Science Policy Outreach Task Force at Northwestern University

OVERVIEW ON HANDLING NON-RECYCLABLE MATERIALS

SPOTlight: Waste-to-energy is promising for biogenic waste but leads to air pollution with other types of waste, especially plastics. It is advantageous to emphasize upstream solutions related to source reduction, recycling, and composting.

How much waste is generated in the U.S., and where does it go?

- The majority of municipal solid waste (MSW), defined as waste from homes, institutions, and commercial sources consisting of everyday items, goes to landfills, while only 25% is recycled [1].
- The total generation of MSW in 2017 amounted to 4.51 pounds per person per day, the largest among industrialized nations [1,2].

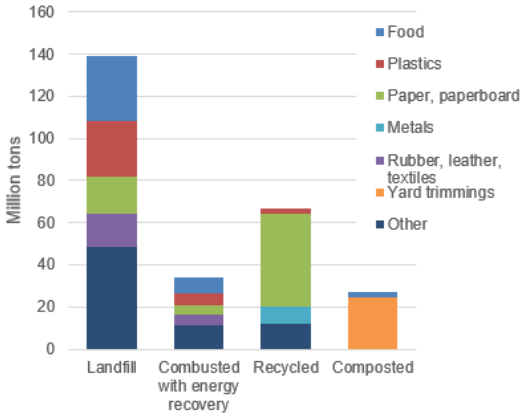

Fig. 1 Total MSW generation in 2017 [1]

What are the options for handling non-recyclable materials?

- The preferred method for waste management is source reduction (preventing waste before it is created through better design and use of materials) and reuse, followed by recycling and composting, then energy recovery, and finally treatment and disposal [1]. The concept of a circular economy, which promotes the minimization of waste from design to production to use, is a popular area for policy development [3].
- Energy recovery from combusting MSW, also known as waste-to-energy, can produce heat, electricity, or fuel through various processes, including combustion, pyrolysis (thermal process without oxygen), and anaerobic digestion (biogenic waste separation without oxygen) [4]. In 2018, 68 U.S. plants generated 14 billion kWh of electricity (0.3% of total U.S. electricity), mostly from biogenic waste and plastics [5].
- Similarly, the EPA's Landfill Methane Outreach Program (LMOP) is a voluntary program that encourages the recovery and use of biogas generated from organic MSW in landfills to produce electricity or renewable natural gas (RNG). IL has 18 operational projects (17 for electricity, 1 RNG) in the LMOP database [6].

Environmental and economic impacts of waste handling options

- MSW landfills are the 3rd largest source of human-related methane emissions, comprising 16% of these emissions in the U.S. in 2016 [2]. Methane is a much more potent greenhouse gas (GHG) than CO_2.
- Waste-to-energy facilities can release air pollutants, including nitrogen oxides, sulfur dioxides (both GHGs), particulate matter, lead, mercury, and dioxins, many of which come from incinerating plastics [7].
- 80% of waste-to-energy facilities are situated in environmental justice communities, defined as areas where more than 25% of residents are low-income, people of color, or both [7].
- A new waste-to-energy facility typically requires at least 100 million USD to finance the construction; average lifetime is 30 years, and most facilities today are >25 years old [4].
- The primary revenue source is from tipping fees from waste drop off, and secondly from electricity generation, where a typical facility generates 550 kilowatt hours (kWh) of energy per ton of waste. At an average price of 4 cents per kWh, revenues per ton of solid waste are often 20 to 30 USD [4,7].

Why is this relevant now, and what is currently being researched and tested in other places?

- In 2018, China banned the import of most plastics and other materials that went to their recycling processors. As a result, communities in the U.S. have reduced recycling or cut their programs entirely [8].
- The city of Toronto collects organic waste from households to create RNG [9]. In Denmark, 18 percent of gas consumption came from RNG produced from biogas by its anaerobic digesters [8].
- The DOE identified key R&D strategies to improve waste-to-energy facilities, such as reducing feedstock variability and researching more pathways for biogas to fuels [10]. Additionally, there are many research efforts focused on the recyclability of plastics and conversion of plastics to fuels or new plastics [11,12].

References and additional resources

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[12] Alexander H. Tullo. "Should plastics be a source of energy?" *Chemical & Engineering News.* (2018). https://cen.acs.org/environment/sustainability/Should-plastics-source-energy/96/i38

EPA created the Waste Reduction Model (WARM) to help solid waste planners and organizations track and voluntarily report greenhouse gas (GHG) emissions reductions, energy savings and economic impacts from six different waste management practices including source reduction, recycling, composting, anaerobic digestion, combustion and landfilling.

WARM can be used by state and local governments, solid waste planners, students, small businesses, and other organizations interested in the GHG, energy and economic impacts from materials management decisions.

https://www.epa.gov/warm/basic-information-about-waste-reduction-model-warm

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