- Other commercialization activities
  - Aries Clean Energy
  - Sierra Energy
  - SunGas Renewables
  - Frontline BioEnergy
- Research Activities & Highlights
- Q & A

# 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 under construction
  - a) MSW feedstock/TRI indirectly heated fluid bed steam reforming gasifier
  - b) Johnson Matthey DAVY™/BP fixed-bed FT
  - c) Start-up in Q1 2021
- 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

# Fulcrum BioEnergy/Sierra Biofuels

MRF - Currently Operational



# Fulcrum BioEnergy/Sierra Biofuels

## Plant Construction Activities, Early 2020



<http://fulcrum-bioenergy.com/facilities/>

# Fulcrum BioEnergy/Sierra Biofuels

## Plant Construction Activities, Late 2020



# Fulcrum BioEnergy/Sierra Biofuels

## FT Skid Under Construction



# Red Rock Bio

## Lakeview, Oregon

- Pathway: gasification to Fischer-Tropsch
- Technology providers
  - Gasification: TCG Global steam reforming
  - FT technology: Velocys and Emerging Fuels Technology
    - Parallel FT trains
  - Hydroprocessing: Haldor Topsoe
- Feedstock: forest residue (136,000 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: Q1 2021



# 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 underway; operational in Q1 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 Commercialization Activities

## Frontline BioEnergy

- Pressurized fluid bed (10 Bar)
- Air or oxygen with steam (TarFreeGas<sup>®</sup>; PMFreeGas<sup>®</sup>)
- 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

## SunGas Renewables

- Spinoff from GTI
- Pressurized fluid bed technology
- Incorporates catalytic tar reforming technology from Andritz and Haldor-Topsoe
- Several FT projects in advanced stages of engineering
  - First commercial deployment planned for Gulf coast USA to produce hydrogen or chemical precursors

## Aemetis – Lanzatech

- 60 GPY cellulosic ethanol project suspended
- InEnTec gasification technology to be used

# Research Activities Summary

- West Biofuels (DOE project)
  - Producing FT wax for FCC co-processing
  - Joint project with NREL
- Feedstock Conversion Interface Consortium
  - DOE National Lab consortium
  - Focuses on feedstock handling and delivery to throat of reactor
  - Extensive interaction with Red Rock Biofuels; gasifier modeling
- Enerkem/National Renewable Energy Laboratory (NREL)
  - High-octane gasoline (triptanes) from syngas: renewable F1 racing fuel
    - Novel catalyst developed (bio-methanol → DME → hydrocarbons); not MTG
    - Scale-up; ExxonMobil
- Ohio State University (DOE project)
  - “Biomass Gasification for Chemicals Production using Chemical Looping”
  - Methanol product
- North Carolina State University (DOE project)
  - Chemical looping technology
  - Combining gasification, air separation and syngas cleaning/conditioning into a single circulating fluidized bed reactor

# Research Highlights

- Lanzatech
  - Syngas fermentation to ethanol and other products (largely oxygenates)
  - Clean syngas a priority
    - Small levels of contaminants fatal to fermentation organisms (ex. ppb HCN)
  - 10 M GPY ATJ (LanzaJet) plant planned for LT's Freedom Pines site in Soperton, GA
    - Ethanol from Aemetis (InEnTec gasification of ag wastes); DOE sponsorship
- Gas Technology Institute
  - Decontamination of Non-recyclable MSW and Preprocessing for Conversion to Diesel
  - GTI U-Gas® technology development
  - DOE project

Thanks for your attention!

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[www.ieabioenergy.com](http://www.ieabioenergy.com)

# RRB Groundbreaking

July, 2018

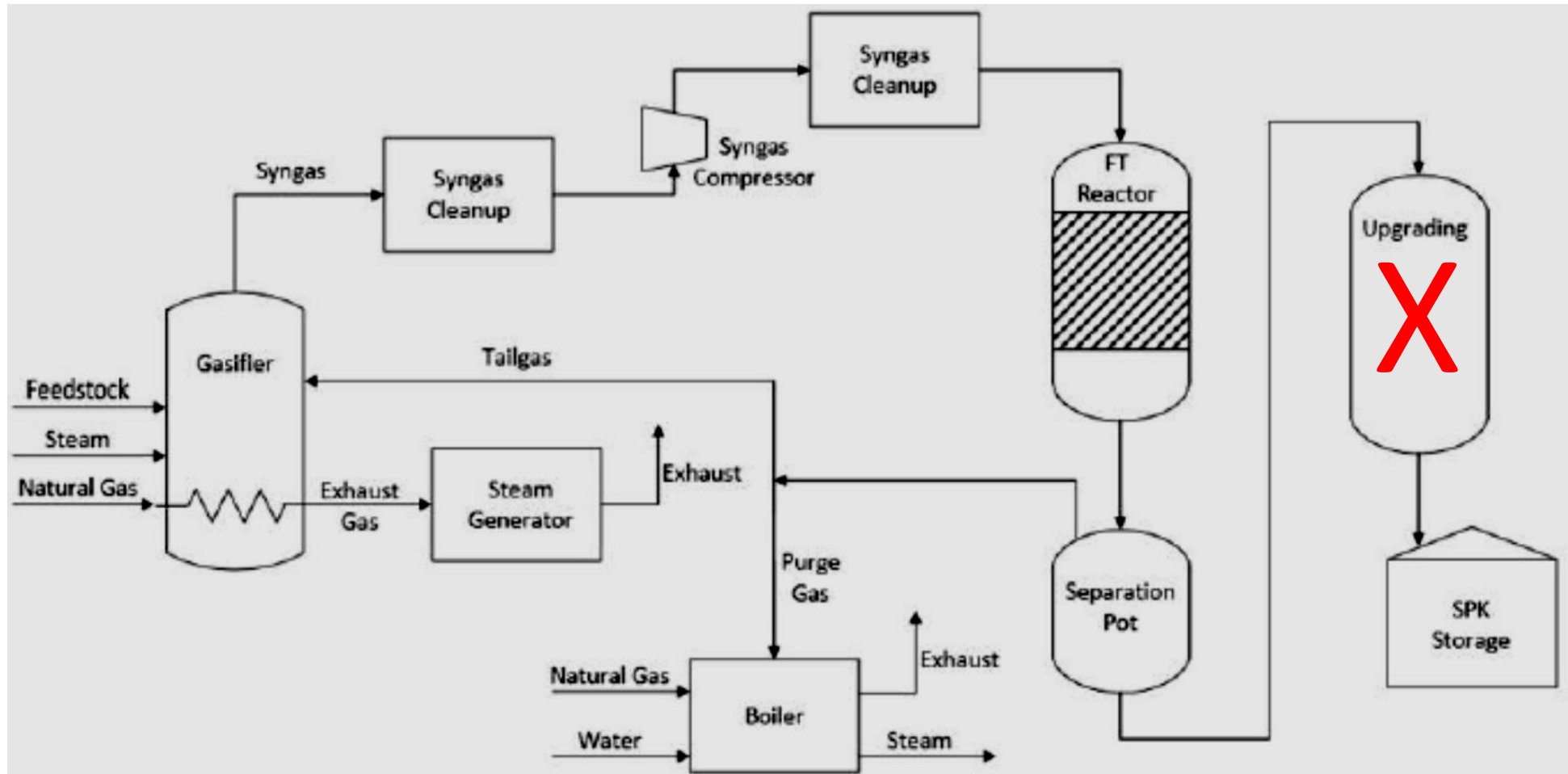


# Feedstock - Sorted MSW





# Fulcrum PFD



# TRI Gasifier

