

Thermal Gasification of Biomass United States Update

IEA Bioenergy Task 33

First Semiannual Task Meeting 2017

Innsbruck, Austria

2 May 2017

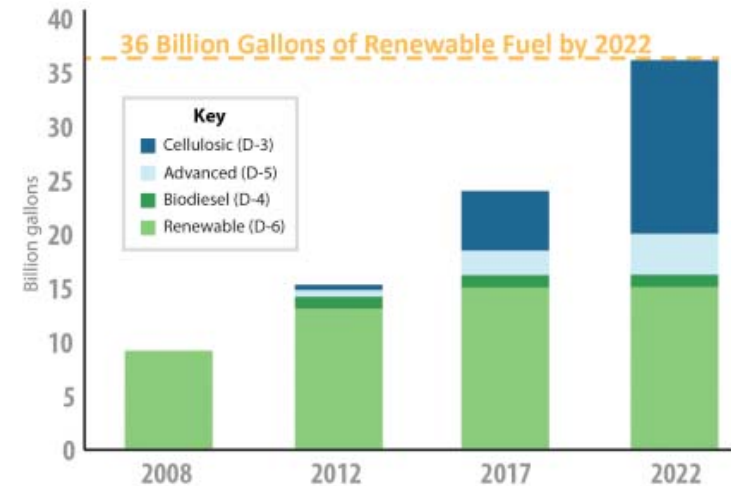
Kevin Whitty

U.S. Federal Policy and Incentives for Biomass Technologies

- Renewable Fuel Standard (EPA)
 - Establishes goals for biofuel usage in the US (36 billion gal of biofuel by 2022)
- Repowering Assistance Biorefinery Program (USDA)
 - Reimburses up to 50% of cost as incentive to convert fossil fuel refineries into biorefineries
- The Biorefinery, Renewable Chemical, and Biobased Product Manufacturing Assistance Program (USDA)
 - Assists in the development, construction, and retrofitting of new and emerging technologies for the development of Advanced Biofuels, Renewable Chemicals, and Biobased Product Manufacturing by providing loan guarantees for up to \$250 million.
- Biomass Crop Assistance Program (USDA)
 - Advanced Biofuel Feedstock Incentives: annual and matching payments for producers of advanced feedstocks.
- U.S. DOE Bioenergy Technologies Office (BETO)
 - Subset of US Department of energy. RDD&D Program.

Renewable Fuel Standard

- U.S. effort to increase production and consumption of biofuels.
- First enacted in 2005 with goal to have 4 billion gallons in 2006 and 7.5 billion by 2012
- Revised in 2007 (RFS2) to increase target to 36 billion gallons by 2022
 - Maximum 15 billion from corn starch ethanol
 - Minimum 16 billion from cellulosic biofuels
 - Push towards fuels with larger GHG reduction
- Enforcement through EPA
 - Tradable Renewable Identification Numbers (RINs) for fuel produced
 - Renewable Volume Obligations (RVOs) for producers to ensure renewable standards being met



U.S. DOE Biomass Energy Technology Office (BETO) Updates

- Budget for FY 2016 \$225 million. Requested \$279 million for FY 2017.
- Recently announced funded R&D project areas
 - Co-optimization of fuels and engines (\$7M)
 - Project definition for pilot and demo bioenergy manufacture (\$13M)
 - Bioproducts to enable biofuels (\$11M)
 - Advancements in algal biomass yield, part 2 (\$15M)
- Continued support for demonstration plants
 - Fulcrum Bioenergy
 - Red Rock Biofuels
 - Emerald Biofuels

Focus on Aviation Biofuels

- DOE Alternative Aviation Biofuels workshop Sept 2016
- Many projects under development focus on aviation fuels



Fulcrum Bioenergy

Sierra Biofuels Plant, Reno, Nevada

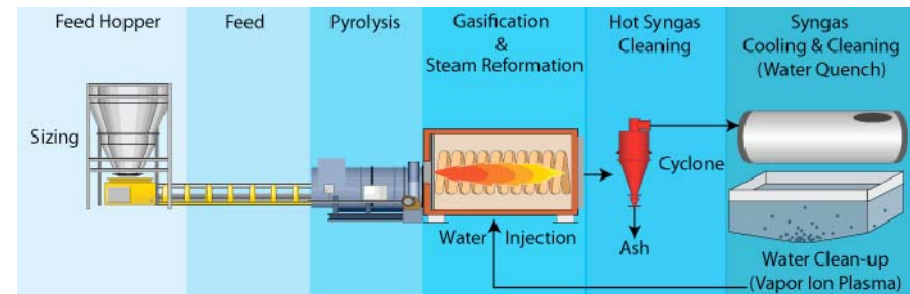
- Waste to FT fuels
- 200,000 t/y MSW
- 10 million gallons syncrude
- TRI gasifier
- Recent \$30 million investment by BP
- Collaboration with Tesoro
- Offtake agreements with United Airlines, Cathay Pacific, Air BP
- Feedstock processing facility built and operational
- Currently finalizing private investment
- Startup targeted for 2019



Red Rock Biofuels

Lakeview, Oregon

- Biomass to FT fuels
- Feedstock: Forest residues
- TCG Global gasifier
- Veolocys for FT
- Targeting jet fuel
- Partnership with FedEx
- Est. \$180-200 million
- Final investment decision expected soon
- No updates since Oct 2016



Indian River Bioenergy Center

INEOS Bio, Vero Beach, Florida

- Feedstock: Vegetable and yard waste, MSW
- Original configuration
 - Products: Ethanol and power
 - Scale: 300 tons feed/day
 - Gasification technology: Proprietary oxygen-blown
- Sept 2016: Ineos has now put facility up for sale and is exiting ethanol business
- Feb 2017: Alliance BioEnergy has made offer for facility
- Apr 2017: Alliance BioEnergy secures feedstock agreements



LanzaTech

Freedom Pines Biorefinery, Soperton, Georgia

- Syngas fermentation to biofuels and other higher-value products
- Process demonstrated on waste gas from steel mills
- 1500 gallons of LanzaTech jet fuel delivered to Virgin Atlantic
- Freedom Pines Biorefinery will use biomass gasification syngas
- Activity at Soperton facility ongoing
- No recent news or announcements

