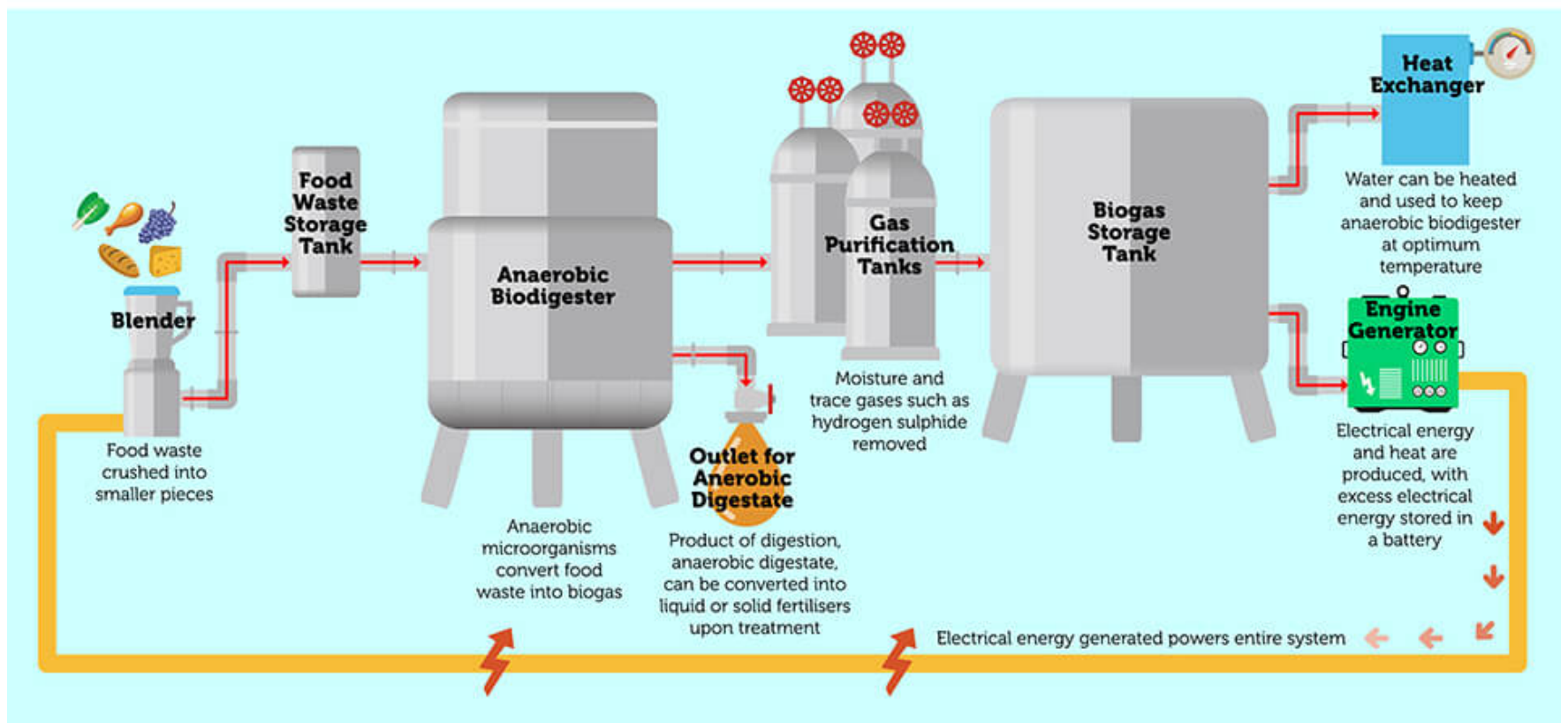


# Thermophilic AD processes and the development of a self-sustainable thermophilic AD system through the coupling of solar energy

at Energy and Environmental Sustainability for Megacities (E2S2) Program



## SELF-SUSTAINING ANAEROBIC DIGESTION SYSTEM FOR FOOD WASTE



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### Background

The integrated solar – AD eco-system is composed of an AD subsystem, a solar collector subsystem, an engine generator, and a heat recovery subsystem. Biogas produced from the AD subsystem is used in the engine generator to generate electricity and heat. Heat is recovered by a heat exchanger to produce hot water that can be used to provide thermophilic conditions. Electricity generated from the solar panels can be used to power ventilation fans or other electrical appliances within the AD facility. The operation process of the system includes food waste collection, pre-treatment of food waste, AD treatment, biogas collection, power generation, and heat recovery.

## Research Questions

The aim of this sub-project is to design and operate anaerobic digesters that treat organic wastes (mainly food waste) generated in cities like Singapore. The digesters will be designed based on the waste disposal patterns and environmental conditions in Singapore to provide an alternative to current food waste management practices (i.e., incineration and composting). The efficiency of anaerobic digestion (AD) process treating food waste is hypothesised to be enhanced via the following specific research questions:

- 1) Thermophilic AD processes
- 2) The coupling of solar panels to bioreactor to provide for the extra energy requirements for the operation of thermophilic AD processes
- 3) Addition of biological enhancement additives such as activated carbon and biochar to enhance efficiency of thermophilic AD processes.
- 4) Bio-augmentation of thermophilic microorganisms to reduce the time required to start up thermophilic digesters

## Methodologies

A mobile anaerobic bio-digester, housed in a 20-foot container, has been placed at Raffles Hall in National University of Singapore (NUS) since January 2018 and treats up to 200kg of food waste daily. The unit takes up two car lots and can be shifted to sites where food waste recycling is required. The mobile food waste treatment system is a compact and self-sustainable anaerobic digestion-based waste-to-energy system with high recovery rates of heat and electricity. The compact mobile food waste treatment system can be shifted to sites where food waste recycling is required. The bio-digester generates electricity and heat, which is used to power the digester, control computer, lights, engines, fans and pumps. The heat output is used to create hot water that is fed back to the jacket encasing the anaerobic biogas tank to maintain an optimal working temperature of either 35 or 50 degrees Celsius. Digestate from the bio-digester is treated before conversion into fertiliser that can be applied within NUS. The excess electrical energy generated is stored in four batteries, which are placed in a mobile phone and tablet charging station situated at the Raffles Hall canteen for complimentary use by students.

For more information, please visit: <https://www.create.edu.sg/about-create/research-centres/e2s2>