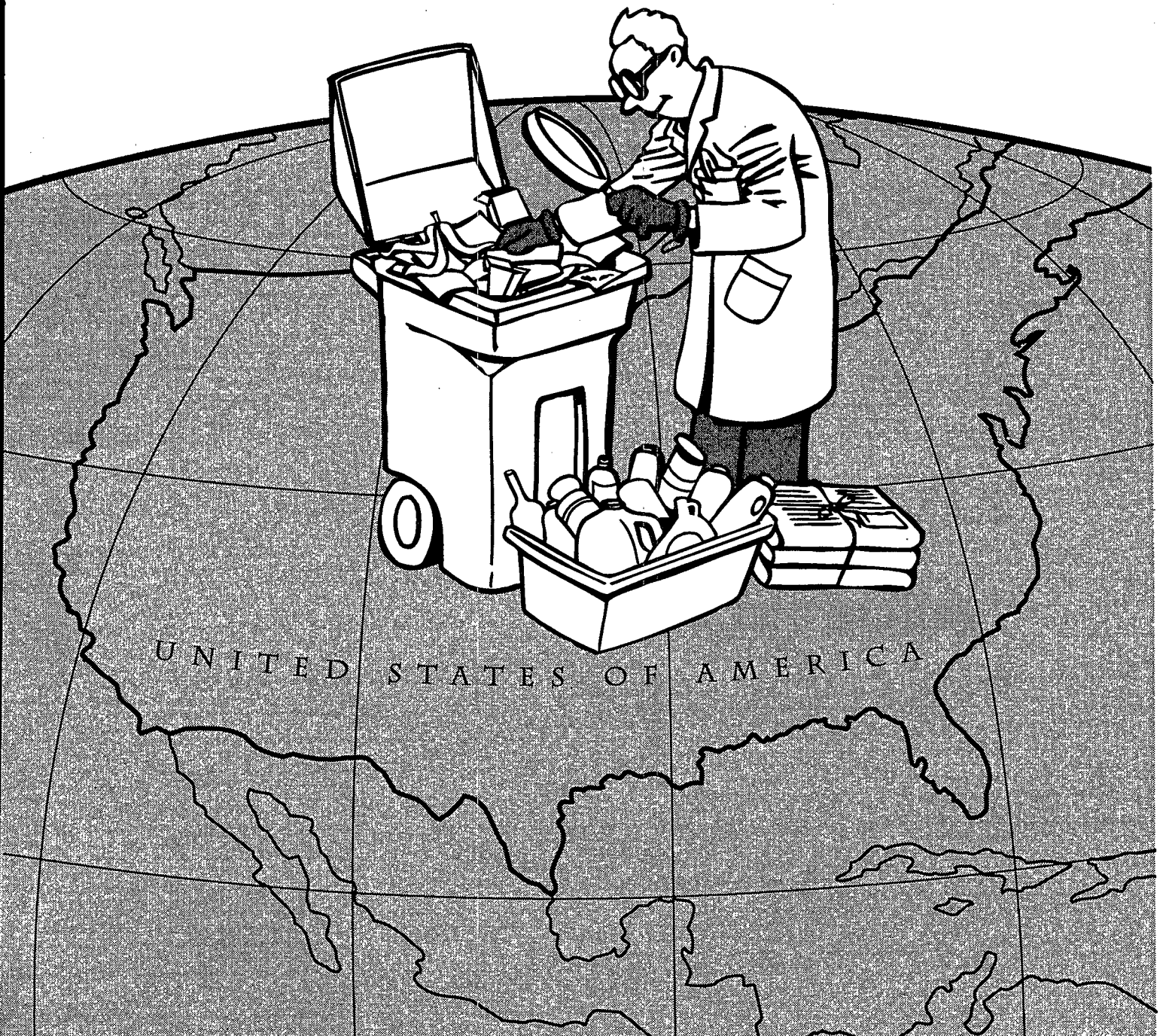
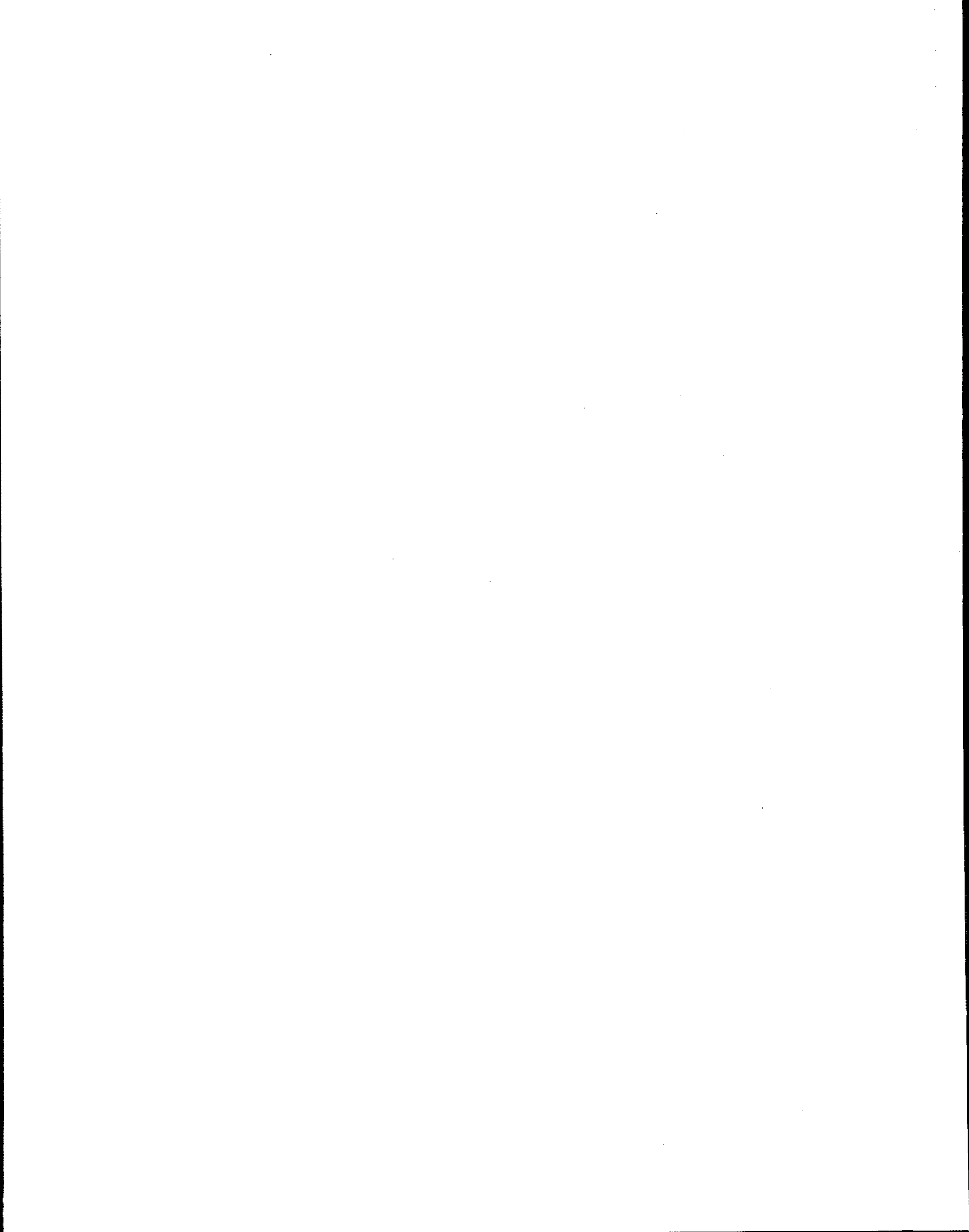




Characterization of Municipal Solid Waste in The United States: 1997 Update Executive Summary





**CHARACTERIZATION OF
MUNICIPAL SOLID WASTE
IN THE UNITED STATES:**

**1997 UPDATE
EXECUTIVE SUMMARY**

Prepared for

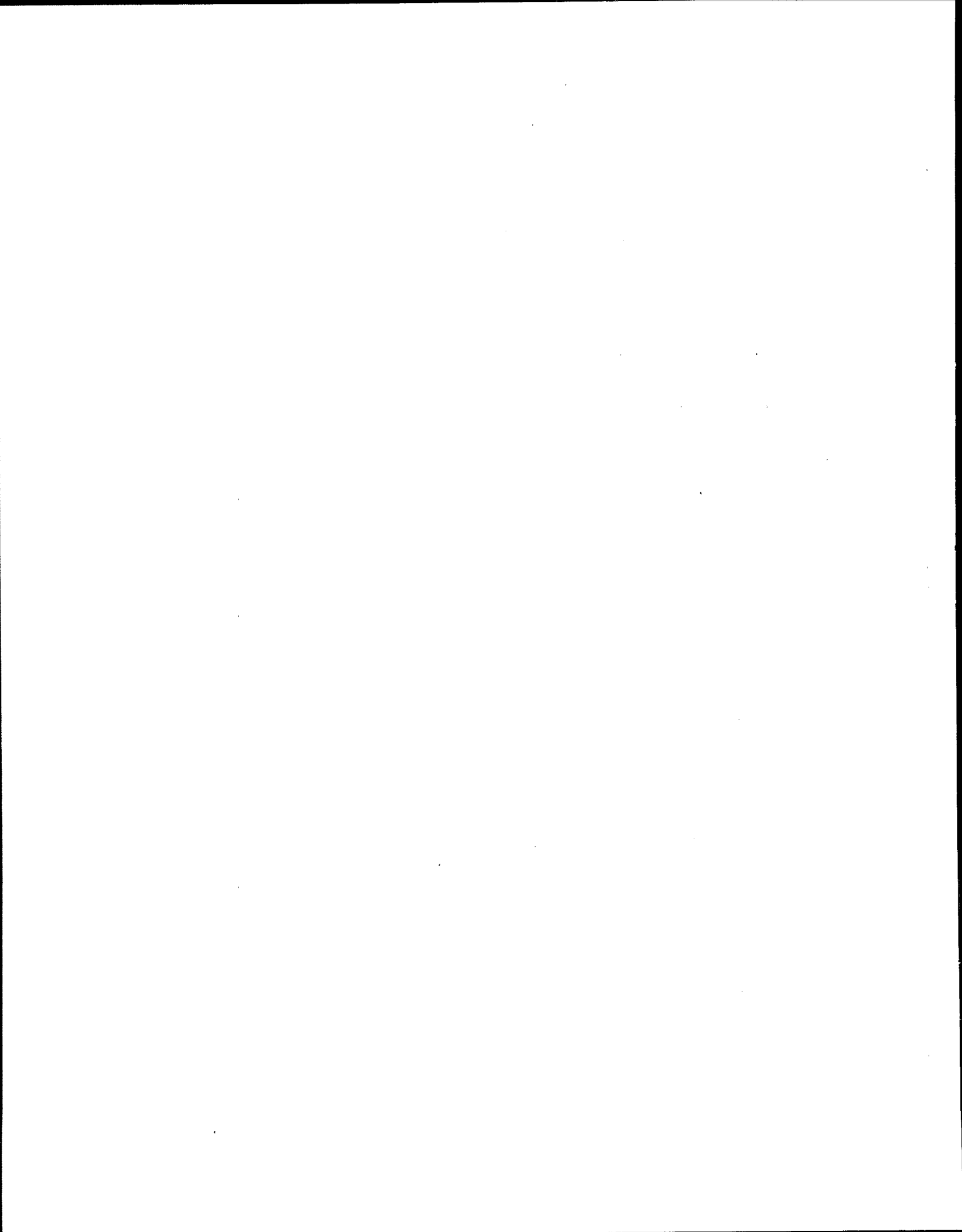
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CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES: 1997 UPDATE

Executive Summary

FEATURES OF THIS REPORT

This report is the latest in a series of reports published by the U.S. Environmental Protection Agency (EPA) describing the national municipal solid waste (MSW) stream. The report characterizes the national solid waste stream for 1996. It also discusses trends and highlights changes that have occurred over the years, both in the types of wastes generated and in the ways they are managed. Although the report does not specifically address local and regional variations in the waste stream, the data in the report can be used to develop approximate estimates of MSW generation and composition in defined areas.

This report includes information on:

- Total MSW generation, recovery, and discards from 1960 to 1996.
- Per capita generation and discard rates.
- Materials (e.g., paper, glass, metals, plastic) that comprise MSW, as well as products (e.g., durable and nondurable goods, containers, packaging) found in the waste stream.
- Aggregate data on the infrastructure for MSW management, including estimates of the number of curbside recycling programs, drop-off centers, materials recovery facilities, and composting programs in the United States.
- Trends in MSW management from 1960 to 1996, including source reduction, recovery for recycling (including composting), and disposal via combustion and landfilling.
- Markets for major recovered materials (paper and paperboard, container glass, aluminum cans, steel in cans and appliances, PET and HDPE plastics, and compost).

REPORT HIGHLIGHTS

1996 MSW Generation and Management:

- A total of 209.7 million tons of MSW was generated in 1996. This reflects a decrease of nearly 2 million tons from 1995, when MSW generation was 211.5 million tons.
- The per capita generation rate in 1996 was 4.3 pounds per person per day, compared to 4.4 pounds per person per day in 1995.
- The per capita discard rate (after recovery for recycling, including composting) was 3.2 pounds per person per day in 1996, down from 3.3 pounds per person per day in 1995.
- Recycling (including composting) recovered 27 percent (57 million tons) of MSW in 1996, up from 26 percent (55 million tons) in 1995.*
- There were nearly 9,000 curbside recycling programs in the United States in 1996, as well as more than 10,000 drop-off centers for recyclables. About 360 materials recovery facilities helped process the recyclables collected. More than 3,000 yard trimmings composting programs were reported.
- Recovery of paper and paperboard reached 41 percent (33 million tons) in 1996, accounting for more than half of the total MSW recovered. In addition, nearly 11 million tons of yard trimmings were recovered for composting in 1996, accounting for the second largest fraction of total recovery. The percentage of yard trimmings composted (38 percent) has more than doubled since 1992.
- Landfills managed 55 percent of MSW generated (116 million tons), down from 57 percent in 1995. Combustion facilities managed 17 percent (36 million tons) of total MSW generated, about the same as in 1995.

* Data shown for years prior to 1996 have been adjusted to reflect the latest revisions to the methodology and therefore may differ slightly from the same measure reported in previous updates.

DEFINITIONS AND METHODOLOGY

Municipal solid waste (MSW) 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, automobile tires, 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 debris, automobile bodies, municipal sludges, combustion ash, and industrial process wastes that might also be disposed in municipal waste landfills or incinerators.

Source reduction activities reduce the amount or toxicity of wastes before they enter the municipal solid waste management system (see **Generation**). Reuse is a source reduction activity involving the recovery or reapplication of a package, used product, or material in a manner that retains its original form or identity. Reuse of products such as refillable glass bottles, reusable plastic food storage containers, or refurbished wood pallets are examples of source reduction.

Generation refers to the amount (weight or volume) of materials and products that enter the waste stream before recycling (including composting), landfilling, or combustion takes place.

Recovery of materials means removing MSW from the waste stream for the purpose of recycling (including composting). Recovery for recycling as defined for this report includes purchases of postconsumer recovered materials plus net exports of the materials. Recovery of yard trimmings includes diverting yard trimmings from disposal to a composting facility. For some materials, recovery for uses such as highway construction or insulation is considered recovery along with materials used in remanufacturing processes.

Combustion includes combustion of mixed MSW, fuel prepared from MSW, or a separated component of MSW (such as rubber tires), with or without energy recovery.

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



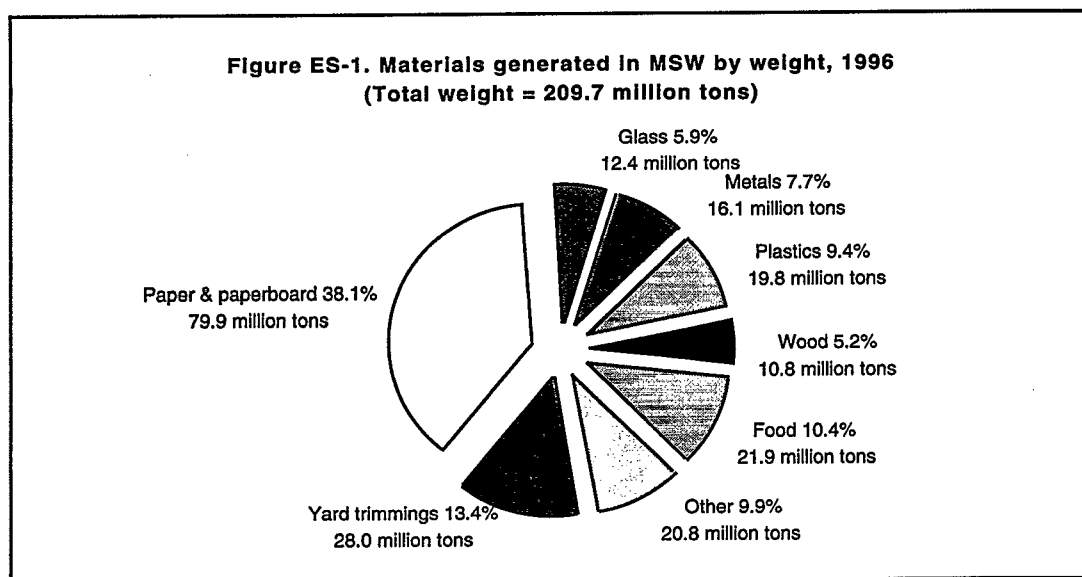
Methodology. There are two primary methods for conducting a waste characterization study. The first is a source-specific approach in which the individual components of the waste stream are sampled, sorted, and weighed. Although this method is useful for defining a local waste stream, extrapolating from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

MUNICIPAL SOLID WASTE IN 1996

MSW consists of both materials and products. Materials in MSW include paper and paperboard, yard trimmings, glass, metal, plastics, wood, and food wastes. Each material category (except for food wastes and yard trimmings) is made up of many different products. Products in MSW are grouped into three main categories: (1) durable goods (e.g., appliances), (2) nondurable goods (e.g., newspapers), and (3) containers and packaging. These product categories generally contain each type of MSW material, with some exceptions. The durable goods category contains no paper and paperboard. The nondurable goods category contains no paper and paperboard. The containers and packaging category includes only very small amounts of rubber, leather, and textiles.

Materials in MSW

In 1996, MSW generation totaled 209.7 million tons. Figure ES-1 provides a breakdown, by weight, of the MSW materials generated in 1996. Paper and paperboard products made up the largest component of MSW generated (38 percent), and yard trimmings comprised the second largest material component (13 percent). Glass, metals, plastics, wood, and food wastes each constituted



between 5 and 10 percent of the total MSW generated. Other materials in MSW, such as rubber, leather, textiles, and miscellaneous wastes, made up approximately 10 percent of the MSW generated in 1996.

A portion of each material category in MSW was recycled or composted in 1996, as illustrated in Table ES-1. It should be noted, however, that recovery rates for some products within a material category are higher than the overall recovery rate for the material category, because some products are not

Table ES-1
GENERATION AND RECOVERY OF MATERIALS IN MSW, 1996
(In millions of tons and percent of generation of each material)

	Weight Generated	Weight Recovered	Recovery as a Percent of Generation
Paper and paperboard	79.9	32.6	40.8%
Glass	12.4	3.2	25.7%
Metals			
Ferrous metals	11.8	4.5	38.0%
Aluminum	3.0	1.0	34.3%
Other nonferrous metals	1.3	0.8	66.8%
<i>Total metals</i>	16.1	6.4	39.6%
Plastics	19.8	1.1	5.3%
Rubber and Leather	6.2	0.6	9.5%
Textiles	7.7	1.0	12.3%
Wood	10.8	0.5	4.5%
Other materials	3.7	0.8	21.2%
<i>Total Materials in Products</i>	156.6	46.0	29.4%
Other Wastes			
Food Wastes	21.9	0.5	2.4%
Yard Trimmings	28.0	10.8	38.6%
Miscellaneous Inorganic Wastes	3.2	Neg.	Neg.
<i>Total Other Wastes</i>	53.1	11.3	21.3%
TOTAL MUNICIPAL SOLID WASTE	209.7	57.3	27.3%

Includes wastes from residential, commercial, and institutional sources.
Neg. = Less than 50,000 tons or 0.05 percent.

recovered at all. For example, aluminum cans are recovered at rates above 60 percent, but the overall recovery rate for aluminum is 34 percent. Likewise, even though corrugated containers are recovered at a rate of nearly 67 percent, the overall recovery rate for paper and paperboard is 41 percent.

For this Update, significant changes were made in the methodologies and data sources for wood and food wastes. These changes, which were incorporated into revised estimates for 1990 through 1995, result in an increase in the estimated total amount of MSW generation previously published. (See Chapter 2 for discussions of these changes.) Because of the increases in generated tonnage, revised total recovery percentages for the years 1990 through 1995 declined slightly.

Products in MSW

Figure ES-2 shows the breakdown, by weight, of MSW products generated in 1996. Containers and packaging comprised the largest portion of products generated, at 33 percent (69 million tons) of total MSW generation. Nondurable goods were the second largest fraction, comprising about 27 percent (56 million tons). The third main category of products is durable goods, which comprised 15 percent (32 million tons) of total MSW generation.

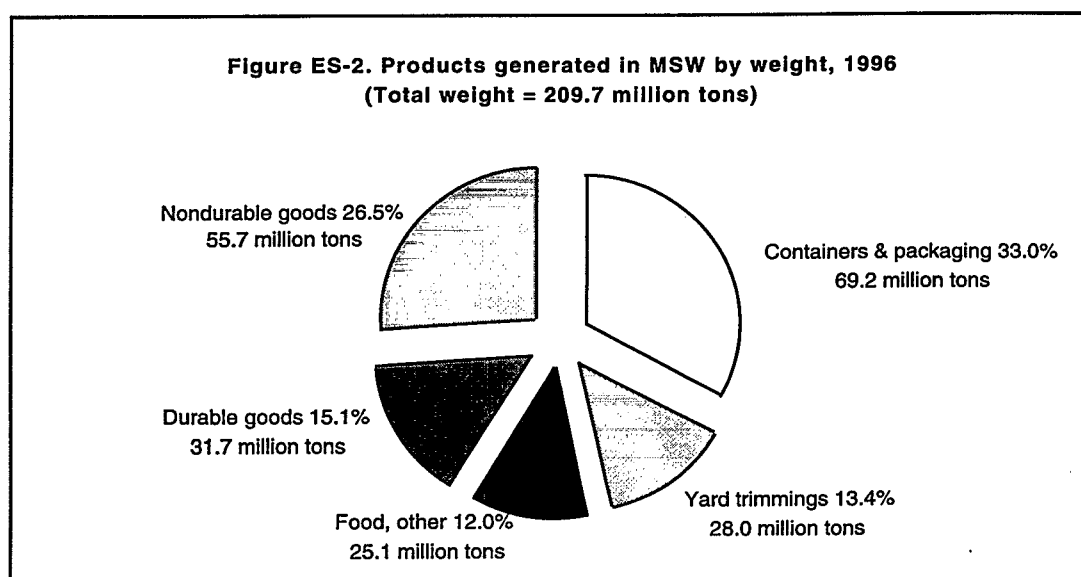


Table ES-2 shows the generation and recovery of the product categories in MSW. Recovery of **containers and packaging** was the highest of the three product categories—40 percent of containers and packaging generated in 1996 were recovered for recycling. About 52 percent of aluminum packaging was recovered (mostly aluminum beverage cans), while more than 56 percent of steel packaging (mostly cans) was recovered. Paper and paperboard packaging recovery was estimated at 54 percent; corrugated containers accounted for most of that figure. Approximately 29 percent of glass containers were recovered overall, while about 8 percent of wood packaging (mostly pallets removed from service) was recovered for recycling. About 10 percent of plastic containers and packaging was recovered in 1996, mostly soft drink, milk, and water bottles.

Overall recovery of **nondurable goods** was 23 percent in 1996. Newspapers constituted the largest portion of this recovery, with 54 percent of newspapers generated being recovered for recycling. High-grade office papers and magazines were also recovered in significant quantities in 1996, at 48 percent and 24 percent, respectively. About 16 percent of clothing and other textile nondurable products also were recovered for recycling.

Overall, **durable goods** were recovered at a rate of 17 percent in 1996, up from 16 percent in 1995. Nonferrous metals had one of the highest recovery rates, at 67 percent, due to the high rate of lead recovery from lead-acid batteries. Nearly 32 percent of ferrous metals were recovered from appliances and miscellaneous durable goods. Excluding retreads and tire-derived fuel use, over 18 percent of tires also were recovered for recycling.

Residential and Commercial Sources of MSW

Sources of MSW, as characterized in this report, include both residential and commercial locations. Residential waste (including waste from multi-family dwellings) is estimated to be 55 to 65 percent of total MSW generation. Commercial waste (including waste from schools, some industrial sites where packaging is generated, and businesses) constitutes between 35 and 45 percent. Local and regional factors, such as climate and level of commercial activity, contribute to these variations.

Table ES-2
GENERATION AND RECOVERY OF PRODUCTS IN MSW
BY MATERIAL, 1996
(In millions of tons and percent of generation of each product)

	Weight Generated	Weight Recovered	Recovery as a Percent of Generation
Durable goods			
Ferrous metals	8.8	2.8	31.8%
Aluminum	0.8	Neg.	Neg.
Other non-ferrous metals	1.3	0.8	66.8%
<i>Total metals</i>	10.9	3.7	33.4%
Glass	1.3	Neg.	Neg.
Plastics	6.3	0.3	4.0%
Rubber and leather	5.4	0.6	11.0%
Wood	4.3	Neg.	Neg.
Textiles	2.4	0.1	5.3%
Other materials	1.0	0.8	74.7%
<i>Total durable goods</i>	31.7	5.4	17.1%
Nondurable goods			
Paper and paperboard	41.4	12.0	29.0%
Plastics	5.3	Neg.	<1%
Rubber and leather	0.8	Neg.	Neg.
Textiles	5.2	0.8	15.8%
Other materials	2.8	Neg.	Neg.
<i>Total nondurable goods</i>	55.7	12.9	23.1%
Containers and packaging			
Steel	3.0	1.7	56.4%
Aluminum	2.0	1.0	52.2%
<i>Total metals</i>	4.9	2.7	54.7%
Glass	11.0	3.2	28.7%
Paper and paperboard	38.5	20.6	53.5%
Plastics	8.2	0.8	9.8%
Wood	6.5	0.5	7.5%
Other materials	0.1	Neg.	Neg.
<i>Total containers and packaging</i>	69.2	27.7	40.1%
Other wastes			
Food wastes	21.9	0.5	2.4%
Yard trimmings	28.0	10.8	38.6%
Miscellaneous inorganic wastes	3.2	Neg.	Neg.
<i>Total other wastes</i>	53.1	11.3	21.3%
TOTAL MUNICIPAL SOLID WASTE	209.7	57.3	27.3%

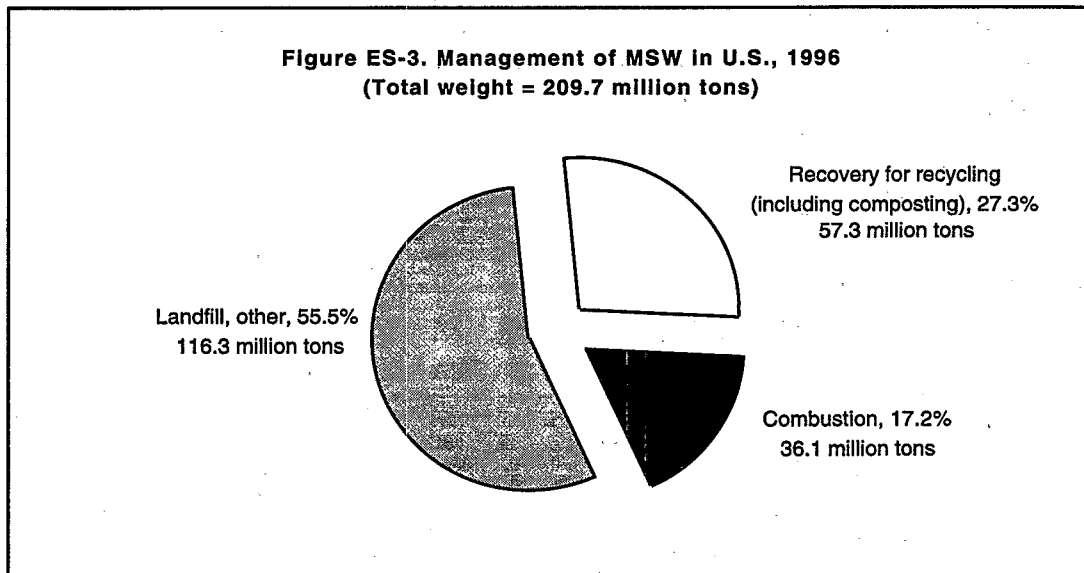
Includes wastes from residential, commercial, and institutional sources.
Neg. = less than 50,000 tons or 0.05 percent.

MANAGEMENT OF MSW

EPA's integrated waste management hierarchy includes the following components:

- Source reduction (including reuse of products and backyard composting of yard trimmings).
- Recycling (including composting).
- Waste combustion (preferably with energy recovery) and landfilling.

Figure ES-3 shows how much MSW was recovered for recycling (including composting) and how much was disposed of by combustion and landfilling in 1996. Approximately 27 percent (57 million tons) of MSW was recycled and composted; an estimated 17 percent (36 million tons) was combusted (nearly all with energy recovery); and the remainder, 55 percent (116 million tons), was landfilled. (Although, of this total small amounts may have been littered or self-disposed rather than landfilled.)



Source Reduction

Source reduction includes the design, manufacture, purchase, or use of materials, such as products and packaging, to reduce their amount or toxicity before they enter the MSW management system. Some examples of source reduction activities are:

- Designing products or packaging to reduce the quantity or the toxicity of the materials used, or to make them easy to reuse.
- Reusing existing products or packaging.
- Lengthening the lives of products to postpone disposal.
- Using packaging that reduces the amount of damage or spoilage to the product.
- Managing nonproduct organic wastes (e.g., food scraps and yard trimmings) through on-site composting or other alternatives to disposal (e.g., leaving grass clippings on the lawn).

Product source reduction activities are not quantified at the national level in this report. The report does include a section discussing source reduction trends in packaging and nondurable paper products.

On a per-person basis, generation of packaging has been about constant, while at the same time, consumption of food and other products has been increasing. Again on a per-person basis, generation of nondurable paper products (newspapers, office papers, mail, and other printed products) has been about constant since 1990, compared to rapid increases in previous years. At the same time, electronic communication media (e-mail, Internet) have been increasing rapidly. There also has been some shift of advertising dollars from printed media to nonprinted media (television, radio, Internet). Trends are not yet clear, but electronic communications and data exchange may be slowing the rate of growth of paper products.

Recovery

Recovery for recycling (including composting) continues to be one of the most effective waste management techniques. In its Annual Survey of solid waste management practices, BioCycle Magazine (April 1997) reports that approximately 51 percent of the U.S. population (135 million people) had access to the nation's nearly 9,000 curbside recycling programs in 1996. Seventy-five percent of the programs were in the Northeast and Midwest. In addition, over 10,000 drop-off centers for recyclables were reported in 1996. About 360 materials recovery facilities helped process the recyclables collected in 1996. An estimated 3,300 yard trimmings composting programs (not backyard composting) existed in 1996; the majority of these programs were in the Northeast and Midwest.

Combustion

Most MSW combustion in the United States involves the recovery of an energy product (generally steam or electricity). Total MSW combustion with energy recovery, referred to as waste-to-energy combustion, currently has a design capacity of 100,000 tons per day. There were 110 waste-to-energy combustion facilities in the United States in 1996; nearly 40 percent of these were located in the Northeast, accounting for 48 percent of total design capacity. In addition, there were 8 facilities preparing refuse-derived fuel, and a small amount of capacity (2,000 tons per day) for incineration without energy recovery.

Landfilling

Although the number of landfills in the United States is decreasing, landfill capacity has remained relatively constant. In 1996, approximately 2,400 municipal solid waste landfills were reported in the contiguous United States, with the Southeast and West having the greatest number of landfills. Thirty-five states had landfills reporting more than 10 years of capacity remaining. Only three states reported having less than 5 years of capacity left.

Trends in MSW Management

MSW generation grew from 88 million tons in 1960 to 214 million tons in 1994 but has since dropped off to about 210 million tons in 1996 (Figure ES-4). In the 1960s and early 1970s, a large percentage of MSW was burned. Through the mid-1980s, incineration declined considerably and landfills became more difficult to site. MSW generation continued to rise, however, while materials recovery rates increased slowly. As a result, the burden on the nation's landfills grew dramatically. Although there are now fewer municipal solid waste landfills, their average size has increased and capacity at the national level does not appear to be a problem. However, regional dislocations sometimes occur. As recovery rates increased in the late 1980s and early 1990s—and combustion stayed constant—discards to landfills have steadily decreased.

