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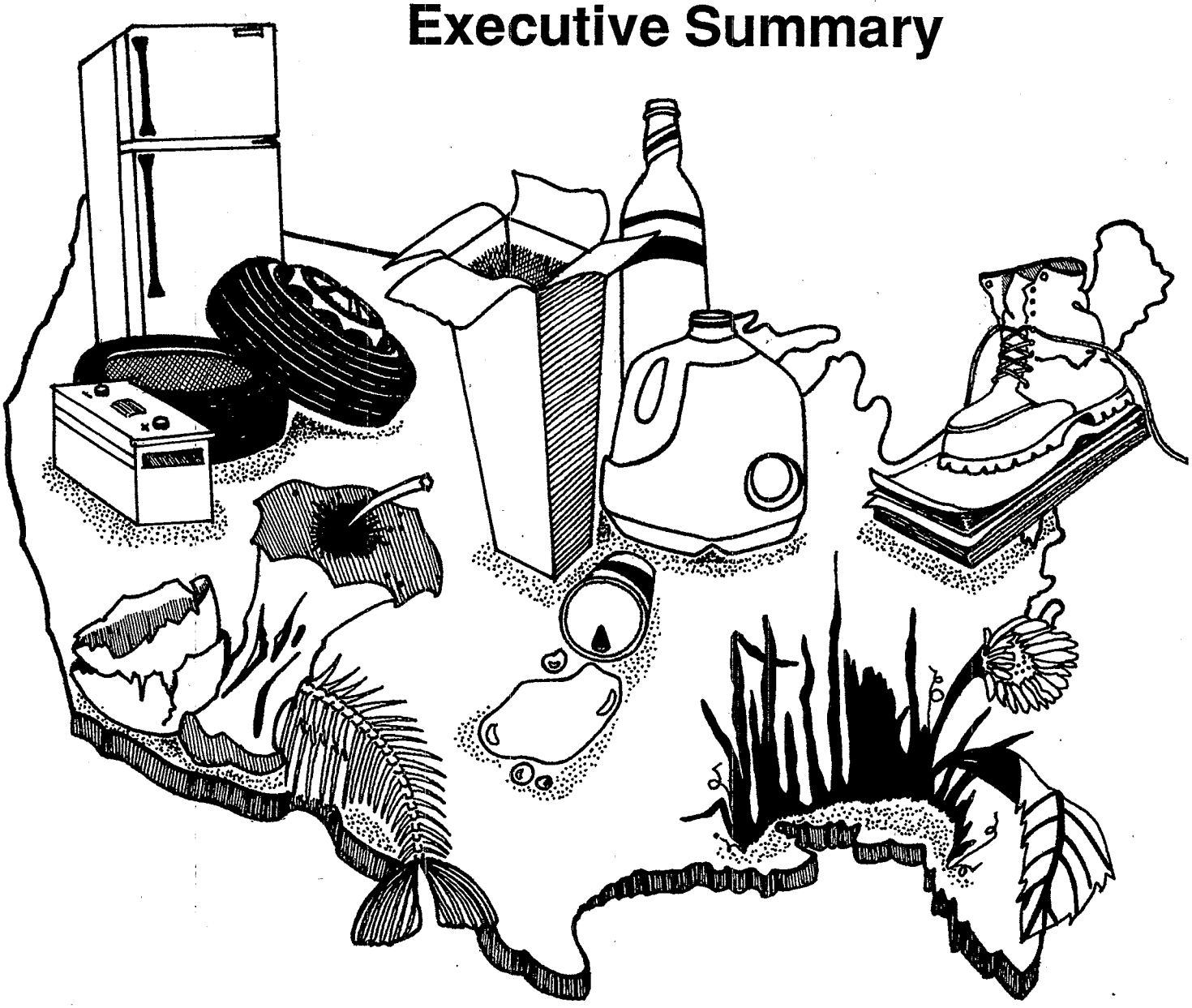
July 1992

EPA

Characterization of Municipal Solid Waste in the United States: 1992 Update

Executive Summary



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CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES 1992 UPDATE

Executive Summary

July 1992

Prepared for

U.S. Environmental Protection Agency
Municipal and Industrial Solid Waste Division
Office of Solid Waste

CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES: 1992 UPDATE

Executive Summary

Many areas of the United States currently face serious problems in safely and effectively managing the garbage they generate. As a nation, we are generating more trash than ever before. At the same time, we are finding that there are limits to traditional trash management practices. As the generation of municipal solid waste (MSW) continues to increase, the capacity to handle it is decreasing. Many landfills and combustors have closed, and new disposal facilities are often difficult to site.

As a result of these problems, many communities face hard choices when weighing trash management options. Some communities end up paying premium prices to transport their garbage long distances to available facilities. Others try to site facilities nearby and encounter intense public conflict. Of course, not all communities face such problems; numerous communities have found creative solutions through source reduction and recycling programs, and have been able to work with the public to site new, environmentally acceptable disposal capacity. Still, for much of the nation, the generation and management of garbage present problems that require our focused attention.

Identifying the components of the waste stream is an important step toward addressing the problems associated with the generation and management of garbage. MSW characterizations, which analyze the quantity and composition of the municipal solid waste stream, involve estimating how much MSW is generated, recycled, combusted, and disposed of in landfills. By determining the makeup of the waste stream, waste characterizations also provide valuable data for setting waste management goals, tracking progress toward those goals, and supporting planning at the national, state, and local levels. For example, waste characterizations can be used to highlight opportunities for source reduction and recycling and provide information on any special management issues that should be considered.

Features of This Report

This report is the most recent in a series of reports released by the U.S. Environmental Protection Agency (EPA) to characterize MSW in the United States. It characterizes the national waste stream based on data through 1990 and includes:

- Information on MSW generation from 1960 to 1990.
- Information on MSW management—recovery for recycling and composting, combustion, and landfilling—from 1960 to 1990.
- Information characterizing MSW by volume as well as by weight.
- Projections for MSW generation to the year 2000.
- Projections for MSW combustion through 2000.
- Projections (presented in three recovery scenarios) for materials recovery for recycling and composting through 2000.

Recent rapid changes in materials recycling and composting make it difficult to predict the future of municipal solid waste management. By presenting three possible scenarios for recovery in 1995 and 2000, this report illustrates how various recovery rates (e.g., 25 percent recovery in 1995) could be achieved. States and local communities can set their own goals and recovery scenarios depending upon their local situations.

Readers should note that this report characterizes the municipal solid waste stream of *the nation as a whole*. The information presented here may not, therefore, correlate with individual state or local estimates of waste generation and management because of local variations in MSW generation or because state or local estimates may include wastes other than MSW.

DEFINITIONS

Municipal solid waste includes wastes such as durable goods, nondurable goods, containers and packaging, food scraps, yard trimmings, and miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources. Examples of waste from these categories include appliances, newspapers, clothing, boxes, disposable tableware, office and classroom paper, wood pallets, and cafeteria wastes. MSW does not include wastes from other sources, such as construction and demolition wastes, municipal sludges, combustion ash, and industrial process wastes that might also be disposed of in municipal waste landfills or incinerators.

Generation refers to the amount (weight, volume, or percentage of the overall waste stream) of materials and products as they enter the waste stream and before materials recovery, composting, or combustion takes place.

Recovery refers to materials removed from the waste stream for the purpose of recycling and/or composting. Recovery does not automatically equal recycling and composting, however. For example, if markets for recovered materials are not available, the materials that were separated from the waste stream for recycling may simply be stored or, in some cases, sent to a landfill or combustor.

Discards include the municipal solid waste remaining after recovery for recycling and composting. These discards are usually combusted or disposed of in landfills, although some MSW is littered, stored, or disposed of on site, particularly in rural areas.

Methodology

There are two primary methods for conducting a waste characterization study. The first is a source-specific approach in which the individual components of the waste stream are sampled sorted, and weighed. Although this method is useful for defining a local waste stream, extrapolating from a limited number of studies can produce a skewed or misleading picture if used for a nationwide characterization of waste. Any errors in the sample or atypical circumstances encountered during sampling would be greatly magnified when expanded to represent the nation's entire waste stream.

The second method, used in this report to estimate the waste stream on a nationwide basis, is called the "material flows methodology." EPA's Office of Solid Waste and its predecessors in the Public Health Service sponsored work in the 1960s and early 1970s to develop the material flows methodology. This methodology is based on production data (by weight) for the materials and products in the waste stream, with adjustments for imports, exports, and product lifetimes.

Report Highlights

This report underscores the problems we face in municipal solid waste management: the generation of MSW continues to increase steadily, both in overall tonnage and in pounds per capita. Nevertheless, the report indicates that the combustion of MSW and materials recovery for recycling have increased in recent years, while discards to landfills have decreased. Major findings include the following:

- **In 1990, 195.7 million tons, or 4.3 pounds per person per day of MSW were generated.** After materials recovery for recycling and composting, discards were 3.6 pounds per person per day. Virtually all of these discards were combusted or sent to a landfill.

- **Without additional source reduction, the amount of waste generated in 1995 is expected to reach 208 million tons. By 2000, generation is projected to reach 222 million tons, or 4.5 pounds per person per day. The per capita figure for the year 2000 is a 5 percent increase over 1990 levels.**

- **Scenarios of 20 percent, 25 percent, and 30 percent recovery were used for 1995. Based on current trends, projected recovery will fall within this range.**

- **Recovery of MSW materials for recycling and composting was 17 percent in 1990. Combustion was 16 percent of total generation, and**

the remaining 67 percent of the municipal solid waste stream was sent to landfills or otherwise disposed.

- **MSW was also characterized by *volume*.** The results indicate which materials in MSW occupy the greatest proportion of volume in landfills, and compare these percentages to those by weight. For example, paper and paperboard products make up 32 percent of the discards (after recovery) by weight and 32 percent by volume; plastics account for 10 percent by weight and 21 percent by volume; and yard trimmings make up 19 percent by weight and 10 percent by volume.

- For the first time in this series of reports, estimates of the fraction of MSW generated by residential and commercial sources were made. It was estimated that 55 to 65 percent of MSW comes from residential sources, and that 35 to 45 percent comes from commercial sources.

Municipal Solid Waste in 1990

In 1990, generation of municipal solid waste totaled 195.7 million tons. Figure ES-1 provides a breakdown by weight of the *materials* generated in MSW in 1990. It shows that paper and paperboard products are the largest component of municipal solid waste by weight (37 percent of generation) and yard trimmings are the second largest component (roughly 18 percent of generation). Five of the remaining materials in MSW—glass, metals, plastics, wood and food wastes—range between 6 and 9 percent each by weight of total MSW generated. Other materials in MSW include rubber, leather, textiles, and small amounts of miscellaneous wastes, which each made up less than 4 percent of MSW in 1990.

Figure ES-1. Materials generated in MSW by weight, 1990
(Total weight = 195.7 million tons)

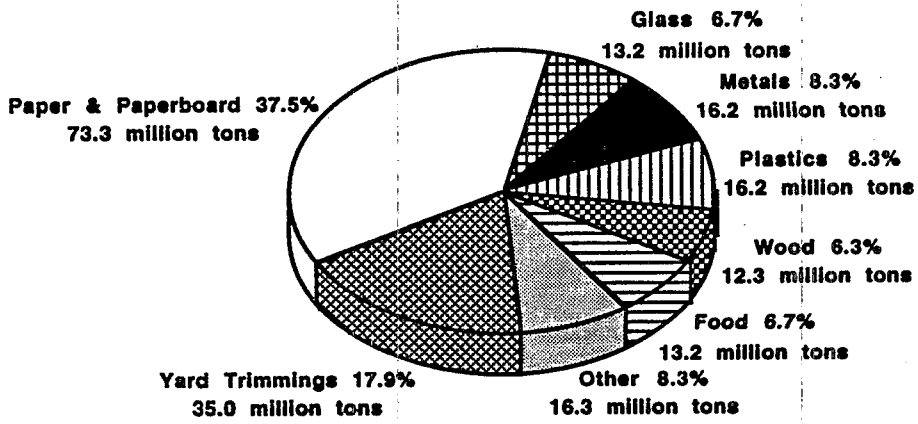
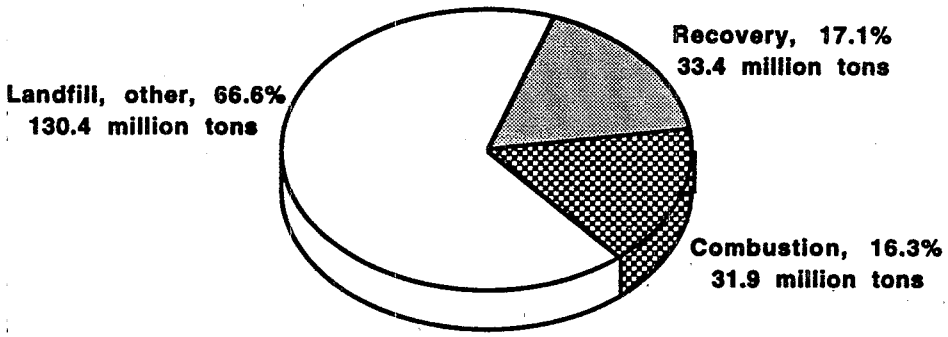


Figure ES-2. Management of MSW in U.S., 1990
(Total weight = 195.7 million tons)



The breakdown of how much waste went to recycling, combustion, and landfills is shown in Figure ES-2. *Recovery of materials* for recycling and composting was an estimated 17 percent in 1990. That amount varied significantly according to the type of waste (Table ES-1). For example, over 28 percent of paper generation was recovered in 1990, while about 2 percent of plastics in MSW were recovered.

The broad categories of materials in MSW are made up of many individual *products*. The products are grouped into major product categories as shown in Figure ES-3. In 1990, containers and packaging were the largest

Figure ES-3. Products generated in MSW by weight, 1990
(Total weight = 195.7 million tons)

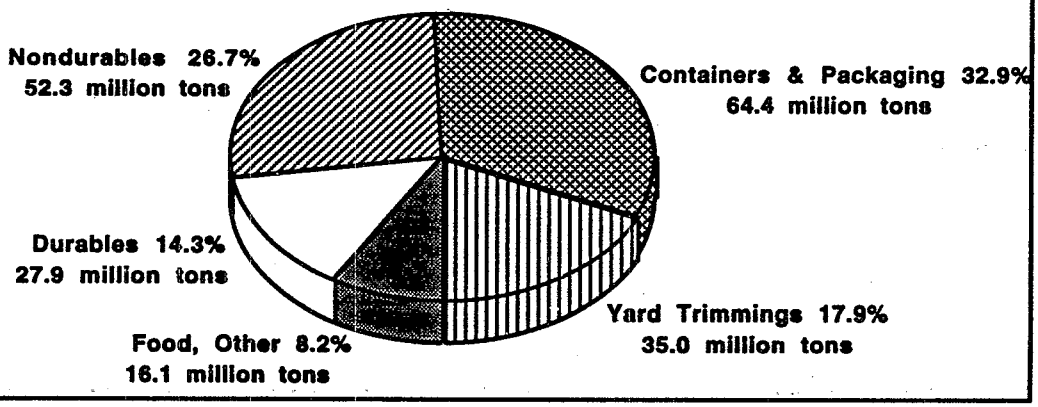


Table ES-1

GENERATION OF MSW, RECOVERY OF MATERIALS AND COMPOSTING OF YARD TRIMMINGS, 1990

	Weight Generated (in Millions of Tons)	Weight Recovered (in Millions of Tons)	Percent of Generation of Each Material
Paper and Paperboard	73.3	20.9	28.6%
Glass	13.2	2.6	19.9%
Metals			
Ferrous	12.3	1.9	15.4%
Aluminum	2.7	1.0	38.1%
Other Nonferrous	1.2	0.8	67.7%
Total Metals	*16.2*	*3.7*	*23.0%*
Plastics	16.2	0.4	2.2%
Rubber and Leather	4.6	0.2	4.4%
Textiles	5.6	0.2	4.3%
Wood	12.3	0.4	3.2%
Other	3.2	0.8	23.8%
Total Materials in Products	144.6	29.2	20.2%
Other Wastes			
Food Wastes	13.2	Neg.	Neg.
Yard Trimmings	35.0	4.2	12.0%
Miscellaneous Inorganic Wastes	2.9	Neg.	Neg.
Total Other Wastes	51.1	4.2	8.2%
TOTAL MSW	195.7	33.4	17.1%

Neg. = Negligible (less than 0.05 percent or 50,000 tons).

single product category generated in MSW by weight, at roughly 33 percent of the total. Nondurable goods (such as newspapers and disposable food service items) were the second largest category, at 27 percent of the total. Yard trimmings were approximately 18 percent and durable goods (such as furniture and tires) were 14 percent of total generation in 1990.

MSW Volume Estimates

Although solid waste is usually characterized by weight, information about volume is important for such issues as determining how quickly landfill capacity is being filled and identifying the rate at which the volumes of various materials in the waste stream are changing.

Volume estimates of solid waste, however, are far more difficult to make than weight estimates. A pound of paper is a pound of paper whether it is in flat sheets, crumpled into a wad, or compacted into a bale, but the volume occupied in each case will be very different. The estimates presented here represent the relative volume of materials as they would typically be found if compacted individually in a landfill (a significant amount of compaction occurs in a landfill). These estimates are based largely on empirical data that are then used to estimate density factors (pounds per cubic yard) for components of solid waste under simulated landfill conditions, with corroboration from actual landfill studies. It should be noted, however, that individual component density measurements serve only to compare component volume requirements, one to another. The component measurements should not be used to estimate landfill densities of mixed municipal solid waste.

Figure ES-4 shows the materials in MSW by volume as a percent of total MSW discards (after recovery) in 1990. The paper and paperboard category ranks first in volume of MSW discarded (32 percent). Plastics rank second in volume, at 21 percent of the total, and yard trimmings are third, at 10 percent. Paper and plastics combined account for over one-half of the volume of MSW discarded in 1990.

Figure ES-4. Landfill volume of materials in MSW, 1990 (In percent of total)

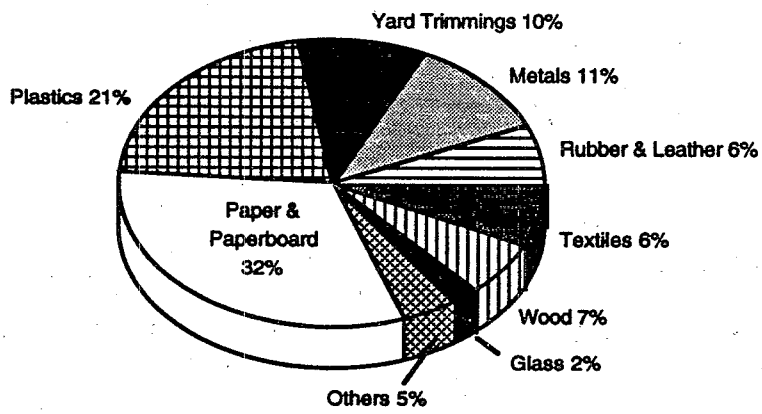


Table ES-2

VOLUME OF MATERIALS DISCARDED IN MSW, 1990

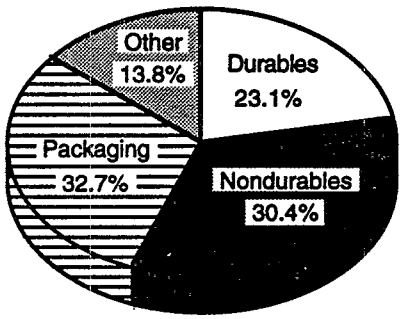
	1990 Discards (mil tons)	Weight (% of MSW total)	Volume (% of MSW total)	Ratio (volume %/ weight %)
Paper and Paperboard	52.4	32.3%	31.9%	1.0
Plastics	15.9	9.8%	21.1%	2.2
Yard Trimmings	30.8	19.0%	9.8%	0.5
Ferrous Metals	10.4	6.4%	8.9%	1.4
Rubber and Leather	4.4	2.7%	6.1%	2.2
Textiles	5.3	3.3%	6.4%	1.9
Wood	11.9	7.3%	6.8%	0.9
Food Wastes	13.2	8.1%	3.2%	0.4
Other	5.7	3.5%	1.4%	0.4
Aluminum	1.6	1.0%	2.2%	2.1
Glass	10.6	6.5%	2.2%	0.3
TOTALS	162.3	100%	100%	1.0

Table ES-2 compares 1990 volume and weight estimates for materials in MSW contained in the report. The right-hand column shows the ratio of volume to weight for each material. A ratio of 1.0 means that the material occupies the same proportion by volume as by weight. Values greater than 1.0 mean that the material occupies a larger proportion of volume than weight.

Four materials stand out as having ratios of approximately 2.0 or greater: plastics, rubber and leather, textiles, and aluminum. By contrast, yard trimmings, food, and glass each have ratios of 0.5 or less, indicating that these materials are quite dense and occupy proportionately less volume in landfills.

Figure ES-5 shows the product categories that make up MSW by volume of total discards in 1990. Containers and packaging (at about 33 percent) and nondurables (at about 30 percent) occupy similar shares of MSW by volume. Durables goods are an estimated 23 percent of MSW discards volume.

Figure ES-5. Landfill volume of MSW product categories, 1990 (in percent of total)



Trends in MSW Generation, Recovery, and Discards

Generation of municipal solid waste grew steadily between 1960 and 1990, from 88 million to over 195 million tons per year. Per capita generation of MSW increased from 2.7 pounds per person per day in 1960 to 4.3 pounds per person per day in 1990. By 2000, projected per capita MSW generation is 4.5 pounds per person per day (222 million tons). This projection suggests a substantial slowing in the rate of increase of MSW generation. Actually achieving the projected decline hinges on diverse variables that are difficult to predict. They range from demographic changes, economic factors, and consumer preferences such as those for lighter packaging materials, to social trends such as the decline in newspaper readership, as well as efforts in source reduction such as backyard composting, packaging reduction, and production of more durable products.

Recovery has increased gradually from about 7 percent of MSW generated in 1960 to 17 percent in 1990. Projected scenarios for recovery are between 20 and 30 percent in 1995 and 25 and 35 percent in 2000. To achieve these recovery rates, some products will have to be recovered at rates of 50 percent or more, and there will have to be substantial composting of yard trimmings.

Combustors handled an estimated 30 percent of MSW generated in 1960, most of them with no energy recovery and no air pollution controls. In the 1960s and 1970s, combustion dropped steadily as the old incinerators were closed, reaching a low of less than 10 percent of MSW generated by 1980. More recently, combustion of MSW has been increasing again (to 32 million tons, or roughly 16 percent of generation, in 1990). All major new facilities have energy recovery and are designed to meet air pollution standards.

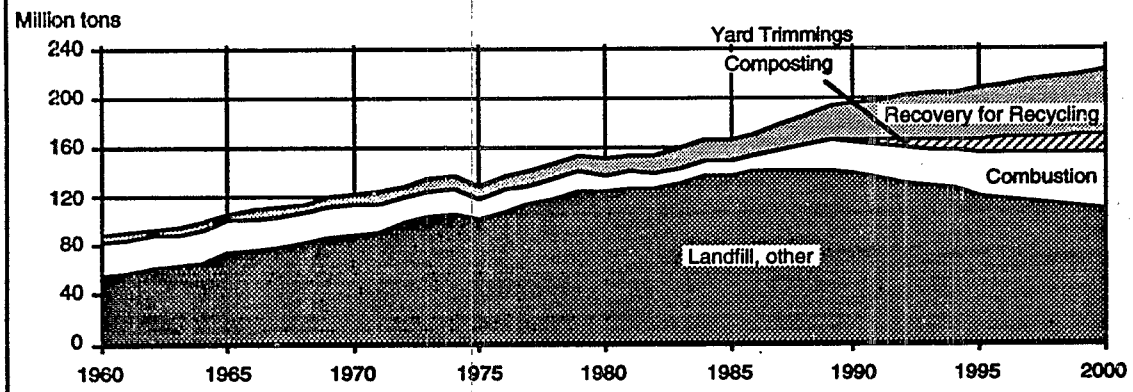
The report projects that about 35 million tons of MSW will be combusted in 1995, and 46 million tons will be combusted in 2000. Estimates of combustion projections are based on an assumption that the facilities will operate at 80 percent of capacity.

Landfill use fluctuates with changes in the use of alternative solid waste management methods. For example, when the use of combustion for MSW management declined and recovery rates were low, the MSW percentage sent to landfills increased (Figure ES-6). Alternatively, when recovery and combustion of MSW increased, the percentage of MSW discarded to landfills declined. In 1960, approximately 62 percent of MSW was sent to landfills. This increased to 81 percent in 1980, then decreased to 67 percent in 1990 due to changing trends in municipal solid waste management.

Recovery for recycling at the 25 percent scenario for 1995 and the 30 percent scenario for 2000 will keep total national discards of MSW after recovery at about the current level of 162 million tons or less, considering projected rates of generation. Composting and combustion are required to substantially decrease the amounts landfilled (Figure ES-6).

As we approach the twenty-first century, integrated waste management with a focus on source reduction and recycling is clearly the solution to our growing waste management needs. Through source reduction, recycling, and composting, we can reduce generation and increase recovery, and, in turn, reduce the quantities of waste that must be managed by combustors and landfills.

Figure ES-6. Municipal solid waste management, 1960 to 2000



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