**Production of Liquid Fuels Biomass via Thermo-Chemical Conversion Processes**

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The overall objective our research is to develop technology for the economical thermo-chemical conversion of lignocellulosic biomass (non-food grade biomass such as agricultural waste, bagasse from sugar mills, citrus peels, switch grass, municipal green waste, etc.) to clean burning liquid fuels. There are two competing routes to production of liquid fuels from biomass: biochemical route via fermentation to alcohols or the thermochemical route to syngas followed by Fischer-Tropsch (FT) synthesis to produce diesel, jet fuel, gasoline or similar hydrocarbon fuels. We have chosen to focus on the thermochemical route because of its versatility and wide applicability. One of the key technological components of the thermochemical process is the catalyst used for FT synthesis. The specific objective of this task is to investigate the development of novel catalyst and support material that is critical for the FTS. We are collaborating with an industry partner to commercialize the process as it is developed.

This project has 4 main objectives:

* + Conduct research at the fundamental level to tackle the major issues facing the commercialization of the Thermochemical conversion of Florida biomass to clean burning fuels.
  + Develop the optimum technology for converting Florida grown biomass into clean burning liquids via the thermo chemical process. We will conduct bench scale and pilot plant studies using syngas produced from typical Florida biomass such as bagasse and switchgrass to determine the yield, kinetics and optimum processing conditions.
  + Establish the economic feasibility of creating an industry built around this process. We will develop the costs of setting up a plant and operating it to establish the profitability of the process given various market scenarios such as fluctuating crude oil prices.
  + Support industry in the effort to commercialize the technology.

**Technology challenges and Innovations:**

Florida is ranked #1 in the Nation with regard to biomass, much of which is from the sugar industry (Bagasse), citrus industry (citrus peels) and forest products (easily grown pine and tall grasses). Many of these biomass products are rich in lignin and hence more suited to conversion via the thermo chemical process as opposed to biochemical conversion to alcohols. Biochemical or fermentation processes of most Florida-based cellulose biomass feed stocks have not yet been established. Additionally, biological processes are slower than thermochemical methods, difficult to control and very susceptible to total shutdown via contamination since one is dealing with a delicate biological system that must be kept viable.



Fig.1. Biomass Conversion to Liquid fuels via Partial Oxidation

In the proposed thermo chemical process, local biomass is first partially oxidized to form a mixture of carbon monoxide and hydrogen (syngas) and then converted to clean burning liquid hydrocarbon fuels such as ethanol or gasoline via the well known Fischer-Tropsch synthesis (FTS) process developed in Germany during the 1920s and 1930s. The key technology development here is the catalyst and the design of the gasifier which involves fine tuning of processing conditions (contact method, temperature, pressure, biomass to oxygen ratio etc.) to achieve optimum production of syngas while minimizing pollutant formation and maximizing energy production. The technology for FTS also need to be adapted to take into account the economic conditions and fuel supply needs of the state of Florida.

The potential impact on the agriculture and energy production in Florida will be significant. The long term implications point to decreasing the dependence of the state on imported oil and gasoline and the development of a strong renewable energy industry tailored specifically to take advantage of the unique biomass production capacity available in Florida. The establishment of this technology will create job opportunities and the need for a highly trained workforce.