Project Title: Artificial Neural Network for MSW Characterization
Name of Prime Applicant: AMP Robotics Corp

AMP Robotics (AMP), in partnership with Idaho National Laboratory (INL), proposes to develop an artificial neural network (ANN) that can identify and characterize, in real time, the organic and plastic constituents of the municipal solid waste (MSW) stream being diverted to landfill. This technology can be integrated into autonomous high-precision sorting in mechanical processing of MSW feedstock for waste-to-energy conversion. MSW represents a valuable and plentiful source of low-cost feedstock, but its heterogeneity and variability are significant barriers to the application of state-of-the-art mechanical sorting devices. Additionally, each energy conversion pathway has different critical material attribute requirements for desired MSW feedstock. Supplying uniform-format MSW feedstock at scale requires real-time identification and characterization of objects and CMAs present in the material stream.

We will use a variety of sensors to identify and characterize MSW. This includes AMP's current vision-based ANN, near-infrared camera, mid-wave infrared, X-ray fluorescence, 3D/depth imaging, and Ramen spectrometer. This combination creates an input of multiple sensors that independently describe the MSW objects. We will develop a new neural network architecture that fuses these sensor signals. Our goal is to advance this MSW ANN from concept to lab-scale demonstration (TRL-4). The achievement of this goal allows us to determine the relevant sensor signals which, when combined with deep learning, will guide lower-cost device commercialization potential. The conceivable impacts of the proposed ANNs are far reaching, and have the potential to transform the cost structure of MSW waste-to-energy feedstock sorting. Sorting operations cannot manage MSW heterogeneity, variety, value, and contamination if they cannot measure it, which is why we are proposing to digitize the waste stream.

The aim of AMP/INL team by the end of this project is most effectively captured in two objectives:

1. Demonstrating a multimodal ANN-based technique can identify MSW material categories at >95% classification accuracy.
2. Provide recommendations for a reduced sensor and spectrum range by at least 30% to enhance data processing speed while preserving >90% accuracy of full spectrum as to guide sensor cost reduction efforts to achieve BETO techno-economic and life cycle cost objectives.

AMP and INL are two leading organizations in the characterization of waste and biomass materials for recovery or conversion. AMP Robotics pioneered industrial artificial intelligence and robotic sorting systems for MRFs. INL is the nation's leading laboratory for bioenergy feedstock including improving feedstock preprocessing technologies, understanding feedstock variability and its implications on conversion processes. Mr. Mark Baybutt (VP Product, AMP Robotics) will lead and manage the project. Joining Mark is an outstanding team of Principal Investigators including Dr. Matanya Horowitz from AMP Robotics and Idaho National Laboratory's Dr. Vicki Thompson, Dr. Jeffrey Lacey, and Michael Griffel.