A Corn Stover Pyrolysis Pathway for Sustainable Aviation Fuel

Principal Investigator: Dr. David C. Dayton, RTI International

Mounting concerns about the impacts of greenhouse gas (GHG) emissions on global climate change are accelerating the demand for alternative feedstocks and new technologies to decarbonize transportation. The scale and complexity of this challenge require the consideration of all technical and non-technical solutions to transition away from petroleum-derived liquid hydrocarbon transportation fuels and toward lower carbon intensity options. Technologies to convert low-carbon feedstocks into sustainable aviation fuel (SAF) are maturing rapidly. Hydroprocessed esters and fatty acids (HEFA) is the primary commercial pathway for producing SAF but the amount of feedstock available for HEFA-based SAF production is limited, and the projected supply will be unable to meet the anticipated demand. High demand and lack of feedstock to meet it creates a sizable market opportunity for alternative advanced biomass conversion technologies to produce SAF.

RTI International and our partners at POET Research, Inc. and the National High Magnetic Field Laboratory (the MagLab) at Florida State University (FSU) will leverage existing capabilities to develop and demonstrate an integrated process to convert preprocessed corn stover into SAF through a catalytic fast pyrolysis (CFP), biocrude intermediate upgrading pathway. The integrated technology consists of a novel corn stover preprocessing step to remove alkali and alkaline earth metals, corn stover CFP, biocrude hydroprocessing, and distillation for SAF recovery.

Optimizing corn stover preprocessing and pyrolysis conditions are required to maximize the yield and quality of biocrude produced. RTI's 1 ton per day (1TPD) CFP unit will be operated to determine optimum process conditions for maximizing high-quality biocrude production from preprocessed corn stover. RTI also developed an efficient biocrude upgrading strategy to maximize and maintain hydrotreating catalyst activity to optimize the fraction of hydrotreated (HDT) products having boiling points in the jet fuel range. Optimization of biocrude production and upgrading will be guided by comprehensive compositional analysis of all biocrude and HDT products to gain a molecular-level understanding of the impact of oxygen and nitrogen speciation on hydrotreating performance. Expert data analysis and interpretation by scientists from the MagLab will provide insights to mitigate the impact of impurities (e.g., nitrogen-containing compounds, alkali and alkaline earth metals [AAEMs]). Finally, RTI will distill HDT products to recover the jet fuel cut, and the MagLab will conduct detailed fuel characterization to ensure that the jet fuel cut can meet ASTM requirements for SAF. The Project Team will incorporate experimental data for SAF production from corn stover CFP in RTI's established process models for the integrated pathway, providing the basis for a techno-economic analysis (TEA) to determine the minimum fuel selling price (MFSP) and a life cycle assessment (LCA). The goal is to demonstrate the technical feasibility of producing SAF from preprocessed corn stover and provide a clear pathway to achieve cost competitiveness in the current SAF market and meet a 70% reduction in GHG emissions compared with petroleum aviation fuel.