Lignocellulosic biorefineries can produce renewable liquid fuels vital to the transportation sector, including replacements for gasoline, diesel, aviation fuel, and marine fuel. However, they also have an important potential role to play in manufacturing high-value bioproducts, creating jobs, supplying electricity, and treating waste in rural communities. The goal of this project is to conceptualize, design, and asses the economic and environmental performance of multi-input, multi-output biorefineries that can convert locally-produced lignocellulosic biomass, manure, and other wet organic waste into liquid fuels, platform chemicals, and high-value products. By the end of the project, the resulting technoeconomic analysis (TEA) and life-cycle assessment (LCA) models will be released as highly customizable, transparent web-based tools for public use. The optimized biorefinery designs will produce a suite of fuels and products that, compared to an identical portfolio of conventional alternatives, will reduce greenhouse gas (GHG) emissions by at least 70%, reduce fossil energy consumption by 50%, and reduce air pollutant emissions (normalized based on monetized local human health damages) by at least 20%.

Specific inputs of interest include: lignocellulosic biomass, to be broken down to sugars and bioconverted to versatile molecules that can serve as both fuels and platform chemicals; manure and other high-moisture waste to potentially be co-digested with the facility's wastewater; and high-biological oxygen demand (BOD) wastewater to potentially be co-digested in the anaerobic digestion section as well. Potential outputs include: digestate for maturation to compost suitable as a soil amendment in agricultural or landscaping applications; high-value bioproducts from biogas including PHA and SCP; electricity from combustion of organic residuals; fuels/platform chemicals (e.g. ethanol or isopentenol); and bio-based compressed natural gas (CNG) for use in local freight trucks (potentially including trucks hauling the biorefinery's inputs and outputs). By designing, simulating, and optimizing multi-input multi-output biorefineries for rural communities, this project will chart a detailed technical vision for advanced biorefineries that not only produce liquid fuels, but also treat organic waste, produce high-value biodegradable polymers, reduce GHG and local air pollutant emissions, and produce valuable soil amendments.