Municipal Solid Waste in The United States: 2000 Facts and Figures

Generation

Reduction

Disposal

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CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES: 2000 UPDATE

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EXECUTIVE SUMMARY

OVERVIEW

This report describes the national municipal solid waste (MSW) stream based on data collected for 1960 through 2000. The historical perspective is useful for establishing trends in types of MSW generated and in the ways it is managed. In this Executive Summary, we briefly describe the methodology used to characterize MSW in the United States and provide the latest facts and figures on MSW generation, recycling, and disposal.

In the United States, we generated approximately 231.9 million tons of MSW in 2000—an increase of 0.9 million tons from 1999.* This is an increase of only 0.3 percent from 1999 to 2000. Excluding composting, the amount of MSW recycled increased to 53.4 million tons, an increase of 3.3 million tons from 1999. This is a 6.6 percent increase in the tons recycled. The tons recovered for recycling (including composting) rose to 69.9 million tons in 2000, up from 64.8 million tons in 1999. The recovery rate for recycling (including composting) was 30.1 percent in 2000, up from 28.1 percent in 1999. (See Tables ES-1 and ES-2 and Figures ES-1 and ES-2.)

MSW generation in 2000 declined to 4.5 pounds per person per day.** The recycling rate in 2000 was 1.4 pounds per person per day. Discards after recycling declined to 3.2 pounds per person per day in 2000 (Table ES-3).

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* Data shown for 1999 have been adjusted to reflect the latest revisions and, therefore, may differ slightly from the same measure reported previously. For example, tonnage of MSW generated in 1999 has been revised upward from 229.9 million tons to 231.0 million tons.

** The 2000 generation, recovery and disposal per person values were calculated from 2000 Census data. For data years 1999 and earlier, population estimates based on 1990 Census data were used. Revised Census data for 1999 and earlier years were not available when this Executive Summary was prepared. The population data series revisions will be included in later editions of this report.

Table ES-1
GENERATION, MATERIALS RECOVERY, COMPOSTING,
AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 - 2000
(In millions of tons)

	Millions of tons							
	1960	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Generation	88.1	121.1	151.6	205.2	211.4	223.4	231.0	231.9
Recovery for recycling	5.6	8.0	14.5	29.0	45.3	48.0	50.1	53.4
Recovery for composting*	Neg.	Neg.	Neg.	4.2	9.6	13.1	14.7	16.5
Total Materials Recovery	5.6	8.0	14.5	33.2	54.9	61.1	64.8	69.9
Discards after Recovery	82.5	113.0	137.1	172.0	156.5	162.3	166.2	162.0

* Composting of yard trimmings and food wastes. Does not include mixed MSW composting or backyard composting.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Table ES-2
GENERATION, MATERIALS RECOVERY, COMPOSTING
AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 - 2000
(In pounds per person per day)

	Pounds per person per day							
	1960	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Generation	2.68	3.25	3.66	4.50	4.40	4.52	4.64	4.51
Recovery for recycling	0.17	0.22	0.35	0.64	0.94	0.97	1.01	1.04
Recovery for composting*	Neg.	Neg.	Neg.	0.09	0.20	0.27	0.30	0.32
Total Materials Recovery	0.17	0.22	0.35	0.73	1.14	1.24	1.31	1.36
Discards after Recovery	2.51	3.03	3.31	3.77	3.26	3.29	3.33	3.15
Population (millions)	179.979	203.984	227.255	249.907	263.168	270.561	272.691	281.422

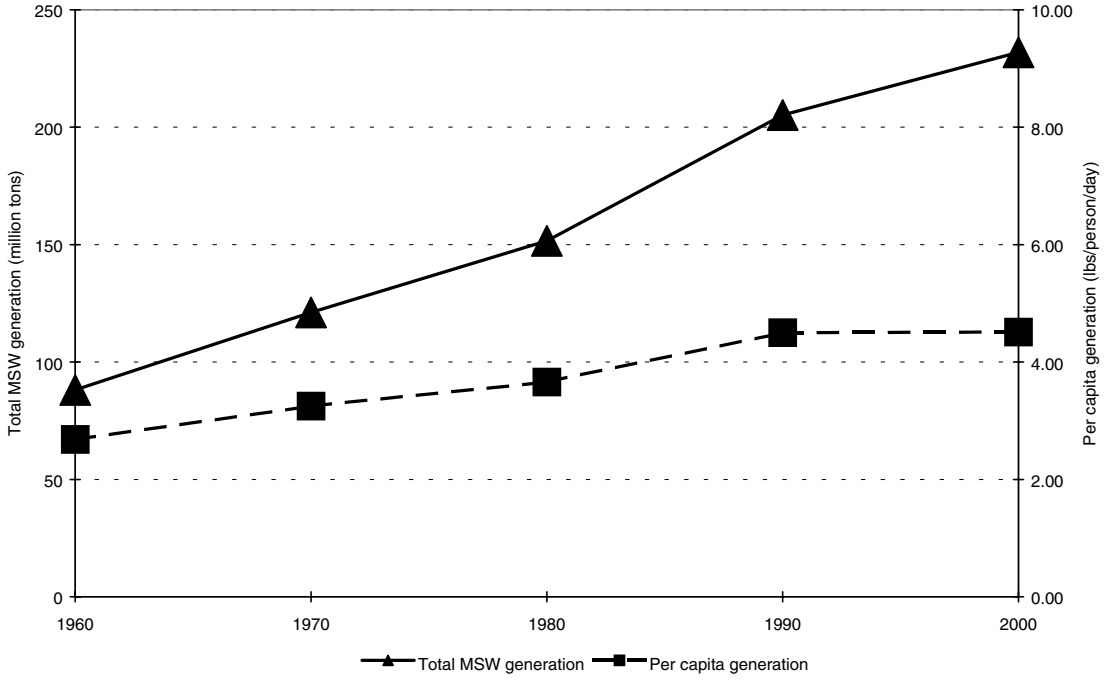
* Composting of yard trimmings and food wastes. Does not include mixed MSW composting or backyard composting.
Details may not add to totals due to rounding.
The per capita discard rate may decline for 1999 and earlier years when revised Census population figures are obtained.
Source: Franklin Associates, Ltd.

Table ES-3
GENERATION, MATERIALS RECOVERY, COMPOSTING,
AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 - 2000
(In percent of total generation)

Percent of total generation								
	1960	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Generation	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Recovery for recycling	6.4%	6.6%	9.6%	14.2%	21.5%	21.5%	21.7%	23.0%
Recovery for composting*	Neg.	Neg.	Neg.	2.0%	4.5%	5.9%	6.4%	7.1%
Total Materials Recovery	6.4%	6.6%	9.6%	16.2%	26.0%	27.4%	28.1%	30.1%
Discards after Recovery	93.6%	93.4%	90.4%	83.8%	74.0%	72.6%	71.9%	69.9%

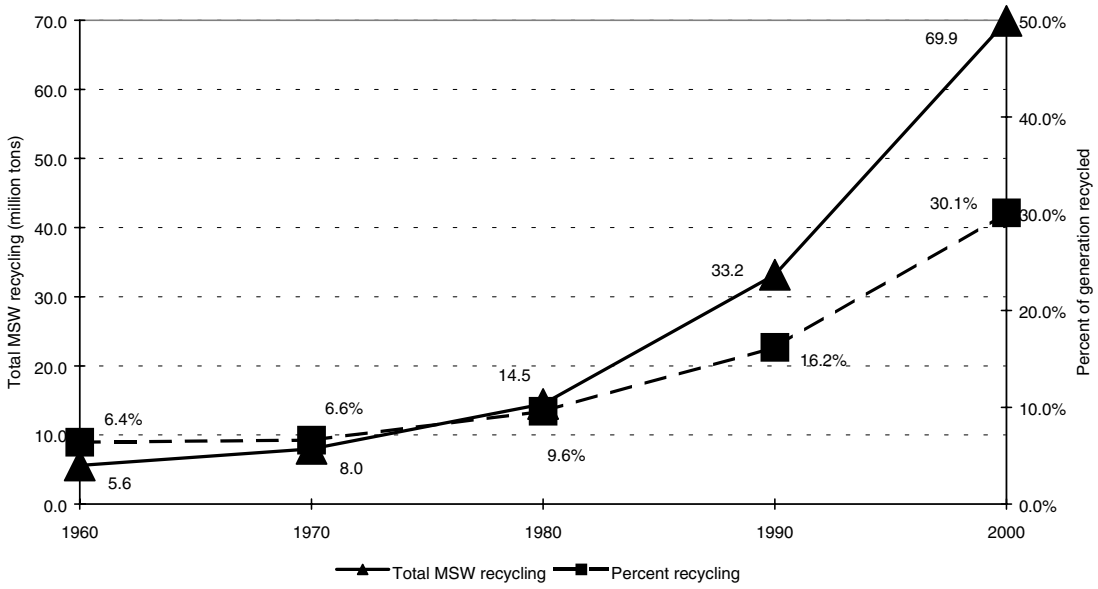
* Composting of yard trimmings and food scraps. Does not include mixed MSW composting or backyard composting.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Figure ES-1: MSW Generation Rates from 1960 to 2000



The state of the economy has a strong impact on consumption and waste generation. Waste generation continued to increase through the 1990s as economic growth continued to be strong. Between 1998 and 1999, paper and paperboard generation increased 4.9 percent. Total MSW generation increased only slightly between 1999 and 2000, and this can be attributed, to a great extent, to a decline in production of paper and paperboard of 1.7 percent.

Figure ES-2: MSW recycling rates from 1960 to 2000



(Paper industry production is very sensitive to economic factors, and 2000 was not a good year for the industry.) At the same time, recovery of products (including paper and paperboard) increased substantially in 2000, and therefore a recycling rate of 30.1 percent was achieved in spite of the slowdown in the economy. The paper and paperboard recovery, as a percent of generation, increased from 40.9 percent to 45.4 percent in 2000. The majority of the increase in recovery came from increased exports in 2000.

WHAT IS INCLUDED IN MUNICIPAL SOLID WASTE?

MSW—otherwise known as trash or garbage—consists of everyday items such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, and batteries. Not included are materials that also may be disposed in landfills, but are not generally considered MSW, such as construction and demolition debris, municipal wastewater treatment sludges, and non-hazardous industrial wastes.

MUNICIPAL SOLID WASTE IN PERSPECTIVE

Trends Over Time

Over the last few decades, the generation, recycling, and disposal of MSW have changed substantially (see Tables ES-1, ES-2, and ES-3 and Figures ES-1 and ES-2). MSW generation has continued to increase from 1960, when it was 88 million tons. The generation rate in 1960 was just 2.7 pounds per person per day; it grew to 3.7 pounds per person per day in 1980; reached 4.5 pounds per person per day in 1990; and it stabilized at 4.5 pounds per person per day in 2000 after increasing through the 1990s.

Over time, recycling rates have increased from 10 percent of MSW generated in 1980 to 16 percent in 1990, to 30 percent in 2000. Disposal has decreased from 90 percent of the amount generated in 1980 to 70 percent of MSW in 2000. This compares to 73 percent in 1999.

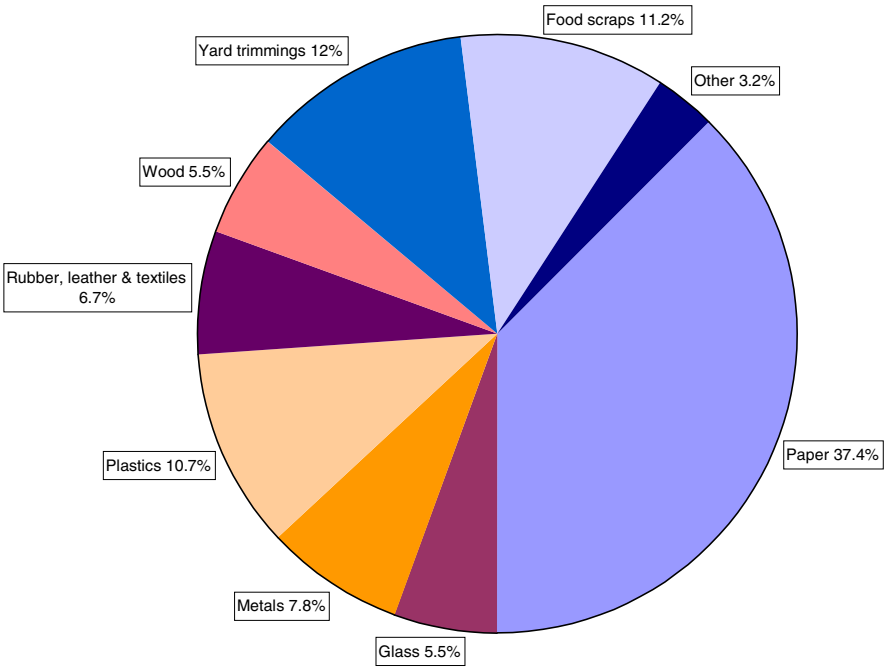
MUNICIPAL SOLID WASTE IN 2000

The U.S. Environmental Protection Agency (EPA) has two ways of analyzing the 231.9 million tons of MSW generated in 2000. The first is by **material** (paper and paperboard, yard trimmings, food scraps, plastics, metals, glass, wood, rubber, leather and textiles, and other); the second is by several major **product** categories. The product-based categories are containers and packaging; nondurable goods (e.g., newspapers) durable goods (e.g., appliances); food scraps; and other materials.

Materials in MSW

A breakdown, by weight, of the MSW **materials** generated in 2000 is provided in Figure ES-3. Paper and paperboard products made up the largest component of MSW generated (37 percent), and yard trimmings comprised the second-largest component (12 percent). Glass, metals, plastics, wood, and food scraps each constituted between 5 and 11 percent of the total MSW generated. Rubber, leather, and textiles combined made up about 7 percent of MSW, while other miscellaneous wastes made up approximately 3 percent of the MSW generated in 2000.

Figure ES-3: 2000 Total MSW Generation - 232 Million Tons (Before Recycling)



A portion of each material category in MSW was recycled or composted in 2000. The highest rates of recovery were achieved with yard trimmings, paper products, and metal products. About 57 percent (15.8 million tons) of yard trimmings were recovered for composting in 2000. This represents nearly a four-fold increase since 1990. About 45 percent (39.4 million tons) of paper and paperboard were recovered for recycling in 2000. Recycling these organic materials alone diverted nearly 24 percent of municipal solid waste from landfills and combustion facilities. In addition, about 6.4 million tons, or about 35 percent, of metals were

recovered for recycling. Recycling rates for all materials categories in 2000 are listed in Table ES-4.

Table ES-4
GENERATION AND RECOVERY OF MATERIALS IN MSW, 2000
(In millons of tons and percent of generation of each material)

	Weight Generated	Weight Recovered	Recovery as a Percent of Generation
Paper and paperboard	86.7	39.4	45.4%
Glass	12.8	2.9	23.0%
Metals			
Steel	13.5	4.6	34.0%
Aluminum	3.2	0.9	27.4%
Other nonferrous metals*	1.4	0.9	66.9%
Total metals	18.0	6.4	35.4%
Plastics	24.7	1.3	5.4%
Rubber and leather	6.4	0.8	12.2%
Textiles	9.4	1.3	13.5%
Wood	12.7	0.5	3.8%
Other materials	4.0	0.9	21.3%
Total Materials in Products	174.7	53.4	30.6%
Other wastes			
Food, other**	25.9	0.7	2.6%
Yard trimmings	27.7	15.8	56.9%
Miscellaneous inorganic wastes	3.5	Neg.	Neg.
Total Other Wastes	57.1	16.5	28.8%
TOTAL MUNICIPAL SOLID WASTE	231.9	69.9	30.1%

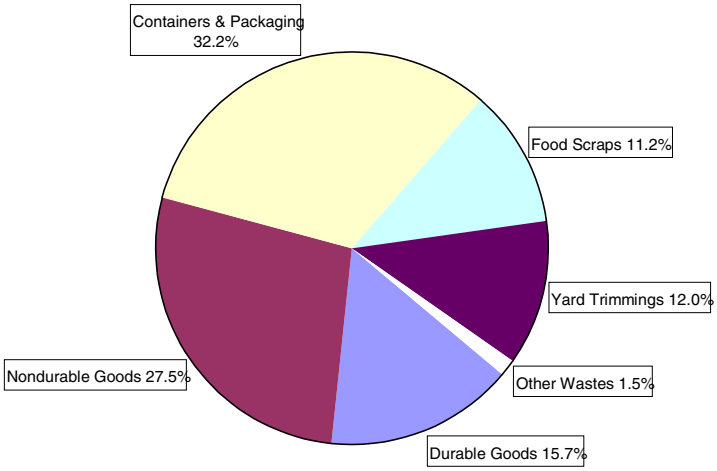
Includes waste from residential, commercial, and institutional sources.
* Includes lead from lead-acid batteries.
** Includes recovery of paper for composting.
Neg. = Less than 50,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Products in MSW

The breakdown, by weight, of **product categories** generated in 2000 is shown in Figure ES-4. Containers and packaging comprised the largest portion of products generated, at 32.2 percent (75 million tons) of total MSW generation. Nondurable goods were the second-largest

fraction, comprising 27.5 percent (64 million tons). The third-largest category of products is durable goods, which comprised 15.7 percent (36 million tons) of total MSW generation.

Figure ES-4: Products Generated in MSW - 2000
(Total Weight = 232 million tons)



The generation and recovery of the product categories in MSW in 2000 is shown in Table ES-5. This table shows that recovery of containers and packaging was the highest of the three product categories – almost 39 percent of containers and packaging generated in 2000 were recovered for recycling. About 55 percent of all aluminum cans were recovered (45 percent of all aluminum packaging, including foil), while 58 percent of steel packaging (mostly cans) was recovered. Paper and paperboard containers and packaging were recovered at a rate of 56 percent; corrugated containers accounted for most of that amount.

Approximately 26 percent of glass containers were recovered, while about 6 percent of wood packaging (mostly wood pallets removed from service) was recovered for recycling. About 9 percent of plastic containers and packaging were recovered, mostly soft drink, milk, and water bottles.

Table ES-5
GENERATION AND RECOVERY OF PRODUCTS IN MSW
BY MATERIAL, 2000
(In millons of tons and percent of generation of each product)

	Weight Generated	Weight Recovered	Recovery as a Percent of Generation
Durable Goods			
Steel	10.6	2.9	27.4%
Aluminum	1.0	Neg.	Neg.
Other non-ferrous metals*	1.4	0.9	64.3%
Total metals	13.0	3.8	29.2%
Glass	1.6	Neg.	Neg.
Plastics	7.5	0.3	4.0%
Rubber and leather	5.5	0.8	14.5%
Wood	4.8	Neg.	Neg.
Textiles	2.8	0.2	7.1%
Other materials	1.1	0.9	81.8%
Total durable goods	36.3	6.0	16.6%
Nondurable Goods			
Paper and paperboard	47.3	17.3	36.6%
Plastics	6.0	Neg.	Neg.
Rubber and leather	0.8	Neg.	Neg.
Textiles	6.4	1.0	15.6%
Other materials	3.2	Neg.	Neg.
Total nondurable goods	63.7	18.3	28.8%
Containers and Packaging			
Steel	2.9	1.7	58.6%
Aluminum	2.0	0.9	45.0%
Total metals	4.9	2.6	53.1%
Glass	11.2	2.9	25.9%
Paper and paperboard	39.4	22.1	56.1%
Plastics	11.2	1.0	8.9%
Wood	7.9	0.5	6.3%
Other materials	0.1	Neg.	Neg.
Total containers and packaging	74.7	29.1	38.9%
Other wastes			
Food, other**	25.9	0.7	2.6%
Yard trimmings	27.7	15.8	56.9%
Miscellaneous inorganic wastes	3.5	Neg.	Neg.
Total Other Wastes	57.1	16.5	28.8%
TOTAL MUNICIPAL SOLID WASTE	231.9	69.9	30.1%

Includes waste from residential, commercial, and institutional sources.
* Includes lead from lead-acid batteries.
** Includes recovery of paper for composting.
Details may not add to totals due to rounding.
Neg. = Less than 50,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Overall recovery of *nondurable goods* was 28.8 percent in 2000. Most of this recovery comes from paper products such as newspapers and high-grade office papers (e.g., white papers). Newspapers constituted the largest portion of this recovery, with 58 percent of newspapers generated being recovered for recycling. An estimated 54 percent of high-grade office papers and 32 percent of magazines were recovered in 2000. Each of these categories' recovery increased both in tonnage and percentage between 1999 and 2000.

Recovery percentages of other paper products in the nondurable goods category also increased between 1999 and 2000, with Standard (A) mail* recovered at an estimated 32 percent, directories at an estimated 18 percent, and other commercial printed products at an estimated 23 percent.

The nondurable goods category also includes clothing and other textile products—16 percent of these products were recovered for recycling or export in 2000.

Overall, *durable goods* were recovered at a rate of 16.6 percent in 2000. Nonferrous metals other than aluminum had one of the highest recovery rates, at 67 percent, due to the high rate of lead recovery from lead-acid batteries. Recovery of steel in all durable goods was 27.5 percent, with high rates of recovery from appliances and other miscellaneous durable goods. Twenty-six percent of rubber in tires was recovered for recycling. (Other tires were retreaded and shredded rubber tires were made into tire-derived fuel.)

One of the products with a very high recovery rate was lead-acid batteries, recovered at a rate of 96.4 percent in 2000. Other products with particularly high recovery rates were steel from major appliances (73.5 percent), corrugated boxes (70.7 percent), newspapers (58.2 percent), steel cans (57.2 percent), and aluminum cans (54.6 percent).

* Standard (A) mail was formerly called Third Class mail by the U.S. Postal Service.

RESIDENTIAL AND COMERCIAL SOURCES OF MSW

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

MANAGEMENT OF MSW

Overview

EPA's integrated waste management hierarchy includes the following three components, listed in order of preference:

- Source reduction (or waste prevention), including reuse of products and onsite, or backyard, composting of yard trimmings
- Recycling, including offsite, or community, composting.
- Disposal, including waste combustion (preferably with energy recovery) and landfilling.

Although EPA encourages the use of strategies that emphasize the top of the hierarchy whenever possible, all three components remain important within an integrated waste management system.

Source Reduction

When EPA established its waste management hierarchy in 1989, it emphasized the importance of *reducing* the amount of waste created, reusing whenever possible, and then recycling what is left. When municipal solid waste is reduced and reused, this is called "source reduction"—meaning the material never enters the waste stream. Instead it is managed at the source of generation.

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

- Designing products or packaging to reduce the quantity or the toxicity of the materials used, or to make them easy to reuse.
- Reusing existing products or packaging; for example, refillable bottles, reusable pallets, and reconditioned barrels and drums.
- Lengthening the lives of products such as tires as fewer need to be produced and therefore disposed of.
- Using packaging that reduces the amount of damage or spoilage to the product.
- Managing nonproduct organic wastes (e.g., food scraps, yard trimmings) through onsite composting or other alternatives to disposal (e.g., leaving grass clippings on the lawn).

As the nation has begun to realize the value of its resources, both financial and material, efforts to reduce waste generation have increased. EPA has been able to estimate source reduction for the nation based on economic and waste data. Table ES-6 shows that steady progress was made in waste prevention since 1990. In 2000, the United States prevented more than *55 million tons* of municipal solid waste from entering the waste stream since 1990.

Table ES-6
SOURCE REDUCTION OF
MUNICIPAL SOLID WASTE SINCE 1990
(In millions of tons)

Year	Million Tons Source Reduced
1992	0.6
1994	8.0
1995	21.4
1996	31.0
1997	31.8
1998	37.3
1999	42.8
2000	55.1

The waste prevention achieved to date comes from all parts of the waste stream. However, reducing the amount of yard trimmings is a particularly important source reduction success story. Table ES-7 shows that almost half of the waste prevented in 2000 came from organic waste materials, particularly yard trimmings. This is likely the result of many locally enacted bans on the disposal of yard trimmings from landfills around the country, as well as successful campaigns promoting onsite composting and the use of mulching lawn mowers.

Prevention of waste other than yard trimmings has been important as well. Containers and packaging represent approximately 28 percent of the materials source reduced in 2000, in addition to nondurable goods (e.g., newspapers, clothing) at 17 percent, durable goods (e.g., appliances, furniture, tires) at 10 percent, and other MSW (e.g., yard trimmings, food scraps) at 45 percent.

Table ES-7
SOURCE REDUCTION BY MAJOR MATERIAL CATEGORIES, 2000
(In millions of tons)

Waste Stream	Million Tons Source Reduced
Durable Goods (e.g., appliances, furniture)	5.4
Nondurable Goods (e.g., newspapers, clothing)	9.3
Containers & Packaging (e.g., bottles, boxes)	15.5
Other MSW (e.g., yard trimmings, food scraps)	25.0
Total Source Reduction (1990 baseline)	55.1

There are several materials for which disposal rates have increased. In particular, clothing and footwear show significant increased disposal rates, as do plastic containers. Part of the rise in plastics use can be attributed to the long-term trend of manufacturers substituting their glass packaging with plastic. However, not all of the increases are due to material substitution.

Much of the nation's increase in waste generation in the 1990s was due to the booming economy. Americans found themselves with additional dollars in their pockets after paying the mortgage or rent and their other expenses. As a result, we increasingly became a nation of consumers. The result was an increasing need for the disposal of municipal solid waste. However, the United States made progress in the area of waste reduction and reuse, as indicated

by the 55 million tons of source reduction in 2000. Had this source reduction not occurred, waste generation in 2000 would have risen from the actual level, 232 million tons, to 287 million tons. Source reduction avoided an increase of nearly 25 percent.

Recycling

- Recycling (including community composting) recovered 30.1 percent (69.9 million tons) of MSW in 2000.
- There were about 9,250 curbside recycling programs in the United States in 2000. This is slightly fewer than the 9,300 curbside recycling programs identified in 1999.
- About 3,800 yard trimmings composting programs were reported in 2000.

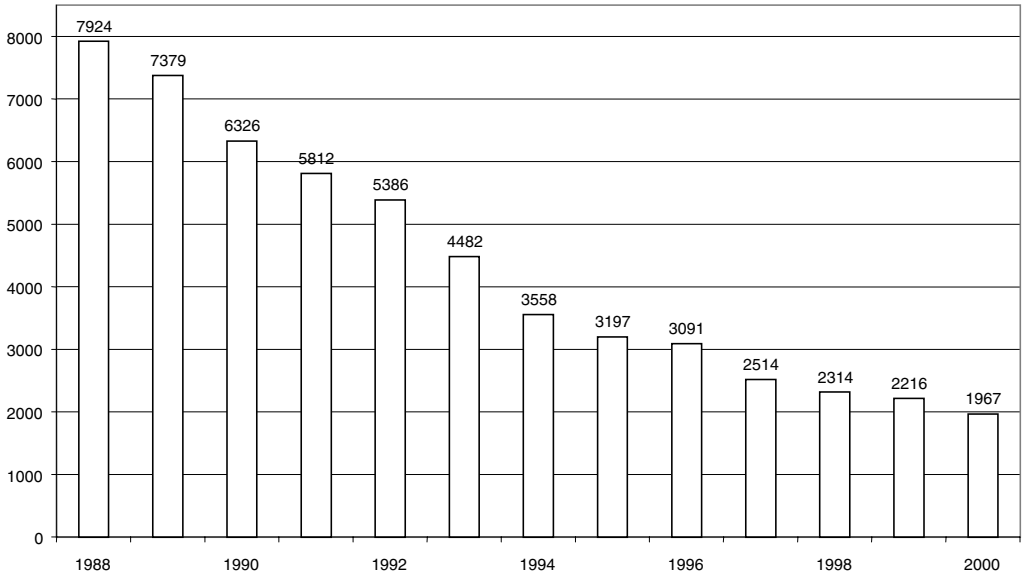
Disposal

An estimated 14.5 percent of MSW was combusted in 2000, slightly down from 14.7 percent in 1999. During 2000, about 55.3 percent of MSW was landfilled, down somewhat from 57.2 percent in 1999. As shown in Figure ES-5, the number of municipal solid waste landfills decreased substantially over the past 10 years, from nearly 8,000 in 1988 to 1,967 in 2000—while average landfill size increased. At the national level, capacity does not appear to be a problem, although regional dislocations sometimes occur.

- The percentage of MSW landfilled decreased slightly from 1999 to 2000. Over the long term, the tonnage of MSW landfilled in 1990 was 140.1 million tons, but decreased to 120.9 million tons in 1995. The tonnage increased to 132.1 million tons in 1999, then declined to 128.3 in 2000. The tonnage landfilled results from an interaction among generation, recycling, and combustion, which do not necessarily rise and fall at the same time.
- The net per capita discard rate (after recovery for recycling, including composting) was 3.15 pounds per person per day, down from 3.33 pounds per person per day in 1999* (Table ES-2).

* Note that the calculated per capita discard rate may decline for 1999 and earlier years when revised Census population figures are obtained.

Figure ES-5: Number of Landfills in the United States

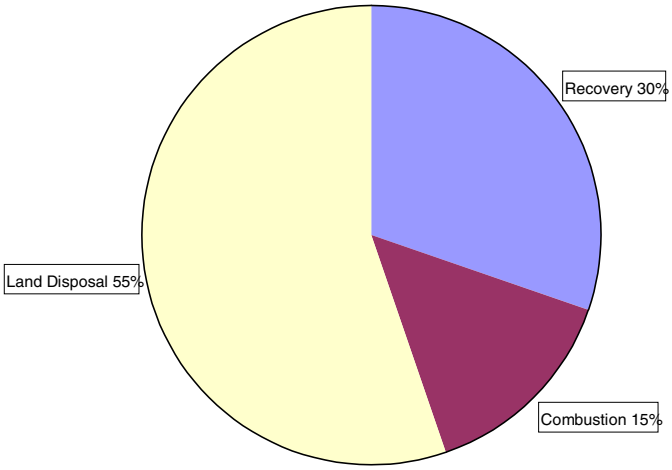


MSW recovered for recycling (including composting) and disposed of by combustion and landfilling in 2000 is shown in Figure ES-6. In 2000, 69.9 millions tons (30.1 percent) of MSW were recycled, 33.7 million tons (14.5 percent) were combusted, and 128.3 million tons (55.3 percent) were landfilled or otherwise disposed. (Relatively small amounts of this total undoubtedly were littered or illegally dumped rather than landfilled.)

PERSPECTIVE FOR THE NATION

As economic growth results in more products and materials being generated, there will be an increased need to invest in source reduction activities such as lightweighting of products and packaging, reuse of products, grasscycling, and backyard composting. Also important will be utilizing existing recycling and composting facilities, further developing this infrastructure, and buying recycled products, to conserve resources and minimize our dependence on disposal through combustion and landfilling.

Figure ES-6: Management of MSW in the United States - 2000



FOR FURTHER INFORMATION

This report and related additional data are available on the Internet at <www.epa.gov/osw>. Additional information on source reduction is available in *National Source Reduction Characterization Report for Municipal Solid Waste in the United States*, EPA530-R-99-034, November 1999.

CHAPTER 1

INTRODUCTION AND METHODOLOGY

INTRODUCTION

This report is the most recent in a series of reports sponsored by the U.S. Environmental Protection Agency (EPA) to characterize municipal solid waste (MSW) in the United States. Together with the previous reports, this report provides a historical database for a 40-year characterization (by weight) of the materials and products in MSW.

Management of the nation's MSW continues to be a high priority issue for communities as we enter the 21st Century. The concept of integrated solid waste management—source reduction of wastes before they enter the waste stream, recovery of generated wastes for recycling (including composting), and environmentally sound disposal through combustion facilities and landfills that meet current standards—is being used by communities as they plan for the future.

This chapter provides background on integrated waste management and this year's characterization report, followed by a brief overview of the method. Next is a section on the variety of uses for the information of this report. Then, more detail on the method is provided, followed by a description of the contents of the remainder of the report.

BACKGROUND

The Solid Waste Management Hierarchy

EPA's 1989 *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.

Each component of the hierarchy is addressed in this report.

Overview of the Method

Readers should note that this report characterizes the municipal solid waste stream of *the nation as a whole*. Data in this report can be used at the national level. It also can be used to address state, regional, and local situations, where more detailed data are not available or would be too expensive to gather. More detail on uses for the information in this report for both national and local uses is provided later in this chapter.

At the state or local level, recycling rates often are developed by counting and weighing all the recyclables collected, then aggregating these data to yield a state or local recycling rate. At the national level, we use instead a *material flows method*, which relies heavily on a mass balance approach. From data gathered from industry associations, key businesses, and industry sources, supported by government data from sources such as the Department of Commerce and the U.S. Census Bureau, we estimate tons of materials and products generated, recycled, or discarded. Other sources of data, such as waste characterizations and surveys performed by government agencies, industry, or the press, supplement these data.

To estimate MSW generation, production data are adjusted by imports and exports from the United States, where necessary. Allowances are made for the average life spans of different products. Information on amounts of disposed MSW managed by combustion comes from industry sources, as well. MSW not managed by recycling (including composting) or combustion is assumed to be landfilled.

In any estimation of MSW generation, it is important to define what is and is not included in municipal solid waste. EPA includes those materials that historically have been handled in the municipal solid waste stream – those materials from municipal sources, sent to municipal landfills. In this report, MSW includes wastes such as product packaging, newspapers,

office and classroom papers, bottles and cans, boxes, wood pallets, food scraps, grass clippings, clothing, furniture, appliances, automobile tires, consumer electronics, and batteries.

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 debris, biosolids (sewage sludges), industrial process wastes, or a number of other wastes that may well go to a municipal waste landfill. These materials, over time, have tended to be handled separately and are not included in the totals in this report. EPA has addressed several of these materials separately, for instance, in *Biosolids Generation, Use, and Disposal in the United States*, EPA 530-R-99-009, September 1999, and *Characterization of Building-Related Construction and Demolition Debris in the United States*, EPA 530-R-98-010, May 1998. Recycling (including composting) is encouraged for these materials as well.

In addition, the source of municipal solid waste is important. EPA's figures include municipal solid waste from homes, institutions such as schools and prisons, commercial sources such as offices, restaurants and small businesses, and occasional industrial sources. MSW does not include wastes of other types or from other sources such as automobile bodies, municipal sludges, and combustion ash, that might be disposed of in municipal waste landfills or combustion facilities.

HOW THIS REPORT CAN BE USED

Nationwide. The data in this report provide a nationwide picture of municipal solid waste generation and management. The historical perspective is particularly useful in establishing trends and highlighting changes that have occurred over the years, both in types of wastes generated and in the ways they are managed. This perspective on MSW and its management is useful in assessing national solid waste management needs and policy. The consistency in method and scope aids in the use of the document for reporting over time. The report is, however, of equal or greater value as a solid waste management planning tool for state and local governments and private firms.

Local or state level. At the local or state level, the data in this report can be used to develop approximate (but quick) estimates of MSW generation in a defined area. That is, the

data on generation of MSW per person nationally may be used to estimate generation in a city or other local area based on the population in that area. This can be of value when a "ballpark" estimate of MSW generation in an area is needed. For example, communities may use such an estimate to determine the potential viability of regional versus single-community solid waste management facilities. This information can help define solid waste management planning areas and the planning needed in those areas. However, for communities making decisions where knowledge of the amount and composition of MSW is crucial (e.g., where a solid waste management facility is being sited), local estimates of the waste stream should be made.

Another useful feature of this report for local planning is the information provided on MSW trends. Changes over time in total MSW generation and the mix of MSW materials can affect the need for and use of various waste management alternatives. Observing trends in MSW generation can help in planning an integrated waste management system that includes facilities sized and designed for years of service.

While the national average data are useful as a checkpoint against local MSW characterization data, any differences between local and national data should be examined carefully. There are many regional variations that require each community to examine its own waste management needs. Factors such as local and regional availability of suitable landfill space, proximity of markets for recovered materials, population density, commercial and industrial activity, and climatic and groundwater variations all may motivate each community to make its own plans.

Specific reasons for regional differences may include:

- Variations in climate and local waste management practices, which greatly influence generation of yard trimmings. For instance, yard trimmings exhibit strong seasonal variations in most regions of the country. Also, the level of backyard composting in a region will affect generation of yard trimmings.

- Differences in the scope of waste streams. That is, a local landfill may be receiving construction and demolition debris in addition to MSW, but this report addresses MSW only.

- Variance in the per capita generation of some products, such as newspapers and telephone directories, depending upon the average size of the publications. Typically, rural areas will generate less of these products on a per person basis than urban areas.

- Level of commercial activity in a community. This influences the generation rate of some products, such as office paper, corrugated boxes, wood pallets, and food scraps from restaurants.

- Variations in economic activity, which affect waste generation in both the residential and the commercial sectors.

- Local and state regulations and practices. Deposit laws, bans on landfilling of specific products, and variable rate pricing for waste collection are examples of practices that can influence a local waste stream.

While caution should be used in applying the data in this report, for some areas, the national breakdown of MSW by material may be the only such data available for use in comparing and planning waste management alternatives. Planning a curbside recycling program, for example, requires an estimate of household recyclables that may be recovered. If resources are not available to adequately estimate these materials by other means, local planners may turn to the national data. This is useful in areas that may have typical MSW generation or in areas where appropriate adjustments in the data can be made to account for local conditions.

In summary, the data in this report can be used in local planning to:

- Develop approximate estimates of total MSW generation in an area.

- Check locally developed MSW data for accuracy and consistency.

- Account for trends in total MSW generation and the generation of individual components.

- Help set goals and measure progress in source reduction and recycling (including composting).

CHARACTERIZATION OF MUNICIPAL SOLID WASTE: IN PERSPECTIVE

The Two Methodologies for Characterizing MSW: Site-Specific Versus Material Flows

There are two basic approaches to estimating quantities of municipal solid waste at the local, state, or national levels—site-specific and material flows.

Site-specific studies. In the first method, which is site-specific, sampling, sorting, and weighing the individual components of the waste stream could be used. 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 scraps 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 were 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 performed in a consistent manner over a long period of time.

Of course, at the state or local level, sampling may not be necessary—many states and localities count all materials recovered for recycling, and many weigh all wastes being disposed to generate state or local recycling rates from the "ground up." To use these figures at the national level would require all states to perform these studies, and perform them in a way conducive to developing a national summary, which so far has not been practical.

Material flows. 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. This report represents the latest version of this database that has been evolving for more than 20 years.

The material flows methodology is based on production data (by weight) for the materials and products in the waste stream. To estimate generation data, specific adjustments are made to the production data for each material and product category. Adjustments are made for imports and exports and for diversions from MSW (e.g., for building materials made of plastic and paperboard, which become construction and demolition debris). Adjustments also are made for the life spans of various products. Finally, food scraps and yard trimmings and a small amount of miscellaneous inorganic wastes are accounted for by compiling data from a variety of waste sampling studies.

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, and dried paint in a can. Some household hazardous wastes (e.g., pesticide left in a can) are included among these product residues.

Municipal Solid Waste Defined in Greater Detail

As stated earlier, EPA includes those materials that historically have been handled in the municipal waste stream—those materials from municipal sources, sent to municipal landfills. In this report, MSW includes wastes such as product packaging, newspapers, office and classroom paper, bottles and cans, boxes, wood pallets, food scraps, grass clippings, clothing, furniture, appliances, automobile tires, consumer electronics, and automotive batteries. For purposes of analysis, these products and materials are grouped in this report into the following categories: durable goods, nondurable goods, containers and packaging, food scraps and yard trimmings, and miscellaneous inorganic wastes.

Municipal solid wastes characterized in this report 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:

Sources and Examples	Example Products

Residential (single- and multi-family homes)	Newspapers, clothing, disposable tableware, food packaging, cans and bottles, food scraps, yard trimmings
Commercial (office buildings, retail and wholesale establishments, restaurants)	Corrugated boxes, food wastes, office papers, disposable tableware, paper napkins, yard trimmings
Institutional (schools, libraries, hospitals, prisons)	Cafeteria and restroom trash can wastes, office papers, classroom wastes, yard trimmings
Industrial (packaging and administrative; *not* process wastes)	Corrugated boxes, plastic film, wood pallets, lunchroom wastes, office papers.

The material flows methodology used in this report does not readily lend itself to 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 factories. The methodology estimates only the total quantity of such boxes generated, not their places of disposal or recovery for recycling.

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, RCRA Subtitle D includes many kinds of wastes. It has been common practice to landfill wastes such as municipal sludges, nonhazardous industrial wastes, residue from automobile salvage operations, and construction and demolition debris along with MSW, but these other kinds of wastes are not included in the estimates presented in this report.

Figure 1. Municipal Solid Waste in the Universe of Subtitle D Wastes	
Subtitle D Wastes	
The Subtitle D Waste included in this report is Municipal Solid Waste, which includes:	
Containers and packaging such as soft drink bottles and paperboard boxes	
Durable goods such as furniture, appliances, and consumer electronics	
Nondurable goods such as newspapers, trash bags, and clothing	
Other wastes such as food scraps and yard trimmings	
Subtitle D Wastes not included in this report are:	
Municipal sludges	Agricultural wastes
Industrial nonhazardous wastes	Oil and gas wastes
Construction and demolition debris	Mining wastes

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 MSW with other residential wastes, are not identified separately in this report. Transportation equipment (including automobiles and trucks) is not included in the wastes characterized in this report.

Certain other materials associated with products in MSW often are 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 packaging materials. 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 little available documentation of these amounts.

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 year

2000 MSW generation, recovery, and discards of products in each material category are included.

In Chapter 3 of the report, estimates of year 2000 MSW management by the various alternatives are summarized. These include recovery for recycling (including composting), combustion, and landfilling. Also presented is a discussion of source reduction practices. Summaries of the infrastructure currently available for each waste management alternative also are included in Chapter 3.

Chapter 4 incorporates an estimate of source reduction for the nation.

A brief discussion of the material flows methodology for estimating generation, recycling (including composting), and disposal is presented in Appendix A. Appendix B provides the methodology and detailed results for source reduction. Appendix C provides the methodology and results for estimates of generation, recovery, and discards of selected consumer electronics.

Figure 1-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 management system from residential, commercial, institutional, and industrial sources and before materials recovery or combustion takes place. Preconsumer (industrial) scrap is not included in the generation estimates. Source reduction activities (e.g., backyard composting of yard trimmings) take place *before* generation.

Source reduction activities reduce the amount or toxicity of wastes before they enter the municipal solid waste management system. Reuse is a source reduction activity involving the recovery or reapplication of a package, used product, or material in a manner that retains its original form or identity. Reuse of products such as refillable glass bottles, reusable plastic food storage containers, or refurbished wood pallets is considered source reduction, not recycling.

Recovery of materials as estimated in this report includes products and yard trimmings removed from the waste stream for the purpose of recycling (including composting). For recovered products, recovery equals reported purchases of postconsumer recovered material (e.g., glass cullet, old newspapers) plus net exports (if any) of the material. Thus, recovery of old corrugated containers (OCC) is the sum of OCC purchases by paper mills plus net exports of OCC. If recovery as reported by a data source includes converting or fabrication (preconsumer) scrap, the preconsumer scrap is *not* counted toward the recovery estimates in this report. Imported secondary materials also are not counted in recovery estimates in this report. For some materials, additional uses, such as glass used for highway construction or newspapers used to make insulation, are added into the recovery totals.

Combustion of MSW was estimated with and without energy recovery. Combustion with energy recovery is often called "waste-to-energy," while combustion without energy recovery is called incineration in this report. Combustion of separated materials—wood, rubber from tires, paper, and plastics—is included in the estimates of combustion in this report.

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

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 report through 2000. The data presented also incorporate some revisions to previously reported data for 1999 and, in some instances, to data for earlier years. The revisions generally are due to revisions and improvements in the data available from data sources used in developing this report.

This chapter discusses how much municipal solid waste is generated, recovered, and disposed of. First, an overview presents this information for the most recent years, and for selected years back to 1960. This information is summarized in Tables 1 to 3 and Figures 10 to 13. Then, throughout the remainder of the chapter, MSW is characterized in more detail. Findings are presented in two basic ways: the first portion of the chapter presents data by *material type*. Some materials types of most use to planners (paper and paperboard, glass, metals, plastics, and rubber and leather) are presented in detail in Tables 4 to 8 and Figures 3 to 9, while data on other materials also is summarized in Figures 12 and 13.

The second portion of the chapter presents data by *product type*. This information is presented in Tables 9 to 23 and Figures 14 to 16. Products are classified into durable goods (e.g., appliances, furniture, tires); nondurable goods (e.g., newspapers, office papers, trash bags, clothing); and containers and packaging (e.g., bottles, cans, corrugated boxes). A fourth major category consists of other wastes—yard trimmings, food scraps, and miscellaneous inorganic wastes. These wastes are not manufactured products, but to provide complete information in each table, they are included in both the product and the material tables.

This chapter provides data on generation, recovery, and disposal of MSW. (See Chapter 1 for definitions of these terms.) Recovery, in this report, means that the materials have been removed from the municipal waste stream. Recovery of materials in products means that the materials are reported to have been purchased by an end user or have been exported from the United States. For yard trimmings, recovery includes estimates of the trimmings delivered to a composting facility (not backyard composting). Under these definitions, residues from a materials recovery facility (MRF) or other waste processing facility are counted as generation (and, of course, discards), since they are not purchased by an end user. Residues from an end user facility (e.g., sludge from a paper deinking mill) are considered to be industrial process wastes that are no longer part of the municipal waste stream.

Additional detail is provided for some of the materials and products in MSW that are of the most interest to planners. These are paper and paperboard, glass, metals, plastics, and rubber and leather (the latter category includes rubber in tires and rubber and leather in clothing and footwear).

MUNICIPAL SOLID WASTE: CHARACTERIZED BY MATERIAL TYPE

Generation, recovery, and discards of materials in MSW, by weight and by percentage of generation or discards, are summarized in Tables 1 through 3. Figures 10 and 11 (later in this chapter) illustrate this data over time. A snapshot, by material, for 2000 is provided in Figures 12 and 13. In the following sections, each material is discussed in detail.

Table 1

MATERIALS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(In thousands of tons and percent of total generation)

	Thousands of Tons							
Materials	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Paper and Paperboard	29,990	44,310	55,160	72,730	81,670	84,160	88,260	86,740
Glass	6,720	12,740	15,130	13,100	12,830	12,640	12,910	12,770
Metals								
Ferrous	10,300	12,360	12,620	12,640	11,640	12,380	13,290	13,460
Aluminum	340	800	1,730	2,810	2,960	3,070	3,120	3,170
Other Nonferrous	180	670	1,160	1,100	1,260	1,360	1,380	1,390
Total Metals	*10,820*	*13,830*	*15,510*	*16,550*	*15,860*	*16,810*	*17,790*	*18,020*
Plastics	390	2,900	6,830	17,130	18,900	22,370	24,080	24,710
Rubber and Leather	1,840	2,970	4,200	5,790	6,030	6,860	6,210	6,370
Textiles	1,760	2,040	2,530	5,810	7,400	8,600	9,060	9,380
Wood	3,030	3,720	7,010	12,210	10,440	12,090	12,360	12,700
Other **	70	770	2,520	3,190	3,650	3,900	4,000	4,030
Total Materials in Products	54,620	83,280	108,890	146,510	156,780	167,430	174,670	174,720
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,740	24,910	25,160	25,900
Yard Trimmings	20,000	23,200	27,500	35,000	29,690	27,730	27,730	27,730
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,290	3,380	3,500
Total Other Wastes	33,500	37,780	42,750	58,700	54,580	55,930	56,270	57,130
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	211,360	223,360	230,940	231,850
	Percent of Total Generation							
Materials	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Paper and Paperboard	34.0%	36.6%	36.4%	35.4%	38.6%	37.7%	38.2%	37.4%
Glass	7.6%	10.5%	10.0%	6.4%	6.1%	5.7%	5.6%	5.5%
Metals								
Ferrous	11.7%	10.2%	8.3%	6.2%	5.5%	5.5%	5.8%	5.8%
Aluminum	0.4%	0.7%	1.1%	1.4%	1.4%	1.4%	1.4%	1.4%
Other Nonferrous	0.2%	0.6%	0.8%	0.5%	0.6%	0.6%	0.6%	0.6%
Total Metals	*12.3%*	*11.4%*	*10.2%*	*8.1%*	*7.5%*	*7.5%*	*7.7%*	*7.8%*
Plastics	0.4%	2.4%	4.5%	8.3%	8.9%	10.0%	10.4%	10.7%
Rubber and Leather	2.1%	2.5%	2.8%	2.8%	2.9%	3.1%	2.7%	2.7%
Textiles	2.0%	1.7%	1.7%	2.8%	3.5%	3.9%	3.9%	4.0%
Wood	3.4%	3.1%	4.6%	6.0%	4.9%	5.4%	5.4%	5.5%
Other **	0.1%	0.6%	1.7%	1.6%	1.7%	1.7%	1.7%	1.7%
Total Materials in Products	62.0%	68.8%	71.8%	71.4%	74.2%	75.0%	75.6%	75.4%
Other Wastes								
Food Scraps	13.8%	10.6%	8.6%	10.1%	10.3%	11.2%	10.9%	11.2%
Yard Trimmings	22.7%	19.2%	18.1%	17.1%	14.0%	12.4%	12.0%	12.0%
Miscellaneous Inorganic Wastes	1.5%	1.5%	1.5%	1.4%	1.5%	1.5%	1.5%	1.5%
Total Other Wastes	38.0%	31.2%	28.2%	28.6%	25.8%	25.0%	24.4%	24.6%
Total MSW Generated - %	100.0%	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 wastes.

** Includes electrolytes in batteries and fluff pulp, feces, and urine in disposable diapers.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Table 2

RECOVERY* OF MUNICIPAL SOLID WASTE, 1960 TO 2000
(In thousands of tons and percent of generation of each material)

	Thousands of Tons							
Materials	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Paper and Paperboard	5,080	6,770	11,740	20,230	32,700	34,360	36,080	39,370
Glass	100	160	750	2,630	3,140	2,940	3,000	2,940
Metals								
Ferrous	50	150	370	2,230	4,130	4,310	4,530	4,580
Aluminum	Neg.	10	310	1,010	930	880	880	870
Other Nonferrous	Neg.	320	540	730	810	930	930	930
Total Metals	*50*	*480*	*1,220*	*3,970*	*5,870*	*6,120*	*6,340*	*6,380*
Plastics	Neg.	Neg.	20	370	990	1,200	1,280	1,340
Rubber and Leather	330	250	130	370	540	860	780	780
Textiles	50	60	160	660	900	1,120	1,230	1,270
Wood	Neg.	Neg.	Neg.	130	450	490	490	480
Other **	Neg.	300	500	680	750	860	860	860
Total Materials in Products	5,610	8,020	14,520	29,040	45,340	47,950	50,060	53,420
Other Wastes								
Food, Other^	Neg.	Neg.	Neg.	Neg.	570	580	550	680
Yard Trimmings	Neg.	Neg.	Neg.	4,200	9,000	12,560	14,170	15,770
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	4,200	9,570	13,140	14,720	16,450
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	54,910	61,090	64,780	69,870
	Percent of Generation of Each Material							
Materials	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Paper and Paperboard	16.9%	15.3%	21.3%	27.8%	40.0%	40.8%	40.9%	45.4%
Glass	1.5%	1.3%	5.0%	20.1%	24.5%	23.3%	23.2%	23.0%
Metals								
Ferrous	0.5%	1.2%	2.9%	17.6%	35.5%	34.8%	34.1%	34.0%
Aluminum	Neg.	1.3%	17.9%	35.9%	31.4%	28.7%	28.2%	27.4%
Other Nonferrous	Neg.	47.8%	46.6%	66.4%	64.3%	68.4%	67.4%	66.9%
Total Metals	*0.5%*	*3.5%*	*7.9%*	*24.0%*	*37.0%*	*36.4%*	*35.6%*	*35.4%*
Plastics	Neg.	Neg.	0.3%	2.2%	5.2%	5.4%	5.3%	5.4%
Rubber and Leather	17.9%	8.4%	3.1%	6.4%	9.0%	12.5%	12.6%	12.2%
Textiles	2.8%	2.9%	6.3%	11.4%	12.2%	13.0%	13.6%	13.5%
Wood	Neg.	Neg.	Neg.	1.1%	4.3%	4.1%	4.0%	3.8%
Other **	Neg.	39.0%	19.8%	21.3%	20.5%	22.1%	21.5%	21.3%
Total Materials in Products	10.3%	9.6%	13.3%	19.8%	28.9%	28.6%	28.7%	30.6%
Other Wastes								
Food, Other^	Neg.	Neg.	Neg.	Neg.	2.6%	2.3%	2.2%	2.6%
Yard Trimmings	Neg.	Neg.	Neg.	12.0%	30.3%	45.3%	51.1%	56.9%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	7.2%	17.5%	23.5%	26.2%	28.8%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.0%	27.4%	28.1%	30.1%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Recovery of electrolytes in batteries; probably not recycled.
Neg. = Less than 5,000 tons or 0.05 percent.
^ Includes recovery of paper for composting.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Table 3

MATERIALS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(In thousands of tons and percent of total discards)

	Thousands of Tons							
Materials	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Paper and Paperboard	24,910	37,540	43,420	52,500	48,970	49,800	52,180	47,370
Glass	6,620	12,580	14,380	10,470	9,690	9,700	9,910	9,830
Metals								
Ferrous	10,250	12,210	12,250	10,410	7,510	8,070	8,760	8,880
Aluminum	340	790	1,420	1,800	2,030	2,190	2,240	2,300
Other Nonferrous	180	350	620	370	450	430	450	460
Total Metals	*10,770*	*13,350*	*14,290*	*12,580*	*9,990*	*10,690*	*11,450*	*11,640*
Plastics	390	2,900	6,810	16,760	17,910	21,170	22,800	23,370
Rubber and Leather	1,510	2,720	4,070	5,420	5,490	6,000	5,430	5,590
Textiles	1,710	1,980	2,370	5,150	6,500	7,480	7,830	8,110
Wood	3,030	3,720	7,010	12,080	9,990	11,600	11,870	12,220
Other **	70	470	2,020	2,510	2,900	3,040	3,140	3,170
Total Materials in Products	49,010	75,260	94,370	117,470	111,440	119,480	124,610	121,300
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,170	24,330	24,610	25,220
Yard Trimmings	20,000	23,200	27,500	30,800	20,690	15,170	13,560	11,960
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,290	3,380	3,500
Total Other Wastes	33,500	37,780	42,750	54,500	45,010	42,790	41,550	40,680
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	156,450	162,270	166,160	161,980
	Percent of Total Discards							
Materials	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Paper and Paperboard	30.2%	33.2%	31.7%	30.5%	31.3%	30.7%	31.4%	29.2%
Glass	8.0%	11.1%	10.5%	6.1%	6.2%	6.0%	6.0%	6.1%
Metals								
Ferrous	12.4%	10.8%	8.9%	6.1%	4.8%	5.0%	5.3%	5.5%
Aluminum	0.4%	0.7%	1.0%	1.0%	1.3%	1.3%	1.3%	1.4%
Other Nonferrous	0.2%	0.3%	0.5%	0.2%	0.3%	0.3%	0.3%	0.3%
Total Metals	*13.1%*	*11.8%*	*10.4%*	*7.3%*	*6.4%*	*6.6%*	*6.9%*	*7.2%*
Plastics	0.5%	2.6%	5.0%	9.7%	11.4%	13.0%	13.7%	14.4%
Rubber and Leather	1.8%	2.4%	3.0%	3.2%	3.5%	3.7%	3.3%	3.5%
Textiles	2.1%	1.8%	1.7%	3.0%	4.2%	4.6%	4.7%	5.0%
Wood	3.7%	3.3%	5.1%	7.0%	6.4%	7.1%	7.1%	7.5%
Other **	0.1%	0.4%	1.5%	1.5%	1.9%	1.9%	1.9%	2.0%
Total Materials in Products	59.4%	66.6%	68.8%	68.3%	71.2%	73.6%	75.0%	74.9%
Other Wastes								
Food Scraps	14.8%	11.3%	9.5%	12.1%	13.5%	15.0%	14.8%	15.6%
Yard Trimmings	24.2%	20.5%	20.1%	17.9%	13.2%	9.3%	8.2%	7.4%
Miscellaneous Inorganic Wastes	1.6%	1.6%	1.6%	1.7%	2.0%	2.0%	2.0%	2.2%
Total Other Wastes	40.6%	33.4%	31.2%	31.7%	28.8%	26.4%	25.0%	25.1%
Total MSW Discarded - %	100.0%	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 wastes.

** Includes electrolytes in batteries and fluff pulp, feces, and urine in disposable diapers.

Details may not add to totals due to rounding.

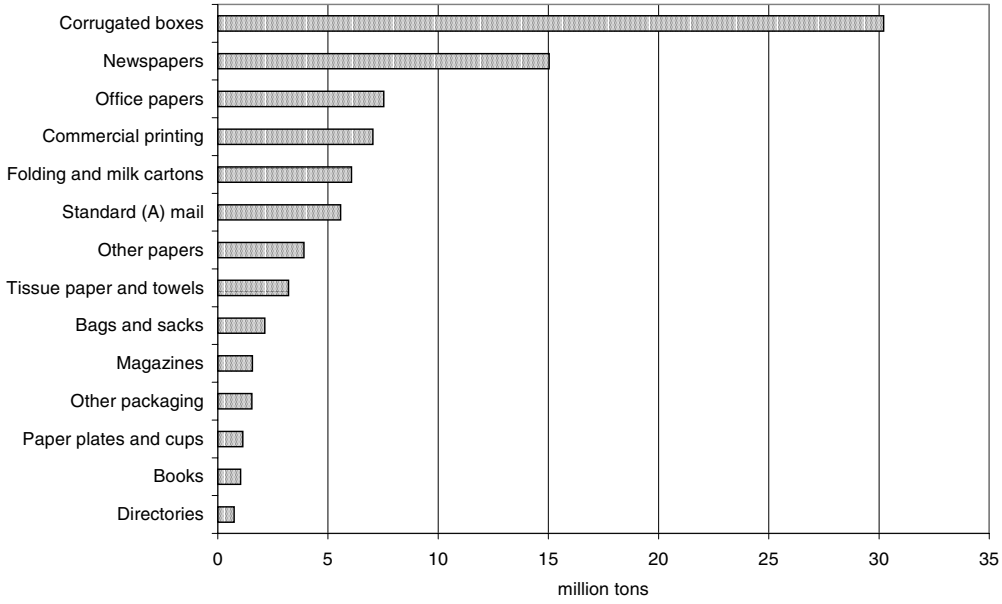
Source: Franklin Associates, Ltd.

Paper and Paperboard

Collectively, the many products made of paper and paperboard* comprise the largest component of MSW. The paper and paperboard category includes products such as office papers, newspapers, corrugated boxes, milk cartons, tissue papers, and paper plates and cups (Figure 2 and Table 4).

Total generation of paper and paperboard in MSW grew from 30 million tons in 1960 to 86.7 million tons in 2000 (Table 1). As a percentage of total MSW generation, paper represented 34 percent in 1960 (Table 1). The percentage has varied over time, but increased to 37.4 percent of total MSW generation in 2000. As Figure 3 illustrates, paper generation declined in 1996, peaked at 88.3 million tons in 1999, and declined to 86.7 million tons in 2000.

Figure 2. Paper and paperboard products generated in MSW, 2000



* The term "cardboard" is often used for products made of paperboard (boxboard and containerboard), but this inexact term is not used in the paper industry.

Table 4

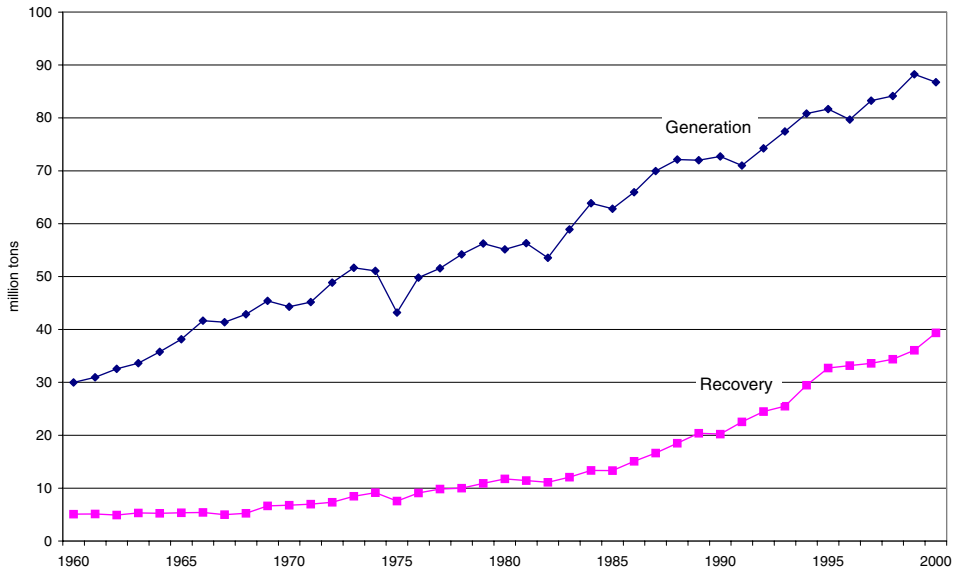
PAPER AND PAPERBOARD PRODUCTS IN MSW, 2000
(In thousands of tons and percent of generation)

Product Category	Generation (Thousand tons)	Recovery (Thousand tons)	Recovery (Percent of generation)	Discards (Thousand tons)
Nondurable Goods				
Newspapers				
Newsprint	12,200	7,250	59.4%	4,950
Groundwood inserts	2,830	1,500	53.0%	1,330
Total Newspapers	15,030	8,750	58.2%	6,280
Books	1,140	220	19.3%	920
Magazines	2,130	680	31.9%	1,450
Office Papers	7,530	4,070	54.1%	3,460
Telephone Directories	740	130	17.6%	610
Standard (A) Mail*	5,570	1,780	32.0%	3,790
Other Commercial Printing	7,040	1,650	23.4%	5,390
Tissue Paper and Towels	3,210	Neg.	Neg.	3,210
Paper Plates and Cups	1,040	Neg.	Neg.	1,040
Other Nonpackaging Paper**	3,910	Neg.	Neg.	3,910
Total Paper and Paperboard Nondurable Goods	47,340	17,280	36.5%	30,060
Containers and Packaging				
Corrugated Boxes	30,210	21,360	70.7%	8,850
Milk Cartons	490	Neg.	Neg.	490
Folding Cartons	5,580	430	7.7%	5,150
Other Paperboard Packaging	200	Neg.	Neg.	200
Bags and Sacks	1,550	300	19.4%	1,250
Other Paper Packaging	1,370	Neg.	Neg.	1,370
Total Paper and Paperboard Containers and Packaging	39,400	22,090	56.1%	17,310
Total Paper and Paperboard	86,740	39,370	45.4%	47,370

* Formerly called Third Class Mail by the U.S. Postal Service.
** Includes tissue in disposable diapers, paper in games and novelties, cards, etc.
Neg. = Less than 5,000 tons or 0.05 percent.
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Figure 3. Paper generation and recovery, 1960 to 2000



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.

The wide variety of products that comprise the paper and paperboard materials total is illustrated in Table 4 and Figure 2. These products are classified as nondurable goods or as containers and packaging, with nondurable goods being the larger category.

Generation. Estimates of paper and paperboard generation are based on statistics published by the American Forest & Paper Association (AF&PA). These statistics include data on new supply (production plus net imports) of the various paper and paperboard grades that go into the products found in MSW. The AF&PA new supply statistics are adjusted to deduct converting scrap, which is generated when sheets of paper or paperboard are cut to make products such as envelopes or boxes. Converting scrap rates vary from product to product; the rates used in this report were developed as part of a 1992 report for the Recycling Advisory Council with a few more recent revisions as new data became available. Various deductions also are made to account for products diverted out of municipal solid waste, such as gypsum

wallboard facings (classified as construction and demolition debris) or toilet tissue (which goes to wastewater treatment plants).

Recovery. Estimates of recovery of paper and paperboard products for recycling are based on annual reports of recovery published by AF&PA. The AF&PA reports include recovery of paper and paperboard purchased by U.S. paper mills, plus exports of recovered paper, plus a small amount estimated to have been used in other products such as animal bedding. Recovery as reported by AF&PA includes both preconsumer and postconsumer paper.

To estimate recovery of postconsumer paper products for this EPA report, estimates of recovery of converting scrap and returned overissue newspapers are deducted from the total recovery amounts reported by AF&PA. In earlier versions of this EPA report, a simplifying assumption that all converting scrap is recovered was made. For more recent updates, various converting scrap recovery rates ranging from 70 percent to 98 percent were applied to the estimates for 1990 through 2000. Because converting scrap and overissue are deducted, the paper recovery rates presented in this report are always lower than the total recovery rates published by AF&PA.

When recovered paper is repulped, and often deinked, at a recycling paper mill, considerable amounts of sludge are generated in amounts varying from 5 percent to 35 percent of the paper feedstock. Since these sludges are generated at an industrial site, they are considered to be industrial process waste, not municipal solid waste; therefore they have been removed from the municipal waste stream.

Recovery of paper and paperboard for recycling is at the highest rate overall compared to most other materials in MSW. As Table 4 shows, 70.7 percent of all corrugated boxes were recovered for recycling in 2000. Newspapers were recovered at a rate of 58.2 percent, and high-grade office papers at 54.1 percent, with lesser percentages of other papers also recovered. Approximately 39.4 million tons of postconsumer paper were recovered in 2000—45.4 percent of total paper and paperboard generation.

Discards After Recovery. After recovery of paper and paperboard for recycling, discards were 47.4 million tons in 2000, or 29.2 percent of total MSW discards.

Glass

Glass is found in MSW primarily in the form of containers (Table 5 and Figures 4 and 5), and also in durable goods such as 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 million tons of MSW in 1960, or 7.6 percent of total generation. Generation of glass continued to grow over the next two decades, but then glass containers were widely displaced by other materials, principally aluminum and plastics. Thus the tonnage of glass in MSW declined in the 1980s, from approximately 15.1 million tons in 1980 to 13.2 million tons in 1985. Beginning about 1987, however, the decline in generation of glass containers slowed (Figure 5), and glass generation in 2000 was 12.8 million tons, about the same as 1995. During the 1990s glass generation has varied from 12.4 to 13.6 million tons per year. Glass was 10 percent of MSW generation in 1980, declining to 5.5 percent in 2000.

Recovery. Most recovered glass containers (bottles) are used to make new glass containers, but a portion goes to other uses such as fiberglass insulation and glasphalt for highway construction. Until recently, the Glass Packaging Institute published estimates of glass bottle recovery annually. Since this data source is no longer available, it was assumed that recovery of glass bottles held steady at 26.3 percent of generation, or 2.9 million tons, in 2000.

Table 5

GLASS PRODUCTS IN MSW, 2000
(In thousands of tons and percent of generation)

Product Category	Generation (Thousand tons)	Recovery (Thousand tons)	Recovery (Percent of generation)	Discards (Thousand tons)
Durable Goods*	1,580	Neg.	Neg.	1,580
Containers and Packaging				
Beer and Soft Drink Bottles	5,860	1,560	26.6%	4,300
Wine and Liquor Bottles	1,970	440	22.3%	1,530
Food and Other Bottles and Jars	3,360	940	28.0%	2,420
Total Glass Containers	11,190	2,940	26.3%	8,250
Total Glass	12,770	2,940	23.0%	9,830

* Glass as a component of appliances, furniture, consumer electronics, etc.
Neg. = Less than 5,000 tons or 0.05 percent.
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Figure 4. Glass products generated in MSW, 2000

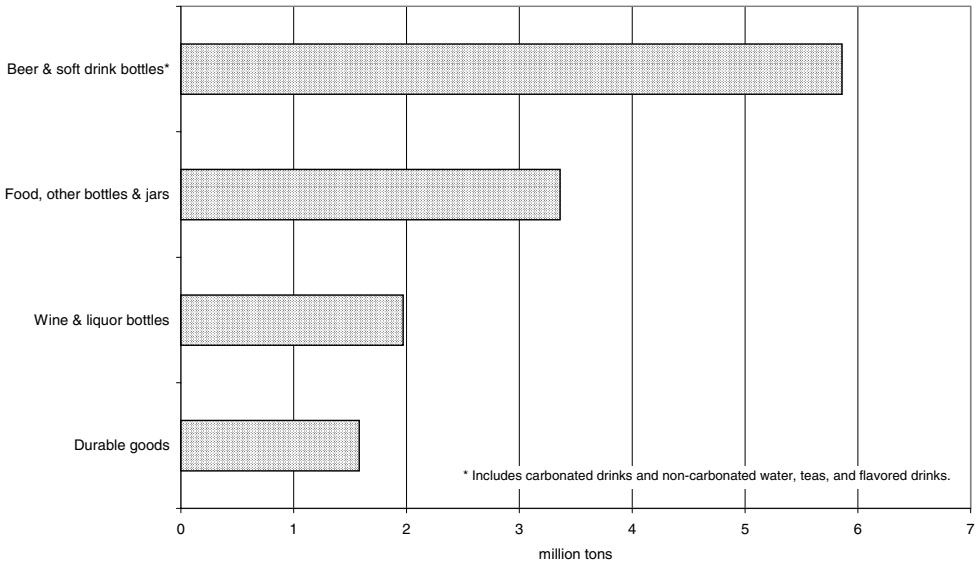
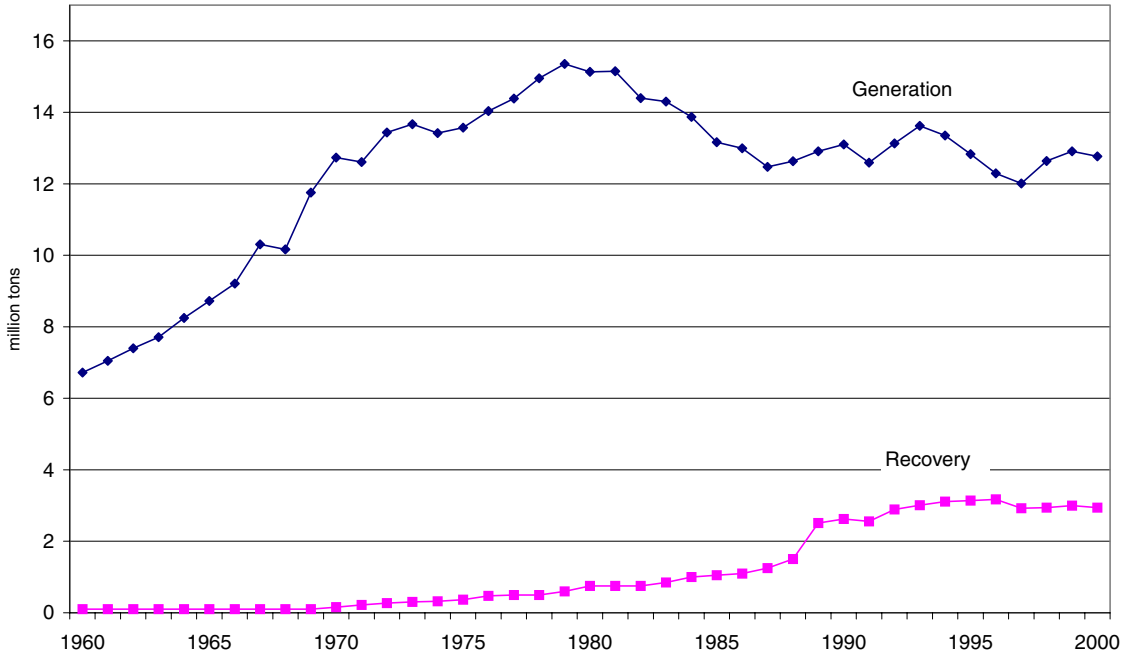


Figure 5. Glass generation and recovery, 1960 to 2000

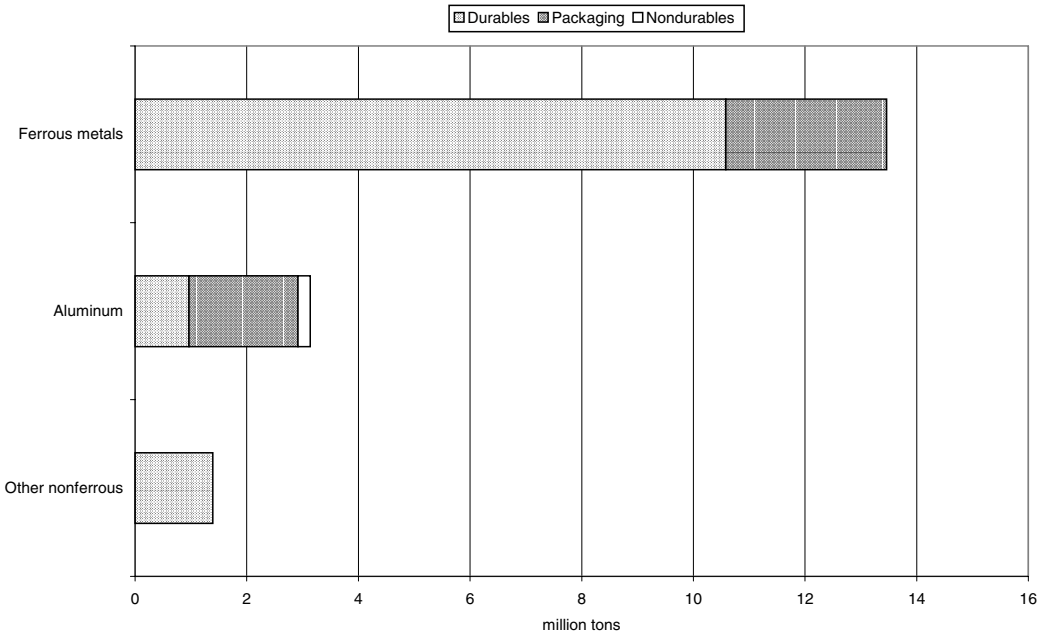


Discards After Recovery. Recovery for recycling lowered discards of glass to 9.8 million tons in 2000 (6.1 percent of total MSW discards).

Ferrous Metals

By weight, ferrous metals (iron and steel) are the largest category of metals in MSW (Figure 6 and Table 6). The largest quantities of ferrous metals in MSW are found in durable goods such as appliances, furniture, tires, and other miscellaneous durable goods. 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.

Figure 6. Metal products generated in MSW, 2000



Total generation and recovery of all metals in MSW from 1960 to 2000 are shown in Figure 7.

Generation. Approximately 10.3 million tons of ferrous metals were generated in 1960. Like glass, the tonnages grew during the 1960s, but began to drop as lighter materials (aluminum and plastics) replaced steel in many applications. Since 1970, generation of ferrous metals has varied between about 11 million tons in 1985 to 13.5 million tons in 2000. The percentage of ferrous metals generation in MSW has declined from 11.7 percent in 1960 to 5.8 percent in 2000.

Recovery. The renewed emphasis on recovery and recycling in recent years has included ferrous metals. Based on data from the Steel Recycling Institute, recovery of ferrous metals from appliances ("white goods") was estimated to be 2.0 million tons in 2000. Overall recovery of ferrous metals from durable goods (large and small appliances, furniture, and tires) was estimated to be 27.5 percent (2.9 million tons) in 2000 (Table 6).

Table 6

METAL PRODUCTS IN MSW, 2000
(In thousands of tons and percent of generation)

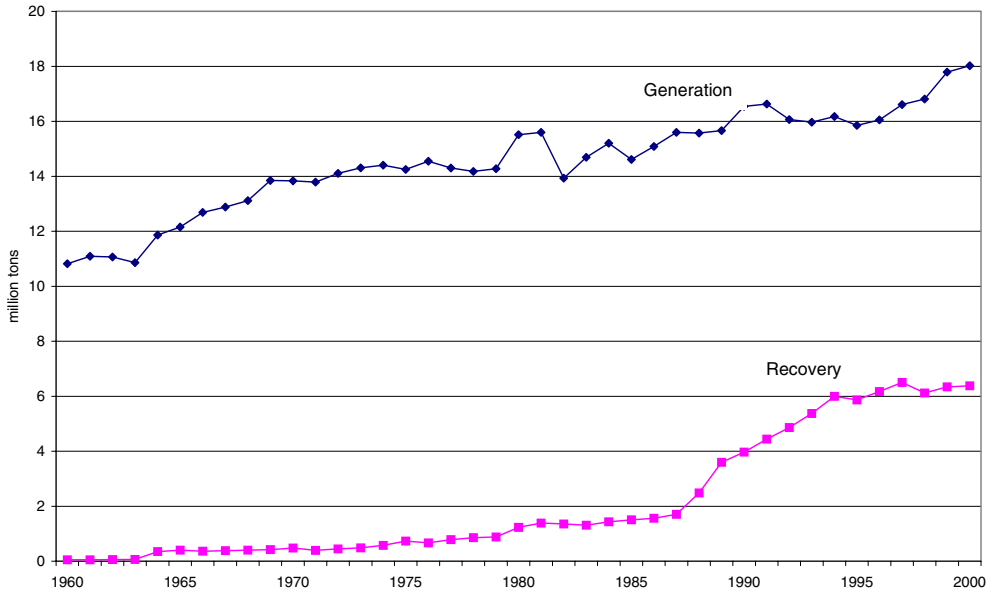
Product Category	Generation (Thousand tons)	Recovery (Thousand tons)	Recovery (Percent of generation)	Discards (Thousand tons)
Durable Goods				
Ferrous metals*	10,580	2,910	27.5%	7,670
Aluminum**	1,000	Neg.	Neg.	1,000
Lead†	960	930	96.9%	30
Other nonferrous metals‡	430	Neg.	Neg.	430
Total Metals in Durable Goods	12,970	3,840	29.6%	9,130
Nondurable Goods				
Aluminum	220	Neg.	Neg.	220
Containers and Packaging				
Steel				
Food and other cans	2,640	1,510	57.2%	1,130
Other steel packaging	240	160	66.7%	80
Total Steel Packaging	2,880	1,670	58.0%	1,210
Aluminum				
Beer and soft drink cans	1,520	830	54.6%	690
Food and other cans	50	Neg.	Neg.	50
Foil and closures	380	40	10.5%	340
Total Aluminum Packaging	1,950	870	44.6%	1,080
Total Metals in Containers and Packaging	4,830	2,540	52.6%	2,290
Total Metals	18,020	6,380	35.4%	11,640
Ferrous	13,460	4,580	34.0%	8,880
Aluminum	3,170	870	27.4%	2,300
Other nonferrous	1,390	930	66.9%	460

* Ferrous metals (iron and steel) 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. = Less than 5,000 tons or 0.05 percent.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Steel food cans and other steel cans were estimated to be recovered at a rate of 57.2 percent (1.5 million tons) in 2000. Approximately 160,000 tons of other steel packaging, mostly steel barrels and drums, were estimated to have been recovered for recycling in 2000.

Discards After Recovery. In 2000, discards of ferrous metals after recovery were 8.9 million tons, or 5.5 percent of total discards.

Figure 7. Metals generation and recovery, 1960 to 2000



Aluminum

The largest source of aluminum in MSW is aluminum cans and other packaging (Table 6 and Figure 6). Other sources of aluminum are found in durable and nondurable goods.

Generation. In 2000, nearly 2.0 million tons of aluminum were generated as containers and packaging, while approximately 1.2 million tons were found in durable and nondurable goods. The total—3.2 million tons—was 1.4 percent of total MSW generation in 2000. Aluminum generation was only 340,000 tons (0.4 percent of MSW generation) in 1960.

Recovery. Aluminum beverage containers were recovered at a rate of 54.6 percent of generation (0.8 million tons) in 2000, and 44.6 percent of all aluminum in containers and packaging was recovered for recycling in 2000.

Discards After Recovery. In 2000, about 2.3 million tons of aluminum were discarded in MSW after recovery, which was 1.4 percent of total MSW 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. Note that only lead-acid batteries from passenger cars, trucks, and motorcycles are included. Lead-acid batteries used in large equipment or industrial applications are not included.

Generation. Generation of other nonferrous metals in MSW totaled 1.4 million tons in 2000. Lead in batteries accounted for 960,000 tons of this amount. Generation of these metals has increased slowly, up from 180,000 tons in 1960. As a percentage of total generation, nonferrous metals have never exceeded 1 percent.

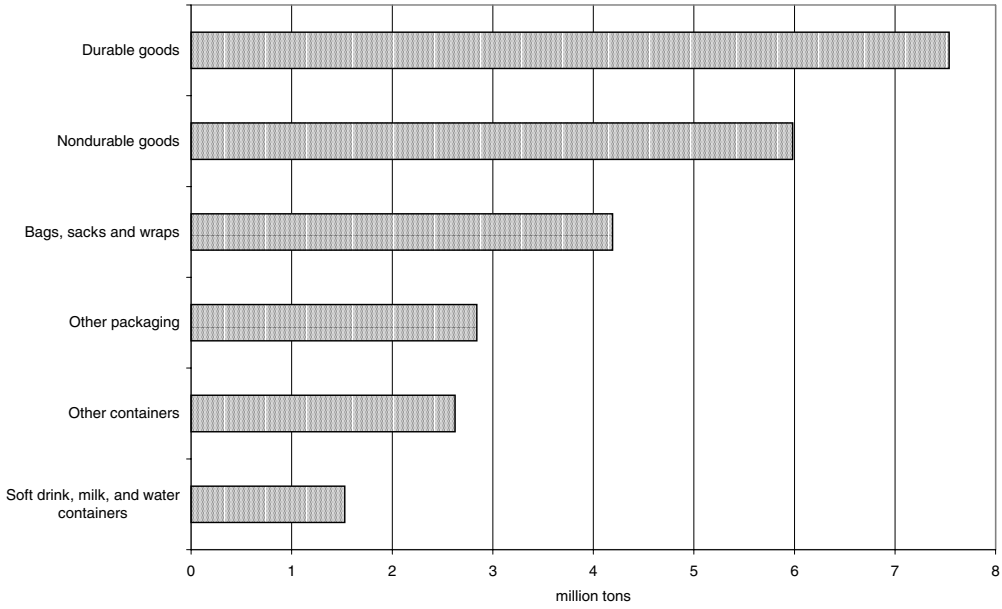
Recovery. Recovery of other nonferrous metals was 930,000 tons in 2000, with most of this being lead recovered from batteries. It was estimated that 96.9 percent of battery lead was recovered in 2000.

Discards After Recovery. In 2000, 460,000 tons of other nonferrous metals were discarded in MSW. Percentages of total discards remained less than 1 percent over the period.

Plastics

Plastics are a rapidly growing segment of MSW. While plastics are found in all major MSW categories, the containers and packaging category has the most plastic tonnage (Figure 8 and Table 7).

Figure 8. Plastics products generated in MSW, 2000



In durable goods, plastics are found in appliances, furniture, casings of lead-acid batteries, and other products. (Note that plastics in transportation products generally are not included in this report.) As shown in Table 7, a wide range of resin types is found in durable goods. While some detail is provided in Table 7 for resins in durable goods, hundreds of different resin formulations are used in appliances, carpets, and other durable goods; a complete listing is beyond the scope of this report.

Plastics are found in such nondurable products as disposable diapers, trash bags, cups, eating utensils, sporting and recreational equipment, medical devices, and household items such as shower curtains. The plastic foodservice items generally are made of clear or foamed polystyrene, while trash bags are made of high-density polyethylene (HDPE) or low-density polyethylene (LDPE). A wide variety of other resins are used in other nondurable goods.

Table 7

PLASTICS IN PRODUCTS IN MSW, 2000
(In thousands of tons, and percent of generation by resin)

Product Category	Generation (Thousand tons)	Recovery (Thousand tons)	Recovery (Percent of Gen.)	Discards (Thousand tons)
Durable Goods				
PET	410			
HDPE	560			
PVC	450			
LDPE/LLDPE	660			
PP	1,200			
PS	640			
Other resins	3,620			
Total Plastics in Durable Goods	7,540	310	4.1%	7,230
Nondurable Goods				
Plastic Plates and Cups				
LDPE/LLDPE	20			20
PS	850			850
Subtotal Plastic Plates and Cups	870			870
Trash Bags				
HDPE	230			230
LDPE/LLDPE	620			620
Subtotal Trash Bags	850			850
All other nondurables*				
PET	210			210
HDPE	410			410
PVC	590			590
LDPE/LLDPE	1,540			1,540
PP	850			850
PS	570			570
Other resins	90			90
Subtotal All Other Nondurables	4,260			4,260
Total Plastics in Nondurable Goods, by Resin				
PET	210			210
HDPE	640			640
PVC	590			590
LDPE/LLDPE	2,180			2,180
PP	850			850
PS	1,420			1,420
Other resins	90			90
Total Plastics in Nondurable Goods	5,980	0	0.0%	5,980
Plastic Containers & Packaging				
Soft drink bottles				
PET	830	290	34.9%	540
Milk and water bottles				
HDPE	690	210	30.4%	480

HDPE = High density polyethylene
LDPE = Low density polyethylene
LLDPE = Linear low density polyethylene
PET = Polyethylene terephthalate
PP = Polypropylene
PS = Polystyrene
PVC = Polyvinyl chloride

Source: Franklin Associates, Ltd.

Table 7 (continued)

PLASTICS IN PRODUCTS IN MSW, 2000
(In thousands of tons, and percent of generation by resin)

Product Category	Generation (Thousand tons)	Recovery (Thousand tons)	Recovery (Percent of Gen.)	Discards (Thousand tons)
Plastic Containers & Packaging, cont.				
Other plastic containers				
PET	880	90		790
HDPE	1,190	170		1,020
PVC	80			80
LDPE/LLDPE	30			30
PP	60			60
PS	0			0
Other resins	390			390
Subtotal Other Containers	2,630	260	9.9%	2,370
Bags, sacks, & wraps				
HDPE	770	30		740
PVC	70			70
LDPE/LLDPE	2,530	150		2,380
PP	640			640
PS	0			0
Other resins	190			
Subtotal Bags, Sacks, & Wraps	4,200	180	4.3%	4,020
Other Plastics Packaging**				
PET	160	50		110
HDPE	980	10		970
PVC	200			200
LDPE/LLDPE	340			340
PP	600	10		590
PS	220			220
Other resins	340	20		320
Subtotal Other Packaging	2,840	90	3.2%	2,750
Total Plastics in Containers & Packaging, by Resin				
PET	1,870	430		1,440
HDPE	3,630	420		3,210
PVC	350			350
LDPE/LLDPE	2,900	150		2,750
PP	1,300	10		1,290
PS	220			220
Other resins	920	20		900
Total Plastics in Cont. & Packaging	11,190	1,030	9.2%	10,160
Total Plastics in MSW, by Resin				
PET	2,490	430		2,060
HDPE	4,830	420		4,410
PVC	1,390			1,390
LDPE/LLDPE	5,740	150		5,590
PP	3,350	10		3,340
PS	2,280			2,280
Other resins	4,630	330		4,300
Total Plastics in MSW	24,710	1,340	5.4%	23,370

HDPE = High density polyethylene
LDPE = Low density polyethylene
LLDPE = Linear low density polyethylene
PET = Polyethylene terephthalate
PP = Polypropylene
PS = Polystyrene
PVC = Polyvinyl chloride

* All other nondurables include plastics in disposable diapers, clothing, footwear, etc.
** Other plastic packaging includes coatings, closures, caps, trays, shapes, etc.
Some detail of recovery by resin omitted due to lack of data.
This table may understate the recovery of plastics due to the dispersed nature of plastics recycling activities.

Source: Franklin Associates, Ltd.

Plastic resins also are used in a variety of container and packaging products such as polyethylene terephthalate (PET) soft drink bottles, high-density polyethylene bottles for milk and water, and a wide variety of other resin types used in other plastic containers, bags, sacks, wraps, and lids.

Generation. Production data on plastics resin use in products are taken from the *Modern Plastics* annual statistical issue and the American Plastics Council (APC) annual plastic recovery survey. The basic data are adjusted for product service life, fabrication losses, and net imports of plastic products to derive generation of plastics in the various products in MSW.

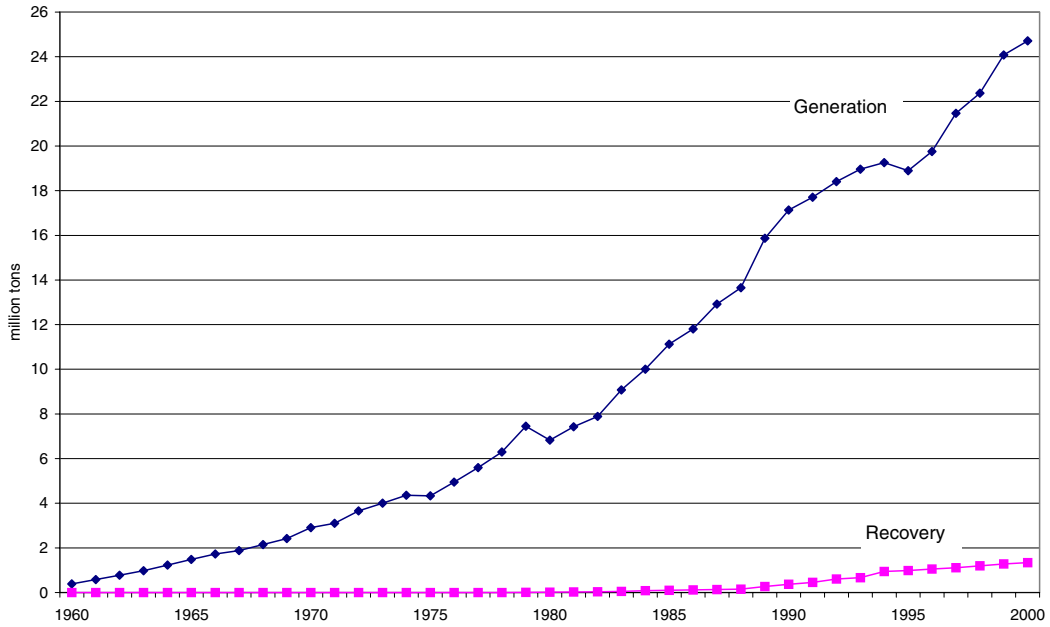
Plastics made up an estimated 390,000 tons of MSW generation in 1960. The quantity has increased relatively steadily to 24.7 million tons in 2000 (Figure 9). As a percentage of MSW generation, plastics were less than 1 percent in 1960, increasing to 10.7 percent in 2000.

Recovery for Recycling. While overall recovery of plastics for recycling is relatively small—1.3 million tons, or 5.4 percent* of plastics generation in 2000 (Table 7)—recovery of some plastic containers is more significant. PET soft drink bottles were recovered at a rate of 34.9 percent in 2000. Recovery of high-density polyethylene milk and water bottles was estimated at about 30.4 percent in 2000. Significant recovery of plastics from lead-acid battery casings and from some other containers was also reported. The primary source of data on plastics recovery is an annual survey conducted for the APC.

Discards After Recovery. Discards of plastics in MSW after recovery were estimated at 23.4 million tons, or 14.4 percent of total MSW discards.

* This number may be low. It is difficult to quantify plastics recovery because, unlike other end users such as paper and steel mills, recovered plastic end users tend to be very dispersed.

Figure 9. Plastics generation and recovery, 1960 to 2000



Other Materials

Rubber and Leather. The predominant source of rubber in MSW is rubber tires from automobiles and trucks (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.

Generation. Generation of rubber and leather in MSW has shown slow growth over the years, increasing from 1.8 million tons in 1960 to 6.4 million tons in 2000. One reason for the relatively slow rate of growth is that tires have been made smaller and longer-wearing than in earlier years.

As a percentage of total MSW generation, rubber and leather has been about 3 percent for many years.

Recovery for Recycling. The only recovery for recycling identified in this category is rubber from tires, and that was estimated to be 780,000 tons (26.1 percent of rubber in tires in 2000) (Table 8). (This recovery estimate does not include tires retreaded or energy recovery from tires.) Overall, 12.2 percent of rubber and leather in MSW was recovered in 2000.

Table 8

RUBBER AND LEATHER PRODUCTS IN MSW, 2000
(In thousands of tons and percent of generation)

Product Category	Generation (Thousand tons)	Recovery (Thousand tons)	Recovery (Percent of generation)	Discards (Thousand tons)
Durable Goods				
Rubber in Tires*	2,990	780	26.1%	2,210
Other Durables**	2,540	Neg.	Neg.	2,540
Total Rubber & Leather Durable Goods	5,530	780	14.1%	4,750
Nondurable Goods				
Clothing and Footwear	540	Neg.	Neg.	540
Other Nondurables	270	Neg.	Neg.	270
Total Rubber & Leather Nondurable Goods	810	Neg.	Neg.	810
Containers and Packaging	30	Neg.	Neg.	30
Total Rubber & Leather	6,370	780	12.2%	5,590

* Automobile and truck tires. Does not include other materials in tires.
** Includes carpets and rugs and other miscellaneous durables.
Neg. = Less than 5,000 tons or 0.05 percent.
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Discards After Recovery. Discards of rubber and leather after recovery were 5.6 million tons in 2000 (3.5 percent of total discards).

Textiles. Textiles in MSW are found mainly in discarded clothing, although other sources identified were furniture, carpets, tires, footwear, and other nondurable goods such as sheets and towels.

Generation. An estimated 9.4 million tons of textiles were generated in 2000 (4 percent of total MSW generation).

Recovery for Recycling and Discards. Significant amounts of textiles are recovered for reuse. However, the reused garments and wiper rags re-enter the waste stream eventually, so this is considered a diversion rather than recovery for recycling and, therefore, not included in the recovery for recycling estimates. Since data on elapsed time from recovery of textiles for reuse to final discard are limited, it was assumed that reused textiles re-enter the waste stream the same year that they are first discarded. It was estimated that 13.5 percent of textiles in clothing and items such as sheets and pillowcases was recovered for export or reprocessing in 2000 (1.3 million tons) leaving discards of 8.1 million tons of textiles in 2000.

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

Generation. Generation of wood in MSW was 12.7 million tons in 2000 (5.5 percent of total MSW generation).

Recovery for Recycling and Discards. Wood pallet recovery for recycling (usually by chipping for uses such as mulch or bedding material, but excluding wood combusted as fuel) was estimated at 480,000 tons in 2000.

Accounting for pallet reuse and recovery for recycling, wood discards were 12.2 million tons in 2000, or 7.5 percent of total MSW discards.

Other Products. Generation of "other products" 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 Scraps

Food scraps included here consist of uneaten food and food preparation scraps from residences, commercial establishments such as grocery stores and sit-down and fast food restaurants, institutional sources such as school cafeterias, and industrial sources such as factory lunchrooms. Food scraps generated during the preparation of packaged food products is considered industrial waste and therefore is not included in MSW food scrap estimates.

Generation. No production data are available for food scraps. Food scraps from residential and commercial sources were estimated using data from sampling studies in various parts of the country in combination with demographic data on population, grocery store sales, restaurant sales, numbers of employees, and numbers of prisoners and students in institutions. Generation of food scraps was estimated to be 25.9 million tons in 2000.

Recovery for Composting and Discards. Beginning in 1994 for this series of reports, a significant amount of food scrap composting from commercial sources was identified. As the data source (a survey published by *BioCycle* magazine) has improved, it has become apparent that some other composted materials (e.g., paper and industrial food processing wastes) have been included with food scraps classified as MSW in the past. For the 2000 estimate, a careful separation of MSW food composted resulted in an estimate of approximately 370,000 tons.

A survey of paper composting conducted by the American Forest & Paper Association yielded an estimate of approximately 160,000 tons of paper composted in 1997. In the absence of better data, this amount was kept constant for the 2000 estimate. Finally, another *BioCycle* survey yielded an estimate of approximately 150,000 tons of MSW composted (after an adjustment to avoid double counting the AF&PA survey). The total—680,000 tons of food scraps and other organic materials composted—is shown in the recovery tables on the line where only food scrap recovery was shown in previous reports.

Yard Trimmings

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

Generation. In earlier versions of this report, generation of yard trimmings was estimated using sampling studies and population data. While in past years, generation of yard trimmings had been increasing steadily as population and residential housing grew (i.e., constant generation on a per capita basis), in more recent years there has been a new trend—local and state legislation on yard trimmings disposal in landfills.

Legislation affecting yard trimmings disposal in landfills was tabulated, using published sources. In 1992, 11 states and the District of Columbia—accounting for more than 28 percent of the nation's population—had legislation in effect that bans or discourages yard trimmings disposal in landfills. The tabulation of existing legislation also showed that by 1997, 23 states and the District of Columbia, representing more than 50 percent of the nation's population, had legislation affecting disposal of yard trimmings. This has led to an increase in backyard composting and the use of mulching mowers to allow grass trimmings to remain in place.

Using these facts, it was estimated that the effect of this legislation was no increase in yard trimmings generation (i.e., entering the waste management system) between 1990 and 1992 (i.e., the increase in yard trimmings due to natural population increases was offset by source reduction efforts). Furthermore, with 50 percent of the population having yard trimmings legislation in 1997, it also was estimated that yard trimmings declined approximately 6 percent annually between 1992 and 1997. In the absence of significant new legislation, yard trimmings generation has been kept constant for 1997 through 2000. An estimated 27.7 million tons of yard trimmings were generated in MSW in 2000. (This compares to an estimated 35 million tons of yard trimmings generated in 1992.)

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* Although limited data are available on the composition of yard trimmings, it is estimated that the average composition by weight is about 50 percent grass, 25 percent brush, and 25 percent leaves. These are "ballpark" numbers that will vary widely according to climate and region of the country.

Recovery for Composting and Discards. Recovery for composting of yard trimmings was estimated using a telephone survey of state agencies, which estimated tonnages composted by facilities along with updated information on numbers of yard trimmings composting facilities. Also, data compiled by *BioCycle* magazine indicated that there were about 3,000 composting facilities for yard trimmings in 1992, increasing to 3,800 facilities in 2000. The survey resulted in an estimate of 15.8 million tons of yard trimmings removed for composting in 2000—a significant increase over the previous estimates. Discards of yard trimmings in 2000 thus were 12.0 million tons. Based on the survey results, the previous estimate of yard trimmings recovery in 1999 was revised upward also, to a point halfway between recovery in 1998 and 2000.

It should be noted that the estimated 15.8 million tons recovered for composting in 2000 does not include yard trimmings recovered for landspreading disposal. It also should be noted that these recovery estimates do not account for backyard composting by individuals and practices such as less bagging of grass clippings. These are source reduction activities taking place onsite, while the yard trimmings recovery estimates are based on material sent offsite. Source reduction activities are estimated in Chapter 4.

Miscellaneous Inorganic Wastes

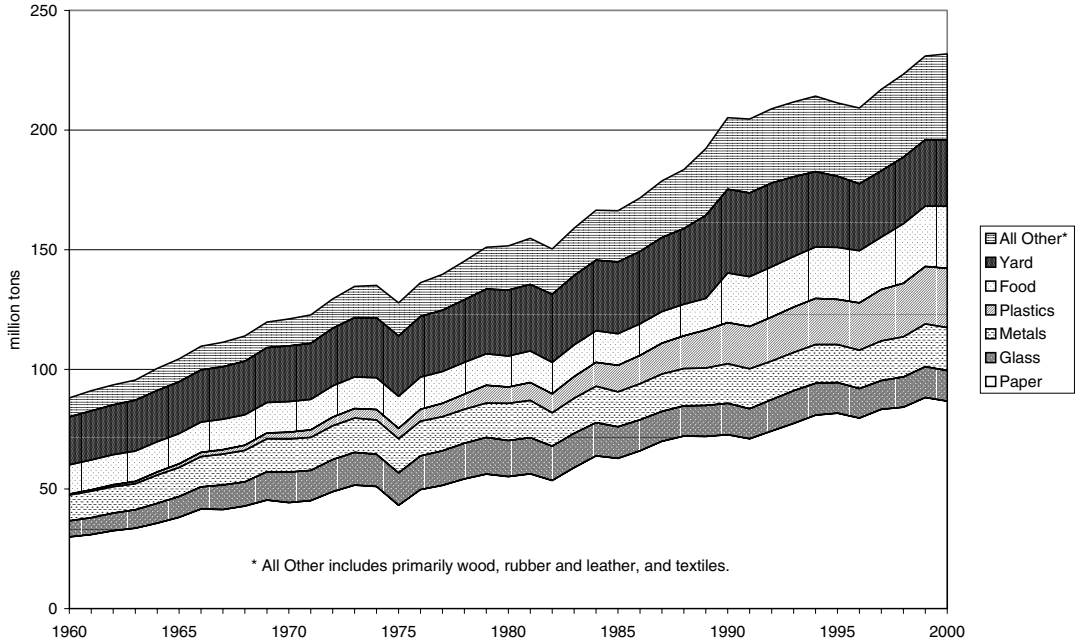
This relatively small category of MSW also is derived from sampling studies. It is not well defined and often shows up in sampling reports as “fines” or “other.” It includes soil, bits of concrete, stones, and the like.

Generation, Recovery, and Discards. This category contributed an estimated 3.5 million tons of MSW in 2000. 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 relatively steadily, from 88.1 million tons in 1960 to 231.9 million tons in 2000.

Figure 10. Generation of materials in MSW, 1960 to 2000

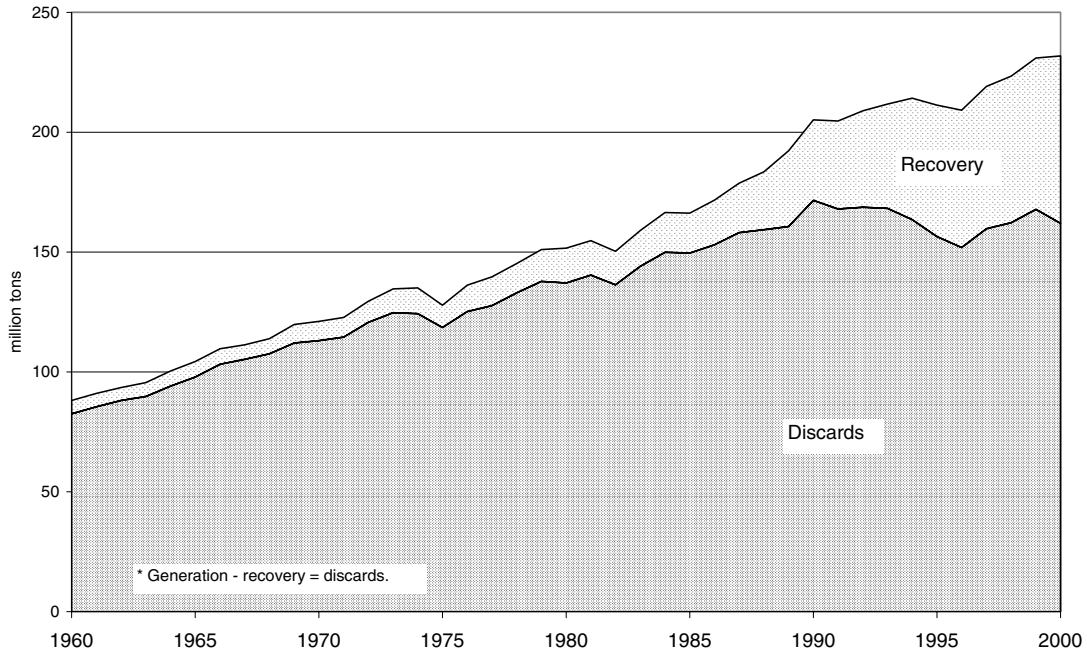


Over the years, paper and paperboard has been the dominant material category generated in MSW, accounting for 37.4 percent of generation in 2000. Yard trimmings, the second largest material component of MSW (12 percent of MSW generation) has been declining as a percentage of MSW in recent years due to state and local legislated landfill bans and increased emphasis on backyard composting and other source reduction measures such as the use of mulching mowers.

Metals accounted for 7.8 percent of MSW generation in 2000; they have remained fairly constant as a source of MSW. Glass generation increased until the 1980s, but decreased somewhat in the 1990s. Glass generation was 12.8 million tons in 2000, 5.5 percent of MSW generated. Food wastes have remained fairly constant in terms of MSW tonnage (11.2 percent of generation in 2000). Plastics have increasingly been used in a variety of products and thus have been a rapidly growing component of MSW. In terms of tonnage contributed, plastics ranked fourth in 2000 (behind paper, yard trimmings, and food scraps), accounting for 10.7 percent of MSW generation.

Recovery and Discards. The effect of recovery on MSW discards is illustrated in Figure 11. Recovery of materials for recycling and composting grew at a rather slow pace from 1960 to the 1980s, increasing from only 6.4 percent of generation in 1960 to 10.9 percent in 1985. Renewed interest in recycling (including composting) as waste management alternatives came about in the late 1980s, and the recovery rate in 1990 was estimated to be 16.2 percent of generation, increasing to 30.1 percent in 2000.

Figure 11. Recovery and discards of MSW,* 1960 to 2000



Estimated recovery of materials (including composting) is shown in Figure 12. In 2000, recovery of paper and paperboard dominated materials recovery at 56 percent of total tonnage recovered, while yard trimmings contributed 23 percent of total recovery. Recovery of other materials, while generally increasing, contributes much less tonnage, reflecting in part the relatively smaller amounts of materials generated in those categories.

Figure 12. Materials recovery,* 2000

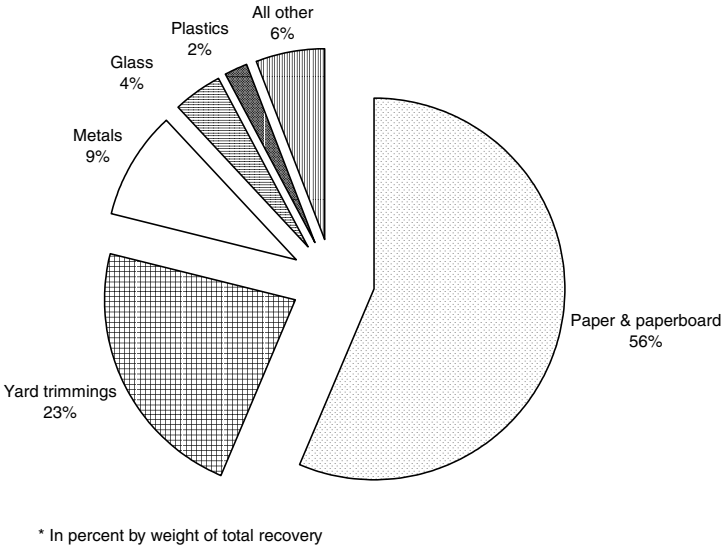
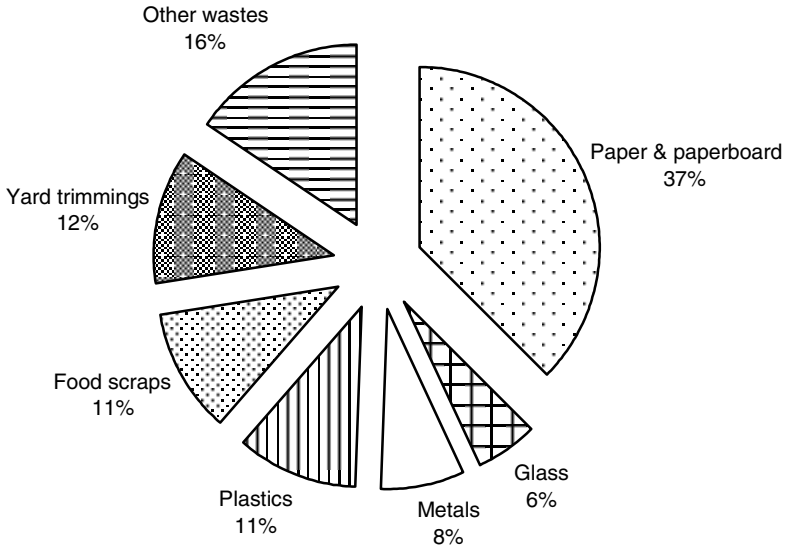
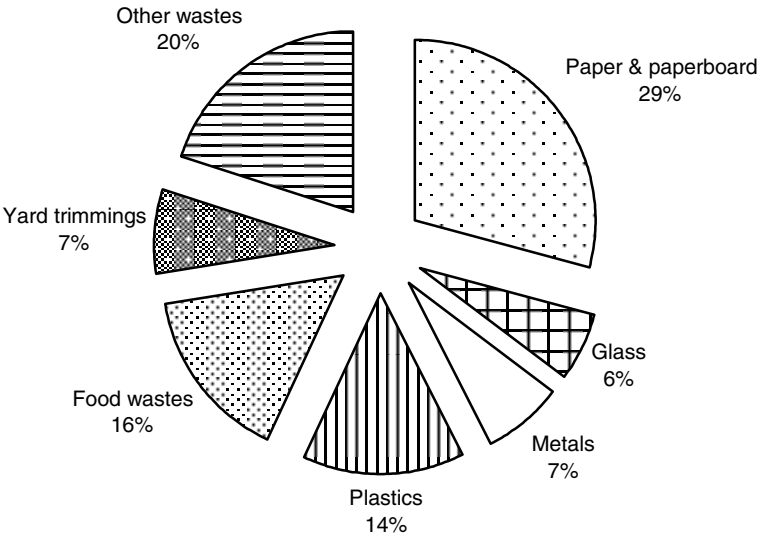


Figure 13 illustrates the effect of recovery of materials for recycling, including composting, on the composition of MSW discards. For example, paper and paperboard were 37.4 percent of MSW generated in 2000, but after recovery, paper and paperboard were 29.2 percent of discards. Materials that have little or no recovery exhibit a larger percentage of MSW discards compared to generation.

Figure 13. Materials generated and discarded in municipal solid waste, 2000
(In percent of total generation and discards)



Generation



Discards

The Chapter 2 section above gave a breakdown of municipal solid waste by material. It described how the 231.9 million tons of MSW was generated, recycled (including composted), and disposed of. The following section breaks out the same 231.9 million tons of MSW by product.

PRODUCTS IN MUNICIPAL SOLID WASTE

The purpose of this section is to show how the products that make up municipal solid waste are generated, recycled (including composted), and discarded. For the analysis, products are divided into three basic categories: durable goods, nondurable goods, and containers and packaging. These three categories generally follow the definitions of the U.S. Department of Commerce, one of EPA's data sources. By these definitions, durable goods, (e.g., appliances) are those that last 3 years or more, while nondurable goods (e.g., newspapers and trash bags) last less then 3 years. For this report, containers and packaging are assumed to be discarded the same year the products they contain are purchased.

The following 15 tables (Tables 9 through 23) show generation, recycling (including composting), and discards of municipal solid waste in the three categories—durable goods, nondurable goods, and containers and packaging. Within these three categories, products are listed by type—for instance, carpets and rugs, office paper, or aluminum cans. The materials the product is made of may be stated as well (for instance, glass beverage containers or steel cans), or the material may be obvious (for instance, magazines are made of paper). Some products, such as tires or appliances, are made of several different material types.

At the bottom of each of these 15 tables (Tables 9 through 23), there is a section titled "Other Wastes." This section contains information on food scraps, yard trimmings, and miscellaneous inorganic wastes. These wastes are not products that can be estimated through the material flows methodology, but they are estimated by other means, as described earlier.

Within Tables 9 through 23, the first three tables—Tables 9 to 11—serve as an index to the other tables. Table 9 shows which tables to consult for detailed information on generation; Table 10 shows which tables to consult for detailed information on recovery; and Table 11 does the same for detailed information on discards. The tables on generation all have the same "bottom line"—231.9 million tons in 2000—with detail provided in different categories—durable goods, nondurable goods, and containers and packaging. For Table 10 and related tables, the "bottom line" is MSW recovered—69.9 million tons; and for Table 11 and related tables, the "bottom line" is MSW discarded—162.0 million tons.

Durable Goods

Durable goods generally are defined as products having a lifetime of 3 years or more, although there are some exceptions. In this report, durable goods include large and small appliances, furniture and furnishings, carpets and rugs, rubber tires, lead-acid automotive batteries, and miscellaneous durable goods (e.g., luggage, consumer electronics) (see Tables 12 through 14). These products often are called "oversize and bulky" in municipal solid waste management practice, and they generally are handled in a somewhat different manner than 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 2000, these include: ferrous metals, plastics, rubber and leather, wood, textiles, glass, other nonferrous metals (e.g., lead, copper), and aluminum.

Generation of durable goods in MSW totaled 36.3 million tons in 2000 (15.7 percent of total MSW generation). After recovery for recycling, 30.3 million tons of durable goods remained as discards in 2000.

Table 9

CATEGORIES OF PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(In thousands of tons and percent of total generation)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 12)*	9,920	14,660	21,800	29,810	31,140	34,360	35,350	36,330
Nondurable Goods *(Detail in Table 15)*	17,330	25,060	34,420	52,170	57,250	60,300	62,990	63,660
Containers and Packaging *(Detail in Table 18)*	27,370	43,560	52,670	64,530	68,390	72,770	76,330	74,730
***Total Product** Wastes*	54,620	83,280	108,890	146,510	156,780	167,430	174,670	174,720
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,740	24,910	25,160	25,900
Yard Trimmings	20,000	23,200	27,500	35,000	29,690	27,730	27,730	27,730
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,290	3,380	3,500
Total Other Wastes	33,500	37,780	42,750	58,700	54,580	55,930	56,270	57,130
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	211,360	223,360	230,940	231,850
	Percent of Total Generation							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 12)*	11.3%	12.1%	14.4%	14.5%	14.7%	15.4%	15.3%	15.7%
Nondurable Goods *(Detail in Table 15)*	19.7%	20.7%	22.7%	25.4%	27.1%	27.0%	27.3%	27.5%
Containers and Packaging *(Detail in Table 19)*	31.1%	36.0%	34.7%	31.4%	32.4%	32.6%	33.1%	32.2%
***Total Product** Wastes*	62.0%	68.8%	71.8%	71.4%	74.2%	75.0%	75.6%	75.4%
Other Wastes								
Food Scraps	13.8%	10.6%	8.6%	10.1%	10.3%	11.2%	10.9%	11.2%
Yard Trimmings	22.7%	19.2%	18.1%	17.1%	14.0%	12.4%	12.0%	12.0%
Miscellaneous Inorganic Wastes	1.5%	1.5%	1.5%	1.4%	1.5%	1.5%	1.5%	1.5%
Total Other Wastes	38.0%	31.2%	28.2%	28.6%	25.8%	25.0%	24.4%	24.6%
Total MSW Generated - %	100.0%	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 wastes.
** Other than food products.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Table 10

RECOVERY* OF MUNICIPAL SOLID WASTE, 1960 TO 2000
(In thousands of tons and percent of generation of each category)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods	350	940	1,360	3,460	5,010	5,710	5,920	6,020
(Detail in Table 13)								
Nondurable Goods	2,390	3,730	4,670	8,800	13,610	14,980	16,130	18,320
(Detail in Table 16)								
Containers and Packaging	2,870	3,350	8,490	16,780	26,720	27,260	28,010	29,080
(Detail in Table 20)								
***Total Product** Wastes*	5,610	8,020	14,520	29,040	45,340	47,950	50,060	53,420
Other Wastes								
Food, Other^	Neg.	Neg.	Neg.	Neg.	570	580	550	680
Yard Trimmings	Neg.	Neg.	Neg.	4,200	9,000	12,560	14,170	15,770
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	4,200	9,570	13,140	14,720	16,450
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	54,910	61,090	64,780	69,870
	Percent of Generation of Each Category							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods	3.5%	6.4%	6.2%	11.6%	16.1%	16.6%	16.7%	16.6%
(Detail in Table 13)								
Nondurable Goods	13.8%	14.9%	13.6%	16.9%	23.8%	24.8%	25.6%	28.8%
(Detail in Table 16)								
Containers and Packaging	10.5%	7.7%	16.1%	26.0%	39.1%	37.5%	36.7%	38.9%
(Detail in Table 21)								
***Total Product** Wastes*	10.3%	9.6%	13.3%	19.8%	28.9%	28.6%	28.7%	30.6%
Other Wastes								
Food, Other^	Neg.	Neg.	Neg.	Neg.	2.6%	2.3%	2.2%	2.6%
Yard Trimmings	Neg.	Neg.	Neg.	12.0%	30.3%	45.3%	51.1%	56.9%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	7.2%	17.5%	23.5%	26.2%	28.8%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.0%	27.4%	28.1%	30.1%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Other than food products.
^ Includes recovery of paper for composting.
Neg. = Less than 5,000 tons or 0.05 percent.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Table 11

CATEGORIES OF PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(In thousands of tons and percent of total discards)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 14)*	9,570	13,720	20,440	26,350	26,130	28,650	29,430	30,310
Nondurable Goods *(Detail in Table 17)*	14,940	21,330	29,750	43,370	43,640	45,320	46,860	45,340
Containers and Packaging *(Detail in Table 22)*	24,500	40,210	44,180	47,750	41,670	45,510	48,320	45,650
***Total Product** Wastes*	49,010	75,260	94,370	117,470	111,440	119,480	124,610	121,300
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,170	24,330	24,610	25,220
Yard Trimmings	20,000	23,200	27,500	30,800	20,690	15,170	13,560	11,960
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,290	3,380	3,500
Total Other Wastes	33,500	37,780	42,750	54,500	45,010	42,790	41,550	40,680
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	156,450	162,270	166,160	161,980
	Percent of Total Discards							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 14)*	11.6%	12.1%	14.9%	15.3%	16.7%	17.7%	17.7%	18.7%
Nondurable Goods *(Detail in Table 17)*	18.1%	18.9%	21.7%	25.2%	27.9%	27.9%	28.2%	28.0%
Containers and Packaging *(Detail in Table 23)*	29.7%	35.6%	32.2%	27.8%	26.6%	28.0%	29.1%	28.2%
***Total Product** Wastes*	59.4%	66.6%	68.8%	68.3%	71.2%	73.6%	75.0%	74.9%
Other Wastes								
Food Scraps	14.8%	11.3%	9.5%	12.1%	13.5%	15.0%	14.8%	15.6%
Yard Trimmings	24.2%	20.5%	20.1%	17.9%	13.2%	9.3%	8.2%	7.4%
Miscellaneous Inorganic Wastes	1.6%	1.6%	1.6%	1.7%	2.0%	2.0%	2.0%	2.2%
Total Other Wastes	40.6%	33.4%	31.2%	31.7%	28.8%	26.4%	25.0%	25.1%
Total MSW Discarded - %	100.0%	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 wastes.
** Other than food products.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Major Appliances. Major appliances in MSW include refrigerators, washing machines, and water heaters. They often are called "white goods" in the trade. Data on unit production of appliances are taken from *Appliance Manufacturer Market Profile*. The unit data are converted to weight using various conversion factors developed over the years, plus data on the materials composition of the appliances. Adjustments also are made for the estimated lifetimes of the appliances, which range up to 20 years.

Generation of major appliances has increased slowly over the years, and in fact was about constant for the past 3 years. In 2000, generation was 3.6 million tons, or 1.6 percent of total MSW generation. In general, appliances have increased in quantity but not in average weight over the years. Ferrous metals (steel and iron) are the predominant materials in major appliances, but other metals, plastics, glass, and other materials are also present.

Data on recovery of ferrous metals from major appliances are taken from a survey conducted by the Steel Recycling Institute. Recovery of ferrous metals from shredded appliances was estimated to be 2.0 million tons in 2000, leaving 1.6 million tons of appliances to be discarded.

Small Appliances. This category includes items such as toasters, hair dryers, electric coffeepots, and the like. Information on shipments of small appliances was obtained from U.S. Department of Commerce data. Information on weights and materials composition of discarded small appliances was obtained through interviews. It was estimated that 1.0 million tons of small appliances were generated in 2000. A small amount of ferrous metals in small appliances is recovered through magnetic separation.

Furniture and Furnishings. Data on sales of furniture and furnishings are provided by the U.S. Department of Commerce in dollars. These data are converted to tons using factors developed for this study over the years. Adjustments are made for imports and exports, and adjustments are made for the lifetimes of the furniture.

Table 12

PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(WITH DETAIL ON DURABLE GOODS)
(In thousands of tons and percent of total generation)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods								
Major Appliances	1,630	2,170	2,950	3,310	3,420	3,650	3,680	3,640
Small Appliances**				460	710	890	940	1,000
Furniture and Furnishings	2,150	2,830	4,760	6,790	7,170	7,600	7,710	7,840
Carpets and Rugs**				1,660	2,230	2,410	2,470	2,570
Rubber Tires	1,120	1,890	2,720	3,610	3,770	4,510	4,630	4,670
Batteries, Lead Acid	Neg.	820	1,490	1,510	1,810	1,930	1,940	1,940
Miscellaneous Durables								
Selected Consumer Electronics***							1,760	2,120
Other Miscellaneous Durables							12,220	12,550
Total Miscellaneous Durables	5,020	6,950	9,880	12,470	12,030	13,370	13,980	14,670
Total Durable Goods	9,920	14,660	21,800	29,810	31,140	34,360	35,350	36,330
Nondurable Goods	17,330	25,060	34,420	52,170	57,250	60,300	62,990	63,660
(Detail in Table 15)								
Containers and Packaging	27,370	43,560	52,670	64,530	68,390	72,770	76,330	74,730
(Detail in Table 18)								
Total Product Wastes†	54,620	83,280	108,890	146,510	156,780	167,430	174,670	174,720
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,740	24,910	25,160	25,900
Yard Trimmings	20,000	23,200	27,500	35,000	29,690	27,730	27,730	27,730
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,290	3,380	3,500
Total Other Wastes	33,500	37,780	42,750	58,700	54,580	55,930	56,270	57,130
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	211,360	223,360	230,940	231,850
	Percent of Total Generation							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods								
Major Appliances	1.8%	1.8%	1.9%	1.6%	1.6%	1.6%	1.6%	1.6%
Small Appliances**				0.2%	0.3%	0.4%	0.4%	0.4%
Furniture and Furnishings	2.4%	2.3%	3.1%	3.3%	3.4%	3.4%	3.3%	3.4%
Carpets and Rugs**				0.8%	1.1%	1.1%	1.1%	1.1%
Rubber Tires	1.3%	1.6%	1.8%	1.8%	1.8%	2.0%	2.0%	2.0%
Batteries, Lead-Acid	Neg.	0.7%	1.0%	0.7%	0.9%	0.9%	0.8%	0.8%
Miscellaneous Durables								
Selected Consumer Electronics***							0.8%	0.9%
Other Miscellaneous Durables							5.3%	5.4%
Total Miscellaneous Durables	5.7%	5.7%	6.5%	6.1%	5.7%	6.0%	6.1%	6.3%
Total Durable Goods	11.3%	12.1%	14.4%	14.5%	14.7%	15.4%	15.3%	15.7%
Nondurable Goods	19.7%	20.7%	22.7%	25.4%	27.1%	27.0%	27.3%	27.5%
(Detail in Table 15)								
Containers and Packaging	31.1%	36.0%	34.7%	31.4%	32.4%	32.6%	33.1%	32.2%
(Detail in Table 19)								
Total Product Wastes†	62.0%	68.8%	71.8%	71.4%	74.2%	75.0%	75.6%	75.4%
Other Wastes								
Food Scraps	13.8%	10.6%	8.6%	10.1%	10.3%	11.2%	10.9%	11.2%
Yard Trimmings	22.7%	19.2%	18.1%	17.1%	14.0%	12.4%	12.0%	12.0%
Miscellaneous Inorganic Wastes	1.5%	1.5%	1.5%	1.4%	1.5%	1.5%	1.5%	1.5%
Total Other Wastes	38.0%	31.2%	28.2%	28.6%	25.8%	25.0%	24.4%	24.6%
Total MSW Generated - %	100.0%	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 wastes. Details may not add to totals due to rounding.

** Not estimated separately prior to 1990.

*** Not estimated separately prior to 1999.

† Other than food products.

Neg. = Less than 5,000 tons or 0.05 percent.

Source: Franklin Associates, Ltd..

Table 13

RECOVERY* OF PRODUCTS IN MUNICIPAL SOLID WASTE, 1960 TO 2000
(WITH DETAIL ON DURABLE GOODS)
(In thousands of tons and percent of generation of each product)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods								
Major Appliances	10	50	130	1,070	2,070	1,940	1,920	2,000
Small Appliances**				10	10	20	20	20
Furniture and Furnishings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Carpets and Rugs**				Neg.	20	20	20	30
Rubber Tires	330	250	150	440	670	1,060	1,280	1,210
Batteries, Lead Acid	Neg.	620	1,040	1,470	1,620	1,870	1,870	1,870
Miscellaneous Durables								
Selected Consumer Electronics***							160	190
Other Miscellaneous Durables							650	700
Total Miscellaneous Durables	10	20	40	470	620	800	810	890
Total Durable Goods	350	940	1,360	3,460	5,010	5,710	5,920	6,020
Nondurable Goods	2,390	3,730	4,670	8,800	13,610	14,980	16,130	18,320
(Detail in Table 16)								
Containers and Packaging	2,870	3,350	8,490	16,780	26,720	27,260	28,010	29,080
(Detail in Table 20)								
Total Product Wastes†	5,610	8,020	14,520	29,040	45,340	47,950	50,060	53,420
Other Wastes								
Food Scraps	Neg.	Neg.	Neg.	Neg.	570	580	550	680
Yard Trimmings	Neg.	Neg.	Neg.	4,200	9,000	12,560	14,170	15,770
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	4,200	9,570	13,140	14,720	16,450
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	54,910	61,090	64,780	69,870
	Percent of Generation of Each Product							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods								
Major Appliances	0.6%	2.3%	4.4%	32.3%	60.5%	53.2%	52.2%	54.9%
Small Appliances**				2.2%	1.4%	2.2%	2.1%	2.0%
Furniture and Furnishings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Carpets and Rugs**				Neg.	0.9%	0.8%	0.8%	1.2%
Rubber Tires	29.5%	13.2%	5.5%	12.2%	17.8%	23.5%	27.6%	25.9%
Batteries, Lead-Acid	Neg.	75.6%	69.8%	97.4%	89.5%	96.9%	96.4%	96.4%
Miscellaneous Durables								
Selected Consumer Electronics***							9.1%	
Other Miscellaneous Durables							5.3%	
Total Miscellaneous Durables	0.2%	0.3%	0.4%	3.8%	5.2%	6.0%	5.8%	6.1%
Total Durable Goods	3.5%	6.4%	6.2%	11.6%	16.1%	16.6%	16.7%	16.6%
Nondurable Goods	13.8%	14.9%	13.6%	16.9%	23.8%	24.8%	25.6%	28.8%
(Detail in Table 16)								
Containers and Packaging	10.5%	7.7%	16.1%	26.0%	39.1%	37.5%	36.7%	38.9%
(Detail in Table 21)								
Total Product Wastes†	10.3%	9.6%	13.3%	19.8%	28.9%	28.6%	28.7%	30.6%
Other Wastes								
Food Scraps	Neg.	Neg.	Neg.	Neg.	2.6%	2.3%	2.2%	2.6%
Yard Trimmings	Neg.	Neg.	Neg.	12.0%	30.3%	45.3%	51.1%	56.9%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	7.2%	17.5%	23.5%	26.2%	28.8%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.0%	27.4%	28.1%	30.1%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Not estimated separately prior to 1990.
*** Not estimated separately prior to 1999.
† Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Table 14

PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(WITH DETAIL ON DURABLE GOODS)
(In thousands of tons and percent of total discards)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods								
Major Appliances	1,620	2,120	2,820	2,240	1,350	1,710	1,760	1,640
Small Appliances**				450	700	870	920	980
Furniture and Furnishings	2,150	2,830	4,760	6,790	7,170	7,600	7,710	7,840
Carpets and Rugs**				1,660	2,210	2,390	2,450	2,540
Rubber Tires	790	1,640	2,570	3,170	3,100	3,450	3,350	3,460
Batteries, Lead acid	Neg.	200	450	40	190	60	70	70
Miscellaneous Durables								
Selected Consumer Electronics***							1,600	1,930
Other Miscellaneous Durables							11,570	11,850
Total Miscellaneous Durables	5,010	6,930	9,840	12,000	11,410	12,570	13,170	13,780
Total Durable Goods	9,570	13,720	20,440	26,350	26,130	28,650	29,430	30,310
Nondurable Goods	14,940	21,330	29,750	43,370	43,640	45,320	46,860	45,340
(Detail in Table 17)								
Containers and Packaging	24,500	40,210	44,180	47,750	41,670	45,510	48,320	45,650
(Detail in Table 22)								
Total Product Wastes†	49,010	75,260	94,370	117,470	111,440	119,480	124,610	121,300
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,170	24,330	24,610	25,220
Yard Trimmings	20,000	23,200	27,500	30,800	20,690	15,170	13,560	11,960
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,290	3,380	3,500
Total Other Wastes	33,500	37,780	42,750	54,500	45,010	42,790	41,550	40,680
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	156,450	162,270	166,160	161,980
	Percent of Total Discards							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods								
Major Appliances	2.0%	1.9%	2.1%	1.3%	0.9%	1.1%	1.1%	1.0%
Small Appliances**				0.3%	0.4%	0.5%	0.6%	0.6%
Furniture and Furnishings	2.6%	2.5%	3.5%	3.9%	4.6%	4.7%	4.6%	4.8%
Carpets and Rugs**				1.0%	1.4%	1.5%	1.5%	1.6%
Rubber Tires	1.0%	1.5%	1.9%	1.8%	2.0%	2.1%	2.0%	2.1%
Batteries, Lead-Acid	Neg.	0.2%	0.3%	0.0%	0.1%	0.0%	0.0%	0.0%
Miscellaneous Durables								
Selected Consumer Electronics***							1.0%	1.2%
Other Miscellaneous Durables							6.9%	7.2%
Total Miscellaneous Durables	6.1%	6.1%	7.2%	7.0%	7.3%	7.7%	7.9%	8.5%
Total Durable Goods	11.6%	12.1%	14.9%	15.3%	16.7%	17.7%	17.7%	18.7%
Nondurable Goods	18.1%	18.9%	21.7%	25.2%	27.9%	27.9%	28.2%	28.0%
(Detail in Table 17)								
Containers and Packaging	29.7%	35.6%	32.2%	27.8%	26.6%	28.0%	29.1%	28.2%
(Detail in Table 23)								
Total Product Wastes†	59.4%	66.6%	68.8%	68.3%	71.2%	73.6%	75.0%	74.9%
Other Wastes								
Food Scraps	14.8%	11.3%	9.5%	12.1%	13.5%	15.0%	14.8%	15.6%
Yard Trimmings	24.2%	20.5%	20.1%	17.9%	13.2%	9.3%	8.2%	7.4%
Miscellaneous Inorganic Wastes	1.6%	1.6%	1.6%	1.7%	2.0%	2.0%	2.0%	2.2%
Total Other Wastes	40.6%	33.4%	31.2%	31.7%	28.8%	26.4%	25.0%	25.1%
Total MSW Discarded - %	100.0%	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 wastes. Details may not add to totals due to rounding.

** Not estimated separately prior to 1990.

*** Not estimated separately prior to 1999.

† Other than food products.

Neg. = Less than 5,000 tons or 0.05 percent.

Source: Franklin Associates, Ltd.

Generation of waste furniture and furnishings in MSW has increased from 2.2 million tons in 1960 to 7.8 million tons in 2000 (3.4 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 also are found in furniture.

Carpets and Rugs. An industry publication, *Carpet and Rug Industrial Review*, publishes data on carpet sales in square yards. These data are converted to tons using various factors developed for this report. An estimated 2.6 million tons of carpets and rugs were generated in MSW in 2000, which was 1.1 percent of total generation.

A small amount of recycling of carpet fiber was identified—estimated to be about 1.2 percent of generation in 2000.

Vehicle Tires. The methodology for estimating generation of rubber tires for automobiles and trucks is based on data on replacement tires purchased and vehicles deregistered as reported by the U.S. Department of Commerce. It is assumed that for each replacement tire purchased, a used tire enters the waste management system, and that tires on deregistered vehicles also enter the waste management system. Retreaded tires are treated as a diversion out of the waste stream; they are assumed to re-enter the waste stream after 2 years of use.

The quantities of tires in units are converted to weight and materials composition using factors developed for this series of reports. In addition to rubber, tires include relatively small amounts of textiles and ferrous metals. Generation of rubber tires increased from 1.1 million tons in 1960 to 4.7 million tons in 2000 (2 percent of total MSW).

Data on recovery of tires in recent years are based on information from the Scrap Tire Management Council. Rubber recovery from tires has been increasing in recent years. In 2000, an estimated 25.9 percent of the weight of tires generated was recovered for recycling, leaving 3.5 million tons to be discarded. (Tires going to combustion facilities as fuel are included in the combustion estimates in Chapter 3.)

Lead-Acid Batteries. The methodology for estimating generation of lead-acid batteries is similar to the methodology for rubber tires as described above. An estimated 1.9 million tons of lead-acid batteries from automobiles, trucks, and motorcycles were generated in MSW in 2000 (less than 1 percent of total generation).

The Battery Council International provided data on recovery of batteries. Recovery of batteries for recycling has fluctuated between 60 percent and 98 percent or higher; recovery has increased since 1980 as a growing number of communities have restricted batteries from disposal at landfills or combustion facilities. In 2000, 96.4 percent of the lead in these batteries was estimated to be recovered for recycling, as well as substantial quantities of the polypropylene battery casings, so discards after recycling of these batteries decreased to 70,000 tons in 2000. (Some electrolytes and other materials in batteries are removed from the municipal solid waste stream along with recovered lead and polypropylene; these materials are counted as "recovered" along with the recyclable materials.)

Miscellaneous Durable Goods. Miscellaneous durable goods include consumer electronics such as television sets, video cassette recorders, and personal computers; luggage; sporting equipment; and the like. An estimated 14.7 million tons of these goods were generated in 2000, amounting to 6.3 percent of MSW generated.

For the previous update of this report, generation of selected consumer electronic products was estimated as a subset of miscellaneous durable goods for the first time. In 2000, an estimated 2.1 million tons of these goods were generated. Of this, approximately 190,000 tons of selected consumer electronics were recovered for recycling. Additional information on consumer electronics can be found in Appendix C.

The miscellaneous durable goods category, as a whole, includes ferrous metals as well as plastics, glass, rubber, wood, and other metals. An estimated 670,000 tons of ferrous metals were estimated to have been recovered from this category through pre-combustion and post-combustion magnetic separation at MSW combustion facilities in 2000, bringing total recovery from this category to 890,000 tons. Discards of miscellaneous durable goods were 13.8 million tons in 2000.

Nondurable Goods

The Department of Commerce defines nondurable goods as those having a lifetime of less than 3 years, and their 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; linens; and other miscellaneous products. (See Tables 15 through 17.)

Generation of nondurable goods in MSW was 63.7 million tons in 2000 (27.5 percent of total generation). Recovery of paper products in this category is quite significant, resulting in 18.3 million tons of nondurable goods recovered in 2000 (28.8 percent of nondurables generation). This means that 45.3 million tons of nondurable goods were discarded in 2000 (28 percent of total MSW discards).

Paper and Paperboard Products. Generation, recovery, and discards of paper and paperboard products in nondurable goods are summarized in Tables 15 through 17. A summary for 2000 was shown earlier in Table 4. Generation of paper and paperboard nondurable products increased each year from 1997 to 1999, but showed only a slight increase from 1999 to 2000. Each of the paper and paperboard product categories in nondurable goods is discussed briefly below.

- Newspapers are by far the largest single component of the nondurable goods category, at 15 million tons generated in 2000 (6.5 percent of total MSW). In 2000, an estimated 58.2 percent of newspapers generated were recovered for recycling, leaving 6.3 million tons discarded (3.9 percent of total MSW discarded). Estimates of newspaper generation are broken down into newsprint (the majority of the weight of newspapers) and groundwood* inserts (primarily advertising) that are a significant portion of the total weight of newspapers. This breakdown is shown in Table 4.

* Groundwood papers, like newsprint, are made primarily from pulp prepared by a mechanical process. The other major type of wood pulp is prepared by a chemical process. The nature of the pulp (groundwood vs. chemical) affects the potential uses for the recovered paper.

- Books amounted to approximately 1.1 million tons, or 0.5 percent of total MSW generation, in 2000. Recovery of books is not well documented, but it was estimated that approximately 220,000 tons of books were recovered in 2000. Books are made of both groundwood and chemical pulp.

- Magazines accounted for an estimated 2.1 million tons, or 0.9 percent of total MSW generation, in 2000. Like books, recovery of magazines is not well documented. It was estimated that 680,000 tons of magazines were recovered in 2000. Magazines are predominately made of coated groundwood, but some uncoated groundwood and chemical pulps also are used.

- Many different kinds of papers are generated in offices. For this report, office-type paper estimates include the high-grade papers such as copier paper, computer printout, and stationery. (7.5 million tons, or 3.2 percent of total MSW generation, in 2000). These papers are almost entirely made of uncoated chemical pulp, although some amounts of groundwood also are used. It should be noted that some of these office-type papers are generated at locations other than offices, including homes and institutions such as schools. Also, other kinds of papers (e.g., newspapers, magazines, and packaging) are generated in offices, but are accounted for in other categories. An estimated 4.1 million tons of office-type papers were recovered in 2000.

- Directories were estimated to generate 740,000 tons (0.3 percent of total MSW) in 2000. These directories are made of groundwood. It was estimated that 130,000 tons of directories were recovered in 2000.

- Standard (A) Mail* includes catalogs and other direct bulk mailings; these amounted to an estimated 5.6 million tons, or 2.4 percent of MSW generation, in 2000. Both groundwood and chemical pulps are used in these mailings. It was estimated that 1.8 million tons were recovered in 2000. The U.S. Postal Service has implemented a program to increase recovery of bulk mail, and many curbside collection programs also include mail.

* The U.S. Postal Service has changed the name of the former Third Class Mail category to Standard (A) Mail.

Table 15

PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(WITH DETAIL ON NONDURABLE GOODS)
(In thousands of tons and percent of total generation)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods	9,920	14,660	21,800	29,810	31,140	34,360	35,350	36,330
(Detail in Table 12)								
Nondurable Goods								
Newspapers	7,110	9,510	11,050	13,430	13,140	13,630	14,870	15,030
Books and Magazines	1,920	2,470	3,390					
Books**				970	1,150	1,140	1,130	1,140
Magazines**				2,830	2,530	2,260	2,210	2,130
Office Papers	1,520	2,650	4,000	6,410	6,640	7,040	7,710	7,530
Directories**				610	490	740	740	740
Standard (A) Mail***				3,820	4,620	5,200	5,320	5,570
Other Commercial Printing	1,260	2,130	3,120	4,460	6,770	6,580	6,270	7,040
Tissue Paper and Towels	1,090	2,080	2,300	2,960	2,970	3,100	3,240	3,210
Paper Plates and Cups	270	420	630	650	970	890	950	1,040
Plastic Plates and Cups†			190	650	780	890	910	870
Trash Bags**				780	780	840	950	850
Disposable Diapers	Neg.	350	1,930	2,700	3,010	3,200	3,310	3,340
Other Nonpackaging Paper	2,700	3,630	4,230	3,840	4,270	4,410	4,620	3,860
Clothing and Footwear	1,360	1,620	2,170	4,010	5,070	6,040	6,250	6,460
Towels, Sheets and Pillowcases**				710	740	750	780	820
Other Miscellaneous Nondurables	100	200	1,410	3,340	3,320	3,590	3,730	4,030
Total Nondurable Goods	17,330	25,060	34,420	52,170	57,250	60,300	62,990	63,660
Containers and Packaging	27,370	43,560	52,670	64,530	68,390	72,770	76,330	74,730
(Detail in Table 18)								
Total Product Wastes‡	54,620	83,280	108,890	146,510	156,780	167,430	174,670	174,720
Other Wastes	33,500	37,780	42,750	58,700	54,580	55,930	56,270	57,130
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	211,360	223,360	230,940	231,850
	Percent of Total Generation							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods	11.3%	12.1%	14.4%	14.5%	14.7%	15.4%	15.3%	15.7%
(Detail in Table 12)								
Nondurable Goods								
Newspapers	8.1%	7.9%	7.3%	6.5%	6.2%	6.1%	6.4%	6.5%
Books and Magazines	2.2%	2.0%	2.2%					
Books**				0.5%	0.5%	0.5%	0.5%	0.5%
Magazines**				1.4%	1.2%	1.0%	1.0%	0.9%
Office Papers	1.7%	2.2%	2.6%	3.1%	3.1%	3.2%	3.3%	3.2%
Directories**				0.3%	0.2%	0.3%	0.3%	0.3%
Standard (A) Mail***				1.9%	2.2%	2.3%	2.3%	2.4%
Other Commercial Printing	1.4%	1.8%	2.1%	2.2%	3.2%	2.9%	2.7%	3.0%
Tissue Paper and Towels	1.2%	1.7%	1.5%	1.4%	1.4%	1.4%	1.4%	1.4%
Paper Plates and Cups	0.3%	0.3%	0.4%	0.3%	0.5%	0.4%	0.4%	0.4%
Plastic Plates and Cups†			0.1%	0.3%	0.4%	0.4%	0.4%	0.4%
Trash Bags**				0.4%	0.4%	0.4%	0.4%	0.4%
Disposable Diapers	Neg.	0.3%	1.3%	1.3%	1.4%	1.4%	1.4%	1.4%
Other Nonpackaging Paper	3.1%	3.0%	2.8%	1.9%	2.0%	2.0%	2.0%	1.7%
Clothing and Footwear	1.5%	1.3%	1.4%	2.0%	2.4%	2.7%	2.7%	2.8%
Towels, Sheets and Pillowcases**				0.3%	0.4%	0.3%	0.3%	0.4%
Other Miscellaneous Nondurables	0.1%	0.2%	0.9%	1.6%	1.6%	1.6%	1.6%	1.7%
Total Nondurables	19.7%	20.7%	22.7%	25.4%	27.1%	27.0%	27.3%	27.5%
Containers and Packaging	31.1%	36.0%	34.7%	31.4%	32.4%	32.6%	33.1%	32.2%
(Detail in Table 19)								
Total Product Wastes‡	62.0%	68.8%	71.8%	71.4%	74.2%	75.0%	75.6%	75.4%
Other Wastes	38.0%	31.2%	28.2%	28.6%	25.8%	25.0%	24.4%	24.6%
Total MSW Generated - %	100.0%	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 wastes. Details may not add to totals due to rounding.
** Not estimated separately prior to 1990.
*** Not estimated separately prior to 1990. Formerly called Third Class Mail by the U.S. Postal Service.
† Not estimated separately prior to 1980.
‡ Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Table 16

RECOVERY* OF PRODUCTS IN MUNICIPAL SOLID WASTE, 1960 TO 2000
(WITH DETAIL ON NONDURABLE GOODS)
(In thousands of tons and percent of generation of each product)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods	350	940	1,360	3,460	5,010	5,710	5,920	6,020
(Detail in Table 13)								
Nondurable Goods								
Newspapers	1,820	2,250	3,020	5,110	7,010	7,210	8,040	8,750
Books and Magazines	100	260	280					
Books**				100	220	160	190	220
Magazines**				300	650	470	550	680
Office Papers	250	710	870	1,700	3,040	3,550	3,630	4,070
Directories**				40	60	100	130	130
Standard (A) Mail***				200	710	980	1,360	1,780
Other Commercial Printing	130	340	350	700	1,120	1,580	1,230	1,650
Tissue Paper and Towels	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Paper Plates and Cups	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Plastic Plates and Cups†			Neg.	10	10	Neg.	Neg.	Neg.
Trash Bags**				Neg.	Neg.	Neg.	Neg.	Neg.
Disposable Diapers				Neg.	Neg.	Neg.	Neg.	Neg.
Other Nonpackaging Paper	40	110	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Clothing and Footwear	50	60	150	520	660	800	860	900
Towels, Sheets and Pillowcases**				120	130	130	140	140
Other Miscellaneous Nondurables	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Nondurable Goods	2,390	3,730	4,670	8,800	13,610	14,980	16,130	18,320
Containers and Packaging	2,870	3,350	8,490	16,780	26,720	27,260	28,010	29,080
(Detail in Table 20)								
Total Product Wastes‡	5,610	8,020	14,520	29,040	45,340	47,950	50,060	53,420
Other Wastes	Neg.	Neg.	Neg.	4,200	9,570	13,140	14,720	16,450
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	54,910	61,090	64,780	69,870
	Percent of Generation of Each Product							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods	3.5%	6.4%	6.2%	11.6%	16.1%	16.6%	16.7%	16.6%
(Detail in Table 13)								
Nondurable Goods								
Newspapers	25.6%	23.7%	27.3%	38.0%	53.3%	52.9%	54.1%	58.2%
Books and Magazines	5.2%	10.5%	8.3%					
Books**				10.3%	19.1%	14.0%	16.8%	19.3%
Magazines**				10.6%	25.7%	20.8%	24.9%	31.9%
Office Papers	16.4%	26.8%	21.8%	26.5%	45.8%	50.4%	47.1%	54.1%
Directories**				6.6%	12.2%	13.5%	17.6%	17.6%
Standard (A) Mail***				5.2%	15.4%	18.8%	25.6%	32.0%
Other Commercial Printing	10.3%	16.0%	11.2%	15.7%	16.5%	24.0%	19.6%	23.4%
Tissue Paper and Towels	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Paper Plates and Cups	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Plastic Plates and Cups†			Neg.	1.5%	1.3%	Neg.	Neg.	Neg.
Trash Bags**				Neg.	Neg.	Neg.	Neg.	Neg.
Disposable Diapers				Neg.	Neg.	Neg.	Neg.	Neg.
Other Nonpackaging Paper	1.5%	3.0%	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Clothing and Footwear	Neg.	Neg.	Neg.	13.0%	13.0%	13.2%	13.8%	13.9%
Towels, Sheets and Pillowcases**				16.9%	17.6%	17.3%	17.9%	17.1%
Other Miscellaneous Nondurables	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Nondurables	13.8%	14.9%	13.6%	16.9%	23.8%	24.8%	25.6%	28.8%
Containers and Packaging	10.5%	7.7%	16.1%	26.0%	39.1%	37.5%	36.7%	38.9%
(Detail in Table 21)								
Total Product Wastes‡	10.3%	9.6%	13.3%	19.8%	28.9%	28.6%	28.7%	30.6%
Other Wastes	Neg.	Neg.	Neg.	7.2%	17.5%	23.5%	26.2%	28.8%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.0%	27.4%	28.1%	30.1%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Not estimated separately prior to 1990.
*** Not estimated separately prior to 1990. Formerly called Third Class Mail by the U.S. Postal Service.
† Not estimated separately prior to 1980.
‡ Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Table 17

PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(WITH DETAIL ON NONDURABLE GOODS)
(In thousands of tons and percent of total discards)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 14)*	9,570	13,720	20,440	26,350	26,130	28,650	29,430	30,310
Nondurable Goods								
Newspapers	5,290	7,260	8,030	8,320	6,130	6,420	6,830	6,280
Books and Magazines	1,820	2,210	3,110					
Books**				870	930	980	940	920
Magazines**				2,530	1,880	1,790	1,660	1,450
Office Papers	1,270	1,940	3,130	4,710	3,600	3,490	4,080	3,460
Directories**				570	430	640	610	610
Standard (A) Mail***				3,620	3,910	4,220	3,960	3,790
Other Commercial Printing	1,130	1,790	2,770	3,760	5,650	5,000	5,040	5,390
Tissue Paper and Towels	1,090	2,080	2,300	2,960	2,970	3,100	3,240	3,210
Paper Plates and Cups	270	420	630	650	970	890	950	1,040
Plastic Plates and Cups†			190	640	770	890	910	870
Trash Bags**				780	780	840	950	850
Disposable Diapers	Neg.	350	1,930	2,700	3,010	3,200	3,310	3,340
Other Nonpackaging Paper	2,660	3,520	4,230	3,840	4,270	4,410	4,620	3,860
Clothing and Footwear	1,310	1,560	2,020	3,490	4,410	5,240	5,390	5,560
Towels, Sheets and Pillowcases**				590	610	620	640	680
Other Miscellaneous Nondurables	100	200	1,410	3,340	3,320	3,590	3,730	4,030
Total Nondurable Goods	14,940	21,330	29,750	43,370	43,640	45,320	46,860	45,340
Containers and Packaging *(Detail in Table 22)*	24,500	40,210	44,180	47,750	41,670	45,510	48,320	45,650
Total Product Wastes‡	49,010	75,260	94,370	117,470	111,440	119,480	124,610	121,300
Other Wastes	33,500	37,780	42,750	54,500	45,010	42,790	41,550	40,680
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	156,450	162,270	166,160	161,980
	Percent of Total Discards							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 14)*	11.6%	12.1%	14.9%	15.3%	16.7%	17.7%	17.7%	18.7%
Nondurable Goods								
Newspapers	6.4%	6.4%	5.9%	4.8%	3.9%	4.0%	4.1%	3.9%
Books and Magazines	2.2%	2.0%	2.3%					
Books**				0.5%	0.6%	0.6%	0.6%	0.6%
Magazines**				1.5%	1.2%	1.1%	1.0%	0.9%
Office Papers	1.5%	1.7%	2.3%	2.7%	2.3%	2.2%	2.5%	2.1%
Directories**				0.3%	0.3%	0.4%	0.4%	0.4%
Standard (A) Mail***				2.1%	2.5%	2.6%	2.4%	2.3%
Other Commercial Printing	1.4%	1.6%	2.0%	2.2%	3.6%	3.1%	3.0%	3.3%
Tissue Paper and Towels	1.3%	1.8%	1.7%	1.7%	1.9%	1.9%	1.9%	2.0%
Paper Plates and Cups	0.3%	0.4%	0.5%	0.4%	0.6%	0.5%	0.6%	0.6%
Plastic Plates and Cups†			0.1%	0.4%	0.5%	0.5%	0.5%	0.5%
Trash Bags**				0.5%	0.5%	0.5%	0.6%	0.5%
Disposable Diapers	Neg.	0.3%	1.4%	1.6%	1.9%	2.0%	2.0%	2.1%
Other Nonpackaging Paper	3.2%	3.1%	3.1%	2.2%	2.7%	2.7%	2.8%	2.4%
Clothing and Footwear	1.6%	1.4%	1.5%	2.0%	2.8%	3.2%	3.2%	3.4%
Towels, Sheets and Pillowcases**				0.3%	0.4%	0.4%	0.4%	0.4%
Other Miscellaneous Nondurables	0.1%	0.2%	1.7%	1.9%	2.1%	2.2%	2.2%	2.5%
Total Nondurables	18.1%	18.9%	21.7%	25.2%	27.9%	27.9%	28.2%	28.0%
Containers and Packaging *(Detail in Table 23)*	29.7%	35.6%	32.2%	27.8%	26.6%	28.0%	29.1%	28.2%
Total Product Wastes‡	59.4%	66.6%	68.8%	68.3%	71.2%	73.6%	75.0%	74.9%
Other Wastes	40.6%	33.4%	31.2%	31.7%	28.8%	26.4%	25.0%	25.1%
Total MSW Discarded - %	100.0%	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 wastes. Details may not add to totals due to rounding.
** Not estimated separately prior to 1990.
*** Not estimated separately prior to 1990. Formerly called Third Class Mail by the U.S. Postal Service.
† Not estimated separately prior to 1980.
‡ Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

- Other Commercial Printing includes a wide range of paper items, including brochures, reports, menus, and invitations. Both groundwood and chemical pulps are used in these varied items. Generation was estimated at 7.0 million tons, or 3 percent of MSW generation, in 2000, with recovery estimated at 1.7 million tons.

- Tissue paper and towels generation includes facial and sanitary tissues and napkins, but not bathroom tissue, which is nearly all diverted from MSW into the wastewater treatment system. Tissue paper and towels (not including bathroom tissue) amounted to 3.2 million tons (1.4 percent of total MSW generation) in 2000. No significant recovery of tissue products for recycling was identified, although there is some composting of these items.

- Paper plates and cups include paper plates, cups, bowls, and other food service products used in homes, in commercial establishments like restaurants, and in institutional settings such as schools. Generation of these products was estimated at 1.0 million tons (0.4 percent of total MSW generation) in 2000. No significant recovery for recycling of these products was identified.

- Other nonpackaging papers—including posters, photographic papers, cards, and games—accounted for 3.9 million tons (1.7 percent of total MSW generation) in 2000. No significant recovery for recycling of these papers was identified.

Overall, generation of paper and paperboard products in nondurable goods was 47.3 million tons in 2000 (Table 4). While newspapers were recovered at the highest rate, other paper products, such as books, magazines, and office papers, also were recovered for recycling, and the overall recovery rate for paper in nondurable goods was 36.5 percent in 2000. Thus 30.1 million tons of paper in nondurables were discarded in 2000.

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. These items are made primarily of polystyrene resin. An estimated 870,000 tons of these products were generated in 2000, or 0.4 percent of total MSW (see Table 15). No significant recovery for recycling was identified in 2000.

Trash Bags. This category includes plastic trash bags made of high-density polyethylene and low-density polyethylene for both indoor and outdoor use. Generation of plastic trash bags

amounted to 850,000 tons in 2000 (0.4 percent of MSW generation). No significant recovery for recycling was identified.

Disposable Diapers. This category includes estimates of both infant diapers and adult incontinence products. Generation was estimated using data on sales of the products along with information on average weights and composition. An estimated 3.3 million tons of disposable diapers were generated in 2000, 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 super-absorbent materials now present in most diapers), and tissue paper.

No significant recycling or composting of disposable diapers was identified in 2000.

Clothing and Footwear. Generation of clothing and footwear was estimated to be 6.5 million tons in 2000 (2.8 percent of total MSW). Textiles, rubber, and leather are major materials components of this category, with some plastics present as well. Generation estimates for these products are based on sales data from the Department of Commerce along with data on average weights for each type of product included. Adjustments are made for net imports of these products based on Department of Commerce data.

The Council for Textile Recycling has reported on recovery of textiles for exports, reprocessing, and reuse. Based on their data, it was estimated that 900,000 tons of textiles in clothing were recovered for export or recycling in 2000. (Reuse is not counted as recycling and is discussed in Chapter 3.)

Towels, Sheets, and Pillowcases. An estimated 820,000 tons of towels, sheets, and pillowcases were generated in 2000. Generation was estimated using a methodology similar to that for clothing. An estimated 140,000 tons of these textiles were recovered for export or recycling in 2000.

Other Miscellaneous Nondurables. Generation of other miscellaneous nondurables was estimated to be 4.0 million tons in 2000 (1.7 percent of MSW). The primary material component

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

Generation of plastic products in miscellaneous nondurables is taken from resin sales data published annually in *Modern Plastics*. Generation of other materials in these nondurable products is estimated based on information in past reports in this series.

Containers and Packaging

Containers and packaging make up a major portion of MSW, amounting to 74.7 million tons of generation in 2000 (32.2 percent of total generation). Generation in this category was lower than generation in 1999, primarily because paper and paperboard packaging declined by 1.7 million tons. In that category, corrugated boxes declined by 1.2 million tons. There were small declines in generation of glass bottles, steel packaging, and aluminum packaging. Plastics packaging generation showed a small increase, and wood packaging (pallets) also increased. Generation, recovery, and discards of containers and packaging are shown in detail in Tables 18 through 23.

There is substantial recovery of many container and packaging products, especially corrugated containers. In 2000, 38.9 percent of containers and packaging generated was recovered for recycling. Because of this recovery, containers and packaging comprised 28.2 percent of total MSW discards in 2000.

Containers and packaging in MSW are made of several materials: paper and paperboard, glass, steel, aluminum, plastics, wood, and small amounts of other materials. Material categories are discussed separately below.

Glass Containers. Glass containers include beer and soft drink bottles (which includes carbonated drinks and non-carbonated waters, teas, and flavored drinks containing not more than 10 percent fruit juice), wine and liquor bottles, and bottles and jars for food, cosmetics, and other products. Generation of glass containers is estimated using Department of Commerce data.

Adjustments are made for imports and exports of empty glass containers and of containers holding products (e.g., imported beer).

Generation of glass containers was 11.2 million tons in 2000, or 4.8 percent of MSW generation (Tables 18 and 19). While generation increased somewhat between 1998 and 1999, it was back to 1998 levels in 2000.

The Glass Packaging Institute no longer reports recovery of glass bottles, and no other data source was found. Therefore, the recovery percentage has been kept constant at 26.3 percent of generation. An estimated 2.9 million tons of glass containers were recovered for recycling in 2000. Glass container discards thus were 8.3 million tons in 2000, or 5.1 percent of total MSW discards.

Steel Containers and Packaging. Steel food and other cans, and other steel packaging (e.g., strapping and steel barrels and drums), totaled 2.9 million tons in 2000 (1.2 percent of total MSW generation), with most of that amount being cans for food products (Tables 18 and 19). Generation estimates are based on data supplied by the Steel Recycling Institute (SRI), the Reusable Industrial Packaging Association, and the Can Manufacturers Institute (CMI). Estimates include adjustments for net imports.

Table 18

PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In thousands of tons)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 12)*	9,920	14,660	21,800	29,810	31,140	34,360	35,350	36,330
Nondurable Goods *(Detail in Table 15)*	17,330	25,060	34,420	52,170	57,250	60,300	62,990	63,660
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	1,400	5,580	6,740	5,640	5,120	5,390	5,620	5,860
Wine and Liquor Bottles	1,080	1,900	2,450	2,030	1,790	1,920	2,010	1,970
Food and Other Bottles & Jars	3,710	4,440	4,780	4,160	4,620	3,880	3,770	3,360
Total Glass Packaging	6,190	11,920	13,970	11,830	11,530	11,190	11,400	11,190
Steel Packaging								
Beer and Soft Drink Cans	640	1,570	520	150	Neg.	Neg.	Neg.	Neg.
Food and Other Cans	3,760	3,540	2,850	2,540	2,690	2,690	2,660	2,640
Other Steel Packaging	260	270	240	200	210	250	240	240
Total Steel Packaging	4,660	5,380	3,610	2,890	2,900	2,940	2,900	2,880
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	100	850	1,550	1,590	1,530	1,530	1,520
Other Cans	Neg.	60	40	20	40	50	50	50
Foil and Closures	170	410	380	330	350	370	380	380
Total Aluminum Packaging	170	570	1,270	1,900	1,980	1,950	1,960	1,950
Paper & Paperboard Pkg								
Corrugated Boxes	7,330	12,760	17,080	24,010	28,800	29,760	31,360	30,210
Milk Cartons**			790	510	510	470	490	490
Folding Cartons**			3,820	4,300	5,310	5,550	5,610	5,580
Other Paperboard Packaging	3,840	4,830	230	290	260	230	240	200
Bags and Sacks**			3,380	2,440	1,980	1,680	1,680	1,550
Wrapping Papers**			200	110	70			
Other Paper Packaging	2,940	3,810	850	1,020	1,150	1,420	1,750	1,370
Total Paper & Board Pkg	14,110	21,400	26,350	32,680	38,080	39,110	41,130	39,400
Plastics Packaging								
Soft Drink Bottles**			260	430	650	820	810	830
Milk Bottles**			230	530	620	700	690	690
Other Containers	60	910	890	1,430	1,180	2,330	2,640	2,630
Bags and Sacks**			390	940	1,200	1,480	1,690	1,650
Wraps**			840	1,530	1,710	1,980	2,550	2,550
Other Plastics Packaging	60	1,180	790	2,040	2,220	2,580	2,680	2,840
Total Plastics Packaging	120	2,090	3,400	6,900	7,580	9,890	11,060	11,190
Wood Packaging	2,000	2,070	3,940	8,180	6,170	7,470	7,650	7,880
Other Misc. Packaging	120	130	130	150	150	220	230	240
Total Containers & Pkg	27,370	43,560	52,670	64,530	68,390	72,770	76,330	74,730
Total Product Wastes†	54,620	83,280	108,890	146,510	156,780	167,430	174,670	174,720
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,740	24,910	25,160	25,900
Yard Trimmings	20,000	23,200	27,500	35,000	29,690	27,730	27,730	27,730
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,290	3,380	3,500
Total Other Wastes	33,500	37,780	42,750	58,700	54,580	55,930	56,270	57,130
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	211,360	223,360	230,940	231,850

* Generation before materials recovery or combustion.
Details may not add to totals due to rounding.
** Not estimated separately prior to 1980. Paper wraps not reported separately after 1996.
† Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Table 19

PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In percent of total generation)

	Percent of Total Generation							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 12)*	11.3%	12.1%	14.4%	14.5%	14.7%	15.4%	15.3%	15.7%
Nondurable Goods *(Detail in Table 15)*	19.7%	20.7%	22.7%	25.4%	27.1%	27.0%	27.3%	27.5%
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	1.6%	4.6%	4.4%	2.7%	2.4%	2.4%	2.4%	2.5%
Wine and Liquor Bottles	1.2%	1.6%	1.6%	1.0%	0.8%	0.9%	0.9%	0.8%
Food and Other Bottles & Jars	4.2%	3.7%	3.2%	2.0%	2.2%	1.7%	1.6%	1.4%
Total Glass Packaging	7.0%	9.8%	9.2%	5.8%	5.5%	5.0%	4.9%	4.8%
Steel Packaging								
Beer and Soft Drink Cans	0.7%	1.3%	0.3%	0.1%	Neg.	Neg.	Neg.	Neg.
Food and Other Cans	4.3%	2.9%	1.9%	1.2%	1.3%	1.2%	1.2%	1.1%
Other Steel Packaging	0.3%	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%
Total Steel Packaging	5.3%	4.4%	2.4%	1.4%	1.4%	1.3%	1.3%	1.2%
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	0.1%	0.6%	0.8%	0.8%	0.7%	0.7%	0.7%
Other Cans	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Foil and Closures	0.2%	0.3%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
Total Aluminum Packaging	0.2%	0.5%	0.8%	0.9%	0.9%	0.9%	0.8%	0.8%
Paper & Paperboard Pkg								
Corrugated Boxes	8.3%	10.5%	11.3%	11.7%	13.6%	13.3%	13.6%	13.0%
Milk Cartons**			0.5%	0.2%	0.2%	0.2%	0.2%	0.2%
Folding Cartons**			2.5%	2.1%	2.5%	2.5%	2.4%	2.4%
Other Paperboard Packaging	4.4%	4.0%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%
Bags and Sacks**			2.2%	1.2%	0.9%	0.8%	0.7%	0.7%
Wrapping Papers**			0.1%	0.1%	0.0%			
Other Paper Packaging	3.3%	3.1%	0.6%	0.5%	0.5%	0.6%	0.8%	0.6%
Total Paper & Board Pkg	16.0%	17.7%	17.4%	15.9%	18.0%	17.5%	17.8%	17.0%
Plastics Packaging								
Soft Drink Bottles**			0.2%	0.2%	0.3%	0.4%	0.4%	0.4%
Milk Bottles**			0.2%	0.3%	0.3%	0.3%	0.3%	0.3%
Other Containers	0.1%	0.8%	0.6%	0.7%	0.6%	1.0%	1.1%	1.1%
Bags and Sacks**			0.3%	0.5%	0.6%	0.7%	0.7%	0.7%
Wraps**			0.6%	0.7%	0.8%	0.9%	1.1%	1.1%
Other Plastics Packaging	0.1%	1.0%	0.5%	1.0%	1.1%	1.2%	1.2%	1.2%
Total Plastics Packaging	0.1%	1.7%	2.2%	3.4%	3.6%	4.4%	4.8%	4.8%
Wood Packaging	2.3%	1.7%	2.6%	4.0%	2.9%	3.3%	3.3%	3.4%
Other Misc. Packaging	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Total Containers & Pkg	31.1%	36.0%	34.7%	31.4%	32.4%	32.6%	33.1%	32.2%
Total Product Wastes†	62.0%	68.8%	71.8%	71.4%	74.2%	75.0%	75.6%	75.4%
Other Wastes								
Food Scraps	13.8%	10.6%	8.6%	10.1%	10.3%	11.2%	10.9%	11.2%
Yard Trimmings	22.7%	19.2%	18.1%	17.1%	14.0%	12.4%	12.0%	12.0%
Miscellaneous Inorganic Wastes	1.5%	1.5%	1.5%	1.4%	1.5%	1.5%	1.5%	1.5%
Total Other Wastes	38.0%	31.2%	28.2%	28.6%	25.8%	25.0%	24.4%	24.6%
Total MSW Generated - %	100.0%	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 separately prior to 1980. Paper wraps not reported separately after 1996.
† Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Table 20

RECOVERY* OF PRODUCTS IN MUNICIPAL SOLID WASTE, 1960 TO 2000
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In thousands of tons)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods	350	940	1,360	3,460	5,010	5,710	5,920	6,020
(Detail in Table 13)								
Nondurable Goods	2,390	3,730	4,670	8,800	13,610	14,980	16,130	18,320
(Detail in Table 16)								
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	90	140	730	1,890	1,670	1,560	1,590	1,560
Wine and Liquor Bottles	10	10	20	210	470	440	450	440
Food and Other Bottles & Jars	Neg.	Neg.	Neg.	520	1,000	940	960	940
Total Glass Packaging	100	150	750	2,620	3,140	2,940	3,000	2,940
Steel Packaging								
Beer and Soft Drink Cans	10	20	50	40	Neg.	Neg.	Neg.	Neg.
Food and Other Cans	20	60	150	590	1,510	1,500	1,510	1,510
Other Steel Packaging	Neg.	Neg.	Neg.	60	50	170	170	160
Total Steel Packaging	30	80	200	690	1,560	1,670	1,680	1,670
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	10	310	990	900	850	850	830
Other Cans	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Foil and Closures	Neg.	Neg.	Neg.	20	30	30	30	40
Total Aluminum Pkg	Neg.	10	320	1,010	930	880	880	870
Paper & Paperboard Pkg								
Corrugated Boxes	2,520	2,760	6,390	11,530	18,480	19,790	20,330	21,360
Milk Cartons**			Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Folding Cartons**			520	340	1,080	230	400	430
Other Paperboard Packaging			Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Bags and Sacks**			Neg.	200	340	300	220	300
Wrapping Papers**			Neg.	Neg.	Neg.			
Other Paper Packaging	220	350	300	Neg.	Neg.	Neg.	Neg.	Neg.
Total Paper & Board Pkg	2,740	3,110	7,210	12,070	19,900	20,320	20,950	22,090
Plastics Packaging								
Soft Drink Bottles**			10	140	300	290	290	290
Milk Bottles**			Neg.	20	190	220	220	210
Other Containers	Neg.	Neg.	Neg.	20	150	250	290	260
Bags and Sacks**			Neg.	30	40	10	10	10
Wraps**			Neg.	30	40	120	130	170
Other Plastics Packaging	Neg.	Neg.	Neg.	20	20	70	70	90
Total Plastics Packaging	Neg.	Neg.	10	260	740	960	1,010	1,030
Wood Packaging	Neg.	Neg.	Neg.	130	450	490	490	480
Other Misc. Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Containers & Pkg	2,870	3,350	8,490	16,780	26,720	27,260	28,010	29,080
Total Product Wastes†	5,610	8,020	14,520	29,040	45,340	47,950	50,060	53,420
Other Wastes								
Food Scraps	Neg.	Neg.	Neg.	Neg.	570	580	550	680
Yard Trimmings	Neg.	Neg.	Neg.	4,200	9,000	12,560	14,170	15,770
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	4,200	9,570	13,140	14,720	16,450
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	54,910	61,090	64,780	69,870

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Not estimated separately prior to 1980. Paper wraps not reported separately after 1996.
† Other than food products.
Details may not add to totals due to rounding.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Table 21

RECOVERY* OF PRODUCTS IN MUNICIPAL SOLID WASTE, 1960 TO 2000
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In percent of generation of each product)

Percent of Generation of Each Product								
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 13)*	3.5%	6.4%	6.2%	11.6%	16.1%	16.6%	16.7%	16.6%
Nondurable Goods *(Detail in Table 16)*	13.8%	14.9%	13.6%	16.9%	23.8%	24.8%	25.6%	28.8%
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	6.4%	2.5%	10.8%	33.5%	32.6%	28.9%	28.3%	26.6%
Wine and Liquor Bottles	Neg.	Neg.	Neg.	10.3%	26.3%	22.9%	22.4%	22.3%
Food and Other Bottles & Jars	Neg.	Neg.	Neg.	12.5%	21.6%	24.2%	25.5%	28.0%
Total Glass Packaging	1.6%	1.3%	5.4%	22.1%	27.2%	26.3%	26.3%	26.3%
Steel Packaging								
Beer and Soft Drink Cans	1.6%	1.3%	9.6%	26.7%	Neg.	Neg.	Neg.	Neg.
Food and Other Cans	Neg.	1.7%	5.3%	23.2%	56.1%	55.8%	56.8%	57.2%
Other Steel Packaging	Neg.	Neg.	Neg.	30.0%	23.8%	68.0%	70.8%	66.7%
Total Steel Packaging	Neg.	1.5%	5.5%	23.9%	53.8%	56.8%	57.9%	58.0%
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	10.0%	36.5%	63.9%	56.6%	55.6%	55.6%	54.6%
Other Cans	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Foil and Closures	Neg.	Neg.	Neg.	6.1%	8.6%	8.1%	7.9%	10.5%
Total Aluminum Pkg	Neg.	1.8%	25.2%	53.2%	47.0%	45.1%	44.9%	44.6%
Paper & Paperboard Pkg								
Corrugated Boxes	34.4%	21.6%	37.4%	48.0%	64.2%	66.5%	64.8%	70.7%
Milk Cartons**			Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Folding Cartons**			Neg.	Neg.	20.3%	4.1%	7.1%	7.7%
Other Paperboard Packaging			Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Bags and Sacks**			Neg.	Neg.	17.2%	17.9%	13.1%	19.4%
Wrapping Papers**			Neg.	Neg.	Neg.			
Other Paper Packaging	7.5%	9.2%	35.3%	Neg.	Neg.	Neg.	Neg.	Neg.
Total Paper & Board Pkg	19.4%	14.5%	27.4%	36.9%	52.3%	52.0%	50.9%	56.1%
Plastics Packaging								
Soft Drink Bottles**			3.8%	32.6%	46.2%	35.4%	35.8%	34.9%
Milk Bottles**			Neg.	3.8%	30.6%	31.4%	31.9%	30.4%
Other Containers	Neg.	Neg.	Neg.	1.4%	12.7%	10.7%	11.0%	9.9%
Bags and Sacks**			Neg.	3.2%	3.3%	0.7%	0.6%	0.6%
Wraps**			Neg.	2.0%	2.3%	6.1%	5.1%	6.7%
Other Plastics Packaging	Neg.	Neg.	Neg.	1.0%	0.9%	2.7%	2.6%	3.2%
Total Plastics Packaging	Neg.	Neg.	Neg.	3.8%	9.8%	9.7%	9.1%	9.2%
Wood Packaging	Neg.	Neg.	Neg.	1.6%	7.3%	6.6%	6.4%	6.1%
Other Misc. Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Containers & Pkg	10.5%	7.7%	16.1%	26.0%	39.1%	37.5%	36.7%	38.9%
Total Product Wastes†	10.3%	9.6%	13.3%	19.8%	28.9%	28.6%	28.7%	30.6%
Other Wastes								
Food Scraps	Neg.	Neg.	Neg.	Neg.	2.6%	2.3%	2.2%	2.6%
Yard Trimmings	Neg.	Neg.	Neg.	12.0%	30.3%	45.3%	51.1%	56.9%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.		
Total Other Wastes	Neg.	Neg.	Neg.	7.2%	17.5%	23.5%	26.2%	28.8%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.0%	27.4%	28.1%	30.1%

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Not estimated separately prior to 1980. Paper wraps not reported separately after 1996.
† Other than food products.
Details may not add to totals due to rounding.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Table 22

PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In thousands of tons)

	Thousands of Tons							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods *(Detail in Table 14)*	9,570	13,720	20,440	26,350	26,130	28,650	29,430	30,310
Nondurable Goods *(Detail in Table 17)*	14,940	21,330	29,750	43,370	43,640	45,320	46,860	45,340
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	1,310	5,440	6,010	3,750	3,450	3,830	4,030	4,300
Wine and Liquor Bottles	1,070	1,890	2,430	1,820	1,320	1,480	1,560	1,530
Food and Other Bottles & Jars	3,710	4,440	4,780	3,640	3,620	2,940	2,810	2,420
Total Glass Packaging	6,090	11,770	13,220	9,210	8,390	8,250	8,400	8,250
Steel Packaging								
Beer and Soft Drink Cans	630	1,550	470	110	Neg.	Neg.	Neg.	Neg.
Food and Other Cans	3,740	3,480	2,700	1,950	1,180	1,190	1,150	1,130
Other Steel Packaging	260	270	240	140	160	80	70	80
Total Steel Packaging	4,630	5,300	3,410	2,200	1,340	1,270	1,220	1,210
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	90	540	560	690	680	680	690
Other Cans	Neg.	60	40	20	40	50	50	50
Foil and Closures	170	410	380	310	320	340	350	340
Total Aluminum Pkg	170	560	950	890	1,050	1,070	1,080	1,080
Paper & Paperboard Pkg								
Corrugated Boxes	4,810	10,000	10,690	12,480	10,320	9,970	11,030	8,850
Milk Cartons**			790	510	510	470	490	490
Folding Cartons**			3,300	3,960	4,230	5,320	5,210	5,150
Other Paperboard Packaging	3,840	4,830	230	290	260	230	240	200
Bags and Sacks**			3,380	2,240	1,640	1,380	1,460	1,250
Wrapping Papers**			200	110	70			
Other Paper Packaging	2,720	3,460	550	1,020	1,150	1,420	1,750	1,370
Total Paper & Board Pkg	11,370	18,290	19,140	20,610	18,180	18,790	20,180	17,310
Plastics Packaging								
Soft Drink Bottles**			250	290	350	530	520	540
Milk Bottles**			230	510	430	480	470	480
Other Containers	60	910	890	1,410	1,030	2,080	2,350	2,370
Bags and Sacks**			390	910	1,160	1,470	1,680	1,640
Wraps**			840	1,500	1,670	1,860	2,420	2,380
Other Plastics Packaging	60	1,180	790	2,020	2,200	2,510	2,610	2,750
Total Plastics Packaging	120	2,090	3,390	6,640	6,840	8,930	10,050	10,160
Wood Packaging	2,000	2,070	3,940	8,050	5,720	6,980	7,160	7,400
Other Misc. Packaging	120	130	130	150	150	220	230	240
Total Containers & Pkg	24,500	40,210	44,180	47,750	41,670	45,510	48,320	45,650
Total Product Wastes†	49,010	75,260	94,370	117,470	111,440	119,480	124,610	121,300
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,170	24,330	24,610	25,220
Yard Trimmings	20,000	23,200	27,500	30,800	20,690	15,170	13,560	11,960
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,290	3,380	3,500
Total Other Wastes	33,500	37,780	42,750	54,500	45,010	42,790	41,550	40,680
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	156,450	162,270	166,160	161,980

* Discards after materials and compost recovery. Does not include construction & demolition debris, industrial process wastes, or certain other wastes. Details may not add to totals due to rounding.
** Not estimated separately prior to 1980. Paper wraps not reported separately after 1996.
† Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

Table 23

PRODUCTS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2000
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In percent of total discards)

	Percent of Total Discards							
Products	**1960**	**1970**	**1980**	**1990**	**1995**	**1998**	**1999**	**2000**
Durable Goods	11.6%	12.1%	14.9%	15.3%	16.7%	17.7%	17.7%	18.7%
(Detail in Table 14)								
Nondurable Goods	18.1%	18.9%	21.7%	25.2%	27.9%	27.9%	28.2%	28.0%
(Detail in Table 17)								
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	1.6%	4.8%	4.4%	2.2%	2.2%	2.4%	2.4%	2.7%
Wine and Liquor Bottles	1.3%	1.7%	1.8%	1.1%	0.8%	0.9%	0.9%	0.9%
Food and Other Bottles & Jars	4.5%	3.9%	3.5%	2.1%	2.3%	1.8%	1.7%	1.5%
Total Glass Packaging	7.4%	10.4%	9.6%	5.4%	5.4%	5.1%	5.1%	5.1%
Steel Packaging								
Beer and Soft Drink Cans	0.8%	1.4%	0.3%	0.1%	Neg.	Neg.	Neg.	Neg.
Food and Other Cans	4.5%	3.1%	2.0%	1.1%	0.8%	0.7%	0.7%	0.7%
Other Steel Packaging	0.3%	0.2%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%
Total Steel Packaging	5.6%	4.7%	2.5%	1.3%	0.9%	0.8%	0.7%	0.7%
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	0.1%	0.4%	0.3%	0.4%	0.4%	0.4%	0.4%
Other Cans	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Foil and Closures	0.2%	0.4%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
Total Aluminum Pkg	0.2%	0.5%	0.7%	0.5%	0.7%	0.7%	0.6%	0.7%
Paper & Paperboard Pkg								
Corrugated Boxes	5.8%	8.8%	7.8%	7.3%	6.6%	6.1%	6.6%	5.5%
Milk Cartons**			0.6%	0.3%	0.3%	0.3%	0.3%	0.3%
Folding Cartons**			2.4%	2.3%	2.7%	3.3%	3.1%	3.2%
Other Paperboard Packaging	4.7%	4.3%	0.2%	0.2%	0.2%	0.1%	0.1%	0.1%
Bags and Sacks**			2.5%	1.3%	1.0%	0.9%	0.9%	0.8%
Wrapping Papers**			0.1%	0.1%	0.0%			
Other Paper Packaging	3.3%	3.1%	0.4%	0.6%	0.7%	0.9%	1.1%	0.8%
Total Paper & Board Pkg	13.8%	16.2%	14.0%	12.0%	11.6%	11.6%	12.1%	10.7%
Plastics Packaging								
Soft Drink Bottles**			0.2%	0.2%	0.2%	0.3%	0.3%	0.3%
Milk Bottles**			0.2%	0.3%	0.3%	0.3%	0.3%	0.3%
Other Containers	0.1%	0.8%	0.6%	0.8%	0.7%	1.3%	1.4%	1.5%
Bags and Sacks**			0.3%	0.5%	0.7%	0.9%	1.0%	1.0%
Wraps**			0.6%	0.9%	1.1%	1.1%	1.5%	1.5%
Other Plastics Packaging	0.1%	1.0%	0.6%	1.2%	1.4%	1.5%	1.6%	1.7%
Total Plastics Packaging	0.1%	1.8%	2.5%	3.9%	4.4%	5.5%	6.0%	6.3%
Wood Packaging	2.4%	1.8%	2.9%	4.7%	3.7%	4.3%	4.3%	4.6%
Other Misc. Packaging	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Total Containers & Pkg	29.7%	35.6%	32.2%	27.8%	26.6%	28.0%	29.1%	28.2%
Total Product Wastes†	59.4%	66.6%	68.8%	68.3%	71.2%	73.6%	75.0%	74.9%
Other Wastes								
Food Scraps	14.8%	11.3%	9.5%	12.1%	13.5%	15.0%	14.8%	15.6%
Yard Trimmings	24.2%	20.5%	20.1%	17.9%	13.2%	9.3%	8.2%	7.4%
Miscellaneous Inorganic Wastes	1.6%	1.6%	1.6%	1.7%	2.0%	2.0%	2.0%	2.2%
Total Other Wastes	40.6%	33.4%	31.2%	31.7%	28.8%	26.4%	25.0%	25.1%
Total MSW Discarded - %	100.0%	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 wastes. Details may not add to totals due to rounding.
** Not estimated separately prior to 1980. Paper wraps not reported separately after 1996.
† Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

The Steel Recycling Institute provided recovery data for steel containers and packaging. An estimated 1.7 million tons of steel packaging were recovered in 2000, or 58 percent of generation. The SRI estimates include recovery from residential sources, pre-combustion and post-combustion magnetic separation of steel cans and other ferrous products at MSW combustion facilities, and recycling of drums and barrels not suitable for reconditioning.

Aluminum Containers and Packaging. Aluminum containers and packaging include beer and soft drink cans (including all carbonated and non-carbonated soft drinks, tea, tonic, waters, and juice beverages), other cans, and foil and closures. Aluminum can generation had been estimated based on can shipments data from the Can Manufacturers Institute and can weight data from the Aluminum Association, while data on other aluminum packaging is based on Department of Commerce data.

In 1996, the Can Manufacturers Association began publishing data on consumption of beverages in cans. The consumption data are adjusted for imports and exports of beverages in cans, and therefore are more accurate for generation calculations than shipments alone. The generation methodology was therefore revised to use consumption data. Total aluminum container and packaging generation in 2000 was 2.0 million tons, or 0.8 percent of total MSW generation.

Formerly, aluminum can recovery data were obtained from the Aluminum Association. More recently, the aluminum can recovery methodology was revised to account for imports of used beverage cans (UBC); these imports have been increasing in recent years. The imported UBC tonnage is now subtracted from the tonnage of UBC reported by the Aluminum Association to have been melted by U.S. end users and recovered for export.* The effect of this change is to lower the aluminum beverage can recovery rate.

* Note, however, that the imported UBC do contribute to recycled aluminum content in can sheet and other aluminum products.

Recovery of aluminum beverage cans in 2000 was 0.8 million tons, or 54.6 percent of generation. Recovery of all aluminum packaging was estimated to be 44.6 percent of total generation in 2000. After recovery for recycling, 1.1 million tons of aluminum packaging were discarded in 2000.

Paper and Paperboard Containers and Packaging. Corrugated boxes are the largest single product category of MSW at 30.2 million tons generated, or 13 percent of total generation, in 2000. Corrugated boxes also represent the largest single category of product recovery, at 21.4 million tons of recovery in 2000 (70.7 percent of boxes generated were recovered). After recovery, 8.9 million tons of corrugated boxes were discarded, or 5.5 percent of MSW discards in 2000.

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, and other paper and paperboard packaging. Overall, paper and paperboard containers and packaging totaled 39.4 million tons of MSW generation in 2000, or 17 percent of total generation.

While recovery of corrugated boxes is by far the largest component of paper packaging recovery, smaller amounts of other paper packaging products are recovered (estimated at 730,000 tons in 2000). The overall recovery rate for paper and paperboard packaging in 2000 was 56.1 percent. Other paper and paperboard packaging such as folding boxes and sacks is generally recovered as mixed papers.

Plastic Containers and Packaging. Many different plastic resins are used to make a variety of packaging products. Some of these include polyethylene terephthalate soft drink bottles, high-density polyethylene milk and water jugs, film products (including bags and sacks) made of low-density polyethylene, and other containers and other packaging (including coatings, closures, etc.) made of polyvinyl chloride, polystyrene, polypropylene, and other resins. Estimates of generation of plastic containers and packaging are based on data on resin sales by end use published annually by *Modern Plastics*, a trade publication, and the American Plastics Council's annual plastics recovery survey.

Plastic containers and packaging have exhibited rapid growth in MSW, with generation increasing from 120,000 tons in 1960 (0.1 percent of generation) to 11.2 million tons in 2000 (4.8 percent of MSW generation). (Note: plastic packaging as a category in this report does not include single-service plates and cups and trash bags, which are classified as nondurable goods.)

Estimates of recovery of plastic products are based on data published annually by the American Plastics Council. Plastic soft drink bottles were estimated to have been recovered at a 34.9 percent rate in 2000 (290,000 tons). Recovery of plastic milk and water bottles was estimated to have been 210,000 tons, or 30.4 percent of generation. Overall, recovery of plastic containers and packaging was estimated to be 1.0 ton, or 9.2 percent, in 2000. Discards of plastic packaging thus were 10.2 million tons in 2000, or 6.3 percent of total MSW discards.

Wood Packaging. Wood packaging includes wood crates and pallets (mostly pallets). Data on production of wood packaging are from the National Wooden Pallet and Container Association and, more recently, the USDA Forest Service Southern Research Station and Virginia Polytechnic Institute. In 2000, 7.9 million tons of wood pallets and other wood packaging were estimated to have been generated, or 3.4 percent of total MSW generation.

Wood pallet recovery for recycling (usually by chipping for uses such as mulch or bedding material, but excluding wood combusted as fuel) was estimated at 480,000 tons in 2000. A considerable number of pallets are refurbished and reused (see Chapter 3).

Wood packaging discards were estimated to have been 7.4 million tons in 2000, or 4.6 percent of total MSW discards.

Other Packaging. Estimates are included for some other miscellaneous packaging such as bags made of textiles, small amounts of leather, and the like. These latter quantities are not well documented; it was estimated that 240,000 tons were generated in 2000.

Summary of Products in Municipal Solid Waste

The materials composition of municipal solid waste generation by product category is 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.

The materials composition of nondurable goods in 2000 is shown in Figure 15. Paper and paperboard made up 74 percent of nondurables in MSW generation, with plastics contributing 9 percent, and textiles 10 percent. Other materials contributed lesser percentages. After recovery for recycling, paper and paperboard were 66 percent of nondurable discards, with plastics being 13 percent, and textiles 12 percent.

The materials composition of containers and packaging in MSW in 2000 is shown in Figure 16. By weight, paper and paperboard products made up 53 percent of containers and packaging generation, with glass and plastics each accounting for 15 percent. Wood was 11 percent, and metals were 6 percent.

Figure 14. Generation of products in MSW, 1960 to 2000

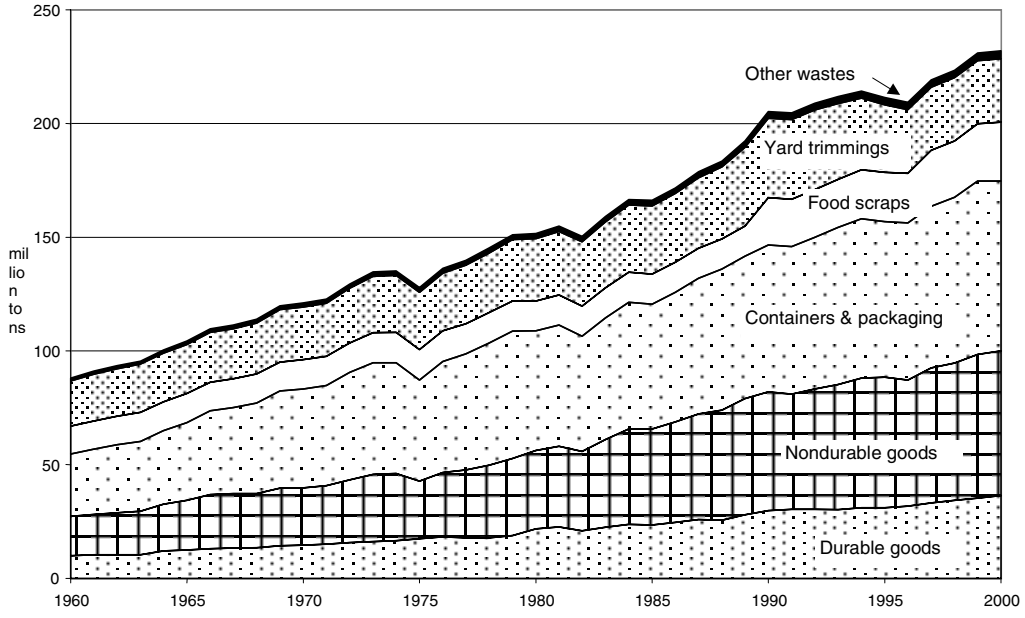
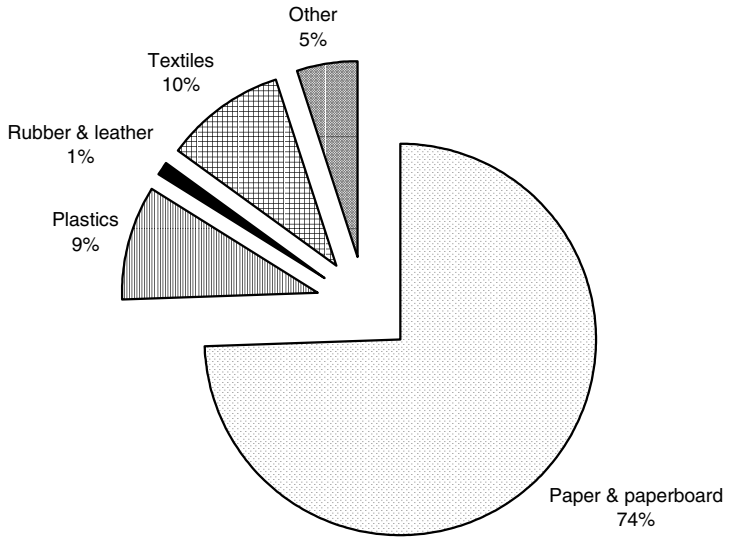
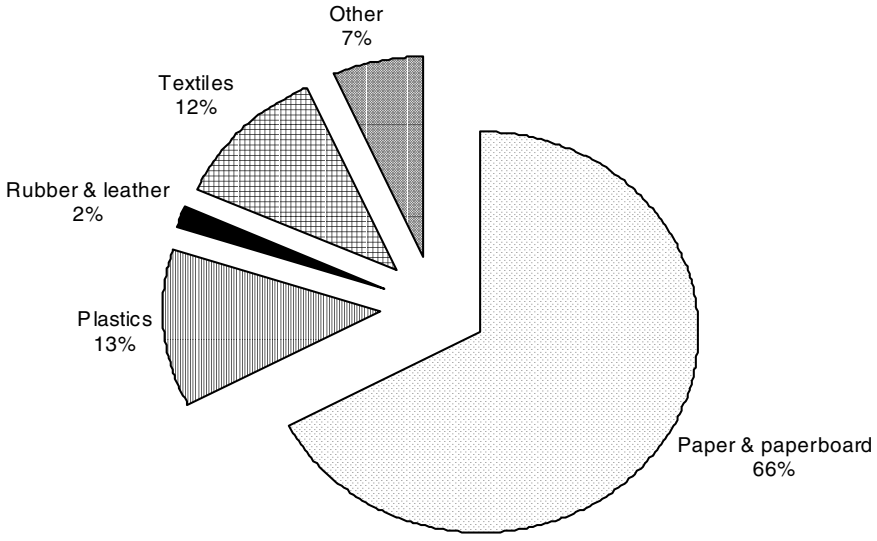


Figure 15. Nondurable goods generated and discarded in municipal solid waste, 2000
(In percent of total generation and discards)

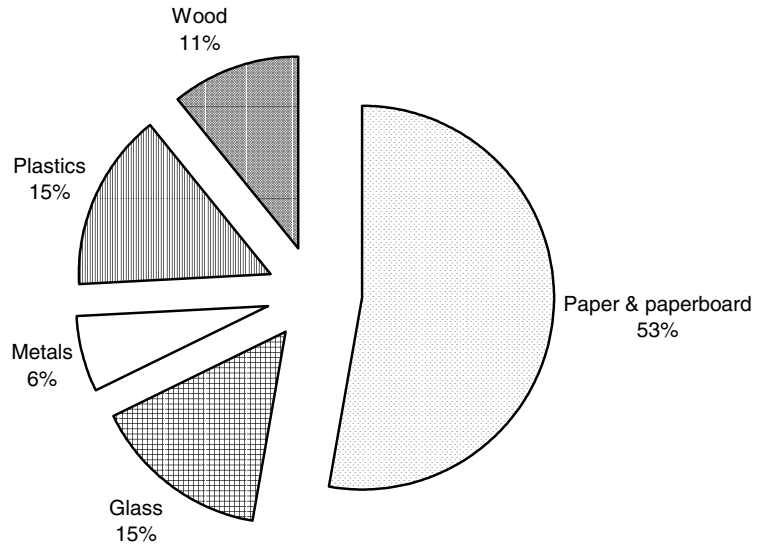


Generation

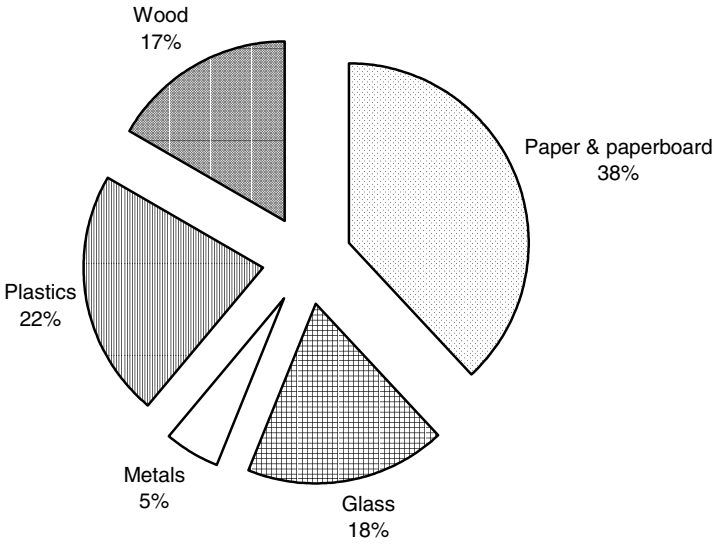


Discards

Figure 16. Containers and packaging generated and discarded in municipal solid waste, 2000
(In percent of total generation and discards)



Generation



Discards

The percentage of materials discards from containers and packaging is affected by recovery for recycling. After recovery for recycling, paper and paperboard dropped to 38 percent of discards. Glass containers accounted for 18 percent of discards of containers and packaging, plastics were 22 percent, wood was 17 percent, and metals were 5 percent.

SUMMARY

The data presented in this chapter can be summarized by the following observations:

MSW Generation

- Total generation of municipal solid waste in 2000 was 231.9 million tons, only 0.3 percent higher than generation in 1999 (230.9 million tons). By contrast, the increase from 1998 to 1999 was 3.3 percent. In 1990, total MSW generation was 205.2 million tons.

- Paper and paperboard products made up the largest percentage of all materials in MSW, at 37.4 percent of total generation. Generation of paper and paperboard products did, however, decline from 88.3 million tons in 1999 to 86.7 million tons in 2000. (The decline was almost certainly due to economic conditions.) Paper and paperboard products have ranged between 37 and 38 percent of generation for the past few years.

- Yard trimmings comprised the second largest material category, estimated at 27.7 million tons, or 12 percent of total generation, in 2000. This compares to 35.0 million tons (17.1 percent of total generation) in 1990. This decline is largely due to state legislation affecting yard trimmings disposal in landfills, including source reduction measures such as backyard composting and leaving grass trimmings on the yard.

- Plastic products generation in 2000 was 24.7 million tons, or 10.7 percent of generation. This was a growth of 630,000 tons (2.5 percent) from 1999 to 2000. Most of this increase in plastics generation came from the durable goods category. By contrast, plastics generation increased by 7.6 percent from 1998 to 1999.

MSW Recovery

- Recovery of materials in MSW increased from 64.8 million tons in 1999 (28.1 percent of total generation) to 69.9 million tons in 2000 (30.1 percent of generation).

- Recovery of products and other wastes in MSW increased by 5.1 million tons from 1999 to 2000. Recovery of paper and paperboard products accounted for most of this increase by growing 3.3 million tons over recovery in 1999. Recovery of paper and paperboard was up from 40.9 percent in 1999 to 45.4 percent in 2000.

- The increase in recovery of paper and paperboard products has been due to increases in recovery, over time, from all categories: corrugated boxes, newspapers, and printing-writing papers such as office papers, books, magazines, directories, Standard (A) mail (catalogs, circulars, etc.), and other commercial printing. Key categories whose recovery rose from 1999 to 2000 include corrugated boxes, newspapers, office papers, Standard (A) mail, and other commercial printing. Recovery of corrugated boxes increased from 20.3 million tons in 1999 to 21.4 million tons in 2000 (from 64.8 percent of generation to 70.7 percent of generation). Newspaper recovery increased from 8.0 million tons in 1999 to 8.8 million tons in 2000 (from 54.1 percent of generation to 58.2 percent of generation). Recovery of office-type (high grade) papers increased from 3.6 million tons in 1999 to 4.1 million tons in 2000 (from 47.1 percent of generation to 54.1 percent of generation). Recovery of Standard (A) mail and other commercial printing both increased by an estimated 420,000 tons from 1999 to 2000.

- Containers and packaging led the major product categories in tonnage and percentage recovery, increasing from 28.0 million tons in 1999 to 29.1 million tons (38.9 percent of generation) in 2000. Nondurable goods had the second-highest tonnage recovery in 2000—18.3 million tons, or 28.8 percent of generation.

- Measured by tonnage, the most-recovered products and materials in 2000 were corrugated boxes (21.4 million tons), yard trimmings (15.8 million tons), newspapers (8.8 million tons), high-grade office papers (4.1 million tons), glass containers (2.9 million tons), and steel from major appliances (2.0 million tons). Collectively, these products accounted for nearly 79 percent of total MSW recovery in 2000.

- Measured by percentage of generation, products and other wastes with the highest recovery rates in 2000 were lead-acid batteries (96.4 percent), corrugated boxes (70.7 percent), newspapers (58.2 percent), steel packaging (58 percent), yard trimmings (56.9 percent), steel in major appliances (54.9 percent of total appliance generation), aluminum beverage cans (54.6 percent), and office papers (54.1 percent).

Long-Term Trends

- Generation of MSW has increased (except in some recession years), from 88.1 million tons in 1960 to 231.9 million tons in 2000.

- Generation of paper and paperboard, the largest material component of MSW, has increased almost every year (1996 and 2000 were exceptions). Generation of yard trimmings, the second largest component, has remained stable during recent years.

- State legislation affecting yard trimmings disposal in landfills and source reduction measures at residences have helped contain generation of yard trimmings. Generation of other materials is generally on an upward trend, although glass generation has declined in some years, including 2000.

- In percentage of total MSW generation, recovery for recycling (including composting) did not exceed 15 percent until 1990. Growth in the recovery rate to current levels (30.1 percent) reflects a rapid increase in the infrastructure for recovery starting in the late 1980s.

- Recovery (as a percentage of generation) of most materials in MSW has increased dramatically over the 40 years for which statistics have been tabulated. Some examples:

	1960	**1980**	**1990**	**2000**
Paper and paperboard	17%	21%	28%	45%
Glass	2%	5%	20%	23%
Metals	1%	8%	24%	35%
Plastics	–	<1%	2%	5%
Yard trimmings	–	–	12%	57%

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.

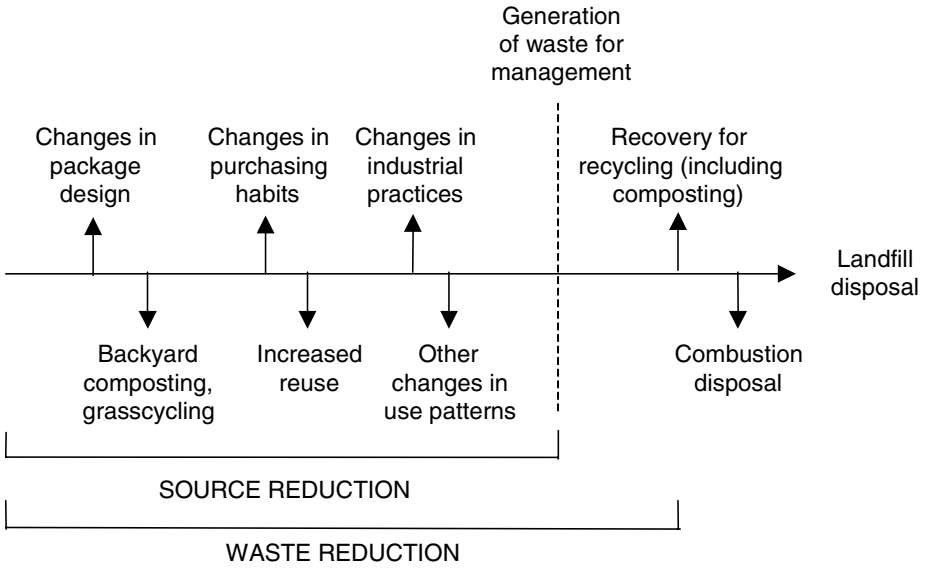
The three components are put into context in Figure 17.

This chapter addresses how source reduction activities are included within an integrated waste management system. Source reduction activities have the effect of reducing MSW generation, while other management alternatives deal with MSW once it is generated. National estimates of source reduction can be found in Chapter 4.

Estimates of the historical recovery of materials for recycling, including yard trimmings for composting, are presented in Chapter 2. Chapter 3 presents estimates of MSW combustion. It also presents estimates for quantities of waste landfilled, which are obtained by subtracting the amounts recovered for recycling (including composting) and the amounts combusted from total MSW generation.

Also included in this chapter is a discussion of the current MSW management infrastructure. Current solid waste collection, processing, and disposal programs and facilities are highlighted with tables and figures.

Figure 17. Diagram of Solid Waste Management



Source: Franklin Associates, Ltd.

SOURCE REDUCTION

Source reduction is gaining more attention as an important solid waste management option. Source reduction, often called "waste prevention," is defined by EPA as "any change in the design, manufacturing, purchase, or use of materials or products (including packaging) to reduce their amount or toxicity before they become municipal solid waste. Prevention also refers to the reuse of products or materials." Thus, source reduction activities affect the waste stream before the point of generation. In this report, MSW is considered to have been generated if it is placed at curbside or in a receptacle such as a dumpster for pickup, or if it is taken by the generator to another site for recycling (including composting) or disposal.

Source reduction encompasses a very broad range of activities by private citizens, communities, commercial establishments, institutional agencies, and manufacturers and distributors. Examples of source reduction actions are shown in Table 24 and include:

- Redesigning products or packages so as to reduce the quantity of materials or the toxicity of the materials used, by substituting lighter materials for heavier ones and lengthening the life of products to postpone disposal.
- Using packaging that reduces the amount of damage or spoilage to the product.

- Reducing amounts of products or packages used through modification of current practices by processors and consumers.

- Reusing products or packages already manufactured.

- Managing non-product organic wastes (food scraps, yard trimmings) through backyard composting or other on-site alternatives to disposal.

Table 24

SELECTED EXAMPLES OF SOURCE REDUCTION PRACTICES

Source Reduction Practice	MSW Product Categories			
	Durable Goods	**Nondurable Goods**	**Containers & Packaging**	**Organics**
Redesign				
Materials reduction	• Downgauge metals in appliances	• Paperless purchase orders	• Concentrates	• Xeriscaping
Materials substitution	• Use of composites in appliances and electronic circuitry		• Cereal in bags • Coffee brick • Multi-use products	
Lengthen life	• High mileage tires • Electronic components reduce moving parts	• Regular servicing • Look at warranties • Extend warranties	• Design for secondary uses	
Consumer Practices				
	• Purchase long lived products	• Repair • Duplexing • Sharing • Reduce unwanted mail	• Purchasing: products in bulk, concentrates	
Reuse				
By design	• Modular design	• Envelopes	• Pallets • Returnable secondary packaging	
Secondary	• Borrow or rent for temporary use • Give to charity • Buy or sell at garage sales	• Clothing • Waste paper scratch pads	• Loosefill • Grocery sacks • Dairy containers • Glass and plastic jars	
Reduce/Eliminate Toxins				
	• Eliminate PCBs	• Soy ink, waterbased • Waterbased solvents • Reduce mercury	• Replace lead foil on wine bottles	
Reduce Organics				
Food scraps				• Backyard composting • Vermi-composting
Yard trimmings				• Backyard composting • Grasscycling

Source: Franklin Associates, Ltd.

Source Reduction Through Redesign

Since source reduction of products and packages can save money by reducing materials and energy costs, manufacturers and packaging designers have been pursuing these activities for many years. Combined with other source reduction measures, redesign can have a significant effect on material use and eventual discards. Design for source reduction can take several approaches.

Materials substitution can make a product or package lighter. For example, there has been a continuous trend of substitution of lighter materials such as plastics and aluminum for materials such as glass and steel. The substitution also may involve a flexible package instead of a rigid package. A product or package can be redesigned to reduce weight or volume. Toxic materials in products or packaging can be replaced with non-toxic substitutes. Considerable efforts have been made in this area in the past few years.

Lengthening product life delays the time when the product enters the municipal waste stream. The responsibility for lengthening product life lies partly with manufacturers and partly with consumers. Manufacturers can design products to last longer and be easier to repair. Since some of these design modifications may make products more expensive, at least initially, manufacturers must be willing to invest in new product development, and consumers must demand the products and be willing to pay for them to make the goal work. Consumers and manufacturers also must be willing to care for and repair products.

Modifying Practices To Reduce Materials Use

Businesses and individuals often can modify their current practices to reduce the amounts of waste generated. In a business office, electronic mail can replace printed memoranda and data. Reports can be copied on both sides of the paper (duplexed). Modifying practices can be combined with other source reduction measures to reduce generation and limit material use.

Individuals and businesses can request removal from mailing lists to reduce the amount of mail received and discarded. When practical, products can be purchased in large sizes or in bulk to minimize the amount of packaging per unit of product. Concentrated products also can reduce packaging requirements; some of these products, such as fabric softeners and powdered detergent, are designed for use with refillable containers.

Reuse of Products and Packages

Similar to lengthening product life, reuse of products and packages delays the time when the items must finally be discarded as waste. When a product is reused, presumably purchase and use of a new product is delayed, although this may not always be true.

Many of the products characterized for this report are reused in sizable quantities (e.g., furniture, wood pallets, and clothing). The recovery of products and materials for recycling (including composting) as characterized in Chapter 2 does *not* include reuse of products, but reuse is discussed in this section.

Durable Goods. There is a long tradition of reuse of durable goods such as large and small appliances, furniture, and carpets. Often this is done informally as individuals pass on used goods to family members and friends. Other durable goods are donated to charitable organizations for resale or use by needy families. Some communities and other organizations have facilitated exchange programs for citizens, and there are for-profit retail stores that deal in used furniture, appliances, and carpets. Individuals resell other at garage sales, flea markets, and the like. Borrowing and sharing items like tools also can reduce the number of products ultimately discarded. There is generally a lack of data on the volume of durable goods reused in the United States and what the ultimate effect on MSW generation might be.

Nondurable Goods. While nondurable goods by their very nature are designed for short-term use and disposal, there is considerable reuse of some items classified as nondurable. In particular, footwear, clothing, and other textile goods often are reused. Much of the reuse is accomplished through the same types of channels as those described above for durable goods. That is, private individuals, charitable organizations, and retail outlets (consignment shops) all

facilitate reuse of discarded clothing and footwear. In addition, considerable amounts of textiles are reused as wiping cloths before being discarded.

Another often-cited waste prevention measure is the use of washable plates, cups, napkins, towels, diapers, and other such products, instead of the disposable variety. (This will reduce solid waste but will have other environmental effects, such as increased water and energy use.) Other reusable items are available, for example: reusable air filters, reusable coffee filters, and reconditioned printer cartridges.

Containers and Packaging. Containers and packaging can be reused in two ways: they can be used again for their original purpose, or they can be used in other ways.

Glass bottles are a prime example of reuse of a container for its original purpose. Refillable glass beer and soft drink bottles can be collected, washed, and refilled for use again. Some years ago large numbers of refillable glass soft drink bottles were used, but single-use glass bottles, plastic bottles, and aluminum cans have largely replaced these. Considerable numbers of beer bottles are collected for refilling, often by restaurants and taverns, where the bottles can easily be collected and returned by the distributor. The Glass Packaging Institute estimates that refillable glass bottles achieve a rate of 8 trips (refillings) per bottle.

Another example in this category is the use of refurbished wood pallets for shipping palletized goods. Based on USDA Forest Service data, more than 6 million tons of wood pallets were refurbished and returned to service in 2000. It also is common practice to recondition steel drums and barrels for reuse.

Many other containers and packages can be recycled, but are not often reused. Some refillable containers (e.g., plastic laundry softener bottles) have been introduced: the original container can be refilled using concentrate purchased in small packages. This practice can achieve a notable source reduction in packaging. As another example, some grocery stores will allow customers to reuse grocery sacks, perhaps allowing a refund for each sack brought back for reuse. Also, many parcel shippers will take back plastic packaging “peanuts” for reuse.

Many ingenious reuses for containers and packaging are possible in the home. People reuse boxes, bags, jars, jugs, and cans for many purposes around the house. There are no reliable estimates as to how these activities affect the waste stream.

Management of Organic Materials

Food scraps and yard trimmings combined made up about 23 percent of MSW generation in 2000, so source reduction measures aimed at these products can have an important effect on waste generation. Composting is the usual method for recovering these organic materials. As defined in this report, composting of organic materials after they are taken to a central composting facility is a waste management activity comparable to recovery for recycling. Estimates for these offsite composting activities are included in this chapter.

There are several types of source reduction that take place at the point of generation (e.g., the yard of a home or business). Estimates for these practices are provided in Chapter 4. The practice of backyard composting of yard trimmings and generation of certain food discards has been growing. There also is a trend toward leaving grass clippings on lawns, sometimes through the use of mulching mowers. Other actions contributing to reduced organics disposal are: establishing variable rates for collection of wastes (also known as unit-based pricing or Pay-As-You-Throw), which encourage residents to reduce the amount of wastes set out; improved technology (mulching mowers); xeriscaping (landscaping with plants that use minimal water and generate minimal waste); and certain legislation such as bans of disposal of yard trimmings in landfills.

Part of the impetus for source reduction of yard trimmings is the large number of state regulations discouraging landfilling or other disposal of yard trimmings. The Composting Council and other sources reported that in 1992, 12 states (amounting to more than 28 percent of the nation's population) had in effect legislation affecting management of yard trimmings. In 1998, 24 states plus the District of Columbia (amounting to about 50 percent of the nation's population) had in effect legislation discouraging disposal of yard trimmings.

RECOVERY FOR RECYCLING (INCLUDING COMPOSTING)

Recyclables Collection

Before recyclable materials can be processed and recycled into new products, they must be collected. Most residential recycling involves curbside recyclables collection, drop-off programs, buy-back operations, and/or container deposit systems. Collection of recyclables from commercial establishments is usually separate from residential recyclables collection programs.

Curbside Recyclables Collection. In 2000, more than 9,200 curbside recyclables collection programs were reported in the United States. As shown in Table 25 and Figure 18, the extent of residential curbside recycling programs varies tremendously by geographic region, with the largest numbers of curbside collection programs in the Northeast and Midwest.

Table 25

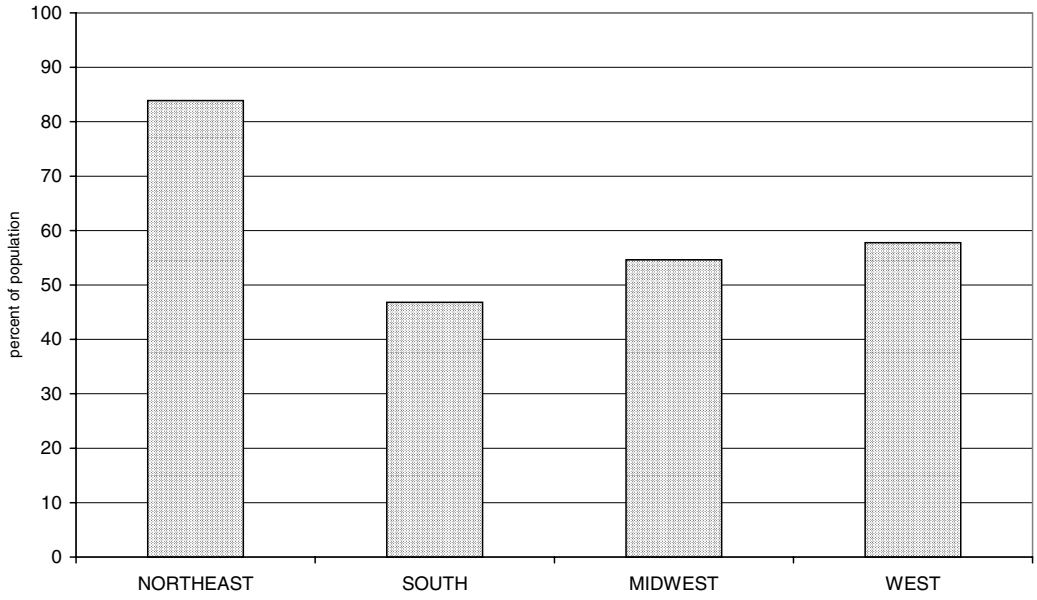
NUMBER AND POPULATION SERVED BY CURBSIDE RECYCLABLES COLLECTION PROGRAMS, 2000

Region	Number of Programs	Population (in thousands)	Population Served (in thousands)	Percent*
NORTHEAST	3,459	51,830	43,482	84%
SOUTH	1,427	80,092	37,510	47%
MIDWEST	3,582	41,389	22,618	55%
WEST	779	51,165	29,555	58%
Total (1)	9,247	224,475	133,165	59%
Percent of Total U.S. Population				49%

* Percent of population served by curbside programs was calculated using population of states reporting data.

Source: Statistical Abstract 2000, U.S. Bureau of Census, BioCycle November 2000.

Figure 18. Population served by curbside recycling, 2000



Source: *BioCycle,* November 2000.

In 2000, nearly one-half (49 percent) of the U.S. population, or 133 million persons, had access to curbside recyclables collection programs. The Northeast region had the largest population served—43.5 million persons. In the Northeast, about 84 percent of the population had access to curbside recyclables collection, while in the South 47 percent of the population had access to curbside recycling.

Drop-off Centers. Drop-off centers typically collect residential materials, although some accept materials from businesses. They are found in locations such as grocery stores, sheltered workshops, charitable organizations, city-sponsored sites, and apartment complexes. Types of materials collected vary greatly; however, drop-off centers can usually accept a greater variety of materials than a curbside collection program.

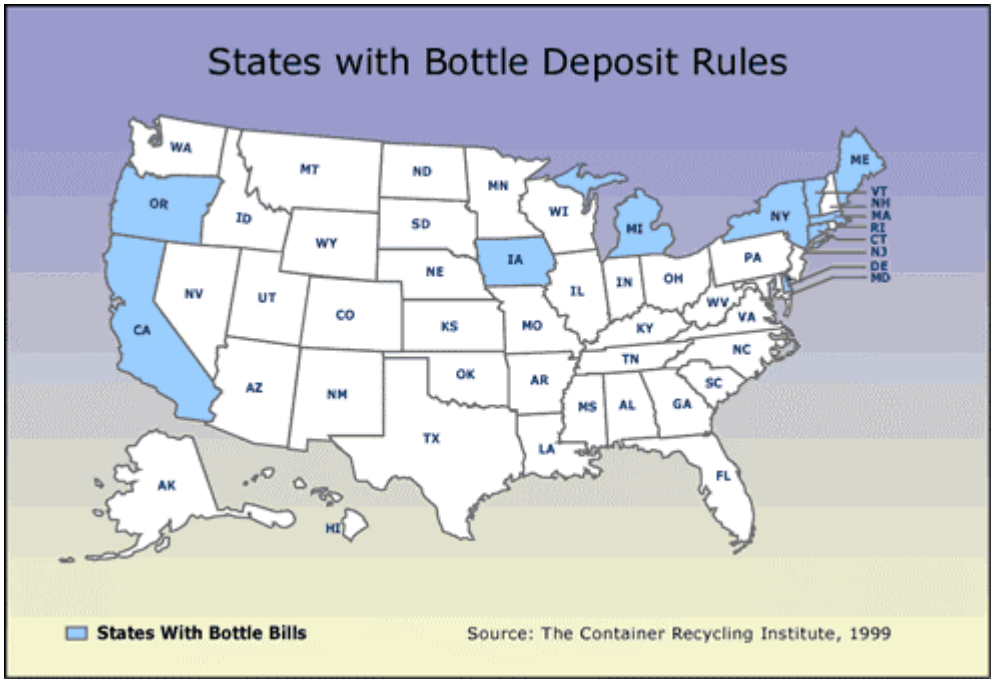
It is difficult to quantify drop-off centers in the United States. It is estimated that there were 12,694 programs in 1997, according to a *BioCycle* survey. In some areas, particularly those with sparse population, drop-off centers may be the only option for collecting recyclable materials. In other areas, they supplement other collection methods.

Buy-back Centers. A buy-back center is typically a commercial operation that pays individuals for recovered materials. This could include scrap metal dealers, aluminum can centers, waste haulers, or paper dealers. Materials are collected by individuals, small businesses, and charitable organizations.

Deposit Systems. Nine states have container deposit systems: Connecticut, Delaware, Iowa, Maine, Massachusetts, Michigan, New York, Oregon, and Vermont (Figure 19). In these programs, the consumer pays a deposit on beverage containers at the point of purchase, which is redeemed on return of the empty containers. California has a similar system where containers can be redeemed, but the consumer pays a redemption fee. With the exception of California, no new deposit laws have been enacted since the early 1980s, due in part to the convenience and economics of curbside recycling.

Deposit systems generally target beverage containers (primarily beer and soft drink), which account for less than 4 percent of total MSW generation. It is estimated that about 35 percent of all recovery of beverage containers comes from the 9 traditional deposit states mentioned above, and an additional 20 percent of recovered beverage containers comes from California. (Note: These recovery estimates reflect not only containers redeemed by consumers for deposit, but also containers recovered through existing curbside and drop-off recycling programs. Containers recovered through these programs eventually are credited to the distributor and counted toward the redemption rate.)

Figure 19.



Commercial Recyclables Collection. The largest quantity of recovered materials comes from the commercial sector. Old corrugated containers (OCC) and office papers are widely collected from commercial establishments. Grocery stores and other retail outlets that require corrugated packaging are part of an infrastructure that brings in the most recovered material. OCC often is baled at the retail outlet and picked up by a paper dealer.

Office paper (e.g., white, mixed color, computer paper, etc.) is part of another commercial recyclables collection infrastructure. Depending on the quantities generated, businesses (e.g., banks, institutions, schools, printing operations, etc.) can sort materials and have them picked up by a paper dealer, or self deliver the materials to the recycler. It should be noted that commercial operations also make recycling available for materials other than paper.

Multi-family residence recycling could be classified as either residential or commercial recyclables collection. Multi-family refuse collection is usually handled as a commercial account by waste haulers. These commercial waste haulers may handle recycling at multi-family dwellings (typically five or more units) as well.

Recyclables Processing

Processing recyclable materials is performed at materials recovery facilities (MRFs), mixed waste processing facilities, and mixed waste composting facilities. Some materials are sorted at the curb and require less attention. Other materials are sorted into categories at the curb, such as a paper category and a container category, with additional sorting at a MRF. Mixed waste also can be processed to pull out recyclable and compostable materials.

Materials Recovery Facilities. Materials recovery facilities vary widely across the United States, depending on the incoming materials and the technology and labor used to sort the materials. In 2000, 480 MRFs were operating in the United States, with an estimated total daily throughput of 62,000 tons per day (Table 26). The most extensive recyclables processing throughput per million persons occurs in the Northeast and West (Figure 20).

The majority of MRFs are considered low technology, meaning that the materials are predominantly sorted manually. MRFs classified as high technology sort recyclables using eddy currents, magnetic pulleys, optical sensors, and air classifiers. As MRFs change and grow, many low-technology MRFs add high tech features, and high-technology MRFs include manual sorting, reducing the distinction between high- and low-technology MRFs.

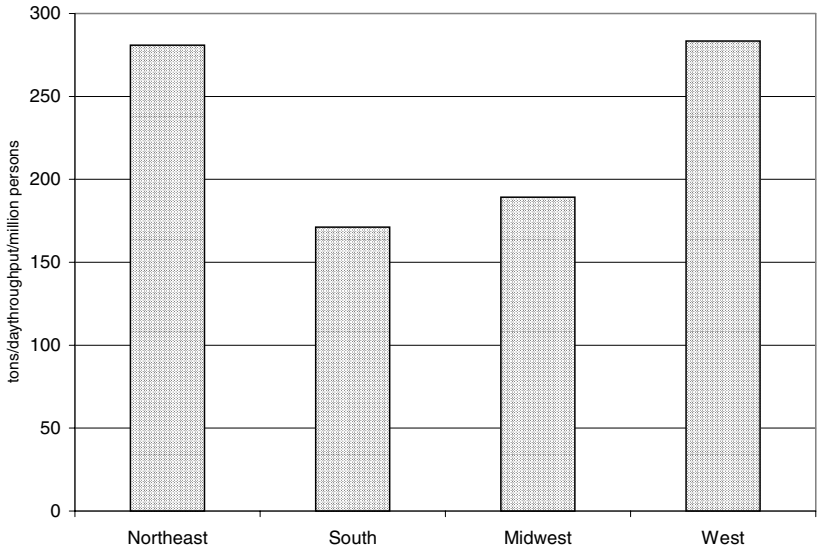
Table 26

MATERIALS RECOVERY FACILITIES, 2000

Region	Number	Estimated Throughput (tpd)
NORTHEAST	107	15,055
SOUTH	149	17,161
MIDWEST	117	12,188
WEST	107	17,567
U.S. Total	**480**	**61,971**

Source: Governmental Advisory Associates, Inc. 2001 report release pending.

Figure 20. Estimated MRF Throughput, 2000
(tons per day per million persons)



Mixed Waste Processing. Mixed waste processing facilities are less common than conventional MRFs, but there are several facilities in operation in the United States, as shown in Figure 21. Mixed waste processing facilities receive waste just as if it were going to a landfill. The mixed waste is loaded on conveyors and, using both mechanical and manual (high and low technology) sorting, recyclable materials are removed for further processing. In 2000, there were reported to be 43 mixed waste processing facilities in the United States, handling about 29,000 tons of waste per day. The Western region of the United States has the largest concentration of these processing facilities.

Mixed Waste Composting. Mixed waste composting starts with unsorted MSW. Large items are removed, as well as ferrous and other metals, depending on the type of operation. Mixed waste composting takes advantage of the high percentage of organic components of MSW, such as paper, food scraps and yard trimmings, wood, and other materials. In 2000, there were 15 mixed waste composting facilities, fewer than the 19 reported in 1999. (Facilities were closed in the South and Midwest.) The highest processing capacity per million persons was found in the South, as shown in Figure 22.

Figure 21. Mixed Waste Processing Estimated Capacity, 2000
(tons per day per million persons)

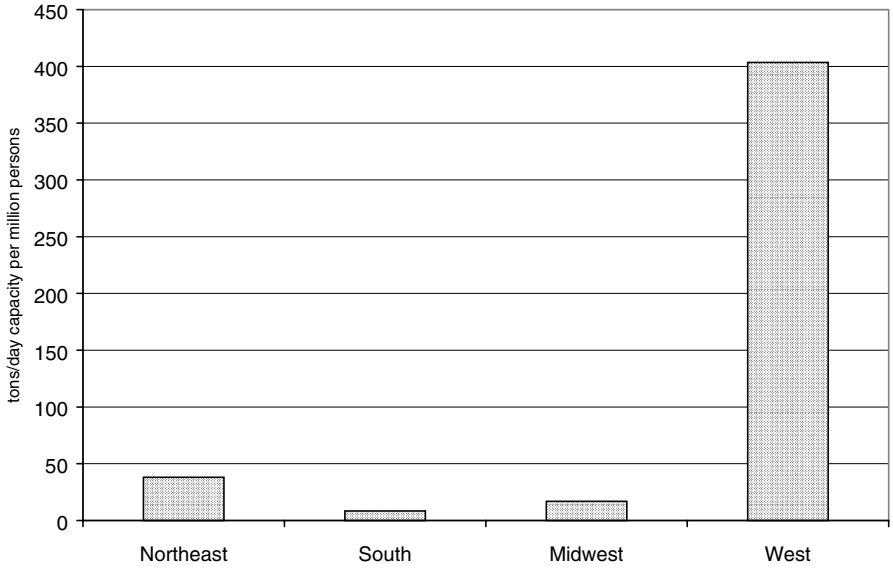
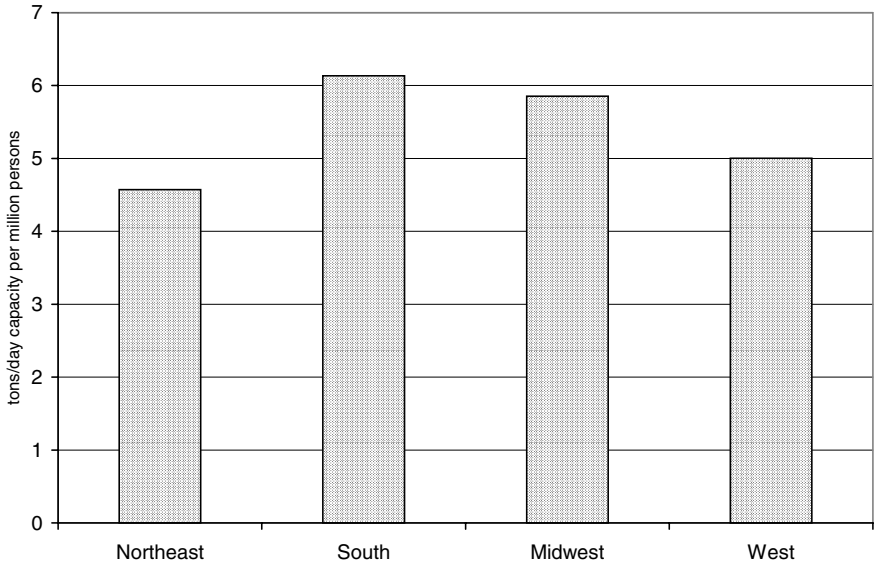
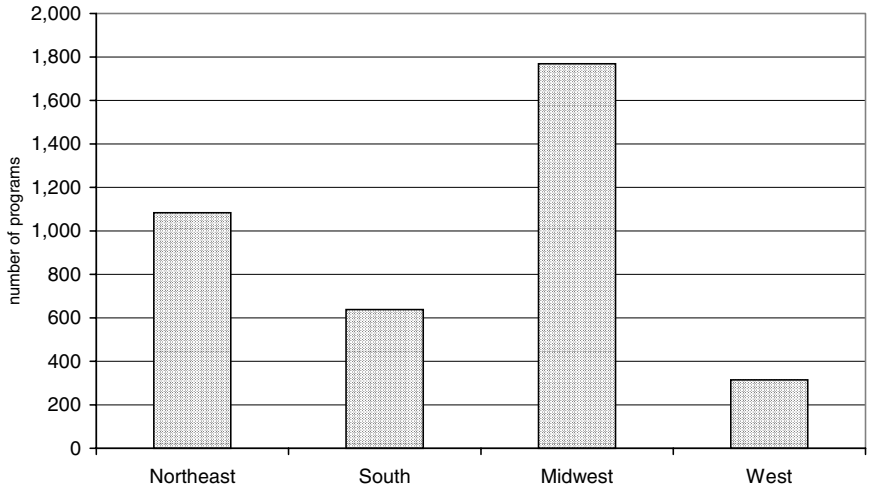


Figure 22. MSW Composting Capacity, 2000
(Capacity in tons per day per million persons)



Yard Trimmings Composting. Yard trimmings composting is much more prevalent than mixed waste composting. Onsite management of yard trimmings is not included in this section, but is discussed in the source reduction section (Chapter 4). In 2000, about 3,800 yard trimmings composting programs were reported. About 75 percent of these programs are in the Northeast and Midwest regions, as shown in Figure 23. Based on 15.8 million tons of yard trimmings recovered for composting in the United States (Table 2, Chapter 2), yard trimmings composting facilities handled approximately 43,200 tons per day in 2000.

Figure 23. Yard Trimmings Composting Programs, 2000
(In number of programs)



COMBUSTION

Most of the municipal solid waste combustion currently practiced in this country incorporates recovery of an energy product (generally steam or electricity). The resulting energy reduces the amount needed from other sources, and the 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; energy recovery became more prevalent in the 1980s.

Total U.S. MSW combustion with energy recovery, referred to as waste-to-energy (WTE) combustion, had a 2000 design capacity of 95,700 tons per day. There were 102 WTE facilities in 2000 (Table 27). In tons of capacity per million persons, the Southern region had the most MSW combustion capacity in 2000 (Figure 24).

In addition to facilities combusting mixed MSW (processed or unprocessed), there is a small but growing amount of combustion of source-separated MSW. In particular, there is considerable interest in using rubber tires as fuel in dedicated facilities or as fuel in cement kilns. In addition, there is combustion of wood wastes and some paper and plastic wastes, usually in boilers that already burn some other type of solid fuel. For this report, it was estimated that about 2.3 million tons of MSW were combusted in this manner in 2000, with tires contributing a majority of that total.

Table 27

MUNICIPAL WASTE-TO-ENERGY* PROJECTS, 2000

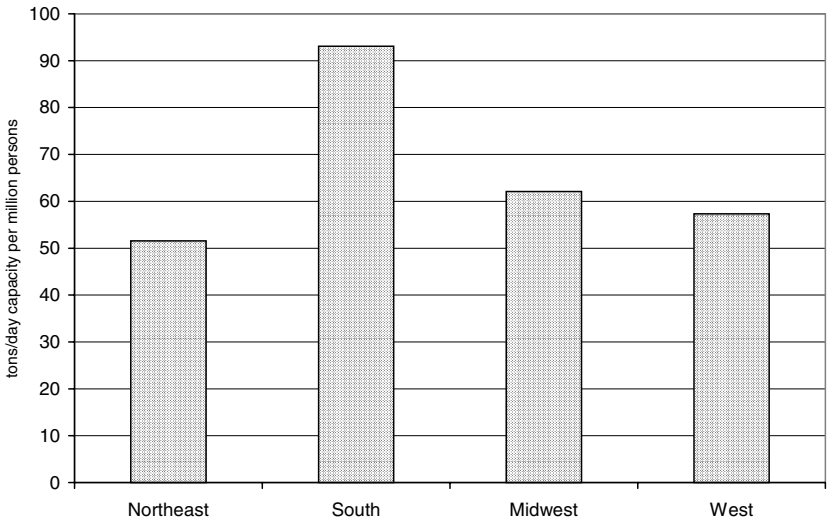
Region	Number Operational	Design Capacity (tpd)
NORTHEAST	40	44,865
SOUTH	34	34,115
MIDWEST	21	12,198
WEST	7	4,559
U.S. Total (1)	102	95,737

* Projects on hold or inactive were not included.
Facilities in Hawaii and Alaska not included.
WTE includes mass burn, modular, and refuse-derived fuel facilities.

Source: "The IWSA Directory of Waste-To-Energy Plants." Integrated Waste Services Association, 2000.

In most cases the facilities have a stated daily capacity, but they normally operate at less than capacity over the course of a year. It was assumed for this report that throughput over a year of operation is 90 percent of rated capacity. The total throughput of MSW through all combustion facilities was an estimated 33.7 million tons, or 14.5 percent of MSW generation, in 2000.

Figure 24. Municipal Waste-to-Energy Capacity, 2000
(Capacity in tons per million persons)



RESIDUES FROM WASTE MANAGEMENT FACILITIES

Whenever municipal wastes are processed, residues will remain. For the purposes of this report, it is assumed that most of these residues are landfilled. MRFs and compost facilities generate some residues when processing various recovered materials. These residues include materials that are unacceptable to end users (e.g., broken glass, wet newspapers), other contaminants (e.g., products made of plastic resins that are not wanted by the end user), or dirt. While residue generation varies widely, 5 to 10 percent is probably typical for a MRF. Residues from a MRF or compost facility are generally landfilled. Since the recovery estimates in this report are based on recovered materials purchased by end users rather than materials entering a processing facility, the residues are counted with other disposed materials.

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 because it generally must be managed separately.* (There are a number of efforts underway to reuse ash.) 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.

LANDFILLS

Although the number of landfills is decreasing, the capacity has remained relatively constant because newer landfills are much larger than those built many years ago. In 2000, approximately 2,000 municipal solid waste landfills were reported in the contiguous United States.

Table 28 and Figure 25 show the number of landfills in each region. The Southeast and West had the largest number of landfills. Thirty-four states had more than 10 years of capacity left. Only two states reported having less than 5 years of capacity remaining.

Table 28

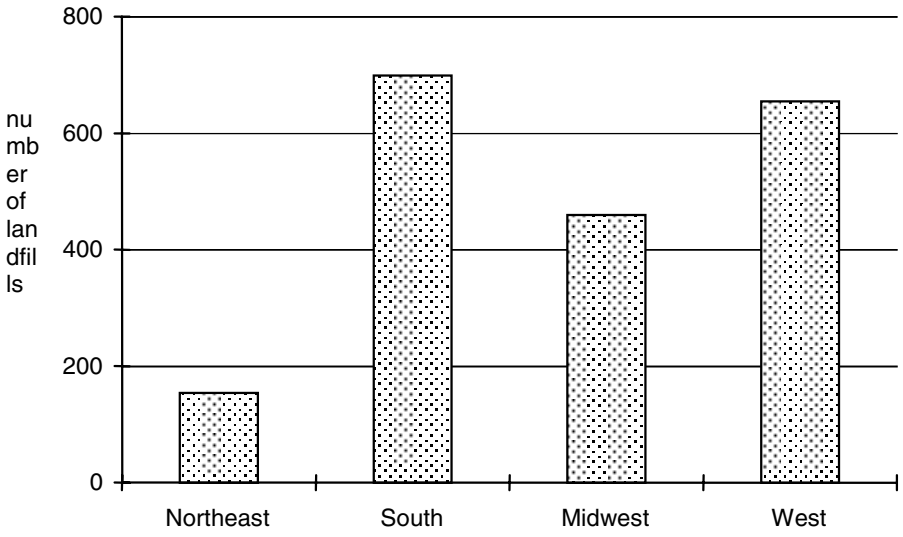
LANDFILL FACILITIES, 2000

Region	Number of Landfills *	Number of States with Years Capacity Remaining		
		> 10 yr	5 to 10 yr	< 5 yr
NORTHEAST	154	6	2	1
SOUTHEAST	699	12	3	1
MIDWEST	459	7	5	0
WEST	655	9	2	0
***U.S. Total** *	1,967	34	12	2

* Excludes landfills reported in Alaska (239) and Hawaii (10).
Source: BioCycle April 2000.

* Note that many combustion facilities do magnetic separation of residues to recover ferrous metals (e.g., steel cans and steel in other miscellaneous durable goods). This recovered steel is included in the total recovery of ferrous metals in MSW reported in Chapter 2.

Figure 25. Number of Landfills in the United States, 2000



Source: *BioCycle* , April 2000.

SUMMARY OF HISTORICAL AND CURRENT MSW MANAGEMENT

This summary provides some perspective on historical and current municipal solid waste management practices in the United States. The results are summarized in Figure 26 and Table 29.

Historically, municipal solid waste generation has grown relatively steadily (from 88.1 million tons in 1960 to 231.9 million tons in 2000). In the 1960s and early 1970s a large percentage of MSW was burned in incinerators, with little recovery for recycling. Landfill disposal typically consisted of open dumping, often accompanied by open burning of the waste for volume reduction. Through the mid-1980s, incineration declined considerably and landfills became difficult to site, while 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 26 shows, discards of MSW to landfill or other disposal peaked in the 1986 - 1987 period, then declined as materials recovery and combustion increased. Thanks to a

small increase in MSW generation along with a significant increase in recovery for recycling (including composting), landfilled tonnage decreased from 1999 to 2000.

Since 1996 (a recession year), the tonnage of MSW landfilled has been growing again. Generation has increased while combustion has declined and recycling has grown slowly. Although there are now fewer municipal solid waste landfills, their average size has increased, and capacity at the national level does not appear to be a problem. It should be noted, however, that there are fewer years of landfill capacity available than there were 3 years ago. Compared to 3 years ago, more states have less than a decade of capacity left, and regional dislocations in landfill capacity sometimes occur.

Recovery of products and yard trimmings has increased steadily, reaching 30.1 percent of generation in 2000. Combustion tonnage has declined since 1997, to 14.5 percent of generation in 2000. Tonnage landfilled reached a low of 115.8 million tons in 1996, then increased again. As a percentage of total MSW generation, landfilling has consistently decreased—from 83.2 percent of generation in 1986 to 55.3 percent in 2000.

Figure 26. Municipal solid waste management, 1960 to 2000

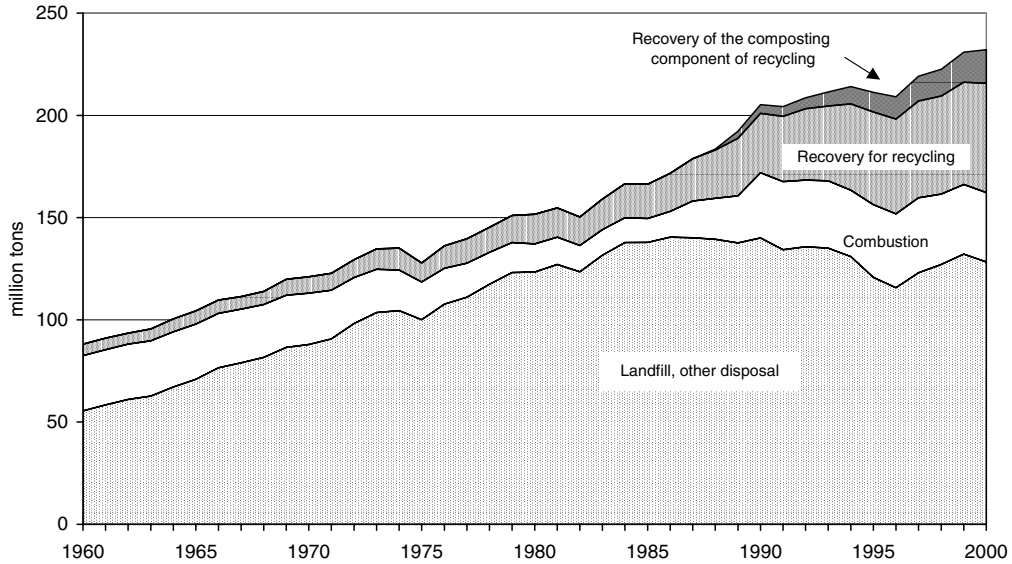


Table 29

GENERATION, MATERIALS RECOVERY, COMPOSTING, COMBUSTION, AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 TO 2000
(In thousands of tons and percent of total generation)

	Thousands of Tons								
	1960	**1970**	**1980**	**1990**	**1994**	**1995**	**1998**	**1999**	**2000**
Generation	88,120	121,060	151,640	205,210	214,360	211,360	223,360	230,940	231,850
Recovery for recycling	5,610	8,020	14,520	29,040	42,150	45,340	47,950	50,060	53,420
Recovery for composting*	Neg.	Neg.	Neg.	4,200	8,480	9,570	13,140	14,720	16,450
Total Materials Recovery	5,610	8,020	14,520	33,240	50,630	54,910	61,090	64,780	69,870
Discards after recovery	82,510	113,040	137,120	171,970	163,730	156,450	162,270	166,160	161,980
Combustion**	27,000	25,100	13,700	31,900	32,490	35,540	34,410	34,040	33,730
Discards to landfill, other disposal†	55,510	87,940	123,420	140,070	131,240	120,910	127,860	132,120	128,250

	Pounds per Person per Day								
	1960	**1970**	**1980**	**1990**	**1994**	**1995**	**1998**	**1999**	**2000**
Generation	2.68	3.25	3.66	4.50	4.51	4.40	4.52	4.64	4.51
Recovery for recycling	0.17	0.22	0.35	0.64	0.89	0.94	0.97	1.01	1.04
Recovery for composting*	Neg.	Neg.	Neg.	0.09	0.18	0.20	0.27	0.30	0.32
Total Materials Recovery	0.17	0.22	0.35	0.73	1.06	1.14	1.24	1.31	1.36
Discards after recovery	2.51	3.04	3.31	3.77	3.44	3.26	3.29	3.33	3.15
Combustion**	0.82	0.67	0.33	0.70	0.68	0.74	0.70	0.68	0.66
Discards to landfill, other disposal†	1.69	2.36	2.98	3.07	2.76	2.52	2.59	2.65	2.50
Population (thousands)	179,979	203,984	227,255	249,907	260,682	263,168	270,561	272,691	281,422

	Percent of Total Generation								
	1960	**1970**	**1980**	**1990**	**1994**	**1995**	**1998**	**1999**	**2000**
Generation	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Recovery for recycling	6.4%	6.6%	9.6%	14.2%	19.7%	21.5%	21.5%	21.7%	23.0%
Recovery for composting*	Neg.	Neg.	Neg.	2.0%	4.0%	4.5%	5.9%	6.4%	7.1%
Total Materials Recovery	6.4%	6.6%	9.6%	16.2%	23.6%	26.0%	27.4%	28.1%	30.1%
Discards after recovery	93.6%	93.4%	90.4%	83.8%	76.4%	74.0%	72.6%	71.9%	69.9%
Combustion**	30.6%	20.7%	9.0%	15.5%	15.2%	16.8%	15.4%	14.7%	14.5%
Discards to landfill, other disposal†	63.0%	72.6%	81.4%	68.3%	61.2%	57.2%	57.2%	57.2%	55.3%

* Composting of yard trimmings and food scraps. Does not include mixed MSW composting or backyard composting.
** Includes combustion of MSW in mass burn or refuse-derived fuel form, and combustion with energy recovery of source separated materials in MSW (e.g., wood pallets and tire-derived fuel).
† Discards after recovery minus combustion.
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

CHAPTER 3

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CHAPTER 4

SOURCE REDUCTION OF MUNICIPAL SOLID WASTE

INTRODUCTION

During the past 40 years, the amount of waste the United States creates has more than doubled, growing from 88 to 232 million tons per year. The most effective way to reduce this growth is by preventing waste from being generated in the first place.

Source reduction, also known as "waste prevention," is the practice of designing, manufacturing, purchasing, or using materials (such as products and packaging) in ways that reduce the amount or toxicity of trash created. Reusing items is another way to reduce waste at the source. Reuse lowers our consumption of new items that eventually enter the waste collection and disposal system.

Source reduction means consuming and throwing away less. It includes actions such as purchasing durable, long-lasting goods and seeking products and packaging that are as free of excessive packaging and toxins as possible. It can be as complex as redesigning a product to use fewer raw materials in production, have a longer life, or be used again after its original use is completed. It can be as simple as declining an unnecessary bag for a small purchase that doesn't really need one. Because source reduction actually prevents the generation of waste in the first place, it is the most preferable method of waste management. Because it decreases our resource use, source reduction protects the environment.

MEASURING SOURCE REDUCTION

Source reduction has been an increasingly important aspect of municipal solid waste programs since the late 1980s. The task of actually measuring how much source reduction has taken place—how much waste prevention there has been—has proved difficult.

This chapter presents the results of EPA studies designed to measure source reduction for the entire municipal solid waste stream. MSW includes wastes such as durable goods, nondurable goods, containers and packaging, food scraps, yard trimmings, and miscellaneous

inorganic wastes from residential, commercial, institutional, and industrial sources. MSW does not include sewage, hazardous wastes, nonhazardous industrial waste, construction and demolition debris, or automobile bodies.

Unlike recycling, where there are actual materials to weigh all through the process, measuring source reduction means trying to measure something that no longer exists. To measure the absence of waste at the national level, a factor had to be found—something in the population or economy that has most closely followed the pattern of waste generation. Population increases or decreases of course have an impact, but EPA analysis showed that population is not the best indicator of waste generation. The gross domestic product (GDP), which measures the value of goods and services produced in the United States, had a relatively good correlation to waste generation. But, going all the way back to 1960, what ended up having the best relationship with waste generation was personal consumption expenditures (PCE)—commonly referred to as "consumer spending." This makes perfect sense since consumer spending reflects the goods and products, including food, and their packaging, which are used, and ultimately discarded, as municipal solid waste.

Between 1960 and 1990, increasing consumer spending produced a measured steep and steady increase in waste generation in the United States. After 1990 consumer spending continued to grow. If the waste stream had grown at the same rate as consumer spending, about 287 million tons of waste would have been generated in 2000. Instead, only 232 million tons of waste were actually generated. That's 55 million tons of waste that never made it into the waste stream. Source reduction is simply the difference between the amount of MSW projected to be generated in 2000 and the actual amount of MSW that was generated in 2000.

The November 1999 *National Source Reduction Characterization Report for Municipal Solid Waste in the United States* (EPA/530-R-99-034) explains the methodology that was used to produce the source reduction estimates presented in this report. Details on the chosen methodology, including an explanation of the reasons for using PCE, are provided in that report. Updates to previously published data are reflected in this report. These updates are the result of recent revisions in national economic data, particularly PCE, made by the U.S. Department of Commerce, as well as adjustments to estimates of historical waste generation.

SOURCE REDUCTION FACTS

More than 55 million tons of MSW were source reduced in the United States in 2000. The precise figure is 55,146,000 tons. Table 30 shows that containers and packaging represent approximately 28 percent of the amount source reduced in 2000. Nondurable goods (e.g., newspapers, clothing) represent 17 percent, durable goods (e.g., appliances, furniture, tires) 10 percent, and other MSW (e.g., yard trimmings, food scraps) 45 percent.

Table 31 lists items that showed significant decreases (source reduction) and increases (source expansion) in waste generation in 2000. The top portion of the table shows 14 major contributors to source reduction. These 14 accounted for 87 percent of the nation's entire 2000 waste reduction. The bottom portion of the table shows four items that together account for 63 percent of the increases in waste generation. A complete listing of source reduction or expansion for individual MSW components can be found in Appendix B.

Table 30: 2000 Source Reduction by Major Material Categories

Waste Stream	Tons Source Reduced	Percentage
Durable Goods (e.g., appliances, furniture)	5,361,000	10%
Nondurable Goods (e.g., newspapers, clothing)	9,302,000	17%
Containers & Packaging (e.g., bottles, boxes)	15,518,000	28%
Other MSW (e.g., yard trimmings, food scraps)	24,965,000	45%
Total Source Reduction (1990 baseline)	55,146,000	100%

Source reduction data for certain materials need to be considered in conjunction with similar data for other related materials. For example, glass containers have contributed significantly to source reduction. This source reduction reflects the fact that plastic containers

have been substituted for glass in many instances. There is significant source expansion of plastic containers shown in this study. In order to correctly reflect the impact of such material substitution, Table 32 shows source reduction and expansion for "functional" categories defined so that individual materials are not taken out of context. Thus, for example, Table 32 shows that source reduction for "Bags and Sacks" is 1,527,000 tons in the aggregate. This is a result of source reduction in paper bags and sacks (1,862,000 tons) and source expansion in plastic bags and sacks (335,000 tons).

Table 31: Significant Source Reduction and Source Expansion Within MSW (Thousands of Tons)

Waste Stream Showing Significant Source Reduction or Source Expansion	Source Reduction / (Expansion)
Significant Source Reduction	
Yard Trimmings	21,219
Newspapers	3,752
Wood Packaging	3,560
Corrugated Boxes	3,369
Food Scraps	3,190
Miscellaneous Durables	2,770
Glass Food/Other Bottles & Jars	2,458
Glass Beer/Soft Drink Bottles	2,028
Paper Bags/Sacks	1,862
Magazines	1,828
Furniture/Furnishings	1,656
Other Nonpackaging Paper	1,510
Office Paper	1,435
Major Appliances	989
Total	51,627
Significant Source Expansion	
Clothing/Footwear	(852)
Other Commercial Printing	(802)
Plastic-Other Containers	(630)
Plastic Wraps	(410)
Total	(2,695)

Table 32: Source Reduction/(Expansion) for Functional Categories - 2000

(Thousands of Tons)

Product	Source Reduction / (Expansion)
Durable Goods	
Miscellaneous Durables	2,770
Furniture/Furnishings	1,656
Major Appliances	989
Tires	379
Batteries, Lead Acid	172
Small Appliances	(248)
Carpets/Rugs	(357)
Subtotal	5,361
Product	**Source Reduction / (Expansion)**
Nondurable Goods	
Publications	5,910
Other Nonpackaging Paper	1,510
Office Paper	1,435
Tissue Paper/Towels	930
Miscellaneous Nondurables	641
Disposable Diapers	436
Trash Bags	241
Towels, Sheets, Pillowcases	173
Plates/Cups	(92)
Standard (A) Mail	(228)
Other Commercial Printing	(802)
	(*continued on next page*)
Clothing/Footwear	(852)
Subtotal	9,302
Packaging	

Product	Source Reduction / (Expansion)
Paper Boxes	3,803
Beverage Containers	3,800
Wood Packaging	3,560
Food Containers	3,370
Bags and Sacks	1,527
Misc. Packaging	(175)
Wrapping	(367)
Packaging Subtotal	15,518
OTHER MSW WASTES	
Yard Trimmings	21,219
Food Scraps	3,190
Misc. Inorganics	556
Subtotal	24,965
Grand Total	55,146

A SOURCE REDUCTION SUCCESS STORY

As shown in Table 32, by far the single largest contributor to source reduction is yard trimmings. Yard trimmings account for 21.2 million out of 55.1 million tons of source reduction, about 38 percent of the total. No other category listed in Table 32 accounts for more than 5.9 million tons. The amount of yard trimmings grew steadily from 1960 to 1990, peaking at 1990 and 35 million tons. It then fell to 27.7 million tons in 2000.

There are many other areas in which major gains in source reduction are possible. For example, consider corrugated boxes. Corrugated boxes provided 3,369 tons of source reduction. However, corrugated box waste grew from 24 million tons in 1990 to 30.2 million tons in 2000. Experience elsewhere, such as Canada's *National Packaging Protocol*, suggests that more source reduction could be accomplished. Canadian statistics show that the quantity of new paper

packaging used declined approximately 1 million tonnes (1.1 million tons) between 1992 and 1996.*

SOURCE REDUCTION BENEFITS

Source reduction, including material reuse, can help reduce waste disposal and handling costs, because it avoids the costs of recycling, municipal composting, landfilling, and combustion. Source reduction also conserves resources, such as water and energy, and reduces pollution, including greenhouse gases, that contribute to global warming.

Source reduction saves natural resources. Waste is not just created when consumers throw items away. Throughout the life cycle of a product—from extraction of raw materials to transportation to processing and manufacturing facilities to manufacture and use—waste is generated. Reusing items or making them with less material decreases waste dramatically. Ultimately, fewer materials will need to be recycled or sent to landfills or waste combustion facilities.

Source reduction reduces toxicity of waste. Selecting nonhazardous or fewer hazardous items is another important component of source reduction. Using less hazardous alternatives for certain items (e.g., cleaning products and pesticides), sharing products that contain hazardous chemicals instead of throwing out leftovers, reading label directions carefully, and using the smallest amount necessary are ways to reduce waste toxicity.

Source reduction reduces costs. The benefits of preventing waste go beyond reducing reliance on other forms of waste disposal. Preventing waste also can mean economic savings for communities, businesses, schools, and individual consumers.

- When these households reduce waste at the source, they dispose of less trash, resulting in lower trash disposal fees and longer landfill life. This reduces the cost of waste management to their community.

* Canadian Council of Ministers of the Environment. *National Packaging Protocol 1996 Milestone Report*. January 1998.

- Industry also has an economic incentive to practice source reduction. When businesses manufacture their products with less packaging, they are buying less raw material. A decrease in manufacturing costs can mean a larger profit margin, with savings that can be passed on to the consumer. Add decreased waste disposal costs to this, and significant savings can be achieved.

- Consumers also can share in the economic benefits of source reduction. Buying products in bulk, with less packaging, or that are reusable (not single-use) frequently means a cost savings. What is good for the environment can be good for the pocketbook as well.

FACTORS IMPACTING SOURCE REDUCTION

Since 1990, source reduction has increased at an impressive rate in the United States—nearly doubling in the last 4 years alone. Economic growth, combined with improvements in materials/resource management, resulted in more than 55 million tons of waste prevented in 2000. This trend may change as the nation's economic growth slows.

A fundamental business principal asserts that waste is an indicator of inefficiency. Therefore, when an organization becomes more efficient in their use of resources, they generate less waste. And, in the business world, increased efficiency translates to increased profits. The prosperity that the United States experienced in the latter half of the 1990s afforded many companies the opportunity to invest in operational efficiencies, thus generating less waste material. This can be seen in the reduction of wood packaging waste due to wooden pallets being reused multiple times instead of being sent to the landfill after just one use. Newspapers also have made large gains in waste reduction. They are being made lighter and slightly smaller than in prior years. It's also likely that the increased use of the Internet has contributed to the reduction in newspaper waste.

Unfortunately, economic prosperity does not always translate into a reduction in waste generation. In some cases it appears that as individuals and some businesses become more prosperous, they also become more wasteful. This is reflected in the expansion of waste from clothing and footwear shown in Table 31 above. Some business-related activities, such as other commercial printing, including reports and prospectuses, also have produced significant increases in waste, also shown in Table 31.

So the good news is that, overall, more products are being made with less waste and Americans are recycling more. The bad news is—we're also consuming more and, in some instances, generating more waste.

ADDITIONAL INFORMATION

Early attempts by localities and states often focused on measuring a single waste stream in a single community. In time, research will develop additional information about specific waste streams for use on a statewide or national level. EPA's *Source Reduction Program Potential Manual* and planning packet, published in 1997 (EPA/530-E-97-001), presents some of this research.

Work by EPA has helped state regulators, local solid waste managers, and residential consumers work together to achieve their impressive reductions in yard trimmings waste. Relevant EPA work includes:

- The *Source Reduction Program Potential Manual* (EPA 530-R-97-002), which showed that grasscycling and home composting have great potential for source reduction.
- The *Organic Materials Management Strategies* (EPA 530-R-99-016), which identified grasscycling and home composting as sources of potential savings in local solid waste management costs.
- *Municipal Solid Waste in the United States: 1999 Facts and Figures* (EPA 530-R-01-014), which highlighted the important role of yard trimmings bans from landfills as a factor in producing source reduction of yard trimmings.

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 were compiled using published data series. U.S. Department of Commerce sources were 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 were 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 were made to account for this.

DIVERSION

Various adjustments were 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.

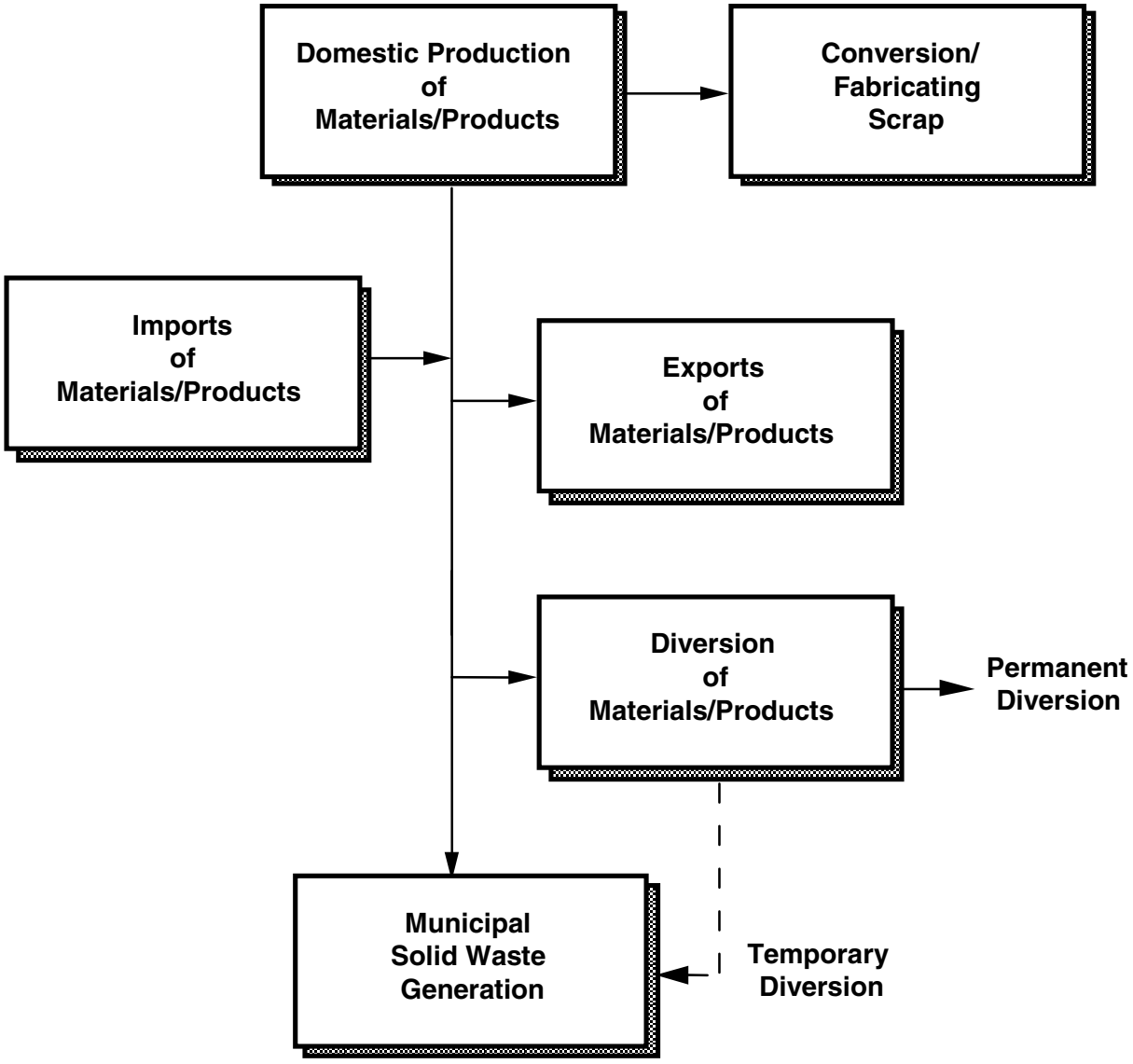


Figure A-1. Material flows methodology for estimating generation of products and materials in municipal solid waste.

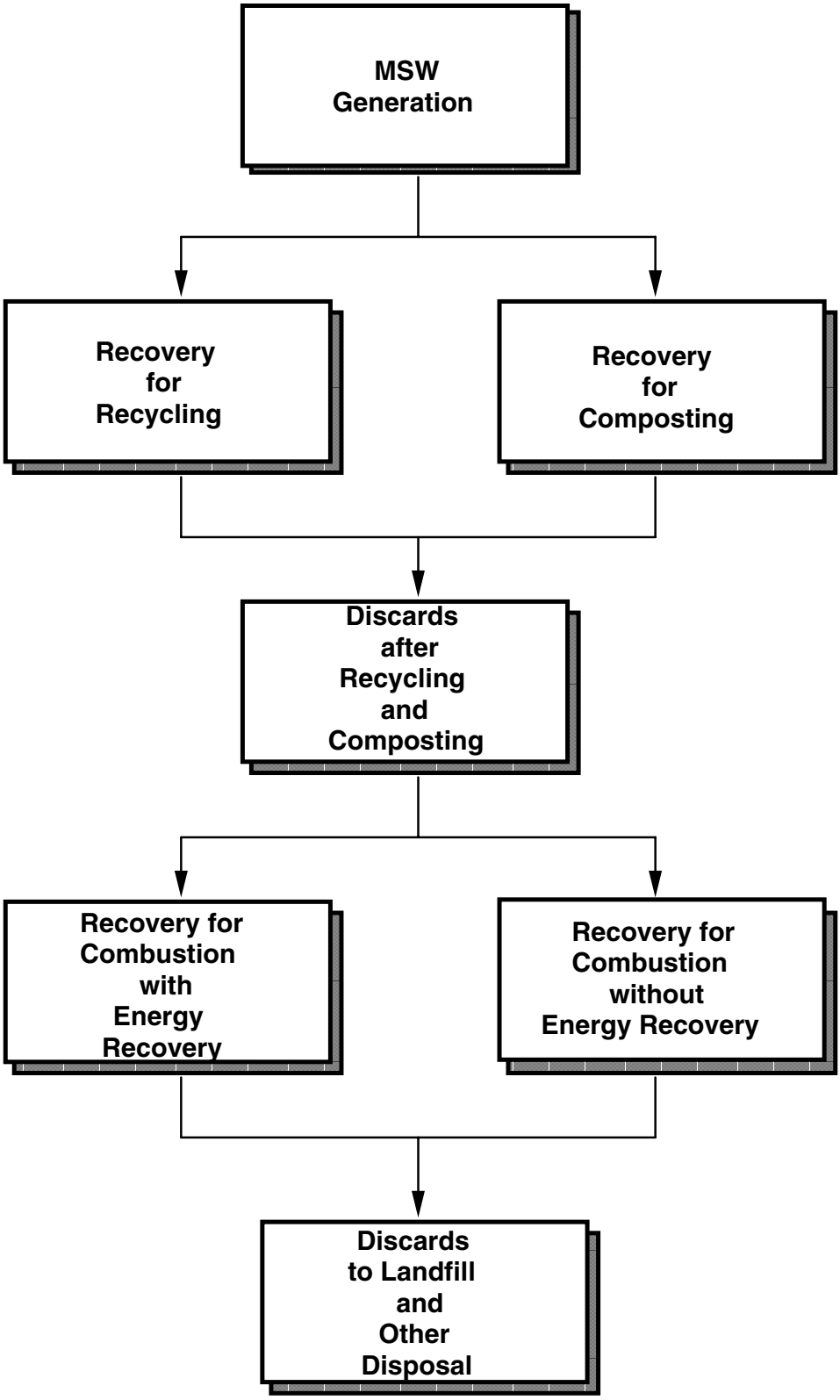


Figure A-2. Material flows methodology for estimating discards of products and materials in municipal solid waste.

APPENDIX B

Table B-1. Source Reduction/Expansion for Individual Components of MSW – 2000 (Thousands of Tons)

Waste Stream by Commodity	Source Reduction / Expansion
Durable Goods	
Miscellaneous Durables	2,770
Furniture/Furnishings	1,656
Major Appliances	989
Tires	379
Batteries, Lead Acid	172
Carpets/Rugs	(248)
Small Appliances	(357)
SR Subtotal	**5,966**
SE Subtotal	**(605)**
Net Value	**5,361**
Nondurable Goods	
Newspapers	**3,752**
Magazines	**1,828**
Other Nonpackaging Paper	**1,510**
Office Paper	**1,435**
Tissue Paper/Towels	**930**
Miscellaneous Nondurables	**641**

(continued on next page)

Waste Stream by Commodity	Source Reduction / Expansion
Disposable Diapers	**436**
Trash Bags	**241**
Books	**217**
Towels, Sheets, Pillowcases	**173**
Telephone Directories	**113**
Plastic Plates/Cups	**39**
Standard (A) Mail	**(131)**
Third Class Mail	**(228)**
Other Commercial Printing	**(802)**
Clothing/Footwear	**(852)**
SR Subtotal	**11,315**
SE Subtotal	**(2,013)**
Net Value	**9,302**
Packaging	
Wood Packaging	**3,560**
Corrugated Boxes	**3,369**
Glass Food/Other Bottles & Jars	**2,458**
Glass Beer/Soft Drink Bottles	**2,028**
Paper Bags/Sacks	**1,862**
Steel Food/Other Cans	**912**

(continued on next page)

Waste Stream by Commodity	Source Reduction / Expansion
Glass Wine/Liquor Bottles	**869**
Aluminum Beer/Soft Drink Cans	**648**
Folding Cartons	**434**
Milk Cartons	**223**
Steel Beer/Soft Drink Cans	**210**
Other Paperboard Packaging	**206**
Wrapping Papers	**154**
Aluminum-Foils/Closure	**82**
Other Paper Packaging	**57**
Plastic Milk Bottles	**51**
Steel-Other Packaging	**40**
Plastics-Other Packaging	**13**
Aluminum-Other Cans	**(22)**
Other Misc. Packaging	**(30)**
Plastic Soft Drink Bottles	**(229)**
Plastic Bags/Sacks	**(335)**
Plastic Wraps	**(410)**
Plastic-Other Containers	**(630)**
SR Subtotal	**17,175**
SE Subtotal	**(1,657)**
Net Value	**15,518**

(continued on next page)

Waste Stream by Commodity	Source Reduction / Expansion
Other Wastes	
Yard Trimmings	**21,219**
Food Scraps	**3,190**
Miscellaneous Inorganic Wastes	**556**
SR Subtotal	**24,965**
SE Subtotal	**0**
Net Value	**24,965**
SR Total	**59,420**
SE Total	**(4,274)**
Grand Total	**55,146**

APPENDIX C

CONSUMER ELECTRONICS IN MUNICIPAL SOLID WASTE

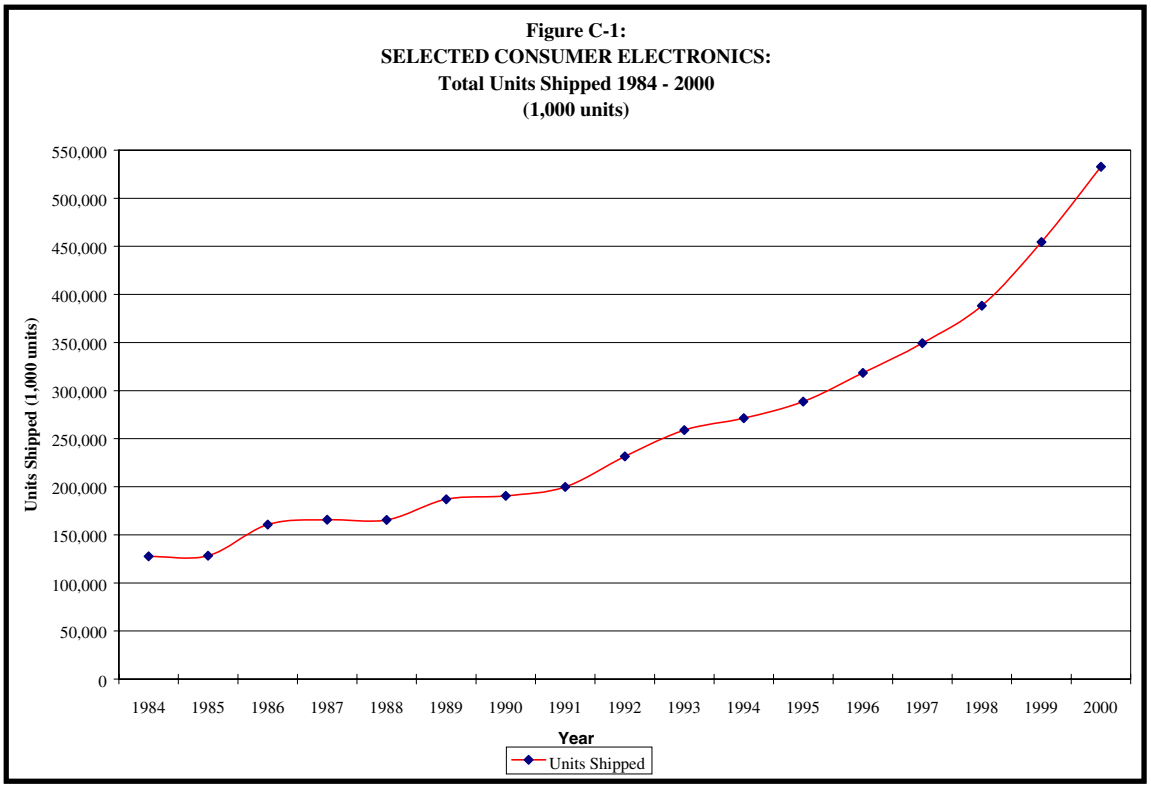
INTRODUCTION

Consumer electronic products (electronics) are a fast growing segment of the MSW stream, creating increasing opportunities for recycling. Generation of these products from both residences and commercial establishments is increasing. In the past two years, EPA has studied consumer electronics to estimate generation, recovery, and disposal of these products.

The tables and figures in this appendix represent the results of the characterization of consumer electronics in MSW. In previous editions of the EPA report, *Characterization of Municipal Solid Waste in the United States*, EPA has included electronics under the category "Miscellaneous Durables," along with other products such as toys, toasters, dishes, and luggage. EPA now has defined consumer electronic products as a subcategory under the Miscellaneous Durables category. Due to data limitations, this appendix addresses many but not all categories of electronic products. (Electronics that are not covered specifically in this appendix are included in the main body of this report in Chapter 2 as part of Other Miscellaneous Durables). The 1999 generation estimates relied on sales data provided by the Consumer Electronics Association (CEA). Generation estimates for 2000 combine CEA data with data from the U.S. Census Bureau.

Consumer electronic products include electronic products used in residences and commercial establishments such as businesses and institutions. Consumer electronics include video and audio equipment and information age products. Video products include standard televisions (TV), projection TV, high density TV, liquid crystal display TV, VCR decks, camcorders, laserdisc players, digital versatile disc players, and TV/personal computers (PC).

Figure C-1:
SELECTED CONSUMER ELECTRONICS:
Total Units Shipped 1984 - 2000
(1,000 units)



Audio products include rack audio systems, compact audio systems, portable compact discs (CD), portable headset audio, total CD players, and home radios. Information products include cordless/corded telephones, wireless telephones, telephone answering machines, facsimile (fax) machines, word processors, personal computers, computer printers, computer monitors, modems, and fax modems. Certain other electronic products such as separate audio components are excluded because of data limitations.

This appendix presents findings for consumer electronics by material composition (e.g., metals, glass, and plastic), as well as total generation, recovery, and discards for 2000. Additionally, this appendix categorizes consumer electronics as video products, audio products, or information products. The growth of selected consumer electronic product sales since 1984 is depicted in Figure C-1. In 1984, less than 150 million units were shipped. The number of units shipped increased to more than 530 million by 2000.

The rapid growth in consumer electronic sales has caused an increase in the quantity of electronic products in the MSW stream. Management of these wastes is a concern to

governmental officials responsible for the safe handling of solid waste. Below, we list the specific electronic products included in this appendix, followed by a discussion of the methodology and data limitations.

PRODUCTS IN CONSUMER ELECTRONICS

The consumer electronics category includes video, audio, and information products. The specific products included in the consumer electronics category were limited by available sales and trade data. For example, pagers and radar detectors were not included because historical data were not available. Some additional items excluded due to inadequate data were: separate audio components, home theater-in-a-box, digital cameras, electronic accessories, and electronic games. It should be noted that consumer electronics not estimated separately will continue to be included in the "Miscellaneous Durables" category in the annual characterization studies in the subcategory "Other Miscellaneous Durables" (Tables 12 to 14 in Chapter 2 of the main report). Table C-1 lists the selected consumer electronic products.

METHODOLOGY

Research was conducted to develop a reproducible methodology for estimating generation, recovery for recycling, and discards of consumer electronics on an annual basis. The methodology relies on published data on shipments of consumer electronics (adjusted for imports and exports) for the years 1984 to 1999. The methodology combines data from two sources: (1) The Consumer Electronics Association (CEA); and (2) the U.S. Department of Commerce trade data. CEA data reflect shipments of consumer electronics to retail outlets. The U.S. Census Bureau's *Current Industrial Reports* include trade data (shipments, imports, and exports) from the U.S. Department of Commerce. In order to estimate generation, the number of units shipped is combined with the average life span and weight of each product. Average weights for consumer electronics were estimated after collecting information from catalogs and consumer electronic magazines and weighing available items. The information was then compared to information from retail shops, repair shops, demanufacturers, recyclers, other organizations, and government agencies to arrive at the estimates for composition of waste after retail sales, recovery for recycling, and discards.

Table C-1
SELECTED CONSUMER ELECTRONICS

Video Products
Televisions
Projection TV
HDTV*
LCD TV
TV/VCR Combinations*
Videocassette Players
VCR Decks
Camcorders
Laserdiscs players
Digital Versatile Disc Players*
TV/PC Combinations*
Audio Products
Rack Audio Systems
Compact Audio Systems
Portable CD
Portable Headset Audio
Total CD Players
Home Radios
Information Products
Cordless/Corded Telephones
Wireless Telephones
Telephone Answering Machines
Fax Machines
Personal Word Processors
Personal Computers
Computer Printers
Computer Monitors
Modems/Fax Modems

*Items not expected to enter the municipal waste stream until after 2000.

DEFINITION OF TERMS

Generation: This analysis defines generation as the weight of products that enter the waste management system from residential and commercial sources, before materials recovery takes place. Primary life and secondary life (reuse) occur before generation. In other words, waste is generated only after the first and any subsequent users of the product are through using it for its original purpose.

Recovery for recycling: This analysis defines recovery for recycling as the products removed from the waste stream for the purpose of recycling. Product recovery for overseas markets is considered recovery for recycling.

Discards: This analysis defines discards as the consumer electronics remaining after recovery for recycling. Discards are presumably combusted or landfilled in MSW or hazardous waste facilities, although some electronic products are placed in storage.

Data Collection and Research

In addition to sales and trade data, information was collected regarding the weight, expected life span, and composition for each type of consumer electronic product analyzed. Numerous research and case studies were reviewed. Additional information sources include manufacturers, retailers, repair shops, demanufacturers, recyclers, industry organizations, and governmental agencies. Table C-2 lists the types of information received from each of these entities.

Generation

Consumer electronic generation was estimated by calculating the annual apparent consumption for each electronic product and estimating how many years a particular product is used before it is disposed. Apparent consumption equals U.S. manufacturer shipments plus U.S.

Table C-2
Consumer Electronics Data Collection

	Information Requested
Manufacturers	Product weights, composition, and life span
Retail Shops	Product weights
Repair Shops	Product composition and life span
Demanufacturers	Product composition and life span
Recyclers	Product composition and life span
Organizations	Information on units shipped
Government	Units shipped, product weights, composition, and life span

Source: Franklin Associates, Ltd.

imports minus U.S. exports. The year in which a particular electronic item enters the municipal solid waste stream was determined from the estimated life span of the item. The average weight of each item also was estimated.

Factory sales through retail outlets for the years 1984 through 1999 were obtained from the Consumer Electronics Association. These data estimate the number of units shipped, adjusted for imports and exports, to U.S. retailers. To supplement the CEA data, *Current Industrial Reports*, published by the U.S. Census Bureau, was used to obtain shipment, import, and export data.

All consumer electronics included in this study have an estimated lifespan. The estimated lifespan includes primary and, when applicable, secondary use (reuse) of a product. Reuse of consumer electronic products thus is taken into account in the methodology. Consumer electronics repair shops provided estimates on life span of all audio and video products. Telephone repair shops provided estimates for life spans of cordless/corded telephones and wireless telephones.

Estimated computer and computer monitor life spans found in the *Electronic Product Recovery and Recycling Baseline Report* for the National Safety Council were used. Estimated life spans for all other computer peripherals, such as personal word processors, printers, fax machines, and fax modems, were based on data gathered from trade associations and businesses.

Life span ranges for the selected consumer electronics are shown in Figure C-3. Televisions have a lifespan of 13 to 15 years—the longest lifespan of all consumer electronics studied. Wireless telephones have the shortest lifespan—2 to 4 years—of all consumer electronics studied. The methodology of this analysis used the life span, weight, and number of shipments to determine the generation for a particular year.

As an example of the methodology, consider VCR generation. VCRs have an estimated lifespan of 7 to 10 years, which corresponds to shipments made from 1990 to 1993. The average total weight of VCR shipments during 1990 and 1993 years, which translates to the weight of VCRs generated in 2000, can be estimated by multiplying the average weight of VCRs manufactured between 1990 and 1993 by the number of VCRs shipped between the same years. The generation of other consumer electronics was estimated similarly based on the expected life of the individual products. Generation of consumer electronics in the waste stream is the summation of the individual product estimates.

The ranges shown in Table C-3 represent both the primary and secondary life of the products. As stated above, the secondary life (or reuse) of a product takes place before a product enters the municipal waste stream.

The average weights for the selected consumer electronics were estimated for the years 1984 through 1999. Since consumer electronics sold in 2000 do not represent the consumer electronics currently entering the waste stream, a time series was developed based on expected life spans. Average weights for these years were estimated after collecting information from catalogs and consumer electronic magazines, and weighing available items. If weights for a specific product and year were not found, average weights were extrapolated from existing estimates. For example, camcorder weights were found for the years 1985, 1990, 1995, and 1998. Camcorder weights for the other years were estimated from these weights. Current average weights were based on information from retail outlets and retail and manufacturers' Web sites.

Table C-3

ESTIMATED LIFE OF SELECTED CONSUMER ELECTRONICS
(in years)

	Range of Primary and Secondary Use (Reuse) Life Expectancy
Video Products	
Direct View Color TV	13 to 15
Projection TV	13 to 15
LCD Color TV	13 to 15
Videocassette Players	7 to 10
VCR Decks	7 to 10
Camcorders	7 to 10
Laserdisc Players	7 to 10
Audio Products	
Rack Audio System	3 to 15
Compact Audio System	3 to 15
Portable CD	3 to 15
Portable Headset Audio	3 to 15
Total CD Players	3 to 15
Home Radios	3 to 15
Information Products	
Cordless/Corded Telephones	3 to 6
Wireless Telephones	2 to 4
Telephone Answering Machines	3 to 6
Fax Machines	3 to 6
Personal Word Processors	3 to 6
Personal Computers	3 to 6
Computer Printers	3 to 5
Computer Monitors	6 to 7
Modem/Fax Modems	3 to 6

Source: Franklin Associates, Ltd.

Retail sources also provided national market data on the number of televisions sold. Due to the wide range of sizes for televisions, televisions have a wide range of weights. To account for the varying weights of televisions, a weighted average was developed by comparing retail and market share data.

All other average weights were estimated after collecting as many weights as possible from the sources listed above for each size and style of product. Market share data were not available for the other products.

Data received from the various information sources were combined to estimate the material composition of the selected consumer electronic products. The primary sources used to estimate composition data include:

- *The Recycling and Demanufacturing of Computers and Electronic Equipment in Pasco County, Florida.*
- *End-of-Life Electronic Equipment Pilot Program Summary Report,* Alachua County, Florida.
- *Recycling Used Electronics,* Minnesota Office of Environmental Assistance.
- *Analysis of Five Community Consumer/Residential Collections End-Of-Life Electronic and Electrical Equipment*.
- Information provided by the National Recycling Coalition.
- Discussions with repair shop personnel, recyclers, and demanufacturers.

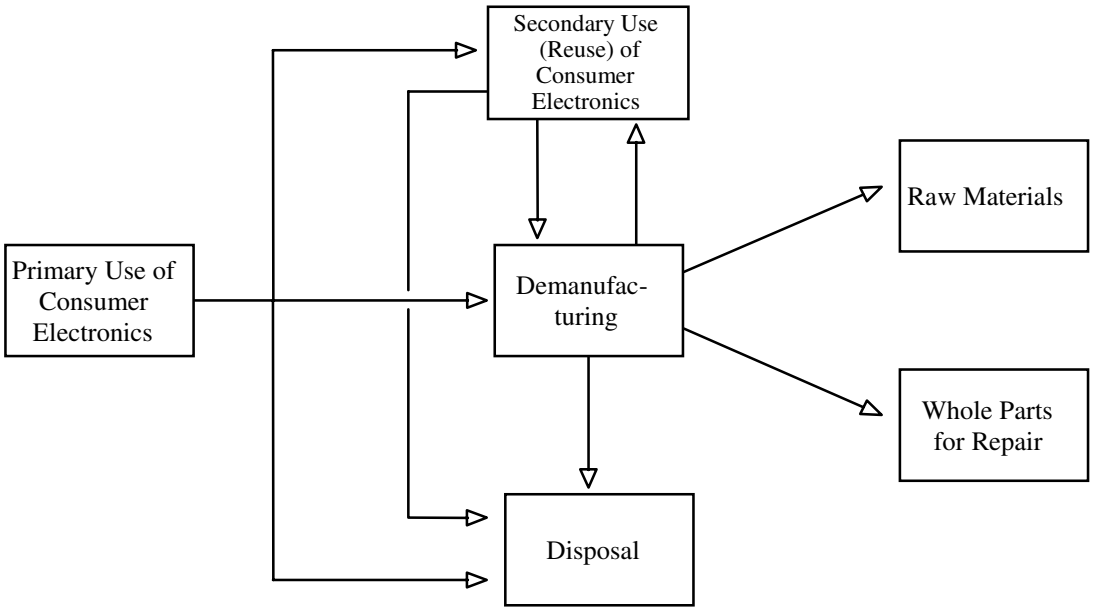
Information on composition for the selected consumer electronics includes products from several different years. Since the composition estimates were developed from recovery data, it was assumed that the data represents a mix of products from various years. Therefore the composition for each specific consumer electronic product was assumed to be the same for the entire data series.

RECOVERED FOR RECYCLING

After primary and secondary use of consumer electronics, recovered products are taken to a demanufacturer (see Figure C-2). Recovery may occur through a local collection program, such as a one-day collection event, or through ongoing collection at a permanent site. Some generators may have the option of taking consumer electronics directly to a demanufacturer or a private recycler. Other consumer electronic products are left at repair shops or traded for new products through retailers or manufacturers. Some retailers and manufacturers have initiated

pilot take-back programs. Repair shops typically will remove any usable parts before recycling or discarding. Demanufacturers recycle the products into raw materials and salvaged parts for repair. Parts that cannot be recycled are to be disposed of by the demanufacturer in accordance with federal, state, and local environmental laws and regulations. Demanufacturing is complicated by the variety of consumer products available for recovery. For example, although all consumer electronics contain plastic, the plastic resins vary from product to product. According to the American Plastic Council, there are few large, homogenous streams of material that can be targeted for recovery through recycling[1]. A number of public and private organizations, including APC, are studying the problems and possible solutions for increased consumer electronic product recovery.

Figure C-2: Life Cycle for Consumer Electronics



[1] *Plastics from Residential Electronics Recycling*. A summary report from the Electrical and Electronics Group of the American Plastics Council. 2000.

Although there has been an increase in collection programs throughout the country to divert old and outdated consumer electronics from disposal, central collection of recovery data does not exist. The recovery estimates in this analysis rely upon the information in the National Safety Council's *Electronic Product Recovery and Recycling Baseline Report; Recycling of Selected Electronic Products in the United States* for TVs, computers, and monitors. For these products, as well as for word processors and printers, data from written reports was supplemented by personal communications with state government experts, representatives of trade associations, and representatives of businesses. All other consumer electronic product recovery was assumed to be negligible.

Discards After Recovery

Since recycling of consumer electronics is in its infancy, the majority of the consumer electronic waste generated is discarded. A factor that could affect the final discard amount is the number of products placed into storage. Storage of consumer electronics exists, but is difficult to quantify. This methodology assumes that consumer electronics are leaving storage at the same rate they are entering. Discards in this analysis equal generation minus recovery for recycling.

RESULTS

The composition by material of the selected consumer electronic products generated is summarized in Table C-4. The material composition of each consumer electronic category is discussed below.

Table C-4
TOTAL GENERATION OF CONSUMER ELECTRONICS BY MATERIAL IN THE MUNICIPAL WASTE STREAM
(In percent of total generation)

Type of Consumer Electronics	Steel	Copper & Brass	Alumi-num	Lead	Other Metals	Glass	Wood	Plastic	Other
Video Products	22%	3%	0%	7%	10%	27%	20%	11%	0%
Audio Products	21%	0%	0%	0%	30%	0%	3%	47%	0%
Information Products	27%	5%	4%	3%	4%	8%	0%	46%	2%
Total	24%	3%	2%	4%	11%	15%	9%	32%	1%

Source: Franklin Associates, Ltd.

Video Products: Video products are composed of 22 percent steel, 27 percent glass, and 11 percent plastic. Televisions are a large portion of this category. Cathode ray tubes (CRTs) are a major source of glass and steel. Plastic is the major component in the frame housings of video products. Lead, which accounts for 7 percent of the material generated from video products, comes from CRTs. The source of the remaining material is circuit boards, wiring, and other small, miscellaneous items.

Audio Products: Audio products contain 51 percent steel and other metals, 47 percent plastic, and 3 percent wood. Usually, audio products are cased in plastic frames that contain steel and other metals.

Information Products: Information products contain 27 percent steel. Copper and brass, aluminum, lead, and other metals comprise 16 percent of information products. Plastic accounts for approximately 46 percent of the weight of information products; however, in many cases, the percentage of plastic is much higher. For example, corded/cordless telephones, wireless phones, and answering machines are reported to be composed mostly of plastic.

Total selected consumer electronic products: As shown in Table C-4, the average composition of all three types of consumer electronic is 24 percent steel, 3 percent copper and brass, 2 percent aluminum, 4 percent lead, 11 percent other metals, 15 percent glass, 9 percent wood, 32 percent plastic, and 1 percent other materials.

Table C-5 summarizes generation, recovery for recycling, and discards for the three types of consumer electronics.

Table C-5
GENERATION, RECOVERY, AND DISCARDS OF CONSUMER ELECTRONICS IN THE MUNICIPAL WASTE STREAM 2000
(in tons)

Type of Consumer Electronics	Total Generation	Total Recovery	% Recovered	Total Discards
Video Products	859,300	1,200	0.1%	858,100
Audio Products	348,200	0	Neg.	348,200
Information Products	916,900	192,500	21%	724,400
Total	2,124,400	193,700	9%	1,930,700

Source: Franklin Associates, Ltd.

Generation, recovery, and discards of each consumer electronic category are discussed below.

Generation: In 2000, a total of 2,124,400 tons of consumer electronics were generated. This includes 859,300 tons of video products, 348,200 tons of audio products, and 916,900 tons of information products.

Recovery: As shown in Table C-5, an estimated 193,700 tons of consumer electronics were recovered in 2000. This includes 1,200 tons of video products and 192,500 tons of information products. Recovery of audio products is considered to be negligible.

Discards: Final discards of the three types of consumer electronics are 1,930,700 tons, or 91 percent of generation.

Generation of selected consumer electronics as a percentage of miscellaneous durables and total MSW is shown in Table C-6. The EPA report *Characterization of Municipal Solid Waste in the United States: 1998 Update* and earlier editions included consumer electronics as part of the larger category "Miscellaneous Durables." Table C-6 separates the selected consumer electronic products category from the miscellaneous durables category. Generation of the selected consumer electronics is estimated at 14 percent of total miscellaneous durables generation, 21 percent of the recovery for recycling, and 14 percent of the discards.

Generation of selected consumer electronic products was estimated at less than 1 percent of total MSW generation and less than one-half of 1 percent of recovery. Selected consumer electronics were estimated to be about one percent of total MSW discards.

Although the weight of the selected consumer electronics that enter the waste stream is estimated at only 1 percent of total MSW discards, some of these products do present a problem. Television and computer CRTs, which contain lead, are for the most part discarded into U.S. landfills. Besides lead, other hazardous materials that may be found in consumer electronics include cadmium, hexavalent chromium, mercury and brominated flame-retardant materials.

Table C-6
SELECTED CONSUMER ELECTRONICS AS A PERCENTAGE OF TOTAL MISCELLANEOUS DURABLE GOODS AND TOTAL MSW, 2000
(1,000 TONS)

	Generation	Recovery	Recovery % of Generation	Discards
Selected Consumer Electronics	2,120	190	9%	1,930
Miscellaneous Durable Goods	12,550	700	6%	11,850
Total Miscellaneous Durable Goods	14,670	890	6%	13,780
Consumer Electronics as % of Misc. Durable Goods	14%	21%		14%
Total MSW	231,850	69,870	30%	161,980
Consumer Electronics as % of Total MSW	0.9%	0.3%		1.2%

Source: Franklin Associates, Ltd.

CURRENT RECOVERY PROGRAMS

Numerous city, county, and state agencies across the United States are considering options for consumer electronics collection and management. Many have conducted 1-day consumer electronics collection events, while others provide ongoing collection programs. Typically both public and private entities work together to ensure the success of the programs. In addition to removing hazardous materials from the waste stream, the collection programs provide valuable information to help guide the development of long-term recovery programs. More information on state, local, and regional programs is available at <www.epa.gov/epr>.

Many times, manufacturers, retailers, and industry organizations lead the collection and recovery efforts. The Electronic Industries Alliance (EIA), in cooperation with several electronics manufacturers[2], has announced an electronics collection and recycling pilot project to evaluate different collection and recycling models. The EIA Electronics Recycling Project is a grant program that assists with funds for regional and state household electronics recycling efforts[3]. Sony Electronics teamed with the Minnesota Office of Environmental Assistance (MOEA) and Waste Management, Inc. (WMI) in October 2000 to provide a public take-back and recycling program free of charge for Sony products. A 3-month pilot program during 1999 that teamed Sony, MOEA, and WMI with the American Plastics Council and Panasonic/Matsushita collected 600 tons of consumer electronics[4].

Hewlett-Packard and IBM PC Recycling Service both allow consumers and businesses to recycle any manufacturer's computer equipment for a fee[5]. The equipment will be either recycled or refurbished and donated to charity. Dell Computer Corporation, Compaq, and Gateway provide their consumers with the options of trading in, recycling or donating old

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[2] Electronic Industries Alliance, Canon, Hewlett Packard, JVC, Kodak, Nokia, Panasonic, Philips Electronics, Sharp, Sony, and Thomson. Press release dated June 21, 2001. www.eiae.org.

[3] www.eia.org/communications/press_release. October 15, 2001.

[4] www.epa.gov/epr/products/emulti.html.

[5] warp.external.hp.com/recycle; www.ibm.com/ibm/environment. September 2001.

computer equipment when new products are purchased[6]. United Recycling Industries provides a computer recycling mail-in program for residents of seven Midwestern states[7].

Best Buy has held 2-day collection events in approximately 10 markets across the country. The programs collected computers, monitors, TVs, VCRs, and other consumer electronics from any manufacturer. Fees were charged for some items such as computer monitors and televisions. The first six collections recovered approximately 100 tons of consumer electronics[8].

Other companies such as Apple Computer, Intel, Philips Electronics, and Xerox have taken product stewardship initiatives through changing the design of their products. Product design to improve the ease of disassembly, using recovered and remanufactured parts, if possible, and reducing the types of plastic resin used in manufacturing are examples of company policies that enhance consumer electronic recyclability.

[6] www.dell.com; www.gateway.com; www.epa.gov. September 2001.

[7] www.unitedrecycling.com/takeback. September 2001.

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APPENDIX C

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Kansas Department of Health and Environment, Kent Forrester
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New Jersey Department of Environmental Protection, Robin Heston
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Wisconsin Department of Natural Resources, Kate Cooper