High Solids *In Situ* Product Recovery; The Next Generation of Arrested Anaerobic Digestion Technology

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This project aims to scale the high solids *In Situ* Product Recovery (ISPR) system (Patent Application No. 63/020,598) originally developed by the National Renewable Energy Laboratory (NREL) to produce > 1.5 kg of Volatile Fatty Acids (VFAs) from solid food waste and subsequently > 1 kg of Sustainable Aviation Fuel (SAF). The system will be scaled at Quasar Energy Group's facility in Wooster OH. VFAs from wet waste feedstocks via arrested anaerobic digestion (AAD) are an important target because they can be used as a chemical intermediate for the production of SAF using chemistry, such as ketonization and hydrodeoxygenation. Furthermore, wet waste feedstocks are available at zero or even negative cost and they generate significant Greenhouse Gas emissions when landfilled, making their use as a feedstock for biofuels particularly attractive because it can lead to cost-advantaged, carbon-negative biofuels. However, the development of an AAD system to produce VFAs is challenging because it involves the integration of an advanced separations system to continuously extract soluble VFAs from sludge-like fluids with solids present. Due to these separation challenges, AAD technology has seen limited commercial success in regard to biofuel production. The specific separations challenges are: (1) difficulty in handling solids has limited AAD units to whey and thin stillage which is only 33.5 kTa of U.S. based feedstock potential (~3 billion gallons of biofuel potential or 5% of U.S. SAF demand), and (2) current AAD separations trains consume more energy than the energy content of the VFA intermediates, precluding their use as fuel precursors.

To address these two hurdles the NREL team has developed an advanced high solids separation system. The significance of this system is that it solves the above two hurdles present in current separations trains of AAD technology. Specifically, the ability to operate in high solids environments allows the use of solid food waste with AAD technology in addition to whey and thin stillage. Additionally, the energy efficiency of the unit is ~ 18-22% of the HHV of the VFAs. This provides a positive energy balance on the VFA product such that their use as fuel precursors is now feasible. This project will scale this system for a first-of-a-kind demonstration at Quasar Energy Group's facility to produce VFAs and subsequently SAF from solid food waste with a positive energy balance.