Project Summary

Next-Generation Feedstocks for the Emerging Bioeconomy

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The goal of this five-year project is to provide farm-scale data on the biomass productivity of advanced switchgrass cultivars ('Liberty', 'Independence', and 'WS10L') across geographic locations (South Dakota, Nebraska, Iowa, and Illinois). Data from 14 field-scale trials will be assessed with machine learning techniques 1) to determine the relative performance and composition of new cultivars compared to traditional switchgrass on land that is marginally productive for commodity crops; 2) to develop best management practices across field trials to reduce yield and feedstock chemical composition variability for energy conversion processes and to maximize ecosystem services; and 3) to generate geospatially resolved technoeconomic analysis to quantify opportunities to meet the BETO goal of less than $3/gasoline gallon equivalent. Additionally, small plot trials will be established near the field-scale trials to compare advanced lines of switchgrass, Miscanthus, prairie cordgrass, and big bluestem that are not yet commercially available. These small plot trials will provide site-specific data for modeling biomass production of next-generation cultivars.

Our multidisciplinary team — led by the University of Illinois (UIUC), Iowa State University, and South Dakota State University, USDA-ARS, National Laboratories, and industry — is uniquely qualified to design and manage field-scale trials; apply precision agriculture tools and sensing to assess indicator of yield, feedstock composition and logistic, soil quality, greenhouse gas emissions, biodiversity, and water quality and quantity impacts at scale; use high-performance computing to provide a range of optimized yield/marginality tradeoffs; and generate geospatial resolved technoeconomic analyses. The partner institutions also have large, instrumented, energy crop research sites that complement the Illinois Energy Farm. We have an extensive, collaborative experience on the establishment and management of herbaceous perennial bioenergy crops, and the team members were participants in the DOE and Sun Grant Regional Feedstock Partnership for large-scale feedstock production research as the director, coordinator, and co-PIs. The team will leverage administrative leadership and facility of the DOE's Center for Advanced Bioenergy and Bioproducts Innovation (CABBI) at UIUC.

The proposed activities will impact the growing U.S. bioeconomy by providing information on production and economic potential, compositional characteristics, and environmental sustainability of switchgrass in the Midwestern U.S. Using recently released switchgrass cultivars and germplasm, we anticipate demonstrating yields that will exceed BETO's goal of achieving >4 dry tons/acre annually at a cost of $84/dry ton or less. Further, since we will demonstrate switchgrass' environmental benefits, we believe that producers will desire to incorporate switchgrass on their farms.