**Title: Intensified biogas conversion to value-added fuels and chemicals**
**Project Director: Dr. J.N. Kuhn, University of South Florida**
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The overall goal of this project is to establish an economically feasible pathway for producing liquid hydrocarbon fuels from residual biomass resources such as forest residues, municipal, and agricultural waste. The long-term goals are to advance the bioeconomy by facilitating regional system development for the sustainable production of liquid hydrocarbon fuels from renewable lignocellulosic biomass; to reduce the dependence on foreign oil; to enhance the environmental quality; to spur economic development; and to enhance the quality of life in a rural economy. The potential impact of a successful outcome of this research is huge since the US has a supply of biomass (nearly a billion tons/year) yet has to import nearly 50% of its liquid fuel needs from politically unstable regions in the world which has national security implications.

This project focuses on the conversion of biogas produced from landfills or anaerobic digestors to high value added liquid hydrocarbon fuels such as diesel, jet fuel and gasoline (Biogas to liquid or BGTL process). The objective of this project is to research and develop novel catalysts for converting the biogas into liquid fuel in a single reactor as opposed to the two-step process currently practiced in industry. Typically, the biogas produced by anaerobic digestion of biomass is a mixture of $CO_2$ and methane with a low calorific and hence low economic value. Because of the distributed nature of the raw material, biogas is produced on a small scale typically less than a few thousand standard cubic feet per minute rate. Converting this gas to a liquid via conventional processing at small scales of operation is economically challenging despite the high value of the product.

There is great incentive to seek ways to overcome the economy of scale barrier limiting BGTL processes. Current state of the art requires a multi-step process consisting of first reforming the biogas to syngas (a mixture of carbon monoxide and hydrogen) and then converting the syngas to liquid hydrocarbons using the century old Fischer-Tropsch synthesis process. Process Intensification provides an opportunity to revolutionize BGTL processes by combining and consolidating multiple unit operations thus reducing capital and operating expenses, reducing waste and byproduct creation, and mitigating environmental impact. We propose to integrate, and therefore to intensify, the process by combining reforming and liquefaction into one integrated processing step where the energy can be recycled locally and the by-product generation can be minimized. The challenge lies at developing a single catalytic system that will achieve this intensification in a single reactor which is the focus of this R&D effort.

The goals of this project will be reached through a ChemCatBio Partnership, in which NREL will perform advanced characterization techniques to provide feedback to USF on the catalysts' physiochemical properties. This will accelerate the determination of structure-function relationships and enable USF to design, synthesize, and evaluate catalyst performance. Big Ox Energy has commercial facilities to produce biogas from anaerobic digestion and will provide industrial support by way of providing technical expertise and advising, bottles of biogas samples for catalyst R&D experiments at USF and NREL, and providing the facilities for the end-of-project demonstration and validation of the technology using a commercial biogas-generating facility.