Systems for the Management and Disposal of Food Waste

Life Cycle Assessment

JULY, 2011

SUMMARY

BACKGROUND

According to the US EPA, food waste is the single largest component of municipal solid waste sent to landfills[1] and many communities worldwide are focusing efforts to divert this organic waste.[2,3] Much of the effort is intended to reduce greenhouse gas emissions, particularly at landfills. Landfills are considered the third largest source of methane,[4] a gas 21 times more potent than carbon dioxide,[5] so various alternatives are being explored. A common yet overlooked means of diversion includes the use of food waste disposers to send food scraps to wastewater treatment plants for processing. Approximately 50% of all US homes have an installed disposer[6].

For decades, wastewater treatment plants protected public health by providing sanitary management of human waste but more recently, these plants have come to be recognized as "resource centers" – producers of clean water, fertilizer and energy. Because food scraps average 70% water, diverting them to wastewater treatment plants is a proven disposal option. InSinkErator,® the Wisconsin-based manufacturer of food waste disposers, sought to better understand the environmental impacts of these appliances using various types of wastewater treatment in comparison to other methods of management such as landfilling and composting. InSinkErator is a division of Emerson Electric Co.

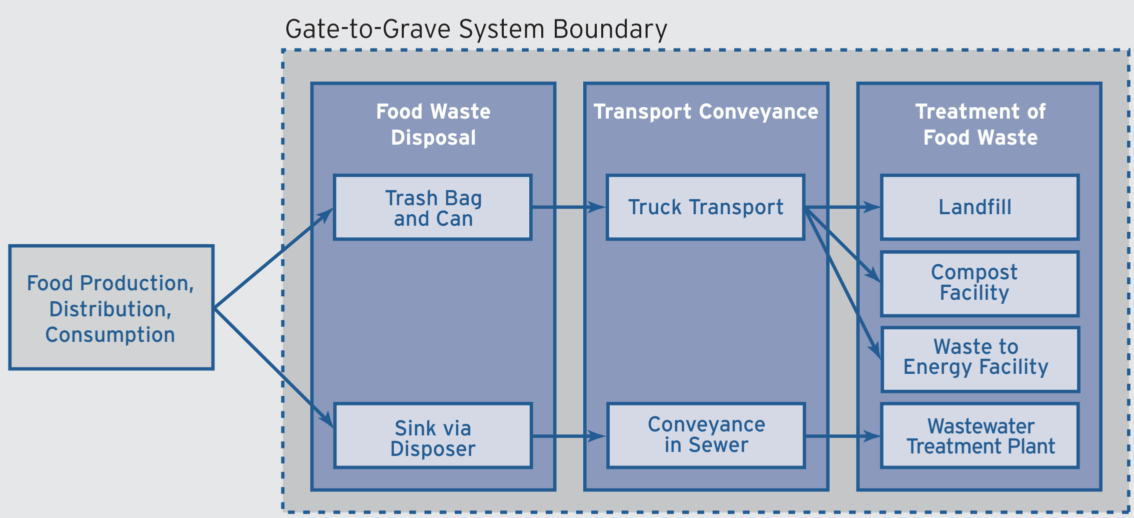
GOAL

The Goal of the Life Cycle Assessment (LCA) study was to understand the environmental impact of food waste disposal pathways in order to help policy makers and others assess the role of food waste disposers in their waste management programs.

THE REPORT

Camp Dresser & McKee (CDM) conducted the initial analysis used by PE International, Inc. to produce a life cycle assessment and report. A thorough and independent review of the LCA was undertaken by a panel of third-party experts.

The study was conducted in accordance with the ISO 14040 series of standards to represent a gate-to-grave comparative assessment of multiple food waste management systems.



1 "Basic Information About Food Waste." US EPA. April 29, 2011. http://www.epa.gov/osw/conserve/materials/organics/food/fd-basic.htm

2 European Commission. 1999. "Landfill of Waste." [Internet, WWW]. Available: European Commission; http://ec.europa.eu/environment/waste/landfilliatindex.htm. [Accessed; 2 December 2010.]

3 California Green Solutions. 2006. [Internet, WWW]. Available: Green Solutions; http://www.californiagreensolutions.com/cgi-bin/gt/tpl.h,content=297. [Accessed; 2 December 2010.]

4 US EPA. 2007. "Inventory of US Greenhouse Gas Emissions and Sinks: 1990 – 2005."

5 Intergovernmental Panel on Climate Change. 1996. "Climate Change 1995: The Science of Climate Change."

6 United States Census Bureau. 2010. "American Housing Survey." [Internet, WWW]. Available: U.S. Census Bureau; http://www.census.gov/hhes/www/housing/ahs/ahs09/1-4.xls [Accessed; 10 November 2010.]

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SCOPE

Twelve end-of-life disposal options were modeled to represent the majority of food waste pathways in the United States including:

- 8 wastewater treatment plant systems
- 1 incineration system
- 2 landfill systems
- 1 composting system

The assessment considered the impacts from manufacturing, packaging, distribution, and use of a food waste disposer over its 10-year life, and disposal at end-of-life. These included:

- Manufacturing, including raw materials, energy, emissions and wastes
- Raw materials used for product packaging
- Warehouse operations and shipping of product
- Consumption of water and power to operate the disposer
- End-of-life disposition of the disposer in a landfill

For the landfill, waste-to-energy and composting systems, the gate-to grave impacts were considered for the waste receptacle and trash bag.

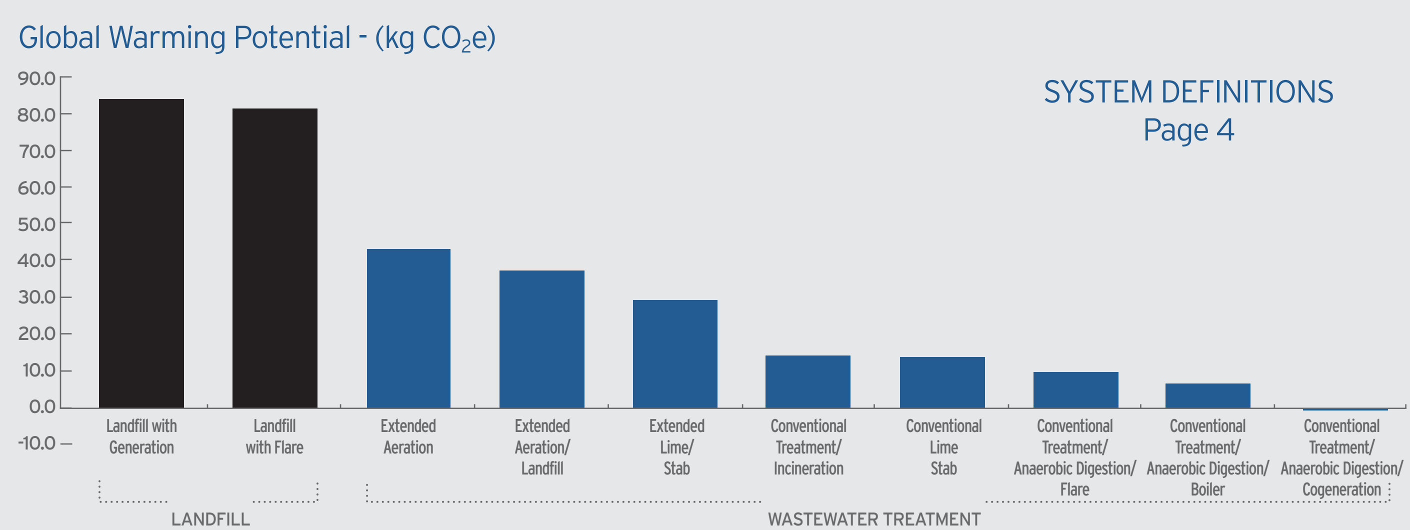
Using a functional unit of 100 kg* of food waste to represent an average amount of household waste disposed of in a year, the scenarios were evaluated for potential environmental impacts according to ISO protocol including:

- **Global warming:** change in the earth's climate caused by the build-up of chemicals that trap heat from reflected sunlight that would have otherwise passed out of the earth's atmosphere.
- **Eutrophication:** the process of excessive vegetative growth occurring in aquatic environments as a result of the high concentration of nutrients.
- **Acidification :** increase in the acidity (hydrogen ion concentration) of water and soil systems.
- **Smog formation:** the creation of air pollution resulting from interaction of sunlight with certain chemicals in the atmosphere.
- **Primary energy demand:** a measure of the total amount of primary energy associated with the product and processes within the life cycle assessment boundaries.

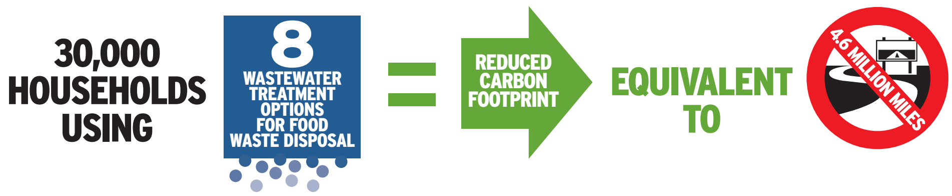
$$* \quad \frac{\text{0.21 LBS FOOD WASTE}}{\text{PERSON DAY}} \times \frac{\text{2.6 PERSONS}}{\text{HOUSEHOLD}} \times \frac{\text{365 DAYS}}{\text{YEAR}} \times \frac{\text{kg}}{\text{2.2046 LB}} = \frac{\text{97 kg}}{\text{YEAR}}$$

MAJOR FINDINGS

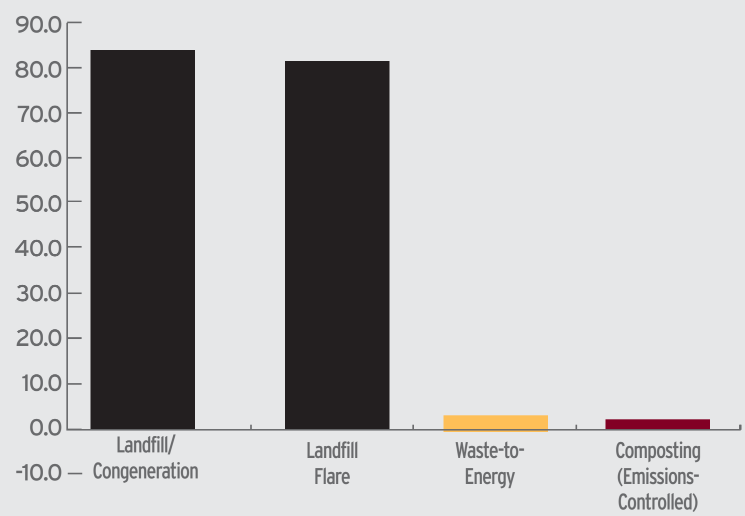
Using a disposer in conjunction with any of the eight wastewater treatment systems results in lower global warming potential than both landfilling options.



For a community of 30,000 households, using any of the eight wastewater treatment options to dispose of food waste instead of landfilling on average would reduce the carbon footprint by 1.9 million kg, the equivalent of not driving 4.6 million miles.

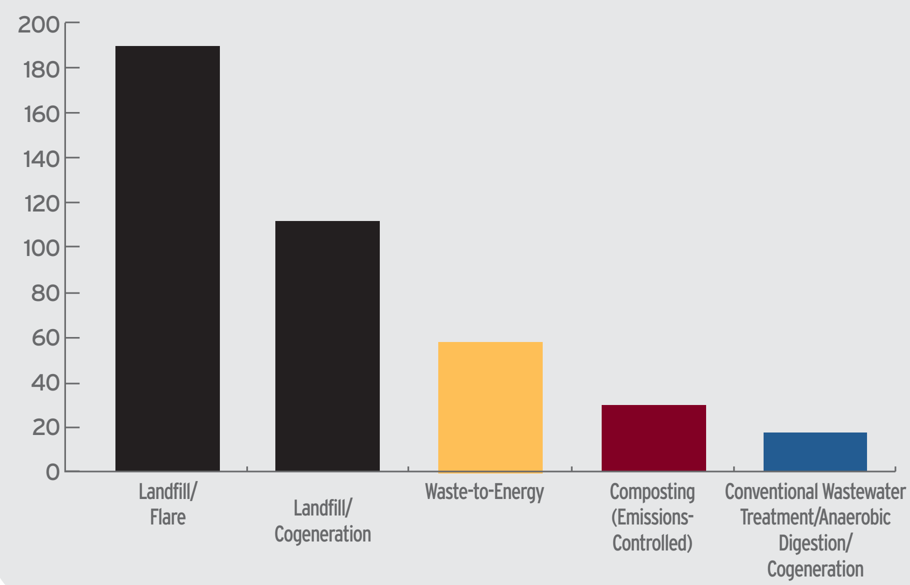


Global Warming Potential - (kg CO_2e)



Sophisticated emissions-controlled composting and incineration also result in lower global warming potential than landfilling.

Primary Energy Demand - Megajoule (MJ)



Using a disposer in combination with advanced wastewater treatment results in the lowest primary energy demand.

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DEFINITIONS

Composting (Emissions-Controlled) - Centralized membrane covered aerated static pile composting technology

Conventional Treatment/Anaerobic Digestion/Boiler - Conventional activated sludge process with anaerobic digestion, biogas used in boilers, and biosolids land applied

Conventional Treatment/Anaerobic Digestion/Cogeneration - Conventional activated sludge process with anaerobic digestion, biogas used for cogeneration, and biosolids land applied

Conventional Treatment/Anaerobic Digestion/Flare - Conventional activated sludge process with anaerobic digestion, biogas flared, and biosolids land applied

Conventional Treatment/Incineration - Conventional activated sludge process with incineration of biosolids

Conventional/Lime Stab - Conventional activated sludge process with lime stabilization, and land application of biosolids

Extended Aeration - Extended aeration sludge process with aerobic digestion, and biosolids land applied

Extended Aeration/Landfill - Extended aeration sludge process with aerobic digestion, and biosolids landfilled

Extended/Lime Stab - Extended aeration sludge process with lime stabilization, and land application of biosolids

Landfill with Generation - Landfill where biogas is used to generate electricity

Landfill with Flare - Landfill where biogas is flared

Waste-to Energy - Mass burn municipal solid waste facility with a reciprocating gate furnace and an integral heat recovery boiler

Megajoule (MJ) - One million (10^6) joules; a joule is a unit of energy

For More Information

The report can provide important information to help community stakeholders understand and assess impacts, risks and opportunities associated with various organic waste management practices and the impact of the utilization of food waste disposers.

For a copy of this document, the Executive Summary or the complete *Life Cycle Assessment of Systems for the Management and Disposal of Food Waste* report, please visit the InSinkErator® web site at www.insinkerator.com/lifecycleassessment

Or write to us at the address below.

Life Cycle Assessment Inquiry
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Headquartered in Racine, WI, InSinkErator, a division of Emerson, is the world's largest manufacturer of food waste disposers and instant hot water dispensers. For more information about InSinkErator visit www.insinkerator.com

Emerson, based in St. Louis, MO, is a global leader in bringing technology and engineering together to provide innovative solutions for customers in industrial, commercial and consumer markets through its network power, process management, industrial automation, climate technologies, and appliance and tools businesses. For more information, visit www.Emerson.com

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