The advances made through this research will help to boost local economies throughout rural America, creating and sustaining good-paying jobs, while moving our nation toward a clean energy economy. — Tom Vilsack
U.S. Secretary of Agriculture

OVERVIEW

The long term goal of this project is to commercialize an integrated anaerobic digestion system (iADs) that promises cost competitive bioenergy and biofuels production from lignocellulosic biomass. iADs is an Ohio State University (OSU) patent pending technology that combines solid state anaerobic digestion (SS-AD) with commercially available liquid anaerobic digestion (L-AD). This combination mitigates technical challenges associated with each alone, and creates synergistic benefits that reduce costs, improve efficiency, and increase biogas production from a wide range of feedstocks. The biogas in turn is converted into bioenergy and biofuels, while the SS-AD digestate can be used to enhance soil quality (closing an ecological loop). We will optimize the SS-AD technology for biogas production from lignocellulosic biomass; develop the upstream and downstream logistics around the iADs; and assess the potential environmental, economic, and social benefits of iADs. Pilot scale SS-AD tests with different feedstocks will be performed to validate the lab scale results and provide the critical data necessary to convince our industrial collaborators to move this technology into the next stage of commercialization, namely, the demonstration phase.

OBJECTIVES

The specific objectives of this proposal are to:

- Develop a sustainable production and supply logistics system to provide multiple feedstocks to iADs for bioenergy and biofuels production;
- Assess impacts of SS-AD digestate application to biofuel crops grown in marginal lands on soil quality and hydrological, microclimatic, and agronomic parameters;
- Develop a pretreatment technology to increase lignocellulosic biomass digestibility and optimize SS-AD technologies to maximize biogas production;
- Integrate feedstock supply chains with a pilot scale iADs to evaluate its potential for commercialization;
- Develop a biogas to liquid hydrocarbon fuels (BTL) technology via catalytic reforming and Fisher-Tropsch (F-T) synthesis;
- Use Life Cycle Assessment (LCA) and process economic models to evaluate the proposed system performance and its environmental, economic, and social impacts on sustainability.
TEAM

To achieve the objectives of this project, we have assembled a multidisciplinary team of scientists in the areas of soil and carbon sequestration, Dr. Rattan Lal, OSU; feedstock supply logistics, Dr. Scott Shearer, OSU; feedstock logistics and process modeling, Dr. Sudhagar Mani, University of Georgia; anaerobic digestion, Dr. Yebo Li, OSU; anaerobic biology, Dr. Zhongtang Yu, OSU; catalyst synthesis, Dr. Fei Yu, Mississippi State University; and life cycle analysis, Dr. Bhavik Bakshi, OSU. The team will work closely with industry collaborators including quasar energy group (quasar), American Electric Power (AEP), Aloterra Energy, Marathon, CNH, AgSTAR, and others.

OUTCOMES

The outcomes of the proposed project include:

- Extension and optimization of novel iADs technology using effluent of L-AD as inoculum and nitrogen source for SS-AD, with increased knowledge about the microbiome in the SS-AD process;
- Miscanthus and crop production with SS-AD digestate that leverages BCAP-funded Miscanthus production for development of Miscanthus feedstock supply logistics (planting, harvesting and storage systems);
- Restoration and soil quality enhancement of marginalized lands, including strip mined lands;
- Assessment of the carbon sequestration in soils, trees, and wetlands and of the magnitude by which gaseous emissions in the biofuel production process can be off-set by net gains in the ecosystem carbon pool;
- A flexible platform system for exploring innovative uses of AD products including testing the techno-economic feasibility for production of liquid hydrocarbon fuels from biogas;
- Positive economic, environmental, and social impacts of iADs.

IMPACTS

The impacts of the project include:

- Extension of the feedstocks of AD from animal manure to all kinds of organic waste;
- Production of liquid transportation fuels from organic waste via anaerobic digestion and F-T synthesis;
- Assessment of the net ecosystem carbon budget in biofuel production.

Additional Information

For more information, contact Mary Wicks, Project Manager, at wicks.14@osu.edu or 330.202.3533.