Biomass 2010
Track 3-Hydrocarbon Fuels Near Term Opportunities

The Thermochemical Biorefinery

www.tri-inc.net

Discussion Topics

- Introduction
- Thermochemical Biorefinery Platform Overview
- Update on DOE assisted demonstration biorefineries
  - NewPage, Wisconsin Rapids, WI
  - Flambeau River Biofuels, Park Falls , WI
- TRI Process Demonstration Unit
  - Process overview
  - Results to date
  - Future plans

Corporate Overview

TRI - Advanced technologies for the conversion of biomass to bio-fuels, bio-chemicals and renewable power

- Formed in 1996
- Proprietary steam reforming gasification system developed with over $50 million of R&D investment from private investor, the U.S. Department of Energy, the California Energy Commission, and the pulp and paper industry
- Research facilities in Durham, NC and Utah
- Technology currently in commercial operation
- Commercializing the Integrated Biorefinery

Thermochemical Platform Biorefinery

The Optimal Thermochemical Biorefinery

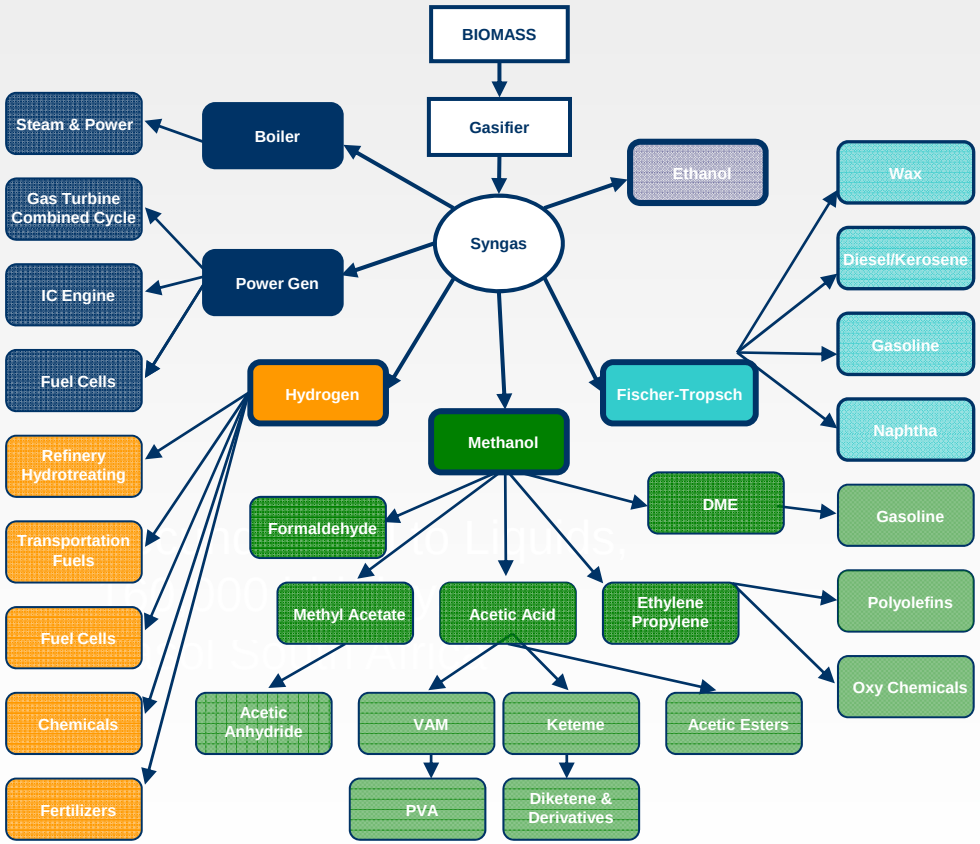
- Processes a wide range of economical biomass feedstocks
- Integrated with host to maximize thermal efficiency and capitalize on installed infrastructure
- Produces some or all of its own power
- Economically scale-able

Biomass gasification is the foundation of the platform

Thermochemical Platform Biorefinery Advantages

The Thermochemical Biorefinery Provides

- Product Optionality to maximize regional economic performance
- Flexibility to respond to market changes by changing the products produced while maintaining the front end (the majority of the asset base)



Flambeau River Biofuels Project
Park Falls, Wisconsin

- Over 100 year old paper mill
- Primary employer in the region
- Entrepreneurial leader with bold vision
- Awarded $30 million DOE financial assistance for demonstration biorefinery
- Capacity;
  - 1000 dtpd forest waste biomass
  - 9.5 million gallons per year diesel fuel
  - 7.6 million gallons per year paraffin
  - 5.3 MW green electricity
  - 160,000 pph steam to paper mill

- Thermochemical biorefinery platform; gasification to FT liquids
  - TRI biomass gasification system
  - TRI syngas clean-up system
  - EFT gas to FT Liquids system
- Status- FEL 3 scope and estimate and pilot plant testing underway

NewPage Corporation: Project Independence Wisconsin Rapids, WI

- Large, integrated pulp and paper mill
- Primary employer in the region
- Awarded $30 million DOE financial assistance for demonstration biorefinery
- Capacity
  - 500 dry tons per day waste wood biomass
  - 5.5-8.5 million gallons per year FT liquids
  - Up to 92 MMBTU/HR tail gas to lime kiln
  - Steam and hot water to paper mill
- Thermochemical biorefinery platform; gasification to FT liquids
  - TRI biomass gasification system
  - TRI syngas clean-up system
  - EFT gas to FT liquids system
- Status - appropriation grade scope and estimate completed, pilot plant testing underway

Process Demonstration Unit (PDU)

- Biomass Feed System
- Steam Reformer
- Carbon Trim Cell
- Gas Clean Up System
- FT GTL

Biomass Feed System

Designed to handle wide range of Biomass

- 230 cuft day bin with live bottom
- Weigh Screw feed to 1st stage piston
- 3-stage hydraulic piston system to feed biomass while preventing back flow of gasifier gases
- High speed biomass injection auger

Steam Reformer and CTC

Proprietary two stage gasifier system capable of 4 tons per day (dry basis) biomass

- Reformer
  - Indirectly heated steam reformer
  - Superheated steam fluidizing media
- Carbon Trim Cell
  - Fine tune H_2:CO ratio

Gas Clean Up

GCU sized for 10% slipstream and includes the following:

- **Primary Gas Clean Up**
  - HRSG to cool syngas
  - Venturi scrubber for removal of particulate
  - Gas Cooler for condensation of residual steam
  - Extraction of tars
  - Scrubber for removal of any trace H_2S
- **Secondary Gas Clean Up**
  - Compressor
  - Scrubbers to remove trace contaminants
  - Packed guard beds to eliminate sulfur species
  - Particulate filters

Fischer Tropsch Reactor

Fixed Bed FT Technology with Proprietary Emerging Fuels Technology (EFT) Cobalt Catalyst

- Three tubes – commercial scale diameter
- Commercial scale tube length to facilitate scale-up
- Exothermic heat removed via steam generated in reactor cooling jacket
- Forms heavy fraction (HFTL), medium fraction (MFTL) and light fraction (LFTL)

PDU Test Status

- Over 4100 hours combined gasifier and biomass feed systems
- Over 1000 hours secondary gas clean-up and FT
- Achieving H_2:CO ratios of 2:1 on a sustained basis
- Producing high quality FT liquids

Questions?