Project Title: High Precision Sorting, Fractionation, and Formulation of Municipal Solid Waste for Biochemical Conversion

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1 Objectives of the project

The goal of this project is to develop an advanced sorting and fractionation technology to separate the organic fraction waste from municipal solid waste (MSW) and to blend and formulate organic waste (>95% purity) with lignocellulosic biomass for biochemical conversion.

Objectives: 1) Design and test 1st stage pre-screening devices to separate 95% of metals and 80% of plastics from MSW (by magnetic separator and disc screen); 2) Conduct mechanical milling (<50 mm) and evaluate 2nd stage screening devices (>4.0 mm, by flip flow screen) to obtain uniform feedstocks; 3) Blend and formulate screened organic waste (95% purity) with lignocellulosic biomass for conversion testing; 4) Conduct techno-economic analysis (TEA) and life cycle assessment (LCA) of the proposed sorting and fractionation process

2 Description of the project

The project is divided into five tasks. After initial verification (Task 1), Task 2 will identify material attributes of the raw MSW and design 1st stage dynamic disc screening process by varying process parameters. Task 3 will develop a fundamental understanding of the quality attributes of separating the organic fraction and perform milling study to understand the shearing force, compression, attrition impact on size reduction and separation, and determine the most important process parameters in flip flow screening that affect separation efficiency and purity of organic stream **(**such as speed, size and types of wastes**)**. Task 4 will blend and formulate the screened organic waste with lignocellulosic biomass for conversion testing. Task 5 will perform TEA and LCA of the proposed sorting and fractionation process.

Methodology: Integration of dynamic disc screening, mechanical milling and flip flow screening is a new strategy to separate organic fraction from MSW. Blending of sorted organic waste from MSW with cellulosic biomass is an original approach to reduce the variability of MSW for biochemical conversion. Process analytical technology (PAT) system will be used to rapidly identify critical quality attributes of separated streams from MSW.

Potential Impact of the Project: Feedstock supply and logistics account for a significant portion of biofuels production cost. MSW provides a great potential for waste-to-energy development. Using new sorting and milling technology can effectively separate a high purity organic fraction from MSW and achieve desired and uniform particle size/shape. The biomass blending and formulation can reduce the feedstock variability and cost. This project will produce conversion-ready feedstocks in support of the BETO cost target of $73/ dry ton. The expected outcomes of this project will result in new high-precision MSW sorting, fractionation and formulation technologies for biochemical conversion. The results will also impact MSW management and waste to energy industries. It will provide guidance for new high-precision MSW sorting and fractionation equipment design and low cost conversion-ready feedstock development.

Major Participants: The project will be conducted by a multidisciplinary team at UC, TU, and INL. The investigators are teamed with complementary backgrounds and expertise, including Drs. Maobing Tu and Drew McAvoy (Environmental Engineers) and Janet Dong (Mechanical Engineer), Dr. Allison Ray (Biological Engineer), Drs. Chenlin Li and Hongqiang Hu (Chemical Engineers), Dr. Marceline Egnin (Plant scientist) and Mrs. Terri Ward (Project Manager).