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10 October 2024

UCT sustainability project converts waste to energy and water resource

The University of Cape Town's (UCT) Centre for Bioprocess Engineering Research (CeBER) has devised a unique and innovative project that breaks down waste and converts it to an energy source for cooking or to produce water that can later be used to irrigate on-campus vegetable gardens.

The project is part of a campus-wide project to support the environmental sustainability goals of UCT's Vision 2030. The five-year long project includes leading research, feasibility studies and proof-of-concept living labs on campus.

Project leader Dr Thanos Kotsiopoulos said the project aims to expand the anaerobic digestion (AD) process. The AD is a four-stage biological process that uses anaerobic bacteria to breakdown waste.

"The project aims to address certain environmental challenges we face. These include increasing food waste volumes, the costs associated with disposing this waste, as well as the significant carbon and water footprints that emanate from landfill disposal," said Kotsiopoulos.

The waste is formed into a multi-product system that incorporates a range of useful stages, including using biogas, a renewable fuel that's produced when organic matter like food or animal waste is broken down by microorganisms in the absence of oxygen, as an energy source for cooking or alternative applications.

The nutrient-rich effluent stream is then channelled through an aeroponic system, also referred to as a vertical farm – the practice of growing plants in an air or mist environment without any substrate, to produce fit-for-purpose water. Solids generated through AD can also be used as fertiliser.

Kotsiopoulos said the constructed arrangements of the vertical farms have the potential to contribute to UCT's interior and exterior landscaping design while also functioning as prospective low-cost climate control arrays that offset building cooling requirements and electricity costs.

He said the purpose of the project is to use circular design thinking to produce renewable energy and bio-based products using food waste, and to develop and implement a campus-wide, integrated sustainable food waste management system to help facilitate a resource-efficient campus.

"All this is important because we currently face significant sustainability challenges like climate change, waste management and resource depletion. This project addresses these issues by promoting a closed-loop system where resources are efficiently used, where minimal waste is generated, and renewable energy is produced or offset. By using organic waste as a feedstock to produce biogas, the project demonstrates how we can decrease fossil fuel resilience and conserve water. This approach advocates for utilising available resources and reduces those environmental impacts associated with traditional practices," said Kotsiopoulos.

He said they have been able to validate the integrated system at lab scale, and successfully scale the project.

Kotsiopoulos said a sub-project devised by a group of fourth-year students involved developing a heat transfer model to simulate the energy balance across the green wall system.

"This model demonstrated that vertical green walls can significantly reduce energy usage to maintain a stable internal environment. Cornerstone to this project's success would be widespread adoption of the technology and to achieve collaborative change in the way that we view waste and its potential as a resource," he concluded.

Dr Thanos Kotsiopoulos Photo: Lerato Maduna

Story by Niémah Davids, UCT News

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Issued by: UCT Communication and Marketing Department

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