

Water-energy-food (WEF) nexus system: multiple scale biodigester and mobile power kiosk project

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Abstract

As the human population grows, so does our energy and agricultural demands along with our output of organic waste. In a Water-Energy-Food Nexus, organic waste can be utilized to produce clean energy and increase the output and quality of agriculture. Methane-rich biogas is produced through the anaerobic digestion of organic matter, which can be used as a versatile, renewable energy source. This project provides a life cycle analysis of multiple scale closed-looped systems that offer a way to dispose of organic wastes and retrieve water for irrigation, nutrients to grow plants, and methane gas that can be used for energy generation. Two systems have been engineered: a household scale integration and a large scale digester that has been modeled in a virtual-reality simulation. These systems are driven by microbial processes, and through its optimization, provides both a sustainable and economical method of waste disposal. Three areas of tests are being conducted weekly for analysis and data interpretation on the relationship between the amount of food waste input to biogas and microbe production. These laboratory tests focus on water quality at multiple locations in the system, tracing compounds in the biogas, and classifying microbial species. The end of these close looped systems are designed to provide nutrient rich water for agricultural farming. The overall objective is to analyze feedstock, and anaerobic digestion processes to yield biogas for electricity and nutrient rich digestate for plant growth to characterize the roadmap of success for food waste management.