United States Environmental Protection Agency

EPA Tools and Resources Webinar: Food Waste

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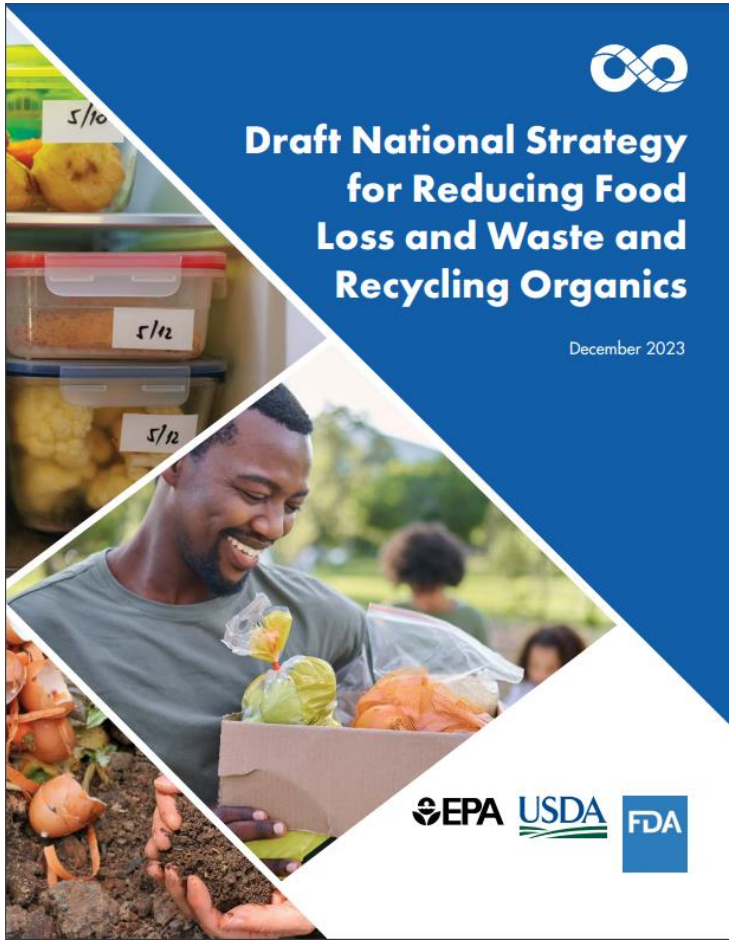
U.S. EPA Office of Research and Development

January 17, 2024

Draft National Strategy for Reducing Food Loss and Waste and Recycling Organics



https://www.epa.gov/circulareconomy/draft-national-strategy-reducing-food-loss-and-waste-and-recycling-organics

EPA, USDA and FDA are seeking input by February 3, 2024

BACKGROUND

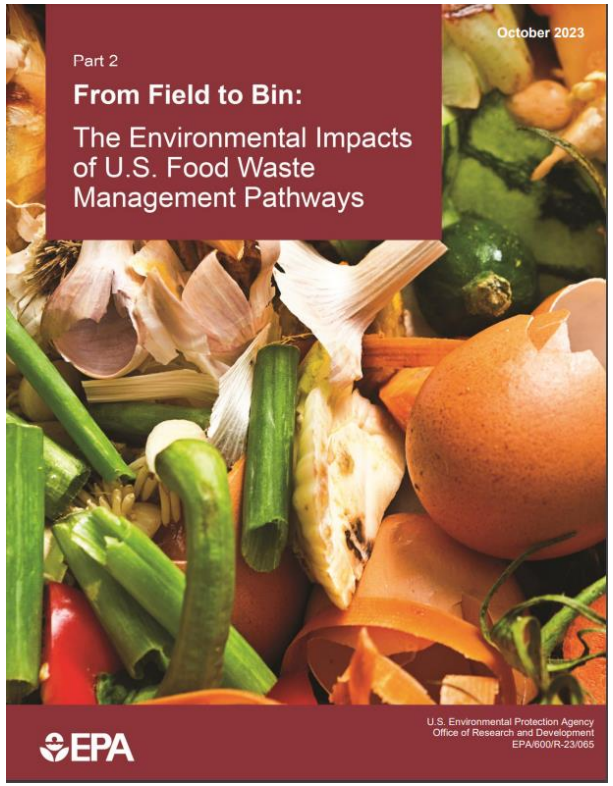
The U.S. wastes more than 1/3 of its food supply.

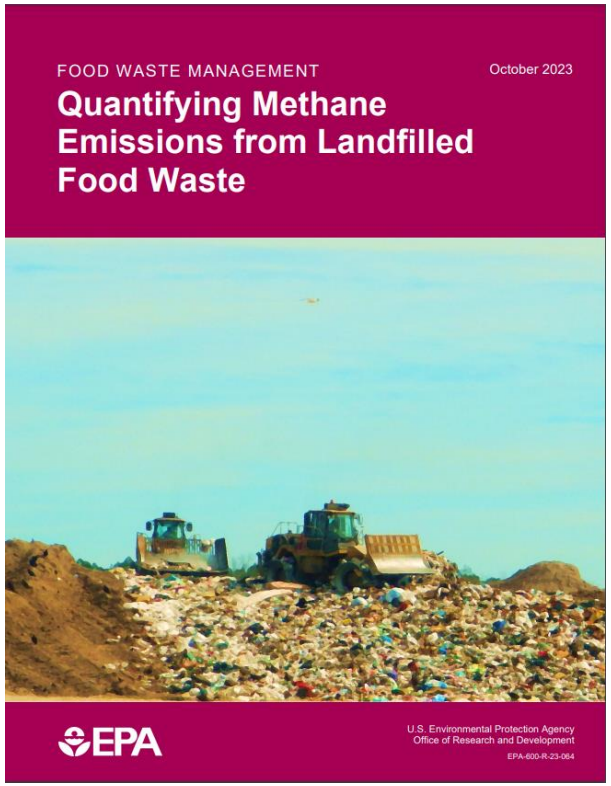
Food waste occurs at all stages of the supply chain: production, processing, distribution, retailers, food service, and homes.

Food that is ultimately wasted results in a "waste" of resources—including agricultural land, water, pesticides, fertilizers, and energy—and the generation of environmental impacts—including greenhouse gas emissions and climate change, consumption and degradation of freshwater resources, loss of biodiversity and ecosystem services, and degradation of soil quality and air quality.

In 2021, EPA released estimates of the environmental impact of food waste up to the point at which it is wasted. For more information, please visit: https://www.epa.gov/land-research/farm-kitchen-environmental-impacts-us-food-waste

Today we will focus on pathways for recycling and disposal of food waste.

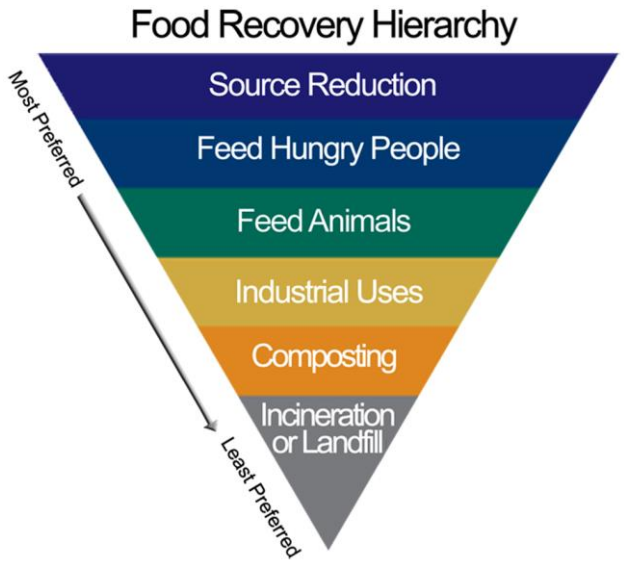




TWO NEW U.S. EPA WASTED FOOD REPORTS

Updating EPA's Food Recovery Hierarchy

New report evaluates 11 common wasted food pathways:



- Source Reduction
- Donation
- Upcycling
- Anaerobic Digestion
- Animal Feed
- Composting
- Controlled Combustion (Incineration)
- Land Application
- Landfill
- Sewer/Wastewater Treatment ("Down the Drain")
- Unharvested/Plowed In

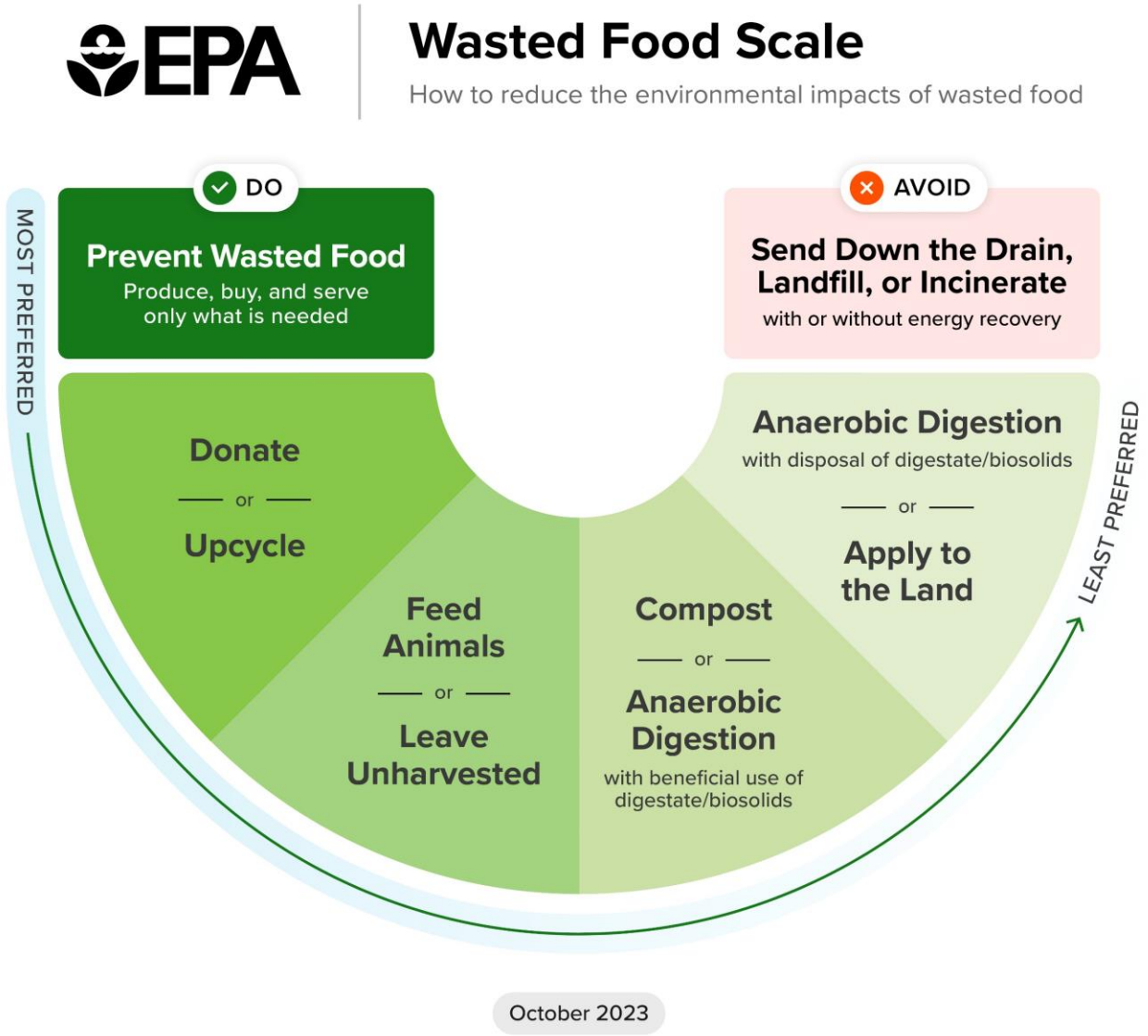
Pathways noted in orange were not included in the EPA Food Recovery Hierarchy developed in 1990s (shown above).

Life Cycle Assessment

- Greenhouse gas (GHG) emissions
- Soil carbon sequestration
- Energy demand
- Acidification
- Particulate matter formation
- Human toxicity
- Ecotoxicity
- Eutrophication
- Water consumption
- Land occupation
- Soil health

Circularity Assessment

- Waste prevention
- Value
- Purity
- Regeneration



The Wasted Food Scale replaces the Food Recovery Hierarchy.

Quantifying Landfill Methane Emissions from Wasted Food

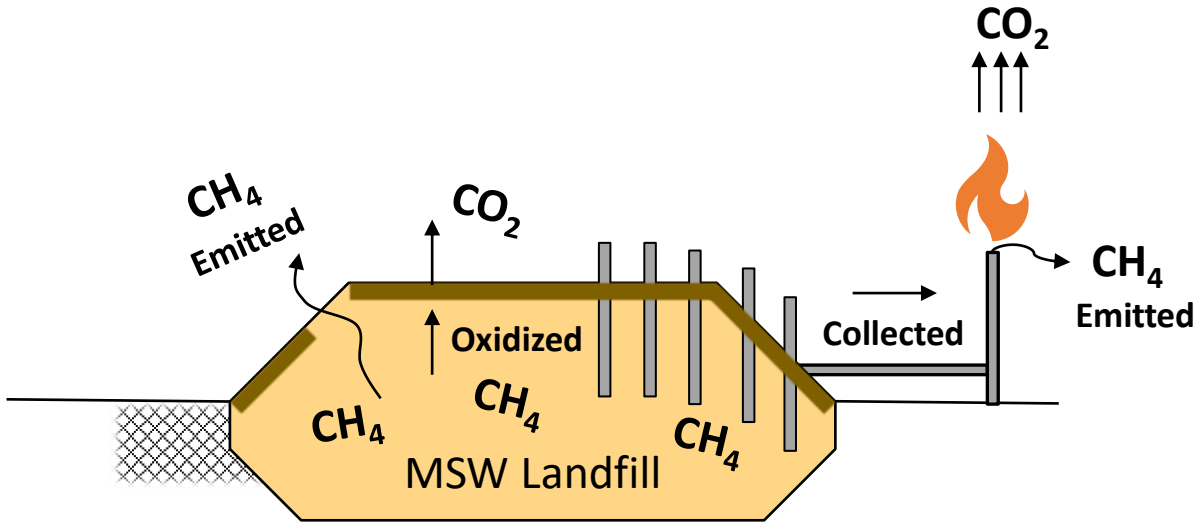
- Methane is a powerful GHG.
- Municipal solid waste (MSW) landfills are the 3rd largest source of methane emissions from human activities in the U.S.
  - Food waste is a large part of the MSW stream that is landfilled.
  - Organic waste (such as food waste) breaks down.
  - Microbes consume organic matter and make methane.
- Landfill methane may be captured by landfill gas collection systems or emitted to the atmosphere (i.e., fugitive emissions).
- In 2021, the White House released the ***U.S. Methane Emissions Reduction Action Plan*** committing to reduce methane emissions from large landfills and reduce food waste in landfills.
- We know food waste generates methane in landfills
  - How much?
- **No peer-reviewed estimate of national landfill methane emissions from food waste existed.**

Landfill Emissions: Model Approach

Methane (CH_4) is the most important GHG to model from MSW landfills

Carbon dioxide (CO_2) from non-fossil sources isn't considered for GHG emissions

$$CH_4 \text{ Emitted} = \text{Generated} - \text{Collected} - \text{Oxidized}$$



Methodology

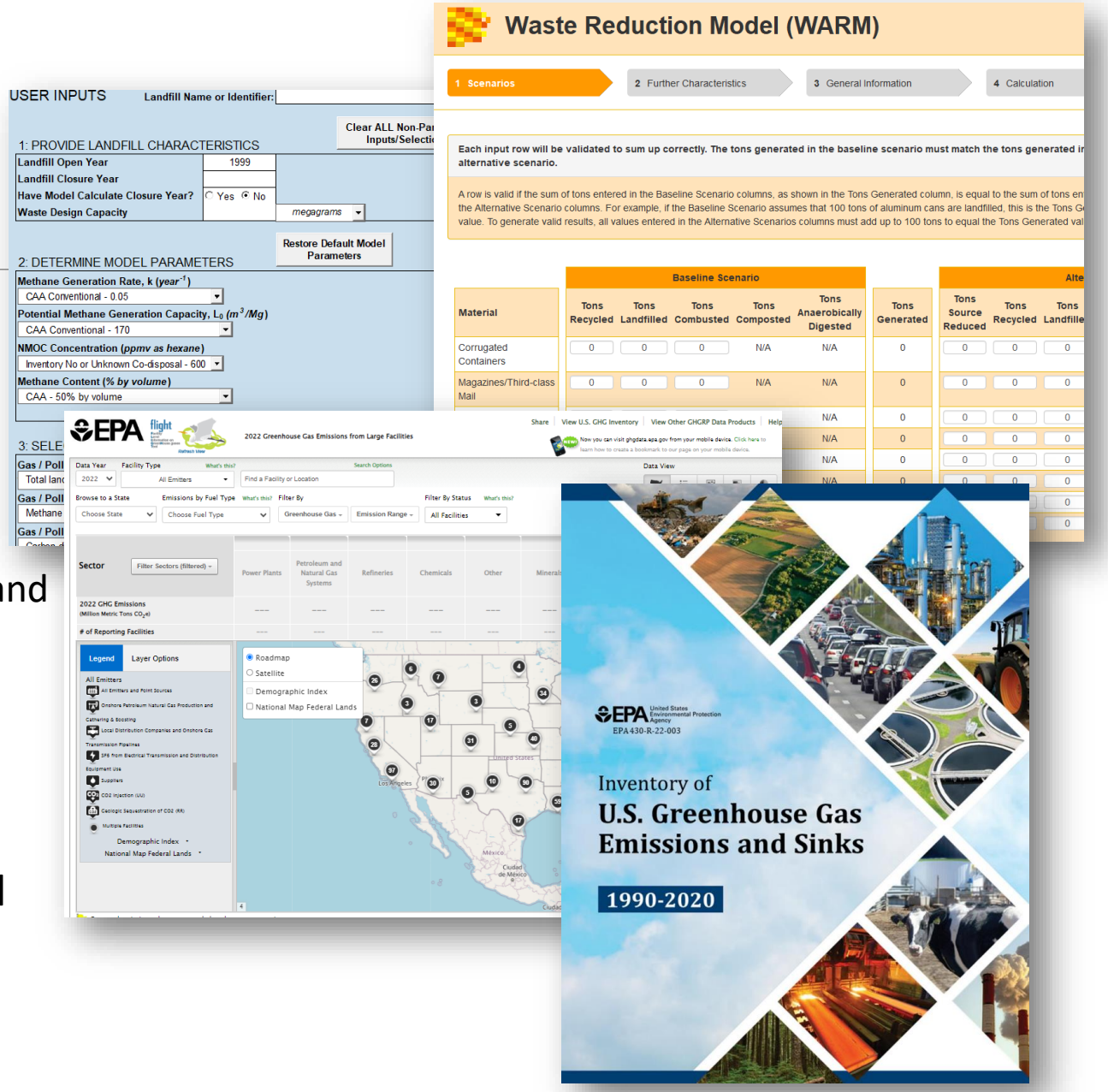
Used EPA tool

- Landfill Gas Emission Model (LandGEM)

Used existing EPA data

- Food waste characteristics - Waste Reduction Model (WARM)
- Waste composition - Facts and Figures: 2018 and previous years
- Annual tons landfilled - EPA's GHG Reporting Program (GHGRP)
- Landfill characteristics - Landfill Methane Outreach Program (LMOP)

Compared to landfill emissions in the annual GHG Inventory (US EPA, 2022)



Model Parameter: Decay Rates

- Waste Reduction Model (WARM) v15
  - Comparing GHG impacts of waste management programs
  - Used their default methane potential and decay rate for food

MSW Component	Decay rate constant (yr^{-1})	Number of years at which point 1/2 the carbon has been degraded (yr)
Branches (Yard)	0.02	35
Cardboard	0.03	23
Copy Paper	0.04	17
Dimensional Lumber	0.11	6.3
Food Waste	0.19	3.7
Leaves (Yard)	0.22	3.2
Grass (Yard)	0.39	1.8

Model Assumptions: Gas Collection Efficiency

- Landfill operators have up to 5 years from burial to install gas collection equipment
- More recent practices, some operators are installing gas collection equipment sooner
  - Not the case in 1990s, early 2000s
- Waste Age ≠ Landfill Age

WARM default gas collection scenario

Landfill Gas Collection Efficiency	Waste Age (Years)
0%	0-4
50%	5-9
75%	10-14
82.5%	15-0
90%	Final Cover

Source: US EPA (2020)

Food CH_4 emissions compared to all emissions from landfills

From 1990 to 2020 total MSW landfill methane emissions decreased by 43%

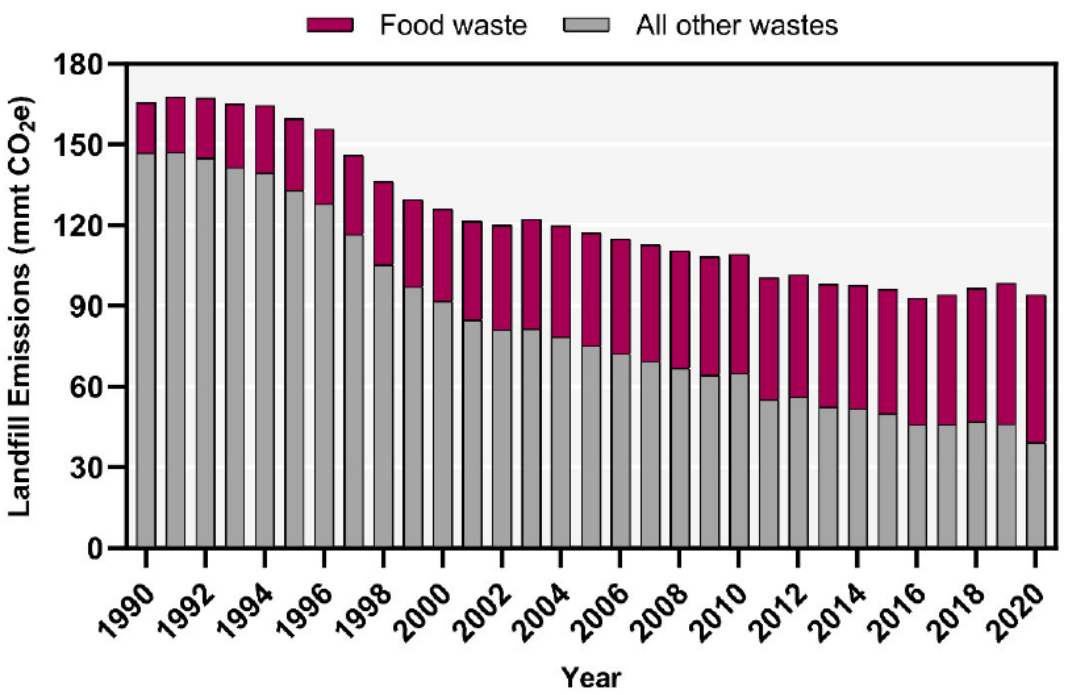
- Expansion of gas collection systems at landfills
- Operators installing more systems, sooner
- Particularly at later points of the landfill lifetime

Methane emissions from landfilled food waste increased steadily by 295%

- Annual increases in landfilled MSW, including food

Food waste emissions occur earlier in disposal timeline

Landfill operators collecting more gas later in the timeline



Source: Krause et al. (2023)

Comparing Landfill CH_4 Generation to Emissions

Contributions	Fugitive Methane Emissions			Methane Generation		
	mmt CO_2e (100 yr GWP)	% Total	mmt CO_2e (20 yr GWP)	mmt CO_2e (100 yr GWP)	% Total	mmt CO_2e (20 yr GWP)
Total	94	100%	309	305	100%	1,000
Food waste	55	59%	180	89	29%	293
Other Waste	39	41%	129	216	71%	707

mmt = million metric tons. CO2e = carbon dioxide equivalents. GWP = Global warming potential. CH4 100-year GWP = 25. CH4 20-year GWP = 82.
Sources: Krause et al. (2023) and U.S. EPA (2022)

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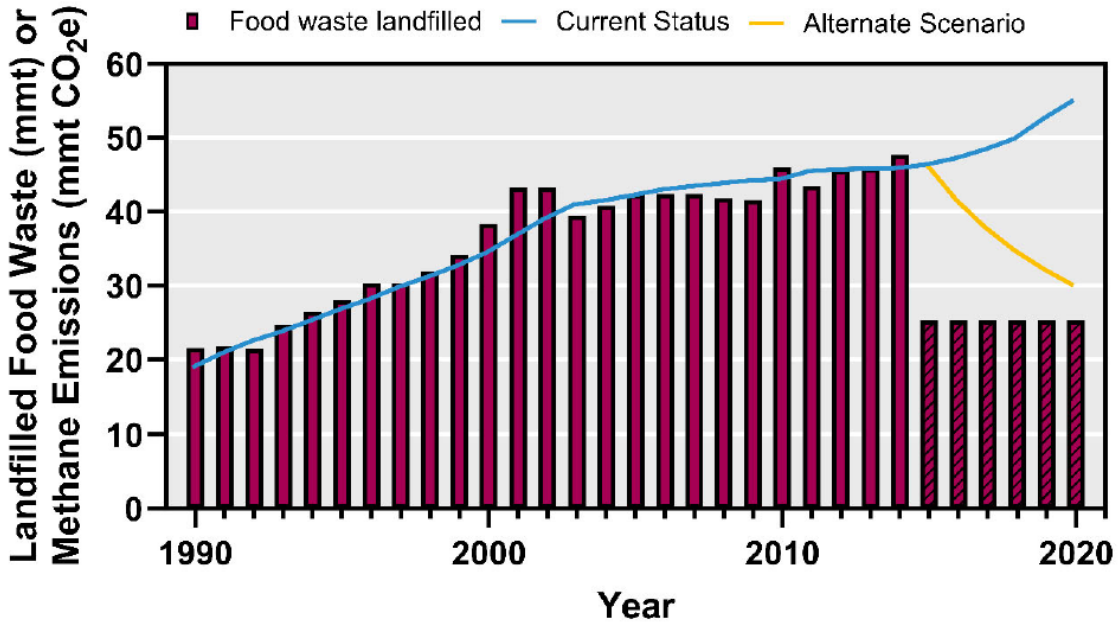
Food generates about 30% of methane generated by landfills but makes up about 60% of its emissions.

A hypothetical scenario of food diversion assuming food waste is cut in half

- Tonnage of food waste landfilled (red columns)
  - Assume landfilled food waste was cut in half in 2015 and held constant (hatch pattern).
- Methane emissions (blue line)
- The yellow line reflects the impact to methane emissions



Source: Krause et al. (2023)

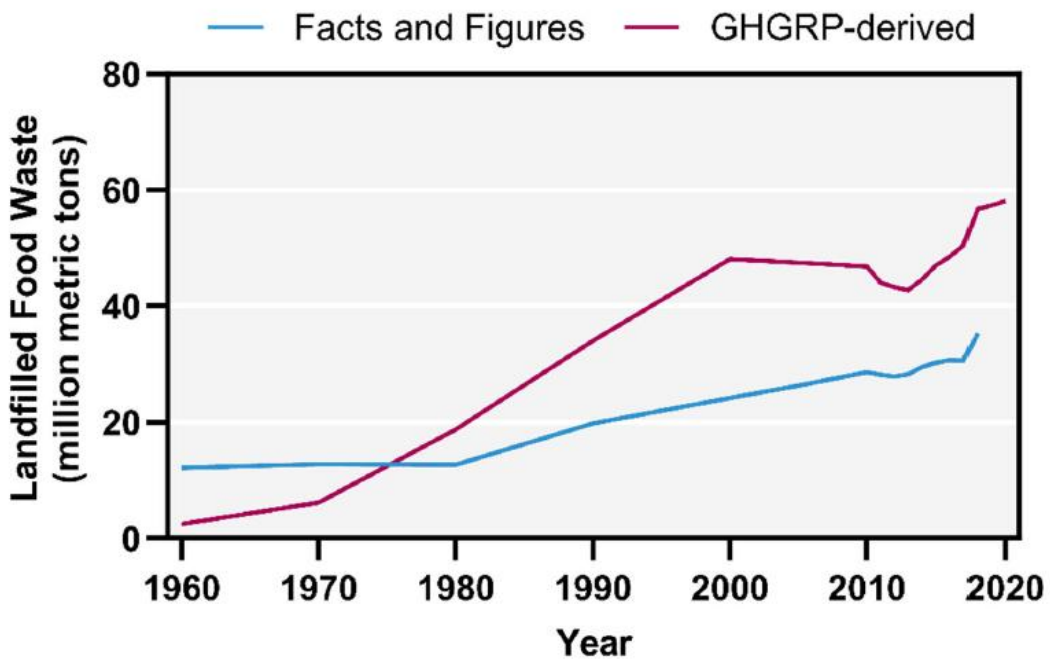
Summary

- EPA datasets and tools were used to model food waste methane emissions
- We compared our results to total MSW landfill emissions reported in the annual GHG Inventory
- 58% emissions are from landfilled food waste
- 61% of methane generated from food is not captured by landfill gas collection systems
- For every **1,000 tons (907 metric tons) of food waste landfilled,** 34 metric tons of fugitive methane emissions (**838 mt CO_2e**) **are released**

Source: Krause et al. (2023)

Future Work

- Quantifying uncertainty in the current model approach
- Updating landfilled MSW quantities based on publicly-available state data
- Reducing uncertainty into the methane collection values
- Replacing or improving models with measurements
  - Other measurement and modeling work to examine impacts to/from other waste infrastructure (e.g., compost facilities)



Source: Krause et al. (2023)

The Bigger Picture

Food waste decays relatively quickly

- Most emissions occur before gas collection systems are installed

Methane emissions from some MSW landfills are decreasing due to gas collection improvements

- Operators installing more systems
- Gas-to-energy systems becoming more popular

Diverting food waste from landfills → anaerobic digesters, compost systems

- Reduces landfill emissions but will have other facility's emissions and from transport

Reducing wasted food upstream (at farms or grocery stores) would have much larger environmental benefits

- Significant resource inputs (land, water, fertilizer, etc.) used to produce and deliver food to consumers

Contacts

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For more information, the reports are available online at EPA's Food Waste Research site:
https://www.epa.gov/land-research/food-waste-research