



Characterization of Municipal Solid Waste in the United States: 1990 Update

Executive Summary



Jo Ward

EPA/530-SW-90-042A

**Characterization of Municipal
Solid Waste in the United
States: 1990 Update**

Executive Summary

June 13, 1990

United States Environmental Protection Agency

Office of Solid Waste

Acknowledgements

The report, *Characterization of Municipal Solid Waste in the United States: 1990 Update*, was developed under EPA contract No. 68-01-7310 under the direction of Paul Kaldjian at EPA. Appreciation is extended to the many individuals in the Office of Solid Waste who reviewed and commented on drafts of the report. EPA also wishes to give special thanks to Jo Nord, the artist of the cover illustration.

Ordering Information

The complete report is available through the National Technical Information Service (NTIS). To order, call NTIS at (703) 487-4650. A fact sheet highlighting the major findings of the report is also available. To obtain additional copies of this Executive Summary (EPA/530-SW-90-042A) or the fact sheet (EPA/530-SW-90-042B) at no charge, call the RCRA/Superfund Hotline at (800) 424-9346; TDD (800) 553-7672 for the hearing impaired. In Washington, DC, the number is (202) 382-3000; TDD (202) 475-9652.

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, 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. Still, for much of the nation, the generation and management of garbage presents problems that require our focused attention.

Identifying the components of the waste stream is an important step toward solving 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 1988 and includes:

- Information on MSW generation from 1960 to 1988.
- Information on recovery for recycling, composting, and combustion from 1960 to 1988.
- Information characterizing MSW by volume as well as by weight.
- Projections for MSW generation to the year 2010.
- Projections for MSW combustion through 2000.
- Projections (presented as a range) for recovery and recycling through 1995.

Unlike previous EPA characterization reports, this report does not include long-range projections for materials recovery. This is due to the significant uncertainties in making those projections. For example, rapid changes are now taking place at the federal, state, and local level that may have profound effects on such projections. In addition, shifts in consumer attitudes and behaviors, industry practices and efforts, and technological advances will greatly influence recovery and recycling. The potential impact of all of these changes is very difficult to predict.

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.

Methodology

There are two primary methods for conducting a waste characterization study. The first is a site-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

DEFINITIONS

Municipal solid waste includes wastes such as durable goods, nondurable goods, containers and packaging, food wastes, yard wastes, and miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources. Examples of waste from these categories include appliances, newspapers, clothing, food scraps, boxes, disposable tableware, office and classroom paper, wood pallets, and cafeteria wastes. MSW does not include wastes from other sources, such as municipal sludges, combustion ash, and industrial nonhazardous 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 (incineration) 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 incinerator.

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.

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. In addition, the report indicates that materials recovery for recycling and the combustion of MSW have increased in recent years, while discards to landfills have decreased. Major findings include the following:

- **In 1988, 180 million tons, or 4.0 pounds per person per day of MSW were generated.** After materials recovery for recycling, discards were 3.5 pounds per person per day. Virtually all of these discards were combusted or sent to a landfill.
- **Without source reduction, the amount of waste generated in 1995 is expected to reach 200 million tons, or 4.2 pounds per person per day. By 2000, generation is projected to reach 216 million tons, or 4.4 pounds per person per day. The per capita figure for the year 2000 is a 10 percent increase over 1988 levels.¹**
- **Based on current trends and information, EPA projects that 20 to 28 percent of MSW will be recovered annually by 1995.** Exceeding this projected range will require fundamental changes in government programs, technology, and corporate and consumer behavior.

¹ This report updates generation projections and estimates from previous reports. The projected per capita generation estimate for the year 2000 has been increased from just under 4 pounds to 4.4 pounds. This report also increases the 1986 per capita generation estimate by 6 percent—from 3.6 to 3.8 pounds. These projections and estimates have been adjusted because the 1990 report includes additional items in the data base, such as automotive batteries and disposable diapers, corrections for imported packaging materials, and changes in the detail available in the data base, e.g., natural rubber in tires and additional plastic items.

- Recovery of MSW materials for recycling was 13 percent in 1988. Combustion was 14 percent of total generation, and the remaining 73 percent of the municipal solid waste stream was sent to landfills or otherwise disposed of.²
- For the first time in this series of characterization reports, MSW is 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 34 percent of the discards (after recovery) by weight and 34 percent by volume; plastics account for 9 percent by weight and 20 percent by volume; and yard wastes make up 20 percent by weight and 10 percent by volume.

Municipal Solid Waste in 1988

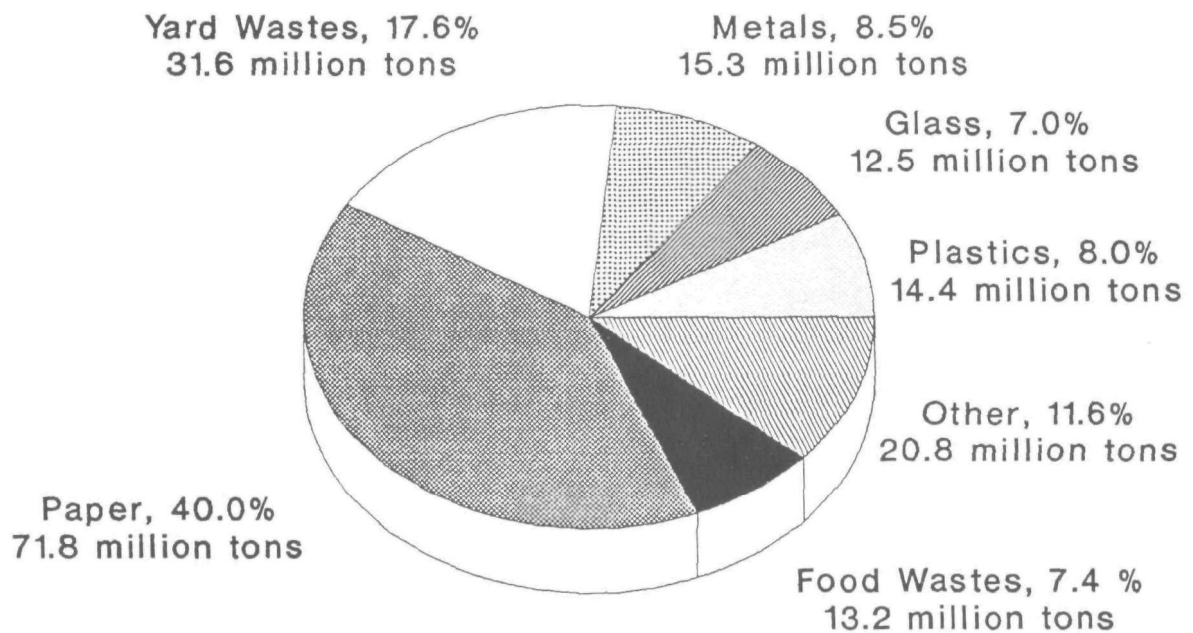
In 1988, generation of municipal solid waste totaled 179.6 million tons. Figure ES-1 provides a breakdown by weight of the *materials* generated in MSW in 1988. It shows that paper and paperboard products are the largest component of municipal solid waste by weight (40 percent of generation) and yard wastes are the second largest component (roughly 18 percent of generation). Four of the remaining materials in MSW—glass, metals, plastics, and food wastes—range between 7 and 9 percent each by weight of total MSW generated. Other materials in MSW include rubber, leather, textiles, wood, and small amounts of miscellaneous wastes, which each made up less than 4 percent of MSW in 1988.

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 13 percent in 1988. That amount varied significantly according to the type of waste (Table ES-1). For example, nearly 26 percent of waste paper was recovered in 1988, while less than 2 percent of plastic wastes 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 1988, containers and packaging were the largest single product category generated in MSW by weight, at roughly 32 percent of the total. Nondurable goods (such as newspapers and disposable food service items) were the second largest category, at 28 percent of the total. Yard wastes were approximately 18 percent and durable goods (such as furniture and tires) were 14 percent of total generation in 1988.

² While essentially all of the 73 percent of the waste stream was sent to landfills, it should be recognized that some waste may be littered, stored, or disposed of at the site of generation.

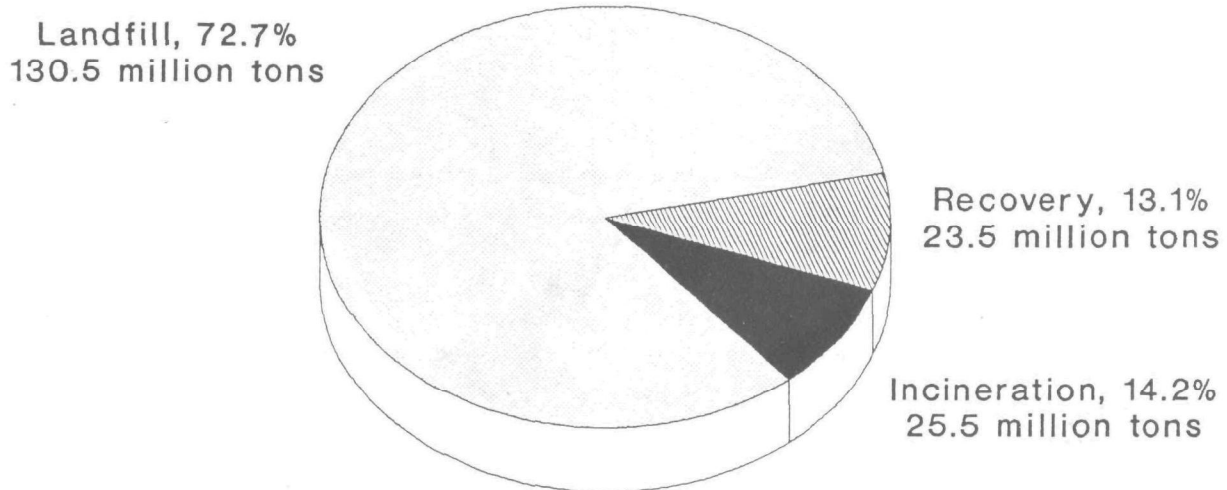
MATERIALS GENERATED IN MSW BY WEIGHT, 1988



TOTAL WEIGHT = 179.6 million tons

FIGURE ES-1

MANAGEMENT OF MSW IN U.S., 1988



TOTAL WEIGHT = 179.6 million tons

FIGURE ES-2

TABLE ES-1

**Generation of MSW, Recovery of Materials
and Composting of Food and Yard Waste, 1988**

	Weight Generated (in Millions of Tons)	Weight Recovered (in Millions of Tons)	Percent of Generation of Each Material
Paper and Paperboard	71.8	18.4	25.6
Glass	12.5	1.5	12.0
Metals			
Ferrous	11.6	0.7	5.8
Aluminum	2.5	0.8	31.7
Other Nonferrous	1.1	0.7	65.1
Total Metals	<u>15.3</u>	<u>2.2</u>	14.6
Plastics	14.4	0.2	1.1
Rubber and Leather	4.6	0.1	2.3
Textiles	3.9	0.0	0.6
Wood	6.5	0.0	0.0
Other	<u>3.1</u>	<u>0.7</u>	21.7
Total Nonfood Product Wastes	132.1	23.1	17.5
Other Wastes			
Food Wastes	13.2	0.0	0.0
Yard Wastes	31.6	0.5	1.6
Miscellaneous Inorganic Wastes	<u>2.7</u>	0.0	0.0
Total Other Wastes	<u>47.5</u>	<u>0.5</u>	1.1
Total MSW	179.6	23.5	13.1

PRODUCTS GENERATED IN MSW BY WEIGHT, 1988

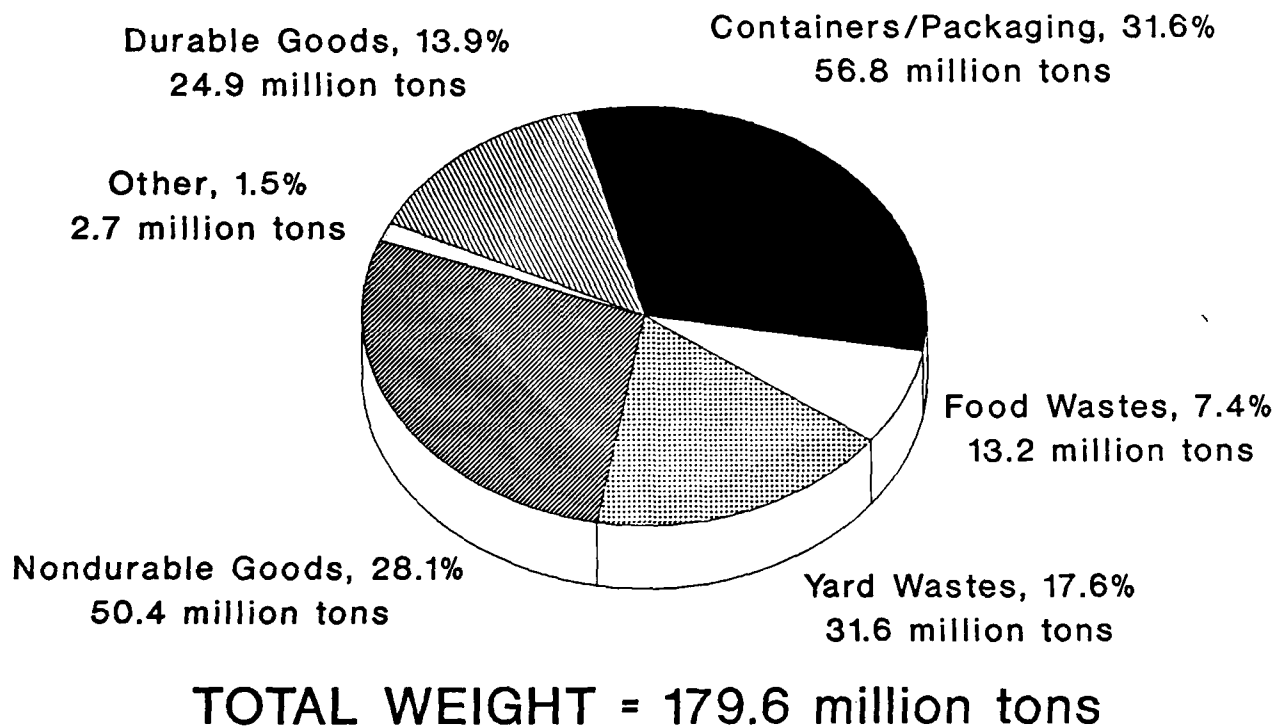


FIGURE ES-3

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 figures in this report are estimations of the volume of materials as they would typically be found 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.

Figure ES-4 shows the materials in MSW by volume as a percent of total MSW discards in 1988. The paper and paperboard category ranks first in volume of MSW discarded (34 percent). Plastics rank second in volume, at 20 percent of the total, and yard wastes are third, at 10 percent. Paper and plastics combined account for over one-half of the volume of MSW discarded in 1988.

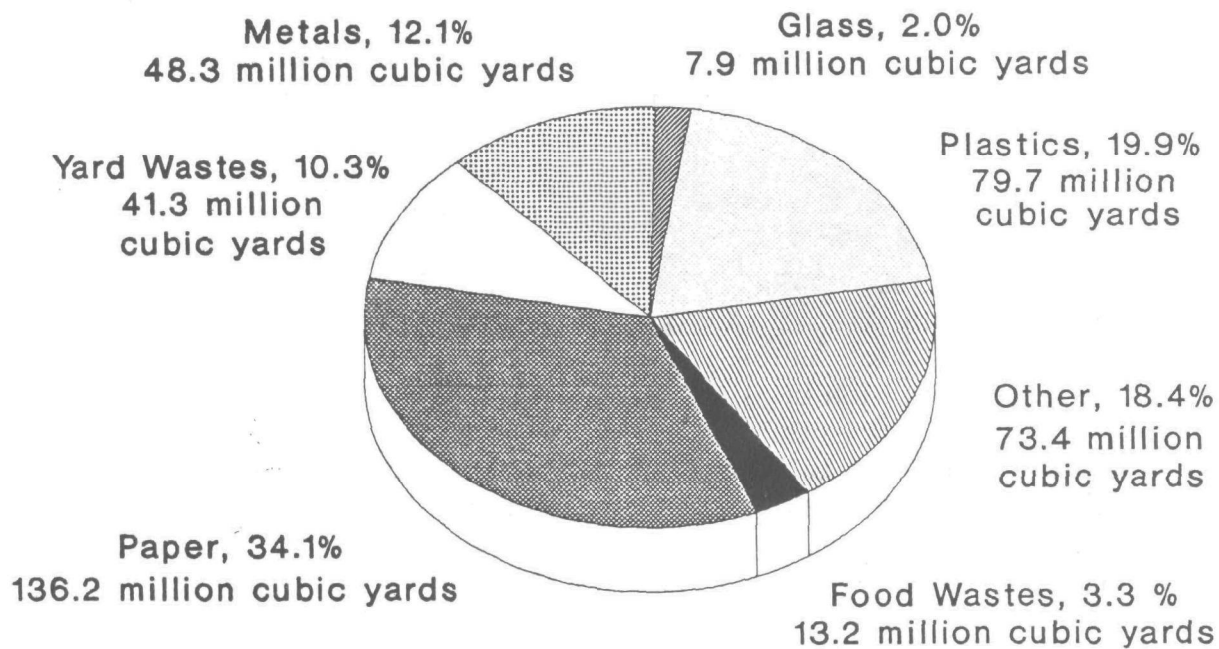
Table ES-2 compares 1988 volume and weight estimates for materials in MSW contained in the report. The right-hand column shows the ratio of volume to weight for each material. A ratio of 1.0 means that the material occupies the same proportion by volume as by weight. Values greater than 1.0 mean that the material occupies a larger proportion of volume than weight. Four materials have ratios greater than 2.0: plastics, rubber and leather, textiles, and aluminum. By contrast, yard wastes, 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 1988. Nondurable goods rank first in volume percentage at 34 percent. Containers and packaging are second in volume (roughly 30 percent), and durable goods are third (approximately 22 percent).

Trends in MSW Generation, Recovery, and Discards

Generation of municipal solid waste grew steadily between 1960 and 1988, from 88 million to nearly 180 million tons per year. Per capita generation of MSW increased from 2.7 pounds per person per day in 1960 to 4.0 pounds per person per day in 1988. Between 1986 and 1988, generation increased from 3.8 to 4.0 pounds per person per day (167 million to 180 million tons per year). By 2000, projected per capita MSW generation is 4.4

LANDFILL VOLUME OF DISCARDS IN MSW, 1988



TOTAL VOLUME = 400 million cubic yards

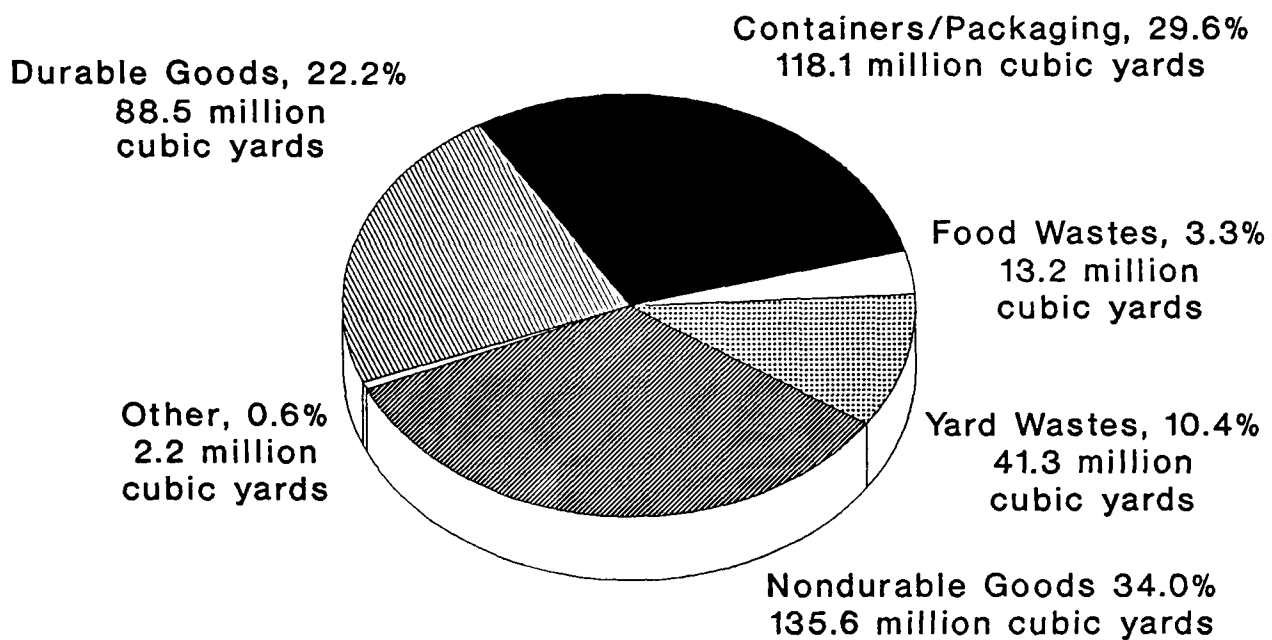
FIGURE ES-4

TABLE ES-2

Volume of Materials Discarded in MSW, 1988

	1988 Discards (mil tons)	Weight (% of MSW total)	Volume (% of MSW total)	Ratio (vol %/ wt %)
Paper and Paperboard	53.4	34.2	34.1	1.0
Plastics	14.3	9.2	19.9	2.2
Yard Wastes	31.0	19.9	10.3	0.5
Ferrous Metals	10.9	7.0	9.8	1.4
Rubber and Leather	4.4	2.9	6.4	2.3
Textiles	3.8	2.5	5.3	2.1
Wood	6.5	4.2	4.1	1.0
Food Wastes	13.2	8.5	3.3	0.4
Other	5.6	3.6	2.5	0.7
Aluminum	1.7	1.1	2.3	2.1
Glass	<u>11.1</u>	<u>7.1</u>	<u>2.0</u>	0.3
TOTALS	156	100	100	1.0

PRODUCTS DISCARDED IN MSW BY VOLUME, 1988



TOTAL VOLUME = 400 million cubic yards

FIGURE ES-5

pounds per person per day (216 million tons). Projected MSW generation in the year 2010 is over 250 million tons, or 4.9 pounds per person per day. Figure ES-6 shows the generation (in millions of tons) of materials in MSW between 1960 and 1988 with projections to 2010.

Recovery has increased gradually from about 7 percent of the waste generated in 1960 to 13 percent in 1988. Recovery is projected to reach between 20 percent and 28 percent of MSW generated in 1995. These projections are presented as a range because of the many unpredictable factors that might influence the growth of recovery and recycling over the next 5 years. These factors include possible changes in the Resource Conservation and Recovery Act (RCRA), which regulates the treatment, storage, and disposal of the nation's solid waste; other federal and state legislative proposals; deposit bills; bans; regional and local efforts; municipal waste combustion and landfill source separation proposals; municipal source reduction and recycling programs; industry efforts and recycling technology. While specific predictions about recycling might be misleading, EPA believes that with fundamental changes in activities and programs related to recycling, we can achieve even higher recycling rates than those projected.

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 25.5 million tons, or roughly 14 percent of generation, in 1988). All major new facilities have energy recovery and are designed to meet air pollution standards.

The report projects that more than 45 million tons of MSW will be combusted in 1995, and 55 million tons will be combusted in 2000. It should be noted that because of the long lead time in planning, permitting, and constructing incineration facilities, projections for combustion are easier to make than projections for recovery. Estimates of combustion projections are based on assumptions that assume 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 incineration for MSW management declines and recovery rates are low, the MSW percentage sent to landfills increases. Alternatively, when recovery and combustion of MSW increase, the percentage of MSW discarded to landfills declines. In 1960, approximately 62 percent of MSW was sent to landfills. This increased to 81 percent in 1980, then decreased to 73 percent in 1988 due to changing trends in municipal solid waste management.

U.S. MSW GENERATION, 1960-2010

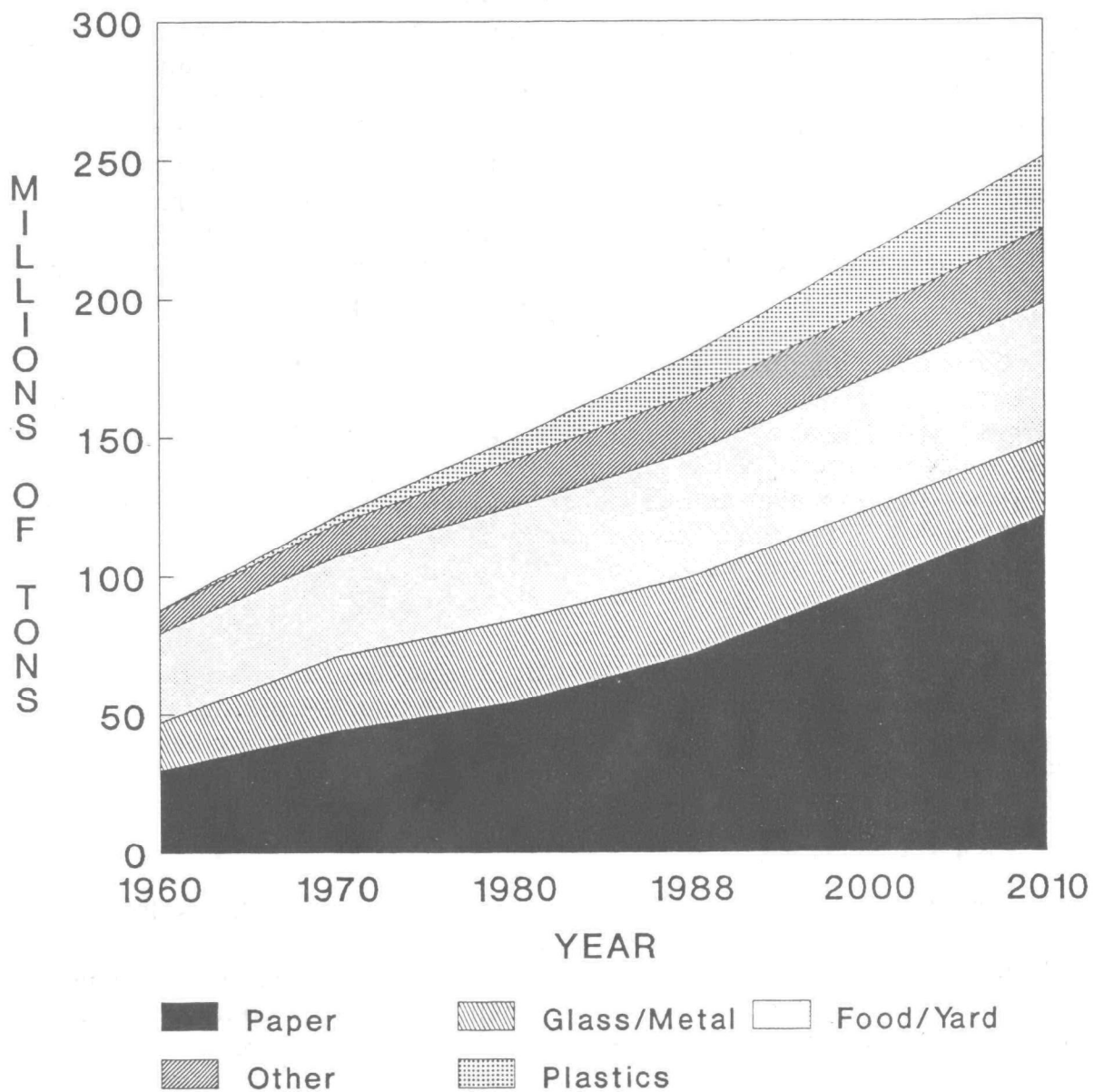


FIGURE ES-6

As we approach the twenty-first century, integrated waste management is clearly the solution to our growing waste needs. Through source reduction and recycling, we can reduce generation and increase recovery, and, in turn, reduce our reliance on combustors and landfills.