EPA Tools and Resources Webinar: U.S. EPA Food Waste Research

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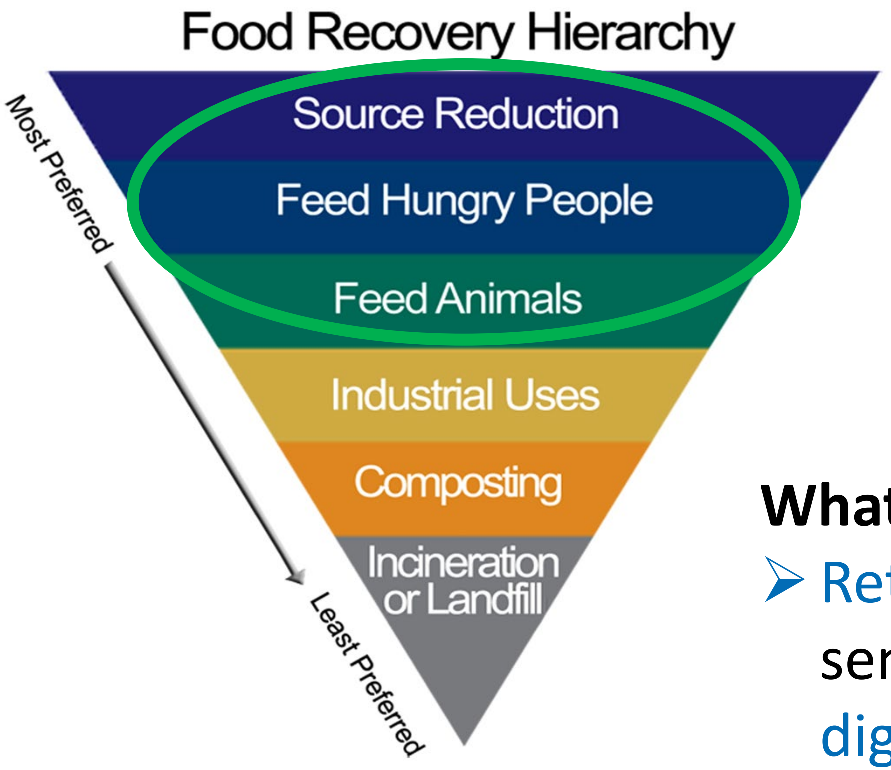
Why Food Waste?

- Wastes Resources
- Impacts Environment
- Meet Commitment
- Meet Stakeholder Needs

U.S. Goal:
Halve Food Loss and Waste by 2030



EPA has aligned the U.S. 2030 goal with the UN Sustainable Development Goal Target 12.3 and EPA's Food Recovery Hierarchy to encourage prevention and keep food in the human food supply chain.

What are we aiming to cut in half by 2030?

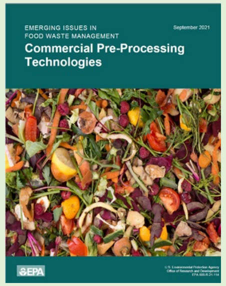
- Retail, food service, and household food waste that is being sent to: Landfill, Controlled combustion, Sewer, Co/anaerobic digestion, Compost/aerobic digestion, and Land application.

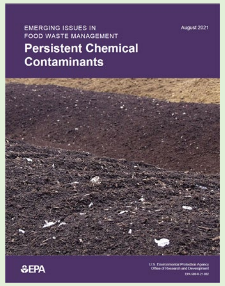
EPA Food Waste Strategy

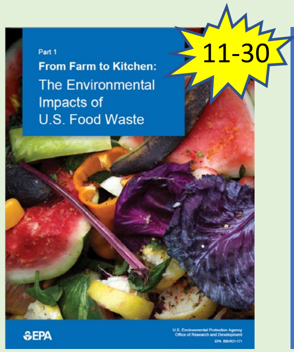
- Next year, EPA will release a strategy to achieve the 2030 goal.
- Look out for opportunities in early 2022 to provide input on how we can cut food waste in half by focusing on prevention and recycling any remaining food waste.

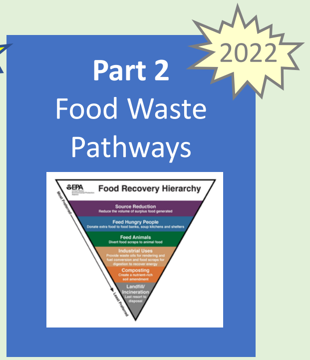
EPA Food Waste Research Portfolio

Synthesizing the “State of the Science” and Identifying Future Research Needs







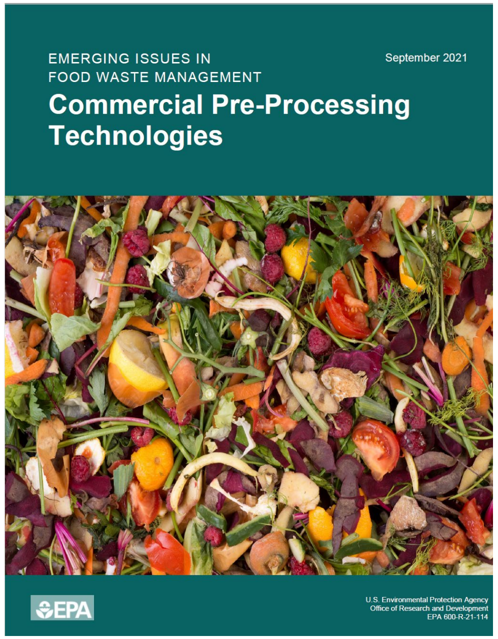


Original Research

- Microplastics from De-Packaging Technologies
- Output and Downstream Impact of Kitchen Digesters
- LCA of Food Waste Management Strategies with USEEIO model

Environmental Indicators

Grant Solicitation: Research to Reduce U.S. Consumer Food Waste



Commercial Food Waste Pre-Processing Technologies

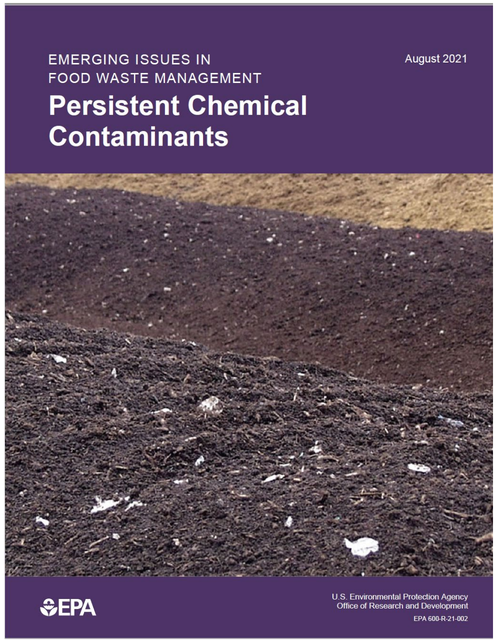
Do pre-processing technologies enable or increase recycling of food waste and/or reduce the overall environmental footprint of food waste?

- The life cycle environmental value of these technologies is unclear. EPA could not conclude whether pre-processing is better environmentally than simply hauling unprocessed food waste directly to the intended destination (for recycling or disposal).
- All these technologies require separation of food waste from other waste streams, which is an important first step toward recycling.
- Grinders and biodigesters may simply shift burden of food waste management from landfills to sewage systems and wastewater treatment plants (with potential for fugitive methane emissions, increased energy use, and operational problems).
- Pulpers and dehydrators reduce the volume and weight of food waste, lowering hauling-related fuel use and GHG emissions.
- Soil amendments created by dehydrators and aerobic in-vessel units are not traditional compost and require further curing and/or processing.
- The use of pre-processing technologies may allow for compliance with organic waste ban thresholds without net environmental benefit.

Related EPA/ORD research:
Biodigesters' environmental impact (in partnership with NYC, who has proposed ban)

Potential future research:
Quantify fugitive methane emissions and loss of biogas potential from food traveling through sewer to anaerobic digesters at wastewater treatment plants

PFAS Contamination of Food Waste Streams



What is the contribution of food waste streams to persistent chemicals in compost? What are the associated risks to human health and environment of applying food waste compost to land?

- Food waste streams are a substantial source of per- and polyfluoroalkyl substances (PFAS) contamination in composts and digestates but are not a major source of persistent herbicides in compost.
- Limited data reports PFAS concentrations in range of 0.11 to 1 µg/kg in food waste samples from commercial and residential sources. Food contact materials (<1 to 485 µg/kg) may contribute more to PFAS levels than food itself (generally <10 µg/kg).
- Composts from mixed feedstocks showed total PFAS levels ranging from 2.3 to 75 µg/kg, with levels in composts made from biosolids > food waste > green and other organic waste.
- PFAS levels in composts with compostable food packaging > those without.
- Full risk assessments are not available; however, concerns about PFAS contamination can affect marketability and value of food waste compost and the frequency of food waste composting.

Potential future research:

Gather new field data on PFAS species/concentrations in food waste streams to assess effect of recent voluntary and state/local regulatory actions

Characterize risk to human health and environment of applying compost made from PFAS-contaminated food waste to soil – and compare to risks from other sources of PFAS

Related EPA/ORD research:
Assess effect of depackaging equipment on the quantity and size of plastic particles in food waste streams

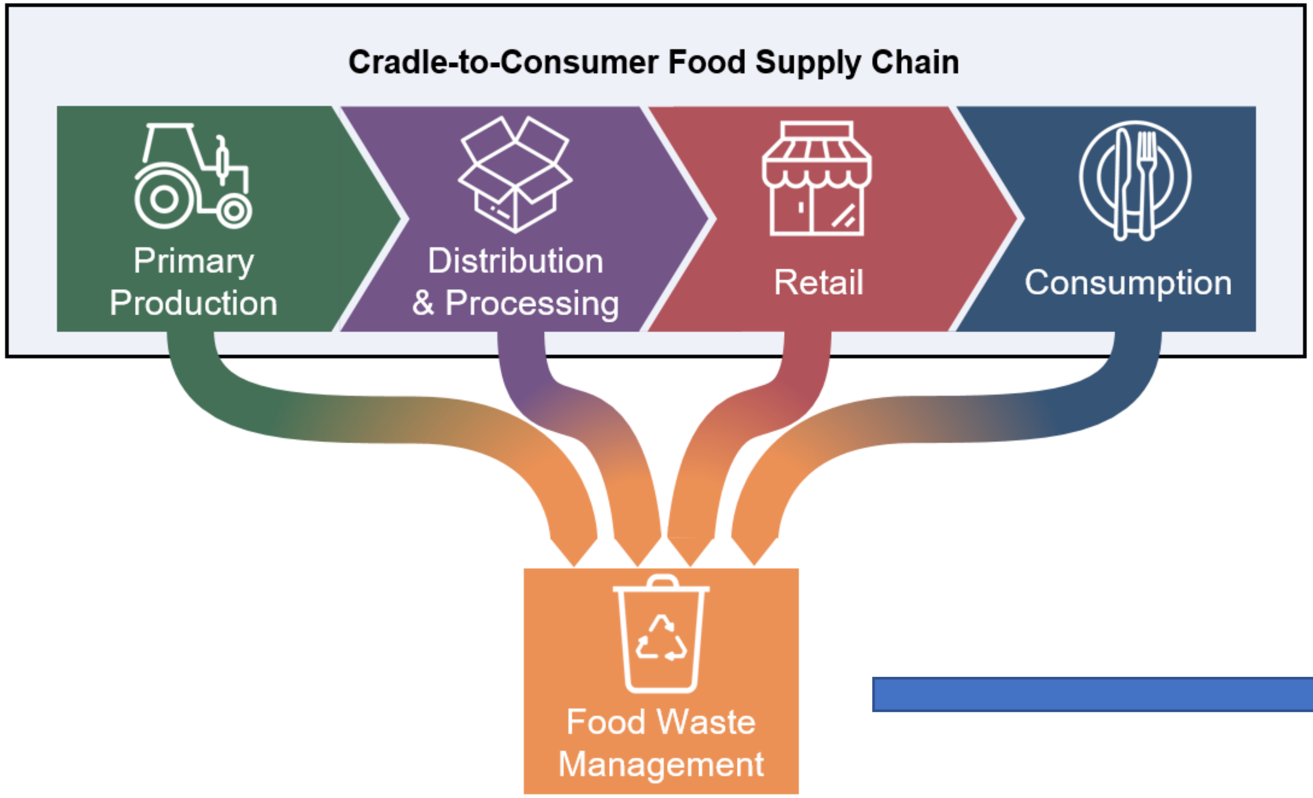
Potential future research:
Determine effect of plastic contamination in food waste streams on biofuel potential and ammonia and greenhouse gas emissions during anaerobic digestion.

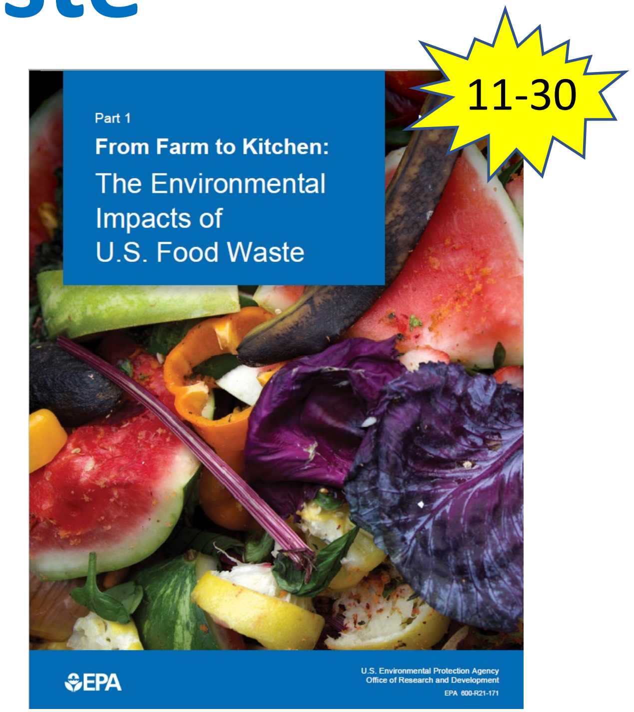
Plastic Contamination of Food Waste Streams

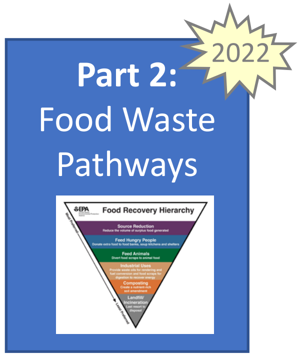
What is latest science related to plastic contamination in food waste streams and its impacts on food waste recycling, the environment, and human health?

- Food packaging and containers (specifically multilayer paper products coated in plastic) is the primary source of plastic contamination in food waste streams.
- Limited data shows grocery store samples with approximately 300,000 microplastic particles (MP) per kg food waste. Additional data shows plastic contamination rates up to 2.8 percent by weight in mixed waste streams and indicates levels in food waste > other organic wastes.
- Food itself is also a source of microplastics with levels generally <1,500 MPs/kg.
- Risks to human health and environment of applying plastic-contaminated compost to land are not well-characterized. Regardless of risks, visible plastic particles in finished products reduces their value and marketability. Recycling facilities sometimes prohibit food waste streams due to anticipated contamination.
- Tests commonly used in the U.S. do not detect particles <4mm in size and thus may miss some microplastics (defined as <5mm). Where regulatory standards are in place, they typically do not address particles <4mm.

Environmental Impacts of U.S. Food Loss and Waste







Study Methods

Purpose

To inform domestic policymakers, researchers, and the public about the:

1. Environmental footprint of food loss and waste in the U.S. and
2. Environmental benefits that can be achieved by reducing U.S. food loss and waste.

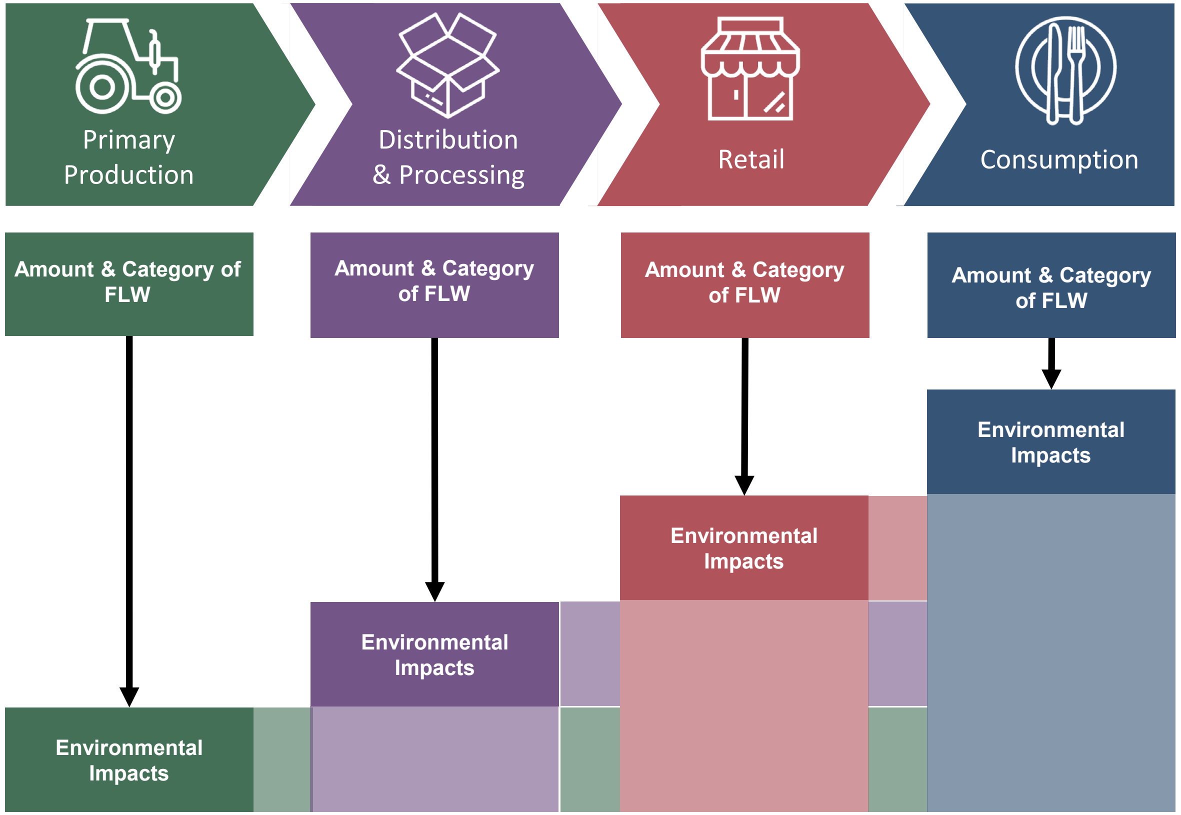
Method

Synthesis of literature identified through systematic search of information published between 2010 and 2021. Most sources cited are peer-reviewed publications; some commonly cited grey literature (e.g., data from ReFED, NRDC, WRI, or WRAP) is referenced to provide context.

Scope

- Food loss and waste is defined as food intended for human consumption but not ultimately consumed by humans. Information about food grown for other purposes, such as biofuels or feed for animals not raised for human consumption, is excluded. When estimating the environmental footprint of producing livestock and farmed seafood, data on animal feed is included when possible.
- Estimates presented include resource use and environmental impacts from cradle-to-consumer food supply chain; implications of food waste management (such as landfill methane emissions) are not included.

Estimating the Cradle-to-Consumer Environmental Footprint of U.S. Food Loss and Waste

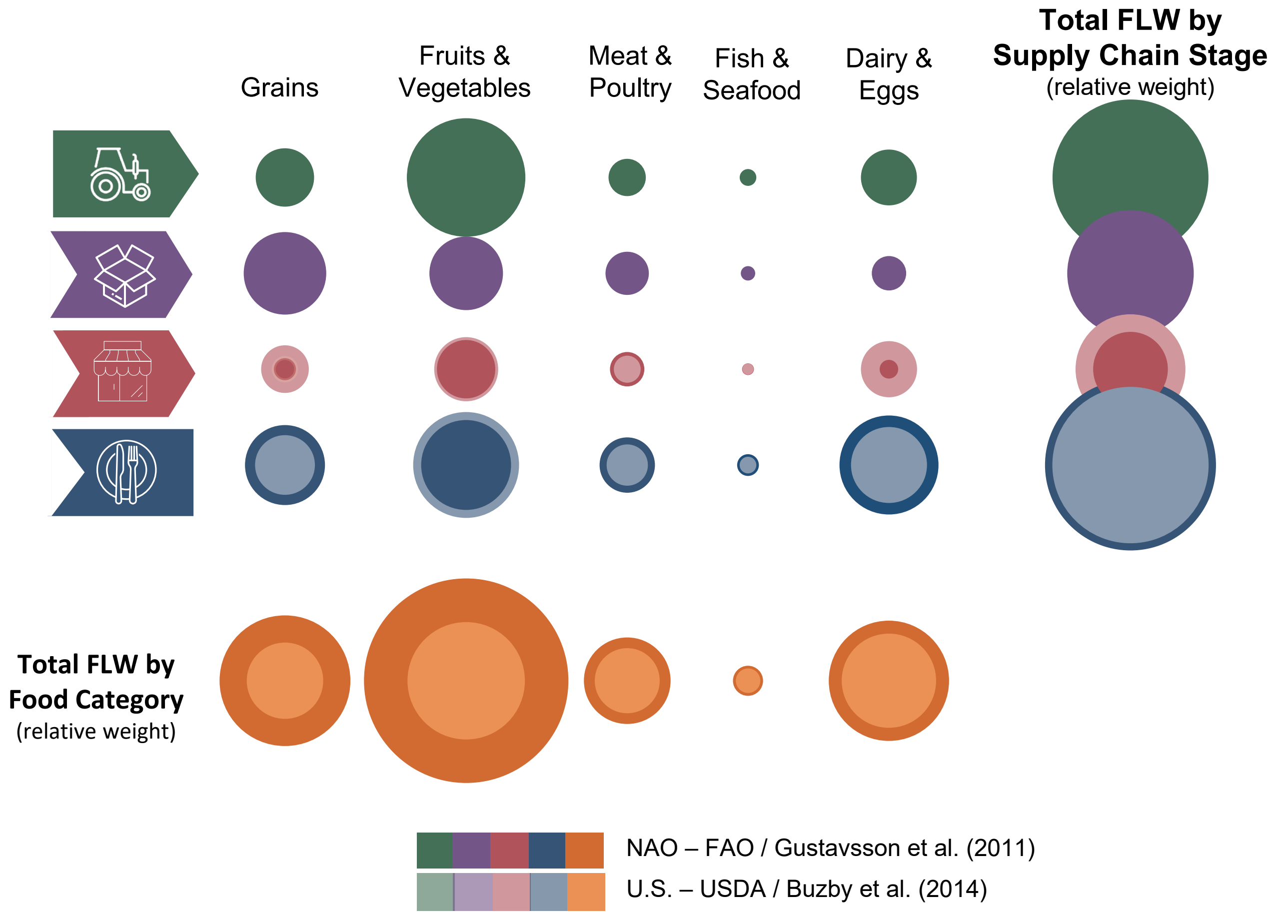


ESTIMATING THE CRADLE-TO-CONSUMER ENVIRONMENTAL FOOTPRINT OF U.S. FLW

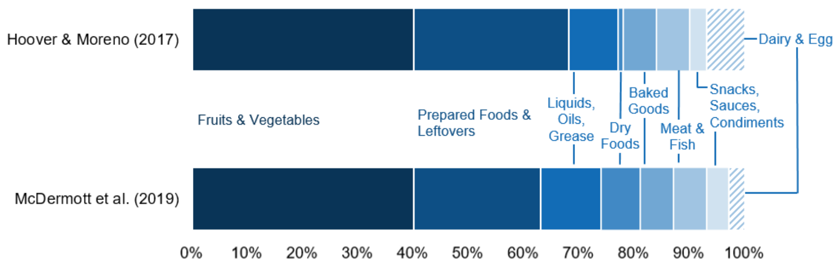
The United States loses or wastes more than one-third of its food supply.

Estimates of U.S. food loss and waste range from 73 to 152 million metric tons (161 to 335 billion pounds) per year, or 223 to 468 kg (492 to 1,032 pounds) per person per year, in studies that include loss and waste during all stages of the food supply chain.

Fruits and vegetables is the food category wasted in the greatest quantity in the United States.

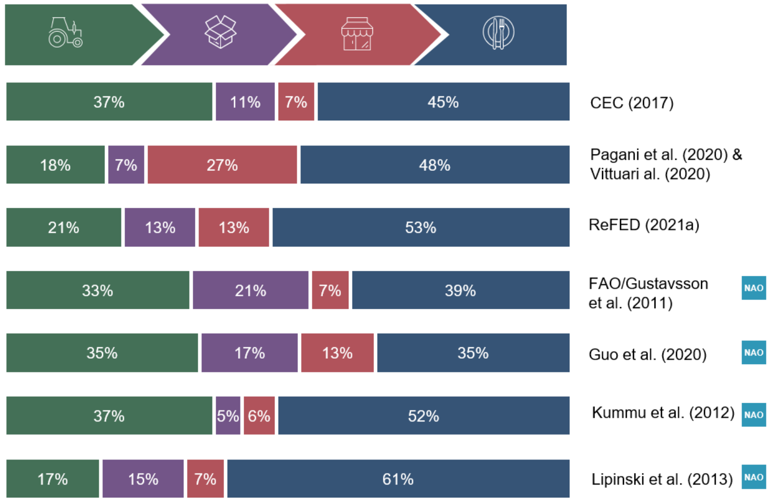


U.S. EDIBLE FLW BY RELATIVE WEIGHT, BY FOOD CATEGORY AND SUPPLY CHAIN STAGE

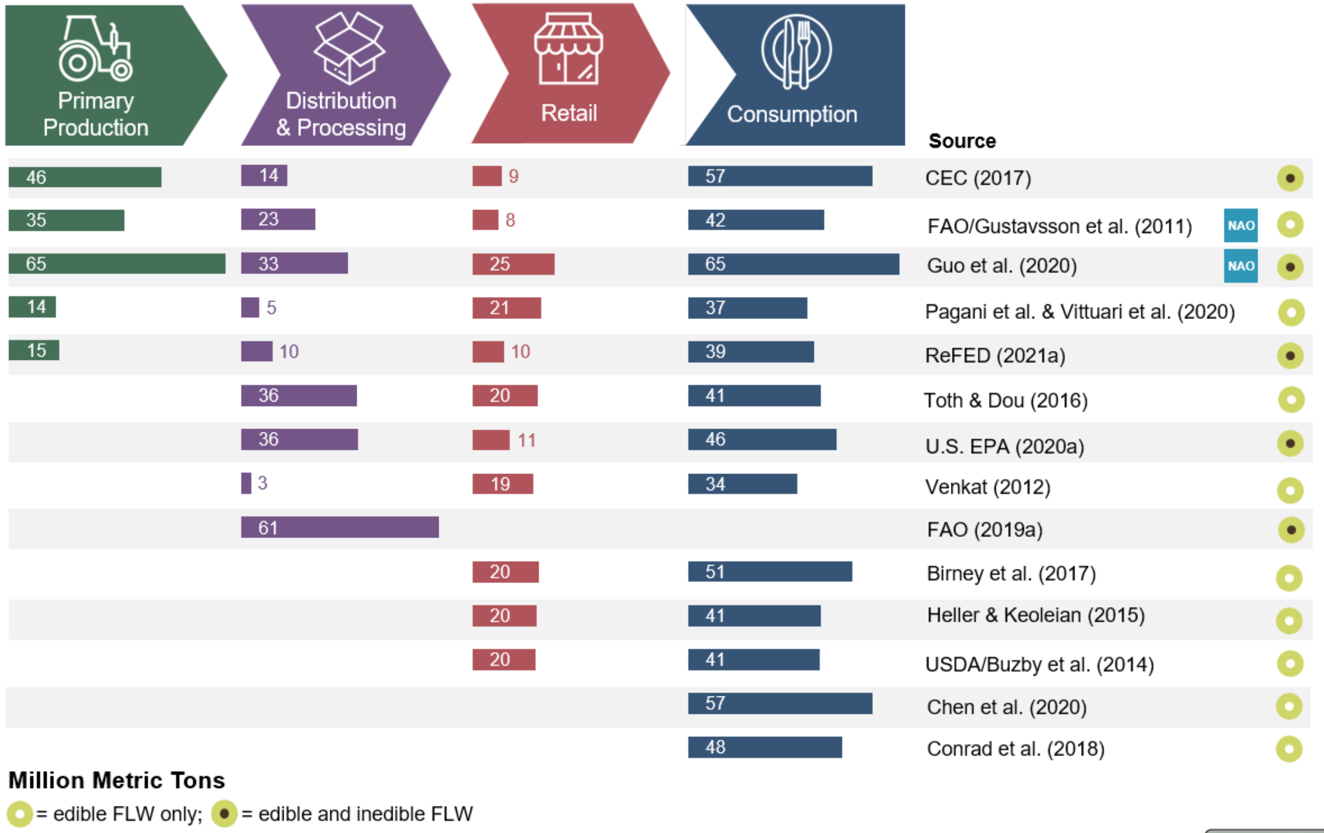


SHARE OF EDIBLE HOUSEHOLD FOOD WASTE, BY FOOD CATEGORY, FROM KITCHEN DIARY STUDIES

The consumption supply chain stage (households and food service) is the greatest contributor to U.S. food loss and waste – although upstream decisions can drive consumer waste.

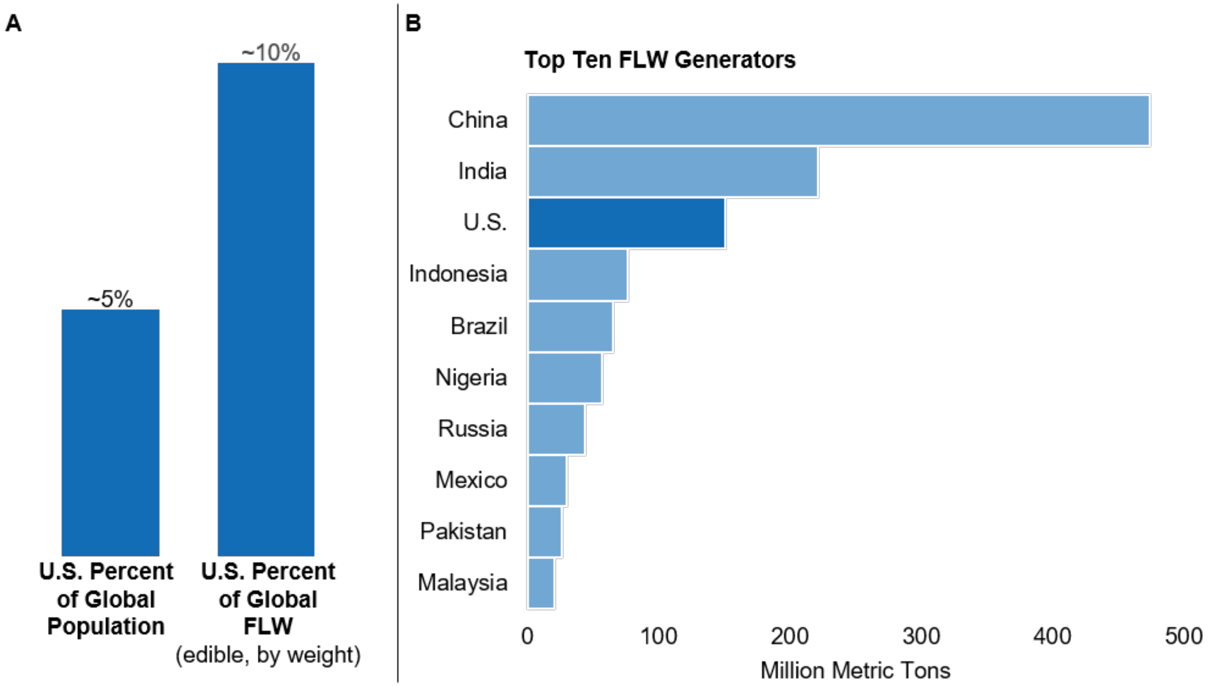


SHARE OF U.S. FLW, BY FOOD SUPPLY CHAIN STAGE



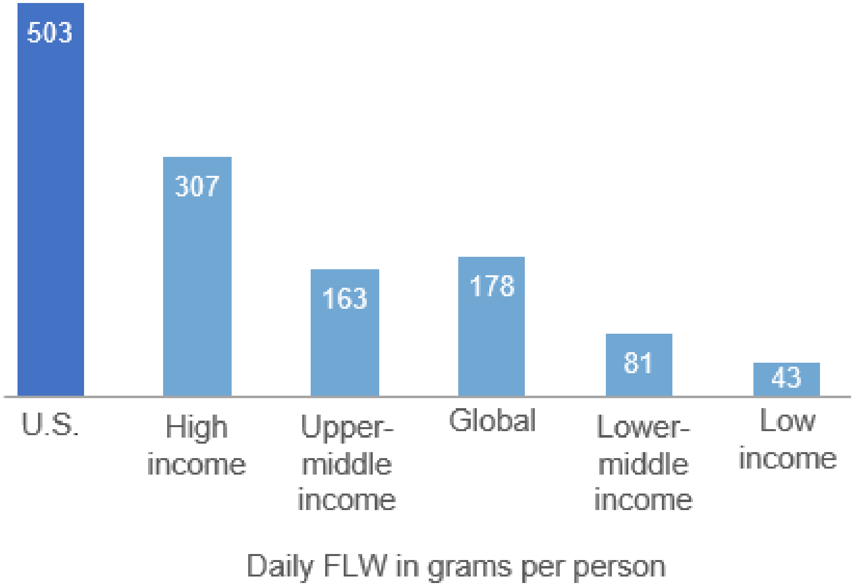
AMOUNT OF U.S. FLW, BY SUPPLY CHAIN STAGE, BY WEIGHT

U.S. Food Loss and Waste in Global context



GLOBAL SIGNIFICANCE OF U.S. FLW

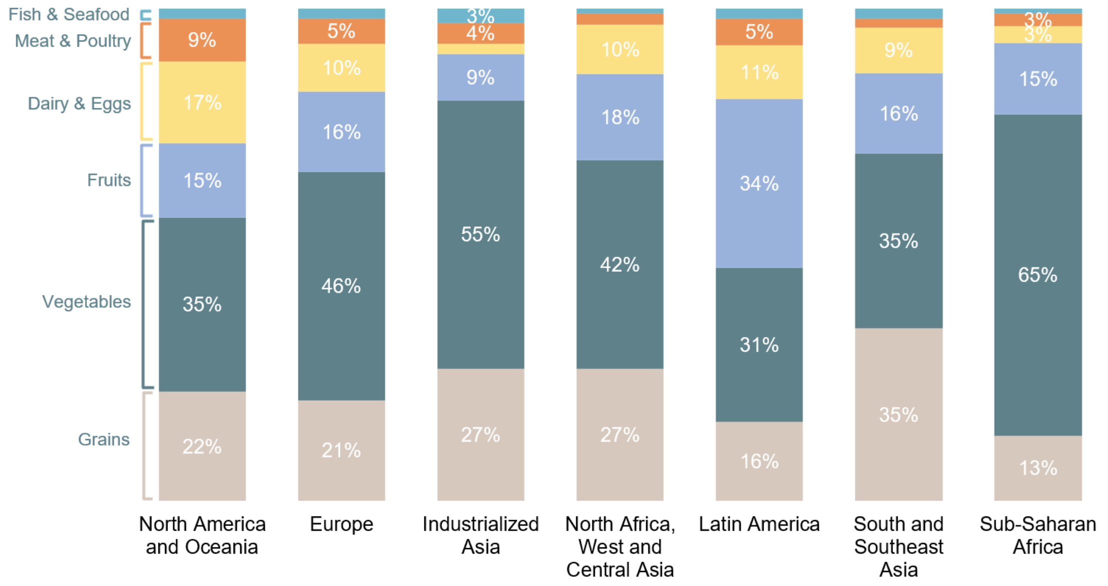
Data Source: UN, 2020a, b; CEC, 2017; FAO, 2011; Guo et al., 2020



MEAN FLW PER PERSON, BY GLOBAL INCOME GROUP

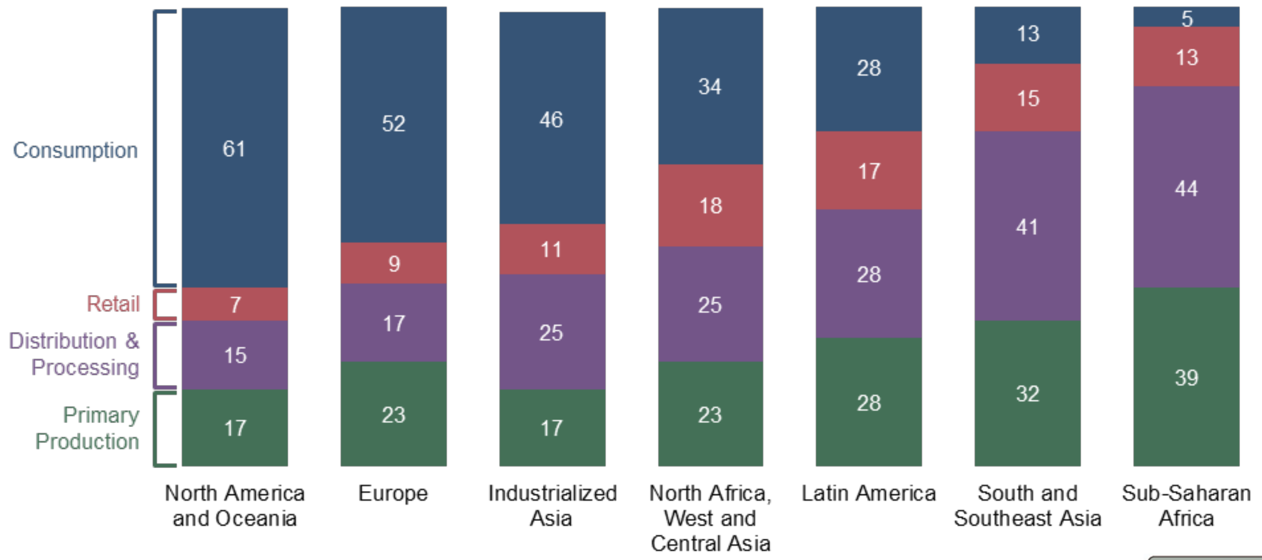
Data Source: [Chen et al. (2020)]

U.S. Food Loss and Waste in Global context (continued)



SHARE OF FLW, BY FOOD CATEGORY, FOR EACH GLOBAL REGION

Data Source: FAO, 2013a, b



SHARE OF CALORIES LOST AND WASTED, BY SUPPLY CHAIN STAGE FOR EACH GLOBAL REGION

Data Source: Lipinski et al. (2013)

Cradle-to-Consumer Environmental Footprint of U.S. Food Loss and Waste

Environmental Impact	Environmental Footprint: Total (Standard Units)	Environmental Footprint: Per Person	Environmental Footprint: Percentage of U.S. Cradle-to-Consumer Food System Footprint	Environmental Footprint: Percentage of U.S. Footprint	Source Scope of FLW
Land Use	560,000 km^2 • (140 million acres)	1,800 m^2 (19,000 sq ft)	16% of agricultural land •	–	Read et al. (2020)
Water Use [a]	22 trillion L • (5.9 trillion gallons)	71,000 L (19,000 gallons)	17% of freshwater used •	5%	Read et al. (2020)
Pesticide Application	350 million kg [b] (780 million pounds)	1 kg • (2.5 pounds)	–	–	Conrad et al. (2018)
Fertilizer Application	6,490 million kg • (14.3 billion pounds)	20.2 kg •, [b] (44.5 pounds)	42% of total fertilizers used	–	Toth and Dou (2016)
Energy Use	2,390 million GJ (664 billion kWh)	7.7 GJ • (2,140 kWh)	20% of energy used	2%	Pagani et al. (2020); Vittuari et al. (2020)
GHG Emissions	170 million MTCO$_2$e •	540 kg CO$_2$e	16% of GHG emissions •	2%	Read et al. (2020)

• = calculated
= personal communication with author
[a] Blue water use.
[b] Accounts for only consumer FLW

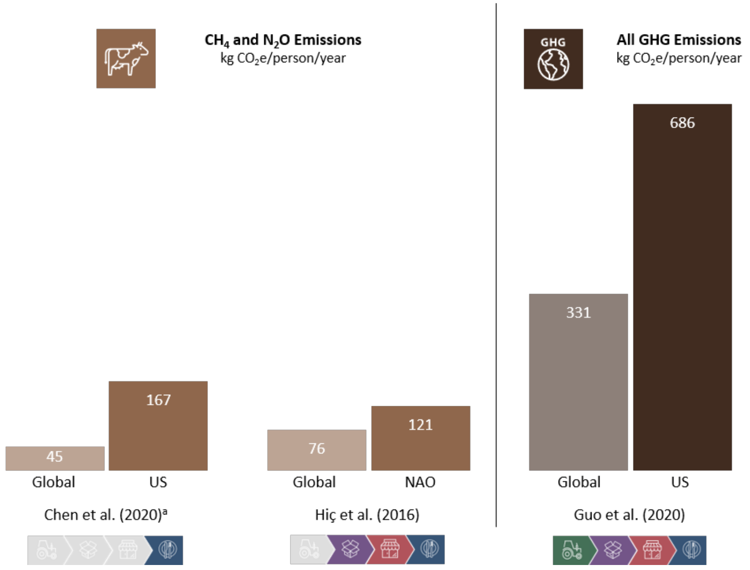
The environmental footprint of U.S. food loss and waste is greater than the global average (and the average high-income country) because:

- ✓ The U.S. loses or wastes more food per person
- ✓ A greater share of U.S. food loss and waste occurs downstream
- ✓ Animal products account for a greater share of U.S. food loss and waste

	FLW g	Cropland m^2	Freshwater L	Fertilizer g N + g P	Non-CO_2 GHG Emissions g CO_2e
U.S.	503	103	151	9	457
High Income	307	81	118	7	315
Upper-Middle Income	163	45	77	5	144
Lower-Middle Income	81	10	19	1	33
Low Income	43	8	12	1	32

DAILY PER PERSON FLW AND ASSOCIATED ENVIRONMENTAL FOOTPRINT, BY GLOBAL INCOME GROUP

Data Source: Chen et al. (2020)



PRIMARY PRODUCTION STAGE GHG EMISSIONS ASSOCIATED WITH FLW

Cradle-to-Consumer Environmental Benefits of Halving U.S. Food Loss and Waste

These are the benefits of food waste prevention; recycling does not confer cradle-to-consumer benefits.

Environmental Impact	Environmental Savings					
	Relative to Current Food System Footprint (as determined by source)					Relative to 2050 BAU Scenario
	Jalava et al. (2016)	Kummu et al. (2012)	Read et al. (2020)	ReFED[a] (2021)	Wood et al. (2020)	Springmann et al. (2018)
Land (million m^2)		82,800 14%	300,000 9%		427,000 16%	209,000 13%
Water (million L)	13%	6,400,000 15%	12,000,000 9%	15,000,000	1,200,000 14%	24,000,000 15%
Fertilizer (million kg)		1,500 NPK 14%	[eutrophication indicator] 10%		337,000 P 15%	2,930 N, 402 P 16%
Energy (million GJ)			940 9%		577 15%	
GHG (million $MTCO_2e$)			92 8.5%	75	87.5 14%	41 9%

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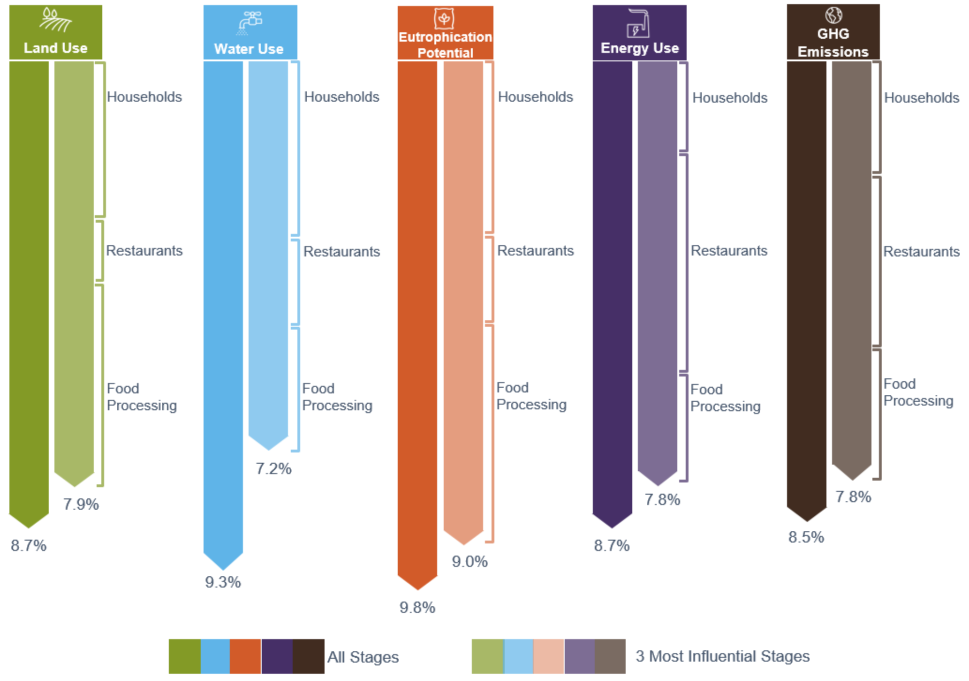
Maximizing Environmental Benefits of Halving U.S. Food Loss and Waste

- Halving food loss and waste in three sectors—food processing, restaurants, and households—provides the majority of the environmental benefits of halving food waste.
- Reducing food waste in retail or institutions (schools, hospitals) provides little direct benefit.
- Halving food loss and waste of three food categories— meat, cereals, and fruits and vegetables— will achieve greatest environmental benefits.



MAXIMUM ENVIRONMENTAL BENEFITS OF HALVING FLW, BY SUPPLY CHAIN STAGE

Data Source: Read et al., 2020

Cradle-to-Consumer Environmental Benefits of Halving Global Food Loss and Waste

These are the benefits of food waste prevention; recycling does not confer cradle-to-consumer benefits.

TAE

Environmental Impact	Environmental Savings							
	Relative to Current Food System Footprint		Relative to 2050 BAU Scenario					Cumulative Impact 2020 to 2100
	Jalava et al. (2016)	Kummu et al. (2012)	Bajželj et al. (2014)[a]	Röös et al. (2017)	Searchinger et al. (2019)	Springmann et al. (2018)	Tilman & Clark (2014)	Clark et al. (2020)[d]
Land (million m^2)	–	9%	11%	11%	6%	14%	–	–
Water[b] (million L)	12%	11%	15%	–	–	13%	–	–
Fertilizer (million kg)	–	10%	12%	–	–	16%[c]	–	–
GHG (million $MTCO_2e$)	–	–	22%	9%	10%	6%	12%	24%

[a] Based on 2009 data. Total land reduction based on the combined average land reduction of cropland and pasture. Reduction values are based on the percentage reduction of each impact category (e.g., GHG emissions, cropland use) from the baseline projected environmental impact of that category.
[b] Water only includes "blue water" (water used for irrigation). It does not include "green water" (water from rainfall or moisture).
[c] Values are 17% reduction for nitrogen fertilizer and 16% reduction for phosphorus fertilizer. Potassium fertilizer is not included in the analysis.
[d] The reduction is estimated to be 24% if using the common 100-year global warming potential. The study also reports an estimate of 27% reduction as CO_2 warming-equivalent (CO_2-we).

Next Steps

- Release of Report (November 30)
- STAR Grant Solicitation
- Release of 2nd report comparing environmental footprints of food waste pathways (2022)
- Planning Future Research

For more information, please visit:
https://www.epa.gov/land-research/food-waste-research

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