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(Far left) Dr Zhang Jingxin blending the food before it goes into the anaerobic digester.
(Left) Prof Tong Yen Wah shows student Gu Danning how the food-waste powered charging station in NUS' Raffles Hall works.
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Charging phones with food waste

University researchers develop system to convert leftover food into electricity

Samantha Boh

It may look like any other mobile phone-charging station, but this locker-like system at the corner of the National University of Singapore's Raffles Hall is actually powered by food waste.

Some 40kg of food, once thrown away each day by students staying at the hall, is now converted into electricity they can use to charge their mobile phones and tablets.

This has been made possible by a food waste digesting system – the brainchild of Associate Professor Tong Yen Wah of the NUS department of chemical and biomolecular engineering and research fellow Zhang Jingxin of the NUS Environmental Research Institute.

It was jointly developed by NUS and researchers from Shanghai Jiao Tong University.

Housed in a 6m mobile container in the hall's carpark, the core of the system is an anaerobic digester, which works like a biochemical stomach that breaks down organic matter in an environment devoid of oxygen.

"Using a specially formulated mix of anaerobic micro-organisms, the digester system breaks down food waste into biogas that is subsequently converted into heat and electrical energy," said Dr Zhang.

Food waste brought to the container is first blended and kept in a storage tank. A pump then pushes it into the anaerobic digester, where it is converted into biogas, and then electricity and heat.

A nutrient-rich substance is also left over from the anaerobic digestion process, which can be processed to produce liquid fertiliser.

The system, which will be ramped up to process about 200kg of food waste a day, also removes moisture and trace gases such as hydrogen sulphide that give food waste its unpleasant smell.

"And the entire system powers itself," said Prof Tong.

The heat generated is used to produce hot water that keeps the anaerobic digester tank at an optimum working temperature of about 50 deg C. Meanwhile, the electricity produced powers all the components in the system, including the pump, sensors, lights and fans.

Excess electricity is stored in batteries, which are used to power the mobile phone charging station.

The team said a tonne of food waste can generate between 200 kilowatt hours (kwh) to 400 kwh of electricity, enough to charge 13,000 to 26,000 phone batteries. The 40kg discarded by Raffles Hall can charge some 1,000 phones.

The amount of electricity produced, however, depends on the composition of the food waste.

"Waste high in carbohydrate, protein and fat content produces more biogas and, thus, more electricity," said Prof Tong.

The team is testing out another anaerobic digester, which can process 400kg of food waste a day, at the NUS Faculty of Science canteen.

Food waste is a growing problem in Singapore, with the amount generated rising by about 40 per cent over the past 10 years. It also accounts for about 10 per cent of the total waste generated here.

Last year, 809,800 tonnes of food was wasted, of which just 16 per cent was recycled.

"We are keen to see whether this model could work in Singapore's public residences. The anaerobic waste digester has the potential to help towns reduce waste and greenhouse gas emissions, as well as be more energy and resource efficient," said Prof Tong.

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