Title: Surface Enhanced Preprocessing of MSW for Year-Round Supply of Conversion-Ready Feedstocks

Project Director: Dr. Jian Shi, University of Kentucky

Co-PIs: Drs. Michael Montross, Dimitrios Koumoulis, Jin Chen, Fazleena Badurdeen (University of Kentucky); Drs. Mark Mba-Wright, Beiwen Li (Iowa Stata University); Drs. Ling Ding, Mikael Karlsson (Idaho National Lab); Jeff Manternach (Red Rock Biofuels); Nathan Rich (Wasatch)

Objectives: The overall goal of this project is to develop advanced NR-MSW feedstock preprocessing technologies through surface enhancement and smart formulation to enable year-round supply of high-quality conversion-ready feedstocks for thermochemical conversion. To achieve the project goal, five interconnected objectives will be pursued: 1) define and characterize key feedstock characteristics in various sources of NR-MSW collected from MRFs using wet-chemistry and 4D imaging methods; 2) develop a smart formulation and densification process for the preparation of MSW blends with enhanced surface properties; 3) test the stability and convertibility of the prepared feedstocks; and 4) conduct feedstock logistics, techno-economic feasibility and environmental impacts analyses. We will use the outcomes to 5) develop a predictive model that guides the preprocessing and formulation strategies adaptable to MSW feedstocks with varying composition profiles.

Project Description: This project addresses FOA subtopic area 1a by focusing on 1) advanced NR-MSW decontamination method to reduce inorganic contamination; 2) smart formulation to improve quality and reduce variability; 3) surface enhanced densification to facilitate long-term storage and transport of NR-MSW. Achieving this goal will lead to significant improvement of feedstock quality characteristics toward better stability and convertibility against the baseline.

Methodology: This project will use a combined experimental and modelling approach. The workplan is divided into 7 tasks: Task 1: Project initiation and validation; Task 2: NR-MSW characterization using wet-chemistry and 4D imaging; Task 3: Develop surface enhanced densification technologies; Task 4: Evaluate stability and convertibility; Task 5: Techno-economic (TEA) and life cycle analysis (LCA); Task 6: Predictive model development, process optimization and technology validation; and Task 7: Promote diversity equity and inclusion.

Potential Impact: The success of this project will help to mitigate the heterogeneity and variability of NR-MSW through smart preprocessing to achieve conversion-ready feedstock characteristics. The developed technologies are transferable to other MSW MRFs therefore could improve current MSW management practice and regulatory standards to facilitate future MSW utilization at large scale. Organic portions of MSW which have been landfilled would be diverted for conversion to biofuels so that landfilling could be reduced or avoided and MSW disposal problem would be addressed, which will enhance societal/environmental/economic sustainability, and increase national energy security. This project will help build interdisciplinary collaborations, leverage expertise and resources across institutes, engage industry collaborators to address such interdisciplinary challenges, and advance biorefinery research while promoting sustainable MSW-based bioeconomy.

Major Participants: University of Kentucky, Iowa State University, Idaho National Laboratory, Red Rock Biofuels, Wasatch Integrated Waste Management