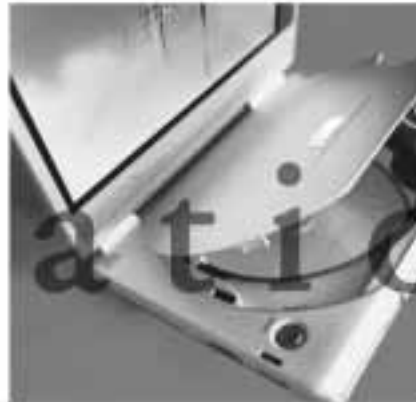




Municipal Solid Waste in The United States: 2001 Facts and Figures

Generation



reuse

Source

Reduction

Disposal



recycle

Office of Solid Waste
and Emergency Response (5305W)
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**CHARACTERIZATION OF MUNICIPAL SOLID WASTE
IN THE UNITED STATES: 2001 UPDATE**

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**MUNICIPAL SOLID WASTE
IN THE UNITED STATES: 2001 FACTS AND FIGURES**

EXECUTIVE SUMMARY

OVERVIEW

This report describes the national municipal solid waste (MSW) stream based on data collected for 1960 through 2001. 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 229.2 million tons of MSW in 2001—a decrease of 2.8 million tons from 2000. This is a decrease of 1.2 percent from 2000 to 2001. Excluding composting, the amount of MSW recovered for recycling increased to 51.4 million tons, an increase of 0.2 million tons from 2000. This is a 0.4 percent increase in the tons recycled. The tons recovered for composting rose slightly to 16.6 million tons in 2001, up from 16.5 million tons in 2000. The recovery rate for recycling (including composting) was 29.7 percent in 2001, up from 29.2 percent in 2000.¹ (See Tables ES-1 and ES-2 and Figures ES-1 and ES-2.)

MSW generation in 2001 declined to 4.4 pounds per person per day. This is a decrease of 2.2 percent from 2000 to 2001. The recycling rate in 2001 was 1.3 pounds per person per day. Discards after recycling declined to 3.1 pounds per person per day in 2001 (Table ES-3).

¹ Data shown for 2000 have been adjusted to reflect the latest revisions and, therefore, may differ from the same measure reported previously. For example, the percentage of MSW recovered for recycling has been revised downward from 30.1 percent to 29.2 percent.

**Table ES-1
GENERATION, MATERIALS RECOVERY, COMPOSTING,
AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 – 2001
(In millions of tons)**

Millions of tons								
	1960	1970	1980	1990	1995	1999	2000	2001
Generation	88.1	121.1	151.6	205.2	213.7	231.4	232.0	229.2
Recovery for recycling	5.6	8.0	14.5	29.0	46.2	50.8	51.2	51.4
Recovery for composting*	Neg.	Neg.	Neg.	4.2	9.6	14.7	16.5	16.6
Total Materials Recovery	5.6	8.0	14.5	33.2	55.8	65.5	67.7	68.0
Discards after Recovery	82.5	113.0	137.1	172.0	158.0	165.9	164.3	161.2

* Composting of yard trimmings, food scraps and other MSW organic material.
Does not include 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 – 2001
(In percent of total generation)**

Percent of total generation								
	1960	1970	1980	1990	1995	1999	2000	2001
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%	21.6%	22.0%	22.1%	22.4%
Recovery for composting*	Neg.	Neg.	Neg.	2.0%	4.5%	6.4%	7.1%	7.2%
Total Materials Recovery	6.4%	6.6%	9.6%	16.2%	26.1%	28.4%	29.2%	29.7%
Discards after Recovery	93.6%	93.4%	90.4%	83.8%	73.9%	71.6%	70.8%	70.3%

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

Figure ES-1: MSW Generation Rates from 1960 to 2001

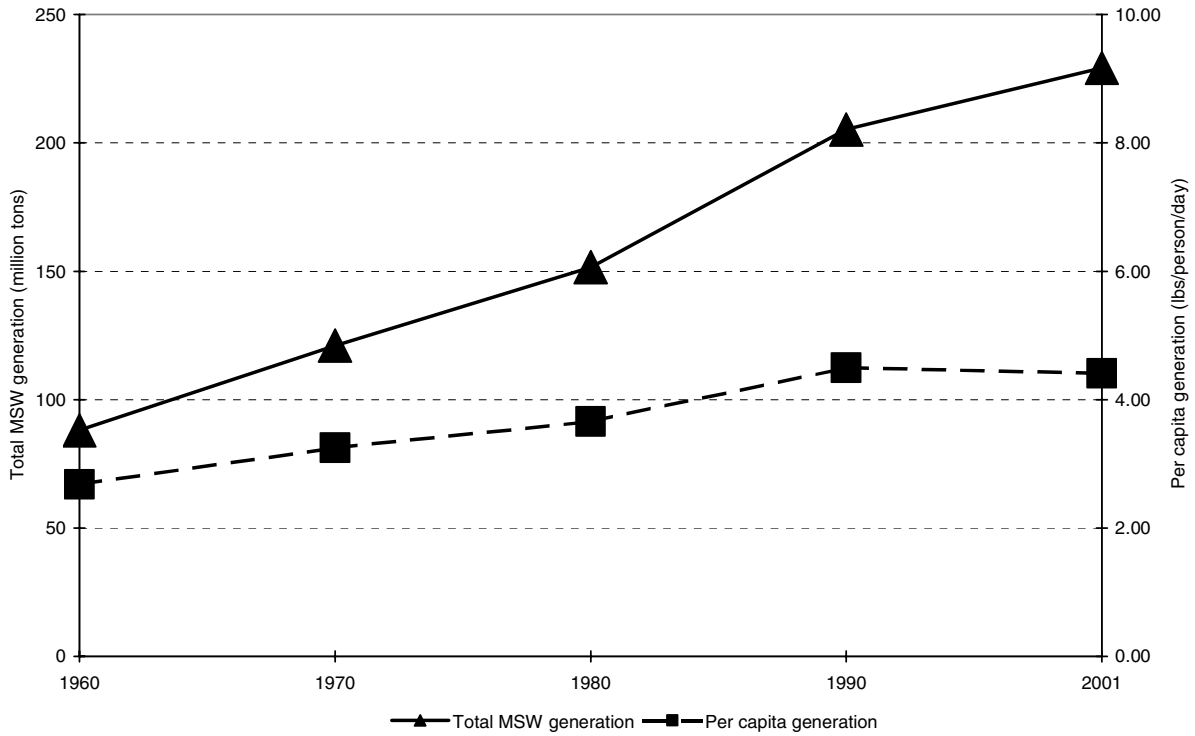
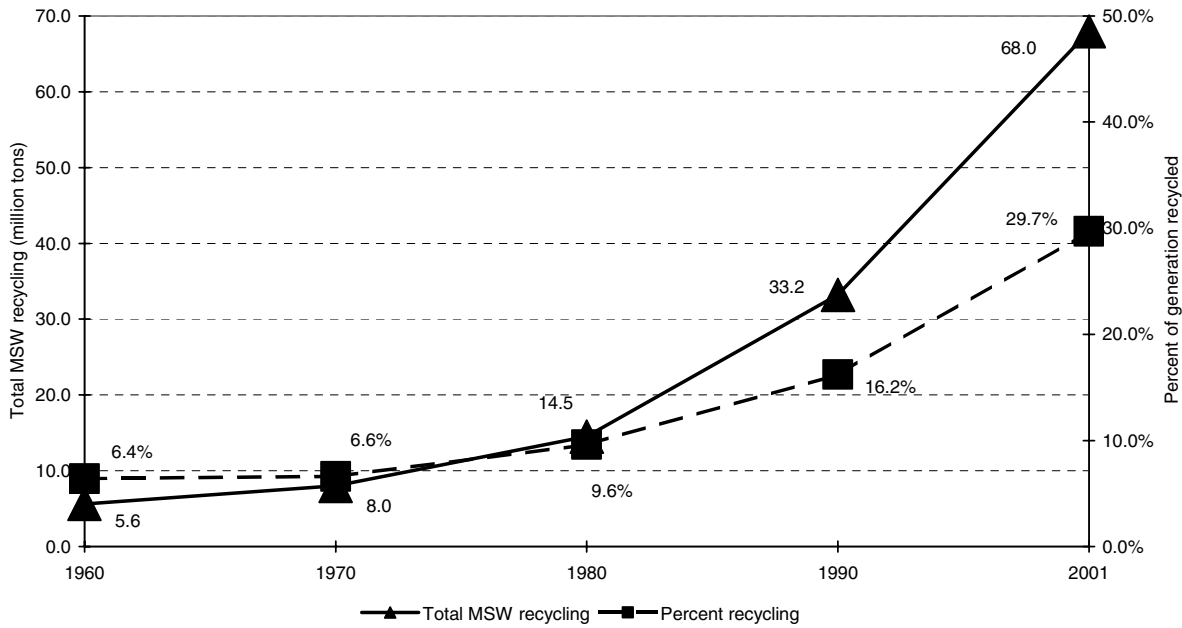


Figure ES-2: MSW Recycling Rates from 1960 to 2001



**Table ES-3
GENERATION, MATERIALS RECOVERY, COMPOSTING
AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 – 2001
(In pounds per person per day)**

Pounds per person per day								
	1960	1970	1980	1990	1995	1999	2000	2001
Generation	2.68	3.25	3.66	4.50	4.45	4.65	4.52	4.41
Recovery for recycling	0.17	0.22	0.35	0.64	0.96	1.02	1.00	0.99
Recovery for composting*	Neg.	Neg.	Neg.	0.09	0.20	0.30	0.32	0.32
Total Materials Recovery	0.17	0.22	0.35	0.73	1.16	1.32	1.32	1.31
Discards after Recovery	2.51	3.03	3.31	3.77	3.29	3.32	3.20	3.10
Population (millions)	179.979	203.984	227.255	249.907	263.168	272.691	281.422	284.797

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

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 1999 and 2000, total MSW generation increased only slightly. Between 2000 and 2001 total MSW generation decreased 1.2 percent, and this can be attributed, to a great extent, to a decline in production of paper and paperboard of 5.7 percent.

(Paper industry production is very sensitive to economic factors, and 2001 was not a good year for the industry.) At the same time, recovery of products (including paper and paperboard) increased slightly in 2001, and therefore a recycling rate of 29.7 percent was achieved in spite of the slowdown in the economy. The paper and paperboard recovery, as a percent of generation, increased from 42.3 percent to 44.9 percent in 2001. Export markets continued to play a major role in paper and paperboard recovery.

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 4.4 pounds per person per day in 2001 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 29.7 percent in 2001. Disposal has decreased from 90 percent of the amount generated in 1980 to 70 percent of MSW in 2001. This compares to 71 percent in 2000.

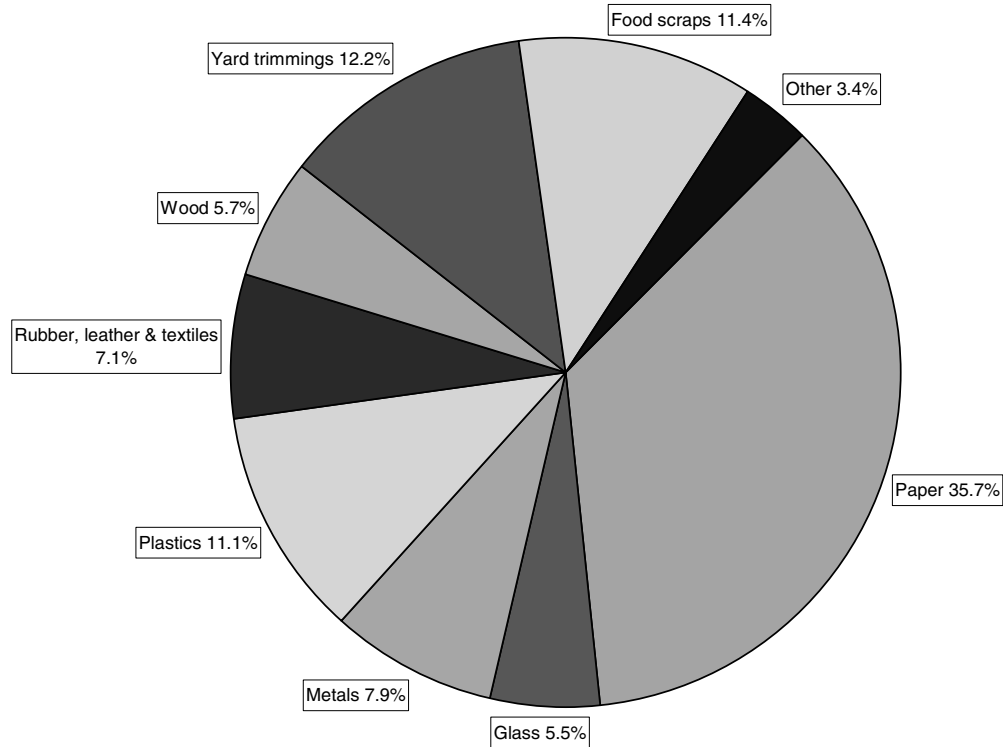
MUNICIPAL SOLID WASTE IN 2001

The U.S. Environmental Protection Agency (EPA) has two ways of analyzing the 229.2 million tons of MSW generated in 2001. 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 2001 is provided in Figure ES-3. Paper and paperboard products made up the largest component of MSW generated (36 percent), and yard trimmings comprised the second-largest component (12 percent). Glass, metals, plastics, wood, and food scraps each constituted between 5 and 12 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 2001.

**Figure ES-3: 2001 Total MSW Generation – 229 Million Tons
(Before Recycling)**



A portion of each material category in MSW was recycled or composted in 2001. 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 2001. This represents nearly a four-fold increase since 1990. About 45 percent (36.7 million tons) of paper and paperboard were recovered for recycling in 2001. Recycling these organic materials alone diverted nearly 23 percent of municipal solid waste from landfills and combustion facilities. In addition, about 6.3 million tons, or about 35 percent, of metals were recovered for recycling. Recycling rates for all materials categories in 2001 are listed in Table ES-4.

**Table ES-4
GENERATION AND RECOVERY OF MATERIALS IN MSW, 2001
(In millions of tons and percent of generation of each material)**

	Weight Generated	Weight Recovered	Recovery as a Percent of Generation
Paper and paperboard	81.9	36.7	44.9%
Glass	12.6	2.4	19.1%
Metals			
Steel	13.5	4.6	33.8%
Aluminum	3.2	0.8	24.5%
Other nonferrous metals*	1.4	0.9	64.8%
<i>Total metals</i>	18.1	6.3	34.5%
Plastics	25.4	1.4	5.5%
Rubber and leather	6.5	1.1	17.4%
Textiles	9.8	1.4	14.6%
Wood	13.2	1.3	9.5%
Other materials	4.2	0.9	20.7%
<i>Total Materials in Products</i>	171.5	51.4	30.0%
Other wastes			
Food, other**	26.2	0.7	2.8%
Yard trimmings	28.0	15.8	56.5%
Miscellaneous inorganic wastes	3.5	Neg.	Neg.
<i>Total Other Wastes</i>	57.7	16.6	28.7%
<i>TOTAL MUNICIPAL SOLID WASTE</i>	229.2	68.0	29.7%

Includes waste from residential, commercial, and institutional sources.

* Includes lead from lead-acid batteries.

** Includes recovery of other MSW organics for composting.

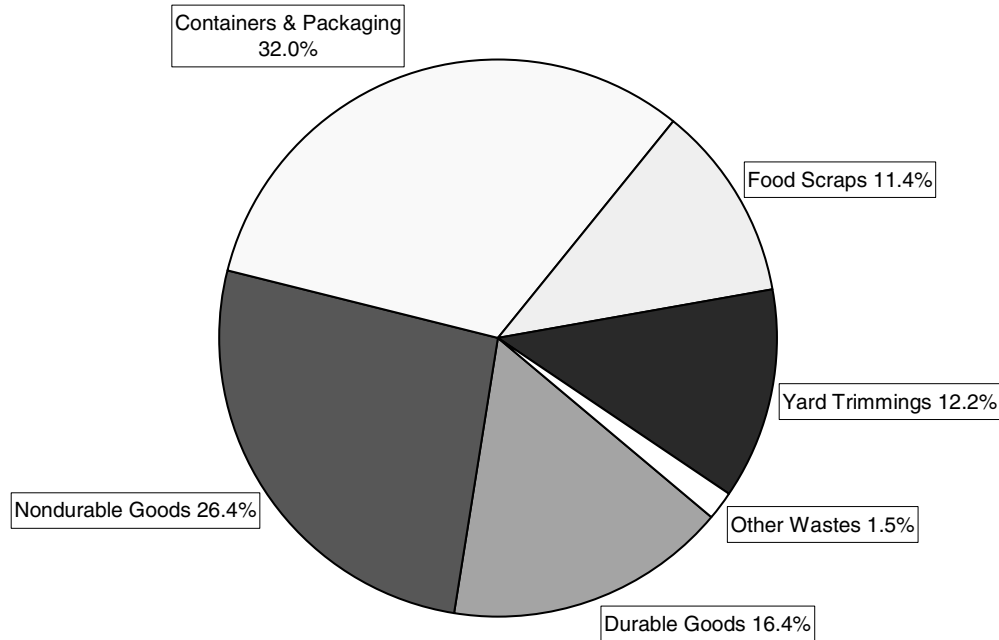
Neg. = Less than 5,000 tons or 0.05 percent.

Source: Franklin Associates, Ltd.

Products in MSW

The breakdown, by weight, of **product categories** generated in 2001 is shown in Figure ES-4. Containers and packaging comprised the largest portion of products generated, at 32.0 percent (74 million tons) of total MSW generation. Nondurable goods were the second-largest fraction, comprising 26.4 percent (60 million tons). The third-largest category of products is durable goods, which comprised 16.4 percent (38 million tons) of total MSW generation.

Figure ES-4: Products Generated in MSW – 2001
(Total Weight = 229 million tons)



The generation and recovery of the product categories in MSW in 2001 are shown in Table ES-5. This table shows that recovery of containers and packaging was the highest of the three product categories—38 percent of containers and packaging generated in 2001 were recovered for recycling. About 49 percent of all aluminum cans were recovered (40 percent of all aluminum packaging, including foil), while 59 percent of steel packaging (mostly cans) was recovered. Paper and paperboard containers and packaging were recovered at a rate of 55 percent; corrugated containers accounted for most of that amount.

Approximately 22 percent of glass containers were recovered, while about 15 percent of wood packaging (mostly wood pallets re-moved from service) was recovered for recycling. About 10 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, 2001
(In millions of tons and percent of generation of each product)**

	Weight Generated	Weight Recovered	Recovery as a Percent of Generation
Durable Goods			
Steel	10.9	3.0	27.8%
Aluminum	1.0	Neg.	Neg.
Other non-ferrous metals*	1.4	0.9	64.8%
<i>Total metals</i>	13.3	4.0	29.6%
Glass	1.7	Neg.	Neg.
Plastics	8.0	0.3	3.9%
Rubber and leather	5.6	1.1	20.1%
Wood	5.0	Neg.	Neg.
Textiles	2.9	0.3	11.8%
Other materials	1.2	0.9	73.7%
<i>Total durable goods</i>	37.6	6.6	17.5%
Nondurable Goods			
Paper and paperboard	43.5	15.6	35.9%
Plastics	6.1	Neg.	Neg.
Rubber and leather	0.9	Neg.	Neg.
Textiles	6.7	1.1	16.1%
Other materials	3.2	Neg.	Neg.
<i>Total nondurable goods</i>	60.4	16.7	27.7%
Containers and Packaging			
Steel	2.6	1.5	58.8%
Aluminum	2.0	0.8	40.0%
<i>Total metals</i>	4.6	2.3	50.8%
Glass	10.9	2.4	22.0%
Paper and paperboard	38.4	21.1	55.0%
Plastics	11.2	1.1	9.6%
Wood	8.2	1.3	15.2%
Other materials	0.2	Neg.	Neg.
<i>Total containers and packaging</i>	73.5	28.1	38.3%
Other wastes			
Food, other**	26.2	0.7	2.8%
Yard trimmings	28.0	15.8	56.5%
Miscellaneous inorganic wastes	3.5	Neg.	Neg.
<i>Total Other Wastes</i>	57.7	16.5	28.7%
TOTAL MUNICIPAL SOLID WASTE	229.2	68.0	29.7%

Includes waste from residential, commercial, and institutional sources.

* Includes lead from lead-acid batteries.

** Includes recovery of other MSW organics for composting.

Details may not add to totals due to rounding.

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

Source: Franklin Associates, Ltd.

Overall recovery of *nondurable goods* was 27.7 percent in 2001. 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 60 percent of newspapers generated being recovered for recycling. An estimated 55 percent of high-grade office papers and 32 percent of magazines were recovered in 2001. Newspaper and high-grade office paper recovery increased in percentage between 2000 and 2001. Magazine recovery remained the same.

Recovery percentage of other commercial printing increased to 22 percent. The other paper products in the nondurable goods category decreased slightly between 2000 and 2001, with Standard (A) mail* recovered at an estimated 32 percent, and directories at an estimated 15 percent.

The nondurable goods category also includes clothing and other textile products—14 percent of these products were recovered for recycling or export in 2001.

Overall, *durable goods* were recovered at a rate of 17.5 percent in 2001. Nonferrous metals other than aluminum had one of the highest recovery rates, at 65 percent, due to the high rate of lead recovery from lead-acid batteries. Recovery of steel in all durable goods was 27.8 percent, with high rates of recovery from appliances and other miscellaneous durable goods. Thirty-nine 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 93.5 percent in 2001. Other products with particularly high recovery rates were steel from major appliances (73.9 percent), corrugated boxes (70.1 percent), newspapers (60.2 percent), steel cans (58.1 percent), and aluminum cans (49.0 percent).

RESIDENTIAL AND COMMERCIAL 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

² Standard (A) mail was formerly called Third Class mail by the U.S. Postal Service.

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 (using a 1990 baseline).

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

* Source reduction estimates for 2001 are not included in this report. The impact to the 2001 MSW waste generation is expected to be similar to 2000.

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.

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

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.

Much of the nation's increase in waste generation in the 1990s was due to the booming economy. As a group, Americans spent more, recycled more, and disposed more. 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, the latest year for which we have estimates available. 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

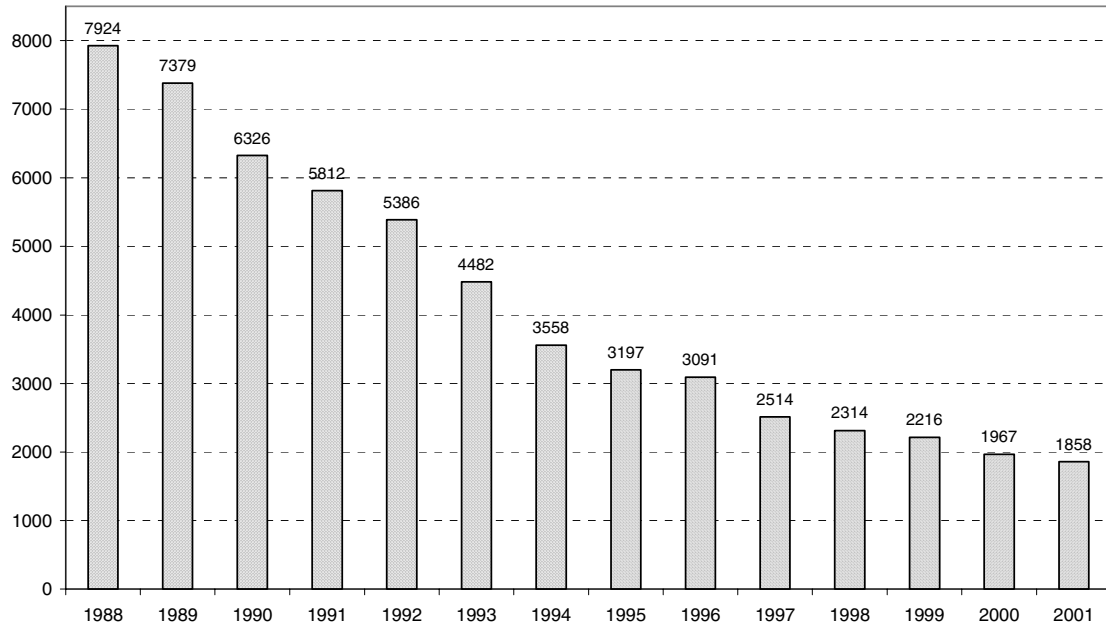
- Recycling (including community composting) recovered 30 percent (68 million tons) of MSW in 2001.
- There were about 9,700 curbside recycling programs in the United States in 2001. This is approximately 5 percent more than the 9,250 curbside recycling programs identified in 2000. Much of this increase was in the western United States.
- About 3,800 yard trimmings composting programs were reported in 2001.

Disposal

An estimated 14.7 percent of MSW was combusted in 2001, slightly higher than the 14.5 percent estimated in 2000. During 2001, about 55.7 percent of MSW was landfilled, down somewhat from 56.3 percent in 2000. 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 1,858 in 2001—while average landfill size increased. At the national level, capacity does not appear to be a problem, although regional dislocations sometimes occur.

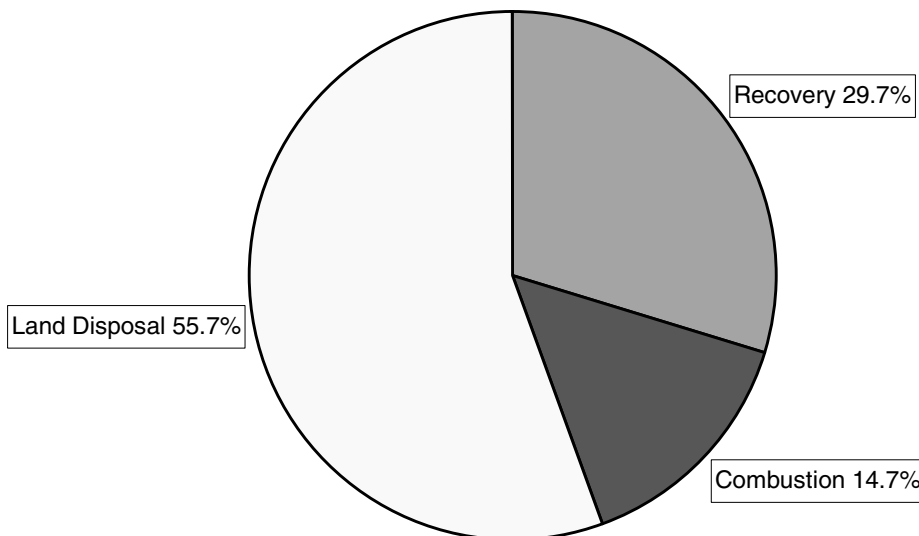
- The percentage of MSW landfilled decreased slightly from 2000 to 2001. Over the long term, the tonnage of MSW landfilled in 1990 was 140.1 million tons, but decreased to 122.4 million tons in 1995. The tonnage increased to 131.8 million tons in 1999, then declined to 127.6 in 2001. The tonnage landfilled 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 3.10 pounds per person per day, down from 3.20 pounds per person per day in 2000 (Table ES-3).

Figure ES-5: Number of Landfills in the U.S.



MSW recovered for recycling (including composting) and disposed of by combustion and landfilling in 2001 is shown in Figure ES-6. In 2001, 68.0 millions tons (29.7 percent) of MSW were recycled, 33.6 million tons (14.7 percent) were combusted, and 127.6 million tons (55.7 percent) were landfilled or otherwise disposed. (Relatively small amounts of this total undoubtedly were littered or illegally dumped rather than landfilled.)

Figure ES-6: Management of MSW in the U.S. - 2001



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.

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 to characterize municipal solid waste (MSW) in the United States. Together with the previous reports, this report provides a historical database for a 41-year characterization (by weight) of the materials and products in MSW.

Management of the nation's municipal solid waste (MSW) continues to be a high priority for communities in 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 in 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 can also 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 this 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, and then aggregating these data to yield a state or local recycling rate. At the national level, we use instead a *materials flow method*, which relies heavily on a mass balance approach. Using data gathered from industry associations, key businesses, and such industry sources, and 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 governments, 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 lifespans 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 wastes, biosolids (sewage sludges) industrial process wastes, or a number of other wastes that, in some cases, may 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*, EPA530-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 restaurants and small businesses, and occasional industrial sources. MSW does not include wastes of other types or from other sources, automobile bodies, municipal sludges, combustion ash, and industrial process wastes that might also be disposed in municipal waste landfills or incinerators.

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 the 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. Such factors 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 wastes 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 will influence 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 Materials Flow

There are two basic approaches to estimating quantities of municipal solid waste at the local, state, or national levels—site-specific and materials flow. This report is based on the materials flow approach.

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 and yard trimmings can only be estimated through sampling and weighing studies.

A disadvantage of sampling studies based on a limited number of samples is that they may be skewed and misleading if, for example, atypical circumstances were experienced during the sampling. These circumstances could include an unusually wet or dry season, delivery of some unusual wastes during the sampling period, or errors in the sampling methodology. Any errors of this kind will be greatly magnified when a limited number of samples are taken to represent a community's entire waste stream for a year. Magnification of errors could be even

more serious if a limited number of samples was relied upon for making the national estimates of MSW. Also, extensive sampling would be prohibitively expensive for making the national estimates. An additional disadvantage of sampling studies is that they do not provide information about trends unless 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.

Materials flow. The second approach to quantifying and characterizing the municipal solid waste stream—the method used for this report—utilizes a materials flow 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 over 20 years.

The materials flow 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 by 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 that become construction and demolition debris.) Adjustments are also made for the lifetimes of products. Finally, food wastes and yard trimmings and a small amount of miscellaneous inorganic wastes are accounted for by compiling data from a variety of waste sampling studies.

One problem with the materials flow 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 also 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 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 paper, bottles and cans, boxes, wood pallets, food scraps, grass clippings, clothing, furniture, appliances, automobile tires, consumer electronics, and batteries. For purposes of analysis, these products and materials are often grouped in this report into the following categories: durable goods, nondurable goods, containers and packaging, food wastes and yard trimmings, and miscellaneous inorganic wastes.

Municipal solid wastes characterized in this report come from residential, commercial, institutional, or industrial sources. Some examples of the types of MSW that come from each of the broad categories of sources are:

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

The materials flow methodology used in this report does not readily lend itself to the quantification of wastes according to their source. For example, corrugated boxes may be

unpacked and discarded from residences, commercial establishments such as grocery stores, institutions such as schools, or 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 & packaging such as soft drink bottles and cardboard boxes	
Durable goods such as furniture and appliances	
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

Figure 1-A: Definition of Terms

The materials flow 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 *ahead of* 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. This, 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 towards the recovery estimates in this report. Imported secondary materials are also 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 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.

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 are often not accounted for because the appropriate data series have not yet been developed. These include, for example, inks and other pigments and some additives associated with 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 2001 MSW generation, recovery, and discards of products in each material category are included.

In Chapter 3 of the report, estimates of 2001 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, incorporating a summary of the most recent (year 2001) estimates of source reduction for the nation. Summaries of the infrastructure currently available for each waste management alternative are also included in Chapter 3.

A brief discussion of the materials flow methodology, for estimating generation, recycling, and disposal is presented in Appendix A. Appendix B provides the methodology and detailed results for source reduction for the year 2000. Appendix C provides the methodology and results for estimates of generation, recovery, and discards of selected consumer electronics.

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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 2001. The data presented also incorporate some revisions to previously reported data for 2000 and, in some instances, to data for earlier years. The revisions are generally 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 (MSW) is generated, recovered, and disposed. 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 material types of most use to planners (paper and paperboard, glass, metals, plastic 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 includes 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 solid 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., sludges from a paper deinking mill) are considered to be industrial process wastes that are no longer part of the municipal solid 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 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 and 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 2001 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 2001
(In thousands of tons and percent of total generation)

Materials	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Paper and Paperboard	29,990	44,310	55,160	72,730	81,670	88,260	86,780	81,860
Glass	6,720	12,740	15,130	13,100	12,830	12,910	12,610	12,570
Metals								
Ferrous	10,300	12,360	12,620	12,640	11,640	13,290	13,460	13,510
Aluminum	340	800	1,730	2,810	2,960	3,120	3,170	3,190
Other Nonferrous	180	670	1,160	1,100	1,260	1,380	1,390	1,420
<i>Total Metals</i>	<i>10,820</i>	<i>13,830</i>	<i>15,510</i>	<i>16,550</i>	<i>15,860</i>	<i>17,790</i>	<i>18,020</i>	<i>18,120</i>
Plastics	390	2,900	6,830	17,130	18,900	24,080	24,710	25,380
Rubber and Leather	1,840	2,970	4,200	5,790	6,030	6,210	6,360	6,500
Textiles	1,760	2,040	2,530	5,810	7,400	9,060	9,380	9,750
Wood	3,030	3,720	7,010	12,210	12,780	12,820	12,940	13,180
Other **	70	770	2,520	3,190	3,650	4,000	4,030	4,150
Total Materials in Products	54,620	83,280	108,890	146,510	159,120	175,130	174,830	171,510
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,740	25,160	25,900	26,200
Yard Trimmings	20,000	23,200	27,500	35,000	29,690	27,730	27,730	27,980
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,380	3,500	3,540
Total Other Wastes	33,500	37,780	42,750	58,700	54,580	56,270	57,130	57,720
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	213,700	231,400	231,960	229,230
Materials	Percent of Total Generation							
	1960	1970	1980	1990	1995	1999	2000	2001
Paper and Paperboard	34.0%	36.6%	36.4%	35.4%	38.2%	38.1%	37.4%	35.7%
Glass	7.6%	10.5%	10.0%	6.4%	6.0%	5.6%	5.4%	5.5%
Metals								
Ferrous	11.7%	10.2%	8.3%	6.2%	5.4%	5.7%	5.8%	5.9%
Aluminum	0.4%	0.7%	1.1%	1.4%	1.4%	1.3%	1.4%	1.4%
Other Nonferrous	0.2%	0.6%	0.8%	0.5%	0.6%	0.6%	0.6%	0.6%
<i>Total Metals</i>	<i>12.3%</i>	<i>11.4%</i>	<i>10.2%</i>	<i>8.1%</i>	<i>7.4%</i>	<i>7.7%</i>	<i>7.8%</i>	<i>7.9%</i>
Plastics	0.4%	2.4%	4.5%	8.3%	8.8%	10.4%	10.7%	11.1%
Rubber and Leather	2.1%	2.5%	2.8%	2.8%	2.8%	2.7%	2.7%	2.8%
Textiles	2.0%	1.7%	1.7%	2.8%	3.5%	3.9%	4.0%	4.3%
Wood	3.4%	3.1%	4.6%	6.0%	6.0%	5.5%	5.6%	5.7%
Other **	0.1%	0.6%	1.7%	1.6%	1.7%	1.7%	1.7%	1.8%
Total Materials in Products	62.0%	68.8%	71.8%	71.4%	74.5%	75.7%	75.4%	74.8%
Other Wastes								
Food Scraps	13.8%	10.6%	8.6%	10.1%	10.2%	10.9%	11.2%	11.4%
Yard Trimmings	22.7%	19.2%	18.1%	17.1%	13.9%	12.0%	12.0%	12.2%
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%	25.5%	24.3%	24.6%	25.2%
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 2001
(In thousands of tons and percent of generation of each material)

Materials	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Paper and Paperboard	5,080	6,770	11,740	20,230	32,700	36,080	36,710	36,730
Glass	100	160	750	2,630	3,140	3,000	2,660	2,400
Metals								
Ferrous	50	150	370	2,230	4,130	4,530	4,580	4,560
Aluminum	Neg.	10	310	1,010	930	880	870	780
Other Nonferrous	Neg.	320	540	730	810	930	930	920
<i>Total Metals</i>	50	480	1,220	3,970	5,870	6,340	6,380	6,260
Plastics	Neg.	Neg.	20	370	990	1,280	1,330	1,390
Rubber and Leather	330	250	130	370	540	780	780	1,130
Textiles	50	60	160	660	900	1,230	1,270	1,420
Wood	Neg.	Neg.	Neg.	130	1,260	1,230	1,240	1,250
Other **	Neg.	300	500	680	750	860	860	860
Total Materials in Products	5,610	8,020	14,520	29,040	46,150	50,800	51,230	51,440
Other Wastes								
Food Scraps	Neg.	Neg.	Neg.	Neg.	570	550	680	730
Yard Trimmings	Neg.	Neg.	Neg.	4,200	9,030	14,170	15,770	15,820
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	4,200	9,600	14,720	16,450	16,550
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	55,750	65,520	67,680	67,990
Materials	Percent of Generation of Each Material							
	1960	1970	1980	1990	1995	1999	2000	2001
Paper and Paperboard	16.9%	15.3%	21.3%	27.8%	40.0%	40.9%	42.3%	44.9%
Glass	1.5%	1.3%	5.0%	20.1%	24.5%	23.2%	21.1%	19.1%
Metals								
Ferrous	0.5%	1.2%	2.9%	17.6%	35.5%	34.1%	34.0%	33.8%
Aluminum	Neg.	1.3%	17.9%	35.9%	31.4%	28.2%	27.4%	24.5%
Other Nonferrous	Neg.	47.8%	46.6%	66.4%	64.3%	67.4%	66.9%	64.8%
<i>Total Metals</i>	0.5%	3.5%	7.9%	24.0%	37.0%	35.6%	35.4%	34.5%
Plastics	Neg.	Neg.	0.3%	2.2%	5.2%	5.3%	5.4%	5.5%
Rubber and Leather	17.9%	8.4%	3.1%	6.4%	9.0%	12.6%	12.3%	17.4%
Textiles	2.8%	2.9%	6.3%	11.4%	12.2%	13.6%	13.5%	14.6%
Wood	Neg.	Neg.	Neg.	1.1%	9.9%	9.6%	9.6%	9.5%
Other **	Neg.	39.0%	19.8%	21.3%	20.5%	21.5%	21.3%	20.7%
Total Materials in Products	10.3%	9.6%	13.3%	19.8%	29.0%	29.0%	29.3%	30.0%
Other Wastes								
Food, Other^	Neg.	Neg.	Neg.	Neg.	2.6%	2.2%	2.6%	2.8%
Yard Trimmings	Neg.	Neg.	Neg.	12.0%	30.4%	51.1%	56.9%	56.5%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	7.2%	17.6%	26.2%	28.8%	28.7%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.1%	28.3%	29.2%	29.7%

* 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 2001
(In thousands of tons and percent of total discards)

Materials	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Paper and Paperboard	24,910	37,540	43,420	52,500	48,970	52,180	50,070	45,130
Glass	6,620	12,580	14,380	10,470	9,690	9,910	9,950	10,170
Metals								
Ferrous	10,250	12,210	12,250	10,410	7,510	8,760	8,880	8,950
Aluminum	340	790	1,420	1,800	2,030	2,240	2,300	2,410
Other Nonferrous	180	350	620	370	450	450	460	500
<i>Total Metals</i>	<i>10,770</i>	<i>13,350</i>	<i>14,290</i>	<i>12,580</i>	<i>9,990</i>	<i>11,450</i>	<i>11,640</i>	<i>11,860</i>
Plastics	390	2,900	6,810	16,760	17,910	22,800	23,380	23,990
Rubber and Leather	1,510	2,720	4,070	5,420	5,490	5,430	5,580	5,370
Textiles	1,710	1,980	2,370	5,150	6,500	7,830	8,110	8,330
Wood	3,030	3,720	7,010	12,080	11,520	11,590	11,700	11,930
Other **	70	470	2,020	2,510	2,900	3,140	3,170	3,290
Total Materials in Products	49,010	75,260	94,370	117,470	112,970	124,330	123,600	120,070
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,170	24,610	25,220	25,470
Yard Trimmings	20,000	23,200	27,500	30,800	20,660	13,560	11,960	12,160
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,380	3,500	3,540
Total Other Wastes	33,500	37,780	42,750	54,500	44,980	41,550	40,680	41,170
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	157,950	165,880	164,280	161,240
Materials	Percent of Total Discards							
	1960	1970	1980	1990	1995	1999	2000	2001
Paper and Paperboard	30.2%	33.2%	31.7%	30.5%	31.0%	31.5%	30.5%	28.0%
Glass	8.0%	11.1%	10.5%	6.1%	6.1%	6.0%	6.1%	6.3%
Metals								
Ferrous	12.4%	10.8%	8.9%	6.1%	4.8%	5.3%	5.4%	5.6%
Aluminum	0.4%	0.7%	1.0%	1.0%	1.3%	1.4%	1.4%	1.5%
Other Nonferrous	0.2%	0.3%	0.5%	0.2%	0.3%	0.3%	0.3%	0.3%
<i>Total Metals</i>	<i>13.1%</i>	<i>11.8%</i>	<i>10.4%</i>	<i>7.3%</i>	<i>6.3%</i>	<i>6.9%</i>	<i>7.1%</i>	<i>7.4%</i>
Plastics	0.5%	2.6%	5.0%	9.7%	11.3%	13.7%	14.2%	14.9%
Rubber and Leather	1.8%	2.4%	3.0%	3.2%	3.5%	3.3%	3.4%	3.3%
Textiles	2.1%	1.8%	1.7%	3.0%	4.1%	4.7%	4.9%	5.2%
Wood	3.7%	3.3%	5.1%	7.0%	7.3%	7.0%	7.1%	7.4%
Other **	0.1%	0.4%	1.5%	1.5%	1.8%	1.9%	1.9%	2.0%
Total Materials in Products	59.4%	66.6%	68.8%	68.3%	71.5%	75.0%	75.2%	74.5%
Other Wastes								
Food Scraps	14.8%	11.3%	9.5%	12.1%	13.4%	14.8%	15.4%	15.8%
Yard Trimmings	24.2%	20.5%	20.1%	17.9%	13.1%	8.2%	7.3%	7.5%
Miscellaneous Inorganic Wastes	1.6%	1.6%	1.6%	1.7%	2.0%	2.0%	2.1%	2.2%
Total Other Wastes	40.6%	33.4%	31.2%	31.7%	28.5%	25.0%	24.8%	25.5%
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.

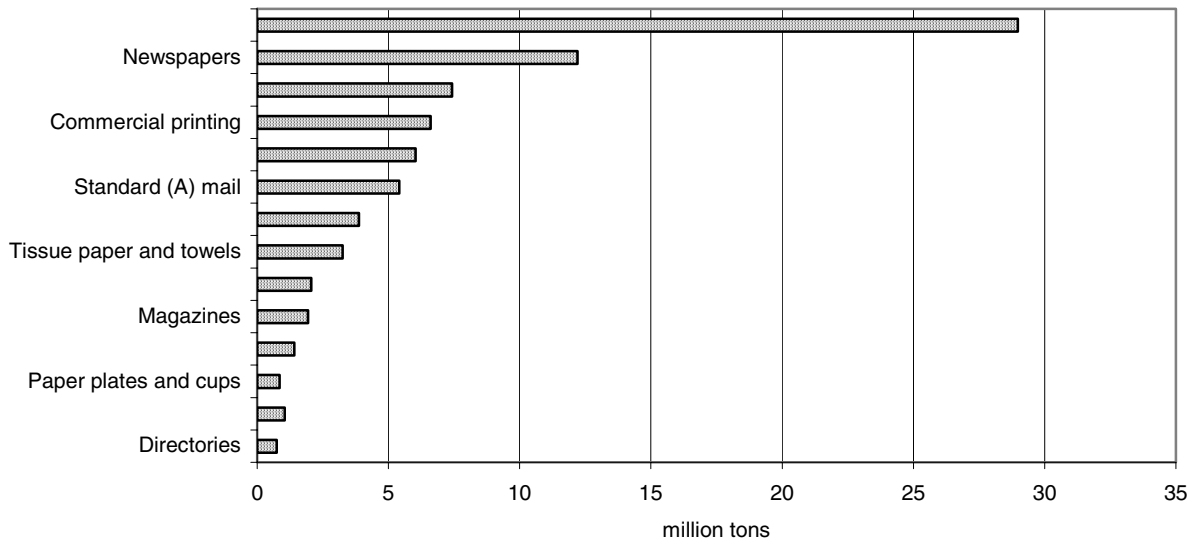
Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Paper and Paperboard

Collectively, the many products made of paper and paperboard³ products comprise the largest component of MSW. The paper and paperboard category includes materials such as paper and cardboard, therefore products such as office papers, newspapers, corrugated boxes, milk cartons, tissue paper, and paper plates and cups (Figure 2 and Table 4).

Figure 2. Paper and paperboard products generated in MSW, 2001



³ 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, 2001
(In thousands of tons and percent of generation)

Product Category	Generation (Thousand tons)	Recovery		Discards (Thousand tons)
		(Thousand tons)	(Percent of generation)	
Nondurable Goods				
Newspapers				
Newsprint	9,980	6,050	60.6%	3,930
Groundwood inserts	2,220	1,300	58.6%	920
Total Newspapers	<u>12,200</u>	<u>7,350</u>	60.2%	<u>4,850</u>
Books	850	180	21.2%	670
Magazines	2,060	660	32.0%	1,400
Office Papers	7,420	4,100	55.3%	3,320
Telephone Directories	740	110	14.9%	630
Standard (A) Mail*	5,410	1,750	32.3%	3,660
Other Commercial Printing	6,610	1,480	22.4%	5,130
Tissue Paper and Towels	3,260	Neg.	Neg.	3,260
Paper Plates and Cups	1,050	Neg.	Neg.	1,050
Other Nonpackaging Paper**	3,880	Neg.	Neg.	3,880
Total Paper and Paperboard Nondurable Goods	<u>43,480</u>	<u>15,630</u>	35.9%	<u>27,850</u>
Containers and Packaging				
Corrugated Boxes	28,980	20,310	70.1%	8,670
Milk Cartons	510	Neg.	Neg.	510
Folding Cartons	5,520	480	8.7%	5,040
Other Paperboard Packaging	190	Neg.	Neg.	190
Bags and Sacks	1,420	310	21.8%	1,110
Other Paper Packaging	1,750	Neg.	Neg.	1,750
Total Paper and Paperboard Containers and Packaging	<u>38,370</u>	<u>21,100</u>	55.0%	<u>17,270</u>
Total Paper and Paperboard	<u>81,850</u>	<u>36,730</u>	44.9%	<u>45,120</u>

* Formerly called Third Class Mail by the U.S. Postal Service.

** Includes tissue in disposable diapers, paper in games and novelties, cards, etc.

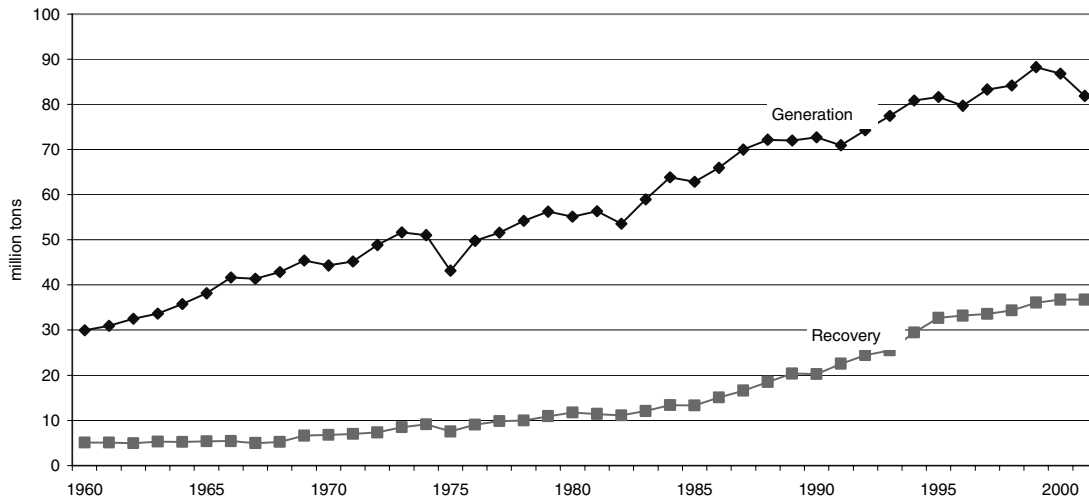
Neg. = Less than 5,000 tons or 0.05 percent.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Total generation of paper and paperboard in MSW has grown from 30 million tons in 1960 to 81.9 million tons in 2001 (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 35.7 percent of total MSW generation in 2001. As Figure 3 illustrates, paper generation declined in 1996, peaked at 88.3 million tons in 1999, and declined to 81.9 million tons in 2001.

Figure 3. Paper generation and recovery, 1960 to 2001



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. In this report, 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 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 (newspapers that were not sold) 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 2001. The converting scrap recovery rates were developed for a 1992 report for the Recycling Advisory Council. 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, 70.1 percent of all corrugated boxes were recovered for recycling in 2001; this is up from 65.1 percent in 1999. Newspapers were recovered at a rate of 60.2 percent, and high grade office papers at 55.3 percent, with lesser percentages of other papers being recovered also. Approximately 36.7 million tons of postconsumer paper were recovered in 2001—44.9 percent of total paper and paperboard generation. This is up from 41.9 percent in 1999.

Discards After Recovery. After recovery of paper and paperboard for recycling, discards were 45.1 million tons in 2001, or 28.0 percent of total MSW discards.

Glass

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

Table 5
GLASS PRODUCTS IN MSW, 2001
(In thousands of tons and percent of generation)

Product Category	Generation (Thousand tons)	Recovery		Discard: (Thousan tons)
		(Thousand tons)	(Percent of generation)	
Durable Goods*	1,670	Neg.	Neg.	1,670
Containers and Packaging				
Beer and Soft Drink Bottles	5,990	1,270	21.2%	4,720
Wine and Liquor Bottles	1,760	360	20.5%	1,400
Food and Other Bottles and Jars	<u>3,150</u>	<u>770</u>	24.4%	<u>2,380</u>
Total Glass Containers	10,900	2,400	22.0%	8,500
Total Glass	<u>12,570</u>	<u>2,400</u>	19.1%	<u>10,170</u>

* 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, 2001

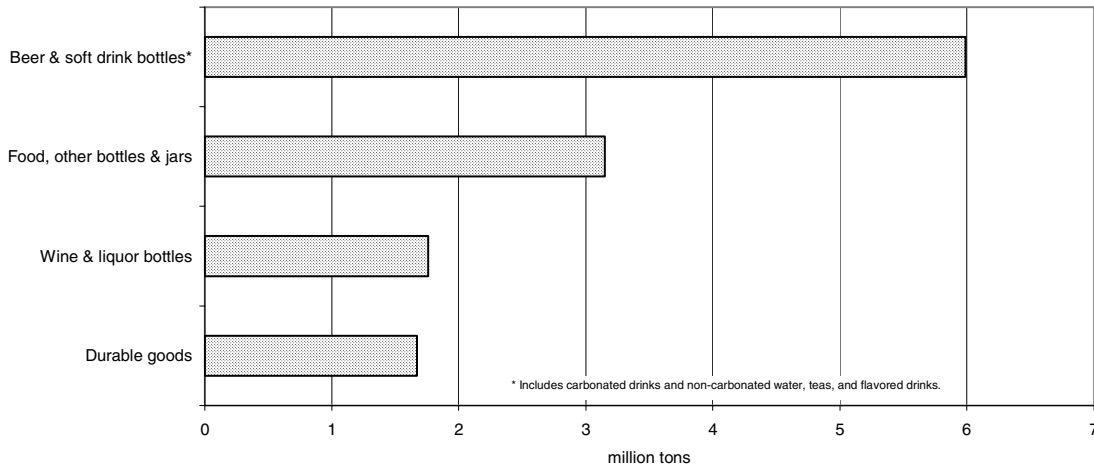
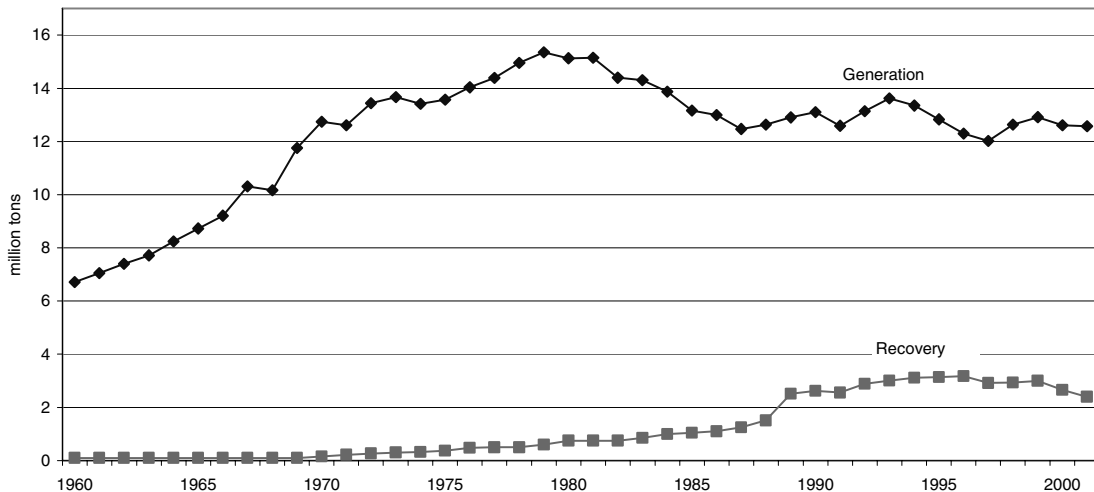


Figure 5. Glass generation and recovery, 1960 to 2001



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 2001 was 12.6 million tons, about the same as 1995. During the 1990s glass generation 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 2001.

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 glassphalt for highway construction. Until recently, the Glass Packaging Institute published estimates of glass bottle recovery annually. Since this data source is not longer available, industry sources were contacted for recovery data. Recovery of glass bottles was estimated at 2.4 million tons in 2001, down from an estimated 2.7 million tons in 2000.

Discards After Recovery. Recovery for recycling lowered discards of glass to 10.2 million tons in 2001 (6.3 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, and tires. 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 MW in this report.

Figure 6. Metal products generated in MSW, 2001

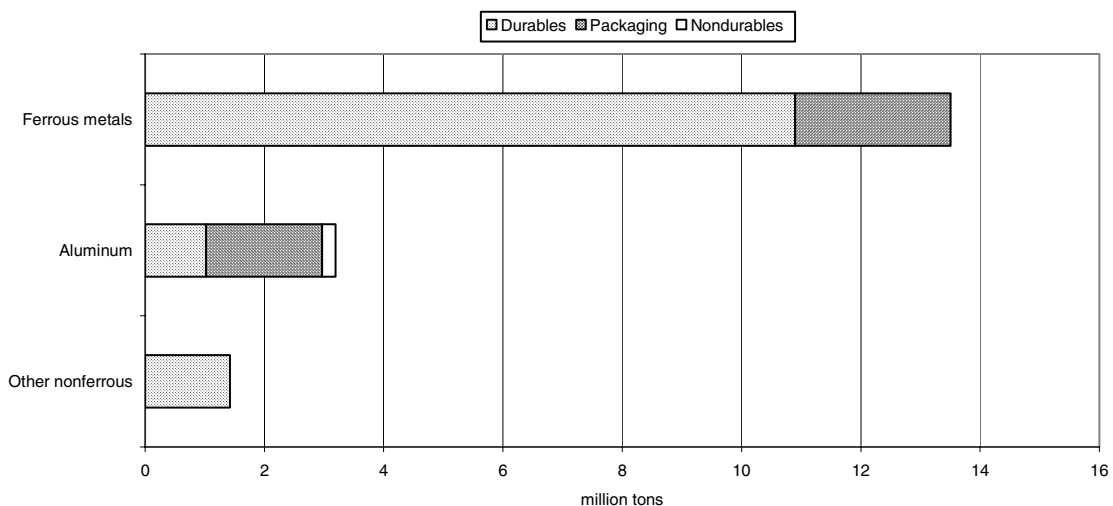


Table 6
METAL PRODUCTS IN MSW, 2001
(In thousands of tons and percent of generation)

Product Category	Generation (Thousand tons)	Recovery		Discards (Thousand tons)
		(Thousand tons)	(Percent of generation)	
Durable Goods				
Ferrous metals*	10,900	3,030	27.8%	7,870
Aluminum**	1,020	Neg.	Neg.	1,020
Lead†	980	920	93.9%	60
Other nonferrous metals‡	440	Neg.	Neg.	440
Total Metals in Durable Goods	13,340	3,950	29.6%	9,390
Nondurable Goods				
Aluminum	230	Neg.	Neg.	230
Containers and Packaging				
Steel				
Food and other cans	2,360	1,370	58.1%	990
Other steel packaging	240	160	66.7%	80
Total Steel Packaging	2,600	1,530	58.8%	1,070
Aluminum				
Beer and soft drink cans	1,510	740	49.0%	770
Food and other cans	50	Neg.	Neg.	50
Foil and closures	390	40	10.3%	350
Total Aluminum Packaging	1,950	780	40.0%	1,170
Total Metals in Containers and Packaging	4,550	2,310	50.8%	2,240
Total Metals	18,120	6,260	34.5%	11,860
Ferrous	13,500	4,560	33.8%	8,940
Aluminum	3,200	780	24.4%	2,420
Other nonferrous	1,420	920	64.8%	500

* 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.

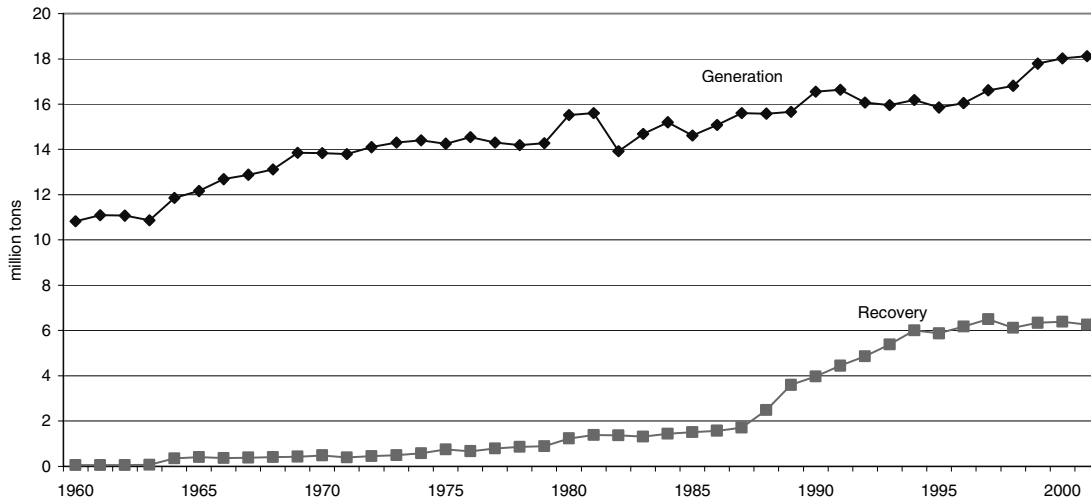
Neg. = Less than 5,000 tons or 0.05 percent.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

Total generation and recovery of all metals in MSW from 1960 to 2001 are shown in Figure 7.

Figure 7. Metals generation and recovery, 1960 to 2001



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 like 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 2001. The percentage of ferrous metals generation in MSW has declined from 11.7 percent in 1960 to 5.9 percent in 2001.

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 2001. Overall recovery of ferrous metals from durable goods (large and small appliances, furniture, and tires) was estimated to be 27.8 percent (3.0 million tons) in 2001 (Table 6).

Steel food cans and other cans were estimated to be recovered at a rate of 58.1 percent (1.4 million tons) in 2001. Approximately 160,000 tons of other steel packaging, mostly steel barrels and drums, was estimated to have been recovered for recycling in 2001.

Discards After Recovery. In 2001, discards of ferrous metals after recovery were 9.0 million tons, or 5.6 percent of total discards.

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 2001, 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 2001. 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 49.0 percent of generation (0.7 million tons) in 2001, and 40.0 percent of all aluminum in containers and packaging was recovered for recycling in 2001.

Discards After Recovery. In 2001, about 2.4 million tons of aluminum were discarded in MSW after recovery, which was 1.5 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 2001. Lead in batteries accounted for 980,000 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 one percent.

Recovery. Recovery of the other nonferrous metals was 920,000 tons in 2001, with most of this being lead recovered from batteries. It was estimated that 93.9 percent of battery lead was recovered in 2001.

Discards After Recovery. In 2001, 500,000 tons of nonferrous metals were discarded in MSW. Percentages of total discards remained less than one percent over the entire 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, 2001

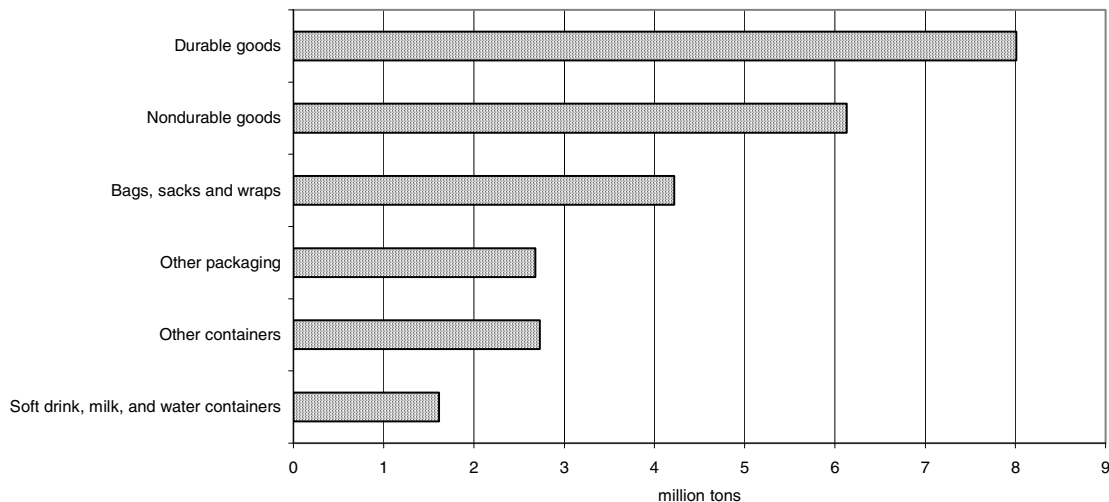


Table 7
PLASTICS IN PRODUCTS IN MSW, 2001
(In thousands of tons, and percent of generation by resin)

Product Category	Generation (Thousand tons)	Recovery		Discards (Thousand tons)
		(Thousand tons)	(Percent of Gen.)	
Durable Goods				
PET	440			
HDPE	590			
PVC	480			
LDPE/LLDPE	700			
PP	1,270			
PS	690			
Other resins	3,840			
Total Plastics in Durable Goods	8,010	310	3.9%	7,700
Nondurable Goods				
Plastic Plates and Cups				
LDPE/LLDPE	20			20
PS	780			780
Subtotal Plastic Plates and Cups	800			800
Trash Bags				
HDPE	220			220
LDPE/LLDPE	610			610
Subtotal Trash Bags	830			830
All other nondurables*				
PET	210			210
HDPE	440			440
PVC	600			600
LDPE/LLDPE	1,640			1,640
PP	900			900
PS	610			610
Other resins	100			100
Subtotal All Other Nondurables	4,500			4,500
Total Plastics in Nondurable Goods, by resin				
PET	210			210
HDPE	660			660
PVC	600			600
LDPE/LLDPE	2,270			2,270
PP	900			900
PS	1,390			1,390
Other resins	100			100
Total Plastics in Nondurable Goods	6,130	0	0.0%	6,130
Plastic Containers & Packaging				
Soft drink bottles				
PET	870	310	35.6%	560
Milk and water bottles				
HDPE	740	210	28.4%	530

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, 2001
(In thousands of tons, and percent of generation by resin)

Product Category	Generation (Thousand tons)	Recovery		Discards (Thousand tons)
		(Thousand tons)	(Percent of Gen.)	
Plastic Containers & Packaging, cont.				
Other plastic containers				
PET	910	110		800
HDPE	1,240	170		1,070
PVC	80			80
LDPE/LLDPE	40			40
PP	70			70
PS	0			0
Other resins	390			390
Subtotal Other Containers	2,730	280	10.3%	2,450
Bags, sacks, & wraps				
HDPE	770	30		740
PVC	70			70
LDPE/LLDPE	2,550	150		2,400
PP	650			650
PS	0			0
Other resins	180			180
Subtotal Bags, Sacks, & Wraps	4,220	180	4.3%	4,040
Other Plastics Packaging**				
PET	150	50		100
HDPE	920	20		900
PVC	190			190
LDPE/LLDPE	320			320
PP	570	10		560
PS	210			210
Other resins	320	20		300
Subtotal Other Packaging	2,680	100	3.7%	2,580
Total Plastics in Containers & Packaging, by resin				
PET	1,930	470		1,460
HDPE	3,670	430		3,240
PVC	340			340
LDPE/LLDPE	2,910	150		2,760
PP	1,290	10		1,280
PS	210			210
Other resins	890	20		870
Total Plastics in Cont. & Packaging	11,240	1,080	9.6%	10,160
Total Plastics in MSW, by resin				
PET	2,580	470		2,110
HDPE	4,920	430		4,490
PVC	1,420			1,420
LDPE/LLDPE	5,880	150		5,730
PP	3,460	10		3,450
PS	2,290			2,290
Other resins	4,830	330		4,500
Total Plastics in MSW	25,380	1,390	5.5%	23,990

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.

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, there are hundreds of different resin formulations used in appliances, carpets, and other durable goods; a complete listing is beyond the scope of this report.

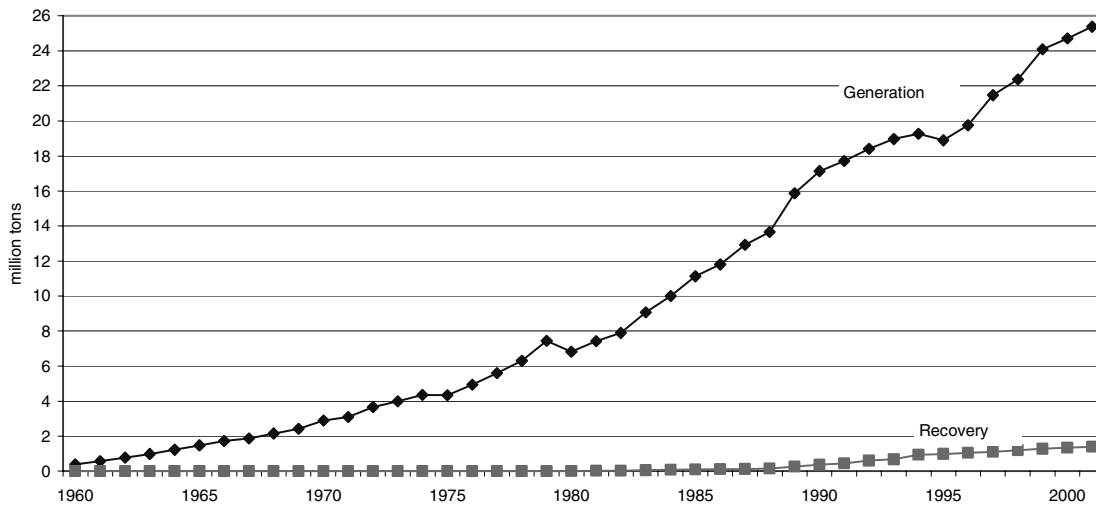
Plastics are found in such nondurable products as disposable diapers, trash bags, cups, eating utensils, sporting and recreational equipment, medical devices, and household items such as shower curtains. The plastic food service items are generally made of clear or foamed polystyrene, while trash bags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

Plastic resins are also 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 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 25.4 million tons in 2001 (Figure 9). As a percentage of MSW generation, plastics were less than one percent in 1960, increasing to 11.1 percent in 2001.

Figure 9. Plastics generation and recovery, 1960 to 2001



Recovery for Recycling. While overall recovery of plastics for recycling is relatively small—1.4 million tons, or 5.5 percent of plastics generation in 2001 (Table 7)—recovery of some plastic containers is more significant. PET soft drink bottles were recovered at a rate of 35.6 percent in 2001. Recovery of high-density polyethylene milk and water bottles was estimated at about 28.4 percent in 2001. 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 American Plastics Council (APC).

Discards After Recovery. Discards of plastics in MSW after recovery were 24.0 million tons, or 14.9 percent of total MSW discards.

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 6.5 million tons in 2001. 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 1,130,000 tons, up from 780,000 tons in 2000. This is 38.4 percent of rubber in tires in 2001, compared to 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, 17.4 percent of rubber and leather in MSW was recovered in 2001, up from 12.2 percent in 2000.

Table 8
RUBBER AND LEATHER PRODUCTS IN MSW, 2001
(In thousands of tons and percent of generation)

Product Category	Generation (Thousand tons)	Recovery		Discards (Thousand tons)
		(Thousand tons)	(Percent of generation)	
Durable Goods				
Rubber in Tires*	2,940	1,130	38.4%	1,810
Other Durables**	<u>2,670</u>	<u>Neg.</u>	Neg.	<u>2,670</u>
Total Rubber & Leather Durable Goods	5,610	1,130	20.1%	4,480
Nondurable Goods				
Clothing and Footwear	580	Neg.	Neg.	580
Other Nondurables	<u>290</u>	<u>Neg.</u>	Neg.	<u>290</u>
Total Rubber & Leather Nondurable Goods	870	Neg.	Neg.	870
Containers and Packaging	20	Neg.	Neg.	20
Total Rubber & Leather	<u>6,500</u>	<u>1,130</u>	17.4%	<u>5,370</u>

* 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 5.4 million tons in 2001 (3.3 percent of total discards).

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

Generation. An estimated 9.8 million tons of textiles were generated in 2001 (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 is limited, it was assumed that reused textiles re-enter the waste stream the same

year that they are first discarded. It was estimated that 14.6 percent of textiles in clothing and items such as sheets and pillowcases was recovered for export or reprocessing in 2001 (1.4 million tons) leaving discards of 8.3 million tons of textiles in 2001.

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 13.2 million tons in 2001 (5.7 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 1.3 million tons in 2001, up from 1.2 million tons in 2000.

Accounting for pallet reuse and recovery for recycling, wood discards were 11.9 million tons in 2001, or 7.4 percent of total MSW discards; this is up from 11.7 million tons in 2000 (7.1 percent of total MSW discards). These numbers are considerably different from last year's figures largely because of updated information on pallets from the Center for Forest Products Marketing and Management (Virginia Tech.).

Other products. Generation of "other products" waste is mainly associated with disposable diapers, which are discussed under Products in Municipal Solid Waste. The only other significant sources of materials in this category are the electrolytes and other materials associated with lead-acid batteries that are not classified as plastics or nonferrous metal.

Food Wastes

Food scraps included here consist of uneaten food and food preparation wastes 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 waste generated during the preparation and packaging of food products is considered industrial waste and therefore not included in MSW food scrap estimates.

Generation. No production data are available for food wastes. Food wastes 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 wastes was estimated to be nearly 26.2 million tons in 2001 (11.4 percent of total generation).

Recovery for Composting and Discards. Beginning in 1994 for this series of reports, a significant amount of food waste 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 wastes classified as MSW in the past. For the 2001 estimate, a more careful separation of MSW food composted resulted in an estimate of approximately 370,000 tons.

Another *BioCycle* survey yielded an estimate of approximately 359,000 tons of MSW composted. The total—729,000 tons of food wastes and other organic materials composted—is shown in the recovery tables on the line where only food waste recovery was shown in previous reports.

Yard Trimmings

Yard trimmings⁴ include grass, leaves, and tree and brush trimmings from residential, institutional, and commercial sources.

⁴ 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.

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 recent years there has been a new trend—local and state legislation discouraging 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 shows that by 1999, 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 was also estimated that yard trimmings generation 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 2001. An estimated 28.0 million tons of yard trimmings were generated in MSW in 2001. (This compares to an estimated 35 million tons of yard trimmings generated in 1992.)

Recovery for Composting and Discards. Recovery for composting of yard trimmings was estimated using a previous survey which estimated tonnages composted by facilities along with updated information on numbers of yard waste composting facilities. Data compiled by *BioCycle* magazine indicate 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 2001—a significant increase over 1995 estimates.

It should be noted that the estimated 15.8 million tons recovered for composting in 2001 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 off-site. The information source is sampling studies, which estimate the quantities received at landfills and transfer stations. Source reduction activities are described further in Chapter 3.

Miscellaneous Inorganic Wastes

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

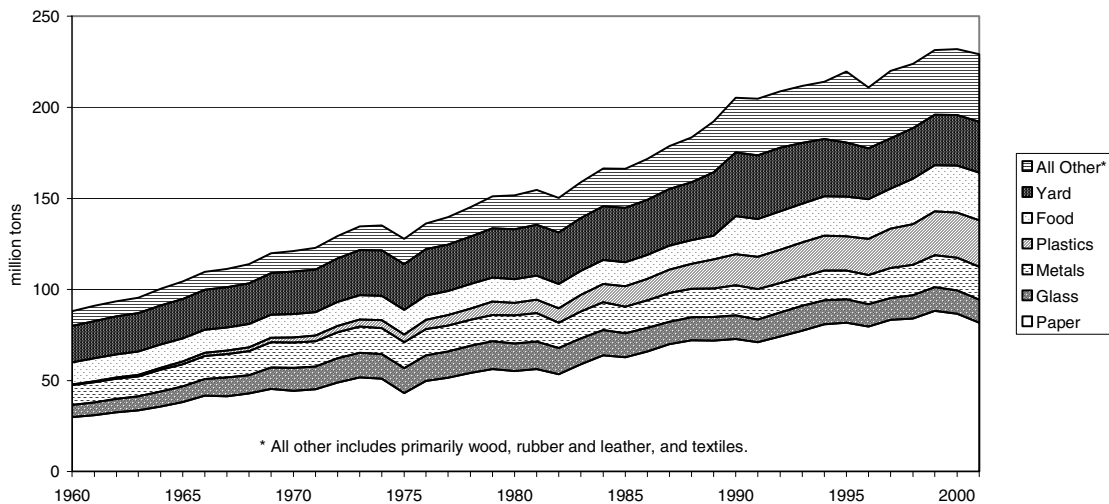
Generation, Recovery, and Discards. This category contributed an estimated 3.4 million tons of MSW in 2001. No recovery of these products was identified; discards are the same as generation.

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 232 million tons in 2000. It decreased slightly to 229.2 million tons in 2001.

Over the years paper and paperboard has been the dominant material category generated in MSW, accounting for 35.7 percent of generation in 2001. Yard trimmings, the second largest material component of MSW (12 percent of MSW generation) have 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.

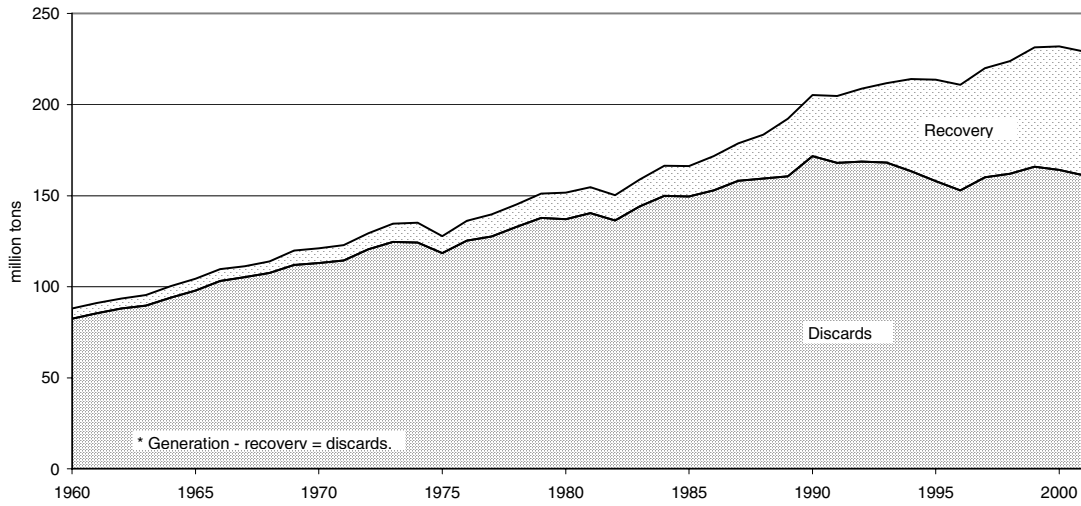
Figure 10. Generation of materials in MSW, 1960 to 2001



Metals account for 7.9 percent of MSW generation and have remained fairly constant as a source of MSW. Glass increased until the 1980s, but decreased somewhat in the 1990s. Glass generation was 12.6 million tons in 2001, 5.5 percent of generation. Food wastes have remained fairly constant in terms of MSW tonnage (11.4 percent of generation in 2001). 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 they ranked fourth in 2001 (behind paper, yard trimmings, and food scraps), and account for 11.1 percent of MSW generation.

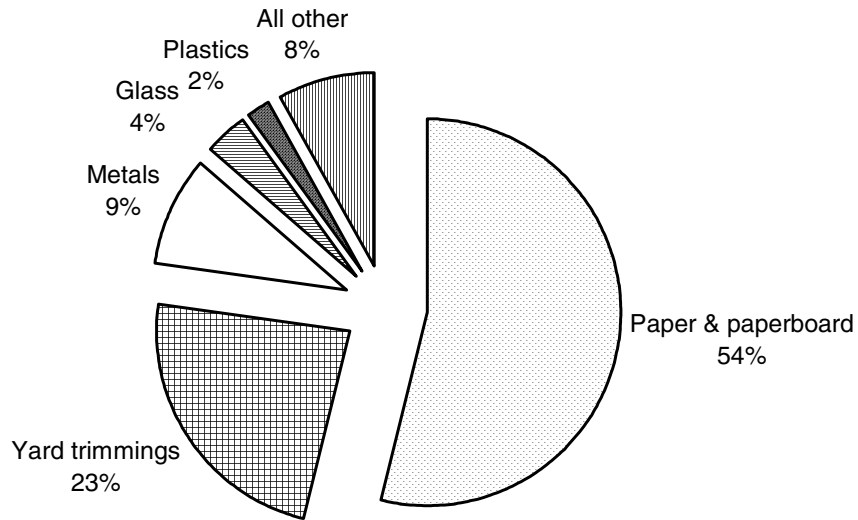
Recovery and Discards. The effect of recovery on MSW discards is illustrated in Figure 11. Recovery of materials for recycling and composting grew at a rather slow pace from 1960 to the 1980s, increasing only from 6.4 percent of generation in 1960 to 10.9 percent in 1985. Renewed interest in recycling (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 2001.

Figure 11. Recovery and discards of MSW,* 1960 to 2001



Estimated recovery of materials (including composting) is shown in Figure 12. In 2001, recovery of paper and paperboard dominated materials recovery at 54 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.

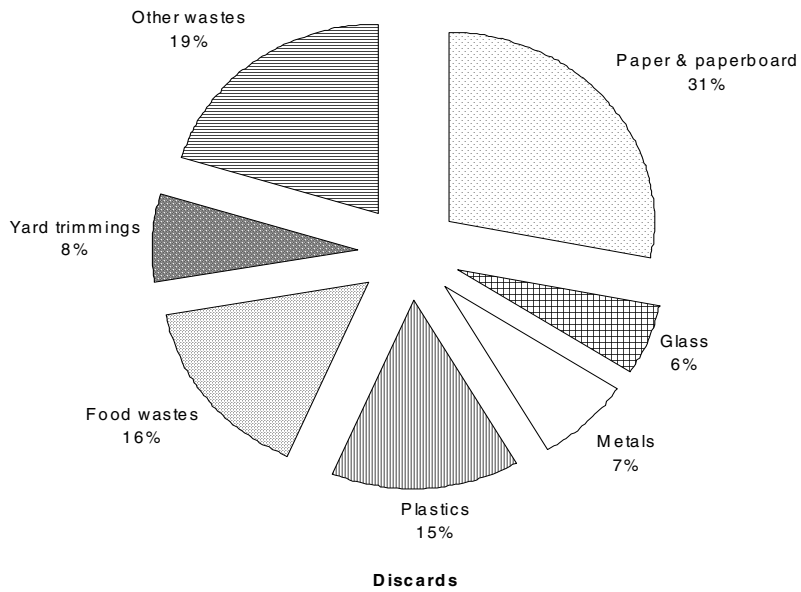
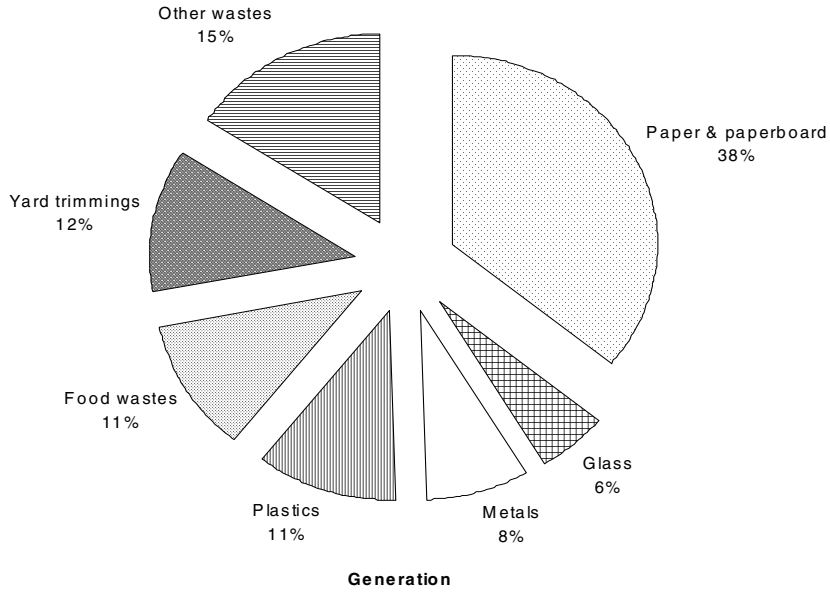
Figure 12. Materials recovery,* 2001



* In percent by weight of total recovery

Figure 13 illustrates the effect of recovery of materials for recycling, including composting, on the composition of MSW discards. For example, paper and paperboard were 38 percent of MSW generated in 2001, but after recovery, paper and paperboard were 31 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, 2001
(In percent of total generation and discards)



The Chapter 2 section above gave a breakdown of municipal solid waste by material. It described how the 229.2 million tons of MSW were generated, recycled (including composted) and disposed of. The following section breaks out the same 229.2 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 than 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 material the product is made of may be stated as well (for instance glass beverage containers or steel cans), or may be obvious (for instance, magazines are made of paper.) 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 contains information on food scraps, yard trimmings, and miscellaneous inorganic wastes. These wastes are not products that can be estimated through the materials flow methodology, but they are estimated by other means, as described earlier.

Within Tables 9 through 23, the first three tables—Tables 9 through 11—serve as an index to the other tables. Table 9 shows what tables to consult for detailed information on generation; Table 10 shows what 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”—229.2 million tons in 2001—with detail provided in different categories—durable goods, nondurable goods, or containers and packaging. For Table 10 and related tables, the “bottom line” is MSW recovered—68 million tons; and for Table 11 and related tables, the “bottom line” is MSW discarded—161.2 million tons.

Durable Goods

Durable goods generally are defined as products having a lifetime of three years or more, although there are some exceptions. In this report, durable goods include 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 are often called “oversize and bulky” in municipal solid waste management practice, and they are generally 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 2001, 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 37.6 million tons in 2001 (16.4 percent of total MSW generation). After recovery for recycling, 31.0 million tons of durable goods remained as discards in 2001.

Table 9

CATEGORIES OF PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2001
(In thousands of tons and percent of total generation)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods <i>(Detail in Table 12)</i>	9,920	14,660	21,800	29,810	31,140	35,350	36,330	37,630
Nondurable Goods <i>(Detail in Table 15)</i>	17,330	25,060	34,420	52,170	57,250	62,990	63,210	60,420
Containers and Packaging <i>(Detail in Table 18)</i>	27,370	43,560	52,670	64,530	70,730	76,790	75,290	73,460
Total Product** Wastes	54,620	83,280	108,890	146,510	159,120	175,130	174,830	171,510
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,740	25,160	25,900	26,200
Yard Trimmings	20,000	23,200	27,500	35,000	29,690	27,730	27,730	27,980
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,380	3,500	3,540
Total Other Wastes	33,500	37,780	42,750	58,700	54,580	56,270	57,130	57,720
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	213,700	231,400	231,960	229,230
Products	Percent of Total Generation							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods <i>(Detail in Table 12)</i>	11.3%	12.1%	14.4%	14.5%	14.6%	15.3%	15.7%	16.4%
Nondurable Goods <i>(Detail in Table 15)</i>	19.7%	20.7%	22.7%	25.4%	26.8%	27.2%	27.3%	26.4%
Containers and Packaging <i>(Detail in Table 19)</i>	31.1%	36.0%	34.7%	31.4%	33.1%	33.2%	32.5%	32.0%
Total Product** Wastes	62.0%	68.8%	71.8%	71.4%	74.5%	75.7%	75.4%	74.8%
Other Wastes								
Food Scraps	13.8%	10.6%	8.6%	10.1%	10.2%	10.9%	11.2%	11.4%
Yard Trimmings	22.7%	19.2%	18.1%	17.1%	13.9%	12.0%	12.0%	12.2%
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%	25.5%	24.3%	24.6%	25.2%
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 2001
(In thousands of tons and percent of generation of each category)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods <i>(Detail in Table 13)</i>	350	940	1,360	3,460	5,010	5,920	6,010	6,590
Nondurable Goods <i>(Detail in Table 16)</i>	2,390	3,730	4,670	8,800	13,610	16,130	16,690	16,710
Containers and Packaging <i>(Detail in Table 20)</i>	2,870	3,350	8,490	16,780	27,530	28,750	28,530	28,140
Total Product** Wastes	5,610	8,020	14,520	29,040	46,150	50,800	51,230	51,440
Other Wastes								
Food, Other^	Neg.	Neg.	Neg.	Neg.	570	550	680	730
Yard Trimmings	Neg.	Neg.	Neg.	4,200	9,030	14,170	15,770	15,820
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	4,200	9,600	14,720	16,450	16,550
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	55,750	65,520	67,680	67,990
Products	Percent of Generation of Each Category							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods <i>(Detail in Table 13)</i>	3.5%	6.4%	6.2%	11.6%	16.1%	16.7%	16.5%	17.5%
Nondurable Goods <i>(Detail in Table 16)</i>	13.8%	14.9%	13.6%	16.9%	23.8%	25.6%	26.4%	27.7%
Containers and Packaging <i>(Detail in Table 21)</i>	10.5%	7.7%	16.1%	26.0%	38.9%	37.4%	37.9%	38.3%
Total Product** Wastes	10.3%	9.6%	13.3%	19.8%	29.0%	29.0%	29.3%	30.0%
Other Wastes								
Food, Other^	Neg.	Neg.	Neg.	Neg.	2.6%	2.2%	2.6%	2.8%
Yard Trimmings	Neg.	Neg.	Neg.	12.0%	30.4%	51.1%	56.9%	56.5%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	7.2%	17.6%	26.2%	28.8%	28.7%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.1%	28.3%	29.2%	29.7%

* 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 2001
 (In thousands of tons and percent of total discards)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods <i>(Detail in Table 14)</i>	9,570	13,720	20,440	26,350	26,130	29,430	30,320	31,040
Nondurable Goods <i>(Detail in Table 17)</i>	14,940	21,330	29,750	43,370	43,640	46,860	46,520	43,710
Containers and Packaging <i>(Detail in Table 22)</i>	24,500	40,210	44,180	47,750	43,200	48,040	46,760	45,320
Total Product** Wastes	49,010	75,260	94,370	117,470	112,970	124,330	123,600	120,070
Other Wastes								
Food Wastes	12,200	12,800	13,000	20,800	21,170	24,610	25,220	25,470
Yard Trimmings	20,000	23,200	27,500	30,800	20,660	13,560	11,960	12,160
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,380	3,500	3,540
Total Other Wastes	33,500	37,780	42,750	54,500	44,980	41,550	40,680	41,170
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	157,950	165,880	164,280	161,240
Products	Percent of Total Discards							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods <i>(Detail in Table 14)</i>	11.6%	12.1%	14.9%	15.3%	16.5%	17.7%	18.5%	19.3%
Nondurable Goods <i>(Detail in Table 17)</i>	18.1%	18.9%	21.7%	25.2%	27.6%	28.2%	28.3%	27.1%
Containers and Packaging <i>(Detail in Table 23)</i>	29.7%	35.6%	32.2%	27.8%	27.4%	29.0%	28.5%	28.1%
Total Product** Wastes	59.4%	66.6%	68.8%	68.3%	71.5%	75.0%	75.2%	74.5%
Other Wastes								
Food Scraps	14.8%	11.3%	9.5%	12.1%	13.4%	14.8%	15.4%	15.8%
Yard Trimmings	24.2%	20.5%	20.1%	17.9%	13.1%	8.2%	7.3%	7.5%
Miscellaneous Inorganic Wastes	1.6%	1.6%	1.6%	1.7%	2.0%	2.0%	2.1%	2.2%
Total Other Wastes	40.6%	33.4%	31.2%	31.7%	28.5%	25.0%	24.8%	25.5%
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, water heaters, etc. They are often 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 are also made for the estimated lifetimes of the appliances, which range up to 20 years.

Generation of major appliances has increased very slowly over the years, and in fact was about constant for the past 4 years. In 2001, 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. We estimated that this number remained steady in 2001.

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 Department of Commerce data. Information on weights and materials composition of discarded small appliances was obtained through interviews. It was estimated that 1.1 million tons of small appliances were generated in 2001. 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 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 2001
(WITH DETAIL ON DURABLE GOODS)
(In thousands of tons and percent of total generation)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods								
Major Appliances	1,630	2,170	2,950	3,310	3,420	3,680	3,640	3,600
Small Appliances**				460	710	940	1,000	1,090
Furniture and Furnishings	2,150	2,830	4,760	6,790	7,170	7,710	7,840	8,100
Carpets and Rugs**				1,660	2,230	2,470	2,570	2,670
Rubber Tires	1,120	1,890	2,720	3,610	3,770	4,630	4,670	4,590
Batteries, lead acid	Neg.	820	1,490	1,510	1,810	1,940	1,940	1,990
Miscellaneous Durables								
Selected Consumer Electronics***						1,760	2,120	2,260
Other Miscellaneous Durables						12,220	12,550	13,330
<i>Total Miscellaneous Durables</i>					12,030	13,980	14,670	15,590
Total Durable Goods	9,920	14,660	21,800	29,810	31,140	35,350	36,330	37,630
Nondurable Goods <i>(Detail in Table 15)</i>	17,330	25,060	34,420	52,170	57,250	62,990	63,210	60,420
Containers and Packaging <i>(Detail in Table 18)</i>	27,370	43,560	52,670	64,530	70,730	76,790	75,290	73,460
Total Product Wastes†	54,620	83,280	108,890	146,510	159,120	175,130	174,830	171,510
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,740	25,160	25,900	26,200
Yard Trimmings	20,000	23,200	27,500	35,000	29,690	27,730	27,730	27,980
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,380	3,500	3,540
Total Other Wastes	33,500	37,780	42,750	58,700	54,580	56,270	57,130	57,720
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	213,700	231,400	231,960	229,230
	Percent of Total Generation							
Products	1960	1970	1980	1990	1995	1999	2000	2001
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%	0.5%
Furniture and Furnishings	2.4%	2.3%	3.1%	3.3%	3.4%	3.3%	3.4%	3.5%
Carpets and Rugs**				0.8%	1.0%	1.1%	1.1%	1.2%
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%	0.8%	0.8%	0.8%	0.9%
Miscellaneous Durables								
Selected Consumer Electronics***						0.8%	0.9%	1.0%
Other Miscellaneous Durables						5.3%	5.4%	5.8%
<i>Total Miscellaneous Durables</i>					5.6%	6.0%	6.3%	6.8%
Total Durable Goods	11.3%	12.1%	14.4%	14.5%	14.6%	15.3%	15.7%	16.4%
Nondurable Goods <i>(Detail in Table 15)</i>	19.7%	20.7%	22.7%	25.4%	26.8%	27.2%	27.3%	26.4%
Containers and Packaging <i>(Detail in Table 19)</i>	31.1%	36.0%	34.7%	31.4%	33.1%	33.2%	32.5%	32.0%
Total Product Wastes†	62.0%	68.8%	71.8%	71.4%	74.5%	75.7%	75.4%	74.8%
Other Wastes								
Food Scraps	13.8%	10.6%	8.6%	10.1%	10.2%	10.9%	11.2%	11.4%
Yard Trimmings	22.7%	19.2%	18.1%	17.1%	13.9%	12.0%	12.0%	12.2%
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%	25.5%	24.3%	24.6%	25.2%
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 2001
(WITH DETAIL ON DURABLE GOODS)
 (In thousands of tons and percent of generation of each product)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods								
Major Appliances	10	50	130	1,070	2,070	1,920	2,000	1,990
Small Appliances**				10	10	20	20	20
Furniture and Furnishings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Carpets and Rugs**				Neg.	20	20	30	30
Rubber Tires	330	250	150	440	670	1,280	1,210	1,770
Batteries, lead acid	Neg.	620	1,040	1,470	1,620	1,870	1,870	1,860
Miscellaneous Durables								
Selected Consumer Electronics***						160	190	210
Other Miscellaneous Durables						650	690	710
<i>Total Miscellaneous Durables</i>	10	20	40	470	620	810	880	920
Total Durable Goods	350	940	1,360	3,460	5,010	5,920	6,010	6,590
Nondurable Goods (Detail in Table 16)	2,390	3,730	4,670	8,800	13,610	16,130	16,690	16,710
Containers and Packaging (Detail in Table 20)	2,870	3,350	8,490	16,780	27,530	28,750	28,530	28,140
Total Product Wastes†	5,610	8,020	14,520	29,040	46,150	50,800	51,230	51,440
Other Wastes								
Food Scraps	Neg.	Neg.	Neg.	Neg.	570	550	680	730
Yard Trimmings	Neg.	Neg.	Neg.	4,200	9,030	14,170	15,770	15,820
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	4,200	9,600	14,720	16,450	16,550
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	55,750	65,520	67,680	67,990
Percent of Generation of Each Product								
Products	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods								
Major Appliances	0.6%	2.3%	4.4%	32.3%	60.5%	52.2%	54.9%	55.3%
Small Appliances**				2.2%	1.4%	2.1%	2.0%	1.8%
Furniture and Furnishings	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Carpets and Rugs**				Neg.	0.9%	0.8%	1.2%	1.1%
Rubber Tires	29.5%	13.2%	5.5%	12.2%	17.8%	27.6%	25.9%	38.6%
Batteries, Lead-Acid	Neg.	75.6%	69.8%	97.4%	89.5%	96.4%	96.4%	93.5%
Miscellaneous Durables								
Selected Consumer Electronics***						9.1%	9.0%	9.3%
Other Miscellaneous Durables						5.3%	5.5%	5.3%
<i>Total Miscellaneous Durables</i>	0.2%	0.3%	0.4%	3.8%	5.2%	5.8%	6.0%	5.9%
Total Durable Goods	3.5%	6.4%	6.2%	11.6%	16.1%	16.7%	16.5%	17.5%
Nondurable Goods (Detail in Table 16)	13.8%	14.9%	13.6%	16.9%	23.8%	25.6%	26.4%	27.7%
Containers and Packaging (Detail in Table 21)	10.5%	7.7%	16.1%	26.0%	38.9%	37.4%	37.9%	38.3%
Total Product Wastes†	10.3%	9.6%	13.3%	19.8%	29.0%	29.0%	29.3%	30.0%
Other Wastes								
Food Scraps	Neg.	Neg.	Neg.	Neg.	2.6%	2.2%	2.6%	2.8%
Yard Trimmings	Neg.	Neg.	Neg.	12.0%	30.4%	51.1%	56.9%	56.5%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	7.2%	17.6%	26.2%	28.8%	28.7%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.1%	28.3%	29.2%	29.7%

* 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 2001
(WITH DETAIL ON DURABLE GOODS)
(In thousands of tons and percent of total discards)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods								
Major Appliances	1,620	2,120	2,820	2,240	1,350	1,760	1,640	1,610
Small Appliances**				450	700	920	980	1,070
Furniture and Furnishings	2,150	2,830	4,760	6,790	7,170	7,710	7,840	8,100
Carpets and Rugs**				1,660	2,210	2,450	2,540	2,640
Rubber Tires	790	1,640	2,570	3,170	3,100	3,350	3,460	2,820
Batteries, lead acid	Neg.	200	450	40	190	70	70	130
Miscellaneous Durables								
Selected Consumer Electronics***						1,600	1,930	2,050
Other Miscellaneous Durables						11,570	11,860	12,620
<i>Total Miscellaneous Durables</i>	5,010	6,930	9,840	12,000	11,410	13,170	13,790	14,670
Total Durable Goods	9,570	13,720	20,440	26,350	26,130	29,430	30,320	31,040
Nondurable Goods <i>(Detail in Table 17)</i>	14,940	21,330	29,750	43,370	43,640	46,860	46,520	43,710
Containers and Packaging <i>(Detail in Table 22)</i>	24,500	40,210	44,180	47,750	43,200	48,040	46,760	45,320
Total Product Wastes†	49,010	75,260	94,370	117,470	112,970	124,330	123,600	120,070
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,170	24,610	25,220	25,470
Yard Trimmings	20,000	23,200	27,500	30,800	20,660	13,560	11,960	12,160
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,380	3,500	3,540
Total Other Wastes	33,500	37,780	42,750	54,500	44,980	41,550	40,680	41,170
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	157,950	165,880	164,280	161,240
	Percent of Total Discards							
Products	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods								
Major Appliances	2.0%	1.9%	2.1%	1.3%	0.9%	1.1%	1.0%	1.0%
Small Appliances**				0.3%	0.4%	0.6%	0.6%	0.7%
Furniture and Furnishings	2.6%	2.5%	3.5%	3.9%	4.5%	4.6%	4.8%	5.0%
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%	2.0%	2.1%	1.7%
Batteries, Lead-Acid	Neg.	0.2%	0.3%	0.0%	0.1%	0.0%	0.0%	0.1%
Miscellaneous Durables								
Selected Consumer Electronics***						1.0%	1.2%	1.3%
Other Miscellaneous Durables						6.9%	7.1%	7.7%
<i>Total Miscellaneous Durables</i>	6.1%	6.1%	7.2%	7.0%	7.2%	7.9%	8.4%	9.1%
Total Durable Goods	11.6%	12.1%	14.9%	15.3%	16.5%	17.7%	18.5%	19.3%
Nondurable Goods <i>(Detail in Table 17)</i>	18.1%	18.9%	21.7%	25.2%	27.6%	28.2%	28.3%	27.1%
Containers and Packaging <i>(Detail in Table 23)</i>	29.7%	35.6%	32.2%	27.8%	27.4%	29.0%	28.5%	28.1%
Total Product Wastes†	59.4%	66.6%	68.8%	68.3%	71.5%	75.0%	75.2%	74.5%
Other Wastes								
Food Scraps	14.8%	11.3%	9.5%	12.1%	13.4%	14.8%	15.4%	15.8%
Yard Trimmings	24.2%	20.5%	20.1%	17.9%	13.1%	8.2%	7.3%	7.5%
Miscellaneous Inorganic Wastes	1.6%	1.6%	1.6%	1.7%	2.0%	2.0%	2.1%	2.2%
Total Other Wastes	40.6%	33.4%	31.2%	31.7%	28.5%	25.0%	24.8%	25.5%
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 8.1 million tons in 2001 (3.5 percent of total MSW). No significant recovery of materials from furniture was identified. Wood is the largest material category in furniture, with ferrous metals second. Plastics, glass, and other materials are also found 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 2.7 million tons of carpets and rugs were generated in MSW in 2001, which was 1.2 percent of total generation.

A small amount of recycling of carpet fiber was identified—estimated to be about 1.1 percent of generation in 2001.

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 two 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 4.6 million tons in 2001 (2.0 percent of total MSW).

Data on recovery of tires in recent years are based on data from the Scrap Tire Management Council. Rubber recovery from tires has been increasing in recent years. In 2001, an estimated 38.6 percent of the weight of tires generated was recovered for recycling, up from 25.9 percent in the year 2000, leaving 2.8 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 2.0 million tons of lead-acid batteries from automobiles, trucks, and motorcycles were generated in MSW in 2001 (less than one 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 2001, 93.9 percent of the lead in these batteries was estimated to be recovered for recycling as well as substantial quantities of the polypropylene battery casings. Discards after recycling of these batteries were 130,000 tons in 2001. (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 15.6 million tons of these goods were generated in 2001, amounting to 6.8 percent of MSW generated. Additional information on consumer electronics, a subset of miscellaneous durable goods, can be found in Appendix C.

As in recent previous updates of this report, generation of selected consumer electronic products were estimated as a subset of miscellaneous durable goods. In 2001, an estimated 2.3 million tons of these goods were generated. Of this, approximately 210,000 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 720,000 tons in 2001 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 2001, bringing total

recovery from this category to 920,000 tons. Discards of miscellaneous durable goods were 14.7 million tons in 2000.

Nondurable Goods

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

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

Generation of nondurable goods in MSW was 60.4 million tons in 2001 (26.4 percent of total generation). Recovery of paper products in this category is quite significant, resulting in 16.7 million tons of nondurable goods recovered in 2001 (27.7 percent of nondurables generation). This means that 43.7 million tons of nondurable goods were discarded in 2001 (27.1 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 2001 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 2001. 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 12.2 million tons generated in 2001 (5.3 percent of total MSW). In 2001, an estimated 60.2 percent of newspapers generated were recovered for recycling, leaving 4.9 million tons discarded (3.0 percent of total MSW discarded). Estimates of newspaper generation are broken down into newsprint

(the majority of the weight of the newspapers) and the groundwood⁵ inserts (primarily advertising) that are a significant portion of the total weight of newspapers. This breakdown is shown in Table 4.

- Books amounted to approximately 0.9 million tons, or 0.4 percent of total MSW generation, in 2001. Recovery of books is not well documented, but it was estimated that approximately 180,000 tons of books were recovered in 2001. 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 2001. Like books, recovery of magazines is not well documented. It was estimated that 660,000 tons of magazines were recovered in 2001. Magazines are predominately made of coated groundwood, but some uncoated groundwood and chemical pulps are also 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, stationery, etc. Generation of these office papers was 7.4 million tons, or 3.2 percent of total MSW generation in 2001. These papers are almost entirely made of uncoated chemical pulp, although some amounts of groundwood are also 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 2001.
- Directories were estimated to generate 740,000 tons (0.3 percent of total MSW) in 2001. These directories are made of groundwood. It was estimated that 110,000 tons of directories were recovered in 2001. The Yellow Pages Publishers Association (YPPA) publishes data on paper use in directories.

⁵ Groundwood papers, like newsprint, are made primarily from pulp prepared by a mechanical process. The nature of the pulp (groundwood vs. chemical) affects the potential uses for the recovered paper.

Table 15
PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 2001
(WITH DETAIL ON NONDURABLE GOODS)
(In thousands of tons and percent of total generation)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 12)	9,920	14,660	21,800	29,810	31,140	35,350	36,330	37,630
Nondurable Goods								
Newspapers	7,110	9,510	11,050	13,430	13,140	14,870	13,800	12,200
Books and Magazines	1,920	2,470	3,390					
Books**				970	1,150	1,130	1,240	850
Magazines**				2,830	2,530	2,210	2,220	2,060
Office Papers	1,520	2,650	4,000	6,410	6,640	7,710	7,420	7,420
Directories**				610	490	740	680	740
Standard (A) Mail***				3,820	4,620	5,320	5,570	5,410
Other Commercial Printing	1,260	2,130	3,120	4,460	6,770	6,270	7,550	6,610
Tissue Paper and Towels	1,090	2,080	2,300	2,960	2,970	3,240	3,220	3,260
Paper Plates and Cups	270	420	630	650	970	950	1,000	1,050
Plastic Plates and Cupst			190	650	780	910	870	800
Trash Bags**				780	780	950	850	830
Disposable Diapers	Neg.	350	1,930	2,700	3,010	3,310	3,340	3,430
Other Nonpackaging Paper	2,700	3,630	4,230	3,840	4,270	4,620	4,140	3,830
Clothing and Footwear	1,360	1,620	2,170	4,010	5,070	6,250	6,460	6,740
Towels, Sheets and Pillowcases**				710	740	780	820	870
Other Miscellaneous Nondurables	100	200	1,410	3,340	3,320	3,730	4,030	4,320
Total Nondurable Goods	17,330	25,060	34,420	52,170	57,250	62,990	63,210	60,420
Containers and Packaging (Detail in Table 18)	27,370	43,560	52,670	64,530	70,730	76,790	75,290	73,460
Total Product Wastes‡	54,620	83,280	108,890	146,510	159,120	175,130	174,830	171,510
Other Wastes	33,500	37,780	42,750	58,700	54,580	56,270	57,130	57,720
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	213,700	231,400	231,960	229,230
	Percent of Total Generation							
Products	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 12)	11.3%	12.1%	14.4%	14.5%	14.6%	15.3%	15.7%	16.4%
Nondurable Goods								
Newspapers	8.1%	7.9%	7.3%	6.5%	6.1%	6.4%	5.9%	5.3%
Books and Magazines	2.2%	2.0%	2.2%					
Books**				0.5%	0.5%	0.5%	0.5%	0.4%
Magazines**				1.4%	1.2%	1.0%	1.0%	0.9%
Office Papers	1.7%	2.2%	2.6%	3.1%	3.1%	3.3%	3.2%	3.2%
Directories**				0.3%	0.2%	0.3%	0.3%	0.3%
Standard (A) Mail***				1.9%	2.2%	2.3%	2.4%	2.4%
Other Commercial Printing	1.4%	1.8%	2.1%	2.2%	3.2%	2.7%	3.3%	2.9%
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%	0.5%
Plastic Plates and Cupst			0.1%	0.3%	0.4%	0.4%	0.4%	0.3%
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%	1.5%
Other Nonpackaging Paper	3.1%	3.0%	2.8%	1.9%	2.0%	2.0%	1.8%	1.7%
Clothing and Footwear	1.5%	1.3%	1.4%	2.0%	2.4%	2.7%	2.8%	2.9%
Towels, Sheets and Pillowcases**				0.3%	0.3%	0.3%	0.4%	0.4%
Other Miscellaneous Nondurables	0.1%	0.2%	0.9%	1.6%	1.6%	1.6%	1.7%	1.9%
Total Nondurables	19.7%	20.7%	22.7%	25.4%	26.8%	27.2%	27.3%	26.4%
Containers and Packaging (Detail in Table 19)	31.1%	36.0%	34.7%	31.4%	33.1%	33.2%	32.5%	32.0%
Total Product Wastes‡	62.0%	68.8%	71.8%	71.4%	74.5%	75.7%	75.4%	74.8%
Other Wastes	38.0%	31.2%	28.2%	28.6%	25.5%	24.3%	24.6%	25.2%
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 2001
(WITH DETAIL ON NONDURABLE GOODS)
(In thousands of tons and percent of generation of each product)

Products	Thousands of Tons							2001
	1960	1970	1980	1990	1995	1999	2000	
Durable Goods (Detail in Table 13)	350	940	1,360	3,460	5,010	5,920	6,010	6,590
Nondurable Goods								
Newspapers	1,820	2,250	3,020	5,110	7,010	8,040	7,740	7,350
Books and Magazines	100	260	280					
Books**				100	220	190	240	180
Magazines**				300	650	550	710	660
Office Papers	250	710	870	1,700	3,040	3,630	4,090	4,100
Directories**				40	60	130	120	110
Standard (A) Mail***				200	710	1,360	1,830	1,750
Other Commercial Printing	130	340	350	700	1,120	1,230	920	1,480
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 Cupst			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	860	900	930
Towels, Sheets and Pillowcases**				120	130	140	140	150
Other Miscellaneous Nondurables	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Nondurable Goods	2,390	3,730	4,670	8,800	13,610	16,130	16,690	16,710
Containers and Packaging (Detail in Table 20)	2,870	3,350	8,490	16,780	27,530	28,750	28,530	28,140
Total Product Wastes‡	5,610	8,020	14,520	29,040	46,150	50,800	51,230	51,440
Other Wastes	Neg.	Neg.	Neg.	4,200	9,600	14,720	16,450	16,550
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	55,750	65,520	67,680	67,990
	Percent of Generation of Each Product							
Products	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 13)	3.5%	6.4%	6.2%	11.6%	16.1%	16.7%	16.5%	17.5%
Nondurable Goods								
Newspapers	25.6%	23.7%	27.3%	38.0%	53.3%	54.1%	56.1%	60.2%
Books and Magazines	5.2%	10.5%	8.3%					
Books**				10.3%	19.1%	16.8%	19.4%	21.2%
Magazines**				10.6%	25.7%	24.9%	32.0%	32.0%
Office Papers	16.4%	26.8%	21.8%	26.5%	45.8%	47.1%	55.1%	55.3%
Directories**				6.6%	12.2%	17.6%	17.6%	14.9%
Standard (A) Mail***				5.2%	15.4%	25.6%	32.9%	32.3%
Other Commercial Printing	10.3%	16.0%	11.2%	15.7%	16.5%	19.6%	12.2%	22.4%
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 Cupst			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%	13.8%	13.9%	13.8%
Towels, Sheets and Pillowcases**				16.9%	17.6%	17.9%	17.1%	17.2%
Other Miscellaneous Nondurables	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Nondurables	13.8%	14.9%	13.6%	16.9%	23.8%	25.6%	26.4%	27.7%
Containers and Packaging (Detail in Table 21)	10.5%	7.7%	16.1%	26.0%	38.9%	37.4%	37.9%	38.3%
Total Product Wastes‡	10.3%	9.6%	13.3%	19.8%	29.0%	29.0%	29.3%	30.0%
Other Wastes	Neg.	Neg.	Neg.	7.2%	17.6%	26.2%	28.8%	28.7%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.1%	28.3%	29.2%	29.7%

* 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 2001
 (WITH DETAIL ON NONDURABLE GOODS)
 (In thousands of tons and percent of total discards)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 14)	9,570	13,720	20,440	26,350	26,130	29,430	30,320	31,040
Nondurable Goods								
Newspapers	5,290	7,260	8,030	8,320	6,130	6,830	6,060	4,850
Books and Magazines	1,820	2,210	3,110					
Books**				870	930	940	1,000	670
Magazines**				2,530	1,880	1,660	1,510	1,400
Office Papers	1,270	1,940	3,130	4,710	3,600	4,080	3,330	3,320
Directories**				570	430	610	560	630
Standard (A) Mail***				3,620	3,910	3,960	3,740	3,660
Other Commercial Printing	1,130	1,790	2,770	3,760	5,650	5,040	6,630	5,130
Tissue Paper and Towels	1,090	2,080	2,300	2,960	2,970	3,240	3,220	3,260
Paper Plates and Cups	270	420	630	650	970	950	1,000	1,050
Plastic Plates and Cup†			190	640	770	910	870	800
Trash Bags**				780	780	950	850	830
Disposable Diapers	Neg.	350	1,930	2,700	3,010	3,310	3,340	3,430
Other Nonpackaging Paper	2,660	3,520	4,230	3,840	4,270	4,620	4,140	3,830
Clothing and Footwear	1,310	1,560	2,020	3,490	4,410	5,390	5,560	5,810
Towels, Sheets and Pillowcases**				590	610	640	680	720
Other Miscellaneous Nondurables	100	200	1,410	3,340	3,320	3,730	4,030	4,320
Total Nondurable Goods	14,940	21,330	29,750	43,370	43,640	46,860	46,520	43,710
Containers and Packaging (Detail in Table 22)	24,500	40,210	44,180	47,750	43,200	48,040	46,760	45,320
Total Product Wastes‡	49,010	75,260	94,370	117,470	112,970	124,330	123,600	120,070
Other Wastes	33,500	37,780	42,750	54,500	44,980	41,550	40,680	41,170
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	157,950	165,880	164,280	161,240
	Percent of Total Discards							
Products	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 14)	11.6%	12.1%	14.9%	15.3%	16.5%	17.7%	18.5%	19.3%
Nondurable Goods								
Newspapers	6.4%	6.4%	5.9%	4.8%	3.9%	4.1%	3.7%	3.0%
Books and Magazines	2.2%	2.0%	2.3%					
Books**				0.5%	0.6%	0.6%	0.6%	0.4%
Magazines**				1.5%	1.2%	1.0%	0.9%	0.9%
Office Papers	1.5%	1.7%	2.3%	2.7%	2.3%	2.5%	2.0%	2.1%
Directories**				0.3%	0.3%	0.4%	0.3%	0.4%
Standard (A) Mail***				2.1%	2.5%	2.4%	2.3%	2.3%
Other Commercial Printing	1.4%	1.6%	2.0%	2.2%	3.6%	3.0%	4.0%	3.2%
Tissue Paper and Towels	1.3%	1.8%	1.7%	1.7%	1.9%	2.0%	2.0%	2.0%
Paper Plates and Cups	0.3%	0.4%	0.5%	0.4%	0.6%	0.6%	0.6%	0.7%
Plastic Plates and Cup†			0.1%	0.4%	0.5%	0.5%	0.5%	0.5%
Trash Bags**				0.5%	0.5%	0.6%	0.5%	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%	2.8%	2.5%	2.4%
Clothing and Footwear	1.6%	1.4%	1.5%	2.0%	2.8%	3.2%	3.4%	3.6%
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%	2.5%	2.7%
Total Nondurables	18.1%	18.9%	21.7%	25.2%	27.6%	28.2%	28.3%	27.1%
Containers and Packaging (Detail in Table 23)	29.7%	35.6%	32.2%	27.8%	27.4%	29.0%	28.5%	28.1%
Total Product Wastes‡	59.4%	66.6%	68.8%	68.3%	71.5%	75.0%	75.2%	74.5%
Other Wastes	40.6%	33.4%	31.2%	31.7%	28.5%	25.0%	24.8%	25.5%
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.

- Standard (A) mail⁶ includes catalogs and other direct bulk mailings; these amounted to an estimated 5.4 million tons, or 2.4 percent of MSW generation, in 2001. Both groundwood and chemical pulps are used in these mailings. It was estimated that 1.8 million tons were recovered in 2001. The U.S. Postal Service has implemented a program to increase recovery of bulk mail, and many curbside collection programs also include mail.
- 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 6.6 million tons, or 3 percent of MSW generation, in 2001, with recovery estimated at 1.5 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 3.3 million tons (1.4 percent of total MSW generation) in 2001. 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 0.8 million tons (0.5 percent of total MSW generation) in 2001. 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 2001. No significant recovery for recycling of these papers was identified.

Overall, generation of paper and paperboard products in nondurable goods was 43.5 million tons in 2001 (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

⁶ Standard (A) mail was formerly called Third Class mail by the U.S. Postal Service.

overall recovery rate for paper in nondurables was 35.9 percent in 2001. Thus 27.9 million tons of paper in nondurables were discarded in 2001.

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 800,000 tons of these products were generated in 2001, or 0.3 percent of total MSW (see Table 15). No significant recovery for recycling was identified in 2001.

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 830,000 tons in 2001 (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 3.4 million tons of disposable diapers were generated in 2001, or 1.5 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 2001.

Clothing and Footwear. Generation of clothing and footwear was estimated to be 6.7 million tons in 2001 (2.9 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 products 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 930,000 tons of textiles in clothing were recovered for export or recycling in 2001. (Reuse is not counted as recycling and is included in the estimates in Chapter 3.)

Towels, Sheets, and Pillowcases. An estimated 870,000 tons of towels, sheets, and pillowcases were generated in 2001. Generation was estimated using a methodology similar to that for clothing. An estimated 150,000 tons of these textiles were recovered for export or recycling in 2001.

Other Miscellaneous Nondurables. Generation of other miscellaneous nondurables was estimated to be 4.3 million tons in 2001 (1.9 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 73.5 million tons of generation in 2001 (32.0 percent of total generation). Generation in this category has declined since 1999, primarily because paper and paperboard packaging declined by 1.0 million tons. There were small declines in generation of glass bottles, and steel packaging, while aluminum packaging held steady. 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 2001, 38.4 percent of containers and packaging generated was recovered for recycling. Because of this recovery, containers and packaging comprised 28.1 percent of total MSW discards in 2001.

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 include 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 both empty glass containers and containers holding products, e.g., imported beer.

Generation of glass containers was 10.9 million tons in 2001, or 4.8 percent of MSW generation (Tables 18 and 19). This is less tonnage than was generated in 1999.

Industry estimates that 2.4 million tons of glass containers were recovered for recycling, or 22 percent of generation, in 2001. Glass container discards were 8.5 million tons in 2001, or 5.3 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 2.6 million tons in 2001 (1.1 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 2001
 (WITH DETAIL ON CONTAINERS AND PACKAGING)
 (In thousands of tons)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 12)	9,920	14,660	21,800	29,810	31,140	35,350	36,330	37,630
Nondurable Goods (Detail in Table 15)	17,330	25,060	34,420	52,170	57,250	62,990	63,210	60,420
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	1,400	5,580	6,740	5,640	5,120	5,620	5,710	5,990
Wine and Liquor Bottles	1,080	1,900	2,450	2,030	1,790	2,010	1,910	1,760
Food and Other Bottles & Jars	3,710	4,440	4,780	4,160	4,620	3,770	3,410	3,150
Total Glass Packaging	6,190	11,920	13,970	11,830	11,530	11,400	11,030	10,900
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	2,660	2,640	2,360
Other Steel Packaging	260	270	240	200	210	240	240	240
Total Steel Packaging	4,660	5,380	3,610	2,890	2,900	2,900	2,880	2,600
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	100	850	1,550	1,590	1,530	1,520	1,510
Other Cans	Neg.	60	40	20	40	50	50	50
Foil and Closures	170	410	380	330	350	380	380	390
Total Aluminum Packaging	170	570	1,270	1,900	1,980	1,960	1,950	1,950
Paper & Paperboard Pkg								
Corrugated Boxes	7,330	12,760	17,080	24,010	28,800	31,360	30,210	28,980
Milk Cartons**			790	510	510	490	550	510
Folding Cartons**			3,820	4,300	5,310	5,610	5,760	5,520
Other Paperboard Packaging	3,840	4,830	230	290	260	240	200	190
Bags and Sacks**			3,380	2,440	1,980	1,680	1,490	1,420
Wrapping Papers**			200	110	70			
Other Paper Packaging	2,940	3,810	850	1,020	1,150	1,750	1,670	1,750
Total Paper & Board Pkg	14,110	21,400	26,350	32,680	38,080	41,130	39,880	38,370
Plastics Packaging								
Soft Drink Bottles**			260	430	650	810	830	870
Milk Bottles**			230	530	620	690	690	740
Other Containers	60	910	890	1,430	1,180	2,640	2,630	2,730
Bags and Sacks**			390	940	1,200	1,690	1,650	1,640
Wraps**			840	1,530	1,710	2,550	2,550	2,580
Other Plastics Packaging	60	1,180	790	2,040	2,220	2,680	2,840	2,680
Total Plastics Packaging	120	2,090	3,400	6,900	7,580	11,060	11,190	11,240
Wood Packaging	2,000	2,070	3,940	8,180	8,510	8,110	8,120	8,170
Other Misc. Packaging	120	130	130	150	150	230	240	230
Total Containers & Pkg	27,370	43,560	52,670	64,530	70,730	76,790	75,290	73,460
Total Product Wastes†	54,620	83,280	108,890	146,510	159,120	175,130	174,830	171,510
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,740	25,160	25,900	26,200
Yard Trimmings	20,000	23,200	27,500	35,000	29,690	27,730	27,730	27,980
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,380	3,500	3,540
Total Other Wastes	33,500	37,780	42,750	58,700	54,580	56,270	57,130	57,720
Total MSW Generated - Weight	88,120	121,060	151,640	205,210	213,700	231,400	231,960	229,230

* 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 2001
 (WITH DETAIL ON CONTAINERS AND PACKAGING)
 (In percent of total generation)

Products	Percent of Total Generation							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 12)	11.3%	12.1%	14.4%	14.5%	14.6%	15.3%	15.7%	16.4%
Nondurable Goods (Detail in Table 15)	19.7%	20.7%	22.7%	25.4%	26.8%	27.2%	27.3%	26.4%
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	1.6%	4.6%	4.4%	2.7%	2.4%	2.4%	2.5%	2.6%
Wine and Liquor Bottles	1.2%	1.6%	1.6%	1.0%	0.8%	0.9%	0.8%	0.8%
Food and Other Bottles & Jars	4.2%	3.7%	3.2%	2.0%	2.2%	1.6%	1.5%	1.4%
Total Glass Packaging	7.0%	9.8%	9.2%	5.8%	5.4%	4.9%	4.8%	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%	1.1%	1.1%	1.0%
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%	1.2%	1.1%
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	0.1%	0.6%	0.8%	0.7%	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%	0.8%	0.8%	0.9%
Paper & Paperboard Pkg								
Corrugated Boxes	8.3%	10.5%	11.3%	11.7%	13.5%	13.6%	13.0%	12.6%
Milk Cartons**			0.5%	0.2%	0.2%	0.2%	0.2%	0.2%
Folding Cartons**			2.5%	2.1%	2.5%	2.4%	2.5%	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%	0.7%	0.6%	0.6%
Wrapping Papers**			0.1%	0.1%	0.0%			
Other Paper Packaging	3.3%	3.1%	0.6%	0.5%	0.5%	0.8%	0.7%	0.8%
Total Paper & Board Pkg	16.0%	17.7%	17.4%	15.9%	17.8%	17.8%	17.2%	16.7%
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%	1.1%	1.1%	1.2%
Bags and Sacks**			0.3%	0.5%	0.6%	0.7%	0.7%	0.7%
Wraps**			0.6%	0.7%	0.8%	1.1%	1.1%	1.1%
Other Plastics Packaging	0.1%	1.0%	0.5%	1.0%	1.0%	1.2%	1.2%	1.2%
Total Plastics Packaging	0.1%	1.7%	2.2%	3.4%	3.5%	4.8%	4.8%	4.9%
Wood Packaging	2.3%	1.7%	2.6%	4.0%	4.0%	3.5%	3.5%	3.6%
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%	33.1%	33.2%	32.5%	32.0%
Total Product Wastes†	62.0%	68.8%	71.8%	71.4%	74.5%	75.7%	75.4%	74.8%
Other Wastes								
Food Scraps	13.8%	10.6%	8.6%	10.1%	10.2%	10.9%	11.2%	11.4%
Yard Trimmings	22.7%	19.2%	18.1%	17.1%	13.9%	12.0%	12.0%	12.2%
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%	25.5%	24.3%	24.6%	25.2%
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 2001
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In thousands of tons)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 13)	350	940	1,360	3,460	5,010	5,920	6,010	6,590
Nondurable Goods (Detail in Table 16)	2,390	3,730	4,670	8,800	13,610	16,130	16,690	16,710
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	90	140	730	1,890	1,670	1,590	1,410	1,270
Wine and Liquor Bottles	10	10	20	210	470	450	400	360
Food and Other Bottles & Jars	Neg.	Neg.	Neg.	520	1,000	960	850	770
Total Glass Packaging	100	150	750	2,620	3,140	3,000	2,660	2,400
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	1,510	1,510	1,370
Other Steel Packaging	Neg.	Neg.	Neg.	60	50	170	160	160
Total Steel Packaging	30	80	200	690	1,560	1,680	1,670	1,530
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	10	310	990	900	850	830	740
Other Cans	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Foil and Closures	Neg.	Neg.	Neg.	20	30	30	40	40
Total Aluminum Pkg	Neg.	10	320	1,010	930	880	870	780
Paper & Paperboard Pkg								
Corrugated Boxes	2,520	2,760	6,390	11,530	18,480	20,330	20,330	20,310
Milk Cartons**			Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Folding Cartons**			520	340	1,080	400	430	480
Other Paperboard Packaging			Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Bags and Sacks**			Neg.	200	340	220	300	310
Wrapping Papers**			Neg.	Neg.	Neg.	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	20,950	21,060	21,100
Plastics Packaging								
Soft Drink Bottles**			10	140	300	290	290	310
Milk Bottles**			Neg.	20	190	220	210	210
Other Containers	Neg.	Neg.	Neg.	20	150	290	260	280
Bags and Sacks**			Neg.	30	40	10	10	10
Wraps**			Neg.	30	40	130	170	170
Other Plastics Packaging	Neg.	Neg.	Neg.	20	20	70	90	100
Total Plastics Packaging	Neg.	Neg.	10	260	740	1,010	1,030	1,080
Wood Packaging	Neg.	Neg.	Neg.	130	1,260	1,230	1,240	1,250
Other Misc. Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Containers & Pkg	2,870	3,350	8,490	16,780	27,530	28,750	28,530	28,140
Total Product Wastes†	5,610	8,020	14,520	29,040	46,150	50,800	51,230	51,440
Other Wastes								
Food Scraps	Neg.	Neg.	Neg.	Neg.	570	550	680	730
Yard Trimmings	Neg.	Neg.	Neg.	4,200	9,030	14,170	15,770	15,820
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	4,200	9,600	14,720	16,450	16,550
Total MSW Recovered - Weight	5,610	8,020	14,520	33,240	55,750	65,520	67,680	67,990

* 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 2001
 (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	1999	2000	2001
Durable Goods (Detail in Table 13)	3.5%	6.4%	6.2%	11.6%	16.1%	16.7%	16.5%	17.5%
Nondurable Goods (Detail in Table 16)	13.8%	14.9%	13.6%	16.9%	23.8%	25.6%	26.4%	27.7%
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	6.4%	2.5%	10.8%	33.5%	32.6%	28.3%	24.7%	21.2%
Wine and Liquor Bottles	Neg.	Neg.	Neg.	10.3%	26.3%	22.4%	20.9%	20.5%
Food and Other Bottles & Jars	Neg.	Neg.	Neg.	12.5%	21.6%	25.5%	24.9%	24.4%
Total Glass Packaging	1.6%	1.3%	5.4%	22.1%	27.2%	26.3%	24.1%	22.0%
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%	56.8%	57.2%	58.1%
Other Steel Packaging	Neg.	Neg.	Neg.	30.0%	23.8%	70.8%	66.7%	66.7%
Total Steel Packaging	Neg.	1.5%	5.5%	23.9%	53.8%	57.9%	58.0%	58.8%
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	10.0%	36.5%	63.9%	56.6%	55.6%	54.6%	49.0%
Other Cans	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Foil and Closures	Neg.	Neg.	Neg.	6.1%	8.6%	7.9%	10.5%	10.3%
Total Aluminum Pkg	Neg.	1.8%	25.2%	53.2%	47.0%	44.9%	44.6%	40.0%
Paper & Paperboard Pkg								
Corrugated Boxes	34.4%	21.6%	37.4%	48.0%	64.2%	64.8%	67.3%	70.1%
Milk Cartons**			Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Folding Cartons**			Neg.	Neg.	20.3%	7.1%	7.5%	8.7%
Other Paperboard Packaging			Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Bags and Sacks**			Neg.	Neg.	17.2%	13.1%	20.1%	21.8%
Wrapping Papers**			Neg.	Neg.	Neg.	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%	50.9%	52.8%	55.0%
Plastics Packaging								
Soft Drink Bottles**			3.8%	32.6%	46.2%	35.8%	34.9%	35.6%
Milk Bottles**			Neg.	3.8%	30.6%	31.9%	30.4%	28.4%
Other Containers	Neg.	Neg.	Neg.	1.4%	12.7%	11.0%	9.9%	10.3%
Bags and Sacks**			Neg.	3.2%	3.3%	0.6%	0.6%	0.6%
Wraps**			Neg.	2.0%	2.3%	5.1%	6.7%	6.6%
Other Plastics Packaging	Neg.	Neg.	Neg.	1.0%	0.9%	2.6%	3.2%	3.7%
Total Plastics Packaging	Neg.	Neg.	Neg.	3.8%	9.8%	9.1%	9.2%	9.6%
Wood Packaging	Neg.	Neg.	Neg.	1.6%	14.8%	15.2%	15.3%	15.3%
Other Misc. Packaging	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Containers & Pkg	10.5%	7.7%	16.1%	26.0%	38.9%	37.4%	37.9%	38.3%
Total Product Wastes†	10.3%	9.6%	13.3%	19.8%	29.0%	29.0%	29.3%	30.0%
Other Wastes								
Food Scraps	Neg.	Neg.	Neg.	Neg.	2.6%	2.2%	2.6%	2.8%
Yard Trimmings	Neg.	Neg.	Neg.	12.0%	30.4%	51.1%	56.9%	56.5%
Miscellaneous Inorganic Wastes	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Total Other Wastes	Neg.	Neg.	Neg.	7.2%	17.6%	26.2%	28.8%	28.7%
Total MSW Recovered - %	6.4%	6.6%	9.6%	16.2%	26.1%	28.3%	29.2%	29.7%

* 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 2001
 (WITH DETAIL ON CONTAINERS AND PACKAGING)
 (In thousands of tons)

Products	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 14)	9,570	13,720	20,440	26,350	26,130	29,430	30,320	31,040
Nondurable Goods (Detail in Table 17)	14,940	21,330	29,750	43,370	43,640	46,860	46,520	43,710
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	1,310	5,440	6,010	3,750	3,450	4,030	4,300	4,720
Wine and Liquor Bottles	1,070	1,890	2,430	1,820	1,320	1,560	1,510	1,400
Food and Other Bottles & Jars	3,710	4,440	4,780	3,640	3,620	2,810	2,560	2,380
Total Glass Packaging	6,090	11,770	13,220	9,210	8,390	8,400	8,370	8,500
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	1,150	1,130	990
Other Steel Packaging	260	270	240	140	160	70	80	80
Total Steel Packaging	4,630	5,300	3,410	2,200	1,340	1,220	1,210	1,070
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	90	540	560	690	680	690	770
Other Cans	Neg.	60	40	20	40	50	50	50
Foil and Closures	170	410	380	310	320	350	340	350
Total Aluminum Pkg	170	560	950	890	1,050	1,080	1,080	1,170
Paper & Paperboard Pkg								
Corrugated Boxes	4,810	10,000	10,690	12,480	10,320	11,030	9,880	8,670
Milk Cartons**			790	510	510	490	550	510
Folding Cartons**			3,300	3,960	4,230	5,210	5,330	5,040
Other Paperboard Packaging	3,840	4,830	230	290	260	240	200	190
Bags and Sacks**			3,380	2,240	1,640	1,460	1,190	1,110
Wrapping Papers**			200	110	70			
Other Paper Packaging	2,720	3,460	550	1,020	1,150	1,750	1,670	1,750
Total Paper & Board Pkg	11,370	18,290	19,140	20,610	18,180	20,180	18,820	17,270
Plastics Packaging								
Soft Drink Bottles**			250	290	350	520	540	560
Milk Bottles**			230	510	430	470	480	530
Other Containers	60	910	890	1,410	1,030	2,350	2,370	2,450
Bags and Sacks**			390	910	1,160	1,680	1,640	1,630
Wraps**			840	1,500	1,670	2,420	2,380	2,410
Other Plastics Packaging	60	1,180	790	2,020	2,200	2,610	2,750	2,580
Total Plastics Packaging	120	2,090	3,390	6,640	6,840	10,050	10,160	10,160
Wood Packaging	2,000	2,070	3,940	8,050	7,250	6,880	6,880	6,920
Other Misc. Packaging	120	130	130	150	150	230	240	230
Total Containers & Pkg	24,500	40,210	44,180	47,750	43,200	48,040	46,760	45,320
Total Product Wastes†	49,010	75,260	94,370	117,470	112,970	124,330	123,600	120,070
Other Wastes								
Food Scraps	12,200	12,800	13,000	20,800	21,170	24,610	25,220	25,470
Yard Trimmings	20,000	23,200	27,500	30,800	20,660	13,560	11,960	12,160
Miscellaneous Inorganic Wastes	1,300	1,780	2,250	2,900	3,150	3,380	3,500	3,540
Total Other Wastes	33,500	37,780	42,750	54,500	44,980	41,550	40,680	41,170
Total MSW Discarded - Weight	82,510	113,040	137,120	171,970	157,950	165,880	164,280	161,240

* 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 2001
 (WITH DETAIL ON CONTAINERS AND PACKAGING)
 (In percent of total discards)

Products	Percent of Total Discards							
	1960	1970	1980	1990	1995	1999	2000	2001
Durable Goods (Detail in Table 14)	11.6%	12.1%	14.9%	15.3%	16.5%	17.7%	18.5%	19.3%
Nondurable Goods (Detail in Table 17)	18.1%	18.9%	21.7%	25.2%	27.6%	28.2%	28.3%	27.1%
Containers and Packaging								
Glass Packaging								
Beer and Soft Drink Bottles	1.6%	4.8%	4.4%	2.2%	2.2%	2.4%	2.6%	2.9%
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%	1.7%	1.6%	1.5%
Total Glass Packaging	7.4%	10.4%	9.6%	5.4%	5.3%	5.1%	5.1%	5.3%
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%	0.7%	0.7%	0.7%	0.6%
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%	0.8%	0.7%	0.7%	0.7%
Aluminum Packaging								
Beer and Soft Drink Cans	Neg.	0.1%	0.4%	0.3%	0.4%	0.4%	0.4%	0.5%
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%	0.7%	0.7%
Paper & Paperboard Pkg								
Corrugated Boxes	5.8%	8.8%	7.8%	7.3%	6.5%	6.6%	6.0%	5.4%
Milk Cartons**			0.6%	0.3%	0.3%	0.3%	0.3%	0.3%
Folding Cartons**			2.4%	2.3%	2.7%	3.1%	3.2%	3.1%
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%	0.7%	0.7%
Wrapping Papers**			0.1%	0.1%	0.0%			
Other Paper Packaging	3.3%	3.1%	0.4%	0.6%	0.7%	1.1%	1.0%	1.1%
Total Paper & Board Pkg	13.8%	16.2%	14.0%	12.0%	11.5%	12.2%	11.5%	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%	1.4%	1.4%	1.5%
Bags and Sacks**			0.3%	0.5%	0.7%	1.0%	1.0%	1.0%
Wraps**			0.6%	0.9%	1.1%	1.5%	1.4%	1.5%
Other Plastics Packaging	0.1%	1.0%	0.6%	1.2%	1.4%	1.6%	1.7%	1.6%
Total Plastics Packaging	0.1%	1.8%	2.5%	3.9%	4.3%	6.1%	6.2%	6.3%
Wood Packaging	2.4%	1.8%	2.9%	4.7%	4.6%	4.1%	4.2%	4.3%
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%	27.4%	29.0%	28.5%	28.1%
Total Product Wastes†	59.4%	66.6%	68.8%	68.3%	71.5%	75.0%	75.2%	74.5%
Other Wastes								
Food Scraps	14.8%	11.3%	9.5%	12.1%	13.4%	14.8%	15.4%	15.8%
Yard Trimmings	24.2%	20.5%	20.1%	17.9%	13.1%	8.2%	7.3%	7.5%
Miscellaneous Inorganic Wastes	1.6%	1.6%	1.6%	1.7%	2.0%	2.0%	2.1%	2.2%
Total Other Wastes	40.6%	33.4%	31.2%	31.7%	28.5%	25.0%	24.8%	25.5%
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 (SRI) provided recovery data for steel containers and packaging. An estimated 1.5 million tons of steel packaging were recovered in 2001, or 59 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 has 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 Institute 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. Total aluminum container and packaging generation in 2001 was 2.0 million tons, or 0.9 percent of total MSW generation.

Formerly, aluminum can recovery data has been obtained from the Aluminum Association. For this report, the aluminum can recovery methodology has been revised to account for imports of used beverage cans (UBC); these imports have been increasing in recent years. The imported UBC 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.⁷ The effect of this change is to lower the aluminum beverage can recovery rate.

Recovery of aluminum beverage cans in 2001 was 0.8 million tons, or 49.0 percent of generation. Recovery of all aluminum packaging was estimated to be 40 percent of total

⁷ Note, however, that the imported UBC do contribute to recycled aluminum content in can sheet and other aluminum products.

generation in 2001. After recovery for recycling, 1.2 million tons of aluminum packaging were discarded in 2001.

Paper and Paperboard Containers and Packaging. Corrugated boxes are the largest single product category of MSW at 29.0 million tons generated, or 13 percent of total generation, in 2001. Corrugated boxes also represent the largest single category of product recovery, at 20.3 million tons of recovery in 2001 (70.1 percent of boxes generated were recovered). After recovery, 8.7 million tons of corrugated boxes were discarded, or 5.4 percent of MSW discards in 2001.)

Other paper and paperboard packaging in MSW includes milk cartons, folding boxes (e.g., cereal boxes, frozen food boxes, some department store boxes), bags and sacks, wrapping papers, and other paper and paperboard packaging. Overall, paper and paperboard containers and packaging totaled 38.4 million tons of MSW generation in 2001, 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 790,000 tons in 2001). The overall recovery rate for paper and paperboard packaging in 2001 was 55.0 percent. Other paper packaging such as folding boxes and sacks is mostly 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 2001 (4.9 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 37 percent rate in 2001 (310,000 tons). Recovery of plastic milk and water bottles was estimated to have been 210,000 tons, or 28.4 percent of generation. Overall, recovery of plastic containers and packaging was estimated to be 1.1 million tons, or 9.6 percent in 2001. Discards of plastic packaging thus were 10.2 million tons in 2001, or 6.3 percent of total MSW generation.

Wood Packaging. Wood packaging includes wood crates and pallets (mostly pallets). Data on production of wood packaging is from the National Wood Pallet and Container Association, and more recently, the USDA Forest Service Southern Research Station and Virginia Polytechnic Institute. In 2001, 8.2 million tons of wood pallets and other wood packaging were estimated to have been generated, or 3.6 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 1,250,000 tons in 2001.

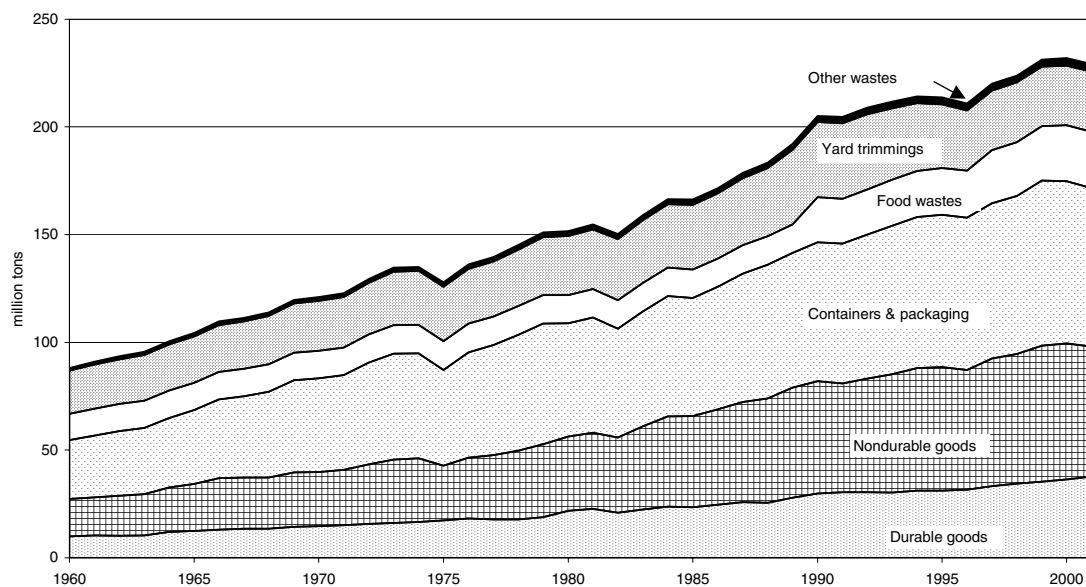
Accounting for pallet reuse and recovery for recycling, wood packaging discards were 6.9 million tons in 2001, or 4.3 percent of total MSW discards.

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 230,000 tons were generated in 2001.

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.

Figure 14. Generation of products in MSW, 1960 to 2001



The materials composition of nondurable goods in 2001 is shown in Figure 15. Paper and paperboard made up 72 percent of nondurables in MSW generation, with plastics contributing 10 percent, and textiles 10 percent. Other materials contributed lesser percentages. After recovery for recycling, paper and paperboard were 64 percent of nondurable discards, with plastics being 14 percent, and textiles 12 percent.

The materials composition of containers and packaging in MSW in 2001 is shown in Figure 16. By weight, paper and paperboard products made up 52 percent of containers and packaging generation, with glass and plastic each accounting for 15 percent. Wood was 11 percent, and metals were 6 percent.

Figure 15. Nondurable goods generated and discarded in municipal solid waste, 2001
(In percent of total generation and discards)

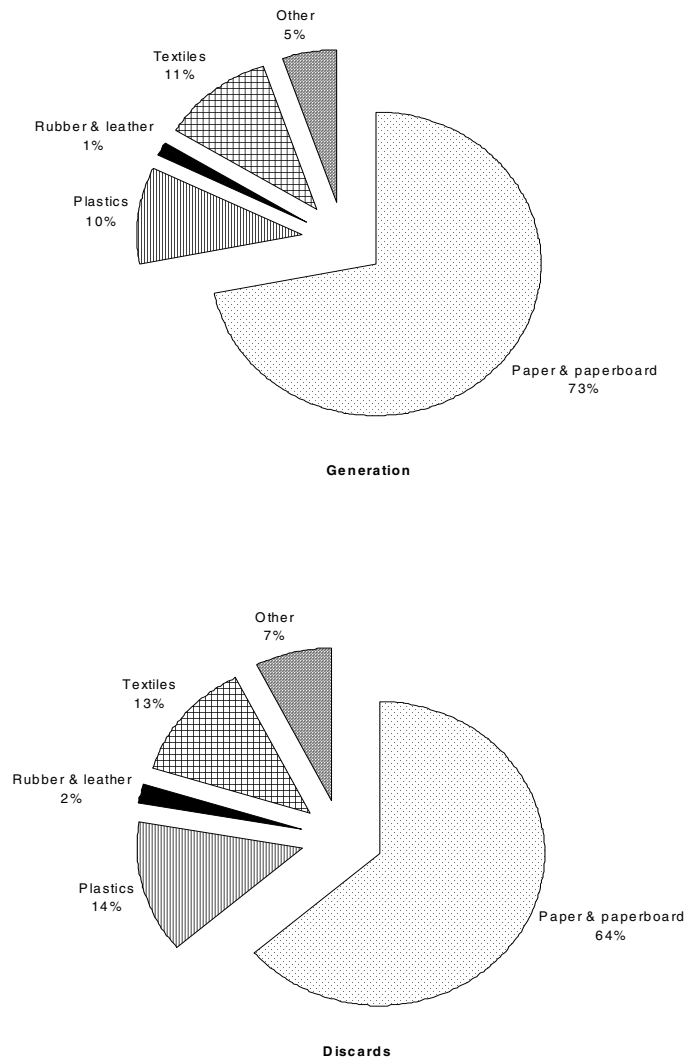
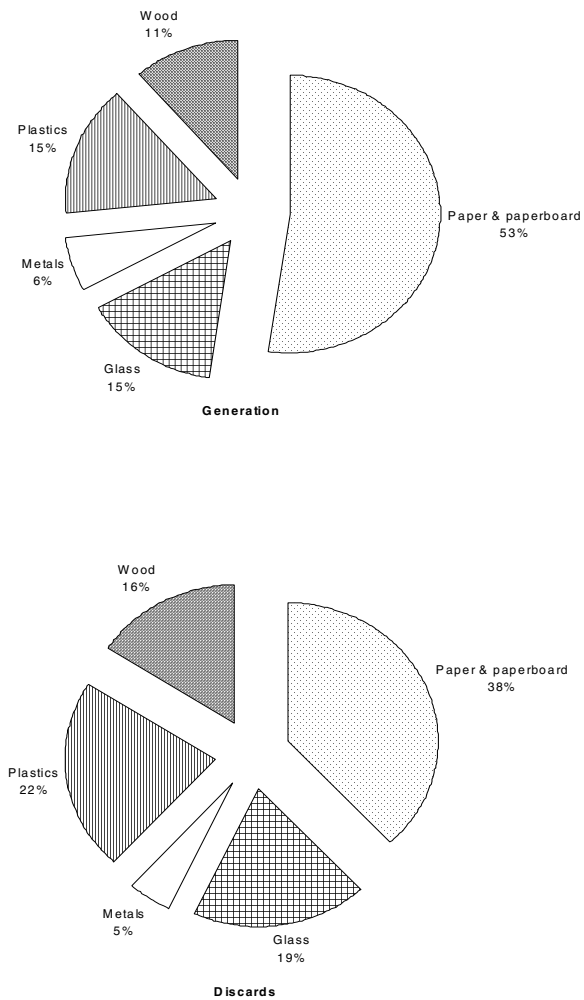


Figure 16. Containers and packaging generated and discarded in municipal solid waste, 2001
(In percent of total generation and discards)



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 19 percent of discards of containers and packaging, plastics were 22 percent, wood was 15 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 2001 was 229.2 million tons, which was 2.7 million tons less than in 2000, when 231.9 million tons were generated. This compares to 1990, when total generation of MSW was 205.2 million tons.
- Paper and paperboard products made up the largest percentage of all the materials in MSW, at 35.7 percent of total generation. Generation of paper and paperboard products declined from 86.8 million tons in 2000 to 81.9 million tons in 2001. This decline was almost certainly due to economic conditions. Paper and paperboard products have ranged between 37 and 38 percent of generation for the past four years.
- Yard trimmings comprised the second largest material category, estimated at 28.0 million tons, or 12.2 percent of total generation, in 2001. This compares to 35.0 million tons (17.1 percent of total generation) in 1990. This decline is largely due to state legislation discouraging yard trimmings disposal in landfills, including source reduction measures such as backyard composting and leaving grass trimmings on the yard.
- Plastic products generation in 2001 was 25.4 million tons, or 11.1 percent of generation. This was a growth of 670,000 tons (2.7 percent) from 2000 to 2001. Most of this increase in plastics generation came from the durable goods category. Plastics generation has grown from 8 percent in the 1990s to 11.1 percent in 2001.

MSW Recovery

- Recovery of materials in MSW increased from 67.7 million tons in 2000 (29.2 percent of total generation) to 68.0 million tons in 2001 (29.7 percent of generation).

- Recovery of products and other wastes in MSW increased slightly from 2000 to 2001. Recovery of paper and paperboard products, the largest component of recovery, also increased slightly. Recovery of paper and paperboard increased from 42.3 percent in 2000 to 44.9 percent in 2001.
- The increase in recovery of paper and paperboard products over the longer term has been due to increases in recovery, over time, from all categories: newspapers, books, magazines, directories, standard (A) mail (advertisements, circulars, etc.), and other commercial printing. In the last year, the key categories showing increases in recovery were other commercial printing, which increased by an estimated 560,000 tons from 2000 to 2001 (from 12.2 percent of generation to 22.4 percent of generation).
- By weight, the recovery of books, magazines, directories, and standard (A) mail decreased slightly. The categories of books, magazines, and office papers showed increases from 2000 to 2001 in percent recovered.
- Although the tons recovered for newspapers declined from 2000 to 2001 from 7.7 million tons to 7.4 million tons, this was likely due to generation of newspapers declining from 13.8 to 12.2 million tons per year. The percent of newspapers recovered rose from 56.1 percent of generation to 60.2 percent of generation.
- Containers and packaging recovery decreased from 28.5 million tons in 2000 to 28.1 million tons in 2001. Generation, too, decreased from 75.3 to 73.5 million tons. The percent of containers and packaging recovered increased from 37.9 percent to 38.3 percent from 2000 to 2001. Nondurable goods had the second highest tonnage recovery in 2001—16.7 million tons, or 27.7 percent of generation.
- Measured by tonnage, the most recovered products and materials in 2001 were corrugated boxes (20.3 million tons), yard trimmings (15.8 million tons), newspapers (7.4 million tons), high grade office papers (4.1 million tons), glass containers (2.4 million tons), steel from large appliances (2.0 million tons), rubber tires (1.8 million tons), standard (A) mail (1.8 million tons), other commercial printing (1.5 million tons), and wood packaging (1.3 million tons). Collectively, these products accounted for about 83 percent of total MSW recovery in 2001.

- Measured by percentage of generation, products with the highest recovery rates in 2001 were lead-acid batteries (93.5 percent), corrugated boxes (70.1 percent), newspapers (60.2 percent), steel packaging (58.8 percent), yard trimmings (56.6 percent), aluminum beverage cans (49 percent), steel in major appliances (55.3 percent), office papers (55.3 percent), rubber tires (38.6 percent), standard (A) mail (32.3 percent), and magazines (32 percent).

Long Term Trends

- Generation of MSW has increased (except in recession years), from 88.1 million tons in 1960 to 231.9 million tons in 2000. It decreased somewhat, to 229.2 million tons in 2001, due most probably to economic factors.
- Generation of paper and paperboard, the largest material component of MSW, has increased in almost every year, again, with the exception of years in which we have experienced slowed economic growth. 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, has helped contain the generation of yard trimmings. Generation of other materials is generally on an upward trend, but will also follow economic indicators.
- 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 percent) reflects a rapid increase in the infrastructure for recovery over the last decade, and more.
- Recovery (as a percentage of generation) of most materials in MSW has increased dramatically over the last 30 years. Some examples:

	1970	1980	1990	2001
Paper and paperboard	15%	21%	28%	45%
Glass	1.3%	5%	20%	20%
Metals	4%	8%	24%	35%
Plastics	Neg.	<1%	2%	5.5%
Yard trimmings	Neg.	--	12%	57%
Rubber tires	13%	5.5%	12%	39%
Batteries	76%	70%	97%	94%

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CHAPTER 3

MANAGEMENT OF MUNICIPAL SOLID WASTE

INTRODUCTION

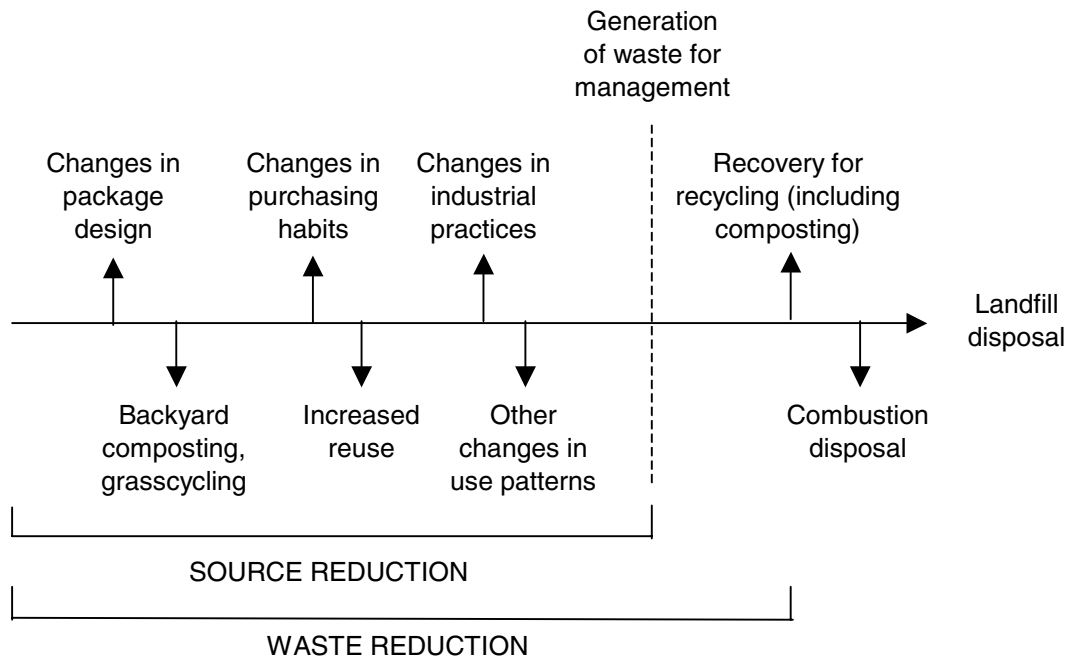
EPA's tiered integrated waste management strategy includes the following components:

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

The three components are put into context in Figure 17.

This chapter addresses the major activities within an integrated waste management system: source reduction, recycling (including composting), and disposal. 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 later in this chapter.

Estimates of the historical recovery of materials for recycling, including yard trimmings for composting, are presented in Chapter 2. Chapter 3 discusses the current MSW management infrastructure. Current solid waste collection, processing, and disposal programs and facilities are highlighted with tables and figures. This chapter 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.

Figure 17. Diagram of solid waste management

Source: Franklin Associates, Ltd.

SOURCE REDUCTION

During the past 40 years, the amount of waste each person creates has almost doubled from 2.7 to 4.41 pounds per day. The most effective way to stop this trend is by preventing waste from being generated in the first place.

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 wastes				• 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 goods at garage sales, flea markets, and the like. Borrowing and sharing items like tools can also 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 eight 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 8 million tons of wood pallets were refurbished and returned to service in 2001. It is also 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 specific activities affect the waste stream.

Management of Organic Materials

Food wastes and yard trimmings combined made up about 24 percent of MSW generation in 2001, 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 recycling activity. Estimates for these off-site 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 later in this chapter. The backyard composting of yard trimmings and certain food discards is a growing source reduction practice. There also is a trend toward leaving grass clippings on lawns, often through the use of mulching mowers. Other actions contributing to reduced organics disposal are: establishment of variable fees 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 on disposal of yard trimmings in landfills.

Part of the impetus for source reduction and recycling 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 over 28 percent of the nation's population) had in effect legislation affecting management of yard trimmings. In 1998, 23 states plus the District of Columbia (amounting to about 50 percent of the nation's population) had legislation discouraging the disposal of yard trimmings.

Measuring Source Reduction

Although source reduction has been an increasingly important aspect of municipal solid waste programs since the late 1980s, the goal of actually measuring how much source reduction has taken place—how much waste prevention there has been—has proved elusive. Early attempts by localities and states often consisted of measuring a single waste stream in a single community. In time, additional research enabled proxy, or estimated values, to be developed for specific waste streams, to use on a state-wide or national level. EPA's Source Reduction Program Potential Manual and planning packet, published in 1997 (EPA530-E-97-001) provides an example of this approach. 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 and disposal. The statistic with the best relationship with waste generation has been found to be Personal Consumption Expenditures (PCE), or “consumer spending.” This makes sense since consumer spending reflects the goods and products, including food, and their packaging, which are purchased, used, and ultimately discarded as municipal solid waste.

Over the last several decades, there has been almost continual increase in waste generation in the United States. If that same rate of generation remained constant through 2000, than about 287 million tons of waste would have been generated. But in 2000, only 232 million tons of waste were actually generated. That is, 55 million tons of waste never made it to the waste stream (Table 24-A). Source reduction is measured as the difference between the amount of MSW that was projected to be generated in 2000 and the actual amount of MSW that was generated in 2000.

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.

Some commodities and products show significant decreases (source reduction) and other show increases in waste generation (source expansion) in 2000. A complete listing of source reduction and source expansion for individual MSW components can be found in Appendix B.

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 generate the source reduction estimates presented in this report. Further detail, including an explanation of the significance of PCE as a predictor of waste, is provided in that report.

Table 24-A
SOURCE REDUCTION OF MUNICIPAL SOLID WASTE, 1992-2000
(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

Table 24-B
SOURCE REDUCTION BY MAJOR MATERIAL CATEGORIES, 2000
(In millions on 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

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 2001, more than 9,700 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 most extensive curbside collection occurring in the Northeast.

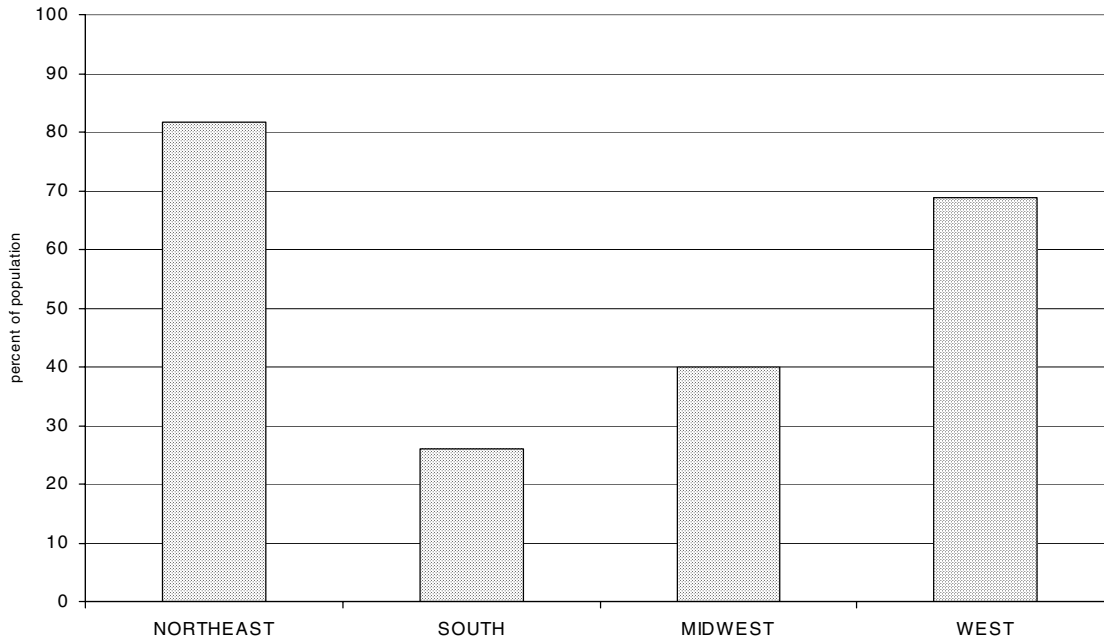
Table 25
NUMBER AND POPULATION SERVED BY
CURBSIDE RECYCLABLES COLLECTION PROGRAMS, 2001

Region	Number of Programs	Population (in thousands)	Population Served	
			(in thousands)	Percent*
NORTHEAST	3,421	53,805	43,981	82%
SOUTH	1,677	101,833	26,496	26%
MIDWEST	3,572	64,687	25,851	40%
WEST	1,034	62,612	43,038	69%
Total	9,704	233,931	139,366	60%
Percent of Total U.S. Population				49%

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

Source: U.S. Census Bureau 2002, *BioCycle* December 2001.

Figure 18. Population served by curbside recycling, 2001



Source: U.S. Census Bureau, *BioCycle* December 2001.

In 2001, nearly one-half (49 percent) of the U.S. population, or 139 million persons, had access to curbside recyclables collection programs. The Northeast region had the largest population served – 44 million persons. In the Northeast about 82 percent of the population had access to curbside recyclables collection, while in the West 69 percent of the population had access to curbside recycling. The largest numbers of programs were located in the Northeast and Midwest regions of the country.

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.

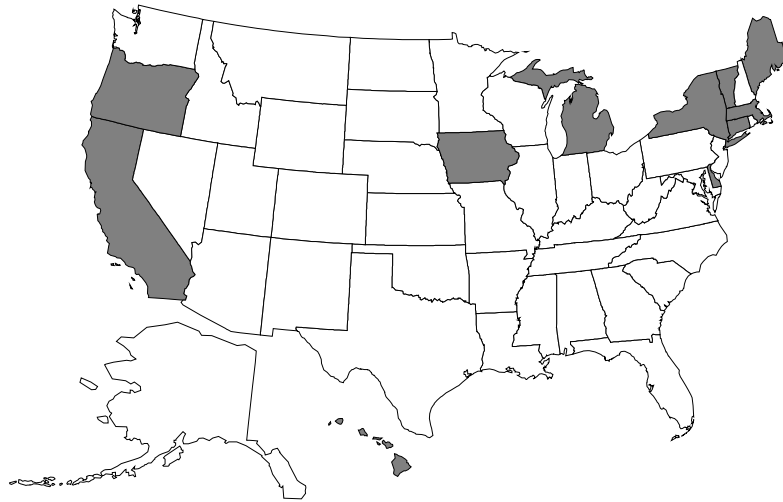
It is difficult to quantify drop-off centers in the United States. It is estimated that there were 12,694 programs in 1997, according to a *BioCycle* survey. In some areas, particularly those

with sparse population, drop-off centers may be the only option for collection of 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. In addition, California has a similar system where containers can be redeemed, but the consumer pays no deposit. Further, in 2002 Hawaii adopted beverage container deposit legislation, which becomes effective in 2005.

Deposit systems generally target beverage containers (primarily beer and soft drink), which account for less than 6 percent of total MSW generation. It is estimated that about 35 percent of all recovery of beverage containers comes from the nine 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 towards the redemption rate.)

Figure 19. States With Bottle Deposit Rules

Source: The Container Recycling Institute, 2002

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 is often 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 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 facility (MRF). Mixed waste can also be processed to pull out recyclable and compostable materials.

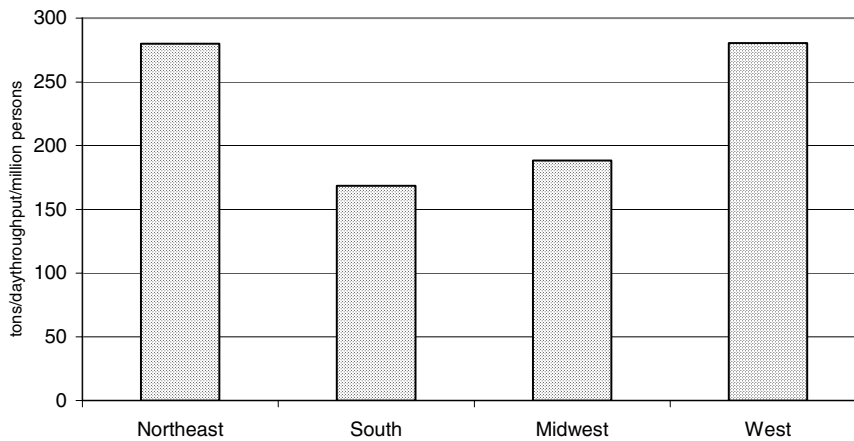
Materials Recovery Facilities. Materials recovery facilities vary widely across the United States, depending on the incoming materials and the technology and labor used to sort the materials. In 2001, 480 MRFs were operating in the United States, with an estimated total daily throughput of 62,000 tons per day (Table 26). The most extensive recyclables processing throughput occurs in the West and the South (Figure 20).

Table 26
MATERIALS RECOVERY FACILITIES, 2001

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

Source: Governmental Advisory Associates, Inc.

Figure 20. Estimated MRF Throughput, 2001
(tons per day per million persons)



Source: U.S. Census Bureau, Governmental Advisory Associates, Inc.

The majority of MRFs are considered low technology, meaning 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. However, high technology MRFs usually include manual sorting, reducing the distinction between high and low technology MRFs.

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 solid waste, which is then loaded on conveyors. Using both mechanical and manual (high and low technology) sorting, recyclable materials are removed for further processing. In 2001, there were reported 43 mixed waste processing facilities in the U.S., handling about 29,000 tons of waste per day. The Western region 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 wastes and yard trimmings, wood, and other materials. In 2001, there were 16 mixed waste composting facilities, fewer than the 19 reported in 1999.

Nationally, mixed waste composting facilities handled about 1,600 tons per day in 2001, and a throughput of about 1,400 tons per day in 2001. Nine of these mixed waste composting facilities were located in the Midwest. In 2001, the highest processing capacity per million persons was found in the South and Midwest, as shown in Figure 22.

Figure 21. Mixed Waste Processing Estimated Capacity, 2001
(tons per day per million persons)

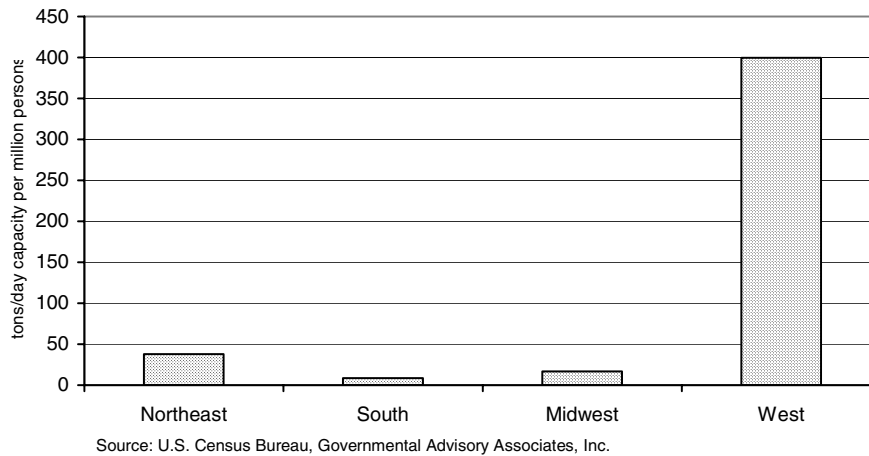
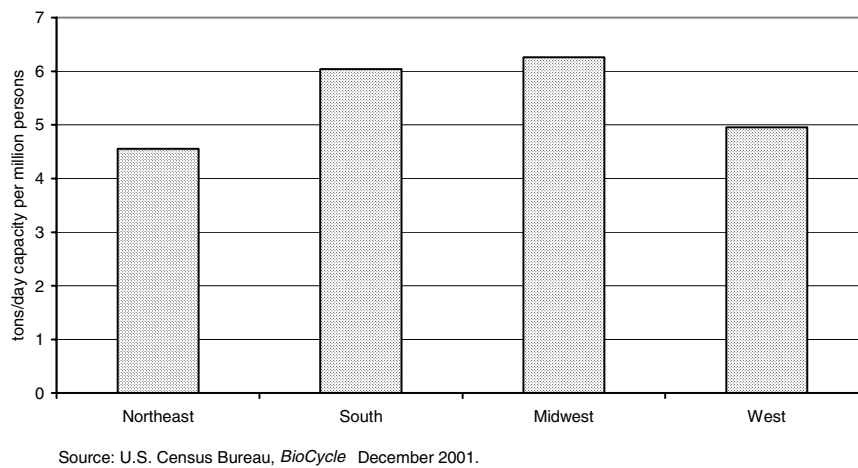
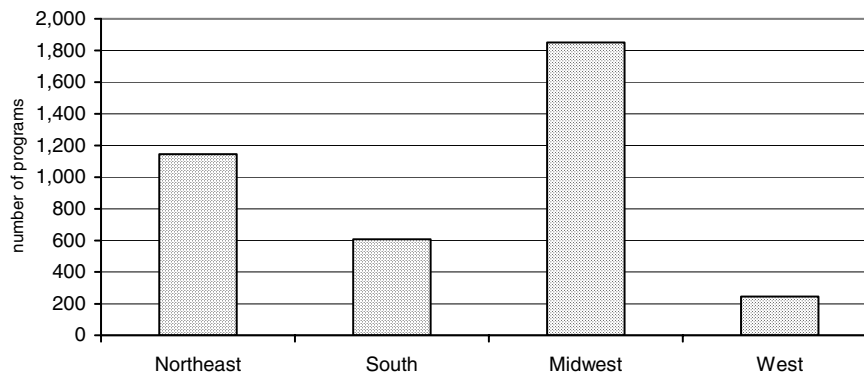


Figure 22. MSW Composting Capacity, 2001
(Capacity in tons per day per million persons)



Yard Trimmings Composting. Yard trimmings composting is much more prevalent than mixed waste composting. On-site management of yard trimmings (back yard composting) is discussed later in this chapter, and is classified as source reduction, not recycling. In 2000, 3,846 yard trimmings composting programs were reported. In 2001, about 75 percent of these programs were 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 2001.

Figure 23. Yard Trimmings Composting Programs, 2001
(In number of programs)



Source: *BioCycle* December 2001.

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 solely 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 2001 design capacity of 95,077 tons per day. There were 97 WTE facilities in

2001 (Table 27), down from 102 in 2000. In tons of capacity per million persons, the Southern region had the most MSW combustion capacity in 2001 (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, rubber tires have been used as fuel in cement kilns, utility boilers, pulp and paper mills, industrial boilers, and dedicated scrap tire-to-energy facilities. 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 2.4 million tons of MSW were combusted in this manner in 2001, with tires contributing a majority of the total.

Table 27
MUNICIPAL WASTE-TO-ENERGY PROJECTS, 2001

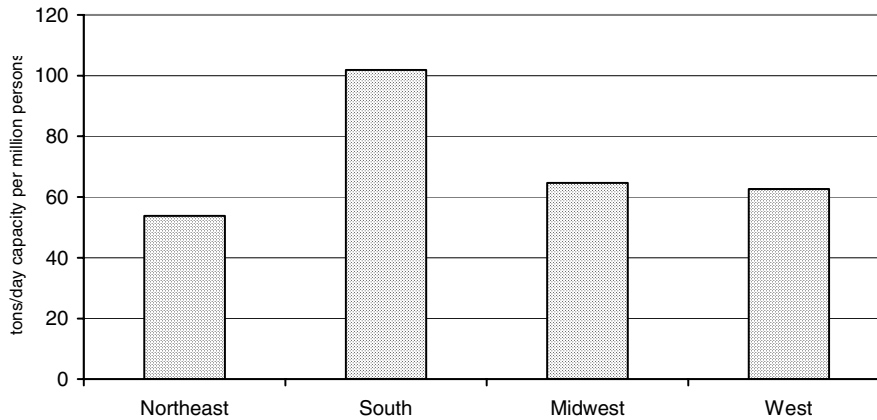
Region	Number Operational	Design Capacity (tpd)
NORTHEAST	40	44,985
SOUTH	30	32,904
MIDWEST	19	12,380
WEST	8	4,808
<i>U.S. Total*</i>	97	95,077

* 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, 2002.

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. In 2001 the total throughput of MSW through all combustion facilities was estimated at 33.6 million tons, or 14.7 percent of MSW generation.

Figure 24. Municipal Waste-to-Energy Capacity, 2001
(Capacity in tons per million persons)



Source: U.S. Census Bureau, Integrated Waste Services Association 2002.

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. Materials processing facilities (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 is managed separately⁸. (There are

⁸ 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.

a number of efforts underway to reuse ash.) As a general “rule of thumb,” MSW combustor ash amounts to about 25 percent (by 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 2001, there were 1,858 municipal solid waste landfills 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. Twenty-nine states had more than 10 years of capacity left, down from 1997, in which 42 states had more than 10 years of capacity left. Six states had 5 to 10 years of capacity remaining. Only three states reported having less than 5 years of capacity remaining. Ten states, however, do not have capacity data available.

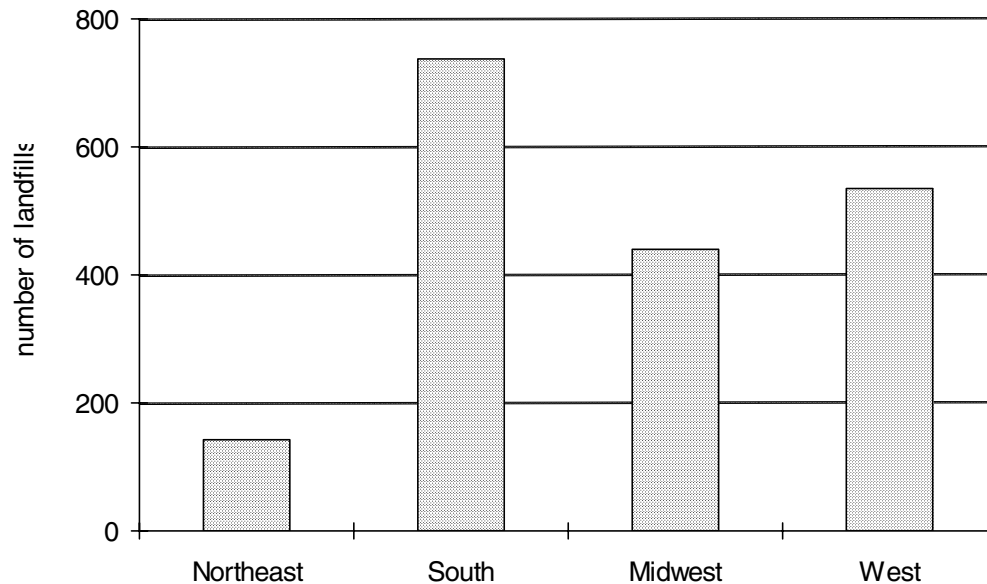
Table 28
LANDFILL FACILITIES, 2001

Region	Number of Landfills *	Number of States with Years Capacity Remaining		
		> 10 yr	5 to 10 yr	< 5 yr
NORTHEAST	143	4	3	2
SOUTHEAST	738	11	1	0
MIDWEST	441	8	2	1
WEST	536	6	0	0
<i>U.S. Total</i> *	1,858	29	6	3

* Excludes landfills reported in Alaska (275) and Hawaii (9).

Capacity data not available for 10 states.

Source: BioCycle December 2001.

Figure 25: Number of Landfills in the U.S., 2001

Source: *BioCycle* December 2001.

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 Table 29 and Figure 26.

Table 29
GENERATION, MATERIALS RECOVERY, COMPOSTING, COMBUSTION,
AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 TO 2001
(In thousands of tons and percent of total generation)

	Thousands of Tons							
	1960	1970	1980	1990	1995	1999	2000	2001
Generation	88,120	121,060	151,640	205,210	213,700	231,400	231,960	229,230
Recovery for recycling	5,610	8,020	14,520	29,040	46,150	50,800	51,230	51,440
Recovery for composting*	Neg.	Neg.	Neg.	4,200	9,600	14,720	16,450	16,550
Total Materials Recovery	5,610	8,020	14,520	33,240	55,750	65,520	67,680	67,990
Discards after recovery	82,510	113,040	137,120	171,970	157,950	165,880	164,280	161,240
Combustion**	27,000	25,100	13,700	31,900	35,540	34,040	33,730	33,600
Discards to landfill, other disposal†	55,510	87,940	123,420	140,070	122,410	131,840	130,550	127,640
Pounds per Person per Day								
	1960	1970	1980	1990	1995	1999	2000	2001
Generation	2.68	3.25	3.66	4.50	4.45	4.65	4.52	4.41
Recovery for recycling	0.17	0.22	0.35	0.64	0.96	1.02	1.00	0.99
Recovery for composting*	Neg.	Neg.	Neg.	0.09	0.20	0.30	0.32	0.32
Total Materials Recovery	0.17	0.22	0.35	0.73	1.16	1.33	1.32	1.31
Discards after recovery	2.51	3.04	3.31	3.77	3.29	3.32	3.20	3.10
Combustion**	0.82	0.67	0.33	0.70	0.74	0.68	0.66	0.65
Discards to landfill, other disposal†	1.69	2.36	2.98	3.07	2.55	2.65	2.54	2.46
Population (thousands)	179,979	203,984	227,255	249,907	263,168	272,691	281,422	284,797
Percent of Total Generation								
	1960	1970	1980	1990	1995	1999	2000	2001
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%	21.6%	22.0%	22.1%	22.4%
Recovery for composting*	Neg.	Neg.	Neg.	2.0%	4.5%	6.4%	7.1%	7.2%
Total Materials Recovery	6.4%	6.6%	9.6%	16.2%	26.1%	28.3%	29.2%	29.7%
Discards after recovery	93.6%	93.4%	90.4%	83.8%	73.9%	71.7%	70.8%	70.3%
Combustion**	30.6%	20.7%	9.0%	15.5%	16.6%	14.7%	14.5%	14.7%
Discards to landfill, other disposal†	63.0%	72.6%	81.4%	68.3%	57.3%	57.0%	56.3%	55.7%

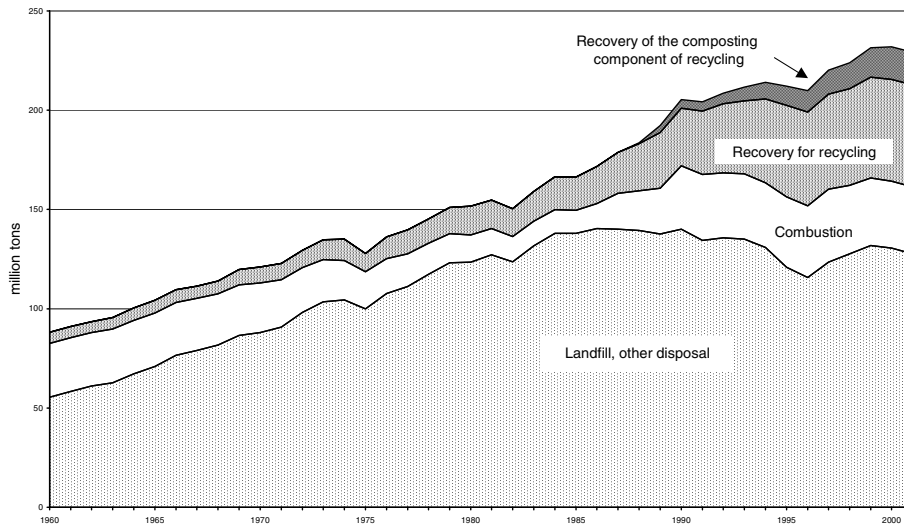
* Composting of yard trimmings, food scraps and other MSW organic material. Does not include backyard composting.

** 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.

Figure 26: Municipal Solid Waste Management, 1960 to 2001

Historically, municipal solid waste generation has grown steadily (from 88 million tons in 1960 to over 225 million tons at present). In the 1960s and early 1970s a large percentage of MSW was burned, with little recovery for recycling. Landfill disposal typically consisted of open dumping, often accompanied with open burning of the waste for volume reduction. Through the mid-1980s, incineration declined considerably and landfills became difficult to site, and 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 apparently peaked in the 1986-1987 period, then began to decline as materials recovery and combustion increased.

More recently, tons landfilled have been growing again, to accommodate increased generation, while since 1997 combustion declined slightly and recycling rose slightly. 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 that there are fewer years of landfill capacity available than there were 2 years ago. Compared to 2 years ago, more states have less than a decade of capacity left. In addition, regional dislocations sometimes occur.

Recovery has increased steadily. Combustion has held steady—14.7 percent of generation in 2001. MSW discards to landfills rose to about 132 million tons in 1999, then declined to 128 million tons in 2001, close to 1998 levels. As a percentage of total MSW generation, landfilling has consistently decreased—from 83 percent of generation in 1986 to 55.7 percent in 2001.

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APPENDIX A

MATERIALS FLOW METHODOLOGY

The materials flow 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.

RECOVERY

Data on recovery of materials and products for recycling are compiled using industry data adjusted, when appropriate, with U.S. Department of Commerce import/export data. Recovery estimates of yard trimmings for composting are developed from data provided by state officials.

DISCARDS

Mathematically, discards equal that portion of generation remaining after recovery for recycling and composting.

MUNICIPAL SOLID WASTE GENERATION, RECOVERY, 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.

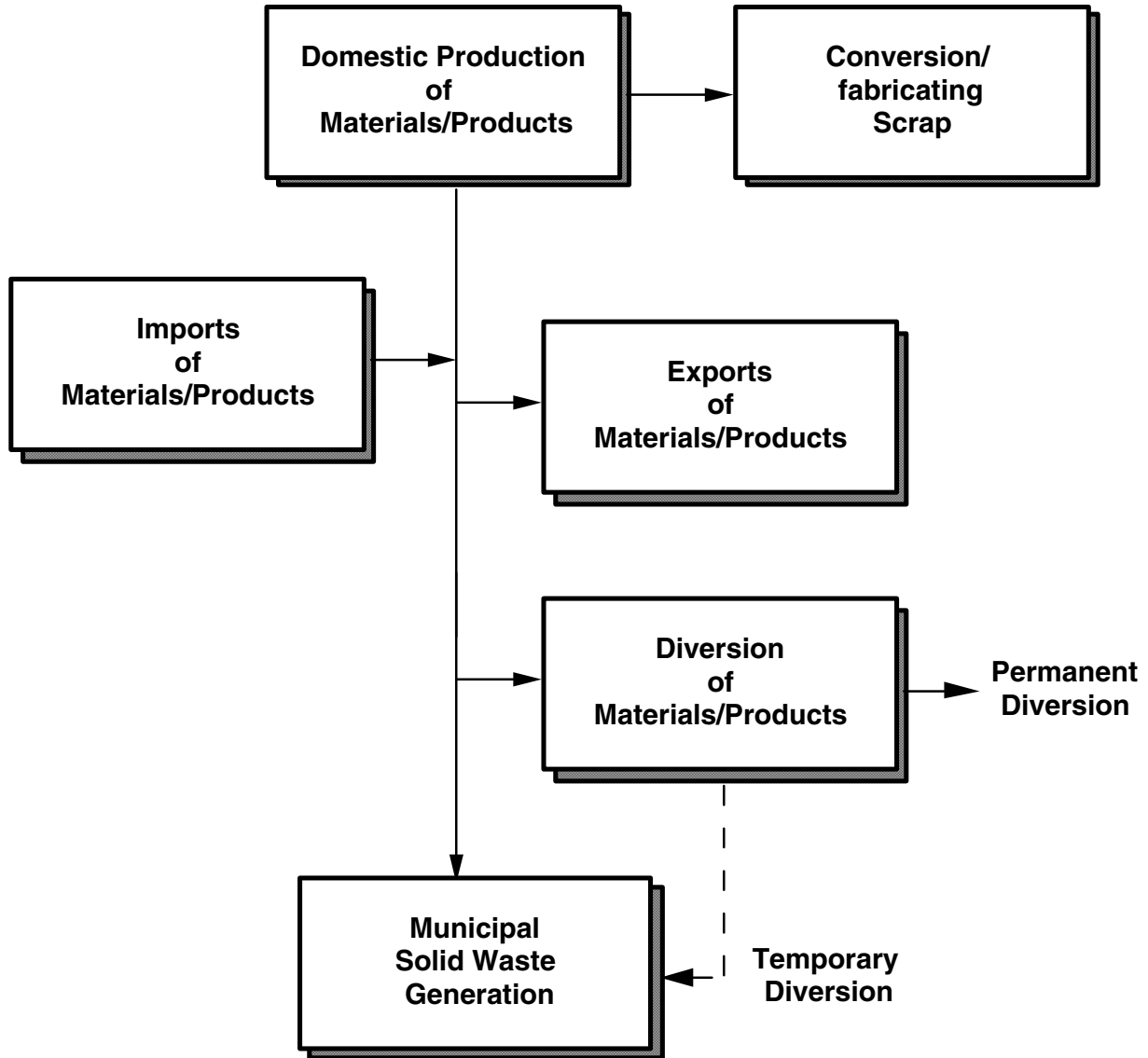


Figure A-1. Material flows methodology for estimating generation of products and materials in municipal solid waste.

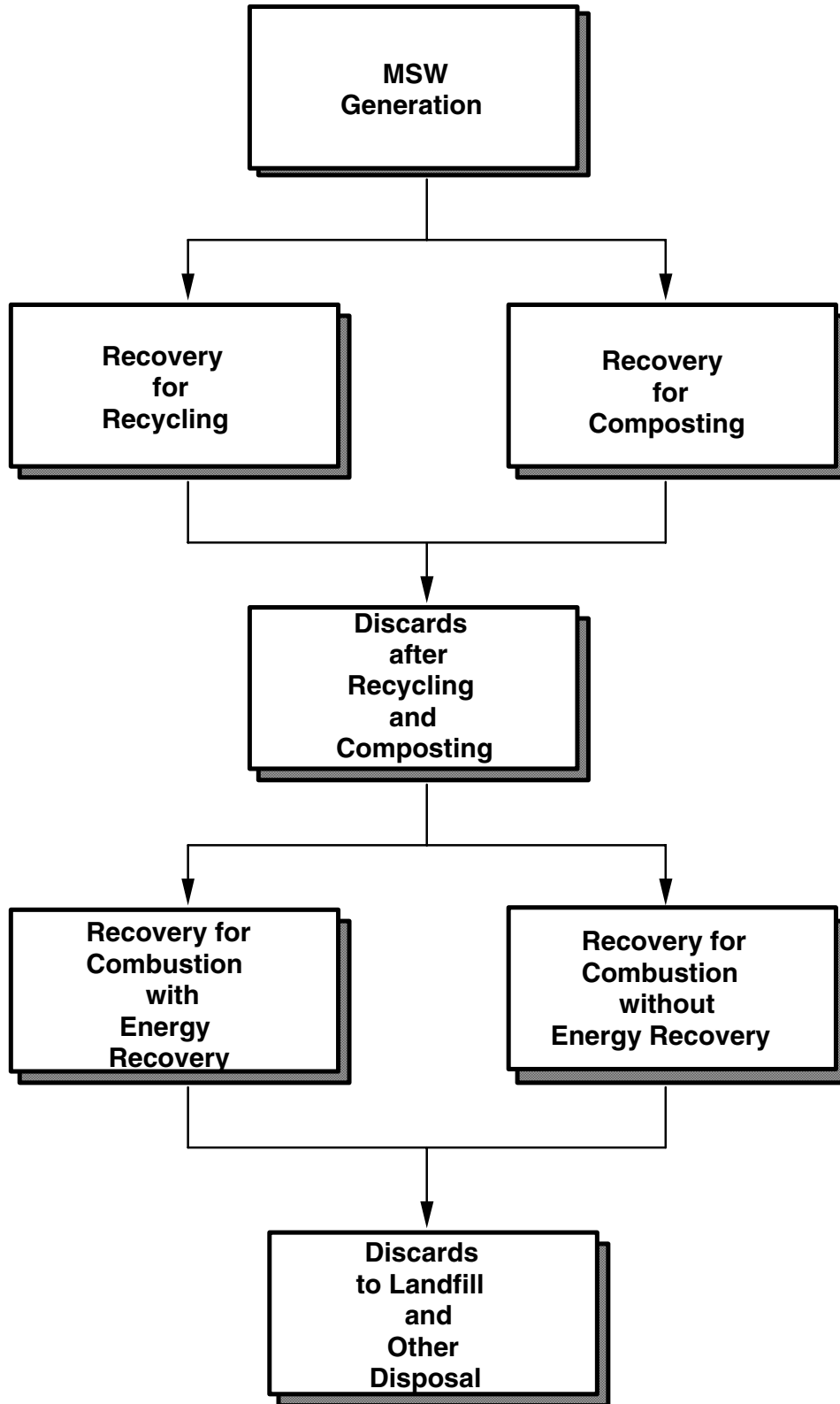


Figure A-2. Material flows methodology for estimating discards of products and materials in municipal solid waste.

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
	<i>(continued on next page)</i>

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)
<i>SR Subtotal</i>	11,315
<i>SE Subtotal</i>	(2,013)
<i>Net Value</i>	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
	<i>(continued on next page)</i>

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)
<i>SR Subtotal</i>	17,175
<i>SE Subtotal</i>	(1,657)
<i>Net Value</i>	15,518
	<i>(continued on next page)</i>

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

APPENDIX C

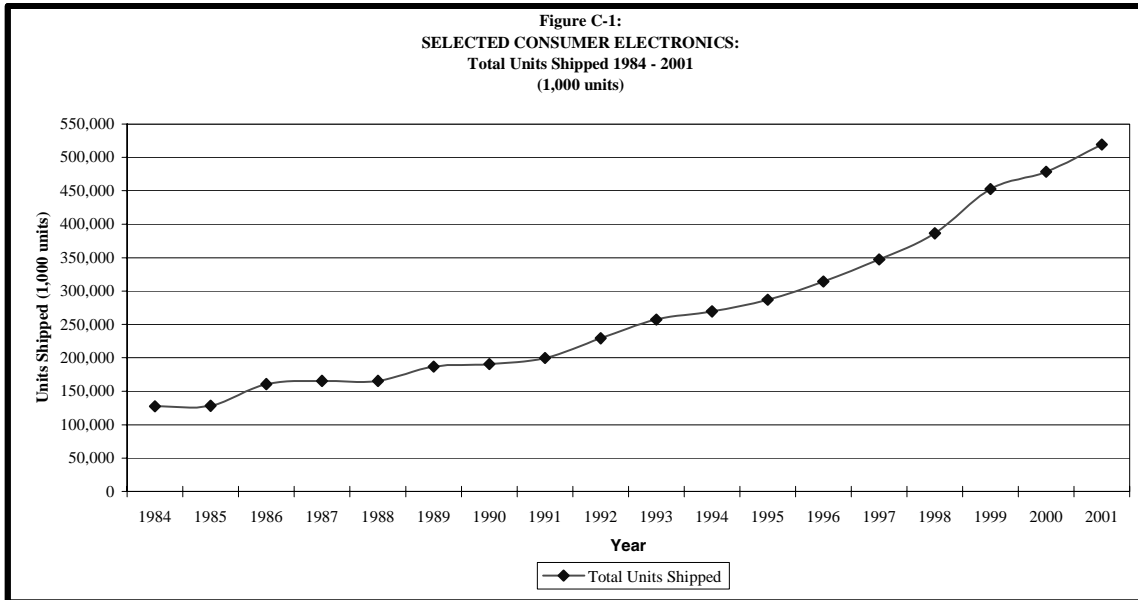
CONSUMER ELECTRONICS IN MUNICIPAL SOLID WASTE

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 three 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 2001 generation estimates are based on sales data provided by the Consumer Electronics Association (CEA), and the Appliance Statistical Review (Dana Chase Publications, Inc., May 2002) along with data from the United States 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 definition TV, liquid crystal display TV, VCR decks, camcorders, laserdisc players, digital versatile disc players, and TV/personal computers (PC).



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 2001. 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 520 million by 2001.

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 studio 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 2000. The methodology combines data from three sources: (1) The Consumer Electronics Association (CEA), and (2) the Appliance Statistical Review, and (3) the U.S. Department of Commerce trade data. CEA and the Appliance Statistical Review 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 2001.

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. 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.

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.

Factory sales through retail outlets for the years 1984 through 2000 were obtained from the Consumer Electronics Association and the Appliance Statistical Review. 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 Table 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 1991 to 1994. The average total weight of VCR shipments from 1991 to 1994 is computed. This average weight of VCRs manufactured between 1991 and 1994 is then multiplied by the number of VCRs shipped between the same years. This yields the generation of VCRs by weight, for 2000. 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 2000. Since consumer electronics sold in 2001 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, 1998, and 2000. 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 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.

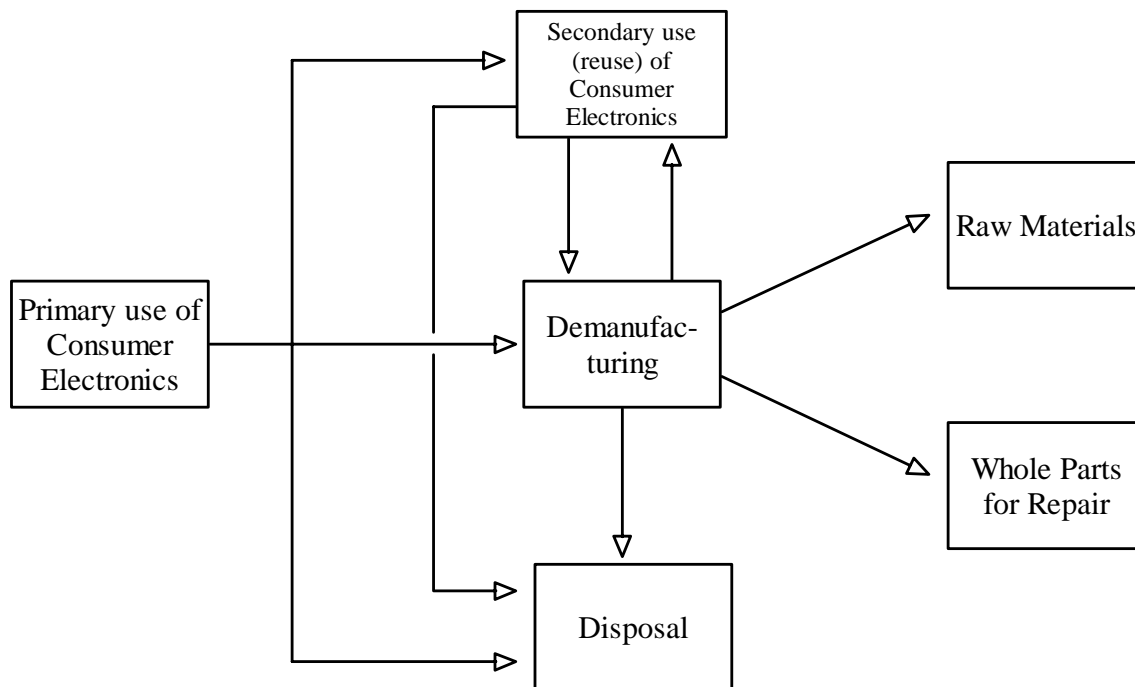
Information on composition for the selected consumer electronics includes products from several different years. Since the composition estimates were developed from recovery data, it was assumed that the data represent a mix of products from various years. Therefore, the composition for each specific 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 salvage 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 Plastics Council (APC), there are few large, homogenous streams of material that can be targeted for recovery through recycling⁹. 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



Although there has been a small 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 figures estimated in this analysis rely upon the information in the National Safety Council's *Electronic Product Recovery and Recycling Baseline Report* and *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 were

⁹ *Plastics from Residential Electronics Recycling*. A summary report from the Electrical and Electronics Group of the American Plastics Council. April 2000.

supplemented by personal communications with recyclers, demanufacturers, 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	Aluminum	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	28%	6%	4%	3%	5%	10%	0%	43%	2%
Total	24%	4%	2%	4%	11%	14%	8%	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 21 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 28 percent steel. Copper and brass, aluminum, lead, and other metals comprise 18 percent of information products. Plastic accounts for approximately 43 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 electronics is 24 percent steel, 4 percent copper and brass, 2 percent aluminum, 4 percent lead, 11 percent other metals, 14 percent glass, 8 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. Generation, recovery, and discards of each consumer electronic category are discussed below.

Table C-5

**GENERATION, RECOVERY, AND DISCARDS OF CONSUMER
ELECTRONICS IN THE MUNICIPAL WASTE STREAM 2001
(in tons)**

Type of Consumer Electronics	Total Generation	Total Recovery	% Recovered	Total Discards
Video Products	806,200	1,100	0.1%	805,100
Audio Products	377,900	0	Neg.	377,900
Information Products	1,076,300	204,500	19%	871,800
Total	2,260,400	205,600	9%	2,054,800

Source: Franklin Associates, Ltd.

Generation: In 2001, a total of 2,260,400 tons of consumer electronics were generated. This includes 806,200 tons of video products, 377,900 tons of audio products, and 1,076,300 tons of information products.

Recovery: As shown in Table C-5, an estimated 205,600 tons of consumer electronics were recovered in 2001. This includes 1,100 tons of video products and 204,500 tons of information products. Recovery of audio products is considered to be negligible.

Discards: Final discards of the three types of consumer electronics were 2,054,800 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. Table C-6 shows that generation of the selected consumer electronic products category is estimated at 14 percent of total miscellaneous durables generation, 23 percent of the recovery for recycling, and 14 percent of the discards.

Generation of selected consumer electronic products was estimated at about 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 potentially present a problem if mismanaged. 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, 2001
(1,000 TONS)

	Generation	Recovery	Recovery % of Generation	Discards
Selected Consumer Electronics	2,260	210	9%	2,050
Miscellaneous Durable Goods	13,330	710	5%	12,620
Total Miscellaneous Durable Goods	15,590	920	6%	14,670
Consumer Electronics as % of Misc. Durable Goods	14%	23%		14%
Total MSW	229,230	67,990	30%	161,240
Consumer Electronics as % of Total MSW	1.0%	0.3%		1.3%

Source: Franklin Associates, Ltd.

CURRENT RECOVERY PROGRAMS

Increasing numbers of city, county, and state agencies across the United States are considering options for consumer electronics collection and management. More and more are conducting 1-day consumer electronics collection events or providing 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 manufacturers¹⁰, has cooperated in a number of electronics collection and recycling pilot projects to evaluate different collection and recycling models. As of November 2002, led by EPA Region 3 and partner governments in the mid-Atlantic region, the *eCycling* partnership had collected more than 2,100 tons of electronics from residents in the mid-Atlantic states and prevented more than 21,000 CRTs from going into regional landfills and incinerators¹¹.

Some manufacturers allow both consumers and businesses to recycle any manufacturer's computer equipment for a fee. For more information on these services, www.eiae.org contains a listing of manufacturers' recycling programs. United Recycling Industries provides a computer recycling mail-in program for residents of seven Midwestern states¹².

Best Buy has held 2-day collection events in about 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 electronics¹³.

Some manufacturers are demonstrating 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.

The Northeast Recycling Coalition (NERC) identified 486 residential used electronics collection programs held in the United States during the last 3 years (1999 - 2001). These were located in 29 states and the District of Columbia. NERC performed a survey of 425 of these communities that had held electronics recycling events, either on a special event or an ongoing basis. They received a 41 percent response rate for this survey.

¹⁰ Electronics Industries Alliance, Canon, Hewlett Packard, JVC, Kodak, Nokia, Panasonic, Philips Electronics, Sharp, Sony and Thomson. Press release dated June 21, 2001. www.eiae.org.

¹¹ www.eia.org, www.epa.gov/epr

¹² www.unitedrecycling.com/takeback/main.html, December 2002.

¹³ www.e4partners.com, September 2001.

Of the 425 programs that responded to the survey, 280 (45 percent) were in Massachusetts. In addition, Minnesota was found to have 30 programs. Several states had between 10 and 29 programs (California, Illinois, Michigan, North Carolina, New Jersey, and New York), and 22 states had between one and nine programs, as of July 2001.

NERC found that there are three main types of electronics collection programs: ongoing collection programs, curbside collection programs, and special event collections. Of these, the most common type is ongoing collection programs—47 percent of communities with electronics programs use this mechanism. Curbside collection programs are used by 8 percent of the communities, and special event collection is the primary collection method for 45 percent of the communities. Special events took in the greatest amounts by weight on a per capita basis. Most of the programs include small businesses and municipal government in addition to residential customers.

Massachusetts has made reuse and recycling of electronics a clear priority. They have achieved this both through regulatory and voluntary means. On April 1, 2000, cathode ray tubes were banned from disposal in Massachusetts. NERC reports that Massachusetts also “deregulated cathode ray tubes as a hazardous waste if handled for recycling.” Over the last several years, the state of Massachusetts strongly supported electronics recycling initiatives through outreach and education. The state established a program so that any community in Massachusetts disposing of more than 200 pounds of electronic equipment could contract with one of two vendors to handle these materials through reuse or recycling. The state of Massachusetts coordinated with the Salvation Army, Goodwill, industry, and local governments. They used technical assistance and grants to help communities to establish CRT recycling programs. The NERC report states, “By July 2001, 75 percent of all Massachusetts communities offered used electronics recycling programs, and 91 percent of Massachusetts residents live in those communities.” More information on these efforts can be found at www.nerc.org.

California has also banned disposal of CRTs in landfills. In 2003, California passed legislation to place a fee on purchases of certain new electronic products containing CRTs.

These fees will go toward funding of CRT recycling programs in the state. Legislation continues to be considered in other states, aimed at finding ways to encourage recycling of electronic waste.

EPA has launched a “Plug-In To Recycling” education campaign (www.epa.gov/epaoswer/osw/conserved/plugin/index.htm) aimed at increasing the safe reuse and recycling of consumer electronics. This effort is intended to raise Americans’ awareness about the need to recycle old electronics and to motivate them to act on this new information. It is also aimed at motivating manufacturers, retailers, recyclers, and government to share in the responsibility of providing Americans with safe, convenient options. It is one of the many projects that EPA is championing to positively impact the environmental aspects of the electronics industry. EPA has a series of projects underway to increase the recycling of electronics now and to work with key stakeholders to ensure that electronics products are designed with fewer toxics, greater energy efficiency, and more resource conservation in mind.

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