United States
Environmental Protection
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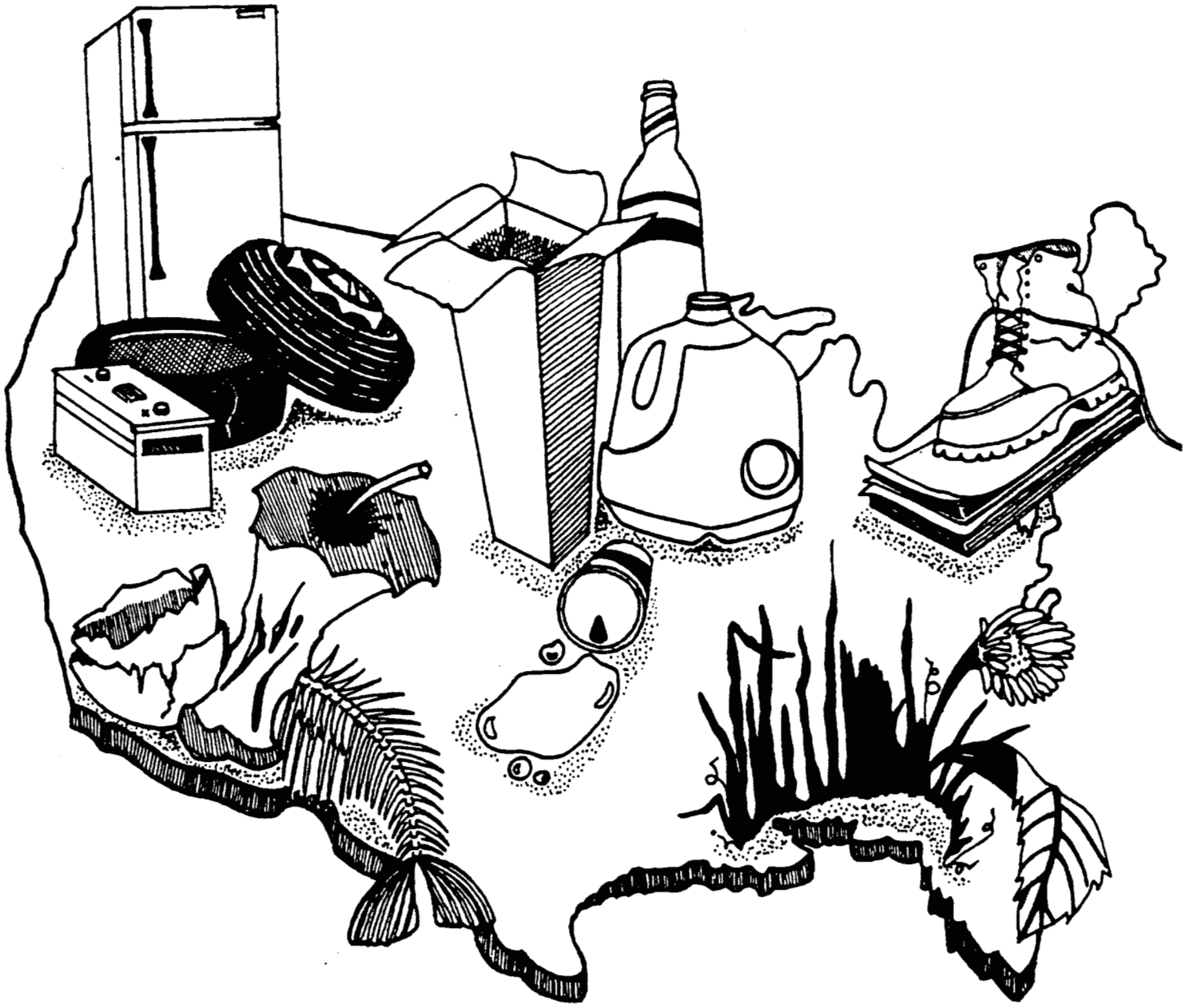
Solid Waste and
Emergency Response
(OS-305)

EPA/530-R-019
July 1992

EPA

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



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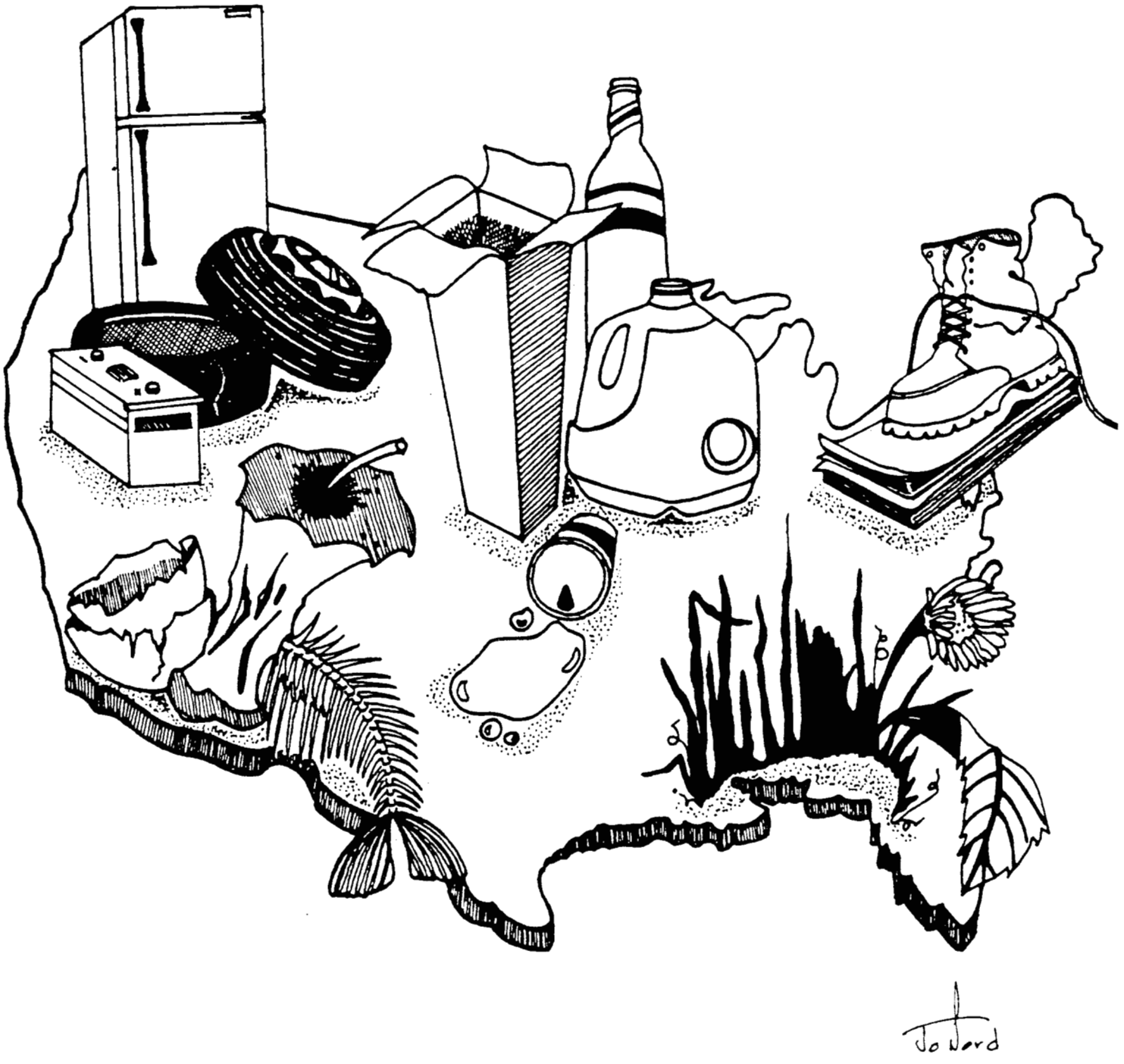

CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES 1992 UPDATE

Final Report

July 1992

Prepared for

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

Printed on recycled paper

Ordering Information

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

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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.

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

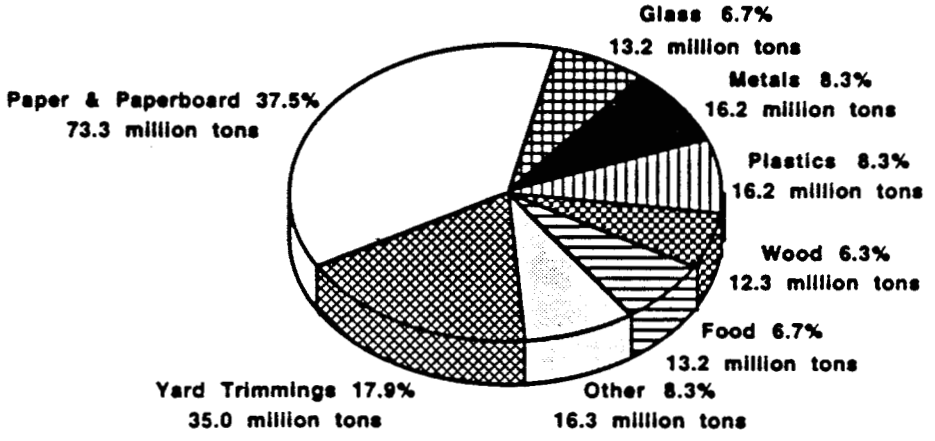
- **MSW was also characterized by *volume*.** The results indicate which materials in MSW occupy the greatest proportion of volume in landfills, and compare these percentages to those by weight. For example, paper and paperboard products make up 32 percent of the discards (after recovery) by weight and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



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:

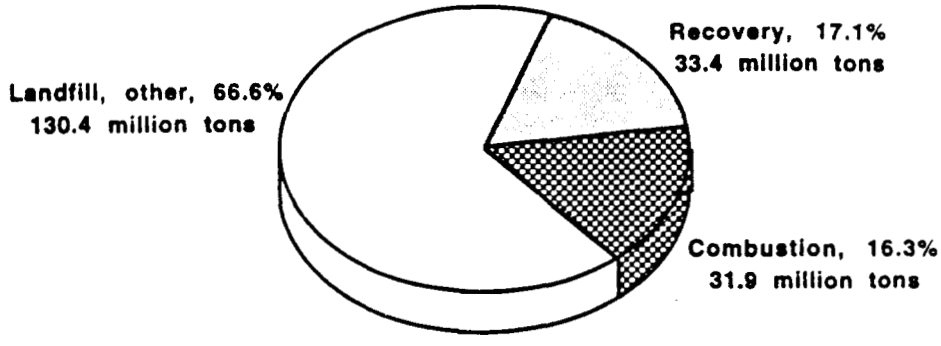
- **In 1990, 195.7 million tons, or 4.3 pounds per person per day of MSW were generated.** After materials recovery for recycling and composting, discards were 3.6 pounds per person per day. Virtually all of these discards were combusted or sent to a landfill.

- **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**

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)

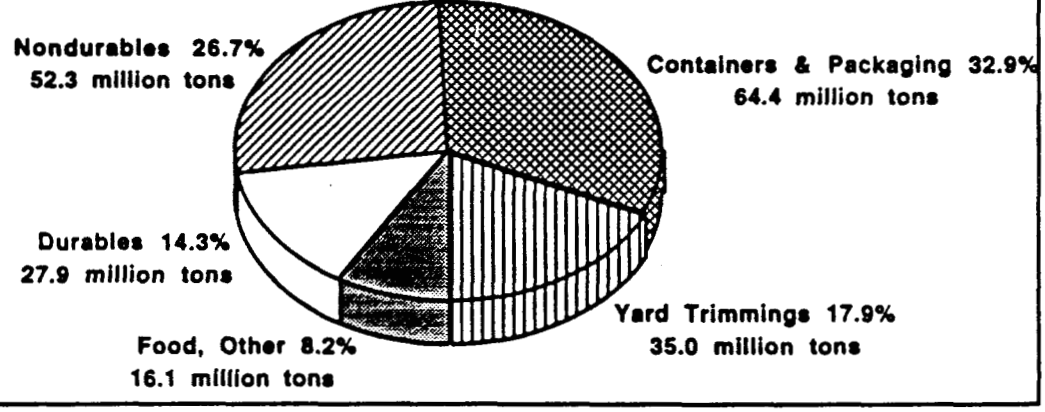


Table ES-1

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)

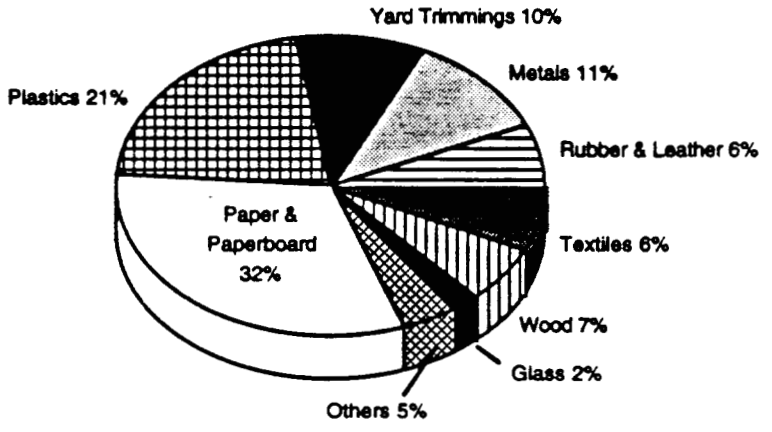


Table ES-2

VOLUME OF MATERIALS DISCARDED IN MSW, 1990

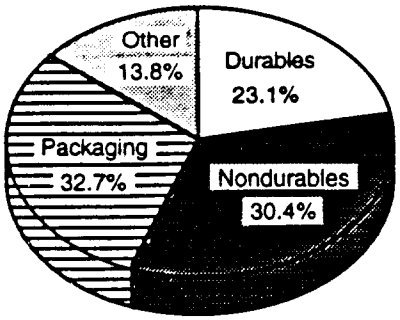
	1990 Discards (mil tons)	Weight (% of MSW total)	Volume (% of MSW total)	Ratio (volume %/ weight %)
Paper and Paperboard	52.4	32.3%	31.9%	1.0
Plastics	15.9	9.8%	21.1%	2.2
Yard Trimmings	30.8	19.0%	9.8%	0.5
Ferrous Metals	10.4	6.4%	8.9%	1.4
Rubber and Leather	4.4	2.7%	6.1%	2.2
Textiles	5.3	3.3%	6.4%	1.9
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 projects.

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.

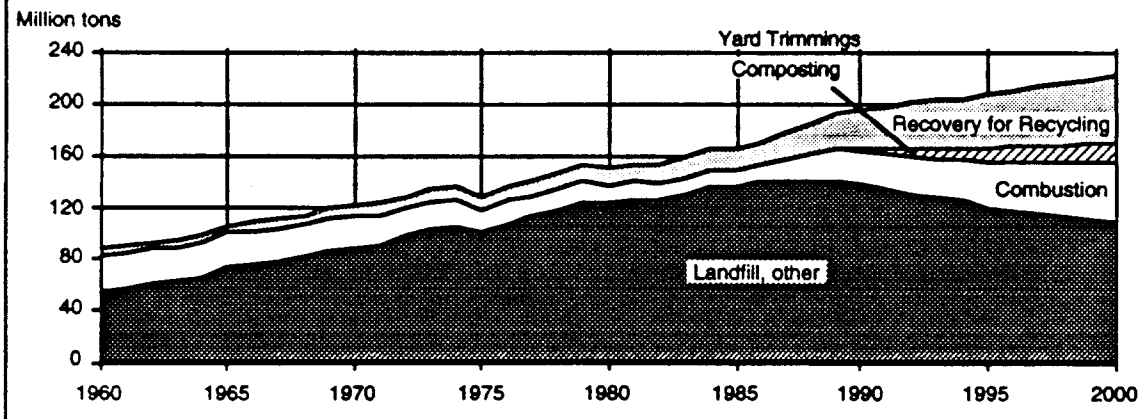
The report projects that about 35 million tons of MSW will be combusted in 1995, and 46 million tons will be combusted in 2000. Estimates of combustion projections are based on an assumption that the facilities will operate at 80 percent of capacity.

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



Chapter 1

INTRODUCTION AND METHODOLOGY

BACKGROUND

This report is the most recent in a 20-year series of reports sponsored by the U.S. Environmental Protection Agency to characterize municipal solid waste (MSW) in the United States. Together with the previous reports, this report provides a historical database for a 30-year characterization (by weight) of the materials and products in MSW, with projections through the year 2000.

HOW THIS REPORT CAN BE USED

The data in this report are best suited for providing a nationwide picture of municipal solid waste generation and management. The historical perspective is particularly useful in establishing trends and highlighting the changes that have occurred over the years, both in types of wastes generated and in the ways they are managed. A common error in using this report is to assume that *all* nonhazardous wastes are included. As shown later in this chapter, municipal solid waste as defined here does *not* include construction and demolition wastes, industrial process wastes, or a number of other wastes that may well go to a municipal waste landfill.

Because local data on generation and management of municipal solid waste are often lacking, state and local planners frequently use the data in this report to make local estimates. That is, data on generation of MSW per person on a national basis may be used to estimate generation in a city or county based on its population. While this method may yield an acceptable "ballpark" estimate, it should be used with caution because there are many local variations in climate, commercial activity, and waste management practices that affect municipal solid waste generation and disposal. (See Chapter 7 for more discussion on how the estimates in this report compare with local sampling studies.)

NEW FEATURES OF THIS REPORT

In addition to the data series that have been previously published by EPA in these MSW characterization reports, the following information and features have been added:

- Separate line items have been added to the products list for: carpets and rugs; books; magazines; telephone books; third class mail; plastic trash bags; and towels, sheets and pillowcases. These items were

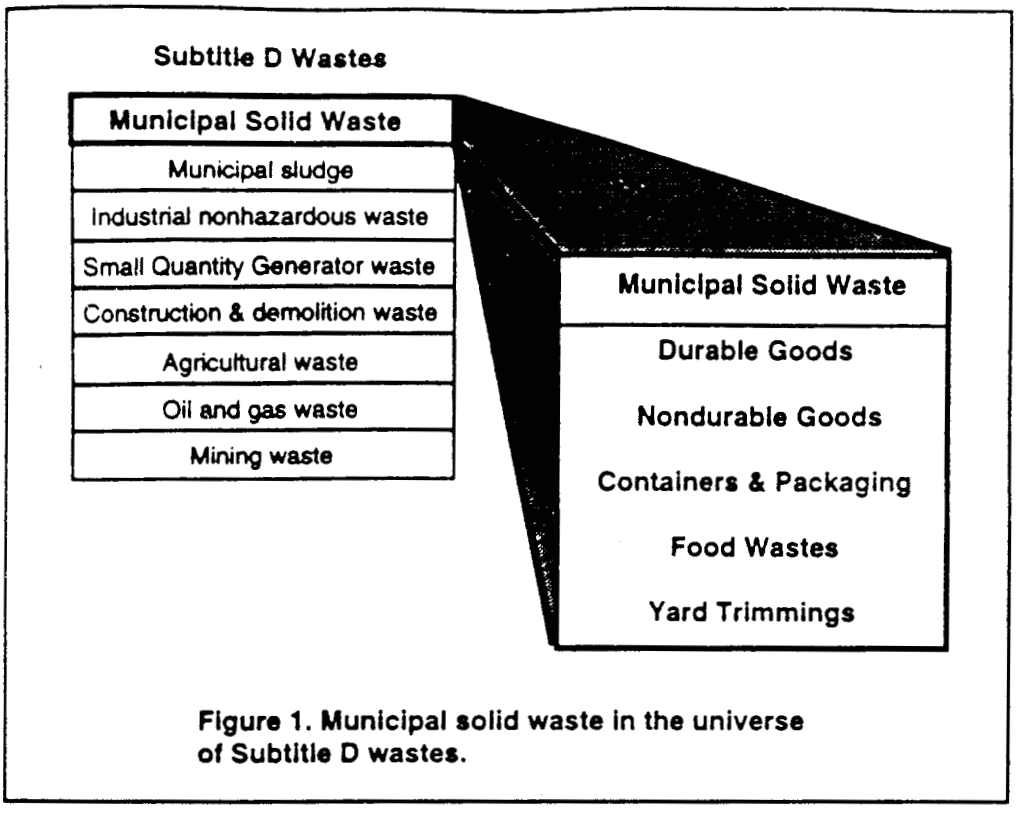


Figure 1. Municipal solid waste in the universe of Subtitle D wastes.

already totally or partially accounted for in aggregated line items, so only a small net addition to total MSW was made (Chapter 2).

- An estimate of the distribution of MSW to residential and commercial sources was made for the first time in this report (Chapter 5).

- Additional research was done on wood wastes, with the result that estimates of wood packaging were increased substantially (Chapter 2).

More information on the differences between this report and previous reports is included in Chapter 7.

MUNICIPAL SOLID WASTE IN PERSPECTIVE

Municipal Solid Waste Defined

Municipal solid waste includes durable goods, nondurable goods, containers and packaging, food wastes and yard trimmings, and miscellaneous inorganic wastes (Figure 1). EPA's 1989 Agenda for Action report states that municipal solid wastes come from residential, commercial, institutional, and industrial sources. Some examples of the types of MSW that come from each of the broad categories of sources are:

Source	Example Products
Residential	Appliances, newspapers, clothing, disposable tableware, food packaging, cans and bottles, food scraps, yard trimmings
Commercial	Corrugated boxes, food wastes, office papers, disposable tableware, paper napkins, yard trimmings
Institutional	Cafeteria and restroom trash can wastes, office papers, classroom wastes, yard trimmings
Industrial	Corrugated boxes, plastic film, wood pallets, lunchroom wastes, office papers.

The material flows methodology used in this report does not lend itself to the quantification of wastes according to their source. For example, corrugated boxes may be unpacked and discarded from residences, commercial establishments such as grocery stores, institutions such as schools, or from factories. The methodology estimates only the total quantity of such boxes disposed, not their places of discard or recovery for recycling. (For this report, estimates were made of the residential/commercial distributions of MSW, but they were not made by the material flows methodology.)

Other Subtitle D Wastes

Some people assume that "municipal solid waste" must include everything that is landfilled in Subtitle D landfills. (Subtitle D of the Resource Conservation and Recovery Act deals with wastes other than the hazardous wastes covered under Subtitle C.) As shown in Figure 1, however, many kinds of wastes are included under Subtitle D. It has been common practice to landfill wastes such as municipal sludge, nonhazardous industrial wastes, fluff from automobile salvage operations, and construction and demolition wastes along with MSW, but these other kinds of wastes *are not included in the estimates presented in this report.*

The Solid Waste Management Hierarchy

EPA's Agenda for Action endorsed the concept of integrated waste management, by which municipal solid waste is reduced or managed through

several different practices, which can be tailored to fit a particular community's needs. The components of the hierarchy are:

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

With the exception of source reduction, this updated characterization report includes estimates of the quantities of MSW managed by each practice in the hierarchy.

METHODOLOGIES FOR CHARACTERIZING MUNICIPAL SOLID WASTE

The Two Methodologies

There are two basic approaches to estimating quantities of municipal solid waste. The first method, which is site-specific, involves sampling, sorting, and weighing the individual components of the waste stream. This method is useful in defining a local waste stream, especially if large numbers of samples are taken over several seasons. Results of sampling also increase the body of knowledge about variations due to climatic and seasonal changes, population density, regional differences, and the like. In addition, quantities of MSW components such as food and yard trimmings can only be estimated through sampling and weighing studies.

A disadvantage of sampling studies based on a limited number of samples is that they may be skewed and misleading if, for example, atypical circumstances were experienced during the sampling. These circumstances could include an unusually wet or dry season, delivery of some unusual wastes during the sampling period, or errors in the sampling methodology. Any errors of this kind will be greatly magnified when a limited number of samples are taken to represent a community's entire waste stream for a year. Magnification of errors could be even more serious if a limited number of samples was relied upon for making the national estimates of MSW. Also, extensive sampling would be prohibitively expensive for making the national estimates. An additional disadvantage of sampling studies is that they do not provide information about trends unless they are performed in a consistent manner over a long period of time.

The second approach to quantifying and characterizing the municipal solid waste stream—the method used for this report—utilizes a material flows approach to estimate the waste stream on a nationwide basis. In the late 1960s and early 1970s, EPA's Office of Solid Waste and its predecessors at the Public Health Service sponsored work that began to develop this

methodology, and this report represents the latest version of this database that has been evolving for over 20 years.

The material flows methodology is based on production data (by weight) for the materials and products in the waste stream. Adjustments are made for imports and exports and for diversions from MSW (e.g., for building materials made of paperboard). Adjustments are also made for the lifetimes of products. Finally, food wastes and yard trimmings and a small amount of miscellaneous inorganic wastes are accounted for by compiling data from a variety of waste sampling studies.

A detailed description of the material flows methodology is included as Appendix A.

Definition of Terms

The material flows methodology produces an estimate of total municipal solid waste generation in the United States, by material categories and by product categories.

The term ***generation*** as used in this report refers to the weight of materials and products as they enter the waste stream from residential, commercial, and institutional sources and before materials recovery or combustion takes place. (In earlier reports in this series, the term "gross discards" is the same as generation.)

Recovery of materials as estimated in this report includes materials or yard trimmings removed from the waste stream for the purpose of recycling or composting, although recovery does not automatically equal recycling. Recycling or composting processes generally leave some residues (e.g., sludges from deinking paper), but estimation of these residues is beyond the scope of this study.

Combustion of MSW was estimated with and without energy recovery. Combustion with energy recovery is often called "waste-to-energy" or incineration with heat recovery.

Discards include the MSW remaining after recovery for recycling and composting. These discards would presumably be combusted or landfilled, although some MSW is littered, stored or disposed on-site, or burned on-site, particularly in rural areas. No good estimates for these other disposal practices are available, but the amounts of MSW involved are presumed to be small.

MATERIALS AND PRODUCTS NOT INCLUDED IN THESE ESTIMATES

As noted earlier, other Subtitle D wastes (illustrated in Figure 1) are not included in these estimates, even though some may be managed along with MSW (e.g., by combustion or landfilling). Household hazardous wastes, while generated as a part of other residential wastes, are not treated separately in this report.

One problem with the material flows methodology is that product residues associated with other items in MSW (usually containers) are not accounted for. These residues would include, for example, food left in a jar, detergent left in a box or bottle, dried paint in a can, etc. Some household hazardous wastes, e.g., pesticide left in a can, are also included among these product residues.

Certain other materials associated with products in MSW are often not accounted for because the appropriate data series have not yet been developed. These include, for example, inks and other pigments and some additives associated with plastic resins. Considerable additional research would be required to estimate these materials, which constitute a relatively small percentage of the waste stream.

Some adjustments are made in this report to account for packaging of imported goods, but there is no documentation of these amounts.

PROJECTIONS

The projections of MSW generation to the year 2000 were not based on total quantities, but were aggregated from separate projections for each product and material. Thus, while most products are projected to grow in tonnage, this is not universally true, and some are projected to decline.

The projections are based on trend analysis of the 30-year historical database developed for each product, from information in government sources such as the **Industrial Outlook** published by the Department of Commerce, and, in some cases, best professional judgment.

It should be emphasized that projections are not predictions. Projections are based on an assumption that there will be no unforeseen changes in current trends. Thus, the economy is assumed to remain stable and population trends are assumed to be as projected by the Bureau of the Census. Additional discussions of projection assumptions are included in Chapter 4.

OVERVIEW OF THIS REPORT

Following this introductory chapter, Chapter 2 presents the results of the municipal solid waste characterization (by weight). Estimates of MSW generation, recovery, and discards are presented in a series of tables, with discussion. Detailed tables and figures summarizing 1990 generation, recovery, and discards of products in each material category are included.

In Chapter 3 of the report, estimates of MSW management by the various alternatives are summarized. These include recovery for recycling and composting, combustion, and landfilling.

Projections of municipal solid waste generation and management to the year 2000 are included in Chapter 4. Projections are made by material and by product. A discussion of assumptions and trends is included.

Chapter 5 of the report provides some additional perspectives on the MSW characterization. Information is included on per capita generation and management of MSW, on residential and commercial sources of MSW, and on organic and inorganic fractions of MSW.

In Chapter 6, a characterization of MSW discards in 1990 by volume (cubic yards) is presented.

The final chapter of this report provides an overview comparison of the results of MSW characterization by the material flows methodology with the results of a number of field sampling studies. Also, the differences between the current update and previous material flows reports are explained.

Chapter 1

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Chapter 2

CHARACTERIZATION OF MUNICIPAL SOLID WASTE BY WEIGHT

INTRODUCTION

The tables and figures in this chapter present the results of the update of EPA's municipal solid waste characterization study through 1990. The findings are presented in two ways: a breakdown of municipal solid waste (MSW) by material, and a breakdown by product (both by weight and by percentage). While some products, e.g., newspapers, are made up of a single material—paper—other products, e.g., rubber tires, contain more than one material, such as rubber, ferrous metals, and textiles. Thus the materials summary tables represent an aggregation of the materials that go into all the products in MSW. (Note that the totals for the materials and the products tables are the same.)

The summary tables and figures provide information on the generation of each material and product, and the recovery for recycling and composting (if any). Tables and figures displaying discards of materials and products after recovery for recycling and composting follow. Recovery means that the materials have been removed from the waste stream. Recovery does not always equal materials recycling, and some residues may result from the recycling, although these are not accounted for in this report.

Additional detail is provided for some of the materials and products in MSW that are of the most interest to planners: paper, glass, metals, plastics, and rubber and leather.

MATERIALS IN MUNICIPAL SOLID WASTE

Generation, recovery, and discards of materials in MSW, by weight and by percentage, are summarized in Tables 1 through 3. Following these tables, each material is discussed in detail.

Paper and Paperboard

By any measure, the many products made of paper and paperboard, taken collectively, are the largest component of MSW. The wide variety of products that comprise the paper and paperboard materials total is illustrated in Table 4 and Figures 2 and 3. In this report, these products are classified as either nondurable goods or as containers and packaging, with nondurable goods being the larger category.

Table 1

MATERIALS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(In millions of tons and percent of total generation)

	Millions of Tons						
Materials	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Paper and Paperboard	29.9	38.0	44.2	43.0	54.7	61.5	73.3
Glass	6.7	8.7	12.7	13.5	15.0	13.2	13.2
Metals							
Ferrous	9.9	10.1	12.6	12.3	11.6	10.9	12.3
Aluminum	0.4	0.5	0.8	1.1	1.8	2.3	2.7
Other Nonferrous	0.2	0.5	0.7	0.9	1.1	1.0	1.2
Total Metals	*10.5*	*11.1*	*14.1*	*14.3*	*14.5*	*14.2*	*16.2*
Plastics	0.4	1.4	3.1	4.5	7.8	11.6	16.2
Rubber and Leather	2.0	2.6	3.2	3.9	4.3	3.8	4.6
Textiles	1.7	1.9	2.0	2.2	2.6	2.8	5.6
Wood	3.0	3.5	4.0	4.4	6.7	8.2	12.3
Other	0.1	0.3	0.8	1.7	2.9	3.4	3.2
Total Materials in Products	54.3	67.5	84.1	87.5	108.5	118.7	144.6
Other Wastes							
Food Wastes	12.2	12.7	12.8	13.4	13.2	13.2	13.2
Yard Trimmings	20.0	21.6	23.2	25.2	27.5	30.0	35.0
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.2	2.5	2.9
Total Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	51.1
Total MSW Generated - Weight	87.8	103.4	121.9	128.1	151.4	164.4	195.7
	Percent of Total Generation						
Materials	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Paper and Paperboard	34.1%	36.8%	36.3%	33.6%	36.1%	37.4%	37.5%
Glass	7.6%	8.4%	10.4%	10.5%	9.9%	8.0%	6.7%
Metals							
Ferrous	11.3%	9.8%	10.3%	9.6%	7.7%	6.6%	6.3%
Aluminum	0.5%	0.5%	0.7%	0.9%	1.2%	1.4%	1.4%
Other Nonferrous	0.2%	0.5%	0.6%	0.7%	0.7%	0.6%	0.6%
Total Metals	*12.0%*	*10.7%*	*11.6%*	*11.2%*	*9.6%*	*8.6%*	*8.3%*
Plastics	0.5%	1.4%	2.5%	3.5%	5.2%	7.1%	8.3%
Rubber and Leather	2.3%	2.5%	2.6%	3.0%	2.8%	2.3%	2.4%
Textiles	1.9%	1.8%	1.6%	1.7%	1.7%	1.7%	2.9%
Wood	3.4%	3.4%	3.3%	3.4%	4.4%	5.0%	6.3%
Other	0.1%	0.3%	0.7%	1.3%	1.9%	2.1%	1.6%
Total Materials in Products	61.8%	65.3%	69.0%	68.3%	71.7%	72.2%	73.9%
Other Wastes							
Food Wastes	13.9%	12.3%	10.5%	10.5%	8.7%	8.0%	6.7%
Yard Trimmings	22.8%	20.9%	19.0%	19.7%	18.2%	18.2%	17.9%
Miscellaneous Inorganic Wastes	1.5%	1.5%	1.5%	1.6%	1.5%	1.5%	1.5%
Total Other Wastes	38.2%	34.7%	31.0%	31.7%	28.3%	27.8%	26.1%
Total MSW Generated - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Generation before materials recovery or combustion. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Table 2

RECOVERY* OF MUNICIPAL SOLID WASTE, 1960 TO 1990
(In millions of tons and percent of total generation of each product)

	Millions of Tons						
Materials	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Paper and Paperboard	5.4	5.7	7.4	8.2	11.9	13.1	20.9
Glass	0.1	0.1	0.2	0.4	0.8	1.0	2.6
Metals							
Ferrous	0.1	0.1	0.1	0.2	0.4	0.4	1.9
Aluminum	Neg.	Neg.	Neg.	0.1	0.3	0.6	1.0
Other Nonferrous	Neg.	0.3	0.3	0.4	0.5	0.5	0.8
Total Metals	*0.1*	*0.4*	*0.4*	*0.7*	*1.2*	*1.5*	*3.7*
Plastics	Neg.	Neg.	Neg.	Neg.	Neg.	0.1	0.4
Rubber and Leather	0.3	0.3	0.3	0.2	0.1	0.2	0.2
Textiles	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	0.2
Wood	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	0.4
Other**	Neg.	0.3	0.3	0.4	0.5	0.5	0.8
Total Materials in Products	5.9	6.8	8.6	9.9	14.5	16.4	29.2
Other Wastes							
Food Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Yard Trimmings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.2
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.2
Total MSW Recovered - Weight	5.9	6.8	8.6	9.9	14.5	16.4	33.4
	Percent of Generation of Each Material						
Materials	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Paper and Paperboard	18.1%	15.0%	16.7%	19.1%	21.8%	21.3%	28.6%
Glass	1.5%	1.1%	1.6%	3.0%	5.3%	7.6%	19.9%
Metals							
Ferrous	1.0%	1.0%	0.8%	1.6%	3.4%	3.7%	15.4%
Aluminum	Neg.	Neg.	Neg.	9.1%	16.7%	26.1%	38.1%
Other Nonferrous	Neg.	60.0%	42.9%	44.4%	45.5%	50.0%	67.7%
Total Metals	*1.0%*	*3.6%*	*2.8%*	*4.9%*	*8.3%*	*10.6%*	*23.0%*
Plastics	Neg.	Neg.	Neg.	Neg.	Neg.	0.9%	2.2%
Rubber and Leather	15.0%	11.5%	9.4%	5.1%	2.3%	5.3%	4.4%
Textiles	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.3%
Wood	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	3.2%
Other	Neg.	100.0%	37.5%	23.5%	17.2%	14.7%	23.8%
Total Materials in Products	10.9%	10.1%	10.2%	11.3%	13.4%	13.8%	20.2%
Other Wastes							
Food Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Yard Trimmings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	12.0%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	8.2%
Total MSW Recovered - %	6.7%	6.6%	7.1%	7.7%	9.6%	10.0%	17.1%

* Recovery of postconsumer wastes for recycling and composting; does not include converting/fabrication scrap.

** Recovery of electrolytes in batteries; probably not recycled.

Details may not add to totals due to rounding.

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

Source: Franklin Associates, Ltd.

Table 3

MATERIALS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(In millions of tons and percent of total discards)

	Millions of Tons						
Materials	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Paper and Paperboard	24.5	32.3	36.8	34.8	42.8	48.4	52.4
Glass	6.6	8.6	12.5	13.1	14.2	12.2	10.6
Metals							
Ferrous	9.8	10.0	12.5	12.1	11.2	10.5	10.4
Aluminum	0.4	0.5	0.8	1.0	1.5	1.7	1.6
Other Nonferrous	0.2	0.2	0.4	0.5	0.6	0.5	0.4
Total Metals	*10.4*	*10.7*	*13.7*	*13.6*	*13.3*	*12.7*	*12.5*
Plastics	0.4	1.4	3.1	4.5	7.8	11.5	15.9
Rubber and Leather	1.7	2.3	2.9	3.7	4.2	3.6	4.4
Textiles	1.7	1.9	2.0	2.2	2.6	2.8	5.3
Wood	3.0	3.5	4.0	4.4	6.7	8.2	11.9
Other	0.1	0.0	0.5	1.3	2.4	2.9	2.4
Total Materials in Products	48.4	60.7	75.5	77.6	94.0	102.3	115.4
Other Wastes							
Food Wastes	12.2	12.7	12.8	13.4	13.2	13.2	13.2
Yard Trimmings	20.0	21.6	23.2	25.2	27.5	30.0	30.8
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.2	2.5	2.9
Total Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	46.9
Total MSW Discarded - Weight	81.9	96.6	113.3	118.2	136.9	148.0	162.3
	Percent of Total Discards						
Materials	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Paper and Paperboard	29.9%	33.4%	32.5%	29.4%	31.3%	32.7%	32.3%
Glass	8.1%	8.9%	11.0%	11.1%	10.4%	8.2%	6.5%
Metals							
Ferrous	12.0%	10.4%	11.0%	10.2%	8.2%	7.1%	6.4%
Aluminum	0.5%	0.5%	0.7%	0.8%	1.1%	1.1%	1.0%
Other Nonferrous	0.2%	0.2%	0.4%	0.4%	0.4%	0.3%	0.2%
Total Metals	*12.7%*	*11.1%*	*12.1%*	*11.5%*	*9.7%*	*8.6%*	*7.7%*
Plastics	0.5%	1.4%	2.7%	3.8%	5.7%	7.8%	9.8%
Rubber and Leather	2.1%	2.4%	2.6%	3.1%	3.1%	2.4%	2.7%
Textiles	2.1%	2.0%	1.8%	1.9%	1.9%	1.9%	3.3%
Wood	3.7%	3.6%	3.5%	3.7%	4.9%	5.5%	7.3%
Other	0.1%	0.0%	0.4%	1.1%	1.8%	2.0%	1.5%
Total Materials in Products	59.1%	62.8%	66.6%	65.7%	68.7%	69.1%	71.1%
Other Wastes							
Food Wastes	14.9%	13.1%	11.3%	11.3%	9.6%	8.9%	8.1%
Yard Trimmings	24.4%	22.4%	20.5%	21.3%	20.1%	20.3%	19.0%
Miscellaneous Inorganic Wastes	1.6%	1.7%	1.6%	1.7%	1.6%	1.7%	1.8%
Total Other Wastes	40.9%	37.2%	33.4%	34.3%	31.3%	30.9%	28.9%
Total MSW Discarded - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Discards after materials and compost recovery. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Table 4

PAPER AND PAPERBOARD PRODUCTS IN MSW, 1990
(In millions of tons and percent of generation)

Product Category	Generation (Million tons)	Recovery (Million tons)	Recovery (Percent of generation)	Discards (Million tons)
Nondurable Goods				
Newspapers	12.9	5.5	42.5%	7.4
Books	1.0	0.1	10.3%	0.9
Magazines	2.8	0.3	10.7%	2.5
Office Papers	6.4	1.7	26.5%	4.7
Telephone Books	0.5	0.1	9.3%	0.5
Third Class Mail	3.8	0.2	5.2%	3.6
Other Commercial Printing	5.5	1.1	19.4%	4.5
Tissue Paper and Towels	3.2	Neg.	Neg.	3.2
Paper Plates and Cups	0.7	Neg.	Neg.	0.7
Other Nonpackaging Paper*	3.8	Neg.	Neg.	3.8
Total Paper and Paperboard Nondurable Goods	40.7	8.9	21.9%	31.8
Containers and Packaging				
Corrugated Boxes	23.9	11.5	48.0%	12.5
Milk Cartons	0.5	Neg.	Neg.	0.5
Folding Cartons	4.3	0.3	7.9%	4.0
Other Paperboard Packaging	0.3	Neg.	Neg.	0.5
Bags and Sacks	2.4	0.2	8.2%	2.2
Wrapping Papers	0.1	Neg.	Neg.	0.1
Other Paper Packaging	1.0	Neg.	Neg.	1.0
Total Paper and Paperboard Containers and Packaging	32.6	12.0	36.9%	20.6
Total Paper and Paperboard	73.3	20.9	28.6%	52.4

* Includes tissue in disposable diapers, paper in games and novelties, cards, etc.
Neg. = Negligible (less than 0.05 percent or 50,000 tons).
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

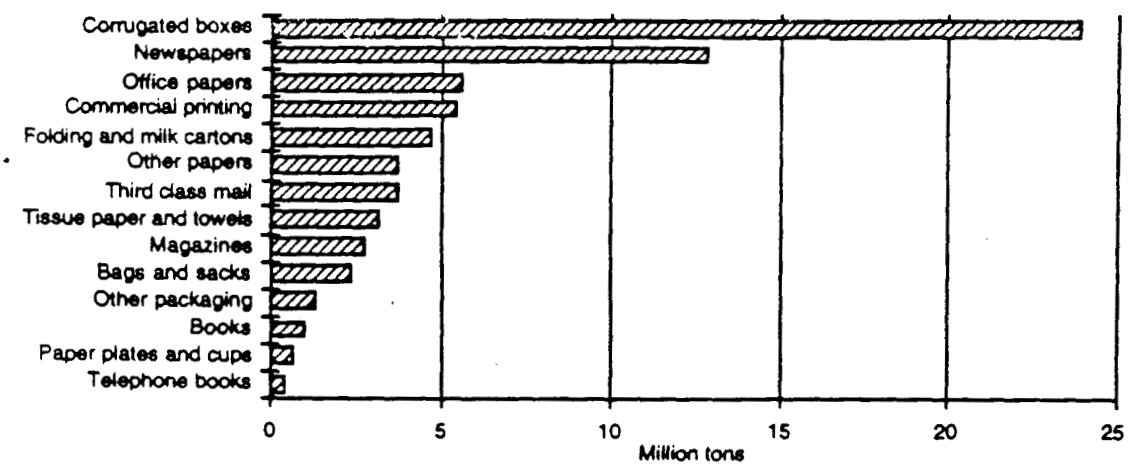
The nondurable paper products include newspapers, books, magazines, office papers, telephone books, third class mail, other commercial printing, tissue paper and towels, paper plates and cups, and other nonpackaging paper such as that used in cards, games, posters and other pictures, etc. The containers and packaging category includes paper in the form of corrugated boxes, milk cartons, other folding cartons (e.g., cereal boxes), bags and sacks, wrapping papers, and other paper and paperboard packaging. (These products are discussed in more detail under the report section on products in MSW.)

Generation. Total generation of paper and paperboard in MSW has grown steadily from nearly 30 million tons in 1960 to over 73 million tons in 1990 (Table 1). As a percentage of total MSW generation, paper represented

about 34 percent in 1960 (Table 1). The percentage has varied over time, but has generally increased, to 37.5 percent of total MSW generation in 1990.

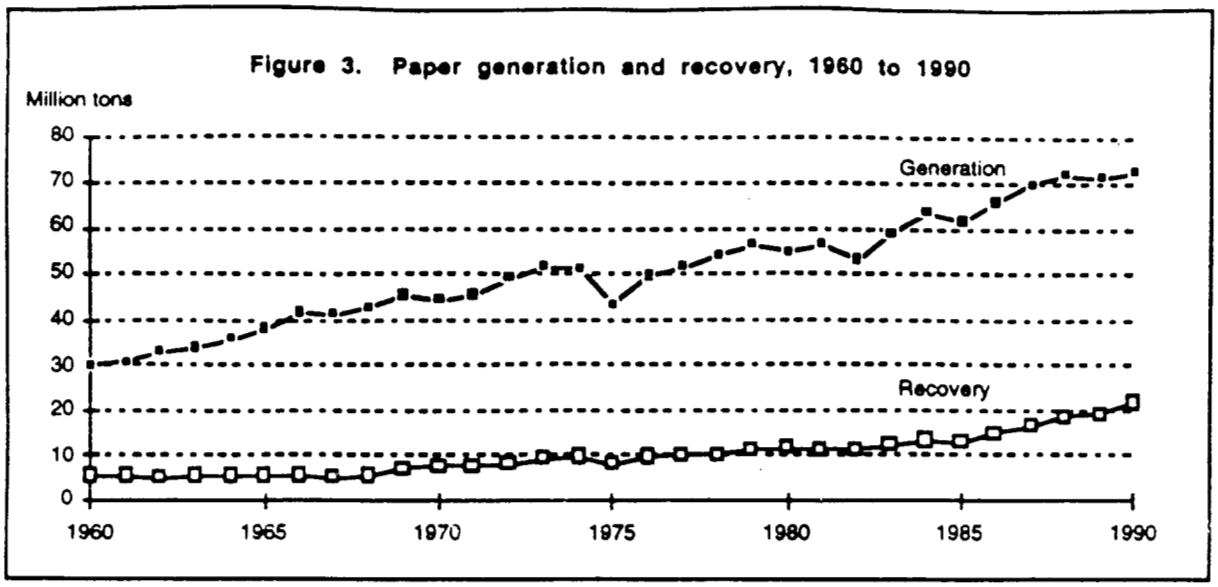
(The sensitivity of paper products to economic conditions can be observed in Figure 3. The tonnage of paper generated in 1975—a severe recession year—was actually less than the tonnage in 1970, and the percentage of total generation was also less in 1975. Similar but less pronounced declines in paper generation can be seen in other recession years.)

Figure 2. Paper and paperboard products generated in MSW, 1990



Recovery. Recovery of paper and paperboard for recycling is at the highest rate overall compared to all other materials in MSW. As Table 4 shows, an estimated 48 percent of all corrugated boxes were recovered for recycling in 1990. Newspapers were recovered at a rate of 42.5 percent and office papers at 26.5 percent, with lesser percentages of other papers being recovered also. About 21 million tons of postconsumer waste paper were recovered in 1990—nearly 29 percent of total generation.

Discards after Recovery. After recovery of paper and paperboard for recycling, discards were over 52 million tons in 1990, or 32 percent of total MSW discards.



Glass

Glass is found in MSW primarily in the form of containers (Table 5 and Figures 4 and 5), but also in durable goods like furniture, appliances, and consumer electronics. In the container category, glass is found in beer and soft drink bottles, wine and liquor bottles, and bottles and jars for food, cosmetics, and other products. More detail on these products is included in the later section on products in MSW.

Generation. Glass accounted for 6.7 millions tons of MSW in 1960, or over 7 percent of total generation. Generation of glass continued to grow over the next two decades, but then glass containers were widely displaced by

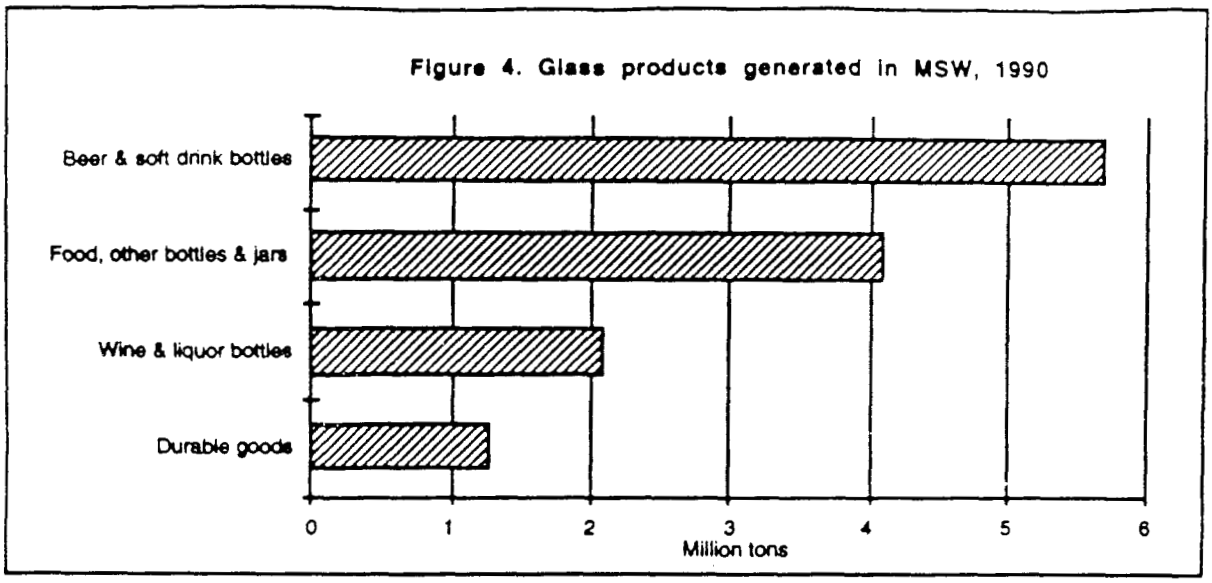
Table 5

GLASS PRODUCTS IN MSW, 1990
(In millions of tons and percent of generation)

Product Category	Generation (Million tons)	Recovery (Million tons)	Recovery (Percent of generation)	Discards (Million tons)
Durable Goods*	1.3	Neg.	Neg.	1.3
Containers and Packaging				
Beer and Soft Drink Bottles	5.7	1.9	33.2%	3.8
Wine and Liquor Bottles	2.1	0.2	10.0%	1.9
Food and Other Bottles and Jars	4.1	0.5	12.7%	3.6
Total Glass Containers	11.9	2.6	22.0%	9.3
Total Glass	13.2	2.6	19.9%	10.6

* Glass as a component of appliances, furniture, consumer electronics, etc.
Neg. = Negligible (less than 0.05 percent or 50,000 tons).
Details may not add to totals due to rounding.

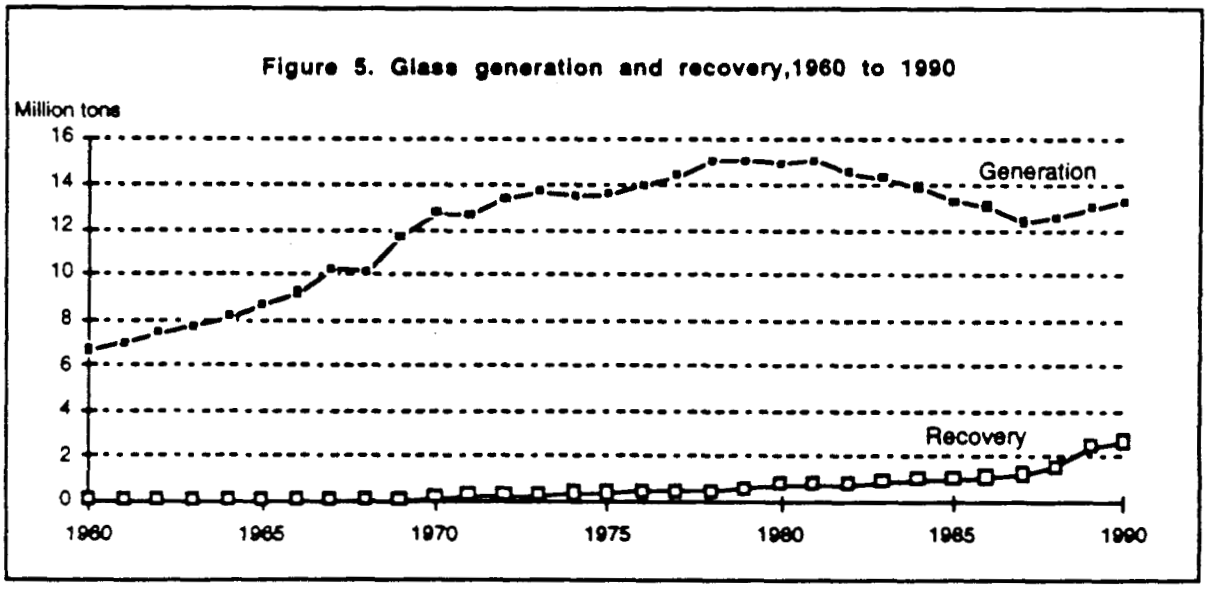
Source: Franklin Associates, Ltd.



other materials, principally aluminum and plastics. Thus the tonnage of glass in MSW declined in the 1980s, from 15 million tons in 1980 to 13.2 million tons in 1985. Beginning about 1987, however, the decline in generation of glass containers reversed (Figure 5), and glass container generation in 1990 was 13.2 million tons, the same as the estimate for 1985. Glass was 9.9 percent of MSW generation in 1980, declining to less than 7 percent in 1990.

Recovery. In 1990 an estimated 22 percent of glass containers was recovered for recycling, with a 20 percent recovery rate for all glass in MSW.

Discards after Recovery. Recovery for recycling lowered discards of glass to 10.6 million tons in 1990 (6.5 percent of total MSW discards).



Ferrous Metals

By weight, ferrous metals are the largest category of metals in MSW (Table 6 and Figure 6). The largest quantities of ferrous metals in MSW are found in durable goods such as appliances, furniture, tires, and other miscellaneous durables. Containers and packaging are the other source of ferrous metals in MSW. Large quantities of ferrous metals are found in construction materials and in transportation products such as automobiles, locomotives, and ships, but these are not counted as MSW in this report.

Generation and recovery of all metals in MSW are shown in Figure 7.

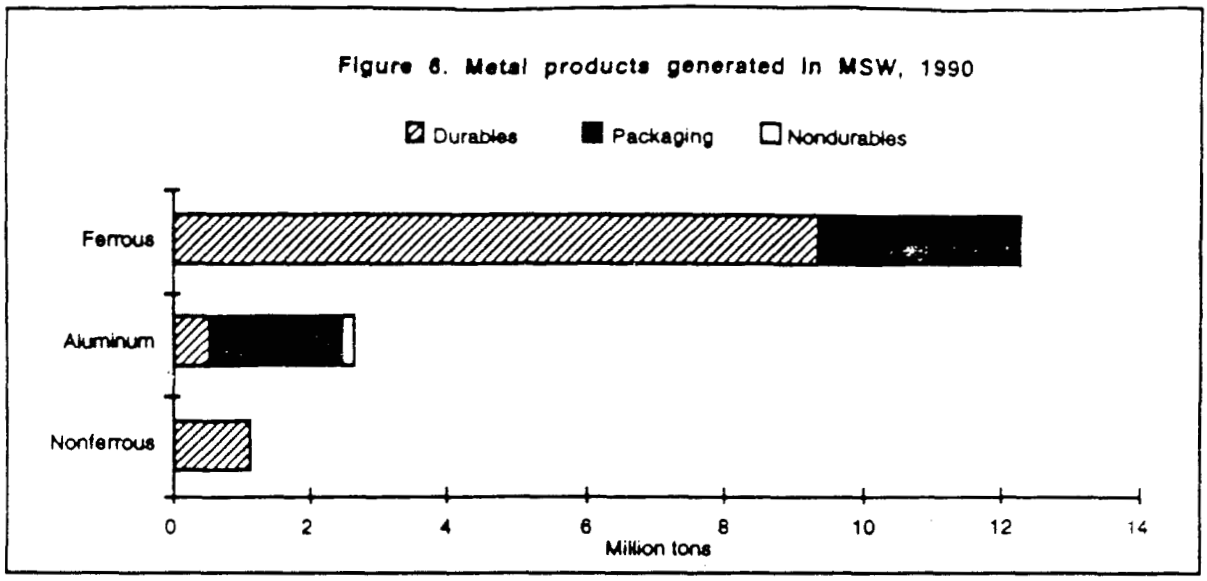
Table 6

METAL PRODUCTS IN MSW, 1990
(In millions of tons and percent of generation)

Product Category	Generation (Million tons)	Recovery (Million tons)	Recovery (Percent of generation)	Discards (Million tons)
Durable Goods				
Ferrous Metals*	9.4	1.3	13.3%	8.2
Aluminum**	0.6	Neg.	Neg.	0.6
Lead†	0.8	0.8	96.3%	Neg.
Other Nonferrous Metals‡	0.4	Neg.	Neg.	0.4
Total Metals in Durable Goods	11.2	2.1	18.5%	9.1
Nondurable Goods				
Aluminum	0.2	Neg.	Neg.	0.2
Containers and Packaging				
Steel				
Beer and soft drink cans	0.1	Neg.	24.7%	0.1
Food and other cans	2.5	0.6	23.4%	1.9
Other steel packaging	0.2	Neg.	Neg.	0.2
Total Steel Packaging	2.9	0.6	22.1%	2.3
Aluminum				
Beer and soft drink cans	1.6	1.0	63.2%	0.6
Food and other cans	0.0	Neg.	Neg.	Neg.
Foil and closures	0.3	Neg.	Neg.	0.3
Total Aluminum Packaging	1.9	1.0	53.3%	0.9
Total Metals in Containers and Packaging	4.8	1.7	34.5%	3.1
Total Metals	16.2	3.7	23.0%	12.5

* Ferrous metals in appliances, furniture, tires, and miscellaneous durables.
** Aluminum in appliances, furniture, and miscellaneous durables.
† Lead in lead-acid batteries.
‡ Other nonferrous metals in appliances and miscellaneous durables.
Neg. = Negligible (less than 0.05 percent or 50,000 tons).
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.



Generation. About 10 million tons of ferrous metals were generated in 1960. Like glass, the tonnages grew during the 1960s and 1970s, but began to drop as lighter materials like aluminum and plastics replaced steel in many applications. Generation of ferrous metals did, however, increase to 12.3 million tons in 1990. The percentage of ferrous metal generation in MSW has declined from over 11 percent in 1960 to 6.3 percent in 1990.

Recovery. Recovery of ferrous metals from MSW has generally not been well documented in the past. The renewed emphasis on recovery and recycling in recent years has, however, included ferrous metals. Recovery of ferrous metals from major appliances ("white goods") was estimated to be about 40 percent in 1990. Overall recovery of ferrous metals from durable goods (large and small appliances, furniture, and tires) was estimated to be about 13 percent in 1990.

An estimated 25 percent of steel beverage cans was recovered in 1990, although the tonnage of these cans in MSW is not large. About 23 percent of food and other steel cans was estimated to be recovered in 1990.

Discards after Recovery. Discards of ferrous metals after recovery were over 10 million tons in 1990, or 6.4 percent of total discards.

Aluminum

The largest source of aluminum in MSW is aluminum cans and other packaging (Table 6 and Figure 6). Relatively small amounts of aluminum are also found in durable and nondurable goods.

Generation. In 1990, 1.9 million tons of aluminum were generated as containers and packaging, while a total of about one million tons was found in

durable and nondurable goods. The total—2.7 million tons—represented 1.4 percent of total MSW generation in 1990. Aluminum generation was only about 400,000 tons (0.5 percent) in 1960.

Recovery. About 53 percent of all aluminum containers and packaging was recovered for recycling in 1990. Nearly all of this recovery was beer and soft drink cans; they were estimated to be recovered at a 63 percent rate in 1990.

Discards after Recovery. In 1990, 1.6 million tons of aluminum were discarded in MSW after recovery, which was one percent of total discards.

Other Nonferrous Metals

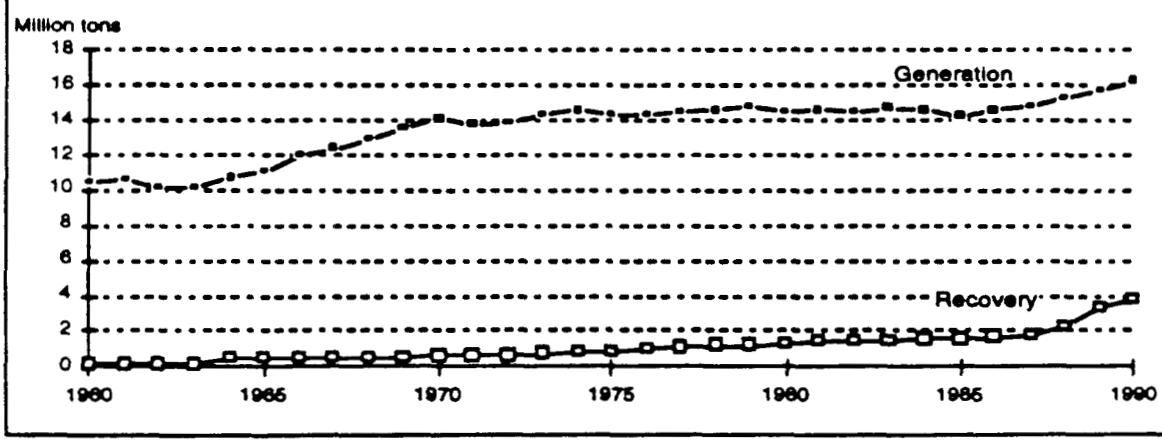
Other nonferrous metals (e.g., lead, copper, zinc) are found in durable products such as appliances, consumer electronics, etc. Lead in lead-acid batteries is the most prevalent nonferrous metal (other than aluminum) in MSW.

Generation. Generation of other nonferrous metals in MSW totaled about 1.2 million tons in 1990. Lead in batteries accounted for over 800,000 tons of this amount. Generation of these metals has increased slowly, from about 200,000 tons in 1960. As a percentage of total generation, nonferrous metals have never exceeded one percent.

Recovery. Recovery of the other nonferrous metals was over 800,000 tons in 1990, with most of this being lead recovered from batteries. It was estimated that about 96 percent of battery lead was recovered in 1990.

Discards after Recovery. An estimated 400,000 tons of nonferrous metals were discarded in MSW in 1990. Percentages of total remained less than one percent over the entire period.

Figure 7. Metals generation and recovery, 1960 to 1990



Plastics

Plastics are a rapidly-growing segment of MSW. Plastics are found in durable and nondurable goods and in containers and packaging, with the latter being the largest category of plastics in MSW (Table 7 and Figure 8).

In durable goods, plastics are found in appliances, furniture, casings of lead-acid batteries, and other products. Plastics are found in such nondurable products as disposable diapers, trash bags, cups, eating utensils, shower curtains, etc. Plastics are also used in a variety of container and packaging products, e.g., condiment and beverage containers, bags, protection for electronic equipment and computers, etc.

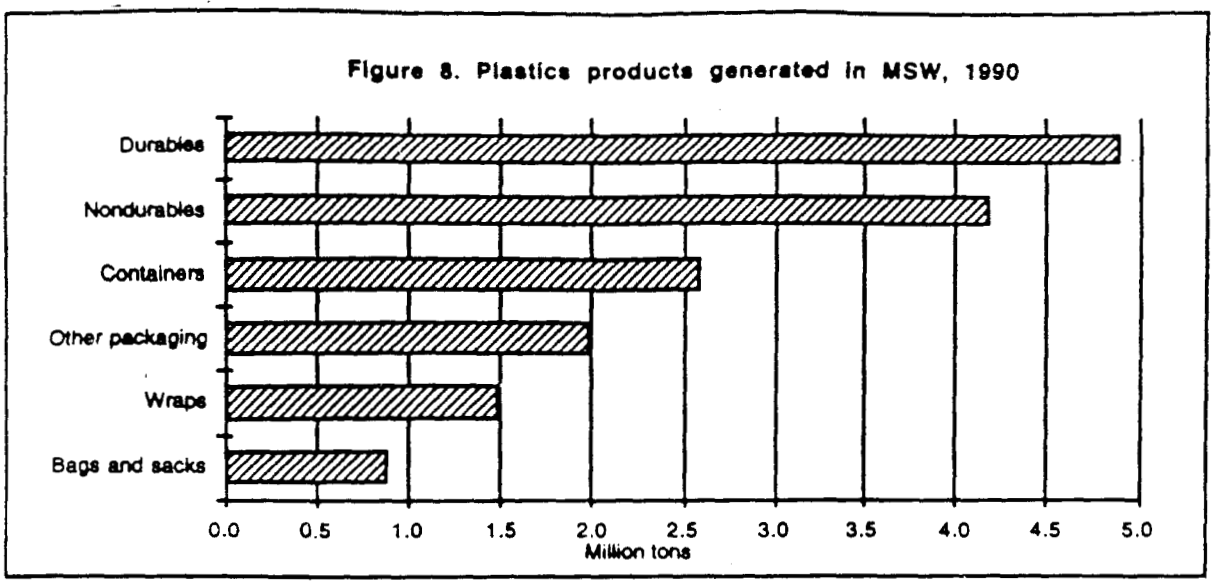
Table 7

PLASTIC PRODUCTS IN MSW, 1990
(In millions of tons and percent of generation)

Product Category	Generation (Million tons)	Recovery (Million tons)	Recovery (Percent of generation)	Discards (Million tons)
Durable Goods*	4.9	0.1	2.0%	4.8
Nondurable Goods				
Plastic Plates and Cups	0.3	Neg.	Neg.	0.3
Trash Bags	0.8	Neg.	Neg.	0.8
Disposable Diapers**	0.3	Neg.	Neg.	0.3
Clothing and Footwear	0.2	Neg.	Neg.	0.2
Other Misc. Nondurables†	2.7	Neg.	Neg.	2.7
Total Plastics Nondurable Goods	4.2	Neg.	Neg.	4.2
Containers and Packaging				
Soft Drink Bottles‡	0.4	0.1	31.5%	0.3
Milk Bottles	0.4	Neg.	6.9%	0.3
Other Containers	1.8	Neg.	1.1%	1.8
Bags and Sacks	0.9	Neg.	Neg.	0.9
Wraps	1.5	Neg.	Neg.	1.5
Other Plastic Packaging	2.0	Neg.	Neg.	2.0
Total Plastics Containers and Packaging	7.1	0.3	3.7%	6.8
Total Plastics	16.2	0.4	2.2%	15.9

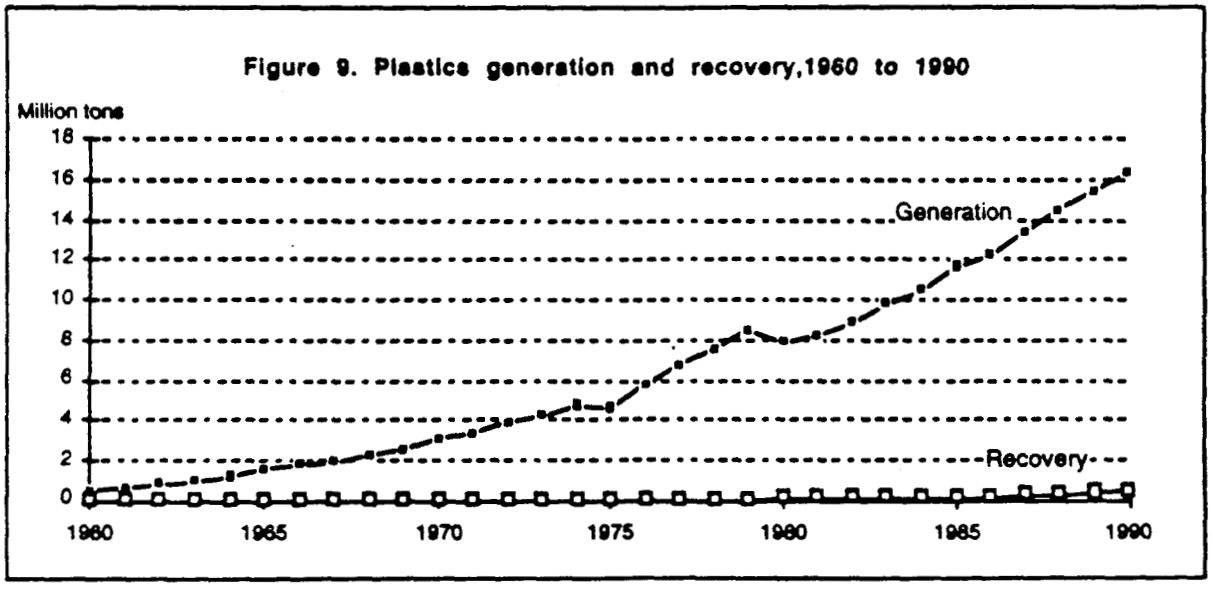
* Plastics as a component of appliances, furniture, lead-acid batteries and miscellaneous durables.
** Does not include other materials in diapers.
† Eating utensils and straws, shower curtains, etc.
‡ Includes bottles and base cups.
Neg. = Negligible (less than 0.05 percent or 50,000 tons).
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.



Generation. Plastics comprised an estimated 400,000 tons of MSW generation in 1960. The quantity grew steadily to over 16 million tons in 1990 (Figure 9). As a percentage of MSW generation, plastics were less than one percent in 1960, increasing to over 8 percent in 1990.

Recovery for Recycling. While overall recovery of plastics for recycling is small—365,000 tons, or about two percent of generation in 1990—an estimated 31.5 percent of plastic (polyethylene terephthalate) soft drink bottles and their base cups were recovered that year. Significant recovery of plastics from lead-acid battery casings and from some other containers was also reported.



Discards after Recovery. Discards of plastics in MSW after recovery were 15.9 million tons, or almost 10 percent of total discards.

Other Materials

Rubber and Leather. The predominant source of rubber in MSW is rubber tires (Table 8). Other sources of rubber and leather include clothing and footwear and other miscellaneous durable and nondurable products. These other sources are quite diverse, including such items as gaskets on appliances, furniture, and hot water bottles, for example.

Table 8

RUBBER AND LEATHER PRODUCTS IN MSW, 1990
(In millions of tons and percent of generation)

Product Category	Generation (Million tons)	Recovery (Million tons)	Recovery (Percent of generation)	Discards (Million tons)
Durable Goods				
Rubber Tires*	1.6	0.2	13.0%	1.4
Other Durables**	2.0	Neg.	Neg.	2.0
Total Rubber & Leather Durable Goods	3.6	0.2	5.8%	3.4
Nondurable Goods				
Clothing and Footwear	0.8	Neg.	Neg.	0.8
Other Nondurables	0.3	Neg.	Neg.	0.3
Total Rubber & Leather Nondurable Goods	1.1	Neg.	Neg.	1.1
Total Rubber & Leather	4.6	0.2	4.4%	4.4

* Does not include other materials in tires.
** Includes carpets and rugs and other miscellaneous durables.
Neg. = Negligible (less than 0.05 percent or 50,000 tons).
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Generation. Generation of rubber and leather in MSW has shown slow growth over the years, increasing from 2 million tons in 1960 to over 4 million tons in 1990. One reason for the relatively slow rate of growth is that tires have been made smaller and longer-wearing than in past years.

As a percentage of total MSW generation, rubber and leather have ranged between 2 and 3 percent of the total over the historical period.

Recovery for Recycling. The only recovery identified in this category is rubber from tires, and that was estimated to be about 200,000 tons

(13 percent of rubber in tires in 1990) (Table 8). This means that about 4.4 percent of all rubber and leather in MSW was recovered in 1990.

Discards after Recovery. Discards of rubber and leather after recovery were over 4 million tons in 1990 (2.7 percent of total discards).

Textiles. Textiles in MSW are found mainly in discarded clothing, although other sources were identified to be furniture, tires, footwear, and other miscellaneous nondurables.

Generation. An estimated 5.6 million tons of textiles were generated in 1990. These products have exhibited slow growth over the study period.

Recovery for Recycling and Discards. A significant amount of textiles is recovered for reuse, but the reused garments and wiper rags re-enter the waste stream eventually, so this is considered a diversion rather than recovery for recycling. Since data on elapsed time from recovery of textiles for reuse to final discard is limited, it was assumed that reused textiles re-enter the waste stream the same year that they are first discarded. It was estimated that about 5 percent of textiles in clothing and items such as sheets and pillowcases was recovered for export in 1990 (about 200,000 tons). This means that about 4 percent of total textiles was recovered, leaving discards of 5.3 million tons of textiles in 1990.

Wood. The sources of wood in MSW include furniture, miscellaneous durables (e.g., cabinets for electronic equipment), wood packaging (crates, pallets), and some other miscellaneous products.

Generation. About 12.3 million tons of wood were generated in MSW in 1990 (6.3 percent of total generation). For this report, wood packaging generation was re-examined carefully, and it was determined that wood packaging (primarily wood pallets) had been underestimated in previous reports for the decade of the 1980s. Previous estimates of wood packaging generation in 1980 and 1985 as shown in Table 1 have been revised upward accordingly.

Recovery for Recycling and Discards. Recovery of wood pallets (usually by chipping) has been increasing along with recovery of other materials. It was estimated that nearly 400,000 tons of wood waste were recovered in 1990, leaving wood discards of 11.9 million tons (7.3 percent of total discards).

Other Products. Generation of "other product" waste is mainly associated with disposable diapers, which are discussed under the section on Products in Municipal Solid Waste. The only other significant source of

materials in this category is the electrolytes and other materials associated with lead-acid batteries that are not classified as plastics or nonferrous metal.

Food Wastes

Food wastes included here consist of uneaten food and food preparation wastes from residences, commercial establishments (restaurants, fast food establishments), institutional sources such as school cafeterias, and industrial sources such as factory lunchrooms.

Generation. As noted earlier, the only source of data on food wastes is on-site sampling studies. As many sampling studies as possible—representing a long time frame—were scrutinized. Sampling studies are generally performed on mixed wastes as received at a transfer station or landfill, and the results are reported by material as a percentage of the total sample. Therefore, the sampling study results for food wastes were integrated into the discards (after recovery) of the other materials in MSW. In addition, an adjustment was made for the moisture transfer that occurs when wastes are mixed prior to sampling. As a check on the sampling methodology, per capita generation of food wastes over the historical period was also calculated.

The sampling studies over a long time frame show food wastes to be a declining percentage of the waste stream, down from almost 15 percent of discards after recycling in 1960 to 8.1 percent in 1990. Generation of food wastes was estimated to be 13.2 million tons in 1990. On a per capita basis, discards of food wastes are declining. This can be attributed to more use of garbage disposals, which send food wastes to the sewer systems rather than MSW, and increasing use of prepared foods both at home and in food service establishments. (When foods are prepared and packaged off-site, the food preparation wastes are categorized as industrial wastes rather than MSW.)

Recovery and Discards. While recovery of food wastes for composting or animal feed has been practiced in some locations, no significant recovery of food wastes was identified in 1990.

Yard Trimmings

Yard trimmings include grass, leaves, and tree and brush trimmings from residential, institutional, and commercial sources.

Generation. Generation of yard trimmings was estimated in exactly the same manner described above for food wastes, based on sampling studies. As a percentage of the waste stream, yard trimmings have been exhibiting a slow decline, although in terms of per capita generation, they have been increasing slightly. An estimated 35 million tons of yard trimmings were generated in MSW in 1990.

Recovery for Composting and Discards. Quantitative national information on composting of yard trimmings is difficult to obtain, but estimates were based on a literature search and telephone contacts with state agencies to determine state policies on removal of yard trimmings from MSW (e.g., by banning leaves from landfills), and estimates of the amounts of waste that might be affected. Removal of yard trimmings for composting was estimated to be about 12 percent of generation in 1990 (4.2 million tons), leaving about 31 million tons of yard trimmings to be discarded.

(It should be noted that these estimates do not account for backyard composting by individuals or practices such as less bagging of grass wastes; since the yard trimming estimates are based on sampling studies at the landfill or transfer station, they are based on the quantities received there.)

Miscellaneous Inorganic Wastes

This relatively small category of MSW is also derived from sampling studies. It is not well defined and often shows up in sampling reports as "fines" or "other." It includes soil, bits of concrete, stones, and the like.

Generation. This category contributed an estimated 2.9 million tons of MSW in 1990.

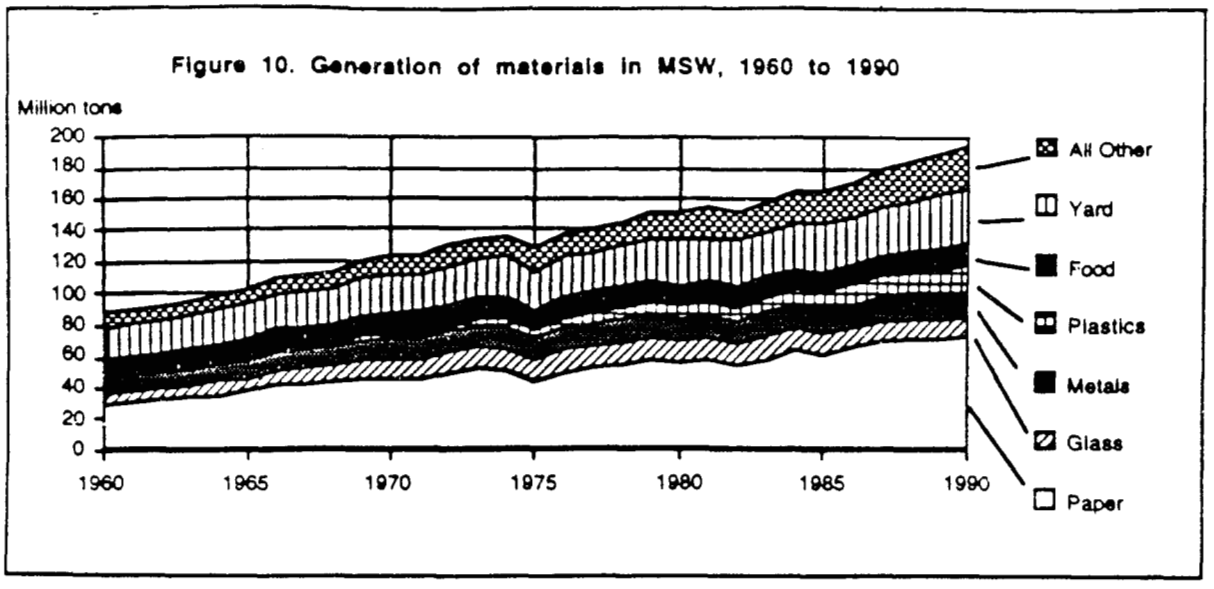
Recovery and Discards. No recovery of these products was identified; discards are the same as generation.

Summary of Materials in Municipal Solid Waste

Generation. Changing quantities and composition of municipal solid waste generation are illustrated in Figure 10. Generation of MSW has grown steadily, from 87.8 million tons in 1960 to 195.7 million tons in 1990. Over the years, paper and paperboard has been the dominant material generated in MSW. Yard trimmings have been the second largest component of MSW. Metals have remained fairly constant as a source of MSW, while glass increased until the 1980s and has since declined or shown a slower rate of increase. Food wastes have remained fairly constant in terms of MSW tonnage.

Plastics have been a rapidly growing component of MSW. In terms of tonnage contributed, they ranked third in 1990 (behind yard trimmings and approximately equal to metals).

Recovery and Discards. The effect of recovery and composting on MSW discards is illustrated in Figure 11. Recovery of materials for recycling grew at a rather slow pace during most of the historical period covered by this data



series, increasing only from 9.6 percent of generation in 1980 to 10 percent in 1985. Renewed interest in recycling and composting as solid waste management alternatives has occurred in the late 1980s, and the recovery rate in 1990 was estimated to be 17.1 percent of generation.

Estimated recovery and composting of materials are shown in Figure 12. In 1990, recovery of paper and paperboard dominated materials recovery at about 63 percent of total tonnage recovered. Recovery of other materials, while generally increasing, contributes much less tonnage.

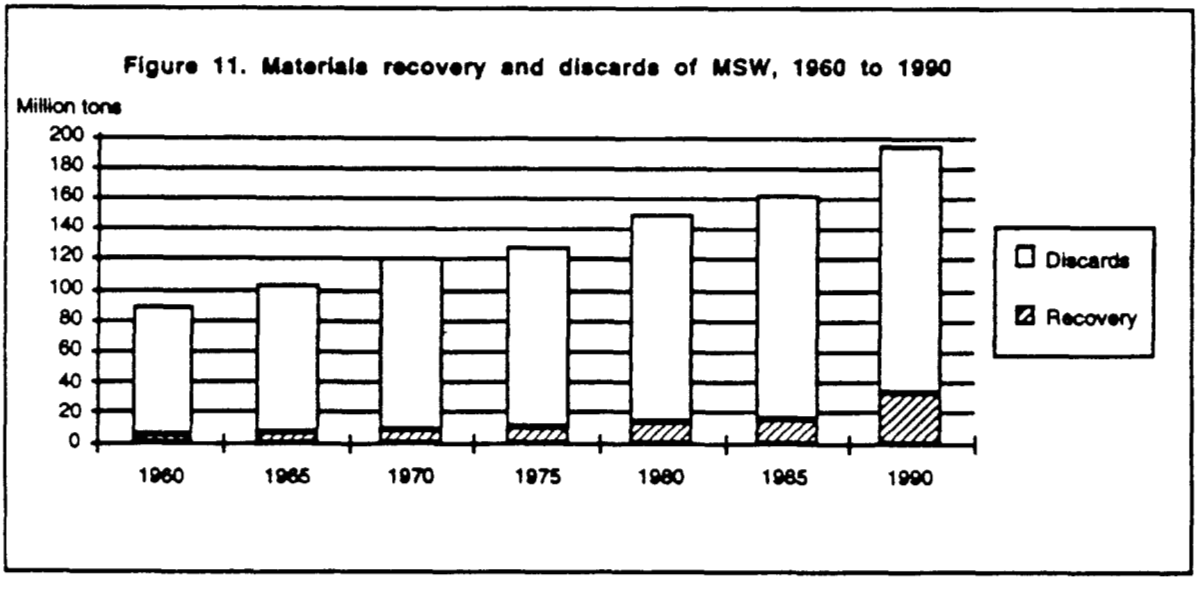
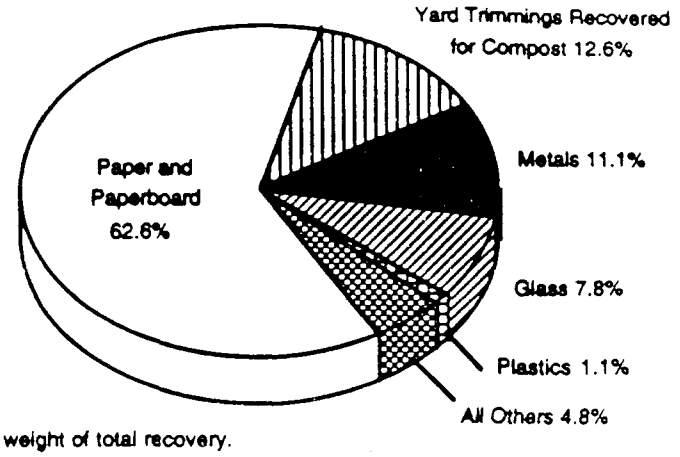


Figure 12. Materials recovery*, 1990



* In percent by weight of total recovery.

Figure 13 illustrates the effect of recovery of materials for recycling, including composting, on the composition of MSW discards. For example, paper and paperboard were over 37 percent of MSW generated in 1990, but after recovery, paper and paperboard were about 32 percent of discards. Materials that have little or no recovery exhibit a larger percentage of MSW discards compared to generation. For instance, food wastes were less than 7 percent of MSW generation in 1990, but about 8 percent of discards.

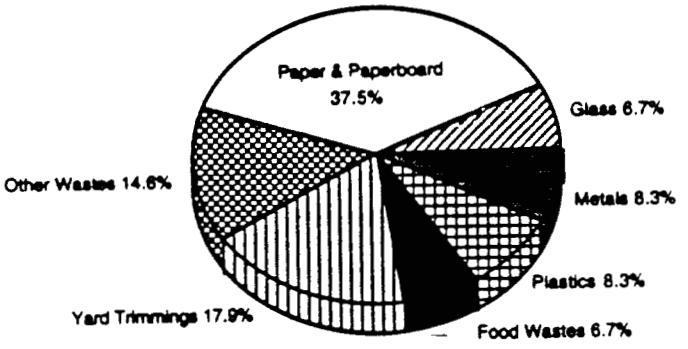
PRODUCTS IN MUNICIPAL SOLID WASTE

Generation, recovery, and discards of products in municipal solid waste are shown in a series of tables in this section. (Note that the totals for these tables are the same as the previous series of tables for materials in MSW.) The products in MSW are categorized as durable goods, nondurable goods, and containers and packaging. Generation, recovery, and discards of these products are summarized in Tables 9 through 11. Each product category is discussed in more detail below, with detailed tables highlighting the products in each.

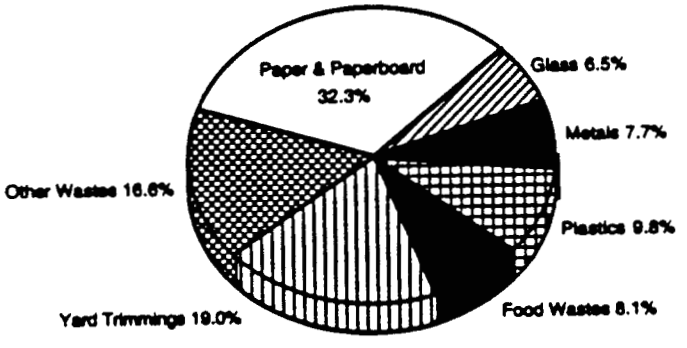
Durable Goods

Durable goods generally are defined as products having a lifetime of three years or more, although there are some exceptions. In this report, durable goods include major appliances, furniture and furnishings, rubber tires, lead-acid automotive batteries, and miscellaneous durables (e.g., small appliances, consumer electronics) (see Tables 12 through 14). These products are often called "oversize and bulky" in municipal solid waste management practice, and they are generally handled in a somewhat different manner than

Figure 13. Materials generated and discarded in MSW, 1990



Generation



Discards

Table 9

CATEGORIES OF PRODUCTS GENERATED*
IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(In millions of tons and percent of total generation)

	Millions of Tons						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods *(Detail in Table 12)*	9.4	11.1	15.1	17.5	19.7	21.5	27.9
Nondurable Goods *(Detail in Table 15)*	17.6	22.2	25.5	25.6	36.5	42.6	52.3
Containers and Packaging *(Detail in Table 18)*	27.3	34.2	43.5	44.4	52.3	54.6	64.4
Total Product** Wastes	54.3	67.5	84.1	87.5	108.5	118.7	144.6
Other Wastes							
Food Wastes	12.2	12.7	12.8	13.4	13.2	13.2	13.2
Yard Trimmings	20.0	21.6	23.2	25.2	27.5	30.0	35.0
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.2	2.5	2.9
Total Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	51.1
Total MSW Generated - Weight	87.8	103.4	121.9	128.1	151.4	164.4	195.7
	Percent of Total Generation						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods *(Detail in Table 12)*	10.7%	10.7%	12.4%	13.7%	13.0%	13.1%	14.3%
Nondurable Goods *(Detail in Table 15)*	20.0%	21.5%	20.9%	20.0%	24.1%	25.9%	26.7%
Containers and Packaging *(Detail in Table 19)*	31.1%	33.1%	35.7%	34.7%	34.5%	33.2%	32.9%
Total Product** Wastes	61.8%	65.3%	69.0%	68.3%	71.6%	72.2%	73.9%
Other Wastes							
Food Wastes	13.9%	12.3%	10.5%	10.5%	8.7%	8.0%	6.7%
Yard Trimmings	22.8%	20.9%	19.0%	19.7%	18.2%	18.2%	17.9%
Miscellaneous Inorganic Wastes	1.5%	1.5%	1.5%	1.6%	1.5%	1.5%	1.5%
Total Other Wastes	38.2%	34.7%	31.0%	31.7%	28.3%	27.8%	26.1%
Total MSW Generated - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Generation before materials recovery or combustion. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

** Other than food products.

Source: Franklin Associates, Ltd.

Table 10

RECOVERY* OF MUNICIPAL SOLID WASTE, 1960 TO 1990
(In millions of tons and percent of generation of each product)

	Millions of Tons						
Products	1960	1965	1970	1975	1980	1985	1990
Durable Goods (Detail in Table 13)	0.4	0.9	0.9	1.0	1.3	1.4	3.1
Nondurable Goods (Detail in Table 16)	2.4	2.8	3.8	3.8	4.8	5.6	9.2
Containers and Packaging (Detail in Table 20)	3.1	3.1	3.9	5.1	8.4	9.4	16.9
*Total Product** Wastes*	5.9	6.8	8.6	9.9	14.5	16.4	29.2
Other Wastes							
Food Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Yard Trimmings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.2
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.2
Total MSW Recovered - Weight	5.9	6.8	8.6	9.9	14.5	16.4	33.4
Products	1960	1965	1970	1975	1980	1985	1990
Durable Goods (Detail in Table 13)	4.3%	8.1%	6.0%	5.7%	6.6%	6.5%	11.2%
Nondurable Goods (Detail in Table 16)	13.6%	12.6%	14.9%	14.8%	13.2%	13.1%	17.5%
Containers and Packaging (Detail in Table 21)	11.4%	9.1%	9.0%	11.5%	16.1%	17.2%	26.3%
*Total Product** Wastes*	10.9%	10.1%	10.2%	11.3%	13.4%	13.8%	20.2%
Other Wastes							
Food Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Yard Trimmings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	12.0%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	8.2%
Total MSW Recovered - %	6.7%	6.6%	7.1%	7.7%	9.6%	10.0%	17.1%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
Details may not add to totals due to rounding.

** Other than food products.

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

Source: Franklin Associates, Ltd.

Table 11

CATEGORIES OF PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(In millions of tons and percent of total discards)

	Millions of Tons						
Products	1960	1965	1970	1975	1980	1985	1990
Durable Goods (Detail in Table 14)	9.0	10.2	14.2	16.5	18.4	20.1	24.8
Nondurable Goods (Detail in Table 17)	15.2	19.4	21.7	21.8	31.7	37.0	43.2
Containers and Packaging (Detail in Table 22)	24.2	31.1	39.6	39.3	43.9	45.2	47.4
*Total Product** Wastes*	48.4	60.7	75.5	77.6	94.0	102.3	115.4
Other Wastes							
Food Wastes	12.2	12.7	12.8	13.4	13.2	13.2	13.2
Yard Trimmings	20.0	21.6	23.2	25.2	27.5	30.0	30.8
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.2	2.5	2.9
Total Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	46.9
Total MSW Discarded - Weight	81.9	96.6	113.3	118.2	136.9	148.0	162.3
	Percent of Total Discards						
Products	1960	1965	1970	1975	1980	1985	1990
Durable Goods (Detail in Table 14)	11.0%	10.6%	12.5%	14.0%	13.4%	13.6%	15.3%
Nondurable Goods (Detail in Table 17)	18.6%	20.1%	19.2%	18.4%	23.2%	25.0%	26.6%
Containers and Packaging (Detail in Table 23)	29.5%	32.2%	35.0%	33.2%	32.1%	30.5%	29.2%
*Total Product** Wastes*	59.1%	62.8%	66.6%	65.7%	68.7%	69.1%	71.1%
Other Wastes							
Food Wastes	14.9%	13.1%	11.3%	11.3%	9.6%	8.9%	8.1%
Yard Trimmings	24.4%	22.4%	20.5%	21.3%	20.1%	20.3%	19.0%
Miscellaneous Inorganic Wastes	1.6%	1.7%	1.6%	1.7%	1.6%	1.7%	1.8%
Total Other Wastes	40.9%	37.2%	33.4%	34.3%	31.3%	30.9%	28.9%
Total MSW Discarded - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Discards after materials and compost recovery. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

** Other than food products.

Source: Franklin Associates, Ltd.

Table 12

PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(WITH DETAIL ON DURABLE GOODS)
(In millions of tons and percent of total generation)

	Millions of Tons						
Products	1960	1965	1970	1975	1980	1985	1990
Durable Goods							
Major Appliances	1.5	1.0	2.7	2.6	2.8	2.7	2.8
Furniture and Furnishings	2.1	2.7	3.4	4.1	5.1	5.8	7.4
Carpets and Rugs**							1.7
Rubber Tires	1.1	1.4	1.9	2.5	2.6	1.9	1.8
Batteries, lead acid	Neg.	0.7	0.8	1.2	1.5	1.5	1.7
Miscellaneous Durables	4.7	5.4	6.3	7.1	7.7	9.6	12.5
Total Durable Goods	9.4	11.1	15.1	17.5	19.7	21.5	27.9
Nondurable Goods	17.6	22.2	25.5	25.6	36.5	42.6	52.3
(Detail in Table 15)							
Containers and Packaging	27.3	34.2	43.5	44.4	52.3	54.6	64.4
(Detail in Table 18)							
Total Product Wastes†	54.3	67.5	84.1	87.5	108.5	118.7	144.6
Other Wastes							
Food Wastes	12.2	12.7	12.8	13.4	13.2	13.2	13.2
Yard Trimmings	20.0	21.6	23.2	25.2	27.5	30.0	35.0
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.2	2.5	2.9
Total Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	51.1
Total MSW Generated - Weight	87.8	103.4	121.9	128.1	151.4	164.4	195.7
	Percent of Total Generation						
Products	1960	1965	1970	1975	1980	1985	1990
Durable Goods							
Major Appliances	1.7%	1.0%	2.2%	2.0%	1.8%	1.6%	1.4%
Furniture and Furnishings	2.4%	2.6%	2.8%	3.2%	3.4%	3.5%	3.8%
Carpets and Rugs							0.9%
Rubber Tires	1.3%	1.3%	1.6%	2.0%	1.7%	1.2%	0.9%
Batteries, Lead-Acid	Neg.	0.6%	0.7%	0.9%	1.0%	0.9%	0.9%
Miscellaneous Durables	5.4%	5.2%	5.2%	5.5%	5.1%	5.8%	6.4%
Total Durable Goods	10.7%	10.8%	12.4%	13.7%	13.0%	13.1%	14.3%
Nondurable Goods	20.0%	21.5%	20.9%	20.0%	24.1%	25.9%	26.7%
(Detail in Table 15)							
Containers and Packaging	31.1%	33.1%	35.7%	34.7%	34.5%	33.2%	32.9%
(Detail in Table 19)							
Total Product Wastes†	61.8%	65.3%	69.0%	68.3%	71.7%	72.2%	73.9%
Other Wastes							
Food Wastes	13.9%	12.3%	10.5%	10.5%	8.7%	8.0%	6.7%
Yard Trimmings	22.8%	20.9%	19.0%	19.7%	18.2%	18.2%	17.9%
Miscellaneous Inorganic Wastes	1.5%	1.5%	1.5%	1.6%	1.5%	1.5%	1.5%
Total Other Wastes	38.2%	34.7%	31.0%	31.7%	28.3%	27.8%	26.1%
Total MSW Generated - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Generation before materials recovery or combustion. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

** New line item added in 1992.

† Other than food products.

Source: Franklin Associates, Ltd.

other components of MSW. That is, they are often picked up separately, and may not be mixed with other MSW at the landfill, combustor, or other waste management facility. Durable goods are made up of a wide variety of materials. In order of tonnage in MSW in 1990, these include: ferrous metals, plastics, wood, rubber and leather, textiles, glass, other nonferrous metals (e.g., lead, copper), and aluminum.

Table 13

RECOVERY* OF PRODUCTS IN MUNICIPAL SOLID WASTE, 1960 TO 1990
(WITH DETAIL ON DURABLE GOODS)
(In millions of tons and percent of generation of each product)

	Millions of Tons						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods							
Major Appliances	Neg.	Neg.	Neg.	Neg.	0.1	0.2	0.9
Furniture and Furnishings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Carpets and Rugs**	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Rubber Tires	0.4	0.3	0.3	0.2	0.1	0.1	0.2
Batteries, lead acid	Neg.	0.6	0.6	0.8	1.0	1.0	1.6
Miscellaneous Durables	Neg.	Neg.	Neg.	Neg.	0.1	0.1	0.4
Total Durable Goods	0.4	0.9	0.9	1.0	1.3	1.4	3.1
Nondurable Goods *(Detail in Table 16)*	2.4	2.8	3.8	3.8	4.8	5.6	9.2
Containers and Packaging *(Detail in Table 20)*	3.1	3.1	3.9	5.1	8.4	9.4	16.9
Total Product Wastes†	5.9	6.8	8.6	9.9	14.5	16.4	29.2
Other Wastes							
Food Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Yard Trimmings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.2
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.2
Total MSW Recovered - Weight	5.9	6.8	8.6	9.9	14.5	16.4	33.4
	Percent of Generation of Each Product						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods							
Major Appliances	Neg.	Neg.	Neg.	Neg.	3.6%	7.4%	32.4%
Furniture and Furnishings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Carpets and Rugs							0.2%
Rubber Tires	36.4%	21.8%	15.8%	8.0%	3.8%	5.3%	11.6%
Batteries, Lead-Acid	Neg.	88.6%	75.0%	66.7%	66.7%	66.7%	96.6%
Miscellaneous Durables	Neg.	Neg.	Neg.	Neg.	1.3%	1.0%	3.0%
Total Durable Goods	4.3%	8.1%	6.0%	5.7%	6.6%	6.5%	11.2%
Nondurable Goods *(Detail in Table 16)*	13.6%	12.6%	14.9%	14.8%	13.2%	13.1%	17.5%
Containers and Packaging *(Detail in Table 21)*	11.4%	9.1%	9.0%	11.5%	16.1%	17.2%	26.3%
Total Product Wastes†	10.9%	10.1%	10.2%	11.3%	13.4%	13.8%	20.2%
Other Wastes							
Food Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Yard Trimmings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	12.0%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	8.2%
Total MSW Recovered - %	6.7%	6.6%	7.1%	7.7%	9.6%	10.0%	17.1%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** New line item added in 1992.
† Other than food products.
Neg. = Negligible (less than 0.05 percent or 50,000 tons)
Source: Franklin Associates, Ltd.

Generation of durable goods in MSW totaled 27.9 million tons in 1990 (over 14 percent of total MSW generation). After recovery for recycling, 24.8 million tons of durable goods remained as discards in 1990.

Major Appliances. Major appliances in MSW include refrigerators, washing machines, water heaters, etc. They are often called "white goods" in

Table 14

PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(WITH DETAIL ON DURABLE GOODS)
(In millions of tons and percent of total generation)

	Millions of Tons						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods							
Major Appliances	1.5	1.0	2.7	2.6	2.7	2.5	1.9
Furniture and Furnishings	2.1	2.7	3.4	4.1	5.1	5.8	7.4
Carpets and Rugs**							1.7
Rubber Tires	0.7	1.1	1.6	2.3	2.5	1.8	1.6
Batteries, lead acid	Neg.	0.1	0.2	0.4	0.5	0.5	0.1
Miscellaneous Durables	4.7	5.4	6.3	7.1	7.6	9.5	12.1
Total Durable Goods	9.0	10.2	14.2	16.5	18.4	20.1	24.8
Nondurable Goods *(Detail in Table 17)*	15.2	19.4	21.7	21.8	31.7	37.0	43.2
Containers and Packaging *(Detail in Table 22)*	24.2	31.1	39.6	39.3	43.9	45.2	47.4
Total Product Wastes†	48.4	60.7	75.5	77.6	94.0	102.3	115.4
Other Wastes							
Food Wastes	12.2	12.7	12.8	13.4	13.2	13.2	13.2
Yard Trimmings	20.0	21.6	23.2	25.2	27.5	30.0	30.8
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.2	2.5	2.9
Total Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	46.9
Total MSW Discarded - Weight	81.9	96.6	113.3	118.2	136.9	148.0	162.3
	Percent of Total Discards						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods							
Major Appliances	1.8%	1.0%	2.4%	2.2%	2.0%	1.7%	1.2%
Furniture and Furnishings	2.6%	2.8%	3.0%	3.5%	3.7%	3.9%	4.6%
Carpets and Rugs	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%
Rubber Tires	0.9%	1.1%	1.4%	1.9%	1.8%	1.2%	1.0%
Batteries, Lead-Acid	Neg.	0.1%	0.2%	0.3%	0.4%	0.3%	Neg.
Miscellaneous Durables	5.7%	5.6%	5.6%	6.0%	5.6%	6.4%	7.5%
Total Durable Goods	11.0%	10.6%	12.5%	14.0%	13.4%	13.6%	15.3%
Nondurable Goods *(Detail in Table 17)*	18.6%	20.1%	19.2%	18.4%	23.2%	25.0%	26.6%
Containers and Packaging *(Detail in Table 23)*	29.5%	32.2%	35.0%	33.2%	32.1%	30.5%	29.2%
Total Product Wastes†	59.1%	62.8%	66.6%	65.7%	68.7%	69.1%	71.1%
Other Wastes							
Food Wastes	14.9%	13.1%	11.3%	11.3%	9.6%	8.9%	8.1%
Yard Trimmings	24.4%	22.4%	20.5%	21.3%	20.1%	20.3%	19.0%
Miscellaneous Inorganic Wastes	1.6%	1.7%	1.6%	1.7%	1.6%	1.7%	1.8%
Total Other Wastes	40.9%	37.2%	33.4%	34.3%	31.3%	30.9%	28.9%
Total MSW Discarded - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Discards after materials and compost recovery. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

** New line item added in 1992.

† Other than food products.

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

Source: Franklin Associates, Ltd.

the trade. Generation of these products in MSW has increased very slowly; it was estimated to be 2.8 million tons in 1990 (less than 2 percent of total). In general, appliances have increased in quantity but not in average weight over the years. Ferrous metals are the predominant materials in major appliances, but other metals, plastics, glass, and other materials are also found.

Some ferrous metals are recovered from shredded appliances, although this quantity is not well documented. Recovery was estimated to be 900,000 tons in 1990, leaving 1.9 million tons of appliances to be discarded.

Furniture and Furnishings. Generation of furniture and furnishings in MSW has increased from 2.1 million tons in 1960 to 7.4 million tons in 1990 (almost 4 percent of total MSW). No significant recovery of materials from furniture was identified.

Wood is the largest material category in furniture, with ferrous metals second. Plastics, glass, and other materials are also found.

Carpets and Rugs. For the first time, carpets and rugs were broken out as a line item for this report. Carpet pads and backing had previously been included along with other plastics in "Miscellaneous Durables," while the carpet fiber was not specifically accounted for in previous reports. An estimated 1.7 million tons of carpets and rugs were generated in MSW in 1990, which was about one percent of total generation.

A small amount of recycling of carpet fiber was identified—less than one percent recovery in 1990.

Rubber Tires. About 70 percent of the rubber used in the United States is used in the manufacture of rubber tires. Generation of rubber tires increased from about one million tons in 1960 to 1.8 million tons in 1990 (about one percent of total MSW). Generation was higher in the 1970s and early 1980s, but the trend to smaller and longer-wearing tires has lowered their quantities. Rubber recovery from tires has been small, but increasing in recent years. In 1990, 13 percent of tire rubber generated was recovered (Table 8).

In addition to rubber, tires include relatively small amounts of textiles and ferrous metals. When all materials in tires are included, tire recovery in 1990 is estimated at 11.6 percent (Table 13).

Lead-Acid Batteries. An estimated 1.7 million tons of lead-acid batteries were generated in MSW in 1990 (less than one percent of total generation).

Recovery of batteries for recycling has fluctuated between 60 percent and 90 percent or higher; recovery has been increasing as a growing number of communities have restricted batteries from disposal at landfills or combustors. In 1990 an estimated 96 percent of the lead in these batteries was recovered for recycling as well as substantial quantities of the polypropylene battery casings, so discards after recycling of these batteries were decreased to less than 100,000 tons in 1990. (Electrolytes and other materials remaining when lead and polypropylene from batteries are recycled were classified as industrial wastes rather than MSW.)

Miscellaneous Durables. Miscellaneous durable goods include small appliances, consumer electronics such as television sets and video cassette recorders, and the like. An estimated 12.5 million tons of these goods were generated in 1990, amounting to over 6 percent of MSW generated. Small amounts of ferrous metals are estimated to be recovered from this category, decreasing discards to 12.1 million tons.

In addition to ferrous metals, this category includes plastics, glass, rubber, wood, and other metals.

Nondurable Goods

The Department of Commerce defines nondurable goods as those having a lifetime of less than three years, and this definition was followed for this report to the extent possible.

Products made of paper and paperboard comprise the largest portion of nondurable goods. Other nondurable products include paper and plastic plates, cups, and other disposable food service products; disposable diapers; clothing and footwear; and other miscellaneous products. (See Tables 15 through 17.)

Generation of nondurable goods in MSW was 52.3 million tons in 1990 (26.7 percent of total generation). Recovery of paper products in this category is quite significant, resulting in over 9 million tons of recovery in 1990 (17.5 percent of generation). This meant that 43.2 million tons of nondurable goods were discarded in 1990 (26.6 percent of discards).

Paper and Paperboard Products. Paper and paperboard products in nondurable goods are summarized in Tables 15 through 17. A summary for 1990 was shown earlier in Table 4. For this updated report, new categories of paper and paperboard nondurables were added. The previous category of books and magazines was separated into its two components. The former categories of office papers and commercial printing were separated into office papers, telephone books, third class mail, and other commercial printing. This additional detail has the effect of lowering estimates of office papers and commercial printing if they are compared to previous estimates that were not disaggregated to the same extent.

Newspapers are the largest single component of this category, at 12.9 million tons generated in 1990 (6.6 percent of total MSW). Over 42 percent of newspapers generated were recovered for recycling in 1990, leaving about 7.4 million tons discarded (4.6 percent of MSW discarded).

Table 15

PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(WITH DETAIL ON NONDURABLE GOODS)
(In millions of tons and percent of total generation)

	Millions of Tons						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods *(Detail in Table 12)*	9.4	11.1	15.1	17.5	19.7	21.5	27.9
Nondurable Goods							
Newspapers	7.1	8.3	9.5	8.8	11.0	12.5	12.9
Books and Magazines	1.9	2.2	2.5	2.3	3.4	4.7	
Books**							1.0
Magazines**							2.8
Office Papers	1.5	2.2	2.7	2.6	4.0	5.7	6.4
Telephone Books**							0.5
Third Class Mail**							3.8
Other Commercial Printing	1.3	1.8	2.1	2.1	3.1	3.2	5.5
Tissue Paper and Towels	1.1	1.5	2.1	2.1	2.3	2.7	3.2
Paper Plates and Cups	0.3	0.3	0.4	0.4	0.6	0.6	0.7
Plastic Plates and Cups†					0.2	0.3	0.3
Trash Bags**							0.8
Disposable Diapers	Neg.	Neg.	0.3	1.2	2.3	2.9	2.6
Other Nonpackaging Paper	2.7	3.9	3.6	3.5	4.2	3.5	3.8
Clothing and Footwear	1.3	1.5	1.5	1.7	2.3	2.7	3.7
Towels, Sheets and Pillowcases**							1.0
Other Miscellaneous Nondurables	0.4	0.5	0.8	0.9	3.1	3.8	3.2
Total Nondurable Goods	17.6	22.2	25.5	25.6	36.5	42.6	52.3
Containers and Packaging *(Detail in Table 18)*	27.3	34.2	43.5	44.4	52.3	54.6	64.4
Total Product Wastes†	54.3	67.5	84.1	87.5	108.5	118.7	144.6
Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	51.1
Total MSW Generated - Weight	87.8	103.4	121.9	128.1	151.4	164.4	195.7
	Percent of Total Generation						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods *(Detail in Table 12)*	10.7%	10.7%	12.4%	13.7%	13.0%	13.1%	14.3%
Nondurable Goods							
Newspapers	8.1%	8.0%	7.8%	6.9%	7.3%	7.6%	6.6%
Books and Magazines	2.2%	2.1%	2.1%	1.8%	2.2%	2.9%	
Books**							0.5%
Magazines**							1.4%
Office Papers	1.7%	2.1%	2.2%	2.0%	2.6%	3.5%	3.3%
Telephone Books**							0.3%
Third Class Mail**							2.0%
Other Commercial Printing	1.5%	1.7%	1.7%	1.6%	2.0%	1.9%	2.8%
Tissue Paper and Towels	1.3%	1.5%	1.7%	1.6%	1.5%	1.6%	1.6%
Paper Plates and Cups	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.3%
Plastic Plates and Cups†					0.1%	0.2%	0.2%
Trash Bags**							0.4%
Disposable Diapers	Neg.	Neg.	0.2%	0.9%	1.5%	1.8%	1.4%
Other Nonpackaging Paper	3.1%	3.8%	3.0%	2.7%	2.8%	2.1%	1.9%
Clothing and Footwear	1.5%	1.5%	1.2%	1.3%	1.5%	1.6%	1.9%
Towels, Sheets and Pillowcases**							0.5%
Other Miscellaneous Nondurables	0.5%	0.5%	0.7%	0.7%	2.0%	2.3%	1.6%
Total Nondurables	20.0%	21.5%	20.9%	20.0%	24.1%	25.9%	26.7%
Containers and Packaging *(Detail in Table 19)*	31.1%	33.1%	35.7%	34.7%	34.5%	33.2%	32.9%
Total Product Wastes†	61.8%	65.3%	69.0%	68.3%	71.6%	72.2%	73.9%
Other Wastes	38.2%	34.7%	31.0%	31.7%	28.3%	27.8%	26.1%
Total MSW Generated - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Generation before materials recovery or combustion. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

** New line item added in 1992. Books and magazines, office papers, commercial printing, and miscellaneous nondurables categories have been partially reallocated.

† Not estimated prior to 1960.

‡ Other than food products.

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

Source: Franklin Associates, Ltd.

Table 16

RECOVERY* OF PRODUCTS IN MUNICIPAL SOLID WASTE, 1960 TO 1990
(WITH DETAIL ON NONDURABLE GOODS)
(In millions of tons and percent of generation of each product)

	Millions of Tons						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods *(Detail in Table 12)*	0.4	0.9	0.9	1.0	1.3	1.4	3.1
Nondurable Goods							
Newspapers	1.8	2.0	2.3	2.4	3.0	3.5	5.5
Books and Magazines	0.1	0.1	0.3	0.2	0.4	0.5	
Books**							0.1
Magazines**							0.3
Office Papers	0.3	0.4	0.7	0.7	1.0	1.1	1.7
Telephone Books**							0.1
Third Class Mail**							0.2
Other Commercial Printing	0.1	0.2	0.3	0.3	0.4	0.5	1.1
Tissue Paper and Towels	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Paper Plates and Cups	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Plastic Plates and Cups†					Neg.	Neg.	Neg.
Trash Bags**							Neg.
Disposable Diapers	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Other Nonpackaging Paper	0.1	0.1	0.2	0.2	Neg.	Neg.	Neg.
Clothing and Footwear	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	0.2
Towels, Sheets and Pillowcases**							Neg.
Other Miscellaneous Nondurables	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Nondurable Goods	2.4	2.8	3.8	3.8	4.8	5.6	9.1
Containers and Packaging *(Detail in Table 18)*	3.1	3.1	3.9	5.1	8.4	9.4	16.9
Total Product Wastes†	5.9	6.8	8.6	9.9	14.5	16.4	29.2
Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.2
Total MSW Recovered - Weight	5.9	6.8	8.6	9.9	14.5	16.4	33.4
	Percent of Generation of Each Product						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods *(Detail in Table 12)*	4.3%	8.1%	6.0%	5.7%	6.6%	6.5%	11.2%
Nondurable Goods							
Newspapers	25.4%	24.1%	24.2%	27.3%	27.3%	28.0%	42.5%
Books and Magazines	5.3%	4.5%	12.0%	8.7%	11.8%	10.6%	
Books**							10.3%
Magazines**							10.7%
Office Papers	20.0%	18.2%	25.9%	26.9%	25.0%	19.3%	26.5%
Telephone Books**							9.3%
Third Class Mail**							5.2%
Other Commercial Printing	7.7%	11.1%	14.3%	14.3%	12.9%	15.6%	19.4%
Tissue Paper and Towels	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Paper Plates and Cups	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Plastic Plates and Cups†					Neg.	Neg.	Neg.
Trash Bags**							Neg.
Disposable Diapers	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Other Nonpackaging Paper	3.7%	2.6%	5.6%	5.7%	Neg.	Neg.	Neg.
Clothing and Footwear	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	5.0%
Towels, Sheets and Pillowcases**							Neg.
Other Miscellaneous Nondurables	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Nondurables	13.6%	12.6%	14.9%	14.8%	13.2%	13.1%	17.4%
Containers and Packaging *(Detail in Table 19)*	11.4%	9.1%	9.0%	11.5%	16.1%	17.2%	26.3%
Total Product Wastes†	10.9%	10.1%	10.2%	11.3%	13.4%	13.8%	20.2%
Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	8.2%
Total MSW Recovered - %	6.7%	6.6%	7.1%	7.7%	9.6%	10.0%	17.1%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** New line item added in 1992. Books and magazines, office papers, commercial printing, and miscellaneous nondurables categories have been partially reallocated.
† Not estimated prior to 1980.
‡ Other than food products.
Neg. = Negligible (less than 0.05 percent or 50,000 tons).
Source: Franklin Associates, Ltd.

Table 17

PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(WITH DETAIL ON NONDURABLE GOODS)
(In millions of tons and percent of total generation)

	Millions of Tons						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods	9.0	10.2	14.2	16.5	18.4	20.1	24.8
(Detail in Table 12)							
Nondurable Goods							
Newspapers	5.3	6.3	7.2	6.4	8.0	9.0	7.4
Books and Magazines	1.8	2.1	2.2	2.1	3.0	4.2	
Books**							0.9
Magazines**							2.5
Office Papers	1.2	1.8	2.0	1.9	3.0	4.6	4.7
Telephone Books**							0.5
Third Class Mail**							3.6
Other Commercial Printing	1.2	1.6	1.8	1.8	2.7	2.7	4.5
Tissue Paper and Towels	1.1	1.5	2.1	2.1	2.3	2.7	3.2
Paper Plates and Cups	0.3	0.3	0.4	0.4	0.6	0.6	0.7
Plastic Plates and Cups†					0.2	0.3	0.3
Trash Bags**							0.8
Disposable Diapers	Neg.	Neg.	0.3	1.2	2.3	2.9	2.6
Other Nonpackaging Paper	2.6	3.8	3.4	3.3	4.2	3.5	3.8
Clothing and Footwear	1.3	1.5	1.5	1.7	2.3	2.7	3.6
Towels, Sheets and Pillowcases**							1.0
Other Miscellaneous Nondurables	0.4	0.5	0.8	0.9	3.1	3.8	3.2
Total Nondurable Goods	15.2	19.4	21.7	21.8	31.7	37.0	43.2
Containers and Packaging	24.2	31.1	39.6	39.3	43.9	45.2	47.4
(Detail in Table 18)							
Total Product Wastes†	48.4	60.7	75.5	77.6	94.0	102.3	115.4
Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	46.9
Total MSW Discarded - Weight	81.9	96.6	113.3	118.2	136.9	148.0	162.3
	Percent of Total Discards						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods	11.0%	10.6%	12.5%	14.0%	13.4%	13.6%	15.3%
(Detail in Table 12)							
Nondurable Goods							
Newspapers	6.5%	6.5%	6.4%	5.4%	5.8%	6.1%	4.6%
Books and Magazines	2.2%	2.2%	1.9%	1.8%	2.2%	2.8%	
Books**							0.5%
Magazines**							1.5%
Office Papers	1.5%	1.9%	1.8%	1.6%	2.2%	3.1%	2.9%
Telephone Books**							0.3%
Third Class Mail**							2.2%
Other Commercial Printing	1.5%	1.7%	1.6%	1.5%	2.0%	1.8%	2.7%
Tissue Paper and Towels	1.3%	1.6%	1.9%	1.8%	1.7%	1.8%	2.0%
Paper Plates and Cups	0.4%	0.3%	0.4%	0.3%	0.4%	0.4%	0.4%
Plastic Plates and Cups†					0.1%	0.2%	0.2%
Trash Bags**							0.5%
Disposable Diapers	Neg.	Neg.	0.3%	1.0%	1.7%	2.0%	1.6%
Other Nonpackaging Paper	3.2%	3.9%	3.0%	2.8%	3.1%	2.4%	2.3%
Clothing and Footwear	1.6%	1.6%	1.3%	1.4%	1.7%	1.8%	2.2%
Towels, Sheets and Pillowcases**							0.6%
Other Miscellaneous Nondurables	0.5%	0.5%	0.7%	0.8%	2.3%	2.6%	2.0%
Total Nondurables	18.6%	20.1%	19.2%	18.4%	23.2%	25.0%	26.6%
Containers and Packaging	29.5%	32.2%	35.0%	33.2%	32.1%	30.5%	29.2%
(Detail in Table 19)							
Total Product Wastes†	59.1%	62.8%	66.6%	65.7%	68.7%	69.1%	71.1%
Other Wastes	40.9%	37.2%	33.4%	34.3%	31.3%	30.9%	28.9%
Total MSW Discarded - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Discards after materials and compost recovery. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

** New line item added in 1992. Books and magazines, office papers, commercial printing, and miscellaneous nondurables categories have been partially reallocated.

† Not estimated prior to 1980.

‡ Other than food products.

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

Source: Franklin Associates, Ltd.

Other paper products in nondurable goods include:

- Books (about 0.5 percent of total MSW generation in 1990)
- Magazines (1.4 percent of total MSW generation in 1990)
- Office papers—copier paper, computer printout, stationery, etc. (3.3 percent of total MSW generation in 1990)
- Telephone books (about 0.3 percent of total MSW in 1990)
- Third class mail—catalogs and other direct bulk mailings (2 percent of MSW generation in 1990)
- Other commercial printing—newspaper inserts, brochures, menus, etc. (2.8 percent of total MSW generation in 1990)
- Tissue paper and towels—facial and sanitary tissues, napkins, but not toilet tissue, which is diverted from MSW (less than 2 percent of total MSW generation in 1990)
- Paper plates and cups—paper plates, cups, bowls, and other food service products used in homes, commercial establishments like restaurants, and in institutional settings such as schools (about 0.3 percent of total MSW generation in 1990)
- Other nonpackaging papers—including posters, photographic papers, cards and games, etc. (about 2 percent of total MSW generation in 1990).

Overall, generation of paper and paperboard products in nondurable goods was over 40 million tons in 1990 (about 20.8 percent of total MSW generation). While newspapers were recovered at the highest rate, other paper products such as books, magazines, and office papers were also recovered for recycling, and the overall recovery rate for paper in nondurables was about 22 percent in 1990 (Table 4). Thus 32 million tons of paper in nondurables were discarded in 1990.

Plastic Plates and Cups. This category includes plastic plates, cups, glasses, dishes and bowls, hinged containers, and other containers used in food service at home, in restaurants and other commercial establishments, and in institutional settings such as schools. Over 300,000 tons of these products were generated in 1990, or about 0.2 percent of total MSW (see Tables 15 through 17).

Disposable Diapers. This category includes estimates of both infant diapers and adult incontinence products. An estimated 2.6 million tons of disposable diapers were generated in 1990, or 1.4 percent of total MSW generation. (This tonnage includes an adjustment for the urine and feces contained within the discarded diapers.) The materials portion of the diapers includes wood pulp, plastics (including the superabsorbent materials now present in most diapers), and tissue paper.

There has been some investigation of recycling/composting of disposable diapers, but no significant recovery was identified for 1990.

Clothing and Footwear. Generation of clothing and footwear was estimated to be 3.7 million tons in 1990 (about 2 percent of total MSW). This category has shown a gradual increase in tonnage over the years. Textiles, rubber, and leather are the major materials components of this category, with some plastics present as well.

It is estimated that about 25 percent of these products are recovered, mostly for reuse as clothing or as wiper rags. Since data on elapsed time from recovery of textiles for reuse to final discard is limited, it was assumed that reused textiles re-enter the waste stream the same year that they are first discarded. It was estimated that about 5 percent of textiles in clothing and footwear was recovered for export in 1990 (about 200,000 tons), leaving discards of about 3.6 million tons.

Towels, Sheets, and Pillowcases. These textile items are included as a line item for the first time in this report. (Previously they were estimated under "Other Miscellaneous Nondurables.") An estimated 1 million tons of these textiles were generated in 1990. An estimated 5 percent of these textiles were recovered for export, leaving discards of about 950,000 tons in 1990.

Other Miscellaneous Nondurables. Generation of other miscellaneous nondurables was estimated to be 3.2 million tons in 1990 (1.6 percent of MSW). (Note that this category is smaller than in previous estimates because some textile items are counted elsewhere.)

The primary material component of miscellaneous nondurables is plastics, although some aluminum, rubber, and textiles are also present. Typical products in miscellaneous nondurables include shower curtains and other household items, disposable medical supplies, novelty items, and the like.

Containers and Packaging

Containers and packaging are a major portion of MSW, amounting to 64.4 millions tons of generation in 1990 (about 33 percent of total generation).

Generation, recovery, and discards of containers and packaging are shown in detail in Tables 18 through 23.

While the weight of containers and packaging generated has increased steadily over the study period, the percentage by weight has actually declined since the early 1970s (Table 19). Substitution of relatively light packaging materials—plastics and aluminum—for heavier glass and steel has accounted for this trend.

Containers and packaging in MSW are made of several materials: paper and paperboard, glass, ferrous metals, aluminum, plastics, wood, and small amounts of other materials. Each materials category is discussed separately below.

Paper and Paperboard Containers and Packaging. Corrugated boxes are the largest single product category of MSW at almost 24 million tons generated, or 12.2 percent of total generation in 1990. Corrugated boxes also represent the largest single category of product recovery, at 11.5 million tons of recovery in 1990 (about 48 percent of boxes generated were recovered). After recovery, 12.5 million tons of corrugated boxes were discarded, or 7.7 percent of MSW discards in 1990.

Other paper and paperboard packaging in MSW includes milk cartons, folding boxes (e.g., cereal boxes, frozen food boxes, some department store boxes), bags and sacks, wrapping papers, and other paper and paperboard packaging. Overall, paper and paperboard containers and packaging totaled 32.6 million tons of MSW generation in 1990, or 16.7 percent of total generation.

While recovery of corrugated boxes is by far the largest component of paper packaging recovery, small amounts of other paper packaging products are recovered (about 500,000 tons in 1990). The overall recovery rate for paper and paperboard packaging in 1990 was about 37 percent. Recovery of other paper packaging like folding boxes and sacks is mostly in the form of mixed papers, a low grade of waste paper.

Glass Containers. Glass containers and packaging include beer and soft drink bottles, wine and liquor bottles, and bottles and jars for food, cosmetics, and other products. Generation of these glass containers was nearly 12 million tons in 1990, or 6.1 percent of MSW generation (Tables 18 and 19). Production of glass containers had been declining in the 1980s, but increased in recent years.

Table 18

PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In millions of tons)

	Millions of Tons						
Products	1960	1965	1970	1975	1980	1985	1990
Durable Goods	9.4	11.1	15.1	17.5	19.7	21.5	27.9
(Detail in Table 12)							
Nondurable Goods	17.6	22.2	25.5	25.6	36.5	42.6	52.3
(Detail in Table 15)							
Containers and Packaging							
Glass Packaging							
Beer and Soft Drink Bottles	1.4	2.6	5.6	6.3	6.7	5.7	5.7
Wine and Liquor Bottles	1.1	1.4	1.9	2.0	2.5	2.2	2.1
Food and Other Bottles & Jars	3.7	4.1	4.4	4.4	4.8	4.2	4.1
Total Glass Packaging	6.2	8.1	11.9	12.7	14.0	12.1	11.9
Steel Packaging							
Beer and Soft Drink Cans	0.6	0.9	1.6	1.3	0.5	0.1	0.1
Food and Other Cans	3.8	3.6	3.5	3.4	2.9	2.6	2.5
Other Steel Packaging	0.2	0.3	0.3	0.2	0.2	0.2	0.2
Total Steel Packaging	4.6	4.8	5.4	4.9	3.6	2.9	2.9
Aluminum Packaging							
Beer and Soft Drink Cans	0.1	0.1	0.3	0.5	0.9	1.3	1.6
Other Cans	Neg.	Neg.	0.1	Neg.	Neg.	Neg.	Neg.
Foil and Closures	0.1	0.2	0.2	0.3	0.3	0.3	0.3
Total Aluminum Packaging	0.2	0.3	0.6	0.8	1.2	1.6	1.9
Paper & Paperboard Pkg							
Corrugated Boxes	7.3	10.0	12.7	13.5	17.0	19.0	23.9
Milk Cartons**					0.6	0.5	0.5
Folding Cartons**					3.7	4.0	4.3
Other Paperboard Packaging	3.8	4.5	4.8	4.4	0.3	0.4	0.3
Bags and Sacks**					3.4	3.1	2.4
Wrapping Papers**					0.2	0.1	0.1
Other Paper Packaging	2.9	3.3	3.8	3.3	0.8	1.3	1.0
Total Paper & Board Pkg	14.0	17.8	21.3	21.2	26.0	28.4	32.6
Plastics Packaging							
Soft Drink Bottles**					0.3	0.4	0.4
Milk Bottles**					0.2	0.3	0.4
Other Containers	0.1	0.3	0.9	1.3	0.9	1.2	1.8
Bags and Sacks**					0.4	0.6	0.9
Wraps**					0.8	1.0	1.5
Other Plastics Packaging	0.1	0.7	1.2	1.4	0.8	1.0	1.9
Total Plastics Packaging	0.2	1.0	2.1	2.7	3.4	4.5	7.0
Wood Packaging	2.0	2.1	2.1	2.0	3.9	4.9	7.9
Other Misc. Packaging	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Total Containers & Pkg	27.3	34.2	43.5	44.4	52.3	54.6	64.4
Total Product Wastes†	54.3	67.5	84.1	87.5	108.5	118.7	144.6
Other Wastes							
Food Wastes	12.2	12.7	12.8	13.4	13.2	13.2	13.2
Yard Trimmings	20.0	21.6	23.2	25.2	27.5	30.0	35.0
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.2	2.5	2.9
Total Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	51.1
Total MSW Generated - Weight	87.8	103.4	121.9	128.1	151.4	164.4	195.7

* Generation *before* materials recovery or combustion.
Details may not add to totals due to rounding.

** Not estimated prior to 1980.

† Other than food products.

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

Source: Franklin Associates, Ltd.

Table 19

PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In percent of total generation)

	Percent of Total Generation						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods *(Detail in Table 12)*	10.7%	10.7%	12.4%	13.7%	13.0%	13.1%	14.3%
Nondurable Goods *(Detail in Table 15)*	20.0%	21.5%	20.9%	20.0%	24.1%	25.9%	26.7%
Containers and Packaging							
Glass Packaging							
Beer and Soft Drink Bottles	1.6%	2.5%	4.6%	4.9%	4.4%	3.5%	2.9%
Wine and Liquor Bottles	1.3%	1.4%	1.6%	1.6%	1.7%	1.3%	1.1%
Food and Other Bottles & Jars	4.2%	4.0%	3.6%	3.4%	3.2%	2.6%	2.1%
Total Glass Packaging	7.1%	7.8%	9.8%	9.9%	9.2%	7.4%	6.1%
Steel Packaging							
Beer and Soft Drink Cans	0.7%	0.9%	1.3%	1.0%	0.3%	0.1%	0.1%
Food and Other Cans	4.3%	3.5%	2.9%	2.7%	1.9%	1.6%	1.3%
Other Steel Packaging	0.2%	0.3%	0.2%	0.2%	0.1%	0.1%	0.1%
Total Steel Packaging	5.2%	4.6%	4.4%	3.8%	2.4%	1.8%	1.5%
Aluminum Packaging							
Beer and Soft Drink Cans	0.1%	0.1%	0.2%	0.4%	0.6%	0.8%	0.8%
Other Cans	Neg.	Neg.	0.1%	Neg.	Neg.	Neg.	Neg.
Foil and Closures	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Total Aluminum Packaging	0.2%	0.3%	0.5%	0.6%	0.8%	1.0%	1.0%
Paper & Paperboard Pkg							
Corrugated Boxes	8.3%	9.7%	10.4%	10.5%	11.2%	11.6%	12.2%
Milk Cartons**					0.4%	0.3%	0.3%
Folding Cartons**					2.4%	2.4%	2.2%
Other Paperboard Packaging	4.3%	4.4%	3.9%	3.4%	0.2%	0.2%	0.1%
Bags and Sacks**					2.2%	1.9%	1.2%
Wrapping Papers**					0.1%	0.1%	0.1%
Other Paper Packaging	3.3%	3.2%	3.1%	2.6%	0.5%	0.8%	0.5%
Total Paper & Board Pkg	15.9%	17.2%	17.5%	16.5%	17.2%	17.3%	16.7%
Plastics Packaging							
Soft Drink Bottles**					0.2%	0.2%	0.2%
Milk Bottles**					0.2%	0.2%	0.2%
Other Containers	0.1%	0.3%	0.7%	1.0%	0.6%	0.7%	0.9%
Bags and Sacks**					0.3%	0.4%	0.5%
Wraps**					0.6%	0.6%	0.8%
Other Plastics Packaging	0.1%	0.7%	1.0%	1.1%	0.5%	0.6%	1.0%
Total Plastics Packaging	0.2%	1.0%	1.7%	2.1%	2.2%	2.7%	3.6%
Wood Packaging	2.3%	2.0%	1.7%	1.6%	2.6%	3.0%	4.0%
Other Misc. Packaging	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Total Containers & Pkg	31.1%	33.1%	35.7%	34.7%	34.5%	33.2%	32.9%
Total Product Wastes†	61.8%	65.3%	69.0%	68.3%	71.7%	72.2%	73.9%
Other Wastes							
Food Wastes	13.9%	12.3%	10.5%	10.5%	8.7%	8.0%	6.7%
Yard Trimmings	22.8%	20.9%	19.0%	19.7%	18.2%	18.2%	17.9%
Miscellaneous Inorganic Wastes	1.5%	1.5%	1.5%	1.6%	1.5%	1.5%	1.5%
Total Other Wastes	38.2%	34.7%	31.0%	31.7%	28.3%	27.8%	26.1%
Total MSW Generated - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Generation before materials recovery or combustion.
Details may not add to totals due to rounding.

** Not estimated prior to 1980.

† Other than food products.

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

Source: Franklin Associates, Ltd.

Table 20

RECOVERY* OF PRODUCTS IN MUNICIPAL SOLID WASTE, 1960 TO 1990
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In millions of tons)

	Millions of Tons						
Products	1960	1965	1970	1975	1980	1985	1990
Durable Goods	0.4	0.9	0.9	1.0	1.3	1.4	3.1
(Detail in Table 13)							
Nondurable Goods	2.4	2.8	3.8	3.8	4.8	5.6	9.2
(Detail in Table 16)							
Containers and Packaging							
Glass Packaging							
Beer and Soft Drink Bottles	0.1	0.1	0.1	0.4	0.8	1.0	1.9
Wine and Liquor Bottles	Neg.	Neg.	Neg.	Neg.	Neg.	0.1	0.2
Food and Other Bottles & Jars	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	0.5
Total Glass Packaging	0.1	0.1	0.2	0.4	0.8	1.1	2.6
Steel Packaging							
Beer and Soft Drink Cans	Neg.	Neg.	Neg.	Neg.	0.1	Neg.	Neg.
Food and Other Cans	Neg.	0.1	0.1	0.1	0.1	0.1	0.6
Other Steel Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Steel Packaging	Neg.	0.1	0.1	0.1	0.2	0.1	0.6
Aluminum Packaging							
Beer and Soft Drink Cans	Neg.	Neg.	Neg.	0.1	0.3	0.6	1.0
Other Cans	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Foil and Closures	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Aluminum Pkg	Neg.	Neg.	Neg.	0.1	0.3	0.6	1.0
Paper & Paperboard Pkg							
Corrugated Boxes	2.5	2.2	2.7	3.6	6.3	7.2	11.5
Milk Cartons**					Neg.	Neg.	Neg.
Folding Cartons**					0.5	0.2	0.3
Other Paperboard Packaging	0.3	0.4	0.5	0.5	Neg.	Neg.	Neg.
Bags and Sacks**					0.3	0.1	0.2
Wrapping Papers**					Neg.	Neg.	Neg.
Other Paper Packaging	0.2	0.3	0.4	0.4	Neg.	Neg.	Neg.
Total Paper & Board Pkg	3.0	2.9	3.6	4.5	7.1	7.5	12.0
Plastics Packaging							
Soft Drink Bottles**					Neg.	0.1	0.1
Milk Bottles**					Neg.	Neg.	Neg.
Other Containers	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Bags and Sacks**					Neg.	Neg.	Neg.
Wraps**					Neg.	Neg.	Neg.
Other Plastics Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Plastics Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	0.1	0.3
Wood Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	0.4
Other Misc. Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Containers & Pkg	3.1	3.1	3.9	5.1	8.4	9.4	16.9
Total Product Wastes†	5.9	6.8	8.6	9.9	14.5	16.4	29.2
Other Wastes							
Food Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Yard Trimmings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.2
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.2
Total MSW Recovered - Weight	5.9	6.8	8.6	9.9	14.5	16.4	33.4

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Not estimated prior to 1980.
† Other than food products.
Details may not add to totals due to rounding.
Neg. = Negligible (less than 0.05 percent or 50,000 tons).
Source: Franklin Associates, Ltd.

Table 21

RECOVERY* OF PRODUCTS IN MUNICIPAL SOLID WASTE, 1960 TO 1990
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In percent of generation of each product)

	Percent of Generation of Each Product						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods	4.3%	8.1%	6.0%	5.7%	6.6%	6.5%	11.2%
(Detail in Table 13)							
Nondurable Goods	13.6%	12.6%	14.9%	14.8%	13.2%	13.1%	17.5%
(Detail in Table 16)							
Containers and Packaging							
Glass Packaging							
Beer and Soft Drink Bottles	7.1%	3.8%	2.6%	6.3%	11.9%	17.5%	33.2%
Wine and Liquor Bottles	Neg.	Neg.	Neg.	Neg.	Neg.	4.5%	10.0%
Food and Other Bottles & Jars	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	12.7%
Total Glass Packaging	1.6%	1.2%	1.3%	3.1%	5.7%	9.1%	22.0%
Steel Packaging							
Beer and Soft Drink Cans	Neg.	Neg.	Neg.	Neg.	10.0%	10.0%	24.7%
Food and Other Cans	Neg.	2.8%	2.9%	2.9%	3.4%	4.3%	23.4%
Other Steel Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	5.0%
Total Steel Packaging	Neg.	2.1%	1.9%	2.0%	4.2%	3.8%	22.1%
Aluminum Packaging							
Beer and Soft Drink Cans	Neg.	Neg.	Neg.	20.0%	32.4%	46.2%	63.2%
Other Cans	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	4.0%
Foil and Closures	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	7.1%
Total Aluminum Pkg	Neg.	Neg.	Neg.	12.5%	23.6%	37.5%	53.3%
Paper & Paperboard Pkg							
Corrugated Boxes	34.2%	22.0%	21.3%	26.7%	37.1%	37.9%	48.0%
Milk Cartons**					Neg.	Neg.	Neg.
Folding Cartons**					13.5%	5.0%	7.9%
Other Paperboard Packaging	7.9%	8.9%	10.4%	11.4%	Neg.	Neg.	Neg.
Bags and Sacks**					8.8%	3.2%	8.2%
Wrapping Papers**					Neg.	Neg.	Neg.
Other Paper Packaging	6.9%	9.1%	10.5%	12.1%	Neg.	Neg.	Neg.
Total Paper & Board Pkg	21.4%	16.3%	16.9%	21.2%	27.3%	26.4%	36.9%
Plastics Packaging							
Soft Drink Bottles**					0.0%	25.0%	31.5%
Milk Bottles**					0.0%	Neg.	6.9%
Other Containers	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	1.2%
Bags and Sacks**					Neg.	Neg.	3.1%
Wraps**					Neg.	Neg.	2.0%
Other Plastics Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	0.9%
Total Plastics Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	2.2%	3.7%
Wood Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	5.0%
Other Misc. Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Containers & Pkg	11.4%	9.1%	9.0%	11.5%	16.1%	17.2%	26.2%
Total Product Wastes†	10.9%	10.1%	10.2%	11.3%	13.4%	13.8%	20.2%
Other Wastes							
Food Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Yard Trimmings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	12.0%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	8.2%
Total MSW Recovered - %	6.7%	6.6%	7.1%	7.7%	9.6%	10.0%	17.1%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.

** Not estimated prior to 1980.

† Other than food products.

Details may not add to totals due to rounding.

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

Source: Franklin Associates, Ltd.

Table 22

PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In millions of tons)

	Millions of Tons						
Products	**1960**	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**
Durable Goods *(Detail in Table 14)*	9.0	10.2	14.2	16.5	18.4	20.1	24.8
Nondurable Goods *(Detail in Table 17)*	15.2	19.4	21.7	21.8	31.7	37.0	43.2
Containers and Packaging							
Glass Packaging							
Beer and Soft Drink Bottles	1.3	2.5	5.5	5.9	5.9	4.7	3.8
Wine and Liquor Bottles	1.1	1.4	1.9	2.0	2.5	2.1	1.9
Food and Other Bottles & Jars	3.7	4.1	4.4	4.4	4.8	4.2	3.6
Total Glass Packaging	6.1	8.0	11.7	12.3	13.2	11.0	9.3
Steel Packaging							
Beer and Soft Drink Cans	0.6	0.9	1.6	1.3	0.5	0.1	0.1
Food and Other Cans	3.8	3.5	3.4	3.3	2.8	2.5	1.9
Other Steel Packaging	0.2	0.3	0.3	0.2	0.2	0.2	0.2
Total Steel Packaging	4.6	4.7	5.3	4.8	3.5	2.8	2.3
Aluminum Packaging							
Beer and Soft Drink Cans	0.1	0.1	0.3	0.4	0.6	0.7	0.6
Other Cans	Neg.	Neg.	0.1	Neg.	Neg.	Neg.	Neg.
Foil and Closures	0.1	0.2	0.2	0.3	0.3	0.3	0.3
Total Aluminum Pkg	0.2	0.3	0.6	0.7	0.9	1.0	0.9
Paper & Paperboard Pkg							
Corrugated Boxes	4.8	7.8	10.0	9.9	10.7	11.8	12.5
Milk Cartons**					0.6	0.5	0.5
Folding Cartons**					3.2	3.8	4.0
Other Paperboard Packaging	3.5	4.1	4.3	3.9	0.3	0.4	0.3
Bags and Sacks**					3.1	3.0	2.2
Wrapping Papers**					0.2	0.1	0.1
Other Paper Packaging	2.7	3.0	3.4	2.9	0.8	1.3	1.0
Total Paper & Board Pkg	11.0	14.9	17.7	16.7	18.9	20.9	20.6
Plastics Packaging							
Soft Drink Bottles**					0.3	0.3	0.3
Milk Bottles**					0.2	0.3	0.4
Other Containers	0.1	0.3	0.9	1.3	0.9	1.2	1.8
Bags and Sacks**					0.4	0.6	0.9
Wraps**					0.8	1.0	1.5
Other Plastics Packaging	0.1	0.7	1.2	1.4	0.8	1.0	1.9
Total Plastics Packaging	0.2	1.0	2.1	2.7	3.4	4.4	6.7
Wood Packaging	2.0	2.1	2.1	2.0	3.9	4.9	7.5
Other Misc. Packaging	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Total Containers & Pkg	24.2	31.1	39.6	39.3	43.9	45.2	47.4
Total Product Wastes†	48.4	60.7	75.5	77.6	94.0	102.3	115.4
Other Wastes							
Food Wastes	12.2	12.7	12.8	13.4	13.2	13.2	13.2
Yard Trimmings	20.0	21.6	23.2	25.2	27.5	30.0	30.8
Miscellaneous Inorganic Wastes	1.3	1.6	1.8	2.0	2.3	2.5	2.9
Total Other Wastes	33.5	35.9	37.8	40.6	42.9	45.7	46.9
Total MSW Discarded - Weight	81.9	96.6	113.3	118.2	136.9	148.0	162.3

* Discards after materials and compost recovery. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

** Not estimated prior to 1980.

† Other than food products.

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

Source: Franklin Associates, Ltd.

Table 23

PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1990
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In percent of total discards)

	Percent of Total Discards						
Products	1960	1965	1970	1975	1980	1985	1990
Durable Goods *(Detail in Table 14)*	11.0%	10.6%	12.5%	14.0%	13.4%	13.6%	15.3%
Nondurable Goods *(Detail in Table 17)*	18.6%	20.1%	19.2%	18.4%	23.2%	25.0%	27.6%
Containers and Packaging							
Glass Packaging							
Beer and Soft Drink Bottles	1.6%	2.6%	4.8%	5.0%	4.3%	3.2%	2.3%
Wine and Liquor Bottles	1.3%	1.4%	1.7%	1.7%	1.8%	1.4%	1.2%
Food and Other Bottles & Jars	4.5%	4.2%	3.9%	3.7%	3.5%	2.8%	2.2%
Total Glass Packaging	7.4%	8.3%	10.4%	10.4%	9.6%	7.4%	5.7%
Steel Packaging							
Beer and Soft Drink Cans	0.7%	0.9%	1.4%	1.1%	0.3%	0.1%	0.1%
Food and Other Cans	4.6%	3.6%	3.0%	2.8%	2.0%	1.7%	1.2%
Other Steel Packaging	0.2%	0.3%	0.3%	0.2%	0.1%	0.1%	0.1%
Total Steel Packaging	5.6%	4.9%	4.7%	4.1%	2.5%	1.9%	1.4%
Aluminum Packaging							
Beer and Soft Drink Cans	0.1%	0.1%	0.3%	0.3%	0.5%	0.5%	0.4%
Other Cans	Neg.	Neg.	0.1%	Neg.	Neg.	Neg.	Neg.
Foil and Closures	0.1%	0.2%	0.2%	0.3%	0.2%	0.2%	0.2%
Total Aluminum Pkg	0.2%	0.3%	0.5%	0.6%	0.7%	0.7%	0.5%
Paper & Paperboard Pkg							
Corrugated Boxes	5.9%	8.1%	8.8%	8.4%	7.8%	8.0%	7.7%
Milk Cartons**					0.4%	0.3%	0.3%
Folding Cartons**					2.3%	2.6%	2.4%
Other Paperboard Packaging	4.3%	4.2%	3.8%	3.3%	0.2%	0.3%	0.2%
Bags and Sacks**					2.3%	2.0%	1.4%
Wrapping Papers**					0.1%	0.1%	0.1%
Other Paper Packaging	3.3%	3.1%	3.0%	2.5%	0.6%	0.9%	0.6%
Total Paper & Board Pkg	13.4%	15.4%	15.6%	14.1%	13.8%	14.1%	12.7%
Plastics Packaging							
Soft Drink Bottles**					0.2%	0.2%	0.2%
Milk Bottles**					0.2%	0.2%	0.2%
Other Containers	0.1%	0.3%	0.8%	1.1%	0.6%	0.8%	1.1%
Bags and Sacks**					0.3%	0.4%	0.6%
Wraps**					0.6%	0.7%	0.9%
Other Plastics Packaging	0.1%	0.7%	1.1%	1.2%	0.6%	0.7%	1.2%
Total Plastics Packaging	0.2%	1.0%	1.9%	2.3%	2.5%	3.0%	4.1%
Wood Packaging	2.4%	2.2%	1.9%	1.7%	2.8%	3.3%	4.6%
Other Misc. Packaging	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Total Containers & Pkg	29.5%	32.2%	35.0%	33.2%	32.1%	30.5%	29.2%
Total Product Wastes†	59.1%	62.8%	66.6%	65.7%	68.7%	69.1%	71.1%
Other Wastes							
Food Wastes	14.9%	13.1%	11.3%	11.3%	9.6%	8.9%	8.1%
Yard Trimmings	24.4%	22.4%	20.5%	21.3%	20.1%	20.3%	19.0%
Miscellaneous Inorganic Wastes	1.6%	1.7%	1.6%	1.7%	1.7%	1.7%	1.8%
Total Other Wastes	40.9%	37.2%	33.4%	34.3%	31.3%	30.9%	28.9%
Total MSW Discarded - %	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

* Discards after materials and compost recovery. Does not include construction & demolition debris, industrial process wastes, or certain other Subtitle D wastes. Details may not add to totals due to rounding.

** Not estimated prior to 1980.

† Other than food products.

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

Source: Franklin Associates, Ltd.

An estimated 2.6 million tons of glass containers were recovered for recycling in 1990, or 22.0 percent of total generation. Glass beer and soft drink containers were estimated to be recovered at a 33 percent rate in 1990. After recovery for recycling, glass container discards were 9.3 million tons in 1990, or 5.7 percent of total discards.

Steel Containers and Packaging. Steel beer and soft drink cans, food and other cans, and other steel packaging (e.g., strapping), totaled 2.9 million tons in 1990 (less than 2 percent of total generation), with most of that amount being "tin" cans for food (Tables 18 and 19). An estimated 640,000 tons of steel packaging were recovered in 1990, or 22 percent of generation. Generation of steel containers and packaging had been declining in the 1980s, but has been stable in recent years.

Aluminum Containers and Packaging. Aluminum containers and packaging, a growth segment of MSW, include beer and soft drink cans, other cans, and foil and closures. Total aluminum container and packaging generation in 1990 was 1.9 million tons, or one percent of total generation.

Aluminum beer and soft drink cans (including aluminum lids on steel cans) were recovered at an estimated 63.2 percent rate in 1990. Recovery of all aluminum packaging was estimated to be 53.3 percent of total generation in 1990. After recovery for recycling, less than one million tons of aluminum packaging were discarded in 1990. This represented less than one percent of MSW discards.

Plastic Containers and Packaging. Many different plastic resins are used to make a variety of packaging products. Some of these include polyethylene terephthalate (PET) soft drink bottles—some with high-density polyethylene (HDPE) base cups, HDPE milk jugs, film products (including bags and sacks) made of low-density polyethylene (LDPE), and containers and other packaging (including coatings, closures, etc.) made of polyvinyl chloride, polystyrene, and other resins.

Plastic containers and packaging have exhibited rapid growth in MSW, with generation increasing from about 200,000 tons in 1960 (less than one percent of generation) to 7.0 million tons in 1990 (3.6 percent of generation). (Note: plastic packaging does not include the single service plates and cups and the trash bags classified as nondurables.)

Plastic soft drink bottles and base cups were estimated to have been recovered at a 31.5 percent rate in 1990. Recovery of plastic milk bottles was estimated to have been about 7 percent of generation. Overall, recovery of plastic containers and packaging was estimated to be 3.7 percent in 1990. Discards of plastic containers and packaging were thus 6.7 million tons in 1990, or 4.1 percent of total discards.

Other Packaging. Estimates are included for wood packaging and some other miscellaneous packaging like bags made of textiles, small amounts of leather, and the like. These latter quantities are not well documented.

Wood packaging, which includes wood crates and pallets, was investigated more intensively for this update than for recent reports. It was determined that wood packaging (mostly pallets) had been underestimated for the decade of the 1980s. Nearly 8 million tons of wood packaging were estimated to have been generated in 1990, compared to the previous estimate of about 2 million tons in 1988. Wood packaging was thus about 4 percent of total generation in 1990. Estimates of wood packaging in previous years were also revised upward to make the data series consistent.

There is increasing recovery of wood pallets, mostly by chipping to make products like mulch. It was estimated that nearly 400,000 tons of wood were recovered in this manner in 1990, or about 5 percent of generation. This left 7.5 million tons discarded in 1990, or 4.6 percent of total discards.

Summary of Products in Municipal Solid Waste

Changing quantities and composition of municipal solid waste generation by product category are illustrated in Figure 14. This figure shows graphically that generation of durable goods has increased very gradually over the years. Nondurable goods and containers and packaging have accounted for the large increases in MSW generation.

Figure 14. Generation of products in MSW, 1960 to 1990

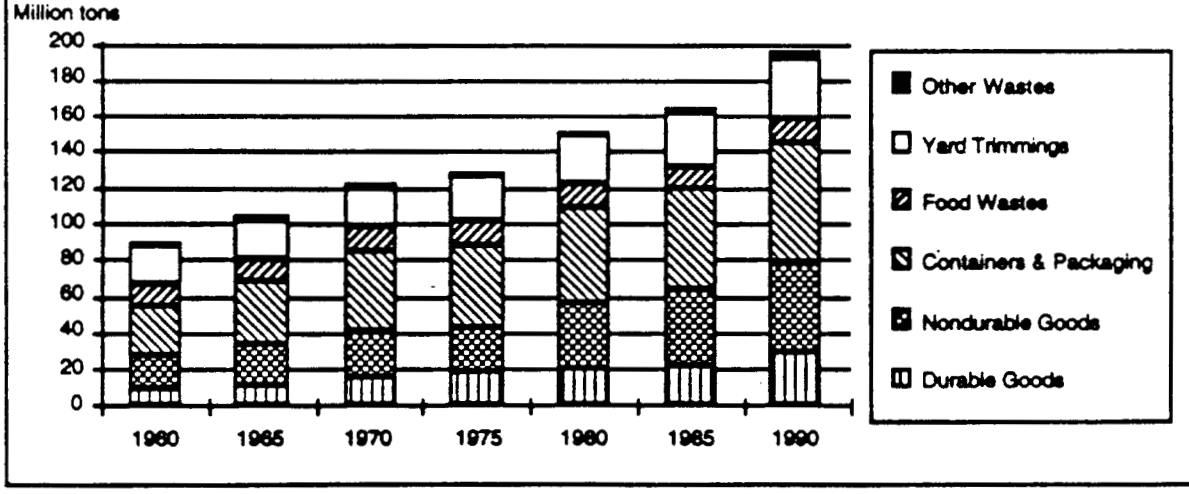
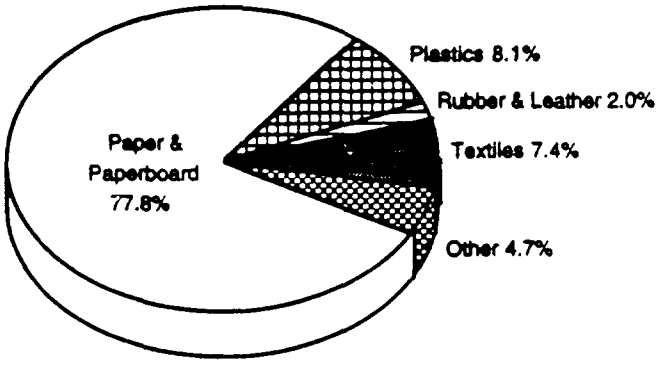
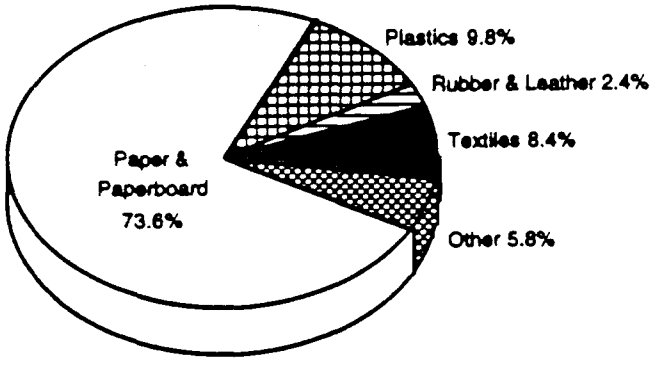


Figure 15. Nondurable goods generated and discarded in MSW, 1990



Generation

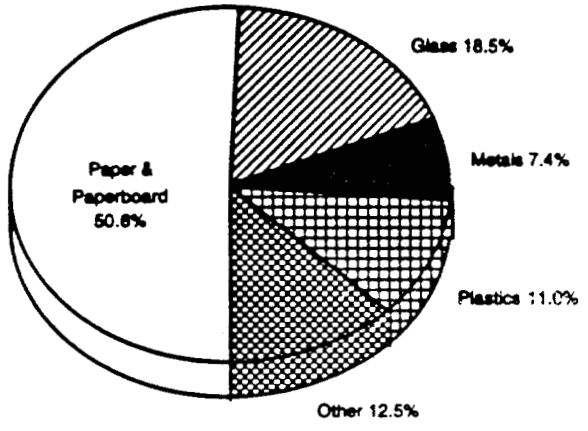


Discards

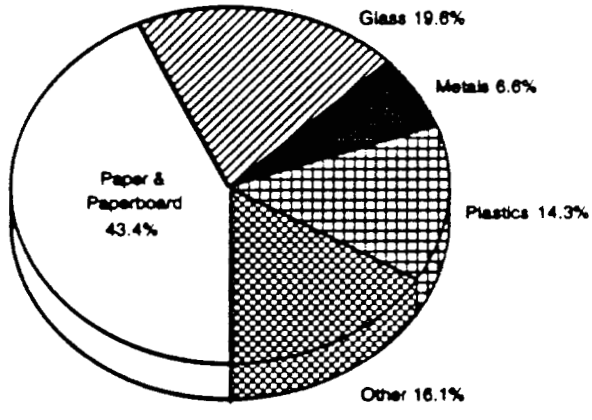
The materials composition of nondurable goods in 1990 is shown in Figure 15. Paper and paperboard made up 77.8 percent of nondurables in MSW generation, with plastics contributing over 8 percent, and textiles 7.4 percent. Other materials contributed lesser percentages. After recovery for recycling, paper and paperboard were 73.6 percent of nondurable discards, with plastics being 9.8 percent, and textiles 8.4 percent.

The materials composition of containers and packaging in MSW in 1990 is shown in Figure 16. Paper and paperboard products made up about half of containers and packaging generation, with glass second at 18.5 percent of containers and packaging generation by weight. Recovery for recycling makes a

Figure 16. Containers and packaging generated and discarded in MSW, 1990



Generation



Discards

significant change, with paper and paperboard being 43.4 percent of containers and packaging discards after recovery takes place. Glass was 19.6 percent of discards of containers and packaging, with other materials making up lesser amounts.

Chapter 2

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Chapter 3

MANAGEMENT OF MUNICIPAL SOLID WASTE

INTRODUCTION

EPA's tiered integrated waste management strategy includes the following components:

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

Characterization of historical municipal solid waste (MSW) management is a component of this report. Estimates of historical recovery of materials and yard trimmings for recycling and composting are presented in Chapter 2. Estimates of MSW combustion are presented in this chapter, and quantities of waste landfilled are estimated by subtracting combustion and recovery for recycling and composting from total MSW generation as estimated in Chapter 2.

Source reduction is not quantified as a line item in this report; there is as yet no generally-accepted methodology for measuring source reduction on a national level. Source reduction activities have the effect of reducing MSW generation, while the other management alternatives deal with MSW once it is generated.

SUMMARY OF HISTORICAL AND PROJECTED MSW MANAGEMENT

The data presented in this chapter and Chapter 2 make possible a comprehensive summary of historical municipal solid waste management. The study results are summarized in Table 24 and Figure 17. Municipal solid waste generation has grown steadily (except for occasional decreases during recession years) from 87.8 million tons in 1960 to 195.7 million tons in 1990.

Recovery for Recycling and Composting of Yard Trimmings

Recovery for recycling and composting had little effect on the total waste stream until the 1980s. Recovery was less than 10 percent of generation in the 1960s and 1970s. A strong emphasis on recovery for recycling, including composting, developed in the latter part of the 1980s, and recovery reached an estimated 17.1 percent of generation in 1990.

Table 24

GENERATION, MATERIALS RECOVERY, COMPOSTING, COMBUSTION, AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 TO 1990
(In millions of tons and percent of total generation)

	Millions of Tons						
	1960	1965	1970	1975	1980	1985	1990
Generation	87.8	103.4	121.9	128.1	151.5	164.4	195.7
Recovery for Recycling	5.9	6.8	8.6	9.9	14.5	16.4	29.2
Recovery for Composting	0.0	0.0	0.0	0.0	0.0	0.0	4.2
Total Materials Recovery	5.9	6.8	8.6	9.9	14.5	16.4	33.4
Discards after Recovery*	81.9	96.6	113.3	118.2	137.0	148.1	162.3
Combustion with Energy Recovery	0.0	0.2	0.4	0.7	2.7	7.6	29.7
Combustion without Energy Recovery	27.0	26.8	24.7	17.8	11.0	4.1	2.2
Total Combustion	27.0	27.0	25.1	18.5	13.7	11.7	31.9
Discards to Landfill, Other Disposal**	54.9	69.6	88.2	99.7	123.3	136.4	130.4

	Percent of Total Generation						
	1960	1965	1970	1975	1980	1985	1990
Generation	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Recovery for Recycling	6.7%	6.6%	7.1%	7.7%	9.6%	9.9%	14.9%
Recovery for Composting	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.1%
Total Materials Recovery	6.7%	6.6%	7.1%	7.7%	9.6%	9.9%	17.1%
Discards after Recovery*	93.3%	93.4%	92.9%	92.3%	90.4%	90.1%	82.9%
Combustion with Energy Recovery	0.0%	0.2%	0.3%	0.5%	1.8%	4.6%	15.2%
Combustion without Energy Recovery	30.8%	25.9%	20.3%	13.9%	7.3%	2.5%	1.1%
Total Combustion	30.8%	26.1%	20.6%	14.4%	9.0%	7.1%	16.3%
Discards to Landfill, Other Disposal**	62.5%	67.3%	72.4%	77.8%	81.4%	82.9%	66.6%

* Does not include residues from recycling/composting processes.
** Does not include residues from recycling, composting, or combustion processes.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Mixed MSW Composting

Composting of yard trimmings is well established in many communities and was found to be increasing rapidly due to state-wide bans of yard trimmings in landfills and other local initiatives. Composting of mixed municipal wastes (e.g., by in-vessel units) is a developing technology in the United States. It was estimated that one-half million tons of mixed MSW were recovered for composting in 1990. Insufficient data were available to make projections for the future of this technology, however.

Combustion of Municipal Solid Waste

Most of the municipal solid waste combustion currently practiced in this country incorporates recovery of an energy product (generally steam or electricity); sale of the energy helps to offset the cost of operating the facility. In past years, it was common to burn municipal solid waste in incinerators as a volume reduction practice; recovery of energy started to become more prevalent in the 1970s.

When municipal solid waste is combusted, a residue (usually called ash) is left behind. Years ago this ash was commonly disposed of along with municipal solid waste, but combustor ash is not counted as MSW in this report. As a general "rule of thumb," MSW combustor ash amounts to about 25 percent (dry weight) of unprocessed MSW input. This percentage will vary from facility to facility depending upon the types of waste input and the efficiency and configuration of the facility.

Previous estimates of combustion with energy recovery were updated and expressed as a percent of MSW generation (Table 24). Surveys by EPA and other organizations were used as references. In addition, a literature search updated lists of facilities that were operational, under construction, or in planning in 1990.

In most cases the facilities have a stated daily capacity, but they normally operate at less than capacity over the course of a year. When information on actual throughputs of MSW was unavailable for a facility, it was assumed for this report that throughput over a year of operation is 80 percent of rated capacity. While this is a more conservative assumption than those often used, it has proven to be reasonably accurate over the years. (While new facilities are reporting operation at very high utilization rates, other facilities do not meet the same standards for annual throughput as compared to rated capacity.)

The surveys revealed that combustion of MSW has increased rapidly since 1985, with numerous new facilities coming into operation. It was estimated that 29.7 million tons of MSW were combusted with energy recovery in 1990.

To provide a complete picture of historical MSW management, updates of the estimates of combustion without energy recovery were also made (Table 24). The estimates indicate that MSW combustion without energy recovery dropped steadily throughout the entire study period, to about 2.2 million tons in 1990.

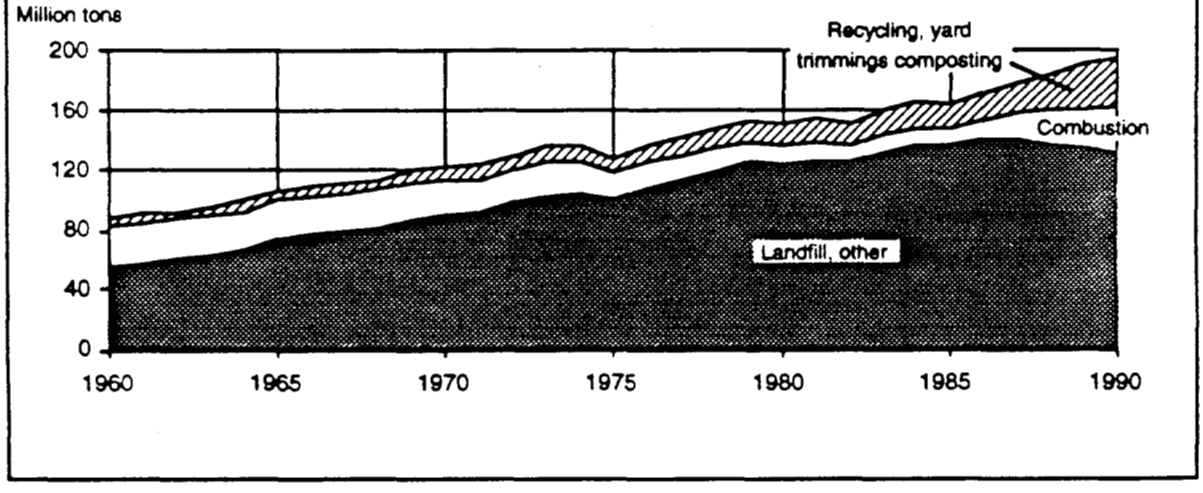
Adding estimates of combustion without energy recovery to the previously estimated combustion with energy recovery brings some interesting insights. It appears that over 30 percent of MSW was burned in 1960. This percentage declined steadily as the old incinerators were closed down due to air pollution regulations. Combustion with energy recovery grew very slowly until the 1980s, with about 15 percent of MSW being combusted in 1990.

Historical Perspective

This summary provides some perspective on why a landfill crisis developed in the 1980s. In the 1960s and early 1970s a large percentage of MSW was burned. The remainder was not usually landfilled as we define landfill in the 1990s; that is, it was not compacted and buried in cells with cover material added daily. In fact, much of this waste was "dumped" and often it was burned at the dump to reduce its volume.

As the old incinerators were closed down and landfills became more difficult and expensive to site, waste generation continued to increase. Materials recovery rates increased very slowly in this time period, and the burden on the nation's landfills grew dramatically. As Figure 17 graphically shows, discards of MSW to landfill or other disposal apparently peaked in the 1986-1987 period, then began to decline as materials recovery and combustion increased.

Figure 17. Municipal solid waste management, 1960 to 1990



Chapter 3

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Chapter 4

PROJECTIONS OF MSW GENERATION AND MANAGEMENT

INTRODUCTION

This chapter presents projections of municipal solid waste generation and management to the year 2000. It should be emphasized that these projections are not predictions. Recent efforts at source reduction are difficult to measure, but almost certainly are affecting MSW generation. No one can foresee with accuracy changes in the economy (e.g., booms and recessions), which also affect the municipal waste stream. In addition, it is difficult to predict which innovations and new products will affect the amounts and types of MSW discards. For example, there have long been predictions of the "paperless office" due to improvements in electronic communications, but in fact, facsimile machines, high-speed copiers, and personal computers have generated unexpectedly large amounts of office papers.

In spite of the limitations, it is useful to look at projections characterizing MSW based on past trends, since it is clear that the composition of the waste stream does change over time. New products (e.g., disposable products) are used, and materials are used in new ways (e.g., composite materials replace simpler products). Planners thus may choose to use different projections than those presented here, but anyone assuming that the current mix of materials in the waste stream will remain constant is disregarding the experience of the past.

OVERVIEW OF THIS CHAPTER

This chapter includes projections of municipal solid waste generation, recovery for recycling and composting, combustion, and landfill through the year 2000. Projections of total MSW recovery for recycling and composting are presented in three scenarios—20 percent, 25 percent, and 30 percent in 1995 and 25 percent, 30 percent, and 35 percent in 2000.

A summary table showing projected MSW generation, recovery at the mid-range scenario, and discards of MSW to combustion and landfill in 1995 and 2000 is included at the end of the chapter.

MATERIALS GENERATION IN MUNICIPAL SOLID WASTE

Projections of materials generated in MSW (by weight) are summarized in Table 25 and Figure 18, and a discussion of each material category follows.

Table 25

PROJECTIONS OF MATERIALS GENERATED*
IN THE MUNICIPAL WASTE STREAM, 1990 TO 2000
(In millions of tons and percent of total generation)

Materials	Millions of Tons			% of Total Generation		
	1990	1995	2000	1990	1995	2000
Paper and Paperboard	73.3	79.2	84.7	37.5%	38.1%	38.1%
Glass	13.2	13.6	13.5	6.7%	6.5%	6.1%
Metals						
Ferrous	12.3	12.0	12.1	6.3%	5.8%	5.4%
Aluminum	2.7	3.1	3.6	1.4%	1.5%	1.6%
Other Nonferrous	1.2	1.4	1.5	0.6%	0.7%	0.7%
Total Metals	*16.2*	*16.5*	*17.1*	*8.3%*	*7.9%*	*7.7%*
Plastics	16.2	20.0	24.8	8.3%	9.6%	11.2%
Rubber and Leather	4.6	5.9	6.5	2.4%	2.8%	2.9%
Textiles	5.6	5.9	6.7	2.9%	2.9%	3.0%
Wood	12.3	13.5	16.0	6.3%	6.5%	7.2%
Other	3.2	3.4	3.7	1.6%	1.7%	1.6%
Total Materials in Products	144.6	158.0	172.9	73.9%	76.0%	77.8%
Other Wastes						
Food Wastes	13.2	13.2	13.2	6.7%	6.3%	5.9%
Yard Trimmings	35.0	33.7	32.9	17.9%	16.2%	14.8%
Miscellaneous Inorganic Wastes	2.9	3.0	3.1	1.5%	1.4%	1.4%
Total Other Wastes	51.1	49.9	49.2	26.1%	24.0%	22.2%
Total MSW Generated	195.7	207.9	222.1	100.0%	100.0%	100.0%

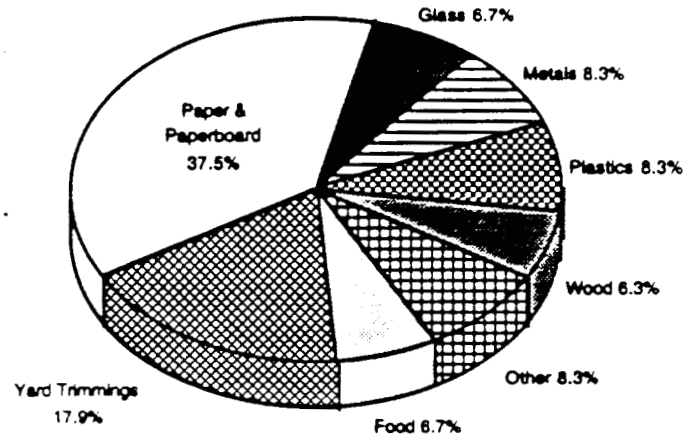
* Generation before materials recovery or combustion.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Paper and Paperboard

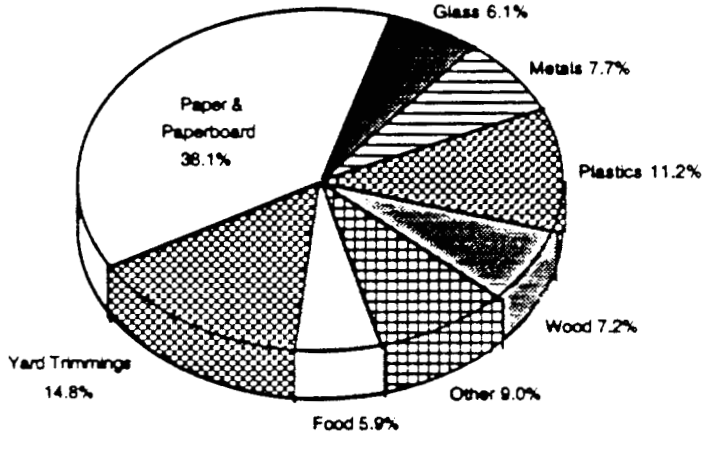
Projections of paper and paperboard generation were based on past trends, with some slowing of growth projected for newsprint, corrugated containers, and paper packaging. These grades of paper are showing the effects of decreased newspaper readership and (perhaps) some source reduction in packaging.

Paper and paperboard is projected to continue to be the dominant material in MSW, reaching a generation of almost 85 million tons in 2000. The paper and paperboard grades are projected to remain at about 38 percent of MSW generation for the next decade.

Figure 18. Materials generated in MSW, 1990 and 2000



1990



2000

Glass

Glass products have been a declining percentage of municipal solid waste, and this trend is projected to continue, with tonnage of glass in MSW remaining fairly constant. Glass generation is projected to be about 13.5 million tons in 2000, or about 6 percent of the total.

Ferrous Metals

Cans made of steel have been declining as a component of MSW. On the other hand, more ferrous metals enter MSW as a component of durable goods than as containers. Since durable goods are an increasing component of MSW, ferrous metals in MSW were projected to remain nearly constant, at

about 12 million tons per year. The percentage of ferrous metals in MSW is projected to decline from 6.3 percent of total generation to 5.4 percent in 2000.

Aluminum

Containers and packaging represent the primary source of aluminum in MSW, although some aluminum is present in durables and nondurables. Aluminum in MSW has grown rapidly, and the growth is projected to continue, to 3.6 million tons in 2000. Because of its light weight, aluminum represents a small percentage of MSW generation—1.4 percent in 1990 and 1.6 percent in 2000.

Other Nonferrous Metals

Other nonferrous metals (e.g., lead, copper, and zinc) are found in durable goods like appliances, furniture, and batteries. Lead-acid (automotive) batteries comprise the majority of this category. Generation of lead-acid batteries is projected to continue to increase, along with small increases in other nonferrous metals. Other nonferrous metals were estimated to be 1.2 million tons in 1990 and are projected to be 1.5 million tons in 2000. These metals are expected to continue to be less than one percent of MSW generation.

Plastics

Generation of plastics in MSW has grown very rapidly in the past three decades, but the rate of increase has been slowing, which is typical of products that achieve sizable market penetration. Plastics in MSW are projected to continue to increase both in tonnage (from 16.2 million tons in 1990 to 24.8 million tons in 2000) and in percentage of total generation (from 8.3 percent of total in 1990 to over 11 percent in 2000).

Wood Wastes

Wood wastes (in furniture and other durables and in pallets) have been increasing in MSW. The tonnage of wood wastes generated is projected to grow from 12.3 million tons in 1990 to 16 million tons in 2000. The percentage of wood wastes is projected to increase from 6.3 percent in 1990 to 7.2 percent of total in 2000.

Other Materials

Other materials in MSW—rubber, leather, and textiles—are projected to have modest growth in tonnage and nearly "flat" percentages of total generation. The apparent growth between 1990 and 2000 for "All Other

Materials" is largely due to the addition of rubber in carpet backing (a new category added for this report).

Food Wastes

Sampling studies over a long period of time show food wastes to be a declining percentage of the waste stream. Per capita discards of food wastes have also been declining over time, which can be explained by the increased use of preprocessed food in homes, institutions, and restaurants, and by the increased use of garbage disposals, which put food wastes into wastewater systems rather than MSW. In making the projections of food wastes, it was assumed that per capita discards will decline slightly up to the year 2000. This means that the tonnage of food wastes remains constant, and their percentage of total MSW continues to decline, to 5.9 percent in 2000 compared to 6.7 percent in 1990.

Yard Trimmings

Based on sampling studies, yard trimmings have been declining as a percentage of MSW, although they have been remaining about constant on a per capita basis. In making projections, it was assumed that per capita discards of yard trimmings would decline after 1990 due to bans on yard trimmings in landfills in many states, accompanied by an increasing practice of backyard composting and leaving grass clippings on lawns instead of bagging them.

As a result of these assumptions, yard trimmings are projected to decline in tonnage, from 35 million tons in 1990 to about 33 million tons in 2000. As a percentage of the total, yard trimmings are projected to decline from about 18 percent in 1990 to about 15 percent in 2000. In spite of this decline, yard trimmings are still projected to be the second largest component of MSW by weight in 2000.

Projected Growth Rates for Materials in MSW

Projected growth rates for the various materials generated in MSW are shown in Table 26. Projected population growth rates (from the Bureau of the Census) are included as well, and it is important to note that the rates of population increase are projected to continue to decline between 1990 and 2000. Paper and paperboard, plastics, wood, and some miscellaneous materials are all projected to increase faster than population, while glass and metals are projected to increase more slowly than population. Food wastes are projected to show no increase, and yard trimmings are projected to decline. Overall, municipal solid waste generation is projected to increase at a rate of 1.3 percent annually between 1990 and 2000.

Table 26

AVERAGE ANNUAL RATES OF INCREASE (OR DECREASE)*
OF GENERATION OF MATERIALS IN MSW
(In annual percent by weight)

	1960-1970	1970-1980	1980-1990	1990-2000
Paper & Paperboard	4.5	2.1	3.4	1.6
Glass	6.8	1.9	0.0	0.2
Metals	2.7	0.5	1.0	0.6
Plastics	27.5	12.1	8.3	4.4
Wood	2.8	6.6	7.7	2.7
All Other Materials**	4.3	4.0	3.5	4.5
Food Wastes	0.3	0.3	0.0	0.0
Yard Trimmings	1.3	1.6	2.4	-2.5
Total MSW	3.5	2.3	2.8	1.3
Population	1.2	1.1	1.0	0.7

* Rates are based on 10-year trend lines for each decade.

** Rubber and leather, textiles, electrolytes in batteries, wood pulp and moisture in disposable diapers, miscellaneous inorganics.

Source: Franklin Associates, Ltd.

Table 27

PROJECTIONS OF CATEGORIES OF PRODUCTS GENERATED*
IN THE MUNICIPAL WASTE STREAM, 1990 to 2000
(In millions of tons and percent of total generation)

	Millions of Tons			% of Total Generation		
Products	1990	1995	2000	1990	1995	2000
Durable Goods *(Detail in Table 28)*	27.9	30.3	33.8	14.3%	14.6%	15.2%
Nondurable Goods *(Detail in Table 29)*	52.3	58.6	64.4	26.7%	28.2%	29.0%
Containers and Packaging *(Detail in Table 30)*	64.4	69.1	74.7	32.9%	33.2%	33.6%
Total Product Wastes **	144.6	158.0	172.9	73.9%	76.0%	77.8%
Other Wastes						
Food Wastes	13.2	13.2	13.2	6.7%	6.3%	5.9%
Yard Trimmings	35.0	33.7	32.9	17.9%	16.2%	14.8%
Miscellaneous Inorganic Wastes	2.9	3.0	3.1	1.5%	1.4%	1.4%
Total Other Wastes	51.1	49.9	49.2	26.1%	24.0%	22.2%
Total MSW Generated	195.7	207.9	222.1	100.0%	100.0%	100.0%

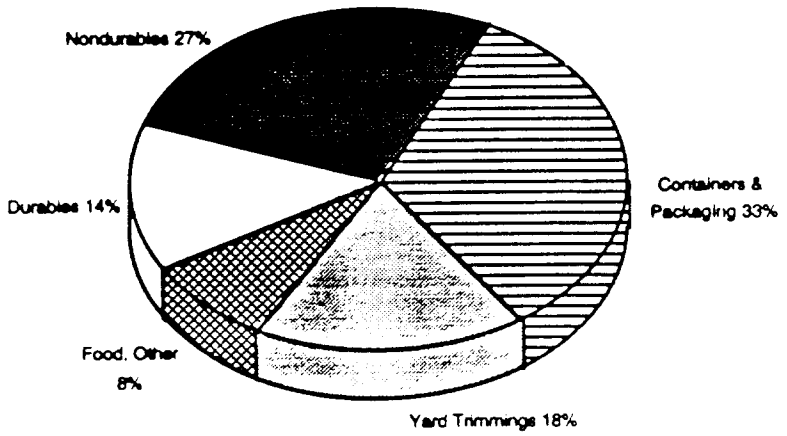
* Generation before materials recovery or combustion.

** Other than food products.

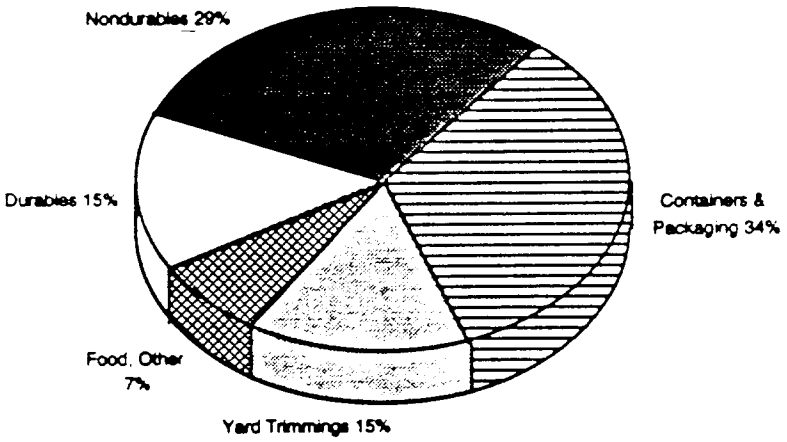
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Figure 19. Products generated in MSW, 1990 and 2000



1990



2000

PRODUCT GENERATION IN MUNICIPAL SOLID WASTE

Projected generation of the products in municipal solid waste is summarized in Table 27 and Figure 19. All categories (except for "other wastes") are projected to grow in tonnage. Containers and packaging are projected to remain the largest single category at between 33 and 34 percent of generation, with nondurables being the second largest category of generation at 29 percent of total in 2000. More detailed observations on the projected growth in the individual product categories follow.

Durable Goods

Overall, durable goods are projected to increase in both tonnage and percent of total generation (Table 28). The trends in generation of major appliances, carpet and rugs, and furniture and furnishings are well established by production numbers, since lifetimes of up to 20 years are assumed. Generation of rubber tires, lead-acid batteries, and miscellaneous durables are projected based on historical trends, which are generally "flat" or exhibiting low rates of growth.

Substitution of relatively light materials like aluminum and plastics for heavier materials like steel has occurred in durables like appliances and furniture as well as other products. Also, cars have become smaller and tires have been made longer-wearing, which tends to reduce the rate of increase at which tires are generated. It was projected that these trends will continue.

Table 28

PROJECTIONS OF PRODUCTS GENERATED*
IN THE MUNICIPAL WASTE STREAM, 1990 TO 2000
(WITH DETAIL ON DURABLE GOODS)
(In millions of tons and percent of total generation)

Products	Millions of Tons			% of Total Generation		
	1990	1995	2000	1990	1995	2000
Durable Goods						
Major Appliances	2.8	3.2	3.4	1.4%	1.5%	1.5%
Furniture and Furnishings	7.4	7.7	9.1	3.8%	3.7%	4.1%
Carpets and Rugs	1.7	2.3	2.8	0.9%	1.1%	1.3%
Rubber Tires	1.8	2.3	2.4	0.9%	1.1%	1.1%
Batteries, Lead-Acid	1.7	2.0	2.2	0.9%	1.0%	1.0%
Miscellaneous Durables	12.5	12.8	13.9	6.4%	6.2%	6.3%
Total Durable Goods	27.9	30.3	33.8	14.3%	14.6%	15.2%
Nondurable Goods *(Detail in Table 29)*	52.3	58.6	64.4	26.7%	28.2%	29.0%
Containers and Packaging *(Detail in Table 30)*	64.4	69.1	74.7	32.9%	33.2%	33.6%
*Total Product Wastes***	144.6	158.0	172.9	73.9%	76.0%	77.8%
Other Wastes						
Food Wastes	13.2	13.2	13.2	6.7%	6.3%	5.9%
Yard Trimmings	35.0	33.7	32.9	17.9%	16.2%	14.8%
Miscellaneous Inorganic Wastes	2.9	3.0	3.1	1.5%	1.4%	1.4%
Total Other Wastes	51.1	49.9	49.2	26.1%	24.0%	22.2%
Total MSW Generated	195.7	207.9	222.1	100.0%	100.0%	100.0%

* Generation before materials recovery or combustion.
** Other than food products.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Nondurable Goods

As noted above, generation of nondurable goods has been increasing rapidly, and this trend is projected to continue (Table 29). About 64 million tons of nondurable goods are projected to be generated in 2000, or 29 percent of total generation.

Table 29

PROJECTIONS OF PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1990 TO 2000 (WITH DETAIL ON NONDURABLE GOODS)
(In millions of tons and percent of total generation)

Products	Millions of Tons			% of Total Generation		
	1990	1995	2000	1990	1995	2000
Durable Goods *(Detail in Table 28)*	27.9	30.3	33.8	14.3%	14.6%	15.2%
Nondurable Goods						
Newspapers	12.9	14.1	15.1	6.6%	6.8%	6.8%
Books	1.0	1.1	1.2	0.5%	0.5%	0.5%
Magazines	2.8	3.3	3.8	1.4%	1.6%	1.7%
Office Papers	6.4	7.5	8.1	3.3%	3.6%	3.6%
Telephone Books	0.5	0.6	0.7	0.3%	0.3%	0.3%
Third Class Mail	3.8	4.2	4.6	2.0%	2.0%	2.0%
Other Commercial Printing	5.5	5.9	6.5	2.8%	2.8%	2.9%
Tissue Paper and Towels	3.2	3.5	3.8	1.6%	1.7%	1.7%
Paper Plates and Cups	0.7	0.7	0.7	0.3%	0.3%	0.3%
Plastic Plates and Cups	0.3	0.5	0.6	0.2%	0.2%	0.3%
Trash Bags	0.8	1.1	1.3	0.4%	0.5%	0.6%
Disposable Diapers	2.6	2.8	2.9	1.4%	1.3%	1.3%
Other Nonpackaging Paper	3.8	3.9	4.1	1.9%	1.9%	1.9%
Clothing and Footwear	3.7	3.9	4.5	1.9%	1.9%	2.0%
Towels, Sheets, & Pillowcases	1.0	1.1	1.2	0.5%	0.5%	0.5%
Other Misc. Nondurables	3.2	4.4	5.5	1.6%	2.1%	2.5%
Total Nondurable Goods	52.3	58.6	64.4	26.7%	28.2%	29.0%
Containers and Packaging *(Detail in Table 30)*	64.4	69.1	74.7	32.9%	33.2%	33.6%
Total Product Wastes**	144.6	158.0	172.9	73.9%	76.0%	77.8%
Other Wastes						
Food Wastes	13.2	13.2	13.2	6.7%	6.3%	5.9%
Yard Trimmings	35.0	33.7	32.9	17.9%	16.2%	14.8%
Miscellaneous Inorganic Wastes	2.9	3.0	3.1	1.5%	1.4%	1.4%
Total Other Wastes	51.1	49.9	49.2	26.1%	24.0%	22.2%
Total MSW Generated	195.7	207.9	222.1	100.0%	100.0%	100.0%

* Generation before materials recovery or combustion.
** Other than food products.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

In 1990, paper products were about 78 percent of nondurables generated. Paper products will continue to be the largest share of nondurables, but most paper products will maintain about the same percentage of total generation throughout the decade.

Based on historical trends, paper plates and cups were projected to show no increase in tonnage or percentage; plastic plates and cups were projected to show growth in tonnage, although not much change in percentage of total generation. (The plates and cups categories include hinged containers and other foodservice items, and it was assumed that there will be no widespread bans of disposable foodservice items.)

Because of declining birth rates and processes that make individual diapers smaller and lighter, disposable diapers began to shown a decline in weight generated after 1985, and generation of disposable diapers was projected to remain rather "flat," which means that they remain about constant as a percentage of total generation. (It was assumed that there will be no widespread bans of disposable diapers.)

Clothing and footwear and other textiles are projected to stay at about the same percentage of total throughout the decade.

Finally, other miscellaneous nondurables, which include many items made of plastics, have been growing historically and the growth is projected to continue, causing this category to continue to increase as a percentage of MSW generation.

Containers and Packaging

Containers and packaging is the largest single category of MSW, and this is projected to continue through the decade (Table 30). Generation was 64.4 million tons in 1990, with an increase to 74.7 million tons in 2000. In percentage of total MSW, containers and packaging were about 33 percent in 1990, with a projected increase to 33.6 percent in 2000.

Tonnage of glass packaging generated has been in decline since the early 1980s as glass was displaced by lighter materials like aluminum and plastics (although there has been some increase in the recent past). Glass containers are projected to continue to be a declining percentage of MSW generation (5.4 percent of total generation in 2000).

Steel packaging generation has also been declining for much the same reasons as glass, and steel packaging is also projected to be a declining percentage of MSW generation (just over one percent of total generation in 2000).

Table 30

PROJECTIONS OF PRODUCTS GENERATED*
IN THE MUNICIPAL WASTE STREAM, 1990 TO 2000
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In millions of tons and percent of total generation)

Products	Millions of Tons			% of Total Generation		
	1990	1995	2000	1990	1995	2000
Durable Goods *(Detail in Table 28)*	27.9	30.3	33.8	14.3%	14.6%	15.2%
Nondurable Goods *(Detail in Table 29)*	52.3	58.6	64.4	26.7%	28.2%	29.0%
Containers and Packaging						
Glass Packaging						
Beer and Soft Drink Bottles	5.7	5.7	5.6	2.9%	2.7%	2.5%
Wine and Liquor Bottles	2.1	2.2	2.2	1.1%	1.1%	1.0%
Food and Other Bottles & Jars	4.1	4.2	4.1	2.1%	2.0%	1.9%
Total Glass Packaging	11.9	12.1	11.9	6.1%	5.8%	5.4%
Steel Packaging						
Beer and Soft Drink Cans	0.1	0.1	0.1	0.1%	0.1%	0.1%
Food and Other Cans	2.5	2.4	2.3	1.3%	1.1%	1.0%
Other Steel Packaging	0.2	0.2	0.2	0.1%	0.1%	0.1%
Total Steel Packaging	2.9	2.7	2.6	1.5%	1.3%	1.2%
Aluminum Packaging						
Beer and Soft Drink Cans	1.6	1.7	2.0	0.8%	0.8%	0.9%
Other Cans	0.0	0.1	0.1	0.0%	0.0%	0.0%
Foil and Closures	0.3	0.4	0.4	0.2%	0.2%	0.2%
Total Aluminum Pkg	1.9	2.2	2.5	1.0%	1.1%	1.1%
Paper & Paperboard Pkg						
Corrugated Boxes	23.9	25.3	27.0	12.2%	12.2%	12.2%
Milk Cartons	0.5	0.5	0.5	0.3%	0.2%	0.2%
Folding Cartons	4.3	4.5	4.7	2.2%	2.2%	2.1%
Other Paperboard Packaging	0.3	0.3	0.3	0.1%	0.1%	0.1%
Bags and Sacks	2.4	2.5	2.5	1.2%	1.2%	1.1%
Wrapping Papers	0.1	0.1	0.1	0.1%	0.1%	0.1%
Other Paper Packaging	1.0	1.0	1.0	0.5%	0.5%	0.5%
Total Paper & Board Pkg	32.6	34.3	36.2	16.7%	16.5%	16.3%
Plastics Packaging						
Soft Drink Bottles	0.4	0.6	0.7	0.2%	0.3%	0.3%
Milk Bottles	0.4	0.5	0.5	0.2%	0.2%	0.2%
Other Containers	1.8	2.8	3.5	0.9%	1.3%	1.6%
Bags and Sacks	0.9	1.2	1.4	0.5%	0.6%	0.6%
Wraps	1.5	1.7	2.0	0.8%	0.8%	0.9%
Other Plastics Packaging	1.9	2.1	2.6	1.0%	1.0%	1.2%
Total Plastics Packaging	7.0	8.7	10.7	3.6%	4.2%	4.8%
Wood Packaging	7.9	8.9	10.6	4.0%	4.3%	4.8%
Other Misc. Packaging	0.2	0.2	0.2	0.1%	0.1%	0.1%
Total Containers & Pkg	64.4	69.1	74.7	32.9%	33.2%	33.6%
Total Product Wastes*	144.6	158.0	172.9	73.9%	76.0%	77.8%
Other Wastes						
Food Wastes	13.2	13.2	13.2	6.7%	6.3%	5.9%
Yard Trimmings	35.0	33.7	32.9	17.9%	16.2%	14.8%
Miscellaneous Inorganic Wastes	2.9	3.0	3.1	1.5%	1.4%	1.4%
Total Other Wastes	51.1	49.9	49.2	26.1%	24.0%	22.2%
Total MSW Generated	195.7	207.9	222.1	100.0%	100.0%	100.0%

* Generation before materials recovery or combustion.
** Other than food products.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Tonnage of aluminum packaging has been increasing steadily over the historical period, and this trend is projected to continue. Because of its light weight, however, aluminum stays at just over one percent of total generation in the projections.

Like other paper and paperboard products, overall generation of paper and paperboard packaging has been increasing rapidly. The increase is almost all in corrugated boxes, which are mainly used for shipping other products. Continued increases in generation of corrugated boxes are projected; tonnage of these boxes is projected to be 27 million tons in 2000, or about 12 percent of total MSW generation. All paper and paperboard packaging is projected to be 16.3 percent of total generation in 2000 (a slight decline from the category's percentage in 1990).

Generation of other paper and paperboard packaging has not exhibited the same growth, generally due to displacement by plastic packaging. Thus generation of milk cartons, other folding cartons, paper bags and sacks, and other paperboard packaging is projected to be almost "flat" over the decade.

Plastics packaging has exhibited rapid historical growth, and the trends are projected to continue. Soft drink bottles, milk bottles, other containers, bags and sacks, wraps, and other packaging are all projected to follow the increasing trends. Generation of all plastics packaging is projected to be 10.7 million tons in 2000, or 4.8 percent of total generation.

PROJECTIONS OF MSW RECOVERY

Prior to the 1980s, rates of recovery for recycling increased slowly and thus projections were relatively easy to make. At this time, however, there is a high level of interest in municipal solid waste management in general, and in recycling and composting in particular. Government agencies at all levels are seeking ways to stimulate materials recovery. Local communities are adding materials recovery and recycling programs rapidly, but there is no accurate nationwide accounting system. In response to the demand for more recovery and more markets for recovered products, industry associations and individual companies have invested large amounts of money and effort in developing new recycling programs and products containing recovered materials.

Because of the rapidly changing situation and uncertainty in the available data, projections of materials recovery were made in scenarios that could achieve different rates of recovery in 1995 and 2000. Scenarios were developed for 20, 25, and 30 percent recovery rates in 1995, and for 25, 30, and 35 percent recovery rates in 2000. These scenarios are based on recovery of postconsumer MSW and do not include industrial scrap. Also, composting of

only yard trimmings is included in these scenarios; estimates of composting of mixed MSW were not made for this report.

The recovery scenarios developed for this report describe sets of conditions that could achieve the selected range of recovery rates. The scenarios are not intended to predict exact recovery rates for any particular material; there are many ways in which a selected overall recovery rate could be achieved.

Discussion of Assumptions

Some general assumptions and principles were used in making the recovery estimates:

- Recovery includes both recovery for recycling and for composting. Recovery does not always equal recycling, however, and residues left after composting or recycling are not accounted for.

- It was assumed that local, state, and federal agencies will continue to emphasize recycling and composting as MSW management alternatives.

- It was assumed that there will not be a nationwide deposit law for beverage containers, but that the present state deposit laws will remain in place.

- It was assumed that affected industries will continue to emphasize recovery and recycling programs, and will make the necessary investments to achieve higher recycling rates.

- It was assumed that the current trend toward banning certain yard trimmings in landfills will continue, providing stimulus for composting programs and for source reduction of yard trimmings by citizens.

- Based on the preceding assumptions, most U.S. citizens will have access to recovery options in 1995, which will often, in fact, be mandated. These options will include curbside collection, dropoff and buyback centers, and, in some instances, mixed waste processing facilities. Recovery will continue to increase between 1995 and 2000 as more recovery systems come on-line.

- In spite of the factors encouraging more recovery as enumerated above, many areas of the U.S. are thinly populated and/or remote from ready markets for recovered materials; many of these areas also have adequate landfill capacity. Therefore, the overall recovery rate

for the entire country may not reflect the rates achieved in communities where conditions are favorable for recycling and composting.

Scenarios for 1995

The ranges of recovery assumptions for the various materials in MSW are shown in Table 31. Assumed recovery rates for both 1995 and 2000 were based on existing recovery rates in 1990, with projected growth that seemed reasonably achievable nationwide. (Details of the assumptions for individual products in MSW are in Appendix B.) Assumptions as to the projected recovery rates for specific products and materials were made in ranges. It is certainly possible (indeed, probable) that any given material will be recovered at higher or lower rates than those given here, but the scenarios illustrate how the selected recovery rates could be reached.

Table 31

PROJECTED GENERATION AND RANGES OF RECOVERY,* 1995
(In millions of tons and percent of generation of each material)

		Recovery					
		Million tons			% of generation		
Materials	Generation	20%	25%	30%	20%	25%	30%
Paper and Paperboard	79.2	23.3	27.1	30.4	29.4%	34.2%	38.4%
Glass	13.2	2.7	3.5	4.3	20.5%	26.5%	32.6%
Metals							
Ferrous	12.0	2.4	3.2	3.9	20.0%	26.7%	32.5%
Aluminum	3.1	1.1	1.2	1.3	35.5%	38.7%	41.9%
Other Nonferrous	1.4	1.0	1.0	1.0	69.5%	71.0%	71.7%
Total Metals	16.5	4.5	5.4	6.2	27.1%	32.6%	37.6%
Plastics	20.0	0.6	0.9	1.4	3.0%	4.5%	7.0%
Rubber & Leather	5.9	0.2	0.3	0.4	3.4%	5.1%	6.8%
Clothing, Other Textiles	5.9	0.3	0.4	0.8	5.1%	6.8%	13.6%
Wood	13.5	0.4	0.9	1.3	3.0%	6.7%	9.6%
Yard Trimmings	33.7	8.8	11.1	15.2	26.1%	32.9%	45.1%
Other Materials**	20.0	0.7	2.3	1.1	3.5%	11.5%	5.5%
Totals	207.9	41.5	51.9	62.3	20.0%	25.0%	30.0%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap. Does not include recovery for mixed MSW composting.

** Food wastes, miscellaneous inorganic wastes, other.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

To reach a recovery rate of 25 percent in 1995, recovery of virtually every material in MSW will need to increase, although products already recovered at high levels (such as aluminum cans and automotive batteries) will show less of an increase. In particular, a dramatic increase in recovery of yard trimmings for composting is projected, due in large part to bans on landfilling of yard trimmings in many states.

Scenarios for 2000

The range of projected recovery rates for materials in MSW under three recovery scenarios in the year 2000 is shown in Table 32. (Details of the assumptions for individual products in MSW are in Appendix B.) Continued increases in recovery in every category will be required to reach the scenarios shown. To reach a recovery rate of 35 percent nationwide in 2000, nearly half

Table 32

PROJECTED GENERATION AND RANGES OF RECOVERY,* 2000
(In millions of tons and percent of generation of each material)

		Recovery					
		Million tons			% of generation		
Materials	Generation	25%	30%	35%	25%	30%	35%
Paper and Paperboard	84.7	28.0	33.8	36.2	33.1%	39.9%	42.7%
Glass	13.5	3.8	4.7	5.3	28.1%	34.8%	39.3%
Metals							
Ferrous	12.1	3.3	3.8	4.4	27.3%	31.4%	36.4%
Aluminum	3.6	1.4	1.5	1.6	38.9%	41.7%	44.4%
Other Nonferrous**	1.5	1.1	1.1	1.1	71.0%	73.3%	73.3%
Total Metals	17.1	5.8	6.4	7.1	33.7%	37.4%	41.5%
Plastics	24.8	1.9	2.5	2.9	7.7%	10.1%	11.7%
Rubber & Leather	6.5	0.3	0.4	0.2	4.6%	6.2%	3.1%
Clothing, Other Textiles	6.7	0.4	0.6	0.9	6.0%	9.0%	13.4%
Wood	16.0	1.1	1.6	2.1	6.9%	10.0%	13.1%
Yard Trimmings	32.9	13.2	15.8	21.1	40.1%	48.0%	64.1%
Other Materials†	19.9	1.0	1.0	1.8	5.0%	5.0%	9.0%
Totals	222.1	55.5	66.8	77.6	25.0%	30.0%	35.0%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap. Does not include recovery for mixed MSW composting.
** Includes some nonferrous metals other than battery lead.
† Food wastes, miscellaneous inorganic wastes, other.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

of all paper and paperboard would be recovered, nearly 40 percent of all glass, over 40 percent of metals, and nearly 12 percent of all plastics in MSW. Sixty-four percent of all yard trimmings would be recovered for composting under this scenario (not including backyard composting).

PROJECTIONS OF MSW DISCARDS AFTER RECOVERY

Discards of municipal solid waste as defined for this report are those wastes remaining after recovery of materials for recycling and composting of yard trimmings. The remaining discards must be managed by mixed MSW composting, combustion, landfilling, or some other means. The effects of projected recovery rates on the amounts and characteristics of municipal solid waste discards are illustrated in Table 33. (A 25 percent recovery scenario for 1995 and a 30 percent recovery scenario for 2000 are shown as examples.)

One interesting observation that can be made from the results in Table 33 is that under the selected scenarios, discards of MSW will decline between 1990 and 1995, then decline only slightly between 1995 and 2000. In other words, the projected recovery will about equal the projected increase in generation of MSW during that time frame (Table 25).

Another interesting observation is that materials that are recovered at relatively high rates will comprise a smaller percentage of discards than they do of generation. For example, paper and paperboard were projected to be about 38 percent of total MSW generation in 2000, but about 33 percent of discards in 2000 under the projected scenario. Plastics, which are projected to have a lower recovery rate, are shown to be about 11 percent of generation in 2000, but about 14 percent of discards. Other materials show similar patterns.

PROJECTIONS OF MSW COMBUSTION

As described in Chapter 3, surveys of municipal solid waste combustion facilities were used to develop historical combustion estimates. These same surveys were used to identify facilities that are under construction or in the planning stages. The surveys indicate that new facilities are scheduled to come into operation in the 1990s, although implementation has often been delayed for a variety of reasons. Using this information, it was projected that 35.4 million tons of MSW will be combusted in 1995 and about 46 million tons in the year 2000 (Table 34). This amounts to about 17 percent of MSW generation in 1995 and about 21 percent in 2000.

While substantial amounts of MSW were burned without energy recovery in past years, most of these older facilities have been closed due to air pollution requirements. It is projected that all major facilities for combustion of MSW will have energy recovery in the future.

Table 33

PROJECTIONS OF MATERIALS DISCARDED* IN MSW, 1990 TO 2000
(In millions of tons and percent of total discards)

Materials	Million tons			% of discards		
	1990	1995 **	2000 †	1990	1995	2000
Paper and Paperboard	52.4	52.1	50.9	32.3%	33.4%	32.8%
Glass	10.6	9.7	8.8	6.5%	6.2%	5.7%
Metals						
Ferrous	10.4	8.8	8.3	6.4%	5.6%	5.3%
Aluminum	1.6	1.9	2.1	1.0%	1.2%	1.4%
Other Nonferrous	0.4	0.4	0.4	0.2%	0.3%	0.3%
Total Metals	*12.5*	*11.1*	*10.8*	*7.7%*	*7.1%*	*6.9%*
Plastics	15.9	19.1	22.3	9.8%	12.2%	14.3%
Rubber & Leather	4.4	5.6	6.1	2.7%	3.6%	3.9%
Clothing, Other Textiles	5.3	5.5	6.1	3.3%	3.5%	3.9%
Wood	11.9	12.6	14.4	7.3%	8.1%	9.3%
Food Wastes	13.2	13.2	13.2	8.1%	8.5%	8.5%
Yard Trimmings	30.8	22.6	17.1	19.0%	14.5%	11.0%
Other Materials	5.3	4.5	5.7	3.3%	2.9%	3.7%
Totals	162.3	156.0	155.4	100.0%	100.0%	100.0%

* Discards after recovery for recycling and composting of yard trimmings.
** Recovery scenario at 25 percent (Table 31).
† Recovery scenario at 30 percent (Table 32).
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

SUMMARY OF PROJECTED MSW MANAGEMENT

A summary of the 1995 and 2000 projections is presented, with similar figures for 1990 included for contrast (Table 34). For the summary, mid-range recovery scenarios were used for 1995 and 2000.

From 1990 to 2000, generation of MSW is projected to increase by 1.3 percent per year compared to 2.8 percent per year between 1980 and 1990. The effect of the mid-range scenarios for materials recovery for recycling and yard trimmings composting causes the discards of MSW to "level off" between 1995 and 2000. Continued increases in MSW combustion further reduce the amounts of MSW remaining to be landfilled from about 130 million tons in 1990 to about 109 million tons in 2000. (The projected amounts of MSW to be landfilled could be higher or lower under other recovery scenarios.)

A graphical illustration of these trends is shown in Figure 20.

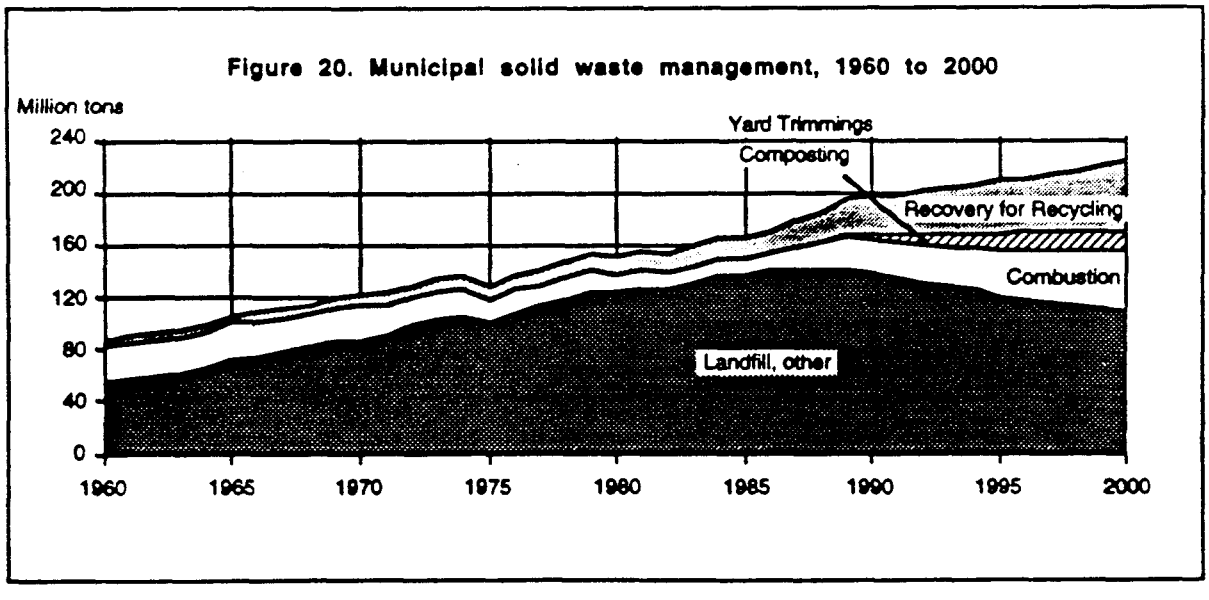
Table 34

GENERATION, RECOVERY, COMBUSTION, AND DISPOSAL OF MUNICIPAL SOLID WASTE, 1990 TO 2000

(In millions of tons and percent of total generation)

	Millions of Tons			% of Generation		
	1990	1995	2000	1990	1995	2000
Generation	195.7	207.9	222.1	100.0%	100.0%	100.0%
Recovery for Recycling	29.2	40.8	50.9	14.9%	19.6%	22.9%
Composting of Yard Trimmings	4.2	11.1	15.8	2.1%	5.3%	7.1%
*Total Materials Recovery**	33.4	51.9	66.7	17.1%	25.0%	30.0%
Discards after Recovery**	162.3	156.0	155.4	82.9%	75.0%	70.0%
Combustion	31.9	35.4	46.2	16.3%	17.0%	20.8%
Landfill, Other Disposal†	130.4	120.6	109.2	66.6%	58.0%	49.2%

* Total recovery rates of 17.1% in 1990, 25% in 1995, and 30% in 2000.
** Does not include residues from recycling/composting processes.
† Does not include residues from recycling, composting, or combustion processes.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.



Chapter 5

ADDITIONAL PERSPECTIVES ON MUNICIPAL SOLID WASTE

INTRODUCTION

In this chapter, the municipal solid waste (MSW) characterization data summarized in the previous chapters are presented again from different perspectives. These are:

- Historical and projected MSW generation and management on a pounds per person per day basis
- Historical and projected MSW generation by material on a pounds per person per day basis
- A classification of 1990 MSW generation into residential and commercial components
- Historical and projected discards of MSW classified into organic and inorganic fractions.

DISCARDS BY INDIVIDUALS

Municipal solid waste planners often think in terms of generation and discards on a per capita basis. Data on MSW generation and management are presented on the basis of pounds per person per day in Table 35. The top line shows a steady increase in per capita generation of MSW, from 2.7 pounds per person per day in 1960 to 4.3 pounds per person per day in 1990, with a projection of 4.5 pounds per person per day in 2000.

This projection indicates a substantial slowing in the rate of increase of per capita MSW generation in the 1990s. The projected decline hinges on diverse variables that are difficult to predict. They range from demographic changes, economic factors, and consumer preferences such as 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 long-lasting products.

After recovery for recycling and composting, discards were reduced to 3.6 pounds per person per day in 1990. Of these discards, an estimated 0.7 pounds per person per day were combusted and 2.9 pounds per person per day were disposed by landfilling or some other method in 1990.

Table 35

PER CAPITA GENERATION, MATERIALS RECOVERY, COMBUSTION, AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 TO 2000

(In pounds per person per day; population in thousands)

	1960	1970	1980	1990	2000
Generation	2.7	3.3	3.7	4.3	4.5
Recovery for Recycling & Composting*	0.2	0.2	0.4	0.7	1.4
Discards after Recovery**	2.5	3.0	3.3	3.6	3.2
Combustion	0.8	0.7	0.3	0.7	0.9
Discards to Landfill, Other Disposal†	1.7	2.4	3.0	2.9	2.2
Population (thousands)	180,671	203,984	227,255	249,924	268,266

* Overall recovery rate of 30% in 2000.
** Does not include residues from recycling/composting processes.
† Does not include residues from recycling, composting, or combustion processes.
Details may not add to totals due to rounding.
Source: Tables 24 and 34. Population from Bureau of the Census, Current Population Reports.

Table 36

PER CAPITA GENERATION* OF MUNICIPAL SOLID WASTE, BY MATERIAL, 1960 TO 2000

(In pounds per person per day)

Materials	1960	1970	1980	1990	2000
Paper and Paperboard	0.9	1.2	1.3	1.6	1.7
Glass	0.2	0.3	0.4	0.3	0.3
Metals	0.3	0.4	0.3	0.4	0.3
Plastics	Neg.	0.1	0.2	0.4	0.5
Rubber and Leather	0.1	0.1	0.1	0.1	0.1
Textiles	0.1	0.1	0.1	0.1	0.1
Wood	0.1	0.1	0.2	0.3	0.3
Other	Neg.	Neg.	0.1	0.1	0.1
Total Materials in Products	1.6	2.2	2.6	3.2	3.5
Food Wastes	0.4	0.3	0.3	0.3	0.3
Yard Trimmings	0.6	0.6	0.7	0.8	0.7
Miscellaneous Inorganic Wastes	Neg.	Neg.	0.1	0.1	0.1
Total MSW Generated	2.6	3.2	3.7	4.3	4.5

* Generation before materials or energy recovery.
Details may not add to totals due to rounding.
Neg. = Negligible (less than 0.05 pounds per person per day).
Source: Table 1. Population from Bureau of the Census, Current Population Reports.

In Table 36, per capita generation of each material category characterized in this study is shown. Paper, plastics, and wood in MSW have grown on a per capita basis. Glass has declined on a per capita basis, while metals, textiles, rubber and leather, and food wastes have been relatively constant. Yard trimmings have been increasing on a per capita basis, but this is projected to decline if current trends to promote backyard composting and leaving grass cuttings on lawns continue and increase.

RESIDENTIAL AND COMMERCIAL GENERATION OF MSW

The sources of MSW generation are of considerable interest to management planners. The material flows methodology does not lend itself well to a distinction as to sources of the materials because the data used are national in scope. Nevertheless, an attempt has been made in this report to classify the MSW product generation in 1990 (Chapter 2) into residential and commercial components. The classification should be considered a first effort and subject to later revision as more data become available.

For purposes of this classification, residential waste was considered to come from both single family and multi-family residences. This is somewhat contrary to a common practice in MSW management to classify wastes collected from apartment buildings as commercial. The rationale used for this report is that the nature of residential waste is basically the same whether it is generated in a single or multi-family residence. (Yard trimmings are probably the primary exception, and this was taken into account.) Because of this approach, the percentage of residential waste shown here is higher than that often reported by waste haulers.

Commercial wastes for the purpose of this classification include MSW from retail and wholesale establishments; hotels; office buildings; airports and train stations; hospitals, schools, and other institutions; and similar sources. No industrial process wastes are included, but normal MSW such as packaging, cafeteria and washroom wastes, and office wastes from industrial sources are included. As is the case for the data in Chapter 2, construction and demolition wastes, sludges, ashes, automobile bodies, and other Subtitle D wastes are not included.

The classification of MSW generation into residential and commercial fractions was made on a product-by-product basis, as shown in Appendix C. The 1990 tonnage generation of each product was allocated to residential or commercial sources on a "best judgment" basis; then the totals were aggregated. Sampling studies were consulted where applicable, although available data on residential/commercial sorting of waste are limited. The results are summarized in Table 37. These are estimates for the nation as a whole, and should not be taken as representative of any particular region of the country.

Chapter 6

CHARACTERIZATION OF MUNICIPAL SOLID WASTE BY VOLUME

INTRODUCTION

Solid waste is generally characterized by weight, either in pounds or tons. Most statistics are compiled by weight, landfill operators generally charge fees by weight, estimates of quantities are stated in tons, and the remainder of this report uses tons or millions of tons to specify the quantity of MSW. Weight can be readily and rapidly measured with a set of scales. People agree that properly calibrated scales will accurately measure weight, but there is no agreed-upon method for measuring volume.

It has been realized for many years, however, that the space occupied by waste is also important. Landfills do not get overweight, their space fills up. It is useful to quantify MSW by cubic yards of space occupied, but volume measurements are far more complex to make than weight measurements. Volume measurements are very contextual. A pound of paper is a pound of paper no matter whether it is in flat sheets, crumpled into a wad, or compacted into a bale. However, the *volume* occupied will be very different in each case. Perhaps the one-pound wad of paper will occupy as much as ten times the volume of a pound of baled paper.

Another problem with volume measurement of MSW is the difficulty in establishing a typical set of environmental conditions to serve as a basis for comparison. We may agree that volumes of MSW in landfills are of interest, but the difficulty arises as to how to define typical landfill conditions. Every waste management system treats waste differently, and achieves different levels of compaction and therefore different volumes for different materials. The waste also degrades with time. As waste remains in a landfill, the surroundings may become more acidic, and the gases in the landfill convert from air to other chemicals, perhaps changing the strength and other physical characteristics of materials. The moisture conditions will also change with time. This makes it extremely difficult to devise a set of standard environmental conditions to serve as a basis for volume measures.

To initiate the process of determining a scientific basis for decision-making, a set of volume factors for MSW has been developed. While it is difficult to attain a high degree of accuracy in volume measurements because of the complexity of the problem, a reasonable approach can shed light on these issues.

Because of the desirability of establishing a national consensus on solid waste volumes, a series of measurements was taken in 1989 to present for the

first time a methodology for measuring volumes and to generate a preliminary set of data (1). This chapter is based in part on the results reported in that reference.

METHODOLOGY AND EXPERIMENTAL PROGRAM

As described in the previous EPA MSW characterization report (2), the basic approach was to set up an experimental program to develop a set of density factors for solid waste components, measured in pounds per cubic yard. The MSW weight data reported in millions of tons (from Chapter 2 of this report) were converted to millions of pounds, and the MSW volume in millions of cubic yards was calculated by dividing the weight values by the density (in pounds per cubic yard).

The experimental program was developed in cooperation with The Garbage Project, administered as a part of the Department of Anthropology, Bureau of Applied Research in Anthropology, The University of Arizona, located in Tucson. They are experienced in landfill sampling and in volume measurement. They use a specially constructed machine that can compact MSW samples so as to replicate landfill conditions.

For purposes of conducting experiments, paper was separated into four broad categories based on similarities of compaction behavior. Plastics were also separated into four categories, with another category for composite mixtures of paper and plastics. The nine categories are listed below (no other materials categories were segregated):

- Nonpackaging paper (paper plates, tissues, towels, mail, newspapers, magazines, books, forms, greeting cards, etc.)
- Corrugated boxes
- Paperboard boxes (food boxes, detergent boxes, milk cartons, six-pack wraps, etc.)
- Other paper and paperboard packaging (bags, wrapping paper, towel rolls, molded pulp egg cartons, cups, hinged fast food containers, cigarette wrappers, etc.)
- Plastic film packaging (bags, wrappers, food wrap films, wet-wipes packs, bubble packaging, condiment packs, etc.)
- Plastic rigid containers (bottles, jars, tubs and lids, microwave trays, hard cosmetic cases, bottle basecups, etc.)

- Other plastic packaging (cookie trays, six-pack ring holders, flexible tubes, polystyrene foam packaging, etc.)

- Nonpackaging plastic (cups, tumblers, eating utensils, pens, razors, toys, food serving trays, hangers, Easter grass, sponges, etc.)

- Composite mixtures of paper and plastic (blister packs, juice concentrate containers, composite cans, diapers, etc.)

A central part of the methodology was to retrieve materials from landfills after they had experienced the actual conditions of the solid waste system. Landfill excavations were made at the Los Reales landfill in Tucson in June 1989. Samples were sorted and compressed, and density measurements were recorded by The Garbage Project staff. The results of these experiments and analysis of the data resulted in a set of density factors for the paper and plastic products.

DENSITY FACTORS FOR LANDFILLED MATERIALS

Data Sources

Best estimates of the density of 24 important categories of waste, reported in pounds per cubic yard as compacted in landfills, are summarized in Table 39. The paper and plastic densities are the result of the experimental efforts described above. The values for other materials are based on prior work by The Garbage Project, other literature sources, and other experiments performed at Franklin Associates. In some cases, estimates were made based on behavior of similar materials. References for the origins of each density value are included in Table 39.

Uncertainties in Density Factor Estimates

Durable Goods. Densities of durable goods present a particular problem, since no experimental values are available. Where it was necessary to include densities of durable products, they were assigned the average density of other wastes. A composite density is shown in Table 39.

Plastic Coatings. Plastic coatings applied to packaging and other products present another special case. These coatings do not act as materials in their own right, but take on the characteristics of the products on which they are applied. Their density was also assumed to be the same as the average density of other products.

Disposable Diapers. At the time (1989) these landfill density experiments were being conducted at the University of Arizona, disposable

Table 39

SUMMARY OF DENSITY FACTORS FOR LANDFILLED MATERIALS

	Density (lb/cu yd)	References*
DURABLE GOODS**	520	12
NONDURABLE GOODS		
Nondurable paper	800	3
Nondurable plastic	315	3
Disposable diapers†		
Diaper materials	795	4
Urine and feces	1,350	13
Rubber	345	5
Textiles	435	6
Misc. nondurables (mostly plastics)	390	11
PACKAGING		
Glass containers		
Beer & soft drink bottles	2,800	5, 9
Other containers	2,800	5, 9
Steel Containers		
Beer & soft drink cans	560	5
Food cans	560	5
Other packaging	560	5
Aluminum		
Beer & soft drink cans	250	9, 10
Other packaging	550	9
Paper and Paperboard		
Corrugated	750	3
Other paperboard	820	3
Paper packaging	740	3
Plastics		
Film	670	3
Rigid containers	355	3
Other packaging	185	3, 11
Wood packaging	800	6
Other miscellaneous packaging	1,015	3
FOOD WASTES	2,000	5
YARD TRIMMINGS	1,500	7, 8

* References are listed at the end of this chapter.

** No measurements were taken for durable goods or plastic coatings.

† Diaper density factor has been increased from 400 lb/cu yd in the 1990 Update (2). See section on Density Factors for discussion.

diapers were included with other composite products as described above. A density of 400 pounds per cubic yard was determined for this category, and this density factor was used for disposable diapers in the 1990 update of this MSW characterization report (2).

Since the 1990 update was completed, additional analyses of disposable diaper density have been conducted. Based on an analysis of the densities of the individual components of the diapers (fluff pulp, tissue, and plastics), a density factor of 795 pounds per cubic yard was derived. This factor does not, however, account for the urine and feces that are discarded with the diapers, and that are included in the weight of disposable diapers shown in previous chapters. A density factor of 1,350 pounds per cubic yard was assumed for the urine and feces based on data for sewage sludge of similar moisture content (13). It should be noted that the density factors used are somewhat theoretical, and that experimental data for diapers as compacted in a landfill might yield a different density factor.

VOLUME OF PRODUCTS DISCARDED

The volume of product discards in cubic yards (Table 40) was derived from Chapter 2 and Table 39. (It is necessary to characterize the volume of MSW *discards* rather than generation because the weight discard estimates most closely match the wastes received at a landfill, where the experimental data were derived. Discards include the waste left after materials recovery and composting and before combustion, landfilling, or other disposal.) The weight values from Tables 14, 17, and 22 are shown in the first column of Table 40, with the volumes being calculated by taking the weight values, converting to pounds, and dividing by the density (in pounds per cubic yard) from Table 39. The results are reported in Table 40 as volume in millions of cubic yards of waste on a landfill volume basis for the individual products.

The data in Table 40 may be useful in comparing the relative volume of each product in a landfill. It is not, however, recommended that total landfill volume requirements be calculated using the individual product densities shown. Waste materials are mixed together when disposed and the materials become intermingled. This intermingling tends to reduce void space that occurs in a single material. Thus, mixed MSW in a landfill would be expected to have greater density than that calculated by using the individual density measurements.

The data in Table 40 are summarized in Figure 21 and Table 41. The three categories of nondurable goods, containers and packaging, and durable goods account for over 86 percent of the waste by volume, while the same three categories account for 71 percent of MSW by weight. Containers and packaging and nondurable goods occupy similar shares of MSW volume.

Table 40

VOLUME OF PRODUCTS DISCARDED IN MSW, 1990

	1990 Discards* (mil tons)	Weight (% of total)	Landfill Density** (lb/cu yd)	Landfill Volume*** (mil cu yd)	Volume (% of total)
DURABLE GOODS	24.8	15.3%	520	95.3	23.1%
NONDURABLE GOODS					
Newspapers	7.4	4.6%	800	18.6	4.5%
Books	0.9	0.5%	800	2.2	0.5%
Magazines	2.5	1.5%	800	6.3	1.5%
Office papers	4.7	2.9%	800	11.8	2.9%
Telephone books	0.5	0.3%	800	1.2	0.3%
Third class mail	3.6	2.2%	800	9.1	2.2%
Other commercial printing	4.5	2.7%	800	11.1	2.7%
Tissue paper and towels	3.2	2.0%	800	8.0	1.9%
Paper plates and cups	0.7	0.4%	800	1.6	0.4%
Plastic plates and cups	0.3	0.2%	355	1.8	0.4%
Trash bags	0.8	0.5%	670	2.3	0.6%
Disposable diapers					
Diaper materials	0.9	0.5%	795	2.2	0.5%
Urine and feces	1.7	1.1%	1,350	2.5	0.6%
Subtotal diapers	2.6	1.6%	—	4.8	1.2%
Other nonpackaging paper	3.8	2.3%	800	9.5	2.3%
Clothing and footwear	3.6	2.5%	435	16.4	4.0%
Towels, sheets & pillowcases	0.9	2.5%	435	4.3	1.0%
Other misc. nondurables	3.2	2.0%	390	16.4	4.0%
Total Nondurable Goods	43.1	26.6%	688	125.3	30.4%
CONTAINERS AND PACKAGING					
Glass Packaging					
Beer and soft drink	3.8	2.3%	2,800	2.7	0.7%
Wine and liquor	1.9	1.2%	2,800	1.3	0.3%
Food and other bottles & jars	3.6	2.2%	2,800	2.6	0.6%
Total Glass Packaging	9.3	5.7%	2,800	6.6	1.6%
Steel Packaging					
Beer and soft drink cans	0.1	0.1%	560	0.4	0.1%
Food and other cans	1.9	1.2%	560	7.0	1.7%
Other steel packaging	0.2	0.1%	560	0.7	0.2%
Total Steel Packaging	2.3	1.4%	560	8.0	1.9%
Aluminum Packaging					
Beer and soft drink cans	0.6	0.4%	250	4.6	1.1%
Other cans	0.0	<0.1%	250	0.2	<0.1%
Foil and closures	0.3	0.2%	550	1.0	0.3%
Total Aluminum Pkg	0.9	0.7%	304	5.9	1.4%
Paper & Paperboard Pkg					
Corrugated boxes	12.5	7.7%	750	33.2	8.1%
Milk cartons	0.5	0.3%	820	1.2	0.3%
Folding cartons	4.0	2.4%	820	9.7	2.4%
Other paperboard packaging	0.3	0.2%	820	0.7	0.2%
Bags and sacks	2.2	1.4%	740	6.0	1.5%
Wrapping paper	0.1	0.1%	800	0.3	0.1%
Other paper packaging	1.0	0.6%	740	2.7	0.7%
Total Paper & Board Pkg	20.6	14.0%	764	53.9	13.1%

(continued on next page)

Table 40 (continued)

VOLUME OF PRODUCTS DISCARDED IN MSW, 1990

	1990 Discards* (mil tons)	Weight (% of total)	Landfill Density** (lb/cu yd)	Landfill Volume*** (mil cu yd)	Volume (% of total)
Plastics Packaging					
Soft drink bottles	0.3	0.2%	355	1.7	0.4%
Milk bottles	0.3	0.2%	355	1.9	0.5%
Other containers	1.8	1.1%	355	10.2	2.5%
Bags and sacks	0.9	0.6%	670	2.7	0.7%
Wraps	1.5	0.9%	670	4.5	1.1%
Other plastics packaging	1.9	1.2%	185	20.3	4.9%
Total Plastics Packaging	6.7	4.1%	326	41.2	10.0%
Wood packaging	7.5	4.6%	800	18.7	4.5%
Other misc. packaging	0.2	0.1%	1,015	0.4	0.1%
Total Containers & Packaging	47.4	29.2%	704	134.8	32.7%
Total Product Waste†	115.3	71.1%	649	355.4	86.2%
Other Wastes					
Food wastes	13.2	8.1%	2,000	13.2	3.2%
Yard trimmings	30.8	20.0%	1,500	41.3	10.0%
Miscellaneous inorganics	2.9	1.8%	2,500	2.3	0.6%
Total Other Wastes	46.9	28.9%	1,651	56.8	13.8%
TOTAL MSW DISCARDED	162.2	100.0%	787 ‡	412.2 ‡	100.0%

* From Tables 14, 17, and 22. Discards after materials recovery and composting, before combustion and landfilling.

** From Table 39.

*** This assumes that all waste is landfilled, but some is combusted and otherwise disposed.

† Other than food products.

‡ This density factor and volume are derived by adding the individual factors. Actual landfill density may be considerably higher (see discussion in text).

Source: Franklin Associates, Ltd.

Figure 21. Landfill volume of MSW product categories, 1990 (In percent of total)

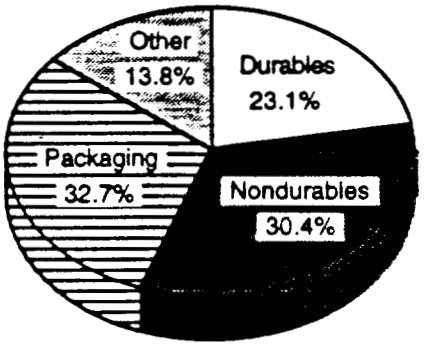


Table 41

SUMMARY OF VOLUME OF PRODUCTS DISCARDED* IN MSW, 1990
(In percent of total)

	Percent by Weight*	Percent by Volume**
Durable Goods	15.3%	23.1%
Nondurable Goods	26.6%	30.4%
Containers and Packaging	29.2%	32.7%
Food Wastes	8.1%	3.2%
Yard Trimmings	20.0%	10.0%
Other	1.8%	0.6%
Total Discards	100.0%	100.0%

* Discards after materials recovery and composting, before combustion and landfilling.
** From Table 40.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

VOLUME OF MATERIALS

These same data are reported by material rather than by product in Table 42 and Figure 22. The values are ranked by landfill volume occupied, with the most voluminous products listed first. Paper occupies the most volume, representing about one-third of the total. This is followed by plastics, at about one-fifth of the total. Those two product categories account for over one-half of the volume occupied by solid waste.

The right-hand column of Table 42 presents the ratio of volume percent to weight percent for each material category. A ratio of 1.0 means that the material occupies the same proportion of volume as weight. Values greater than 1.0 mean that a larger proportion of volume is occupied than weight. Four materials stand out as having ratios of approximately 2.0 or greater: plastics, rubber and leather, textiles, and aluminum. On the other hand, yard trimmings, food, and glass each have ratios of 0.5 or less, illustrating that these materials are quite dense and occupy proportionately less volume in landfills.

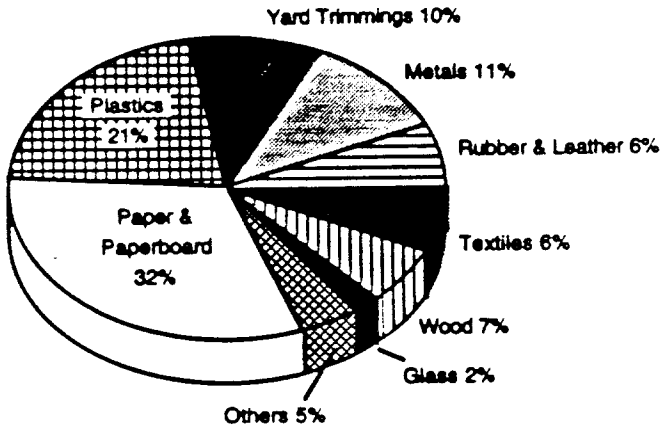
Table 42

VOLUME OF MATERIALS DISCARDED IN MSW, 1990

	1990 Discards* (mil tons)	Weight* (% of MSW total)	Landfill Density** (lb/cu yd)	Landfill Volume*** (mil cu yd)	Volume (% of MSW total)	Ratio (vol %/ wt%)
Paper & Paperboard	52.4	32.3	784	133.6	31.9	1.0
Plastics	15.9	9.8	359	88.5	21.1	2.2
Yard Trimmings	30.8	19.0	1,500	41.1	9.8	0.5
Ferrous Metals	10.4	6.4	560	37.2	8.9	1.4
Rubber & Leather	4.4	2.7	346	25.6	6.1	2.2
Textiles	5.3	3.3	400	26.7	6.4	1.9
Wood	11.9	7.3	840	28.4	6.8	0.9
Food Wastes	13.2	8.1	2,000	13.2	3.2	0.4
Other†	5.7	3.5	2,000	5.7	1.4	0.4
Aluminum	1.6	1.0	366	9.0	2.2	2.1
Glass	10.6	6.5	2,268	9.3	2.2	0.3
Totals	162.3	100.0	776	418.3 ‡	100.0 ‡	1.0

* From Table 3. Discards after materials recovery and landfilling, before combustion and landfilling.
** Composite factors derived by Franklin Associates, Ltd.
*** This assumes that all waste is landfilled, but some is combusted and otherwise disposed.
† Found by difference to obtain total to match products table. Note: Results in this table and Table 40 are not identical due to rounding differences.
‡ This density factor and volume are derived by adding the individual factors. Actual landfill density may be considerably higher (see discussion in text).
Source: Franklin Associates, Ltd.

Figure 22. Landfill volume of materials in MSW, 1990 (In percent of total)



VALIDITY OF RESULTS

These volume data should not be interpreted as highly accurate. The results reported here represent an initial attempt to use this method for analyzing solid waste. While bringing an important perspective to solid waste, the results should be viewed as approximate and not definitive. As discussed before, volume measurements of solid waste are quite complex at best, and will never accurately represent particular situations. For example, individual materials just entering a landfill will occupy more volume than the same materials after substantial settling and compaction have occurred.

The density values in Table 39 are based on sorted MSW categories, but later tests conducted by The Garbage Project indicate that mixing wastes results in a higher than expected density. For example, mixing one cubic yard of paper with one cubic yard of plastic results in less than two cubic yards of material. This is because the intermingling of two or more different materials with different characteristics results in a filling of more air spaces than occurs with a single material. This effect is apparently enhanced when materials are compacted in landfills because of the shaking or vibration created by the movement of heavy equipment on the MSW.

These observations suggest that *if all wastes are mixed together, the total volume* may actually be less than when the wastes are separated. There is no suggestion, however, that this effect would significantly change the *relative* measures recorded in the tables, such as the various percentages and ratios calculated. Therefore, these results do show in a general way which components of waste are the most voluminous, and which occupy less volume than average. It is clear that this perspective needs to be used in solid waste policy decisions.

Chapter 6

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5. Reference 3, Appendix B, Table 21.

6. Estimates based on very limited experimental data with landfill samples.

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9. Franklin Associates estimates based on experiments with nonlandfilled material.

10. Rankin, S. **Recycling Plastics in Municipal Solid Wastes.** Center for Plastics Recycling Research at Rutgers. The State University of New Jersey. January 1989.

11. Based on densities from Reference 3 as applied to a detailed profile of this category.

12. No measurements were taken for durable goods. The value shown assumes that durable products have the same landfill density as nondurable products made of the same materials.

13. Welch, R.O., et al. **Study of Environmental Impacts of Disposables versus Reusables**. Midwest Research Institute and Franklin Associates, Ltd. for the U.S. Environmental Protection Agency. April 1, 1977.

Chapter 7

COMPARISON OF MSW ESTIMATES

INTRODUCTION

As explained in Chapter 1, there are two basic methodologies for estimating quantities and composition of MSW:

- The material flows approach used in this report
- Sampling, sorting, and weighing of waste on-site.

Both methodologies have validity; both must be used with care if they are to be effective for solid waste management purposes.

This chapter compares the MSW estimates in this report with other estimates from two perspectives. First, the estimates in the current report are compared with previous material flows estimates. Second, the estimates in the current report are compared with some of the estimates made by on-site sampling studies.

COMPARISON WITH PREVIOUS MATERIAL FLOWS STUDIES

The material flows methodology has been evolving for about 20 years. Over the years increasing levels of detail have been added as new data became available and as new funding from public and private sources allowed more complete analyses of the materials and products in MSW. For example, the current report includes line items for some products—e.g., disposable diapers and plastic soft drink bottles—that were insignificant in the early 1970s when the methodology was first being developed. Many new types of packaging have come into common use in the past two decades, and the current estimates include more detailed information on paper and plastic packaging than was available previously.

When changes have been made in the database, e.g., to account for additional products, the changes were generally—to the extent data were available—carried backward in the data series as well as being added to the recent years. This has been done to preserve the integrity of the data series by avoiding discontinuities in the database. (There are, however, some discontinuities introduced by the information sources.)

Comparison of Current and Previous Estimates Based on Historical Data

The last year for which MSW was characterized in the 1990 study update was 1988. To highlight changes that have been made in this 1992 update, Table 43 was prepared. Overall, the estimate of generation of MSW in 1988 has been increased by less than 3 percent, from 179.6 million tons of MSW to 184.2 million tons. This increased estimate is almost entirely due to an upward revision of wood packaging generation.

Table 43

COMPARISON OF THE 1990 AND THE 1992 ESTIMATES FOR 1988 MATERIALS GENERATION*
(In millions of tons and percent)

Materials	Previous Estimate**	Current Estimate***	Percent Difference	Comments
Paper and paperboard	71.8	71.7	<1.0%	Revisions in data source.
Glass	12.5	12.5	—	No change.
Metals				
Ferrous	11.6	11.6	—	No change.
Aluminum	2.5	2.5	—	No change.
Other nonferrous	1.1	1.1	—	No change.
Plastics	14.4	14.4	—	No change.
Rubber and leather	4.6	4.6	—	No change.
Textiles	3.9	3.9	—	No change.
Wood	6.5	11.2	+72.3%	Previous estimates too low.
Other†	3.1	3.1	—	No change.
Total Product Waste‡	132.1	136.7	+3.5%	Differences due to wood wastes.
Food wastes	13.2	13.2	—	No change.
Yard trimmings	31.6	31.6	—	No change.
Miscellaneous inorganic wastes	2.7	2.7	—	No change.
Total MSW Generated	179.6	184.2	+2.6%	Differences due to wood wastes.
Pounds per Person per Day	4.00	4.11	+2.7%	

* Generation before recovery for recycling and composting.
** From Table 1 of the June 1990 EPA MSW characterization report.
*** From the work sheets prepared for this report.
† Includes part of materials in disposable diapers and lead-acid batteries.
‡ Other than food products.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Comparison of Current and Previous Projections of MSW Generation

As discussed in earlier chapters of this report, projections of MSW generation are done on a material-by-material and product-by-product basis. The projections are made using trend analysis, available reports from government (Department of Commerce) sources, industry sources, and in some instances, best professional judgment on the industries involved.

Projections were updated for this 1992 report based on an additional two years of historical data.

A comparison of projections of MSW generation for the year 2000 as made for the 1990 update and for this report is shown in Table 44, with results discussed below.

Paper and Paperboard. While generation of paper and paperboard has continued to grow, growth is unevenly distributed among the grades. Thus, growth of printing-writing papers, tissue papers, and newsprint is projected to stay on present trends, but growth in generation of corrugated boxes, boxboard, and paper packaging is projected to slow. Overall, less rapid growth for paper and paperboard is projected as compared to projections made in 1990.

Table 44

COMPARISON OF THE 1990 AND THE 1992 PROJECTIONS OF MATERIALS GENERATION* IN 2000
(In millions of tons and percent)

Materials	Previous Estimate**	Current Estimate***	Percent Difference	Comments
Paper and paperboard	96.1	84.7	-11.9%	Growth less rapid than in past.
Glass	10.3	13.5	+31.1%	Decline in containers has slowed.
Metals				
Ferrous	12.0	12.1	<1.0%	
Aluminum	3.5	3.6	+2.8%	Minor adjustment.
Other nonferrous	1.5	1.5	—	No change.
Plastics	21.1	24.8	+17.5%	Trends reevaluated.
Rubber and leather	5.3	6.5	+26.4%	Trends reevaluated.
Textiles	4.3	6.7	+55.8%	Added carpet fiber, sheets.
Wood	8.4	16.0	+90.5%	Wood packaging added; growth item.
Other†	3.0	3.7	+23.3%	Trends reevaluated.
Total Product Waste‡	165.4	172.9	+4.5%	
Food wastes	13.3	13.2	<1.0%	
Yard trimmings	34.4	32.9	-4.4%	Source reduction practices.
Miscellaneous inorganic wastes	2.9	3.1	+6.9%	Trends reevaluated.
Total MSW Generated	216.0	222.1	+2.8%	
Pounds per Person per Day	4.41	4.54	+2.9%	

* Generation before any materials recovery.
** From Table 27 of the June 1990 EPA MSW characterization report.
*** From Table 25 of this report.
† Includes part of materials in disposable diapers and lead-acid batteries.
‡ Other than food products.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Glass. Generation of glass has been in decline in the past decade. Since the last update, however, there has been some increase in generation of glass containers. Therefore, projections of glass generation for 2000 were increased.

Plastics. Continued growth in miscellaneous nondurable plastic products and in certain plastic containers led to an increased projection of plastic generation in 2000.

Rubber and Leather. Projected generation in this category was adjusted upward somewhat based on trends since the 1990 update.

Textiles. Carpet fibers, which had previously not been accounted for, were added for the 1992 update. In addition, sheets, towels, and pillowcases were added as a line item; these were not fully accounted for previously. Projections were adjusted upward accordingly.

Wood. Estimated generation of wood packaging was increased considerably for this update, and projections were revised as well. Wood packaging has been growing more rapidly than previously anticipated.

Yard Trimmings. Since the last update, many states have banned yard trimmings from landfills, and many communities are taking measures to reduce generation of yard trimmings. Previous projections of yard trimmings generation were therefore revised downward to account for these recent source reduction practices.

COMPARISON WITH ESTIMATES MADE BY SAMPLING STUDIES

Comparison of estimates made by the material flows methodology with estimates made by sampling and weighing MSW are of interest, but must be approached with caution. For one thing, the waste stream sampled in any particular study may not be comparable to the mix of products included in the material flows methodology. For example, industrial waste is often included in waste received and sampled at a landfill or transfer station. Seasonal variations in the waste stream may also affect the results of a sampling study.

Another important factor to consider when comparing results is moisture transfer among materials in wastes as they are collected. The material flows methodology characterizes wastes in their as-generated condition. That is, moisture in disposable diapers is accounted for, and estimates of food wastes and yard trimmings have been adjusted to include the moisture inherent in the discards. Wastes as sampled, however, have been mixed together prior to sampling, and the moisture in the wastes has been transferred among products. For example, paper products in MSW absorb large quantities of moisture from food wastes and yard trimmings, and

the latter wastes thus contain less moisture than they did in their as-generated condition. This moisture transfer may significantly affect the relative weight percentages of the materials in MSW.

Municipal solid waste composition estimated by the material flows methodology is compared with composition estimated by sampling studies in Table 45. The sampling study results are presented in ranges; the first set represents the results of 16 studies as compiled by Franklin Associates, the second set is taken from a recent Office of Technology Assessment report on MSW, and the third set is a more recent compilation made by Franklin Associates. For each material category, the percentage estimated by the material flows methodology falls within the range found in the sampling studies. (The sole exception is an "other" category, which is not well defined.)

Table 45

COMPARISON OF MSW DISCARDS BY MATERIAL FLOWS AND SAMPLING METHODOLOGIES
(In percent of total by weight)

Material	1990 Material Flows Estimate*	Range of 16 Sampling Studies**	Range of 9 Sampling Studies†	Range of 8 Sampling Studies‡
Paper and paperboard	32.3	14.4 - 54.2	29.9 - 45.9	29.1 - 43.8
Glass	6.5	2.8 - 19.9	3.6 - 12.9	3.3 - 5.9
Metals	7.7	4.3 - 11.5	1.5 - 9.4	4.4 - 8.8
Plastics	9.8	4.9 - 9.7	5.3 - 12.6	6.3 - 10.2
Rubber, leather, textiles	6.0	1.9 - 5.9	1.1 - 7.2	3.2 - 5.6
Wood	7.3	0.8 - 12.9	0.7 - 8.2	4.5 - 15.1
Food wastes	8.1	5.1 - 19.3	1.3 - 28.8	6.5 - 9.8
Yard trimmings	19.0	3.5 - 30.9	0.0 - 39.7	5.1 - 19.8
Other	3.3	NA NA	3.8 - 16.6	NA NA

* Discards after recovery for recycling and composting.
** Compiled by Franklin Associates from a variety of sources. 1984-1988 time frame.
† Office of Technology Assessment.
‡ Compiled by Franklin Associates from a variety of sources. 1987-1990 time frame.
NA - Not available.

Another interesting comparison of the material flows and sampling methodologies was made by Dr. Edwin Korzun and others at Florida Institute of Technology. As part of a study for the State of Florida, they did a careful analysis of waste received at landfills in Brevard County, Florida. They were particularly careful to sort out wastes that are not classified as MSW, e.g., construction, demolition, and industrial wastes. As a result of their research, they concluded that:

> "The comparison of the broad categories indicates that the sum of the subcategories from Franklin [for EPA] and those obtained locally, known to be site specific for a particular Florida county, do not vary widely. Since no major differences were observed it was concluded that the Franklin [for EPA] subcategories of the percentage of materials in the United States municipal solid waste stream could be utilized to estimate those same components in the state of Florida with reasonable accuracy."

It seems clear that both the material flows and sampling methodologies have valid uses in estimating municipal solid waste generation and discards. Whatever methodology is used, it is most important to be very clear as to what wastes are being measured and at what point in the solid waste management system the measurements are being taken.

Chapter 7

REFERENCES

1. U.S. Environmental Protection Agency. **Characterization of Municipal Solid Waste in the United States: 1990 Update.** EPA/530-SW-90-042. June 1990.

2. Congress of the United States, Office of Technology Assessment. **Facing America's Trash: What Next for Municipal Solid Waste?** (OTA-O-424). October 1989.

3. Korzun, E.A., et al. "The Impact of Increased Recycle Rates on Markets for Recycled Paper, Plastic, Metals, Glass, and Rubber in Florida." Florida Institute of Technology, Melbourne, Florida. Undated.

Appendix A

MATERIAL FLOWS METHODOLOGY

Appendix A

MATERIAL FLOWS METHODOLOGY

The material flows methodology is illustrated in Figures A-1 and A-2. The crucial first step is making estimates of the generation of the materials and products in MSW (Figure A-1).

DOMESTIC PRODUCTION

Data on domestic production of materials and products are compiled for 1970 through 1988, using published data series. U.S. Department of Commerce sources are used where available, but in several instances more detailed information on production of goods by end use is available from trade associations. The goal is to obtain a consistent historical data series for each product and/or material.

CONVERTING SCRAP

The domestic production numbers are then adjusted for converting or fabrication scrap generated in the production processes. Examples of these kinds of scrap would be clippings from plants that make boxes from paperboard, glass scrap (cullet) generated in a glass bottle plant, or plastic scrap from a fabricator of plastic consumer products. This scrap typically has a high value because it is clean and readily identifiable, and it is almost always recovered and recycled within the industry that generated it. Thus, converting/fabrication scrap is *not* counted as part of the postconsumer recovery of waste.

ADJUSTMENTS FOR IMPORTS/EXPORTS

In some instances imports and exports of products are a significant part of MSW, and adjustments are made to account for this.

DIVERSION

Various adjustments are made to account for diversions from MSW. Some consumer products are permanently diverted from the municipal waste stream because of the way they are used. For example, some paperboard is used in building materials, which are not counted as MSW. Another example of diversion is toilet tissue, which is disposed in sewer systems rather than becoming MSW.

In other instances, products are temporarily diverted from the municipal waste stream. For example, textiles reused as rags are assumed to enter the waste stream the same year the textiles are initially discarded.

ADJUSTMENTS FOR PRODUCT LIFETIME

Some products (e.g., newspapers and packaging) normally have a very short lifetime; these products are assumed to be discarded in the same year they are produced. In other instances (e.g., furniture and appliances), products have relatively long lifetimes. Data on average product lifetimes are used to adjust the data series to account for this.

MUNICIPAL SOLID WASTE GENERATION AND DISCARDS

The result of these estimates and calculations is a material-by-material and product-by-product estimate of MSW generation, recovery, and discards.

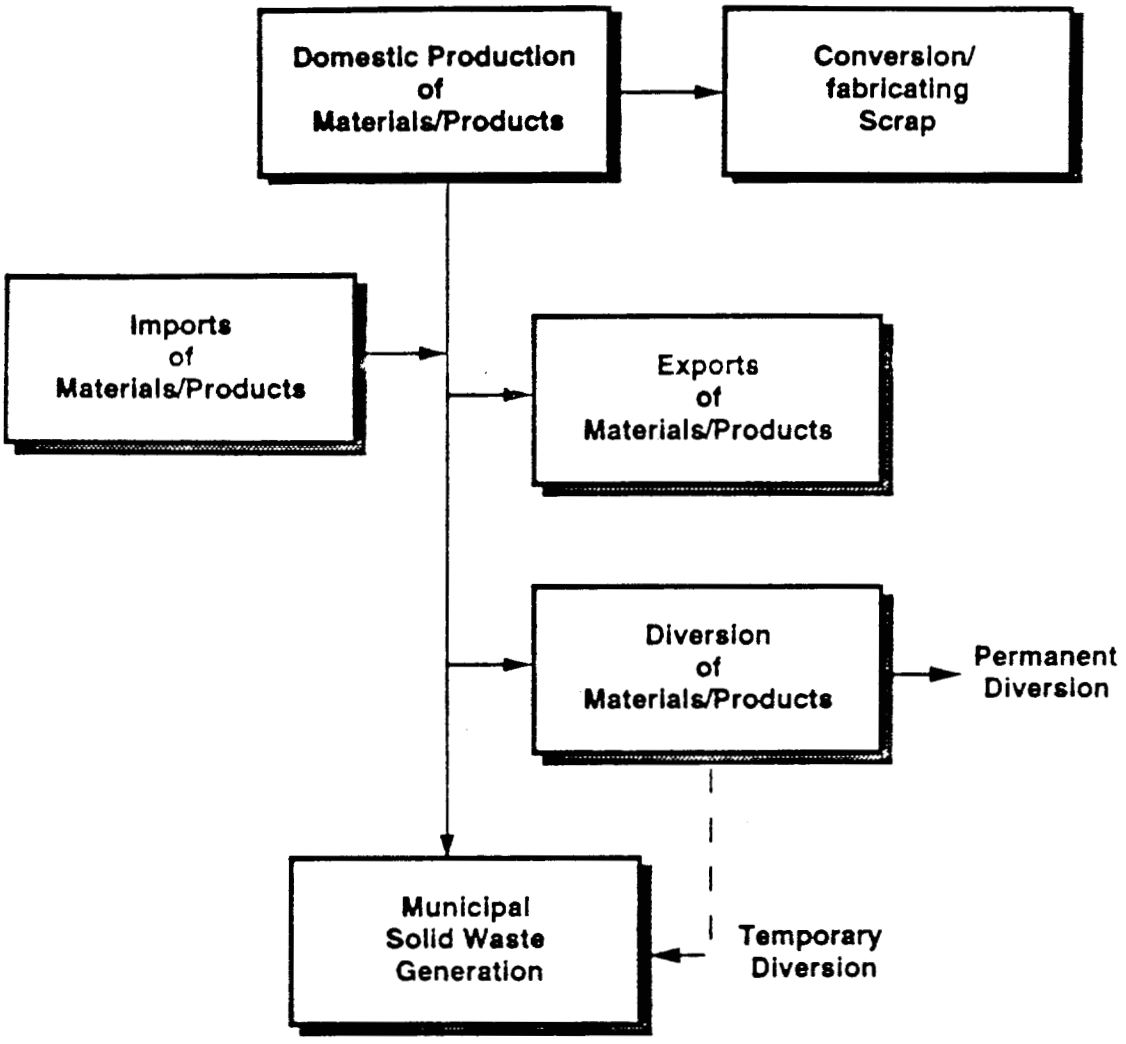


Figure A-1. Material flows methodology for estimating generation of products and materials in municipal solid waste.

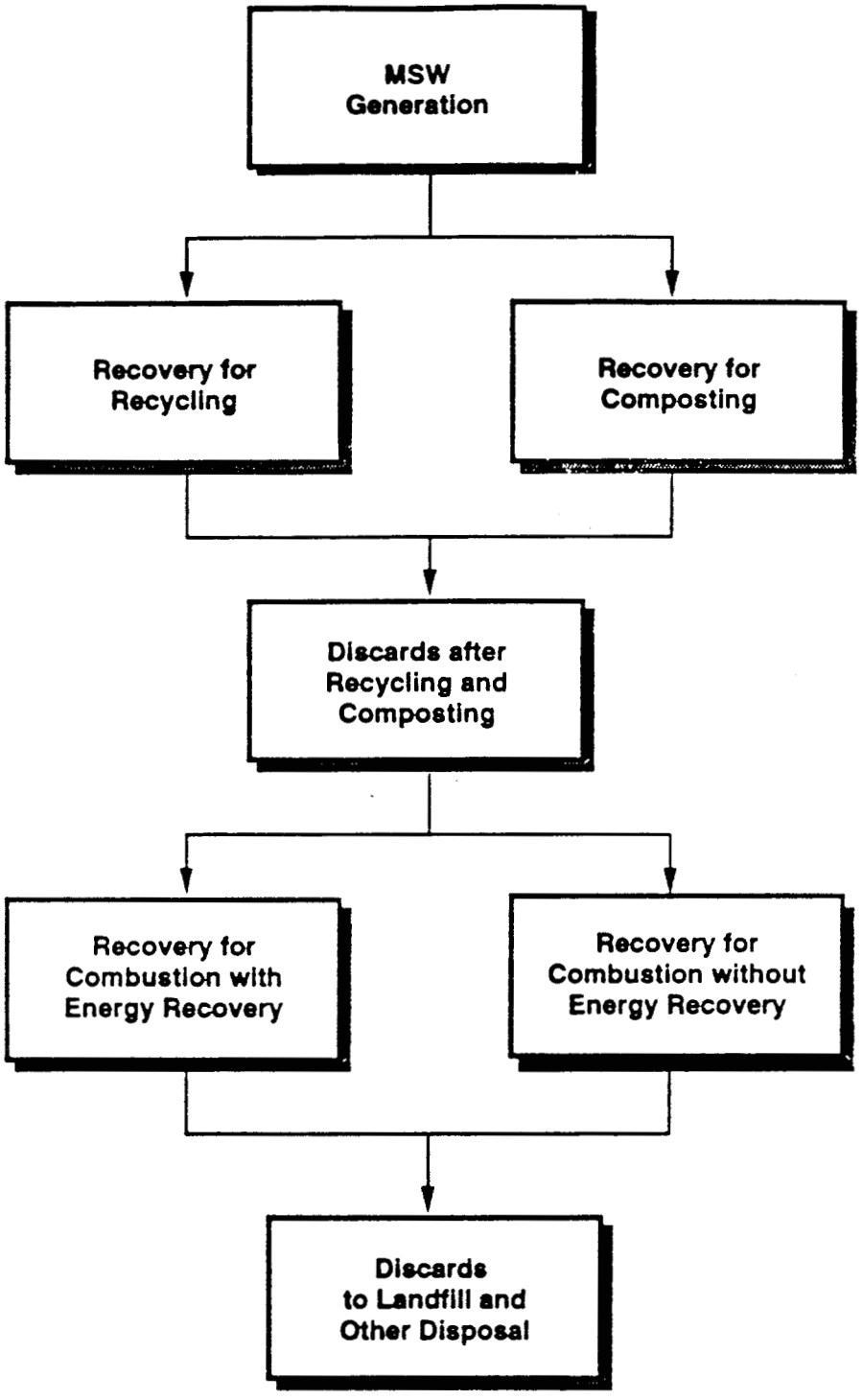


Figure A-2. Material flows methodology for estimating recovery and discards of municipal solid waste.

Appendix B

RECOVERY SCENARIOS, 1995 AND 2000

Appendix B

RECOVERY SCENARIOS, 1995 AND 2000

Because of the rapidly changing situation and uncertainty in the available data, projections of materials recovery were made in scenarios that could achieve different rates of recovery in 1995 and 2000. Scenarios were developed for total MSW recovery rates of 20, 25, and 30 percent in 1995, and for 25, 30, and 35 percent recovery rates in 2000. These scenarios are based on recovery of postconsumer MSW and do not include industrial scrap. Also, composting of only yard wastes is including in these scenarios; estimates of composting of mixed MSW were not made for this report.

The recovery scenarios developed for this report describe sets of conditions that could achieve the selected range of recovery rates. The scenarios are not intended to predict exact recovery rates for any particular material; there are many ways in which a selected overall recovery rate could be achieved.

Discussion of Assumptions

Some general assumptions and principles were used in making the recovery estimates:

- Recovery includes both recovery for recycling and for composting. Recovery does not always equal recycling, however, and residues left after composting or recycling are not accounted for.

- It was assumed that local, state, and federal agencies will continue to emphasize recycling and composting as MSW management alternatives.

- It was assumed that there will not be a nationwide deposit law for beverage containers, but that the present state deposit laws will remain in place.

- It was assumed that affected industries will continue to emphasize recovery and recycling programs, and will make the necessary investments to achieve higher recycling rates.

- It was assumed that the current trend toward banning certain yard wastes in landfills will continue, providing stimulus for composting programs and for source reduction of yard wastes by citizens.

- Based on the preceding assumptions, most U.S. citizens will have access to recovery options in 1995, which will often, in fact, be mandated.

- These options will include curbside collection, dropoff and buyback centers, and, in some instances, mixed waste processing facilities. Recovery will continue to increase between 1995 and 2000 as more recovery systems come on-line.

- In spite of the factors encouraging more recovery as enumerated above, many areas of the U.S. are thinly populated and/or remote from ready markets for recovered materials; many of these areas also have adequate landfill capacity. Therefore, the overall recovery rate for the entire country may not reflect the rates achieved in communities where conditions are favorable for recycling and composting.

The ranges of recovery assumptions for the various materials in MSW are shown in Table B-1 for 1995 and Table B-2 for 2000. Assumed recovery rates for both 1995 and 2000 were based on existing recovery rates in 1990, with projected growth that seemed reasonably achievable nationwide. Projections for each product in MSW were made separately, and the results were aggregated, with some minor adjustments to achieve the three selected scenarios for each year. Assumptions as to the projected recovery rates for specific products and materials were made in ranges. It is certainly possible (indeed, probable) that any given material will be recovered at higher or lower rates than those given here, but the scenarios illustrate how the selected recovery rates could be reached.

Table B-1

SCENARIOS FOR RECOVERY* OF MSW, 1995
(In millions of tons and percent of generation)

Products	Generation	20% Recovery		25% Recovery		30% Recovery	
		Tons	%	Tons	%	Tons	%
Durable Goods							
Major Appliances (ferrous metals only)	2.5	1.1	45.0	1.5	60.0	1.8	70.0
Rubber Tires (rubber only)	2.0	0.2	10.0	0.3	15.0	0.4	20.0
Batteries, lead acid							
Nonferrous metals	1.0	1.0	95.0	1.0	97.0	1.0	98.0
Plastics	0.1	0.1	92.0	0.1	95.0	0.1	96.0
Misc. Durables (ferrous metals only)	4.4	0.2	5.0	0.4	10.0	0.7	15.0
Other Durables	20.3	0.9	4.4	1.0	4.9	1.1	5.5
Total Durable Goods	30.3	3.5	11.5	4.3	14.2	5.0	16.6
Nondurable Goods							
Newspapers	14.1	6.3	45.0	7.1	50.0	7.8	55.0
Books	1.1	0.1	10.0	0.2	18.0	0.3	25.0
Magazines	3.3	0.8	25.0	1.0	30.0	1.2	35.0
Office Papers	7.5	2.6	35.0	3.0	40.0	3.4	45.0
Telephone Books	0.6	0.1	15.0	0.2	25.0	0.2	35.0
Third Class Mail	4.2	0.2	4.0	0.4	10.0	0.8	20.0
Other Commercial Printing	5.9	0.6	10.0	1.2	20.0	1.5	25.0
Textiles, Footwear	5.0	0.3	5.0	0.4	7.0	0.8	15.0
Other Nondurables	16.8	0.0	0.1	0.0	0.3	0.1	0.4
Total Nondurable Goods	58.6	11.0	18.8	13.4	22.9	15.9	27.2
Containers and Packaging							
Glass Containers							
Beer & Soft Drink Bottles	5.7	2.0	35.0	2.3	40.0	2.6	45.0
Other Glass Containers	6.4	0.7	11.3	1.2	18.3	1.7	26.6
Total Glass Packaging	12.1	2.7	22.4	3.5	28.5	4.3	35.2
Steel Containers							
Beer & Soft Drink Cans	0.1	0.1	45.0	0.1	50.0	0.1	55.0
Food and Other Cans	2.4	1.1	45.0	1.2	50.0	1.3	55.0
Other Steel Packaging	0.2	0.0	3.0	0.0	5.0	0.0	10.0
Total Steel Packaging	2.7	1.1	42.1	1.3	46.8	1.4	51.8
Aluminum Packaging							
Beer & Soft Drink Cans	1.7	1.0	60.0	1.2	67.0	1.2	70.0
Other Cans	0.1	0.0	15.0	0.0	30.0	0.0	30.0
Other Aluminum Packaging	0.4	0.0	5.0	0.0	10.0	0.1	15.0
Total Aluminum Packaging	2.2	1.1	49.0	1.2	55.9	1.3	59.1
Paper & Paperboard Packaging							
Corrugated Containers	25.3	12.1	48.0	13.2	52.0	13.9	55.0
Other Packaging	9.0	0.2	20.0	2.2	25.0	2.7	30.0
Total Paper & Board Pkg	34.3	12.3	36.0	15.4	44.9	16.6	48.5
Plastics Packaging							
Soft Drink Bottles	0.6	0.2	35.0	0.2	40.0	0.3	45.0
Milk Bottles	0.5	0.0	10.0	0.1	20.0	0.1	25.0
Other Containers	2.8	0.1	5.0	0.3	10.0	0.4	15.0
Other Plastics Packaging	4.9	0.1	3.0	0.2	5.0	0.5	10.0
Total Plastics Packaging	8.7	0.5	6.1	0.8	9.6	1.3	14.6
Wood Packaging	8.9	0.4	5.0	0.9	10.0	1.3	15.0
Other Misc. Packaging	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Total Containers & Packaging	69.1	18.2	26.4	23.1	33.4	26.2	37.9
Total Product Wastes*	158.0	32.8	20.7	40.8	25.8	47.1	29.8
Other Wastes							
Yard Trimmings	33.7	8.8	26.0	11.1	33.0	15.2	45.0
Food, Other	16.2	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL MSW	207.9	41.5	20.0	51.9	25.0	62.3	30.0

* Does not include recovery for mixed waste composting.

** Other than food products.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Table B-2

SCENARIOS FOR RECOVERY* OF MSW, 2000
(In millions of tons and percent of generation)

Products	Generation	25% Recovery		30% Recovery		35% Recovery	
		Tons	%	Tons	%	Tons	%
Durable Goods							
Major Appliances (ferrous metals only)	2.7	1.7	65.0	1.9	70.0	2.1	80.0
Rubber Tires (rubber only)	2.1	0.3	15.0	0.4	20.0	0.2	10.0
Batteries, lead acid							
Nonferrous metals	1.1	1.1	95.0	1.1	98.0	1.1	98.0
Plastics	0.1	0.1	95.0	0.1	98.0	0.1	98.0
Misc. Durables (ferrous metals only)	4.0	0.4	10.0	0.6	15.0	0.8	20.0
Other Durables	23.8	1.0	4.4	1.3	5.6	2.1	8.9
Total Durable Goods	33.8	4.6	13.8	5.4	16.1	6.5	19.2
Nondurable Goods							
Newspapers	15.1	7.1	47.0	7.9	52.0	8.5	56.0
Books	1.2	0.2	15.0	0.3	25.0	0.4	35.0
Magazines	3.8	1.1	30.0	1.3	35.0	1.5	40.0
Office Papers	8.1	2.8	35.0	3.4	42.0	4.2	52.0
Telephone Books	0.7	0.2	35.0	0.3	40.0	0.3	45.0
Third Class Mail	4.6	0.5	12.0	0.9	20.0	1.1	25.0
Other Commercial Printing	6.5	1.3	20.0	2.0	30.0	2.6	40.0
Textiles, Footwear	5.7	0.4	7.0	0.6	10.0	0.9	15.0
Other Nondurables	18.9	0.0	0.1	0.1	0.4	0.1	0.6
Total Nondurable Goods	64.4	13.7	21.3	16.6	25.8	19.6	30.4
Containers and Packaging							
Glass Containers							
Beer & Soft Drink Bottles	5.6	2.2	40.0	2.8	50.0	3.1	55.0
Other Glass Containers	6.4	1.6	24.8	1.9	29.8	2.2	34.8
Total Glass Packaging	11.9	3.8	31.9	4.7	39.2	5.3	44.2
Steel Containers							
Beer & Soft Drink Cans	0.1	0.1	55.0	0.1	60.0	0.1	65.0
Food and Other Cans	2.3	1.1	50.0	1.3	55.0	1.4	60.0
Other Steel Packaging	0.2	0.0	1.0	0.0	5.0	0.0	10.0
Total Steel Packaging	2.6	1.2	46.8	1.3	51.7	1.5	56.7
Aluminum Packaging							
Beer & Soft Drink Cans	2.0	1.3	65.0	1.4	70.0	1.5	75.0
Other Cans	0.1	0.0	30.0	0.0	35.0	0.0	40.0
Other Aluminum Packaging	0.4	0.0	10.0	0.1	15.0	0.1	20.0
Total Aluminum Packaging	2.5	1.4	54.8	1.5	59.8	1.6	64.8
Paper & Paperboard Packaging							
Corrugated Containers	27.0	14.0	52.0	15.4	57.0	16.2	60.0
Other Packaging	9.2	0.8	9.0	2.3	25.0	1.4	15.0
Total Paper & Board Pkg	36.2	14.9	41.1	17.7	48.9	17.6	48.6
Plastics Packaging							
Soft Drink Bottles	0.7	0.3	45.0	0.3	50.0	0.4	55.0
Milk Bottles	0.5	0.2	30.0	0.2	35.0	0.2	40.0
Other Containers	3.5	1.0	30.0	1.2	35.0	1.4	40.0
Other Plastics Packaging	6.0	0.3	5.7	0.7	11.2	0.9	14.4
Total Plastics Packaging	10.7	1.8	17.3	2.4	22.5	2.8	26.5
Wood Packaging	10.6	0.8	8.0	1.3	12.0	1.7	16.0
Other Misc. Packaging	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Total Containers & Packaging	74.7	23.9	32.0	28.9	38.6	30.5	40.8
Total Product Waste*	172.9	42.3	24.5	50.9	29.5	56.5	32.7
Other Wastes							
Yard Trimmings	32.9	13.2	40.0	15.8	48.0	21.1	64.0
Food, Other	16.3	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL MSW	222.1	55.5	25.0	66.7	30.0	77.6	34.9

* Does not include recovery for mixed waste composting.

** Other than food products.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Appendix C

RESIDENTIAL/COMMERCIAL FRACTIONS OF MUNICIPAL SOLID WASTE

Appendix C

RESIDENTIAL/COMMERCIAL FRACTIONS OF MUNICIPAL SOLID WASTE

The material flows methodology does not lend itself well to a distinction as to sources of the materials because the data used are national in scope. For this report, however, a first effort to classify municipal solid waste into residential and commercial fractions was made. The classifications are subject to later revision as more data become available.

For purposes of this classification, residential waste was considered to come from both single family and multi-family residences. This is somewhat contrary to a common practice in MSW management to classify wastes collected from apartment buildings as commercial. The rationale used for this report is that the nature of residential waste is basically the same whether it is generated in a single or multi-family residence. (Yard trimmings are probably the primary exception, and this was taken into account.) Because of this approach, the percentage of residential waste shown here is higher than that often reported by waste haulers.

Commercial wastes for the purpose of this classification include MSW from retail and wholesale establishments; hotels; office buildings; airports and train stations; hospitals, schools, and other institutions; and similar sources. No industrial process wastes are included, but normal MSW such as packaging, cafeteria and washroom wastes, and office wastes from industrial sources are included. Construction and demolition wastes, sludges, ashes, automobile bodies, and other Subtitle D wastes are not included.

The classification of MSW generation into residential and commercial fractions was made on a product-by-product basis, as shown in Table C-1. The 1990 tonnage generation of each product (from Chapter 2) was allocated to residential or commercial sources on a "best judgment" basis; then the totals were aggregated. Sampling studies were consulted where applicable, although available data on residential/commercial sorting of waste are limited. These are estimates for the nation as a whole, and should not be taken as representative of any particular region of the country.

Also, while this appendix contains estimates for each component of MSW by source, there is substantial uncertainty associated with the individual estimates. For this reason, the report provides final estimates for commercial and residential MSW in a range, and encourages the use of this range rather than a point estimate. A reasonable range for residential wastes would be 55 to 65 percent of total MSW generation, while commercial wastes probably range between 35 to 45 percent of total generation.

Table C-1
WORKSHEET FOR ESTIMATES OF
RESIDENTIAL/COMMERCIAL FRACTIONS OF MSW, 1990

	1990 Generation Million tons	Residential		Commercial	
		Percent	Tons	Percent	Tons
Durable Goods					
Major Appliances	2.8	95	2.7	5	0.1
Furniture and Furnishings	7.4	80	5.9	20	1.5
Carpets and Rugs	1.7	80	1.4	20	0.3
Rubber Tires	1.8	5	0.1	95	1.7
Batteries, lead acid	1.7	5	0.1	95	1.6
Miscellaneous Durables	12.5	80	10.0	20	2.5
Total Durable Goods	**27.9**		20.1		7.8
Nondurable Goods					
Newspapers	12.9	90	11.6	10	1.3
Books	1.0	80	0.8	20	0.2
Magazines	2.8	65	1.8	35	1.0
Office Papers	6.4	25	1.6	75	4.8
Telephone Books	0.5	60	0.3	40	0.2
Third Class Mail	3.8	65	2.5	35	1.3
Other Commercial Printing	5.5	65	3.6	35	1.9
Tissue Paper and Towels	3.2	60	1.9	40	1.3
Paper Plates and Cups	0.7	20	0.1	80	0.6
Plastic Plates and Cups	0.3	20	0.1	80	0.2
Trash Bags	0.8	95	0.8	5	0.0
Disposable Diapers	2.6	90	2.3	10	0.3
Other Nonpackaging Paper	3.8	50	1.9	50	1.9
Clothing and Footwear	3.7	60	2.2	40	1.5
Towels, Sheets and Pillowcases	1.0	90	0.9	10	0.1
Other Miscellaneous Nondurables	3.2	50	1.6	50	1.6
Total Nondurable Goods	**52.3**		34.0		18.2
Containers and Packaging					
Glass Packaging					
Beer and Soft Drink Bottles	5.7	80	4.6	20	1.1
Wine and Liquor Bottles	2.1	80	1.7	20	0.4
Food and Other Bottles & Jars	4.1	85	3.5	15	0.6
Total Glass Packaging	**11.9**		9.7		2.2
Steel Packaging					
Beer and Soft Drink Cans	0.1	80	0.1	20	0.0
Food and Other Cans	2.5	85	2.2	15	0.4
Other Steel Packaging	0.2	5	0.0	95	0.2
Total Steel Packaging	**2.9**		2.3		0.6
Aluminum Packaging					
Beer and Soft Drink Cans	1.6	80	1.3	20	0.3
Other Cans	0.0	50	0.0	50	0.0
Foil and Closures	0.3	90	0.3	10	0.0
Total Aluminum Packaging	**1.9**		1.5		0.4

(continued on next page)

Table C-1 (continued)
WORKSHEET FOR ESTIMATES OF
RESIDENTIAL/COMMERCIAL FRACTIONS OF MSW, 1990

	1990 Generation Million tons	Residential		Commercial	
		Percent	Tons	Percent	Tons
Paper & Paperboard Pkg					
Corrugated Boxes	23.9	10	2.4	90	21.5
Milk Cartons	0.5	50	0.3	50	0.3
Folding Cartons	4.3	60	2.6	40	1.7
Other Paperboard Packaging	0.3	50	0.1	50	0.1
Bags and Sacks	2.4	90	2.2	10	0.2
Wrapping Papers	0.1	90	0.1	10	0.0
Other Paper Packaging	1.0	70	0.7	30	0.3
Total Paper & Board Pkg	**32.6**		8.4		24.2
Plastics Packaging					
Soft Drink Bottles	0.4	80	0.3	20	0.1
Milk Bottles	0.4	95	0.3	5	0.0
Other Containers	1.8	80	1.5	20	0.4
Bags and Sacks	0.9	90	0.8	10	0.1
Wraps	1.5	80	1.2	20	0.3
Other Plastics Packaging	1.9	80	1.5	20	0.4
Total Plastics Packaging	**7.0**		5.7		1.2
Wood Packaging	7.9	0	0.0	100	7.9
Other Misc. Packaging	0.2	70	0.1	30	0.1
Total Containers & Pkg	**64.4**		27.9		36.6
Total Product Wastes	**144.6**		82.0		62.5
Other Wastes					
Food Wastes	13.2	50	6.6	50	6.6
Yard Trimmings	35.0	90	31.5	10	3.5
Miscellaneous Inorganic Wastes	2.9	50	1.5	50	1.5
Total Other Wastes	**51.1**		39.6		11.6
Total MSW Generated	**195.7**	62	**121.6**	38	**74.1**
Range		55-65		35-45	

Source: Franklin Associates, Ltd.

United States
Environmental Protection
Agency

Solid Waste and
Emergency Response
(OS-305)

EPA/530-SW-91-024
July 1992

Office of Solid Waste

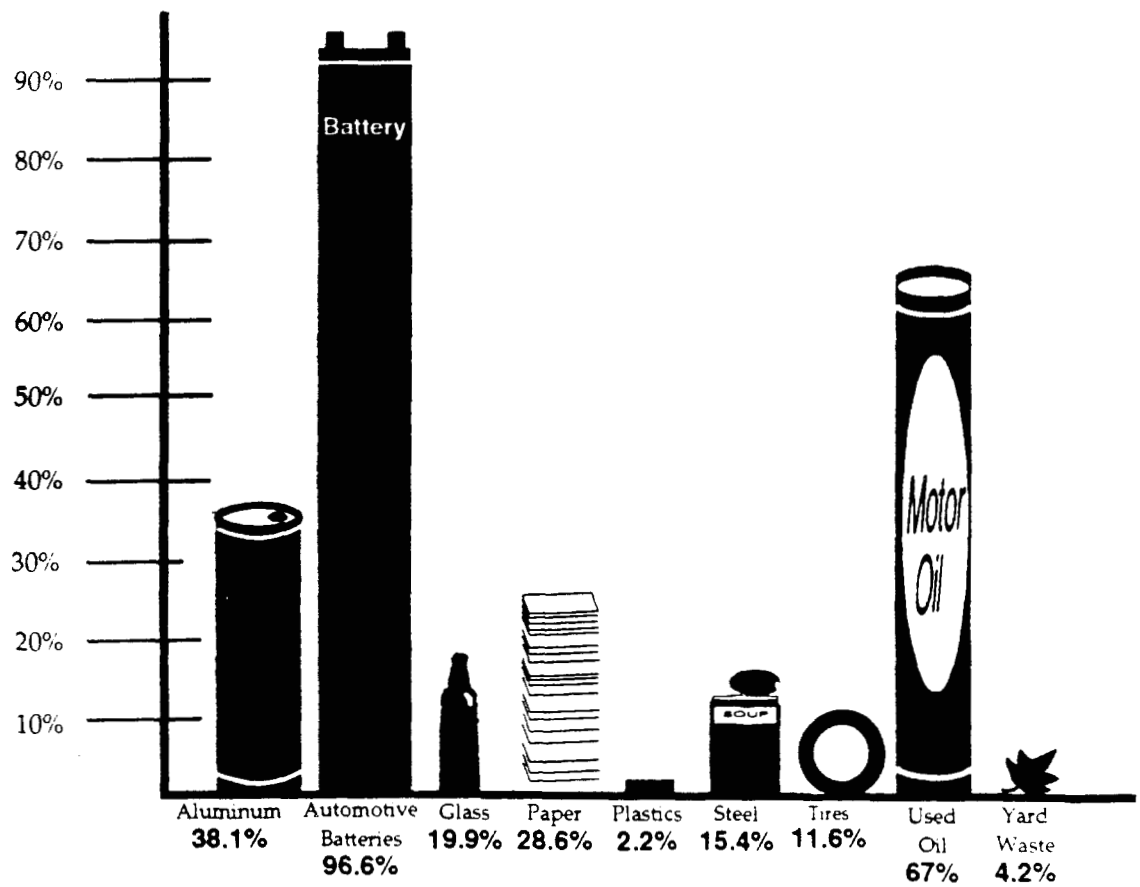
EPA

Environmental Fact Sheet

Recycling Municipal Solid Waste: Facts and Figures

In the United States, we generate approximately 195 million tons of municipal solid waste (MSW) annually—an average of 4.3 pounds per person per day. To safely and effectively manage all of this trash, communities across the nation are using "integrated waste management systems," which combine source reduction, recycling, combustion, and landfilling to manage waste. Recycling, including composting, is a key component of many integrated waste management systems. EPA has challenged the nation to reduce and recycle at least 25 percent of MSW (in 1990, the nation's overall recycling rate was just over 17 percent). Many communities have far exceeded the national goal. This fact sheet describes nine of the primary components of the MSW stream, along with their generation rate, the percentage of the MSW stream they comprise, and their recovery rate.

Recovery Rates for Major MSW Components



Aluminum

Generation: A total of 2.7 million tons of aluminum waste are generated annually. Aluminum containers and packaging, such as soft drink and beer cans, contribute 1.9 million tons.

Percent: Aluminum makes up 1.4 percent of the total MSW generated annually.

Recovery: Fifty-four percent of all aluminum containers and packaging are recycled. The overall recycling rate for aluminum is 38.1 percent.

The markets for scrap aluminum are strong. Aluminum has a high market value, and aluminum cans supply a large percentage of the income for many municipal recycling programs. Almost all the aluminum collected is used to make new cans.

Automotive Batteries

Generation: About 1.5 million tons of used automotive (lead-acid) batteries are generated annually. In addition, many of the 2.5 billion household batteries purchased each year are discarded into the MSW stream.

Percent: Batteries constitute less than 1 percent of the MSW stream.

Recovery: About 96 percent of automotive batteries are recycled each year.

Although automotive batteries constitute a small portion of the MSW stream, they contain metals that may be a concern when disposed of in landfills and combustors. All three components of automotive batteries are recyclable: the lead, the acid, and the plastic casing. Retailers often accept used automotive batteries that manufacturers recycle into new batteries.

Glass

Generation: Approximately 13.2 million tons of glass waste are generated annually. Food and beverage containers make up over 90 percent of this amount; the remaining 10 percent comes from products like cookware and glassware, home furnishings, and plate glass.

Percent: Glass constitutes 6.7 percent of the MSW stream.

Recovery: About 22 percent of all glass beverage containers are recycled. Glass has an overall recovery rate of 19.9 percent.

Glass manufacturers typically use 30 percent crushed glass (known as "cullet") along with raw materials to make new glass. Cullet also can be used as an aggregate in road building.

Paper and Paperboard

Generation: Nearly 73.3 million tons of paper and paperboard waste are generated annually.

Percent: Paper and paperboard constitute the largest portion of the MSW stream, representing 37.5 percent.

Recovery: Paper has an overall recycling rate of 28.6 percent. About 48 percent of corrugated boxes, 42.5 percent of newspapers, 10.3 percent of books, 10.7 percent of magazines, and 26.5 percent of office papers are currently recycled.

At times, market supply for some recovered paper products, such as newsprint, has exceeded the capacity of mills to use the materials. Markets for recycled paper products, however, are generally stable and expanding as more mills build new deinking facilities to process waste paper and as the demand for recycled paper products grows. Significant new capacity will be on line by 1994. Paper is recycled into paper products, paperboard products, and construction products.

Plastics

Generation: Over 16 million tons of plastic waste are generated annually.

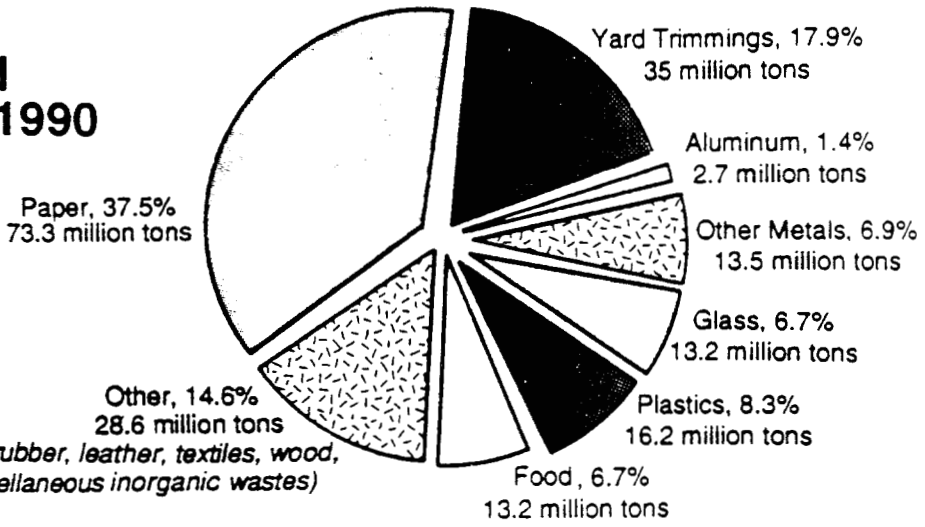
Percent: Plastics comprise 8.3 percent of the total MSW stream.

Recovery: About 2.2 percent of all plastics are currently recycled, with plastic soda bottles being the most commonly recycled product (more than 31.5 percent are recovered).

Plastics' share of the waste stream is growing by weight and volume. Most plastics that end up in the waste stream are from packaging and containers. Plastics recycling has increased dramatically over the past 2 years. Products made from recycled plastic include drainage pipes, toys, carpet, filler for pillows and sleeping bags, and cassette casings. While accounting for only about 8 percent of the MSW stream by weight, plastics make up over 20 percent of the total waste stream by volume.

Materials Generated in MSW by Weight, 1990

Total Weight = 195.7 Million Tons



Steel

Generation: About 12.3 million tons of steel waste are generated annually.

Percent: Steel constitutes 6.3 percent of the MSW stream.

Recovery: Overall, about 15.4 percent of steel in MSW is recycled. Over 22 percent of steel cans are recycled. Much greater amounts of steel are recovered; however, these steel products (e.g., junked cars, steel girders) are usually not considered MSW.

Demand for steel scrap is growing as steelmakers are using more steel scrap to produce new steel products and less scrap is being produced within the steel making process. Some steel foundries are also beginning to use steel cans as a source of new raw materials.

Tires

Generation: Approximately 1.6 million tons of rubber tires (or 240 million scrap tires— about 1 tire per person) are generated annually.

Percent: Tires make up about 1.8 percent of the MSW stream.

Recovery: Annually, 11.6 percent of scrap tires are recycled.

Scrap used tires are difficult to dispose of in landfills and waste combustors. An estimated 2 to 3 billion are currently stockpiled. These stockpiles can provide convenient habitats for rodents, serve as breeding grounds for mosquitos, and pose fire hazards. Of the scrap tires that are utilized, most are burned for energy. Scrap tires also are used for rubberized asphalt paving, molded rubber products, and athletic surfaces.

Used Oil

Generation: Over 1.3 billion gallons of used oil are generated yearly.

Percent: Used oil makes up less than 1 percent of the MSW stream.

Recovery: Sixty-seven percent of all used oil is recovered (900 million gallons). Only 10 percent of the amount generated by people who change their own motor oil is returned to collection programs.

If disposed of improperly (i.e., poured down sewage drains), used oil can contaminate soil, ground water, and surface water. Many state and local governments are taking steps to ensure the safe and effective management of used oil. In some communities, used motor oil is collected at service stations, corporate or municipal collection sites, or at the curbside.

Yard Trimmings

Generation: Thirty-five million tons of yard trimmings (including grass, leaves, and tree and brush trimmings) are generated annually.

Percent: Yard trimmings make up 17.9 percent of the MSW stream.

Recovery: Each year, 4.2 percent of the yard trimmings produced are composted.

Yard trimmings can be transformed into compost for homeowners, farmers, public agencies, landscapers, and nurseries. Grass clippings can be beneficial when left on the lawn.

For More Information

This fact sheet and the resources listed below are available to the public, free of charge, by calling the RCRA Hotline at (800) 424-9346, or, for the hearing impaired, TDD (800) 553-7672.

Characterization of Municipal Solid Waste in the United States: 1992 Update—Executive Summary	EPA530-S-92-019
Characterizing Municipal Solid Waste: Facts & Figures	EPA530-F-92-019
Decision-Makers Guide to Solid Waste Management (Vol. 1)	EPA/530-SW-89-072
The Facts About Plastics in the Marine Environment	EPA/530-SW-90-017B
The Facts on Degradable Plastics	EPA/530-SW-90-017D
The Facts on Recycling Plastics	EPA/530-SW-90-017E
How to Set Up a Local Program to Recycle Used Oil	EPA/530-SW-89-039A
Methods to Manage and Control Plastic Wastes—Executive Summary	EPA/530-SW-89-051A
Plastics: The Facts About Production, Use, and Disposal	EPA/530-SW-90-017A
Plastics: The Facts on Source Reduction	EPA/530-SW-90-017C
Recycle: You Can Make a Ton of Difference	EPA530-F-92-003
Recycling Used Oil: 10 Steps to Change Your Oil	EPA/530-SW-89-039C
Recycling Used Oil: For Service Stations and Other Vehicle-Service Facilities	EPA/530-SW-89-039D
Recycling Used Oil: What Can You Do?	EPA/530-SW-89-039B
Recycling Works! State and Local Solutions to Solid Waste Management Problems	EPA/530-SW-89-014

The following EPA publications are available for a fee from the National Technical Information Service (NTIS). Call (703) 487-4650.

Characterization of Municipal Solid Waste in the United States: 1992 Update	PB92-207 166
Methods to Manage and Control Plastic Wastes	PB90-163 106
Office Paper Recycling: An Implementation Manual	PB90-199 431
Yard Waste Composting: A Study of Eight Programs	PB90-163 114

Source of data for this fact sheet: U.S. EPA's *Characterization of Municipal Solid Waste in the United States: 1992 Update*. Office of Solid Waste and Emergency Response. Data are from 1990.

United States Environmental Protection Agency | Solid Waste and Emergency Response (OS-305) | EPA/530-F-92-019 June 1992

Office of Solid Waste

EPA

Environmental Fact Sheet

Characterizing Municipal Solid Waste: Facts and Figures

EPA recently released the 1992 Update to its report "Characterization of Municipal Solid Waste in the United States." MSW refers to waste generated by commercial and household sources that is typically collected and disposed in municipal solid waste facilities. The report presents information from 1960 to 1990 on waste generation, disposal, combustion, and recovery through composting and recycling. This fact sheet highlights some of the report's key findings reflecting national approximations and projections.

The Current Picture

Recycling Makes Large Gains

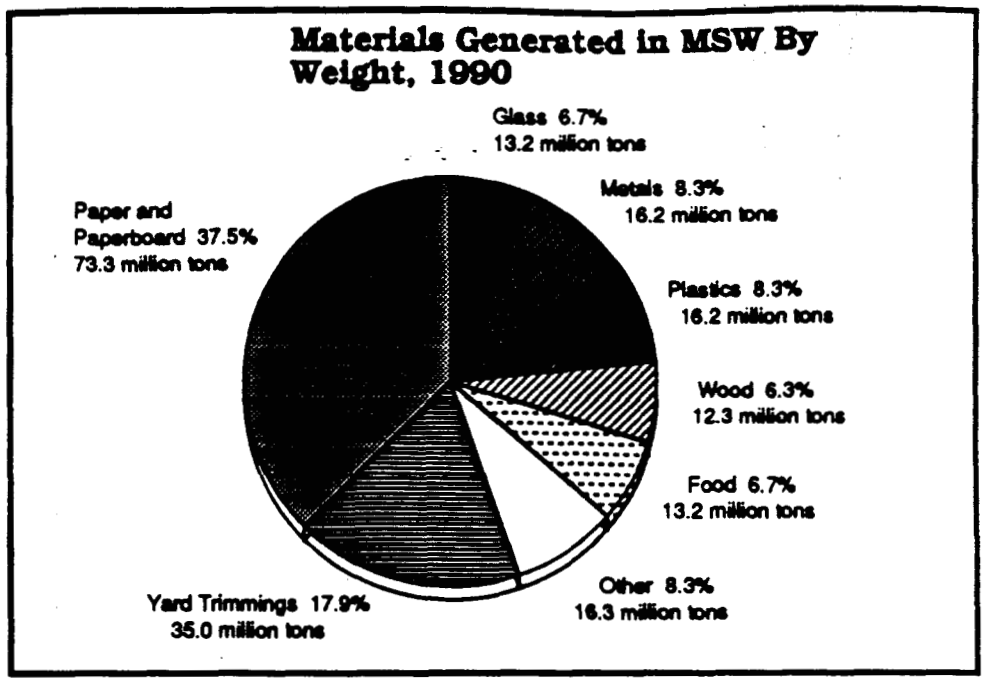
In 1990, Americans generated 195 million tons of municipal solid waste, an eight percent increase over 1988. Of this total, 33 million tons were recovered for recycling or composting, representing a 17 percent recycling rate in 1990. This compares to a 13 percent rate in 1988. The amount of yard debris that was collected for composting increased dramatically, from 2 percent of yard debris in 1988 to 12 percent in 1990. The net result is that between 1985 and 1990, the amount of material recovered annually from MSW more than doubled, from 16.4 to 33.4 million tons. Two important factors in these improvements are the efforts of communities to compost yard trimmings and to set up recycling programs, and the efforts of manufacturers to use more recycled materials recovered from MSW.

Waste Generation Rates Also Rising

Despite this good news, Americans are still producing more garbage today than ever before. In 1988, U.S. households, commercial establishments, and institutions generated 180 million tons of MSW, or 4 pounds per person per day (ppd). In 1990, the per capita waste generation rate jumped to 4.3 ppd. So, although Americans recycled more, they also generated and threw away more: evidence that many opportunities for recycling and source reduction still exist. (Simply put, source reduction is waste prevention. It includes many actions that reduce the overall amount or toxicity of waste created.)

MSW Management After Recycling and Composting

In 1990, 16 percent of all MSW was managed by combustion, up from 14 percent in 1988. The amount of MSW landfilled is on the decline, from 73 percent in 1988 to 67 percent in 1990. The study projects an increase in combustion with energy recovery and a continued decrease in landfilling through the 1990s.



This pie chart illustrates the composition of the nation's 1990 waste stream by material type. Composition will likely vary based on local conditions. Figures are based on data from the EPA Report: "Characterization of Municipal Solid Waste in the United States: 1992 Update."

Future Trends

Waste Generation

EPA projects that while the amount of waste generated in the U.S. will continue to increase during the 90's, it will do so at a much slower rate. Per capita waste generation is not expected to reach 4.5 ppd until 2000, in part due to source reduction efforts. As additional source reduction initiatives build on progress through activities like backyard composting, reduction of packaging materials, and production of more durable products, we may be able to actually reduce the per capita rate. However, a wide range of variables affect waste generation rates, including cultural and demographic changes, shifts in work patterns, the economy, technical innovations and efforts in source reduction. The number of variables make overall waste generation patterns difficult to predict.

Recycling

EPA's MSW report also develops several possible recycling scenarios for the years 1995 and 2000. These scenarios project recycling rates of 20 - 30 percent in 1995 and 25 - 35 percent in 2000. To achieve the highest projected rates, affected industries would need to continue to invest in plants and equipment to utilize recovered materials; the growth in yard debris composting would also need to continue; most citizens would need access to recycling programs; and secondary materials markets would have to continue to grow.

For More Information

The information in this Fact Sheet is based on the EPA report *Characterization of Municipal Solid Waste in the United States: 1992 Update.* For a free copy of this report's executive summary, call the RCRA Hotline, toll free, at (800) 424-9346, or TDD (800) 553-7672, for the hearing impaired. In the Washington, D.C. area, the number is (703) 920-9810 or TDD (703) 486-3323. Copies of the entire report are available for a charge through the National Technical Information Service by calling (703) 486-3323.