Summary/Abstract for Public Release

Applicant Name: Pacific Northwest National Laboratory

Project Director/Principal Investigator(s): Juan A. Lopez-Ruiz

Project Title: Scale-up of hybrid chemical, electro- and thermo-catalytic (Hy-CET) process to enable the electrification of sustainable aviation fuel production from lignocellulosic agricultural waste

Project Objectives: We propose to develop a Hy-CET process for the conversion of lignocellulosic agricultural waste into sustainable aviation fuels (SAF) and hydrogen (H_2). The innovation in this approach is integrating process intensification and electrochemical manufacturing in a single process. First, the lignocellulosic agricultural waste is treated with a proprietary chemical organosolv method (Co-Solvent Enhanced Lignin Fractionation, CELF). CELF-derived bio-crude and wastewater are treated by the PNNL-proprietary Clean Sustainable Electrochemical Treatment (CleanSET) to upgrade bio-crude while simultaneously generating H_2 gas. The CleanSET-treated CELF-derived bio-crude is converted in a hydrotreater into biofuels, including SAF, and the excess H_2 is used as chemical reductant and for heat and power generation. The Hy-CET technology aims to decarbonize SAF production using renewable biomass and renewable energy sources instead of fossil sources.

Project Description: We will optimize the CleanSET electrocatalysts and reaction conditions to improve the energy efficiency towards the targeted reactions using surrogate CELF-feedstocks (Task 1). We will assess performance and long-term stability of optimized electrodes at relevant reaction conditions using real CELF-derived streams provided by CogniTek (Task 2). We will perform a techno-economic and life-cycle assessments to estimate capital and operation costs, carbon and (electrical) energy efficiency, and (renewable) energy requirements as a function of operation scales (Task 3). We will identify the most cost-effective process scale for distributed manufacturing and determine the greenhouse gas emission reduction. The CELF-derived bio-crude will be upgraded using PNNL's hydrotreating technologies (Task 4) before and after electrolysis to determine the improvements in biofuel yield/composition and co-processability. EWT will design and build (Task 5) a CleanSET skid with pre-pilot (L/min) processing capacity using the optimized conditions discovered in Tasks 1 and 2. The TEA and LCA models will be updated with results from Tasks 4 and 5 to draft a pilot-to-market plan.

Potential Impact of the Project: The Hy-CET process can be co-located where (agricultural) lignocellulosic feedstocks and renewable energy (e.g., wind, solar, hydro) are readily accessible to produce biofuels, including SAF, H_2, and clean water for reutilization (e.g., process, irrigation). The CleanSET technology can treat any bio-crude and wastewaters generated during biomass and waste liquefaction (hydrothermal liquefaction, pyrolysis) and represents a means to electrify (with renewable energy) and decarbonize biofuel production.

Major Participants: CogniTek Management Systems, Inc. (CogniTek) and Evoqua Water Technologies (EWT)