



Municipal Solid Waste (MSW)



Vortex Energy Group LLC
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Information for volume of MSW based on different populations per week

The amount of municipal solid waste generated per week can vary significantly based on a number of factors including location, local recycling practices, waste management policies, and the standard of living. However, a general estimate can be made using average waste generation rates. In the United States, the average person generates about 4.9 pounds of solid waste per day, according to the Environmental Protection Agency (EPA). That's far higher than the global average of 1.6 pounds per day.

In Puerto Rico, the average person generates about 5.56 pounds per day, higher than the U.S. This means that they generate an incredible 2,029 pounds per year per person. With a population of 3,242,204, that means that a total of 18 million pounds (9,000 tons) per day and almost 7 billion pounds (3.2 billion tons) per year is generated on the island.

The total weekly estimated calculation of waste for municipalities of different populations:

1. For a population of 10,000:

Daily waste=10,000×4.9 lbs=49,000 lbs/day

Weekly waste=49,000 lbs/day×7 days=343,000 lbs=**171.5 tons**

2. For a population of 15,000:

Daily waste=15,000×4.9 lbs=73,500 lbs/day

Weekly waste=73,500 lbs/day×7 days=514,500 lbs=**257.25 tons**

3. For a population of 20,000:

Daily waste=20,000×4.9 lbs=98,000 lbs/day

Weekly waste=98,000 lbs/day×7 days=686,000 lbs=**343 tons**

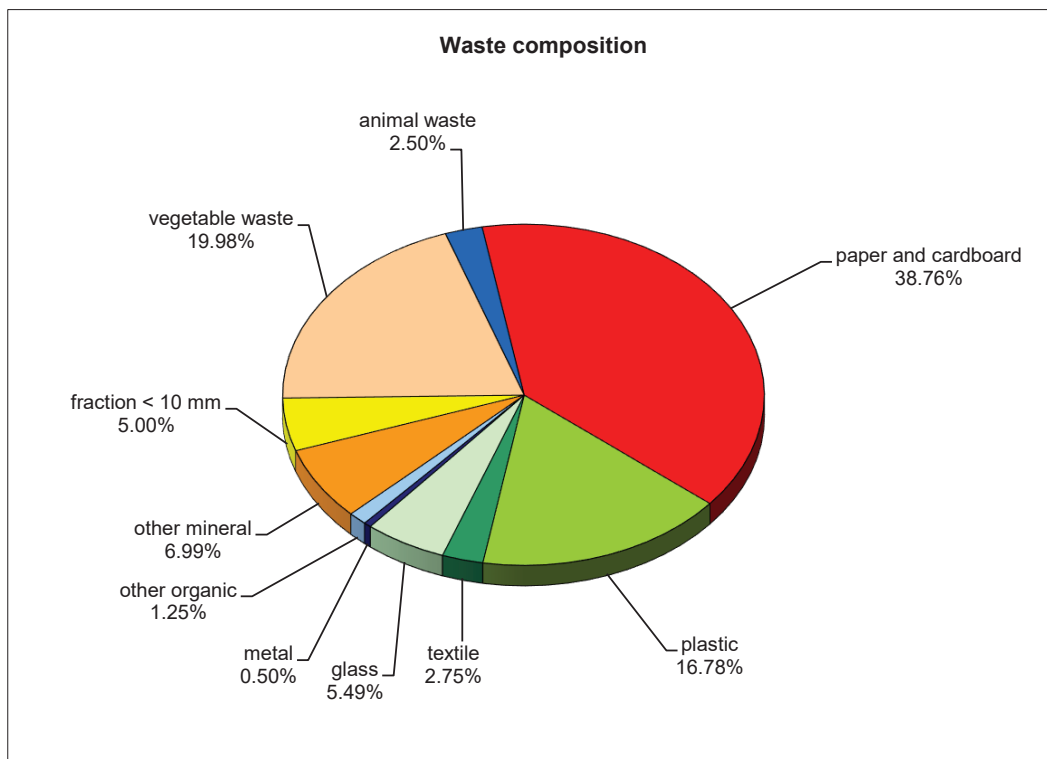
4. For a population of 25,000:

Daily waste=25,000×4.9 lbs=122,500 lbs/day

Weekly waste=122,500 lbs/day×7 days=857,500 lbs=**428.75 tons**

The **ThermoMAX3™** can accept up to 4 tons per hour for MSW (based on typical waste composition models and factoring for the amount of non-combustibles) = 96 tons per day / 672 tons per week. The calculation can be made for cities based on their size, but keep in mind that this would be to destroy all MSW for the entire population. For larger populations, and to reduce carbon emissions from additional transportation of the waste materials, multiple systems could be installed in different areas of the municipalities. Also, the **ThermoMAX6™** can accept up to 8 tons per hour for MSW, which is 192 tons per day / 1,344 tons per week. Using the information above, 3 **ThermoMAX6™** systems could be used for a population of 75,000.





Analysis

Waste sample number 005834

Symbol	Name	Characteristic	Individual component as % of sample
1	food waste vegetable origin	Food waste Vegetable origin remains of vegetable substances, resulting in the preparation of food, such as peelings, leftover vegetables and fruits, rotten vegetables and fruits, leftover post-consumer food, food products treated as waste, such as breads, cereals or flour in packs, and other waste impossible to precisely specify	20.0
2	Waste food of animal origin	The remnants of meat, bone, meat, fish, fats, cheese, etc.	2.50
3	Waste of paper and cardboard	Any residues and products paper and cardboard	38.8
4	Plastic waste	Any residues and plastic products	16.8

5	Textile waste	Any leftovers and products out of wool, cotton, linen and chemical fiber	2.75
6	Glass waste	All glassware and glass cullet	5.50
7	metal	All products and scrap of all types of metal	0.50
8	Other organic waste	Organic waste remaining after being selected, ingredients such as plant residues1-5, the dried flowers, grass, tree branches, etc.	1.25
9	Other mineral waste	Mineral waste remaining after being selected from components number 6-7as pieces of concrete, bricks, debris, ceramic, etc.	7.00
10	fraction<10 mm	Mostly soil and ash	5.00
Total			100.00 ± 0.5%

Projected performance based on initial testing and design criteria

Composition of exhaust gases

Primary 99.998% exhaust components:

6.979	carbon dioxide
13.958	water vapor
5.583	oxygen
73.478	nitrogen
99.998	

Remaining .002% (20 parts per million) exhaust components possible, depending on original waste material:

cadmium
thallium
mercury
antimony
carbon monoxide
arsenic
lead
chromium
cobalt
copper
manganese
nickel
vanadium
nitrogen dioxide
hydrogen chloride
hydrofluoric acid
total organic carbon
sulfur dioxide



U.S. Municipal Solid Waste

Municipal Solid Waste (MSW), commonly called “trash” or “garbage,” includes wastes such as durable goods (e.g., tires, furniture), nondurable goods (e.g., newspapers, plastic plates/cups), containers and packaging (e.g., milk cartons, plastic wrap), and other wastes (e.g., yard waste, food). This category of waste generally refers to common household waste, as well as office and retail wastes, but excludes industrial, hazardous, and construction wastes. The handling and disposal of MSW is a growing concern as the volume of waste generated in the U.S. continues to increase.¹

Generation Statistics

- Total annual MSW generation in the U.S. has increased by 93% since 1980, to 292 million U.S. short tons (tons) per year in 2018.¹
- Per capita MSW generation increased by 34% over the same time period, from 3.7 to 4.9 pounds per person per day.¹ For comparison, MSW generation rates (in lbs/person/day) are 2.5 in Sweden, 3.9 in Germany, and 2.8 in the United Kingdom.² At the 2018 per capita rate, an American weighing 180 pounds generates their own weight in MSW every 37 days.
- In 2021, per capita generation of MSW was 29 pounds per \$1,000 of GDP in the U.S., 18 in Sweden, 23 in the UK, and 29 in Germany.^{3,4}
- Packaging, containers, and durable goods made up 48% of MSW generation in 2018. Most of the remainder was split between nondurable goods, food waste, and yard waste.¹

Management Methods

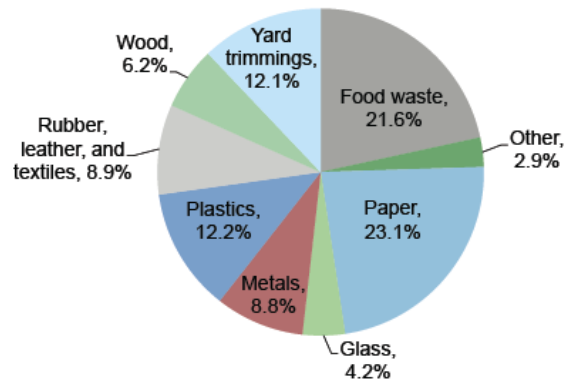
Landfill

- In 2018, 50% of MSW generated in the U.S. was disposed of in 1,278 landfills.^{1,5}
- The 2022 combined capacity of the two largest landfill corporations in the U.S. was 10.3 billion cubic yards.⁶
- Landfill disposal (“tipping”) fees in 2020 in the U.S. averaged \$53.72 per ton, a 3% decrease from 2019.⁷ These fees are used as funding for operation and maintenance of landfills, but there is still a lack of funding for research and technologies for waste diversion.⁸
- Environmental impacts of landfill disposal include loss of land area, emissions of methane (CH₄, a greenhouse gas) to the atmosphere, and potential leaching of hazardous materials to groundwater, though proper design reduces this possibility.^{9,10}
- Landfills were the third largest source of U.S. anthropogenic CH₄ emissions in 2021, accounting for 122.6 million metric tons (Mt) CO₂e emissions, about 1.9% of total GHG emissions.⁹

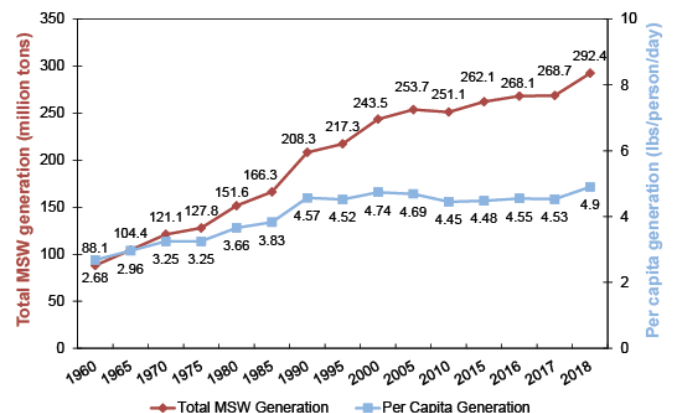
Combustion

- In 2018, 11.8% of MSW generated in the U.S. was disposed of through waste incineration with energy recovery.¹
- Combustion reduces waste 75-85% by weight and 85-95% by volume, leaving behind a residue called ash. A majority of this ash is landfilled, although recent attempts have been made to reuse the residue.¹² In 2021, 64 power plants burned 28 million tons of MSW and generated about 13.6 billion kWh of electricity.¹³
- Biogenic MSW (paper, food, and yard waste) accounted for 45% (6.12 billion kWh) of the electricity produced, or about 0.15% of total U.S. electricity generation.^{13,14}
- Incineration of MSW generates a variety of pollutants (CO₂, heavy metals, dioxins, particulates) that contribute to impacts such as climate change, smog, acidification, and human health impacts (asthma and heart and nervous system damage).¹⁵

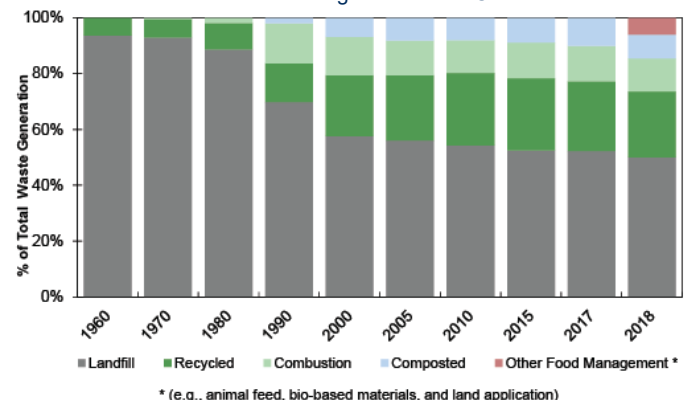
U.S. MSW Composition, 2018¹



U.S. Annual MSW Generation¹



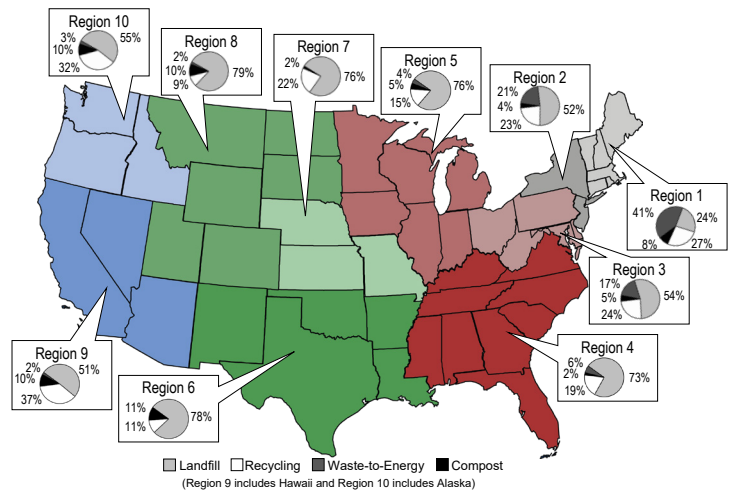
MSW Management in the U.S.¹



Recycling and Composting

- In 2018, 32.1% of MSW (by weight) generated in the U.S. was recovered for recycling or composting, diverting 93.9 million tons of material from landfills and incinerators—about 2.8 times the amount diverted in 1990.¹
- In 2018, 27% of recovered MSW was composted.¹
- Only 53% of people in the U.S. live in communities that automatically provide curbside recycling services; 82% of cities with curbside recycling collect material single-stream, meaning materials such as glass and paper are separated at the recycling plant.^{16,17} The number of curbside programs in the U.S. has increased more than ninefold since 1988.^{18,19}
- In 2018, 97% of corrugated boxes were recovered for recycling in 2018; other highly recycled products include lead-acid batteries (99%), newspapers (65%), major appliances (60%), and aluminum beverage cans (50%).¹
- Common products with poor recycling rates include: carpet (9%), small appliances (6%), and furniture (0.3%).²⁰

Regional MSW Management, 2010¹¹

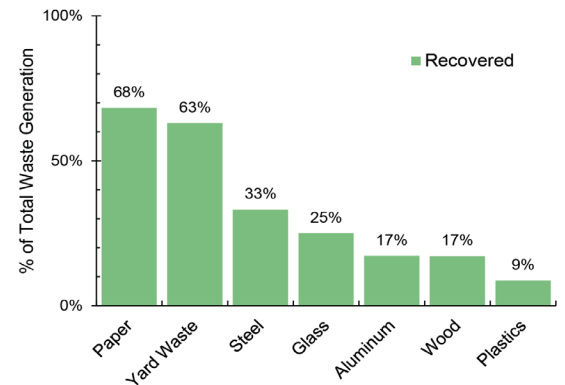


Solutions and Sustainable Alternatives

Source Reduction

- Source reduction activities help prevent materials from entering the MSW stream and are the most effective way to reduce waste generation.²¹
- Identify opportunities to reuse materials at home or in your community. Purchase items like furniture and appliances from reuse centers and consignment shops.
- Packaging and containers made up 28% of the MSW generated in 2018. Minimize the volume of packaging material required by selecting efficiently packaged products or buying in bulk.¹
- Purchase products with post-consumer recycled content and encourage companies to implement source reduction programs.
- In 2018, 2.5 million tons of paper and plastic plates and cups were disposed.²⁰ Choose reusable plates, cups, and silverware over disposable goods and reuse them to make up for their greater production burdens compared to disposables.²²
- Food waste makes up 24% of MSW in the U.S., more than any other material. Yet only 5% is recovered or composted. Reduce food waste through meal planning and composting of scraps.²³

Recovery of Materials in MSW, 2018¹



Encourage Supportive Public Policy

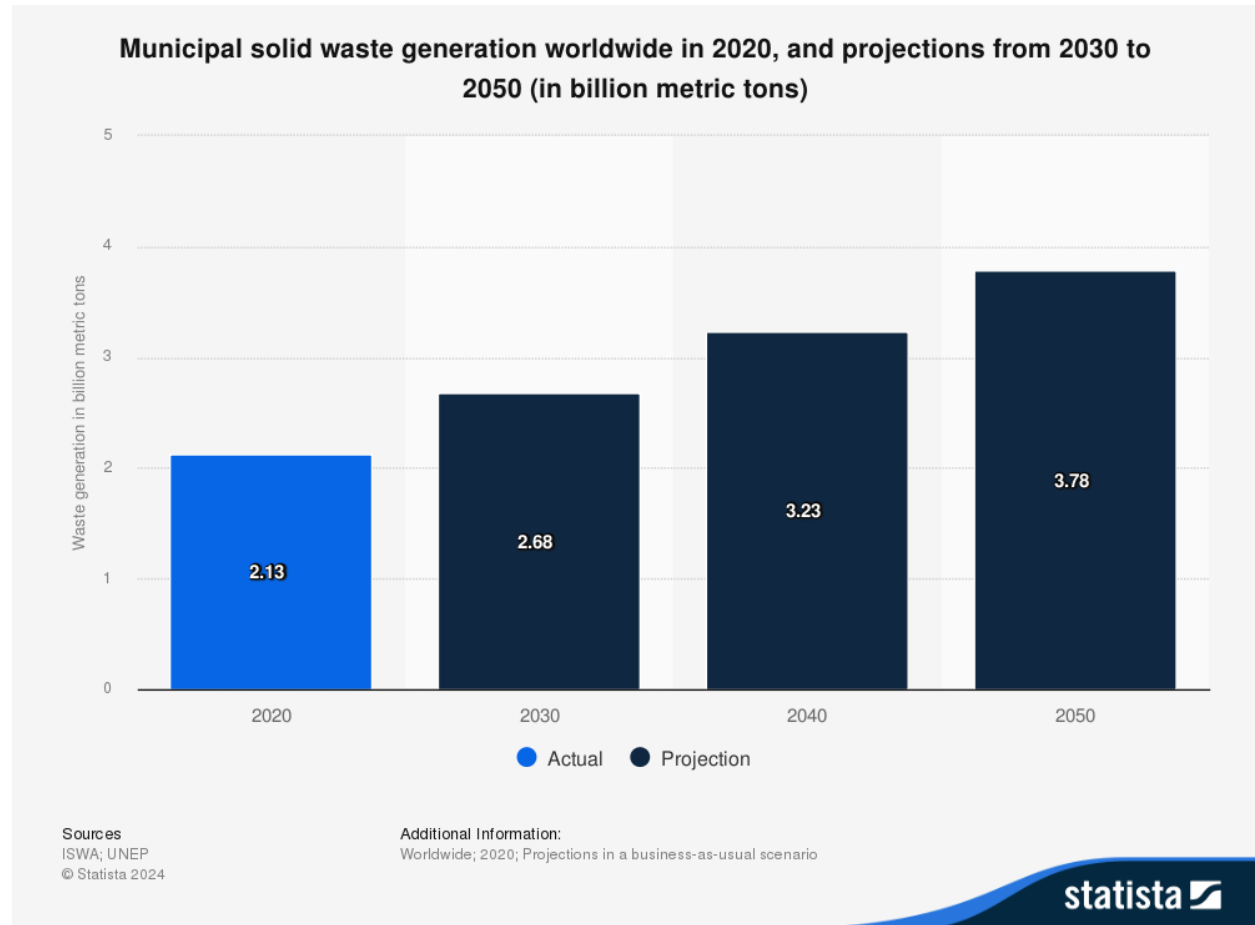
- Many communities have implemented Pay-As-You-Throw programs, designed to limit the volume of MSW per household by charging residents for waste collection based on the weight they throw away.²⁴
- In 2020, the U.S. Department of Agriculture, Environmental Protection Agency and Food and Drug Administration renewed the Winning on Reducing Food Waste initiative, to continue to promote the reduction of food loss and waste.²⁵
- In 2021, 25 states introduced food waste-related legislation to reduce the amount of food waste going to landfills.²³
- Implementation of curbside recycling and composting programs can help reduce the burden of waste disposal.
- Although most states restrict landfill disposal of certain materials, some states do not restrict the disposal of potentially hazardous items (e.g., oil, batteries, tires, and electronics).²⁶
- Ten states (CA, CT, HI, IA, ME, MA, MI, NY, OR, and VT) have deposit laws to encourage the return of empty beverage containers.²⁷
- In June 2021, the U.S. House of Representatives held a hearing to discuss plastic waste reduction and recycling research. The Plastic Waste Reduction and Recycling Research Act was also considered for the role it could play in support of increasing federal investments in plastic waste reduction, recycling R&D, and recycling standards development.²⁸

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Global statistics for municipal solid waste (MSW)

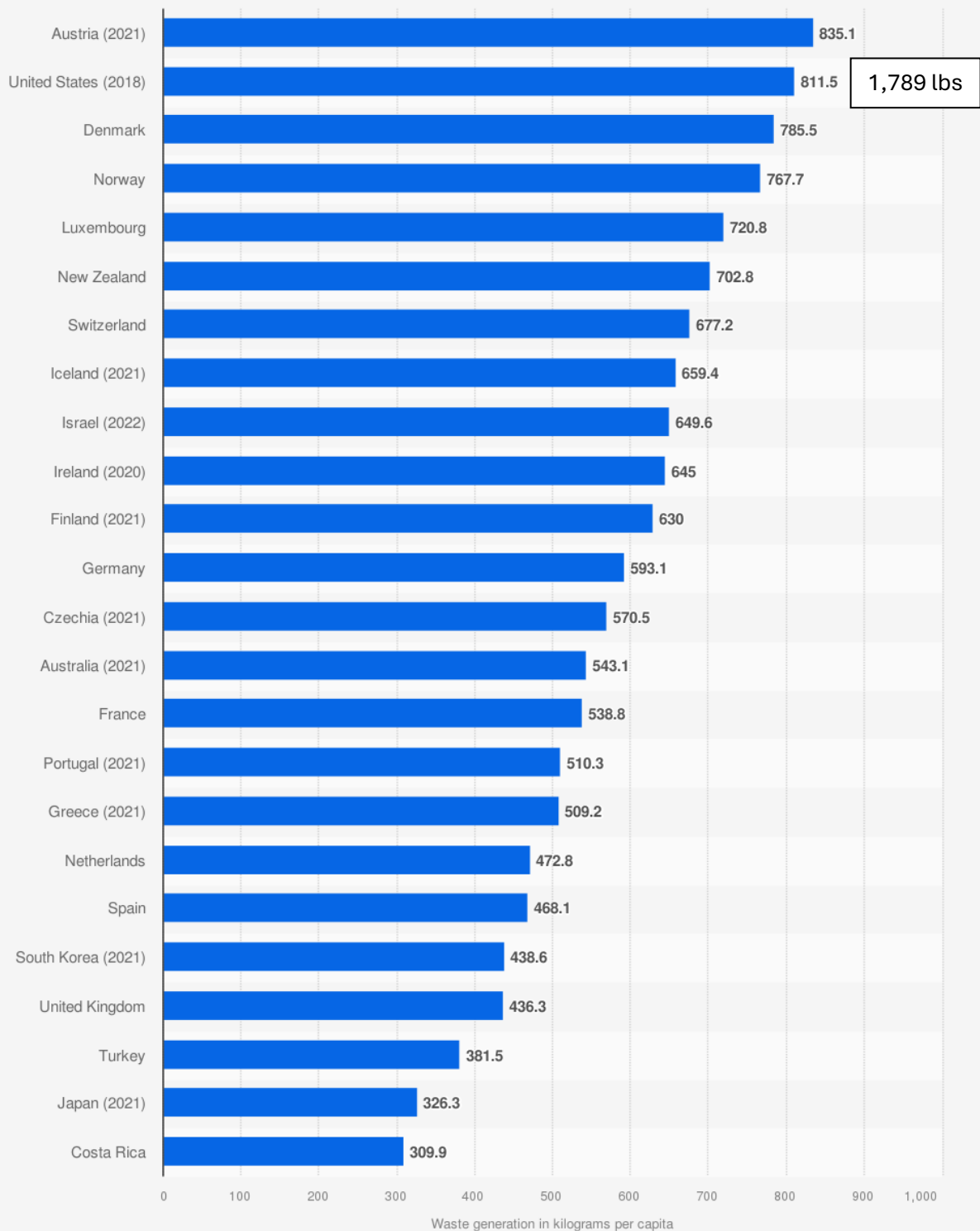
The following are some statistics related to the total volume and the per capita volume of MSW around the world. Conversions are below each graph.



Note: 1 metric ton = 1.10231 US tons

2.13 billion metric tons = 2,347,923,092 US tons

**Per capita generation of municipal waste worldwide as of 2022, by select country
(in kilograms)**



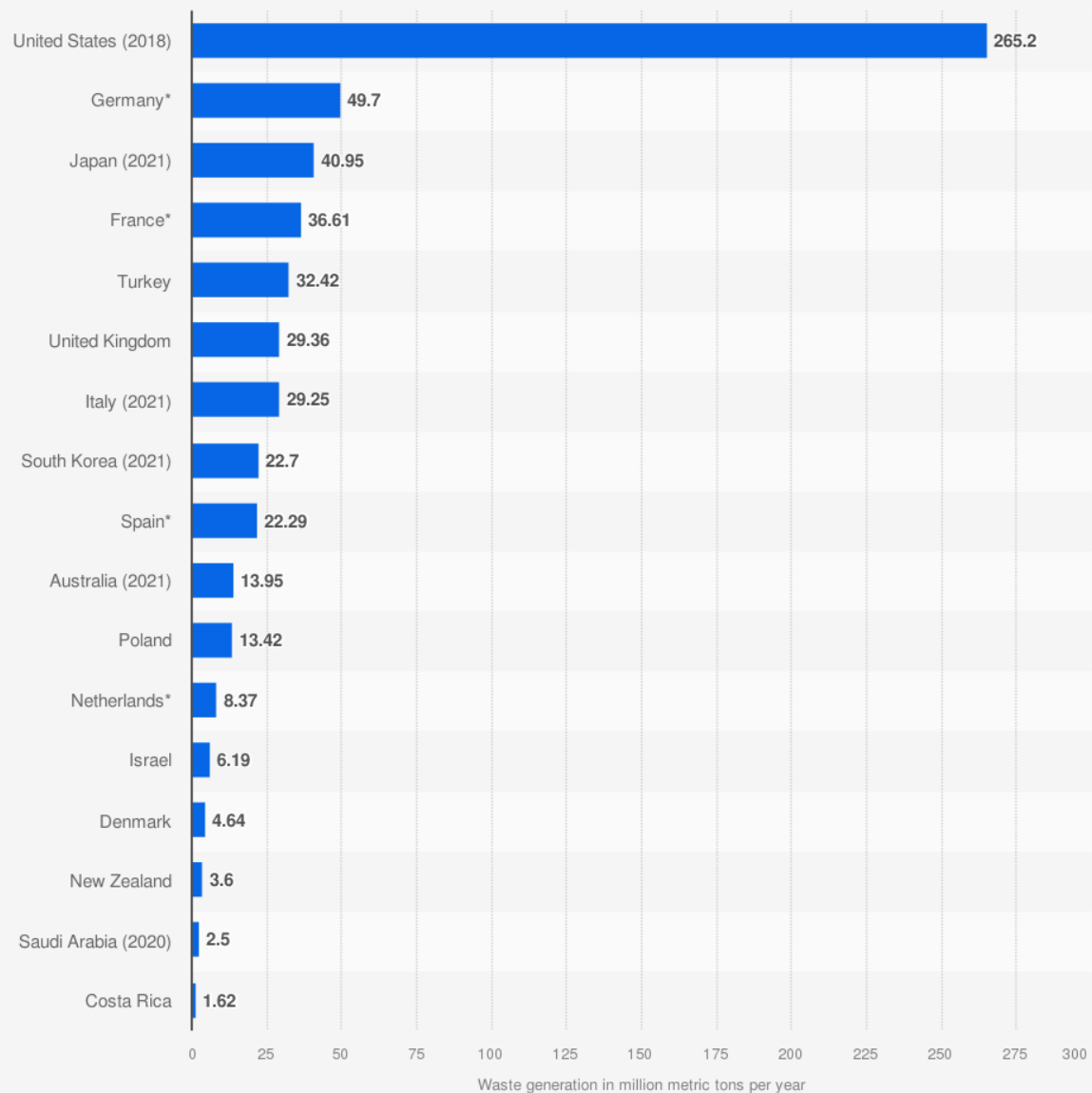
Source
OECD
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Additional Information:
Worldwide; 2022 or latest data available

1 kilogram = 2.20462 pounds

811.5 kilograms = 1,789 pounds

Municipal waste generation worldwide as of 2022, by select country (in million metric tons)



Source
OECD
© Statista 2024

Additional Information:
Worldwide; 2022, or latest available data

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Note: 1 metric ton = 1.10231 US tons

265.2 million metric tons = 292,332,960 US tons