Bio-crude Production and Upgrading to Renewable Diesel
Topic Area 2: Drop-in Renewable Diesel Fuel Blendstocks

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A lot of activity in catalytic pyrolysis and hydroprocessing has occurred in the past 10 to 15 years with notable successes and failures; however, very little technical information is available in the open literature from continuous, integrated pilot-scale studies. The next step along the technology commercialization pathway is to scale-up the catalytic biomass pyrolysis process, integrate this technology with a hydroprocessing unit, and demonstrate the long-term operation and performance of the integrated process.

RTI International is developing an advanced biofuels technology that integrates catalytic biomass pyrolysis and hydrotreating to produce hydrocarbon-based biofuels. Additional separations technology is being developed to recover valuable products from bio-crude or fractionate bio-crude prior to upgrading.

The goal of the proposed project is to maximize the yield of bio-crude from a catalytic biomass pyrolysis process and effectively and efficiently upgrade the bio-crude intermediate into a renewable diesel blendstock. This goal is not unique; however, innovative approaches will be investigated to achieve the technical targets for an economically feasible integrated advanced biofuels process. There are two focuses of the proposed project. The first focus is to optimize the physical and chemical characteristics of biomass feedstock, in a commercially viable manner, to maximize bio-crude yields (independent of oxygen content) in catalytic biomass pyrolysis. The second focus is to improve bio-crude upgrading efficiency by fractionating the liquid intermediate and independently hydroprocessing each fraction to maximize biofuel production.

The proposed Project Team build on years of experience to seek innovative solutions that address technical challenges across the value chain from feedstock preparation, to biomass conversion, to intermediate upgrading, and to biofuel production. The proposed Project Team consists of RTI; Idaho National Laboratory (INL); Forest Concepts, LLC; the National Renewable Energy Laboratory (NREL); and Haldor Topsoe A/S (HTAS).

INL, in collaboration with Forest Concepts, will evaluate physical property requirements for selected feedstocks to develop correlations that reduce the risk of feeding upsets in RTI's 1 ton per day (TPD) catalytic biomass pyrolysis unit.

RTI and NREL will evaluate selected catalysts to maximize bio-crude yields in the 1 TPD catalytic biomass pyrolysis unit to produce bio-crude samples with varying composition in large enough quantities for upgrading studies.

RTI and HTAS will develop a new strategy to upgrade bio-crude that will minimize process severity while maximizing time on stream. A systems approach will be taken to maximize the efficiency of biofuel production by fractionating bio-crude, determining the most efficient way to process each fraction (hydrocracking or hydrotreating) or how best to re-combine the fraction for ultimate biofuel production. Instead of trying to maximize deoxygenation during the catalytic biomass pyrolysis step, the goal will be to optimize bio-crude yields during the conversion step while managing downstream hydrodeoxygenation by pre-treating, fractionating, or co-processing bio-crude fractions to maximize biofuels carbon efficiency.

The outcome of the proposed project is to improve the technical feasibility of renewable diesel production from cellulosic biomass by demonstrating the production of 100 gallons of a renewable diesel blendstock that can be blended at more than 20% into a diesel blend meeting ASTM D975 specifications. Techno-economic analysis, based on experimental results collected during the proposed project, will substantiate the economic viability of a fully integrated process design.