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Converting Food Waste to Energy with a Biodigester

GLOBAL IMPACT ARTICLE SERIES

Different types of biodigesters use different organic material, but the most common system uses animal waste from farms or material from wastewater treatment plants. These are typically the largest systems with significant waste streams that are continuously available. Some biodigesters can handle a mix of organic (e.g. food, animal waste, yard waste) and inorganic materials (e.g. plastics, recyclables).

A GLOBAL PROBLEM: WASTING FOOD & METHANE

Most organic waste, including food, is concentrated in economically wealthy countries. According to the U.S. Environmental Protection Agency (EPA), food waste is one of the least recovered waste materials, and when it gets to a landfill, its decomposition process releases methane, which contributes to global warming.

Climate change leaders often mention carbon dioxide much more often than methane. Although, over a 20-year period a single pound of methane traps as much heat as 72 pounds of carbon dioxide. As a result, capturing methane can significantly reduce global climate change.

The potential to convert food waste to usable energy caught the attention of several U-M Dow Sustainability Fellows. In response, Dow Fellows with expertise in law, policy, business, and natural resources formed a team to create a feasibility study analyzing the costs and benefits of building an on-campus anaerobic biodigester to reduce waste and generate energy. The team worked with and presented their findings to the U-M Office of Campus Sustainability (OCS). OCS leaders considered the team's analysis and recommendations and are in the process of facilitating partnerships with Environment, Health and Safety experts and other campus units.

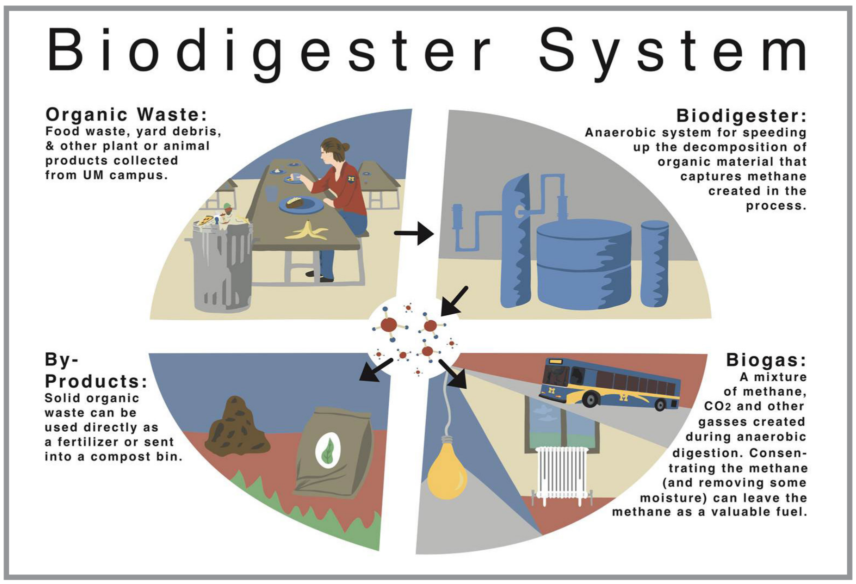
> *"Determining the best physical location for a biodigester and developing the necessary safety regulations is a challenge with a large biodigester unit," said Andrew Berki, Director, Office of Campus Sustainability... "We see the utilization of biodigester technology as an exciting approach to making progress on the institution's landfill waste reduction goal."*

The University of Michigan's (U-M) sustainability commitment includes goals to significantly reduce landfill waste and greenhouse gas emissions. While U-M is making progress on both fronts, there is room for improvement. For example:

- Following a 2012 trash sort, it was determined that approximately 2,500 tons of organic waste could potentially be converted to energy.
- In 2014, U-M sent close to 12,000 tons of waste to the landfill. That amount of waste could fill the U-M football field about 15-feet deep.
- In 2016, U-M generated approximately 431 tons of organic food waste from U-M Residence Halls, and 2,100 tons of other organic waste.
- Based on estimates from the Office of Campus Sustainability, an estimated 35 percent of the total (12,000 tons) of U-M waste currently going to landfills could be diverted to a compost/organic system.

HOW A BIODIGESTER WORKS

Anaerobic biodigester systems work by taking advantage of natural biological processes through a closed system. A tank without oxygen allows microbes to break down organic matter, like food waste. As waste is broken down, microbes release methane, carbon dioxide, and other gases. The system captures and stores gases to use as a valuable energy sources. According to the EPA, diverting 50% of food waste from landfills and capturing the methane could provide enough electricity to power 2.5 million homes. Also, the solid and liquid residue that remains at the end of the biological process is nutrient-rich, and can be used as either fertilizer or compost, depending on the raw materials used.



COSTS AND BENEFITS

The Dow Fellows team focused on analyzing the costs and benefits to the university of building an on-campus biodigester. The team used data from NATH Sustainable Solutions, a company that creates biodigester systems suitable for the scale of U-M's waste production, and created a detailed cost-benefit model for the university.

Converting food waste to energy would assist the university in its efforts to meet two of its more challenging campus sustainability goals:

1. Reducing the amount of waste sent to landfills by 40 percent; and
2. Reducing greenhouse gas emissions 25 percent below fiscal year 2006 levels, by 2025.

> *"The nonmonetary benefits are, I think, very significant," says Harry Wolberg, a Ford School of Public Policy student who worked on the project. "It could be a great opportunity for engineers and scientists — a lab for students."*

Achieving U-M's goals requires eliminating 5,300 tons of landfill waste and 170,000 metric tons of CO_2 equivalent per year. A new biodigester could be one way to achieve multiple goals. While a biodigester has numerous monetary costs and benefits to consider, addressing community awareness goals to enhance the sustainability culture on campus is also important.

This engineering solution has the potential to raise awareness about how waste can be converted to energy. Informed by the input of multiple industry experts and stakeholders, the team's results suggest an investment in biodigester technology could help further U-M's sustainability goals and improve the university's overall culture of sustainability (see additional recommendations below).

RECOMMENDATIONS

Collecting detailed data to improve the estimated amount of organic matter is one of the team's primary recommendations. U-M's relatively small amount of organic matter, and issues with scale and cost effectiveness, present barriers for the university to implement the technology. The limited data on university waste streams is also a challenge. "Baseline data is very important" for this project, says Micaela Battiste, project team member from the Ross School of Business and School for Environment and Sustainability, but "not much information actually existed."

Additional Recommendations

- Evaluate the significant waste stream coming from the hospital, as it is currently not quantified.
- Develop relationships with third-party waste management companies and interested stakeholders to a) take advantage of the expertise and b) create the foundations for trust and partnership that can smooth the road to creating a flexible, resilient waste management program.

U-M STUDENT TEAM MEMBERS

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- Seth Buchsbaum, Law School and School of Natural Resources and Environment
- Andrew Eberle, Law School
- Harry Wolberg, Ford School of Public Policy

U-M ADVISORS

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Made possible by The Dow Chemical Company Foundation, the Dow Sustainability Fellows Program at the University of Michigan supports full-time graduate students and postdoctoral scholars who are committed to finding interdisciplinary, actionable, and meaningful sustainability solutions on local-to-global scales. The program prepares future sustainability leaders to make a positive difference in organizations worldwide. We believe that diversity, equity, and inclusion are key to individual empowerment, and the advancement of sustainability knowledge, learning, and leadership.