Solid Waste

C+

GRADE COMPARISON

2025: C+

2021: C+

Photo: Sigmund

SOLID WASTE

EXECUTIVE SUMMARY

The nation's solid waste management system—trash and recycling—is managed by both the public and private sector and is funded by user fees and some government grants or dedicated program funds. Little data exists on solid waste, in part because of its management by private companies. Available information from federal and state government is updated infrequently. Based on public data, funding and capacity are currently sufficient to address immediate needs despite steady growth in the volume of municipal solid waste (MSW)—from 251 million tons in 2010 to 292 million tons as measured in 2018. Meanwhile, demand for recyclable materials has weakened, and alternative funding sources or market incentives have not been scaled. After rising in previous decades, recycling rates are plateauing, having grown from 14.5 million tons in 1980 to 65 million in 2010 and 69 million in 2018.[1] Potential risks to public health are emerging contaminants such as per- and polyfluoroalkyl substances (PFAS) found in legacy landfills. These chemicals will require improved monitoring and treatment. To enhance America's solid waste systems, decision-makers should update policies and practices to use MSW as a resource and mobilize improved catalysts for residential and commercial waste diversion.

BACKGROUND

Municipal solid waste (MSW), more commonly called trash or garbage, consists of everyday items that are used and then thrown away, such as product packaging, grass clippings, furniture, clothing, bottles, food waste, newspapers, appliances, paint, and batteries. After these items are removed from the waste stream for recycling and composting, the remainder is deposited into disposal facilities. The nation's solid waste management system comprises landfills, waste transfer stations, recycling centers, composting facilities, and waste-to-energy facilities, all of which are interconnected with the nation's other critical infrastructure systems, including roads, rail, energy grid, telecommunications, among others.

American cities lacked organized refuse collection removal until the early 1800s. The lack of state and regional funding made solid waste management a local responsibility, centered on municipal dumps. City and county sanitation departments expanded nationwide and included trucks, motorized street sweepers, incineration, and open landfills that were developed in the following decades. The Resource Conservation and Recovery Act of 1976 (RCRA) is the defining legislation for MSW management practice in America today. It forced the closure of open dumps nationwide, though not always properly, and required regional planning for MSW, including recycling.

The U.S. waste and recycling industry was worth an estimated $91 billion in revenue during 2022, up from $82 billion in 2021.[2] The sector employs 135,000 workers nationwide, and there are nearly 180,000 refuse trucks on the road in North America today.[3]

CAPACITY AND CONDITION

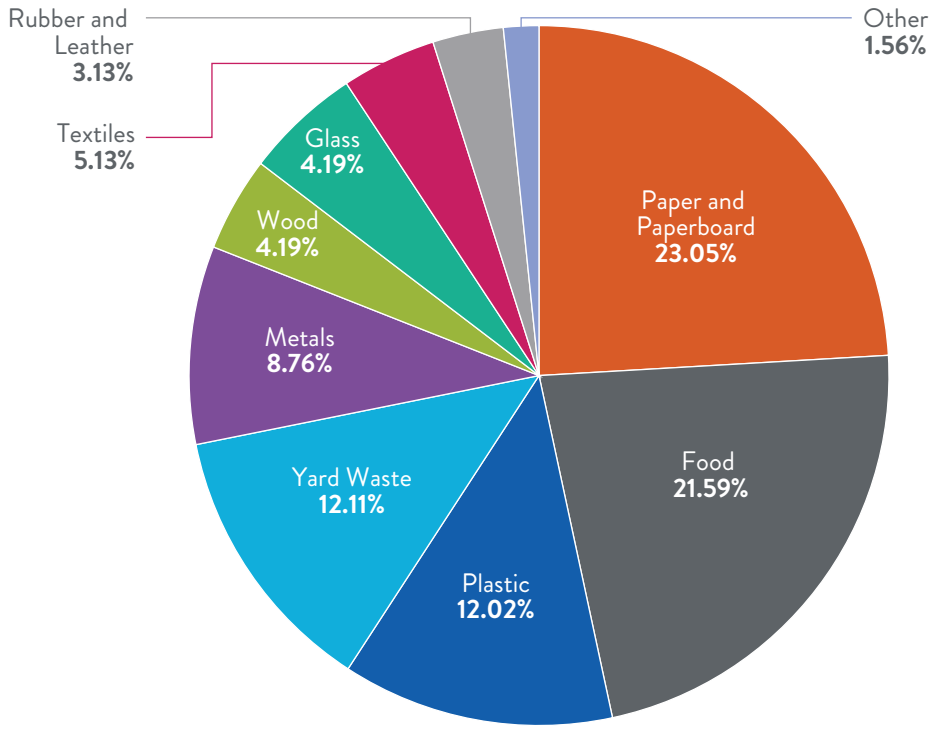
The Environmental Protection Agency (EPA) found that the total generation of MSW in 2018, the last year data was made available, was 292.4 million tons or 4.9 pounds per person per day. This compares to 262 million tons in 2015 and 251 million tons in 2010 and represents an increase in the per capita MSW generation rate from 4.45 to 4.51 pounds per person/day between 2010 and 2018.[4] Although MSW generation per person is growing, the 7.4% population growth over the same period accounts for much of that growth.[5] Approximately 69 million tons of MSW were recycled, 25 million tons were composted, and 35 million tons were combusted for energy recovery, which equates to 44.1% of this generated MSW being productively reused.[6]

For decades, the U.S. relied on selling recyclables in international markets to help manage the nation's municipal waste. From 2010 to 2017, the U.S. exported an annual average of $3.3 billion of wastepaper for recycling (accounting for 36% of the world's wastepaper exports in 2017), and China was the main wastepaper destination, averaging 60% of the exports over this period. In 2018, the Chinese government through its National Sword policy banned imports of various plastics and mixed papers and set a standard for contamination levels that most U.S. exporters of recyclables could not meet, thus reducing an important source of international demand for U.S. recyclables. A replacement for this market has proved challenging and seriously impacted the ability to expand recycling programs.[7]

According to the Organization for Economic Co-operation and Development (OECD), when dealing with plastic waste in 2019, the U.S. mismanaged (litter) 4%, placed in landfills 73%, incinerated 19%, and recycled just 4%.[8] Most plastics in use today are primary plastics, made from crude oil or gas. Global production of plastics from recycling has more than quadrupled from 6.8 million tons in 2000 to 29.1 million tons in 2019, but this is still only 6% of the size of total plastics production.[9]

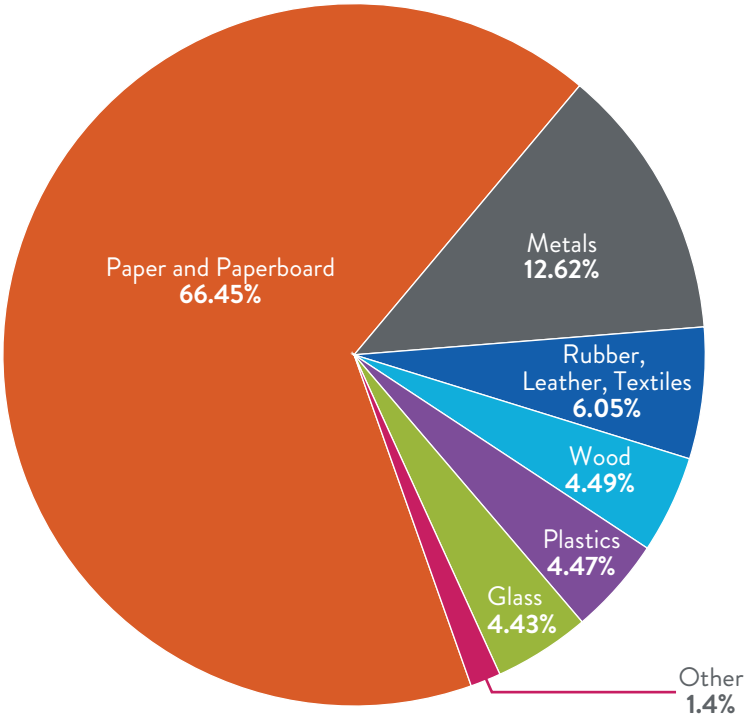
An additional 17.7 million tons of food waste management pathways are supported by animal feed, bio-based materials/biochemical processing, co-digestion/anaerobic digestion, donation, land application, and sewer/wastewater treatment. Finally, nearly 35 million tons of MSW (11.8%) were combusted with energy recovery, and more than 146 million tons of MSW (50%) were landfilled.[10]

EPA Source Generation, 2018



Source: National Overview: Facts and Figures on Materials, Wastes and Recycling | US EPA

EPA Recycling by Materials, 2019



Source: National Overview: Facts and Figures on Materials, Wastes and Recycling | US EPA

Although information on compost production and distribution, and characteristics of compost facilities and compost operations are limited, compost production appears to be growing in the U.S. According to the Environmental Research and Education Foundation (EREF), in a survey of over 300 composting facilities, the number of facilities increased by 55% between 2016 and 2021, whereas an 83% increase in tonnage was processed. Similar growth was also observed from 2016 to 2019 with a 39% increase in the number of active facilities and a 57% increase in the tonnage processed.[11]

In 2022, 63 U.S. power plants generated about 12.8 billion kW·h of electricity from burning about 26.6 million tons of combustible MSW for electricity generation. Biomass materials accounted for about 61% of the combustible MSW's weight and about 45% of the electricity generated. The remainder of the combustible MSW was non-biomass material, mainly plastics. Many large landfills also use landfill gas to energy facilities supplying power to the utility grid using the methane gas produced from decomposing biomass in landfills. In comparison to peer countries, Japan combusts approximately 75% of its MSW, whereas the United Kingdom combusts 42%. The lack of available land in those countries plays a role in the high usage of waste-to-energy facilities.[12]

Closed landfills are also used for solar power with government incentives such as the Inflation Reduction Act geared toward reducing carbon emissions. When the energy potential (methane) dwindles while the landfill is closed, a developer can use the interconnection already in place from a methane capture facility to add a solar facility.

FUNDING AND FUTURE NEED

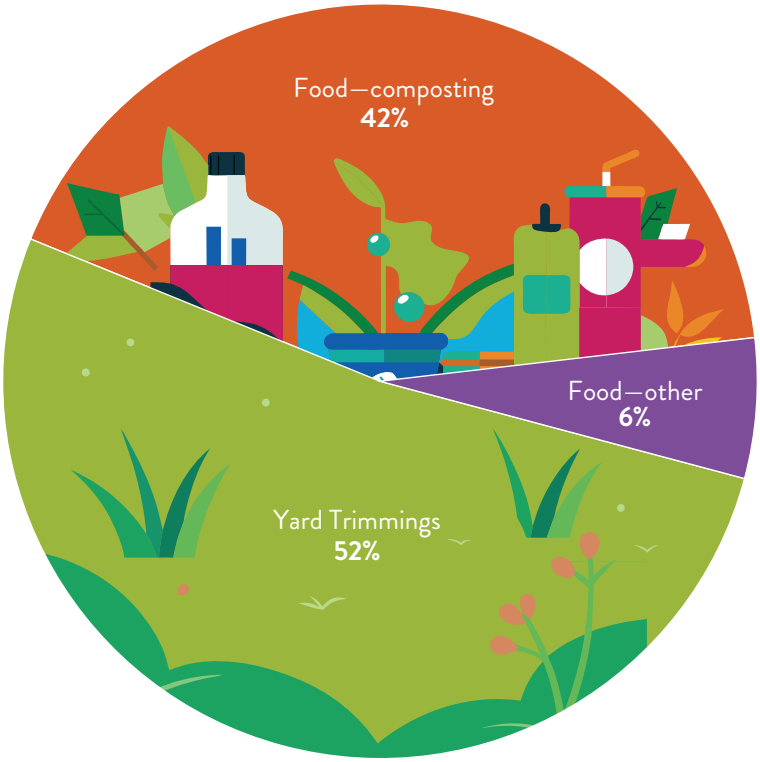
The solid waste industry, including trash collection, landfills, recycling facilities, and waste combustion costs, is self-funded through trash collection or tipping fees and the sale of recycled materials and energy. While the Infrastructure Investment and Jobs Act (IIJA) provided funding for the solid waste sector, funds were not eligible for Operation and Maintenance. Under IIJA, EPA is developing three new waste prevention, reuse, and recycling programs: Solid Waste Infrastructure for Recycling Grant Program, the Recycling Education and Outreach Grant Program, and the Battery Collection Best Practices and Voluntary Battery Labeling Guidelines.

Tipping fees are paid by those who dispose of waste in a landfill. The fee is based on the weight of the waste and used to cover the costs of landfill operations, including construction, operations, and closing costs. Some states have tipping fees that are collected by the state, while others allow local municipalities to collect the fees.

A survey of 342 landfills found a decrease in average tipping fees to $56.80 in 2023, a 3% drop from the 2022 fee of $58.47, but higher than the $55.36 tipping fee in 2019. The survey also measured weighting fees based on the relative amount of MSW disposed via landfills and the tip fee at each facility to create a ton-weighted average. The ton-weighted average decreased to $57.63 in 2023, a ten-cent decrease from the $57.73 weighted average in 2022. Tipping fees fluctuate over time and range widely among states, regions, and municipalities.[13]

Compost facilities rely on differing revenue sources with larger facilities relying on tipping fees for 80% of their revenue, while smaller facilities generate more revenue from product sales and "other" revenue streams. EREF market analysis shows that approximately one-third of the compost produced is sold for agricultural purposes, and landscaping was the most common market with 68% of materials sold to this market.[14]

EPA Composting, 2018



Source: National Overview: Facts and Figures on Materials, Wastes and Recycling | US EPA

OPERATION AND MAINTENANCE

The waste disposal industry operates largely at the local level. A 2001 snapshot of the U.S. waste disposal enterprise by EREF estimated 27,000 organizations, both in the private and public sector, provide solid waste collection and disposal in the United States; more than 55% of these were in the public sector, and the remaining 45% were privately held.

Landfills in the U.S. are subject to some EPA regulations designed to ensure public safety and protect the environment. Landfills are designed with multiple layers of protection to prevent leachate from entering the groundwater or polluting the soil. A layer of soil or other appropriate material reduces air emissions, odors, and wind-blown litter, discouraging scavengers. Once complete, landfills are subject to strict regulations and monitored following closure. While landfills are an unpopular necessity, they represent the final stop for waste that cannot be otherwise reused. When properly regulated, multiple safeguards are put in place to prevent decomposing waste from harming the environment or creating a public nuisance.[15]

In 1978, the Supreme Court recognized that interstate transportation of solid waste was "commerce" within the meaning of the Commerce Clause. The justices struck down a New Jersey regulation that banned the disposal of waste that originated outside the state, in turn limiting the ability of states to ban the import of MSW.[16]

States play a lead role in addressing federal criteria for operating MSW and industrial waste landfill regulations and may set more stringent requirements. Without an approved state program, waste facilities must meet federal requirements. Regulations address common design elements associated with landfills, including location restrictions, liner requirements, leachate collection, greenhouse gas emissions and removal systems, groundwater monitoring requirements, and closure and post-closure care requirements.

Photo: U.S. Environmental Protection Agency

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PUBLIC SAFETY

Solid waste management is closely tied to other infrastructure, such as roads, bridges, rail, energy, and inland waterways, such that service interruptions elsewhere can have an impact on solid waste collection and, in turn, compromise public health. Disasters often result in significant amounts of debris, which put pressure on local waste collection and disposal systems. These impacts can be amplified by damage to other forms of infrastructure such as roads and bridges, which compromise the removal of debris.

The Centers for Disease Control and Prevention found that most people in the U.S. have been exposed to a potentially harmful class of synthetic chemicals, called PFAS, for short, which are increasingly found in landfills. These chemicals are found in products that are discarded in landfills, such as nonstick cookware, waterproof clothing, and firefighting foams used to extinguish aircraft fires quickly and prevent them from reigniting. Exposure to certain levels of PFAS can cause adverse health effects, including cancer. Currently, no discharge limits are tied to leachate from landfills. However, some facilities are being asked to test their leachate and are being proactive with treatment of the leachate and managing residuals of treatment.[17]

RESILIENCE AND INNOVATION

Natural disasters are a concern for landfills and other waste management facilities as they are for all forms of infrastructure. Events such as floods, hurricanes, earthquakes, and others generate large amounts of debris, causing considerable disposal challenges for local public officials. However, facilities are designed factoring in safety when it comes to rainfall events, often placing them away from floodplains. Weather events are becoming more frequent, and clients, regulators, and designers are evaluating additional factors of safety beyond current design regulations.[18]

From innovative landfill designs to advanced equipment, new technologies are playing a role in improving landfill operations' efficiency, safety, and sustainability. One example is uncrewed aerial vehicles (UAVs). UAVs monitor and manage landfills using artificial intelligence to analyze data collected from landfills and predict potential issues. Machine learning algorithms can also be used to identify the types of waste being dumped at the landfill, which can help with waste segregation and recycling.

Innovative technologies and recycling efforts have proven successful in improving the safety, sustainability, and efficiency of the nation's waste disposal system. However, both the continued underuse of waste-to-energy practices and the potential of recycling highlights the need for research and development of new policies, economic feasibility plans, and management practices.

RECOMMENDATIONS TO RAISE THE GRADE

- Promote, enhance, or facilitate the development of resource recovery facilities, including those for recycling, composting, reuse, and energy recovery, as well as technologies for reducing waste generation.
- Develop cost-effective recycling and sustainable waste handling options for municipalities, specifically in communities where scale and the use of older outdated systems is an impediment.
- Emphasize source reduction through redesigning the manufacturer's packaging of goods, setting standards for the recyclability of materials (e.g., single-use plastics), and addressing the true cost of waste by implementing deposits on bottles and fees on plastic bags.
- Encourage programs that educate on the reduction of food waste and the composting of what is generated.
- Strengthen domestic markets for recycled materials in the U.S. by supporting companies looking to build domestic reprocessing plastic facilities and reuse plastics.
- Promote materials as reusable with a life cycle beyond initial use, and pivot solid waste beyond "garbage" or "trash" to potential resources.
- Oppose efforts to ban the interstate movement of MSW to regional solid waste facilities designed by state and federal regulations, recognizing that such transport may be appropriate and beneficial in regional solid waste planning efforts.
- Accelerate and increase investment in PFAS research aimed at the characterization, treatment, and analysis of these compounds and understanding their health impacts.

Photo: Wipeoutwaste Mecknc.gov

SOURCES

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