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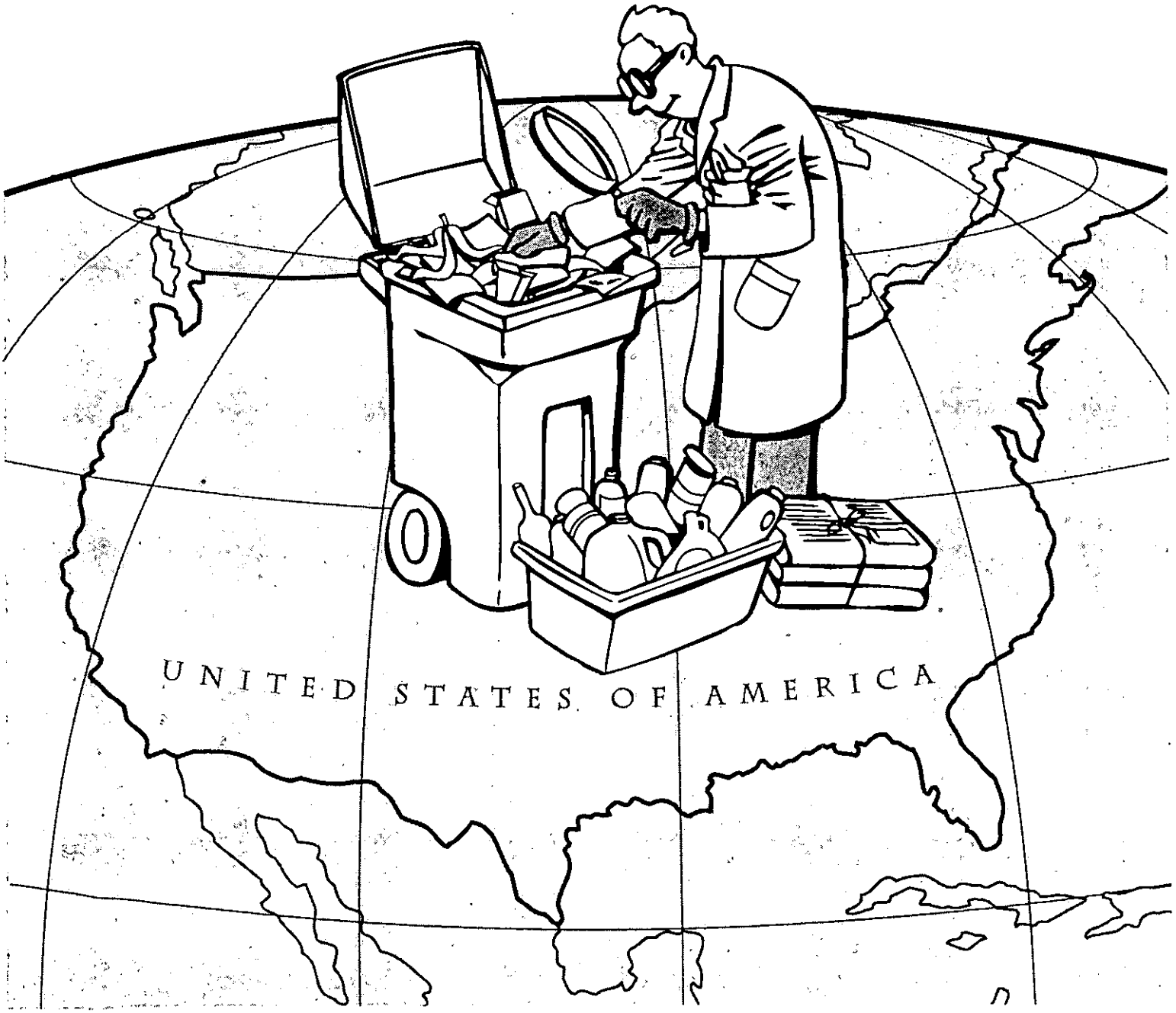
# Characterization of Municipal Solid Waste in The United States: 1996 Update



# CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES

## 1996 UPDATE

Prepared for

U.S. Environmental Protection Agency
Municipal and Industrial Solid Waste Division
Office of Solid Waste
Report No. EPA530-R-97-015

by

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June 1997

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# CHARACTERIZATION OF MUNICIPAL SOLID WASTE IN THE UNITED STATES: 1996 UPDATE

## Executive Summary

## FEATURES OF THIS REPORT

This report is the latest in a series of reports published by the U.S. Environmental Protection Agency (EPA) describing the national municipal solid waste (MSW) stream. The report characterizes the national solid waste stream for the previous calendar year based on data collected from 1960 through 1995. It also discusses trends and highlights changes that have occurred over the years, both in the types of wastes generated and in the ways they are managed. Although the report does not specifically address local and regional variations in the waste stream, the data in the report can be used to develop approximate estimates of MSW generation and composition in defined areas.

This report includes information on:

- Total MSW generation, recovery, and discards from 1960 to 1995.
- Per capita generation and discard rates.
- Materials (e.g., paper, glass, metals, plastic) that comprise MSW, as well as products (e.g., durable and nondurable goods, containers, packaging) found in the waste stream.
- Aggregate data on the infrastructure for MSW management, including estimates of the number of curbside recycling programs, drop-off centers, and materials recovery facilities in the United States.
- Trends in MSW management from 1960 to 1995, including examples of source reduction of specific products, selected materials reuse programs, recovery for recycling (including composting), and disposal via combustion and landfilling.
- Projections for MSW generation and management through 2010, including three scenarios of conditions that could achieve targeted recovery rates.

## REPORT HIGHLIGHTS

### 1995 MSW Generation and Management:

- A total of 208 million tons of MSW was generated in 1995. This reflects a decrease of more than 1 million tons from 1994, when MSW generation was over 209 million tons.

- The per capita generation rate in 1995 was 4.3 pounds per person per day, compared to 4.4 pounds per person per day in 1994.

- The per capita discard rate (after recovery for recycling, including composting) was 3.2 pounds per person per day in 1995, down from 3.3 pounds per person per day in 1994.

- Recycling (including composting) recovered 27 percent (56 million tons) of MSW in 1995, up from 25 percent (52 million tons) in 1994.

- There were over 7,000 curbside recycling programs in the United States in 1995, as well as nearly 9,000 drop-off centers for recyclables. More than 300 materials recovery facilities helped process the recyclables collected.

- Recovery of paper and paperboard reached 40 percent (33 million tons) in 1995, accounting for more than half of the total MSW recovered. In addition, more than 9 million tons of yard trimmings were recovered for composting in 1995, accounting for the second largest fraction of total recovery. The percentage of yard trimmings composted (30 percent) has doubled since 1992.

- Landfills managed 57 percent of MSW generated (118 million tons), down from 60 percent in 1994. Combustion facilities managed 16 percent (33.5 million tons) of the total MSW generated, slightly more than the 15 percent managed in 1994.

**Trends in MSW Generation and Management:**

- Per capita MSW generation is expected to remain relatively stable through the year 2000. This rate will remain steady because even though the per capita generation of certain MSW components will continue to rise, source reduction efforts are beginning to have an effect.

- Generation of yard trimmings is projected to decline from 29.8 million tons in 1995 to 27.1 million tons in 2000. This decline is due to the effect of source reduction efforts, such as grasscycling and backyard composting, spurred, in part, by legislation passed by many states banning yard trimmings from landfills or charging residents separately for pickup.

- Generation rates for paper and paperboard, plastics, and wood are all projected to increase faster than population until 2010, while generation rates for glass, metals, and food wastes are projected to increase at about the same rate as population growth.

- Annual generation of MSW is projected to increase to 222 million tons by the year 2000 and 253 million tons in 2010. Containers and packaging are expected to remain the largest category of products in MSW, at 36 percent of total generation by 2000 and 38 percent by 2010. Nondurables will remain the second largest category at 28 percent of total MSW generation by 2000 and 29 percent by 2010.

- For the year 2000, possible recovery scenarios are presented for 30 and 35 percent recovery levels. Possible recovery scenarios between 30 and 40 percent are made for the year 2010.

- Combustion is expected to remain relatively unchanged, managing about 16 percent of the total MSW generated by the year 2000 (36 million tons) and 15 percent by 2010 (39 million tons).

- While the percentage of total MSW being disposed of in landfills is decreasing, the actual tonnage is expected to increase to 119 million tons by 2000, and 125 million tons by 2010. Landfilling is expected to continue to be the single most predominant MSW management method in future years.

## DEFINITIONS AND METHODOLOGY

**Municipal solid waste ( MSW)** includes wastes such as durable goods, nondurable goods, containers and packaging, food scraps, yard trimmings, and miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources. Examples of waste from these categories include appliances, automobile tires, newspapers, clothing, boxes, disposable tableware, office and classroom paper, wood pallets, and cafeteria wastes. MSW does not include wastes from other sources, such as construction and demolition debris, automobile bodies, municipal sludges, combustion ash, and industrial process wastes that might also be disposed in municipal waste landfills or incinerators.

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

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

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

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

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

◆ ◆ ◆

**Methodology.** There are two primary methods for conducting a waste characterization study. The first is a source-specific approach in which the individual components of the waste stream are sampled, sorted, and weighed. Although this method is useful for defining a local waste stream, extrapolating from a limited number of studies can produce a skewed or misleading picture if used for a nationwide characterization of waste. Atypical circumstances encountered during sampling or errors in the sample would be greatly magnified when expanded to represent the nation's entire waste stream. The second method, which is used in this report, is called the "material flows methodology." EPA's Office of Solid Waste and its predecessors in the Public Health Service sponsored work in the 1960s and early 1970s to develop the material flows methodology. This methodology is based on production data (by weight) for the materials and products in the waste stream, with adjustments for imports, exports, and product lifetimes.

Note that when the report is updated, there are numerical discrepancies in waste generation, recovery, and discards from previous editions. These differences are due to revised estimates from source data (e.g., industry associations and federal agencies) made to the MSW characterization database.

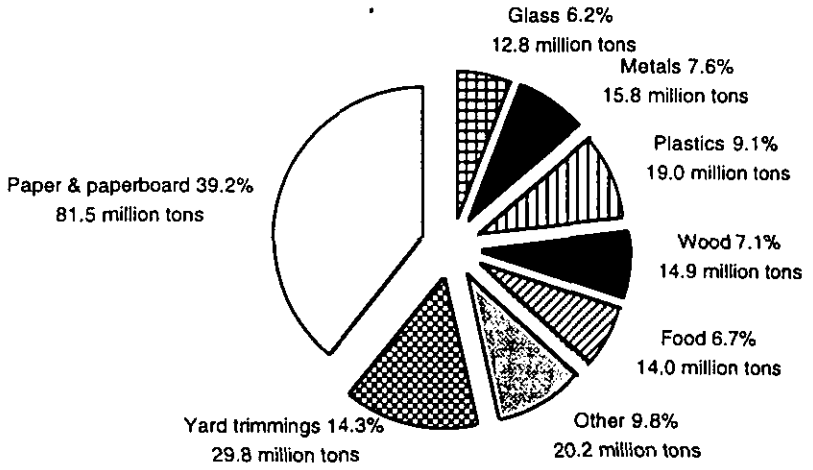
## MUNICIPAL SOLID WASTE IN 1995

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

### Materials in MSW

In 1995, MSW generation totaled 208 million tons. Figure ES-1 provides a breakdown, by weight, of the MSW materials generated in 1995. Paper and paperboard products made up the largest component of MSW generated (39 percent), and yard trimmings comprised the second largest material component (14 percent). Glass, metals, plastics, wood, and food wastes each constituted

**Figure ES-1. Materials generated in MSW by weight, 1995 (Total weight = 208.0 million tons)**



between 6 and 10 percent of the total MSW generated. Other materials in MSW, such as rubber, leather, textiles, and miscellaneous wastes, made up approximately 10 percent of the MSW generated in 1995.

A portion of each material category in MSW was recycled (including being composted) in 1995, as illustrated in Table ES-1. It should be noted, however, that recovery rates for some products within a material category are higher than the overall recovery rate for the material category, because some products are not

**Table ES-1**

**GENERATION AND RECOVERY OF MATERIALS IN MSW, 1995**
**(In millions of tons and percent of generation of each material)**

| | Weight Generated | Weight Recovered | Recovery as a Percent of Generation |
|---|---|---|---|
| Paper and paperboard | 81.5 | 32.6 | 40.0% |
| Glass | 12.8 | 3.1 | 24.5% |
| Metals | | | |
| Ferrous metals | 11.6 | 4.2 | 36.5% |
| Aluminum | 3.0 | 1.0 | 34.5% |
| Other nonferrous metals | 1.3 | 0.9 | 69.4% |
| *Total metals* | 15.8 | 6.2 | 38.9% |
| Plastics | 19.0 | 1.0 | 5.2% |
| Rubber and Leather | 6.0 | 0.5 | 8.9% |
| Textiles | 7.4 | 0.9 | 12.2% |
| Wood | 14.9 | 1.4 | 9.6% |
| Other materials | 3.6 | 0.8 | 23.1% |
| ***Total Materials in Products*** | 161.1 | 46.6 | 28.9% |
| Other Wastes | | | |
| Food Wastes | 14.0 | 0.6 | 4.1% |
| Yard Trimmings | 29.8 | 9.0 | 30.3% |
| Miscellaneous Inorganic Wastes | 3.2 | Neg. | Neg. |
| ***Total Other Wastes*** | 46.9 | 9.6 | 20.4% |
| ***TOTAL MUNICIPAL SOLID WASTE*** | 208.0 | 56.2 | 27.0% |

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

recovered at all. For example, aluminum cans are recovered at rates above 60 percent, but the overall recovery rate for aluminum is only 35 percent. Likewise, even though corrugated containers are recovered at rates above 64 percent, the overall recovery rate for paper and paperboard is 40 percent.

## Products in MSW

Figure ES-2 shows the breakdown, by weight, of MSW products generated in 1995. Containers and packaging comprised the largest portion of products generated, at 35 percent (73 million tons) of total MSW generation. Nondurable goods were the second largest fraction, comprising about 27 percent (57 million tons). The third main category of products is durable goods, which comprised 15 percent (31 million tons) of total MSW generation.

**Figure ES-2. Products generated in MSW by weight, 1995**
**(Total weight = 208.0 million tons)**

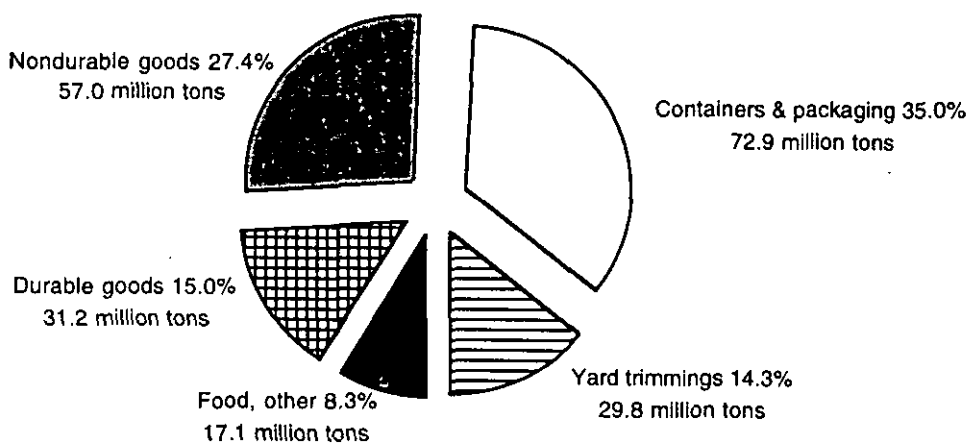



Table ES-2 shows the generation and recovery of the product categories in MSW. Recovery of **containers and packaging** was the highest of the three product categories—38 percent of containers and packaging generated in 1995 were recovered for recycling. About 52 percent of aluminum packaging was recovered (mostly aluminum beverage cans), while more than 54 percent of steel

**Table ES-2**

**GENERATION AND RECOVERY OF PRODUCTS IN MSW BY MATERIAL, 1995**

**(In millions of tons and percent of generation of each product)**

| | Weight Generated | Weight Recovered | Recovery as a Percent of Generation |
|---|---|---|---|
| **Durable goods** | | | |
| Ferrous metals | 8.7 | 2.7 | 30.7% |
| Aluminum | 0.8 | Neg. | Neg. |
| Other non-ferrous metals | 1.3 | 0.9 | 69.4% |
| *Total metals* | 10.8 | 3.6 | 33.1% |
| Glass | 1.3 | Neg. | Neg. |
| Plastics | 6.2 | 0.2 | 3.8% |
| Rubber and leather | 5.2 | 0.5 | 10.3% |
| Wood | 4.2 | Neg. | Neg. |
| Textiles | 2.3 | 0.1 | 5.0% |
| Other materials | 1.1 | 0.8 | 77.8% |
| *Total durable goods* | 31.2 | 5.3 | 17.0% |
| **Nondurable goods** | | | |
| Paper and paperboard | 43.5 | 12.7 | 29.3% |
| Plastics | 5.1 | Neg. | <1% |
| Rubber and leather | 0.8 | Neg. | Neg. |
| Textiles | 5.0 | 0.8 | 15.8% |
| Other materials | 2.7 | Neg. | Neg. |
| *Total nondurable goods* | 57.0 | 13.5 | 23.7% |
| **Containers and packaging** | | | |
| Steel | 2.8 | 1.6 | 54.6% |
| Aluminum | 2.0 | 1.0 | 51.6% |
| *Total metals* | 4.8 | 2.6 | 53.4% |
| Glass | 11.5 | 3.1 | 27.3% |
| Paper and paperboard | 38.1 | 19.9 | 52.3% |
| Plastics | 7.7 | 0.7 | 9.7% |
| Wood | 10.6 | 1.4 | 13.5% |
| Other materials | 0.1 | Neg. | Neg. |
| *Total containers and packaging* | 72.9 | 27.8 | 38.1% |
| **Other wastes** | | | |
| Food wastes | 14.0 | 0.6 | 4.1% |
| Yard trimmings | 29.8 | 9.0 | 30.3% |
| Miscellaneous inorganic wastes | 3.2 | Neg. | Neg. |
| *Total other wastes* | 46.9 | 9.6 | 20.4% |
| *TOTAL MUNICIPAL SOLID WASTE* | 208.0 | 56.2 | 27.0% |

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

packaging (mostly cans) was recovered. Paper and paperboard packaging recovery was estimated at 52 percent; corrugated containers accounted for most of that figure. Approximately 27 percent of glass containers were recovered overall, while about 14 percent of wood packaging (mostly pallets) was recovered. About 10 percent of plastic containers and packaging was recovered in 1995, most of which was made up of soft drink, milk, and water bottles.

Overall recovery of **nondurable goods** was almost 24 percent in 1995. Newspapers constituted the largest portion of this recovery, with 53 percent of newspapers generated being recovered for recycling. Office papers and magazines were also recovered in significant quantities in 1995, at 44 percent and 28 percent, respectively. Over 16 percent of clothing and other textile nondurable products also were recovered for recycling.

Overall, **durable goods** were recovered at a rate of 17 percent in 1995, up from 15 percent in 1994. Nonferrous metals had one of the highest recovery rates, at 70 percent, due to the high rate of lead recovery from lead-acid batteries. Nearly 31 percent of ferrous metals were recovered from appliances and miscellaneous durable goods. Excluding retreads and tire derived fuel use, over 17 percent of tires also were recovered for recycling.

**Residential and Commercial Sources of MSW**

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

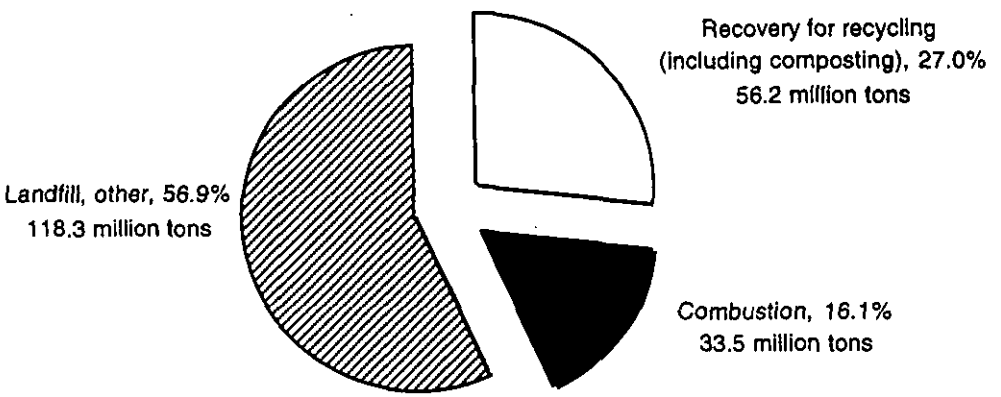
## MANAGEMENT OF MSW

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

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

Figure ES-3 shows how much MSW was recovered for recycling (including composting) and how much was disposed of by combustion and landfilling in 1995. Approximately 27 percent (56 million tons) of MSW was recycled and composted; an estimated 16 percent (33 million tons) was combusted (nearly all with energy recovery); and the remainder, 57 percent (118 million tons), was landfilled (small amounts may have been littered or self-disposed).

**Figure ES-3. Management of MSW in U.S., 1995**
**(Total weight = 208.0 million tons)**



## Source Reduction

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

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

Although product source reduction activities are not quantified at the national level in this report, the report includes several case studies that illustrate the impact of source reduction on different product categories. For example, newspaper publishers have reduced the weight of their newsprint from 93 pages per pound in 1985 to 118 pages per pound in 1995. Efforts to reuse electronics, durable goods, textiles, and pallets have also been successful. Numerous businesses exist nationwide, for example, that upgrade and repair computers, and use their valuable components to rebuild other electronic items.

## Recovery

Recovery for recycling (including composting) continues to be one of the most effective waste management techniques. In 1995, approximately 46 percent of the U.S. population (121 million people) had access to the nation's 7,000 curbside recycling programs. Most of these programs (40 percent) were in the

Midwest, although the Northeast had the largest population served. In addition, nearly 9,000 drop-off centers for recyclables were reported in 35 states in 1995.

More than 300 materials recovery facilities helped process the recyclables collected in 1995. An estimated 3,300 yard trimmings composting programs (not backyard composting) existed in 1995, the majority of which were in the Northeast and Midwest.

**Combustion**

Most MSW combustion in the United States involves the recovery of an energy product (generally steam or electricity). Total MSW combustion with energy recovery, referred to as waste-to-energy combustion, currently has a design capacity of 99,000 tons per day. There were 112 waste-to-energy combustion facilities in the United States in 1995: One-third of these were located in the Northeast, accounting for 60 percent of the total design capacity.

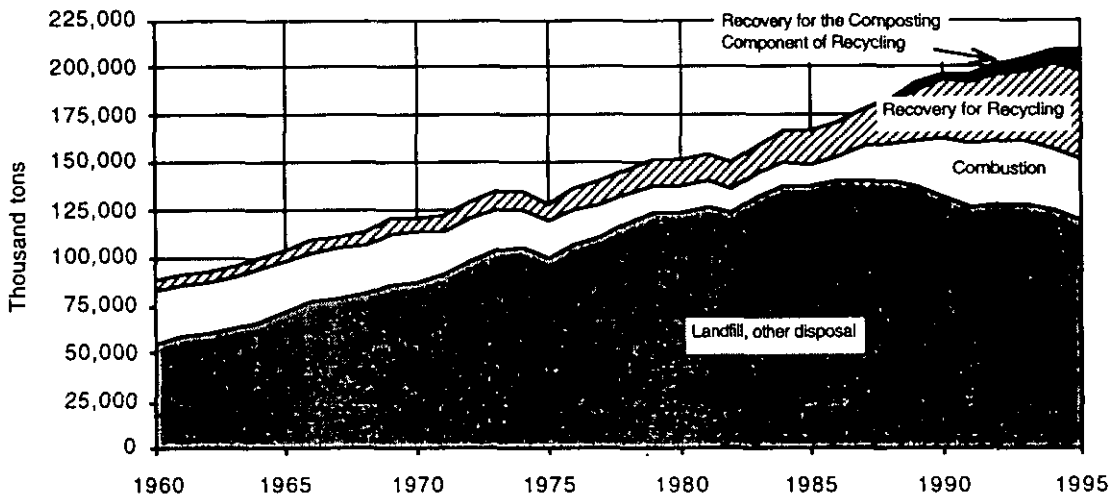
**Landfilling**

Although the number of landfills in the United States is decreasing, landfill capacity has remained relatively constant. In 1995, more than 2,500 landfills existed in the United States, with the Southeast and West having the greatest number of landfills. Excluding Alaska and Hawaii, thirty-seven states have landfills reporting more than 10 years of capacity remaining. Only two states report having less than 5 years of capacity left.

**Trends in MSW Management**

MSW generation has grown steadily from 88 million tons in 1960 to 208 million tons in 1995 (Figure ES-4). In the 1960s and early 1970s, a large percentage of MSW was burned. Through the mid-1980s, incineration declined considerably and landfills became more difficult to site. MSW generation continued to rise, however, while materials recovery rates increased slowly. As a result, the burden on the nation's landfills grew dramatically. As recovery rates increased in the late 1980s and early 1990s—and combustion stayed constant—discards to landfills have steadily decreased.

**Figure ES-4. Municipal Solid Waste Management, 1960 to 1995**




The report presents projections for MSW generation and management through 2010, including possible scenarios for recovery. The MSW generation projections are based on historical trends in combination with expected population and subsequent economic growth. For the year 2000, possible recovery scenarios are presented for 30 and 35 percent recovery levels. Possible recovery scenarios between 30 and 40 percent are made for the year 2010.

To achieve these increased levels of recovery, EPA assumed that local, state, and federal agencies would continue to emphasize recycling (including composting) as a priority; that industries would continue to make the necessary investments in recovery and utilization of materials; that sufficient end-user capacity would be available for most recovered materials; that state and local governments would continue to expand programs designed to keep yard trimmings out of landfills; and that most U.S. citizens would continue to have access to some sort of recovery program and that they would be willing to participate.

# Chapter 1

# INTRODUCTION AND METHODOLOGY

## BACKGROUND

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 35-year characterization (by weight) of the materials and products in MSW, with projections through the year 2010.

Management of the nation's municipal solid waste (MSW) continues to be a high priority issue for many communities as we near the turn of the century. Increasingly, 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.

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.

Identifying the components of the waste stream is an important step toward addressing the issues associated with the generation and management of municipal solid wastes. MSW characterizations, which analyze the quantity and composition of the municipal solid waste stream, involve estimating how much MSW is generated, recycled (including composting), combusted, and disposed of in landfills. By determining the makeup of the waste stream, waste characterizations also provide valuable data for setting waste management goals, tracking progress toward those goals, and supporting planning at the national, state, and local levels. For example, waste characterizations can be used to highlight opportunities for source reduction and recycling and provide information on any special management issues that should be considered.

Readers should note that this report characterizes the municipal solid waste stream of *the nation as a whole.* Local and regional variations are not addressed, but suggestions for use of the information in this report by local planners are included in this chapter.

## HOW THIS REPORT CAN BE USED

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 report is, however, of equal or greater value as a solid waste management planning tool for state and local governments and private firms.

A common error in using this report is to assume that *all* nonhazardous wastes are included. As shown later in this chapter, municipal solid waste as defined here does *not* include construction and demolition wastes, industrial process wastes, or a number of other wastes that may well go to a municipal waste landfill.

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 possible reasons for these differences, for example:

- Scope of waste streams may differ. That is, a local landfill may be receiving construction and demolition wastes in addition to MSW, but this report addresses MSW only.

- Per capita generation of some products, such as newspapers and telephone directories, varies widely 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.

- The level of commercial activity in a community will influence the generation rate of some products, such as office paper, corrugated boxes, wood pallets, and food wastes from restaurants.

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

- Variations in climate and local waste management practices will 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.

- Generation and discards of other products will be affected by 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 can reasonably be expected to have typical/average 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 the following ways for local planning:

- to develop approximate estimates of total MSW generation in an area

- to check locally developed MSW data for accuracy and consistency

- to help estimate quantities of recyclables and other MSW components in an area

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

## MUNICIPAL SOLID WASTE IN PERSPECTIVE

### Municipal Solid Waste Defined

Municipal solid waste includes durable goods, nondurable goods, containers and packaging, food wastes and yard trimmings, and miscellaneous inorganic wastes (Figure 1). Municipal solid wastes characterized in this report come from residential, commercial, institutional, and industrial sources. Some examples of the types of MSW that come from each of the broad categories of sources are:

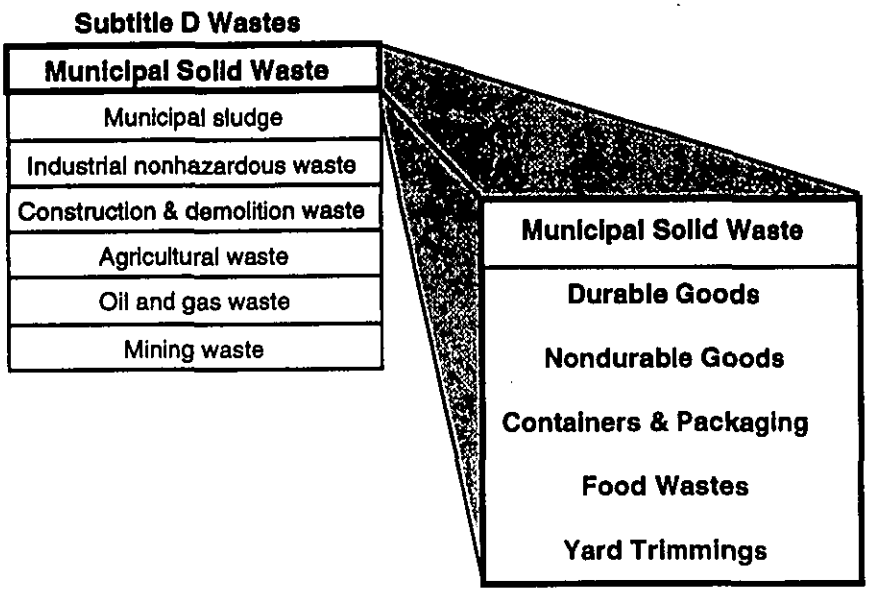
| Sources and Examples | Example Products |
|---|---|
| Residential (single- and multi-family homes) | Newspapers, clothing, disposable tableware, food packaging, cans and bottles, food scraps, yard trimmings |
| Commercial (office buildings, retail and wholesale establishments, restaurants) | Corrugated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

The material flows methodology used in this report does not readily lend itself to 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 sludge, nonhazardous industrial wastes, residue from automobile salvage operations, and construction and demolition wastes along

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




with MSW, but these other kinds of wastes *are not included in the estimates presented in this report.*

## The Solid Waste Management Hierarchy

EPA's 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.

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

## METHODOLOGIES FOR CHARACTERIZING MUNICIPAL SOLID WASTE

### The Two Methodologies

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

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

The second approach to quantifying and characterizing the municipal solid waste stream—the method used for this report—utilizes a material flows approach to estimate the waste stream on a nationwide basis. In the late 1960s and early 1970s, EPA's Office of Solid Waste and its predecessors at the Public Health Service sponsored work that began to develop this methodology. This report represents the latest version of this database that has been evolving for over 20 years.

The material flows methodology is based on production data (by weight) for the materials and products in the waste stream. Generation data is the result of making specific adjustments 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). 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 material flows methodology is that product residues associated with other items in MSW (usually containers) are not accounted for. These residues would include, for example, food left in a jar, detergent left in a box or bottle, dried paint in a can, etc. Some household hazardous wastes, e.g., pesticide left in a can, are also included among these product residues.

**Definition of Terms**

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

The term ***generation*** as used in this report refers to the weight of materials and products as they enter the waste management system from residential, commercial, institutional, and industrial sources and before materials recovery or combustion takes place. Preconsumer (industrial) scrap is not included in the generation estimates. Source reduction activities (e.g., backyard composting of yard trimmings) take place *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. Thus, recovery of old corrugated containers (OCC) is the sum of OCC purchases by paper mills plus net exports of OCC. If recovery as reported by a data source includes converting or fabrication (preconsumer) scrap, the preconsumer scrap is *not* counted towards the 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 is called incineration in this report. Combustion of separated materials—wood, rubber from tires, paper, and plastics—is included in the estimates of combustion in this report.

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

## PROJECTIONS

The projections of MSW generation to the year 2010 were not based on total quantities, but were aggregated from separate projections for each product and material. The projections are based on trend analysis of the 35-year historical database developed for each product (including trends in per person generation), from information in other government and private sources, and, in some cases, best professional judgment. In the case of paper products, the relationship with real Gross Domestic Product was taken into account.

Based on correlations of MSW generation with population and Gross Domestic Product (GDP), the projections for most products were kept higher than projected population growth but lower than projected GDP growth. (See Chapter 5 of EPA report 530-R-94-042, ***Characterization of Municipal Solid Waste in the United States: 1994 Update***, for an explanation of the correlation of MSW generation with these demographic and economic factors.)

It should be emphasized that projections are not predictions. Projections are based on an assumption that there will be no unforeseen changes in current trends. Thus, the economy is assumed to remain stable and population trends

are assumed to be as projected by the Bureau of the Census. Additional discussions of projection assumptions are included in Chapter 4.

## OVERVIEW OF THIS REPORT

Following this introductory chapter, Chapter 2 presents the results of the municipal solid waste characterization (by weight). Estimates of MSW generation, recovery, and discards are presented in a series of tables, with discussion. Detailed tables and figures summarizing 1995 MSW generation, recovery, and discards of products in each material category are included.

In Chapter 3 of the report, estimates of 1995 MSW management by the various alternatives are summarized. These include recovery for recycling (including composting), combustion, and landfilling. A discussion of source reduction is also included in Chapter 3. In a new feature, "snapshot" summaries of the infrastructure available for each waste management alternative are included in Chapter 3.

Projections of municipal solid waste generation and management to the year 2010 are included in Chapter 4. Projections are made by material and by product. A discussion of assumptions and trends is included. In addition, there is a discussion of the potential effects of source reduction in this chapter.

## Chapter 1

## REFERENCES


Darnay, A., and W.E. Franklin, ***The Role of Packaging in Solid Waste Management, 1966 to 1976.*** Public Health Service Publication No. 1855. U.S. Government Printing Office. 1969.

Franklin, W.E., and A. Darnay. ***The Role of Nonpackaging Paper in Solid Waste Management, 1966 to 1976.*** Public Health Service Publication No. 2040. U.S. Government Printing Office. 1971.

Darnay, A., and W.E. Franklin. ***Salvage Markets for Materials in Solid Wastes.*** Environmental Protection Publication SW-29c. U.S. Government Printing Office. 1972.

Franklin, W.E., et al. ***Base Line Forecasts of Resource Recovery 1972 to 1990.*** Midwest Research Institute for the U.S. Environmental Protection Agency. March 1975.

U.S. Environmental Protection Agency, Office of Solid Waste Management Programs. ***Second Report to Congress: Resource Recovery and Source Reduction*** (SW-122). 1974.

Smith, F.L., Jr. ***A Solid Waste Estimation Procedure: Material Flows Approach.*** U.S. Environmental Protection Agency (SW-147). May 1975.

U.S. Environmental Protection Agency, Office of Solid Waste Management Programs. ***Third Report to Congress: Resource Recovery and Source Reduction*** (SW-161). 1975.

U.S. Environmental Protection Agency, Office of Solid Waste Management Programs. ***Fourth Report to Congress: Resource Recovery and Waste Reduction*** (SW-600). 1977.

Franklin Associates, Ltd. ***Post-consumer Solid Waste and Resource Recovery Baseline.*** Prepared for the Resource Conservation Committee. May 16, 1979.

Franklin Associates, Ltd. ***Post-consumer Solid Waste and Resource Recovery Baseline: Working Papers.*** Prepared for the Resource Conservation Committee. May 16, 1979.

Resource Conservation Committee. ***Choices for Conservation: Final Report to the President and Congress*** (SW-779). July 1979.

Franklin Associates, Ltd. ***Characterization of Municipal Solid Waste in the United States, 1960 to 2000.*** U.S. Environmental Protection Agency. July 11, 1986.

Franklin Associates, Ltd. ***Characterization of Municipal Solid Waste in the United States, 1960 to 2000 (Update 1988).*** U.S. Environmental Protection Agency. March 30, 1988.

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

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1992 Update.*** (EPA/530-R-92-019). July 1992.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1994 Update.*** EPA/530-R-94-042. November 1994.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1995 Update.*** EPA/530-R-945-001. March 1996.

U.S. Environmental Protection Agency, Municipal Solid Waste Task Force, Office of Solid Waste. ***The Solid Waste Dilemma: An Agenda for Action.*** February 1989.

U.S. Environmental Protection Agency, Office of Solid Waste. ***Subtitle D Study Phase I Report*** (EPA/530-SW-054). October 1986.

## Chapter 2

# CHARACTERIZATION OF MUNICIPAL SOLID WASTE BY WEIGHT

## INTRODUCTION

The tables and figures in this chapter present the results of the update of EPA's municipal solid waste characterization study through 1995. The data presented also incorporate revisions to previously reported data for 1994 and, in some instances, to data for earlier years. The revisions are generally due to revisions in the various source data series used to prepare this report.

The findings are presented in two ways: a breakdown of municipal solid waste (MSW) by material, and a breakdown by product (both by weight and by percentage of generation or discards). While some products, for example, paper towels, are made up of a single material—paper—other products, for example, rubber tires, contain more than one material, such as rubber, ferrous metals, and textiles. Thus the materials summary tables represent an aggregation of the materials that go into all the products in MSW. (Note that the totals for the materials and the products tables are the same.)

The summary tables and figures provide information on generation of each material and product, and recovery for recycling (including composting, if any). Tables and figures displaying discards of materials and products after recovery for recycling (including composting) follow.

Recovery 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 exported. 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 (a MRF) or other waste processing facility are counted as generation, 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: paper, glass, metals, plastics, and rubber and leather.

## MATERIALS IN MUNICIPAL SOLID WASTE

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

**Table 1**

**MATERIALS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1995**

**(In thousands of tons and percent of total generation)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Materials** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| Paper and Paperboard | 29,990 | 44,310 | 55,160 | 72,720 | 70,990 | 74,260 | 77,430 | 80,840 | 81,540 |
| Glass | 6,720 | 12,740 | 15,130 | 13,110 | 12,590 | 13,130 | 13,620 | 13,350 | 12,830 |
| Metals | | | | | | | | | |
| *Ferrous* | 10,300 | 12,360 | 12,620 | 12,640 | 12,660 | 12,080 | 11,920 | 11,780 | 11,590 |
| Aluminum | 340 | 800 | 1,730 | 2,810 | 2,840 | 2,870 | 2,930 | 3,040 | 2,950 |
| Other Nonferrous | 180 | 670 | 1,160 | 1,100 | 1,130 | 1,120 | 1,110 | 1,350 | 1,310 |
| *Total Metals* | *10,820* | *13,830* | *15,510* | *16,550* | *16,630* | *16,070* | *15,960* | *16,170* | *15,850* |
| Plastics | 390 | 2,900 | 6,830 | 17,130 | 17,710 | 18,410 | 18,970 | 19,260 | 18,990 |
| Rubber and Leather | 1,840 | 2,970 | 4,200 | 5,790 | 5,870 | 5,800 | 5,680 | 6,210 | 6,030 |
| Textiles | 1,760 | 2,040 | 2,530 | 5,810 | 6,060 | 6,630 | 6,820 | 7,260 | 7,400 |
| Wood | 3,030 | 3,720 | 7,010 | 11,900 | 12,110 | 12,980 | 13,490 | 14,370 | 14,860 |
| Other ** | 70 | 770 | 2,520 | 3,190 | 3,310 | 3,370 | 3,410 | 3,700 | 3,630 |
| ***Total Materials in Products*** | 54,620 | 83,280 | 108,890 | 146,200 | 145,270 | 150,650 | 155,380 | 161,160 | 161,130 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 12,200 | 12,800 | 13,000 | 13,200 | 13,660 | 13,560 | 13,720 | 13,870 | 14,020 |
| Yard Trimmings | 20,000 | 23,200 | 27,500 | 35,000 | 35,000 | 35,000 | 33,250 | 31,500 | 29,750 |
| Miscellaneous Inorganic Wastes | 1,300 | 1,780 | 2,250 | 2,900 | 2,950 | 3,000 | 3,050 | 3,100 | 3,150 |
| ***Total Other Wastes*** | 33,500 | 37,780 | 42,750 | 51,100 | 51,610 | 51,560 | 50,020 | 48,470 | 46,920 |
| ***Total MSW Generated - Weight*** | 88,120 | 121,060 | 151,640 | 197,300 | 196,880 | 202,210 | 205,400 | 209,630 | 208,050 |
| | **Percent of Total Generation** | | | | | | | | |
| **Materials** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| Paper and Paperboard | 34.0% | 36.6% | 36.4% | 36.9% | 36.1% | 36.7% | 37.7% | 38.6% | 39.2% |
| Glass | 7.6% | 10.5% | 10.0% | 6.6% | 6.4% | 6.5% | 6.6% | 6.4% | 6.2% |
| Metals | | | | | | | | | |
| Ferrous | 11.7% | 10.2% | 8.3% | 6.4% | 6.4% | 6.0% | 5.8% | 5.6% | 5.6% |
| Aluminum | 0.4% | 0.7% | 1.1% | 1.4% | 1.4% | 1.4% | 1.4% | 1.5% | 1.4% |
| Other Nonferrous | 0.2% | 0.6% | 0.8% | 0.6% | 0.6% | 0.6% | 0.5% | 0.6% | 0.6% |
| *Total Metals* | *12.3%* | *11.4%* | *10.2%* | *8.4%* | *8.4%* | *7.9%* | *7.8%* | *7.7%* | *7.6%* |
| Plastics | 0.4% | 2.4% | 4.5% | 8.7% | 9.0% | 9.1% | 9.2% | 9.2% | 9.1% |
| Rubber and Leather | 2.1% | 2.5% | 2.8% | 2.9% | 3.0% | 2.9% | 2.8% | 3.0% | 2.9% |
| Textiles | 2.0% | 1.7% | 1.7% | 2.9% | 3.1% | 3.3% | 3.3% | 3.5% | 3.6% |
| Wood | 3.4% | 3.1% | 4.6% | 6.0% | 6.2% | 6.4% | 6.6% | 6.9% | 7.1% |
| Other ** | 0.1% | 0.6% | 1.7% | 1.6% | 1.7% | 1.7% | 1.7% | 1.8% | 1.7% |
| ***Total Materials in Products*** | 62.0% | 68.8% | 71.8% | 74.1% | 73.8% | 74.5% | 75.6% | 76.9% | 77.4% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 13.8% | 10.6% | 8.6% | 6.7% | 6.9% | 6.7% | 6.7% | 6.6% | 6.7% |
| Yard Trimmings | 22.7% | 19.2% | 18.1% | 17.7% | 17.8% | 17.3% | 16.2% | 15.0% | 14.3% |
| Miscellaneous Inorganic Wastes | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% |
| ***Total Other Wastes*** | 38.0% | 31.2% | 28.2% | 25.9% | 26.2% | 25.5% | 24.4% | 23.1% | 22.6% |
| ***Total MSW Generated - %*** | 100.0% | 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 1995**

**(In thousands of tons and percent of generation of each material)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Materials** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| Paper and Paperboard | 5,080 | 6,770 | 11,740 | 20,230 | 22,520 | 24,470 | 25,480 | 29,470 | 32,620 |
| Glass | 100 | 160 | 750 | 2,620 | 2,560 | 2,890 | 3,010 | 3,110 | 3,140 |
| Metals | | | | | | | | | |
| Ferrous | 50 | 150 | 370 | 2,580 | 3,050 | 3,350 | 3,910 | 4,120 | 4,230 |
| Aluminum | Neg. | 10 | 310 | 1,010 | 1,010 | 1,110 | 1,050 | 1,150 | 1,020 |
| Other Nonferrous | Neg. | 320 | 540 | 730 | 740 | 710 | 700 | 990 | 910 |
| *Total Metals* | *50* | *480* | *1,220* | *4,320* | *4,800* | *5,170* | *5,660* | *6,260* | *6,160* |
| Plastics | Neg. | Neg. | 20 | 370 | 450 | 600 | 670 | 940 | 1,000 |
| Rubber and Leather | 330 | 250 | 130 | 370 | 390 | 380 | 360 | 500 | 530 |
| Textiles | 50 | 60 | 160 | 670 | 700 | 780 | 800 | 870 | 900 |
| Wood | Neg. | Neg. | Neg. | 390 | 790 | 1,060 | 1,310 | 1,430 | 1,430 |
| Other ** | Neg. | 300 | 500 | 680 | 680 | 670 | 650 | 910 | 840 |
| ***Total Materials in Products*** | 5,610 | 8,020 | 14,520 | 29,650 | 32,890 | 36,020 | 37,940 | 43,490 | 46,620 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | 480 | 570 |
| Yard Trimmings | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,000 | 9,000 |
| Miscellaneous Inorganic Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Other Wastes*** | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,480 | 9,570 |
| ***Total MSW Recovered - Weight*** | 5,610 | 8,020 | 14,520 | 33,850 | 37,690 | 41,420 | 44,840 | 51,970 | 56,190 |
| | **Percent of Generation of Each Material** | | | | | | | | |
| **Materials** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| Paper and Paperboard | 16.9% | 15.3% | 21.3% | 27.8% | 31.7% | 33.0% | 32.9% | 36.5% | 40.0% |
| Glass | 1.5% | 1.3% | 5.0% | 20.0% | 20.3% | 22.0% | 22.1% | 23.3% | 24.5% |
| Metals | | | | | | | | | |
| Ferrous | 0.5% | 1.2% | 2.9% | 20.4% | 24.1% | 27.7% | 32.8% | 35.0% | 36.5% |
| Aluminum | Neg. | 1.3% | 17.9% | 35.9% | 35.6% | 38.7% | 35.8% | 37.8% | 34.6% |
| Other Nonferrous | Neg. | 47.8% | 46.6% | 66.4% | 65.5% | 63.4% | 63.1% | 73.3% | 69.5% |
| *Total Metals* | *0.5%* | *3.5%* | *7.9%* | *26.1%* | *28.9%* | *32.2%* | *35.5%* | *38.7%* | *38.9%* |
| Plastics | Neg. | Neg. | 0.3% | 2.2% | 2.5% | 3.3% | 3.5% | 4.9% | 5.3% |
| Rubber and Leather | 17.9% | 8.4% | 3.1% | 6.4% | 6.6% | 6.6% | 6.3% | 8.1% | 8.8% |
| Textiles | 2.8% | 2.9% | 6.3% | 11.5% | 11.6% | 11.8% | 11.7% | 12.0% | 12.2% |
| Wood | Neg. | Neg. | Neg. | 3.3% | 6.5% | 8.2% | 9.7% | 10.0% | 9.6% |
| Other ** | Neg. | 39.0% | 19.8% | 21.3% | 20.5% | 19.9% | 19.1% | 24.6% | 23.1% |
| ***Total Materials in Products*** | 10.3% | 9.6% | 13.3% | 20.3% | 22.6% | 23.9% | 24.4% | 27.0% | 28.9% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | 3.5% | 4.1% |
| Yard Trimmings | Neg. | Neg. | Neg. | 12.0% | 13.7% | 15.4% | 20.8% | 25.4% | 30.3% |
| Miscellaneous Inorganic Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Other Wastes*** | Neg. | Neg. | Neg. | 8.2% | 9.3% | 10.5% | 13.8% | 17.5% | 20.4% |
| ***Total MSW Recovered - %*** | 6.4% | 6.6% | 9.6% | 17.2% | 19.1% | 20.5% | 21.8% | 24.8% | 27.0% |

* 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.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

**Table 3**

**MATERIALS DISCARDED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1995**
**(In thousands of tons and percent of total discards)**

| | *Thousands of Tons* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Materials** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| Paper and Paperboard | 24,910 | 37,540 | 43,420 | 52,490 | 48,470 | 49,790 | 51,950 | 51,370 | 48,920 |
| Glass | 6,620 | 12,580 | 14,380 | 10,490 | 10,030 | 10,240 | 10,610 | 10,240 | 9,690 |
| Metals | | | | | | | | | |
| Ferrous | 10,250 | 12,210 | 12,250 | 10,060 | 9,610 | 8,730 | 8,010 | 7,660 | 7,360 |
| Aluminum | 340 | 790 | 1,420 | 1,800 | 1,830 | 1,760 | 1,880 | 1,890 | 1,930 |
| Other Nonferrous | 180 | 350 | 620 | 370 | 390 | 410 | 410 | 360 | 400 |
| *Total Metals* | *10,770* | *13,350* | *14,290* | *12,230* | *11,830* | *10,900* | *10,300* | *9,910* | *9,690* |
| Plastics | 390 | 2,900 | 6,810 | 16,760 | 17,260 | 17,810 | 18,300 | 18,320 | 17,990 |
| Rubber and Leather | 1,510 | 2,720 | 4,070 | 5,420 | 5,480 | 5,420 | 5,320 | 5,710 | 5,500 |
| Textiles | 1,710 | 1,980 | 2,370 | 5,140 | 5,360 | 5,850 | 6,020 | 6,390 | 6,500 |
| Wood | 3,030 | 3,720 | 7,010 | 11,510 | 11,320 | 11,920 | 12,180 | 12,940 | 13,430 |
| Other ** | 70 | 470 | 2,020 | 2,510 | 2,630 | 2,700 | 2,760 | 2,790 | 2,790 |
| ***Total Materials in Products*** | 49,010 | 75,260 | 94,370 | 116,550 | 112,380 | 114,630 | 117,440 | 117,670 | 114,510 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 12,200 | 12,800 | 13,000 | 13,200 | 13,660 | 13,560 | 13,720 | 13,390 | 13,450 |
| Yard Trimmings | 20,000 | 23,200 | 27,500 | 30,800 | 30,200 | 29,600 | 26,350 | 23,500 | 20,750 |
| Miscellaneous Inorganic Wastes | 1,300 | 1,780 | 2,250 | 2,900 | 2,950 | 3,000 | 3,050 | 3,100 | 3,150 |
| ***Total Other Wastes*** | 33,500 | 37,780 | 42,750 | 46,900 | 46,810 | 46,160 | 43,120 | 39,990 | 37,350 |
| ***Total MSW Discarded - Weight*** | 82,510 | 113,040 | 137,120 | 163,450 | 159,190 | 160,790 | 160,560 | 157,660 | 151,860 |
| | **Percent of Total Discards** | | | | | | | | |
| **Materials** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| Paper and Paperboard | 30.2% | 33.2% | 31.7% | 32.1% | 30.4% | 31.0% | 32.4% | 32.6% | 32.2% |
| Glass | 8.0% | 11.1% | 10.5% | 6.4% | 6.3% | 6.4% | 6.6% | 6.5% | 6.4% |
| Metals | | | | | | | | | |
| Ferrous | 12.4% | 10.8% | 8.9% | 6.2% | 6.0% | 5.4% | 5.0% | 4.9% | 4.8% |
| Aluminum | 0.4% | 0.7% | 1.0% | 1.1% | 1.1% | 1.1% | 1.2% | 1.2% | 1.3% |
| Other Nonferrous | 0.2% | 0.3% | 0.5% | 0.2% | 0.2% | 0.3% | 0.3% | 0.2% | 0.3% |
| *Total Metals* | *13.1%* | *11.8%* | *10.4%* | *7.5%* | *7.4%* | *6.8%* | *6.4%* | *6.3%* | *6.4%* |
| Plastics | 0.5% | 2.6% | 5.0% | 10.3% | 10.8% | 11.1% | 11.4% | 11.6% | 11.8% |
| Rubber and Leather | 1.8% | 2.4% | 3.0% | 3.3% | 3.4% | 3.4% | 3.3% | 3.6% | 3.6% |
| Textiles | 2.1% | 1.8% | 1.7% | 3.1% | 3.4% | 3.6% | 3.7% | 4.1% | 4.3% |
| Wood | 3.7% | 3.3% | 5.1% | 7.0% | 7.1% | 7.4% | 7.6% | 8.2% | 8.8% |
| Other ** | 0.1% | 0.4% | 1.5% | 1.5% | 1.7% | 1.7% | 1.7% | 1.8% | 1.8% |
| ***Total Materials in Products*** | 59.4% | 66.6% | 68.8% | 71.3% | 70.6% | 71.3% | 73.1% | 74.6% | 75.4% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 14.8% | 11.3% | 9.5% | 8.1% | 8.6% | 8.4% | 8.5% | 8.5% | 8.9% |
| Yard Trimmings | 24.2% | 20.5% | 20.1% | 18.8% | 19.0% | 18.4% | 16.4% | 14.9% | 13.7% |
| Miscellaneous Inorganic Wastes | 1.6% | 1.6% | 1.6% | 1.8% | 1.9% | 1.9% | 1.9% | 2.0% | 2.1% |
| ***Total Other Wastes*** | 40.6% | 33.4% | 31.2% | 28.7% | 29.4% | 28.7% | 26.9% | 25.4% | 24.6% |
| ***Total MSW Discarded - %*** | 100.0% | 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

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

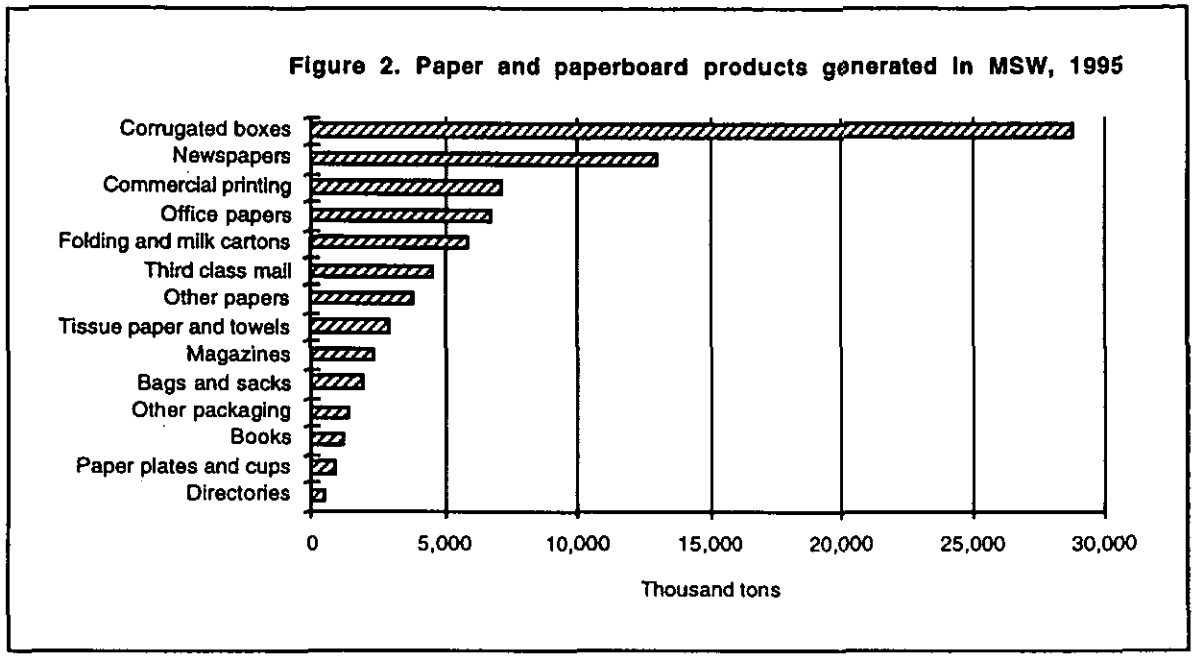
**Table 4**

**PAPER AND PAPERBOARD PRODUCTS IN MSW, 1995**
**(In thousands of tons and percent of generation)**

| Product Category | Generation (Thousands tons) | Recovery (Thousands tons) | Recovery (Percent of generation) | Discards (Thousands tons) |
|---|---|---|---|---|
| **Nondurable Goods** | | | | |
| Newspapers | | | | |
| Newsprint | 10,660 | 5,700 | 53.5% | 4,960 |
| Groundwood inserts | 2,470 | 1,260 | 51.0% | 1,210 |
| *Total Newspapers* | 13,130 | 6,960 | 53.0% | 6,170 |
| Books | 1,170 | 220 | 18.8% | 950 |
| Magazines | 2,370 | 670 | 28.3% | 1,700 |
| Office Papers | 6,800 | 3,010 | 44.3% | 3,790 |
| Telephone Directories | 490 | 60 | 12.2% | 430 |
| Third Class Mail | 4,620 | 710 | 15.4% | 3,910 |
| Other Commercial Printing | 7,110 | 1,100 | 15.5% | 6,010 |
| Tissue Paper and Towels | 2,950 | Neg. | Neg. | 2,950 |
| Paper Plates and Cups | 970 | Neg. | Neg. | 970 |
| Other Nonpackaging Paper* | 3,870 | Neg. | Neg. | 3,870 |
| *Total Paper and Paperboard Nondurable Goods* | 43,480 | 12,730 | 29.3% | 30,750 |
| **Containers and Packaging** | | | | |
| Corrugated Boxes | 28,800 | 18,480 | 64.2% | 10,320 |
| Milk Cartons | 510 | Neg. | Neg. | 510 |
| Folding Cartons | 5,310 | 1,070 | 20.2% | 4,240 |
| Other Paperboard Packaging | 260 | Neg. | Neg. | 260 |
| Bags and Sacks | 1,990 | 340 | 17.1% | 1,650 |
| Wrapping Papers | 70 | Neg. | Neg. | 70 |
| Other Paper Packaging | 1,120 | Neg. | Neg. | 1,120 |
| *Total Paper and Paperboard Containers and Packaging* | 38,060 | 19,890 | 52.3% | 18,170 |
| *Total Paper and Paperboard* | 81,540 | 32,620 | 40.0% | 48,920 |

* 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.

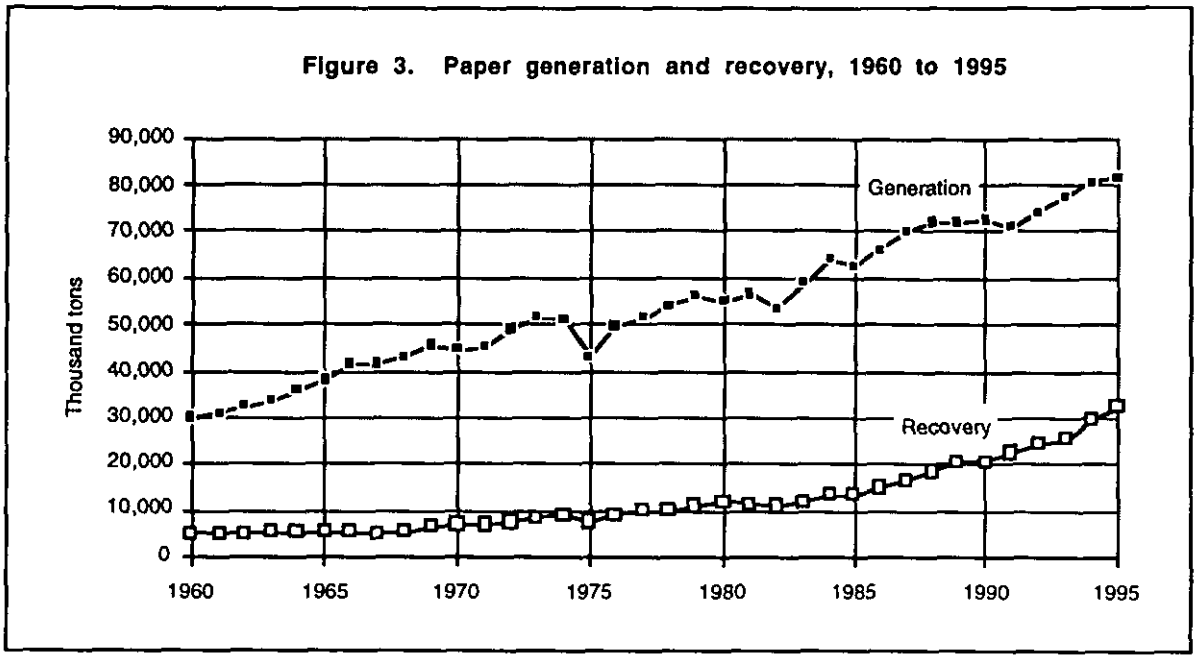
Source: Franklin Associates, Ltd.




Total generation of paper and paperboard in MSW has grown steadily from 30 million tons in 1960 to 81.5 million tons in 1995 (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 39.2 percent of total MSW generation in 1995.

(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.)

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




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

To estimate recovery of postconsumer paper products for this EPA report, estimates of recovery of converting scrap and returned overissue newspapers are deducted from the total recovery amounts reported by AF&PA. In earlier versions of this EPA report, a simplifying assumption that all converting scrap is recovered was made. For recent updates, various converting scrap recovery rates ranging from 70 percent to 98 percent were applied to the estimates for 1990 through 1995. 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 all other materials in MSW. As Table 4 shows, 64.2 percent of all corrugated boxes were recovered for recycling in 1995. Newspapers were recovered at a rate of 53.0 percent, and high grade office papers at 44.3 percent, with lesser percentages of other papers being recovered also. Approximately 32.6 million tons of postconsumer paper were recovered in 1995—40.0 percent of total paper and paperboard generation.

**Discards After Recovery.** After recovery of paper and paperboard for recycling, discards were 48.9 million tons in 1995, or 32.2 percent of total MSW discards.

## Glass

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

**Generation.** Glass accounted for 6.7 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

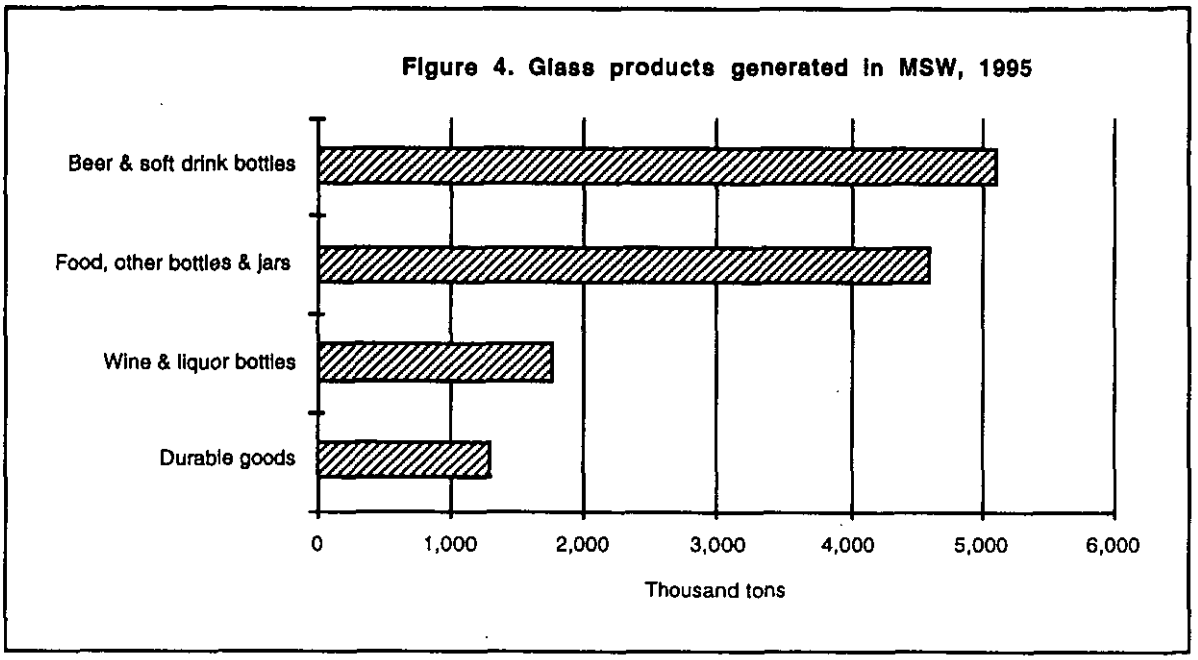
**Table 5**

**GLASS PRODUCTS IN MSW, 1995**
**(In thousands of tons and percent of generation)**

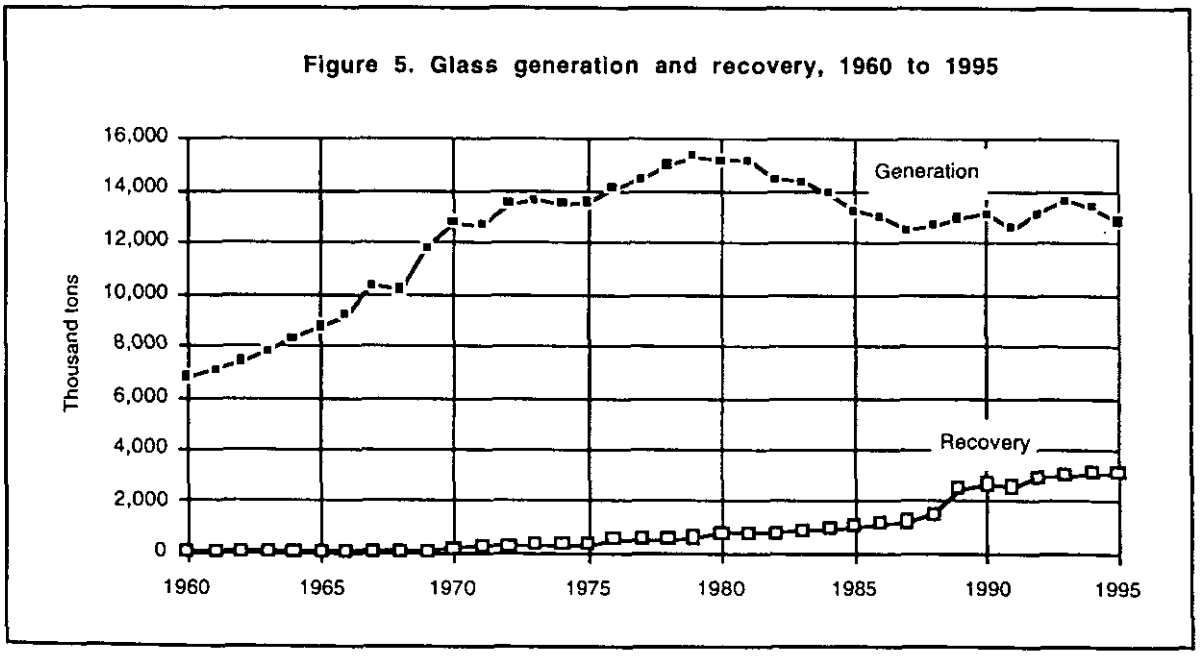
| Product Category | Generation (Thousand tons) | Recovery (Thousand tons) | Recovery (Percent of generation) | Discards (Thousand tons) |
|---|---|---|---|---|
| **Durable Goods*** | 1,300 | Neg. | Neg. | 1,300 |
| **Containers and Packaging** | | | | |
| Beer and Soft Drink Bottles | 5,120 | 1,670 | 32.6% | 3,450 |
| Wine and Liquor Bottles | 1,790 | 470 | 26.3% | 1,320 |
| Food and Other Bottles and Jars | 4,620 | 1,000 | 21.6% | 3,620 |
| *Total Glass Containers* | 11,530 | 3,140 | 27.2% | 8,390 |
| *Total Glass* | 12,830 | 3,140 | 24.5% | 9,690 |

* 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.




1985. Beginning about 1987, however, the decline in generation of glass containers slowed (Figure 5), and glass generation in 1995 was 12.8 million tons, about the same as 1987. During the 1990's glass generation has varied from 12.6 to 13.6 million tons per year. Glass was 10 percent of MSW generation in 1980, declining to 6.2 percent in 1995.



**Recovery.** Published estimates indicate 3.1 million tons of glass containers were recovered for recycling in 1995. Based on 1995 glass generation, an estimated 27.2 percent of glass containers was recovered for recycling, with a 24.5 percent recovery rate for all glass in MSW. Most of the recovered glass went into new glass containers, but a portion went to other uses such as fiberglass and glasphalt for highway construction. The Glass Packaging Institute reported a recovery rate of 37 percent for glass containers in 1995; this recovery rate includes an allowance for refilling of bottles. Since this EPA report classifies refilling as reuse (source reduction) rather than recovery for recycling, the recovery rate estimated for this report is 27.2 percent of glass containers.

**Discards After Recovery.** Recovery for recycling lowered discards of glass to 9.7 million tons in 1995 (6.4 percent of total MSW discards).

## Ferrous Metals

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

Total generation and recovery of all metals in MSW from 1960 to 1995 are shown in Figure 7.

*Figure 6. Metal products generated in MSW, 1995*

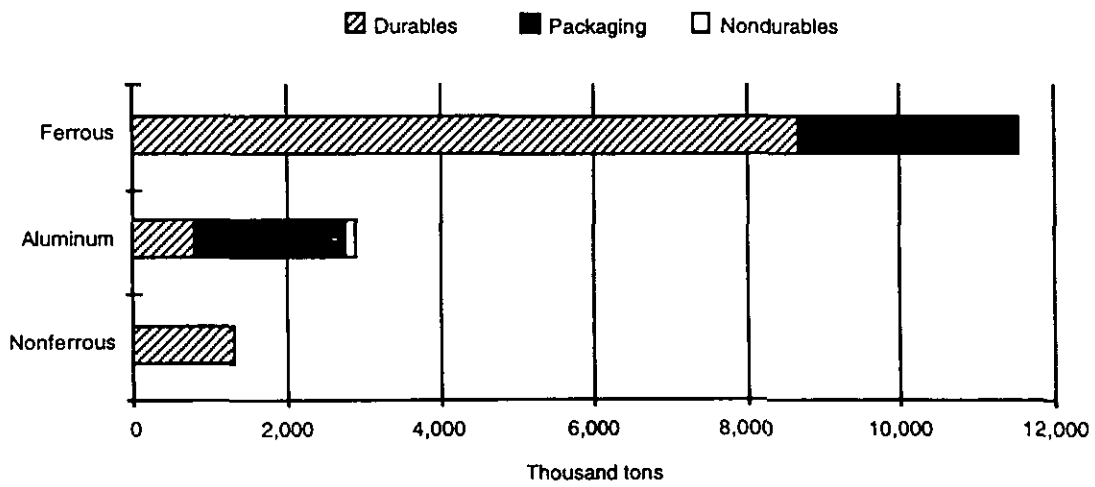


Table 6

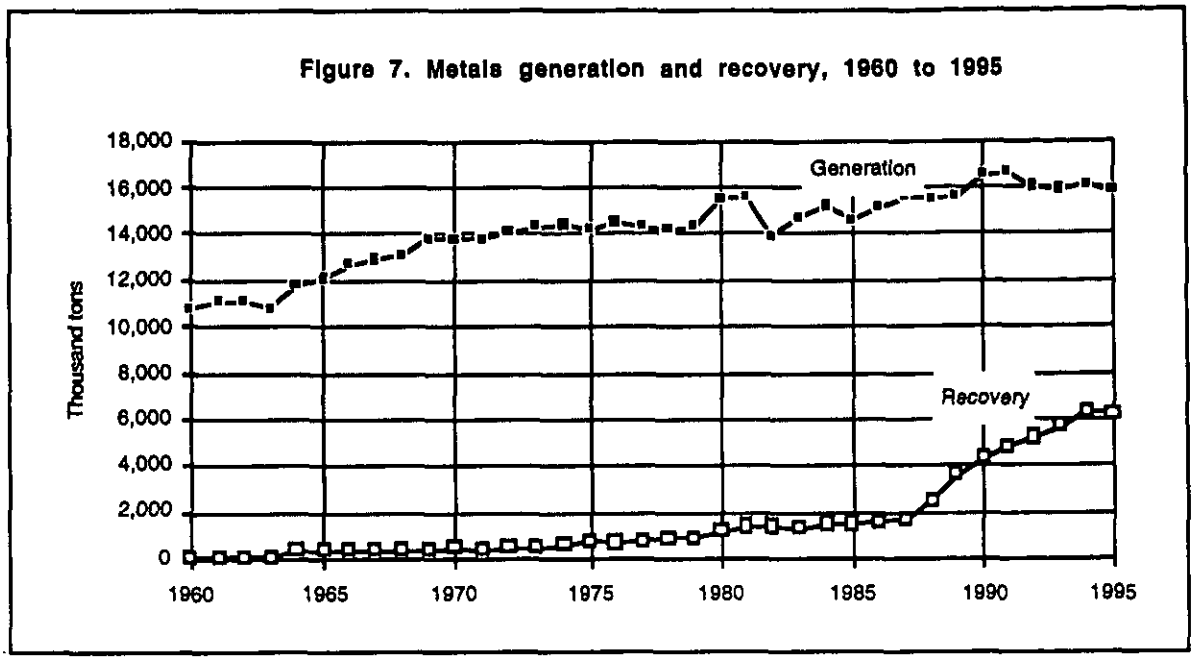
METAL PRODUCTS IN MSW, 1995
(In thousands of tons and percent of generation)

| Product Category | Generation (Thousand tons) | Recovery (Thousand tons) | Recovery (Percent of generation) | Discards (Thousand tons) |
|---|---|---|---|---|
| **Durable Goods** | | | | |
| Ferrous metals* | 8,740 | 2,680 | 30.7% | 6,060 |
| Aluminum** | 800 | Neg. | Neg. | 800 |
| Lead† | 950 | 910 | 95.8% | 40 |
| Other nonferrous metals‡ | 360 | Neg. | Neg. | 360 |
| *Total Metals in Durable Goods* | 10,850 | 3,590 | 33.1% | 7,260 |
| **Nondurable Goods** | | | | |
| Aluminum | 180 | Neg. | Neg. | 180 |
| **Containers and Packaging** | | | | |
| **Steel** | | | | |
| Food and other cans | 2,640 | 1,500 | 56.8% | 1,140 |
| Other steel packaging | 210 | 50 | 23.8% | 160 |
| *Total Steel Packaging* | 2,850 | 1,550 | 54.4% | 1,300 |
| **Aluminum** | | | | |
| Beer and soft drink cans | 1,580 | 990 | 62.7% | 590 |
| Food and other cans | 40 | Neg. | 7.0% | 40 |
| Foil and closures | 350 | 30 | 8.6% | 320 |
| *Total Aluminum Packaging* | 1,970 | 1,020 | 51.8% | 950 |
| *Total Metals in Containers and Packaging* | 4,820 | 2,570 | 53.3% | 2,250 |
| *Total Metals* | 15,850 | 6,160 | 38.9% | 9,690 |
| Ferrous | 11,590 | 4,230 | 36.5% | 7,360 |
| Aluminum | 2,950 | 1,020 | 34.6% | 1,930 |
| Other nonferrous | 1,310 | 910 | 69.5% | 400 |

* Ferrous metals in appliances, furniture, tires, and miscellaneous durables.
** Aluminum in appliances, furniture, and miscellaneous durables.
† Lead in lead-acid batteries.
‡ Other nonferrous metals in appliances and miscellaneous durables.
Neg. = Less than 5,000 tons or 0.05 percent.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

**Generation.** Approximately 10.3 million tons of ferrous metals were generated in 1960. Like glass, the tonnages grew during the 1960s and 1970s, but began to drop as lighter materials like aluminum and plastics replaced steel in many applications. Generation of ferrous metals did, however, increase to 12.7 million tons in 1991, then dropped to 11.6 million tons in 1995. The percentage of ferrous metals generation in MSW has declined from 11.7 percent in 1960 to 5.6 percent in 1995.

**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 2.1 million tons of the total ferrous in appliances in 1995. Overall recovery of ferrous metals from durable goods (large and small appliances, furniture, and tires) was estimated to be 30.7 percent (2.7 million tons) in 1995 (Table 6).

Steel beverage cans, food cans, and other cans were estimated to be recovered at a rate of 56.8 percent (1.5 million tons) in 1995. Approximately 50,000 tons of other steel packaging, such as steel strapping, was estimated to have been recovered for recycling in 1995.

**Discards After Recovery.** Discards of ferrous metals after recovery were 7.4 million tons in 1995, or 4.8 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 (almost one-third of generation) are found in durable and nondurable goods.

**Generation.** In 1995, approximately 2.0 million tons of aluminum were generated as containers and packaging, while a total of approximately 1.0 million tons was found in durable and nondurable goods. The total—3.0 million tons—represented 1.4 percent of total MSW generation in 1995. 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 62.7 percent of generation (990,000 tons) in 1995, and 51.8 percent of all aluminum in containers and packaging was recovered for recycling in 1995.

**Discards After Recovery.** In 1995, 1.9 million tons of aluminum were discarded in MSW after recovery, which was 1.3 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 car and 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 1.3 million tons in 1995. Lead in batteries accounted for 950,000 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 910,000 tons in 1995, with most of this being lead recovered from batteries. It was estimated that 95.8 percent of battery lead was recovered in 1995.

**Discards After Recovery.** In 1995, 400,000 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. Plastics are found in durable and nondurable goods and in containers and packaging, with the latter being the largest category of plastics in MSW (Table 7 and Figure 8).

In durable goods, plastics are found in appliances, furniture, casings of lead-acid batteries, and other products. (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,

Table 7

PLASTICS IN PRODUCTS IN MSW, 1995
(In thousands of tons, and percent of generation by resin)

| Product Category | Generation (Thousand tons) | Recovery (Thousand tons) | Recovery (Percent of Gen.) | Discards (Thousand tons) |
|---|---|---|---|---|
| **Durable Goods** | | | | |
| PET | 440 | 30 | | 410 |
| HDPE | 680 | 40 | | 640 |
| PVC | 480 | Neg. | | 480 |
| LDPE/LLDPE | 800 | 20 | | 780 |
| PP | 1,220 | 110 | | 1,110 |
| PS | 740 | 10 | | 730 |
| Other resins | 1,850 | 30 | | 1,820 |
| *Total Plastics in Durable Goods* | 6,210 | 240 | 3.9% | 5,970 |
| **Nondurable Goods** | | | | |
| Plastic Plates and Cups | | | | |
| LDPE/LLDPE | 20 | | | 20 |
| PS | 770 | 10 | | 760 |
| *Subtotal Plastic Plates and Cups* | 790 | | | |
| Trash Bags | | | | |
| HDPE | 200 | | | 200 |
| LDPE/LLDPE | 550 | | | 550 |
| *Subtotal Trash Bags* | 750 | | | 750 |
| All other nondurables* | | | | |
| PET | 120 | | | 120 |
| HDPE | 310 | | | 310 |
| PVC | 530 | | | 530 |
| LDPE/LLDPE | 1,290 | | | 1,290 |
| PP | 710 | | | 710 |
| PS | 500 | | | 500 |
| Other resins | 80 | | | 80 |
| *Subtotal All Other Nondurables* | 3,540 | | | 3,540 |
| **Total Plastics in Nondurable Goods, by resin** | | | | |
| PET | 120 | | | 120 |
| HDPE | 510 | | | 510 |
| PVC | 530 | | | 530 |
| LDPE/LLDPE | 1,860 | | | 1,860 |
| PP | 710 | | | 710 |
| PS | 1,270 | 10 | | 1,260 |
| Other resins | 80 | | | 80 |
| *Total Plastics in Nondurable Goods* | 5,080 | 10 | 0.2% | 5,070 |
| **Plastic Containers & Packaging** | | | | |
| Soft drink bottles | | | | |
| PET | 620 | 290 | | 330 |
| HDPE | 40 | 10 | | 30 |
| *Subtotal Soft Drink Bottles* | 660 | 300 | 45.5% | 360 |
| Milk and water bottles | | | | |
| HDPE | 630 | 190 | 30.2% | 440 |

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, 1995**
**(In thousands of tons, and percent of generation by resin)**

| Product Category | Generation (Thousand tons) | Recovery (Thousand tons) | Recovery (Percent of Gen.) | Discards (Thousand tons) |
|---|---|---|---|---|
| **Plastic Containers & Packaging, cont.** | | | | |
| Other plastic containers | | | | |
| PET | 330 | 40 | | 290 |
| HDPE | 700 | 120 | | 580 |
| PVC | 70 | Neg. | | 70 |
| LDPE/LLDPE | 30 | Neg. | | 30 |
| PP | 70 | Neg. | | 70 |
| PS | 40 | Neg. | | 40 |
| Other resins | 10 | Neg. | | 10 |
| *Subtotal Other Containers* | 1,250 | 160 | 12.8% | 1,090 |
| Bags, sacks, & wraps | | | | |
| HDPE | 430 | 10 | | 420 |
| PVC | 60 | | | 60 |
| LDPE/LLDPE | 1,960 | 70 | | 1,890 |
| PP | 380 | | | 380 |
| PS | 60 | | | 60 |
| *Subtotal Bags, Sacks, & Wraps* | 2,890 | 80 | 2.8% | 2,810 |
| Other Plastics Packaging** | | | | |
| PET | 180 | Neg. | | 180 |
| HDPE | 530 | Neg. | | 530 |
| PVC | 360 | Neg. | | 360 |
| LDPE/LLDPE | 480 | Neg. | | 480 |
| PP | 530 | 20 | | 510 |
| PS | 140 | Neg. | | 140 |
| Other resins | 50 | Neg. | | 50 |
| *Subtotal Other Packaging* | 2,270 | 20 | 0.9% | 2,250 |
| **Total Plastics in Containers & Packaging, by resin** | | | | |
| PET | 1,130 | 330 | | 800 |
| HDPE | 2,330 | 330 | | 2,000 |
| PVC | 490 | Neg. | | 490 |
| LDPE/LLDPE | 2,470 | 70 | | 2,400 |
| PP | 980 | 20 | | 960 |
| PS | 240 | Neg. | | 240 |
| Other resins | 60 | Neg. | | 60 |
| *Total Plastics in Containers & Packaging* | 7,700 | 750 | 9.7% | 6,950 |
| **Total Plastics in MSW, by resin** | | | | |
| PET | 1,690 | 360 | | 1,330 |
| HDPE | 3,520 | 370 | | 3,150 |
| PVC | 1,500 | Neg. | | 1,500 |
| LDPE/LLDPE | 5,130 | 90 | | 5,040 |
| PP | 2,910 | 130 | | 2,780 |
| PS | 2,250 | 20 | | 2,230 |
| Other resins | 1,990 | 30 | | 1,960 |
| *Total Plastics in MSW* | 18,990 | 1,000 | 5.3% | 17,990 |

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.
Neg. = Less than 5,000 tons or 0.05 percent. Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

household items such as shower curtains, etc. The plastic foodservice items are generally made of clear or foamed polystyrene, while trash bags are made of high-density polyethylene or low-density polyethylene. A wide variety of other resins are used in other nondurable goods.

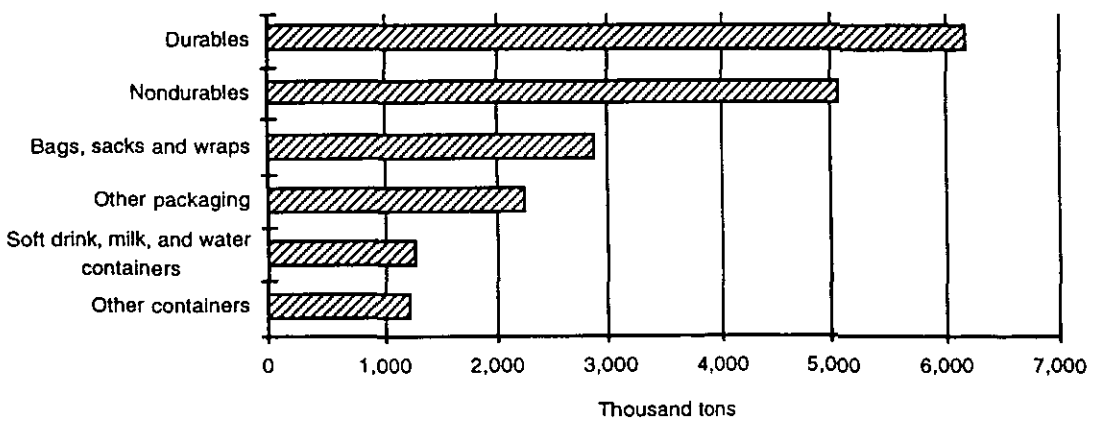
Plastic resins are also used in a variety of container and packaging products such as polyethylene terephthalate (PET) soft drink bottles, high-density polyethylene (HDPE) bottles for milk and water, and a wide variety of other resin types used in other plastic containers, bags, sacks, wraps, lids, etc.

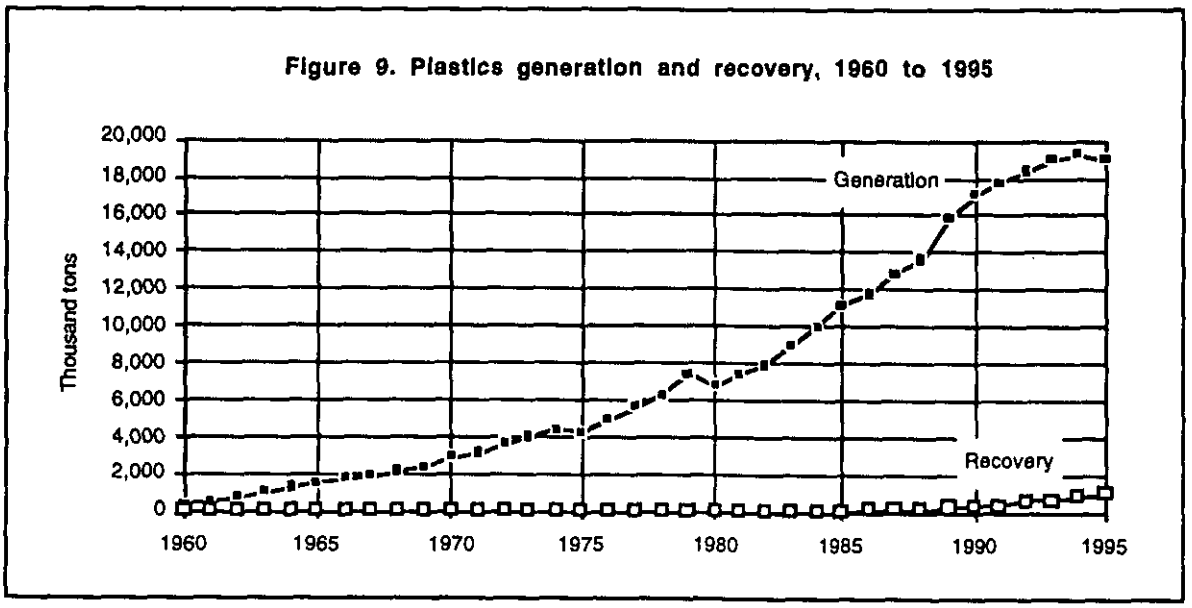
**Generation.** Production data on plastics resin use in products is taken from the ***Modern Plastics*** annual statistical issue and the American Plastics Council annual plastic recovery survey. The basic data are adjusted for product service life, fabrication losses, and for net imports of plastic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

Plastics comprised an estimated 390,000 tons of MSW generation in 1960. The quantity has increased relatively steadily to 19.0 million tons in 1995 (Figure 9). As a percentage of MSW generation, plastics were less than one percent in 1960, increasing to 9.1 percent in 1995.

**Recovery for Recycling.** While overall recovery of plastics for recycling is relatively small—1.0 million tons, or 5.3 percent of plastics generation in 1995 (Table 9)—recovery of some plastic containers is increasing. Plastic (polyethylene terephthalate) soft drink bottles and their base cups were recovered at a rate of about 45.5 percent in 1995. Recovery of high-density polyethylene milk and water bottles was estimated at about 30.2 percent in 1995. Significant recovery of plastics from lead-acid battery casings and from some other containers was also reported.

**Figure 8. Plastics products generated in MSW, 1995**






The primary source of data on plastics recovery is an annual survey conducted for the American Plastics Council (APC). Recently there has been a change in the way APC reports plastics recovery data. In previous years, APC had reported the quantity of resin actually recycled after being cleaned and processed. Starting in 1994 data reported by APC are recovery for recycling before processing at the reclaimer. Thus, the plastics data are now more consistent with the data reported for the other materials.

**Discards After Recovery.** Discards of plastics in MSW after recovery were 18.0 million tons, or 11.8 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 6.0 million tons in 1995. 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 3.0 percent for many years.

Table 8

**RUBBER AND LEATHER PRODUCTS IN MSW, 1995**
**(In thousands of tons and percent of generation)**

| Product Category | Generation (Thousand tons) | Recovery (Thousand tons) | Recovery (Percent of generation) | Discards (Thousand tons) |
|---|---|---|---|---|
| **Durable Goods** | | | | |
| Rubber in Tires* | 3,060 | 530 | 17.3% | 2,530 |
| Other Durables** | 2,190 | Neg. | Neg. | 2,190 |
| *Total Rubber & Leather Durable Goods* | 5,250 | 530 | 10.1% | 4,720 |
| **Nondurable Goods** | | | | |
| Clothing and Footwear | 540 | Neg. | Neg. | 540 |
| Other Nondurables | 220 | Neg. | Neg. | 220 |
| *Total Rubber & Leather Nondurable Goods* | 760 | Neg. | Neg. | 760 |
| **Containers and Packaging** | 20 | Neg. | Neg. | 20 |
| *Total Rubber & Leather* | 6,030 | 530 | 8.8% | 5,500 |

* 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.

**Recovery for Recycling.** The only recovery for recycling identified in this category is rubber from tires, and that was estimated to be 530,000 tons (17.3 percent of rubber in tires in 1995) (Table 8). (This recovery estimate does not include tires retreaded or energy recovery from tires.) Overall, 8.8 percent of rubber and leather in MSW was recovered in 1995.

**Discards After Recovery.** Discards of rubber and leather after recovery were 5.5 million tons in 1995 (3.6 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 7.4 million tons of textiles were generated in 1995 (3.6 percent of total MSW generation).

**Recovery for Recycling and Discards.** A significant amount of textiles is 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 12.2 percent of textiles in clothing and items such as sheets and pillowcases was recovered for export or reprocessing in 1995 (900,000 tons) leaving discards of 6.5 million tons of textiles in 1995.

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

**Generation.** Generation of wood in MSW was 14.9 million tons in 1995 (7.1 percent of total MSW generation).

**Recovery for Recycling and Discards.** Recovery of wood pallets (usually by chipping) has been increasing along with recovery of other materials. It was estimated that 1.4 million tons of wood waste were recovered in 1995, leaving wood discards of 13.4 million tons (8.8 percent of total discards).

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

**Food Wastes**

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

**Generation.** Obviously no production data are available for food wastes. Food wastes from residential and commercial sources were estimated using data from sampling studies in combination with demographic data on population, numbers of garbage disposers in homes, grocery store sales, restaurant sales, numbers of employees, and numbers of prisoners and students in institutions.

Generation of food wastes was estimated to be 14.0 million tons in 1995. The use of garbage disposals, which send food wastes to wastewater treatment systems rather than MSW, and use of prepared foods both at home and in food service establishments, affect the amount of food waste in MSW. (When foods are prepared and packaged off site, food preparation wastes are categorized as industrial wastes rather than MSW.)

It should be noted that recent residential food waste sampling studies in Seattle, Washington and Crawford County, Illinois indicate higher per capita

residential food waste generation rates than those used in this study. As additional sampling data becomes available, increasing the estimate of food waste generation may be warranted.

**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. In 1995 this amount was estimated at 570,000 tons, or 4.1 percent of food waste generation. As discussed in Chapter 3, composting of food wastes in backyard composting projects is classified as source reduction. Discards of food wastes in 1995 were 13.5 million tons, or 8.9 percent of total discards.

### Yard Trimmings

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

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

Using data published by the Composting Council as updated from more recent sources, legislation affecting yard trimmings disposal in landfills was tabulated. In 1992, 11 states and the District of Columbia —accounting for over 28 percent of the nation's population—had in effect legislation banning or discouraging yard trimmings disposal in landfills. The tabulation of existing legislation also shows that by 1996-97, over two dozen states including more than 50 percent of the nation's population will have legislation requiring source separation or banning of yard trimmings from landfills. Also, data compiled by ***BioCycle*** magazine indicates that there were about 3,000 composting facilities for yard trimmings in 1992, increasing to over 3,300 facilities in 1995.

Using these facts, it was estimated that the effect of this legislation was no increase in yard trimmings generation (e.g., 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 expected to have yard trimmings legislation in 1996-97, it was also estimated that yard trimmings declined approximately 5.5 percent annually between 1992 and 1995. Because of this

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* Although there are limited data 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.

phenomenon, yard trimmings generation is shown to be declining. An estimated 29.8 million tons of yard trimmings were generated in MSW in 1995 (this compares to an estimated 35 million tons of yard trimmings generated in 1992).

**Recovery for Composting and Discards.** Quantitative national information on composting of yard trimmings is difficult to obtain, but estimates were based on a literature search, telephone conversations with state officials, and data on numbers of composting programs. Recovery data from state officials were adjusted where appropriate to exclude quantities of non-yard trimmings included in recovery values such as disaster waste. Some states consider landspreading of yard trimmings or yard trimmings used as landfill cover as recovery. Average tons recovered per compost facility from those states with data was used to account for facilities in states without recovery quantity data.

Removal of yard trimmings for composting was estimated to be 30.3 percent of generation in 1995 (9.0 million tons), leaving 20.8 million tons of yard trimmings to be discarded. (It should be noted that the estimated 9.0 million tons recovered for composting does not include yard trimmings recovered for landspreading disposal.)

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

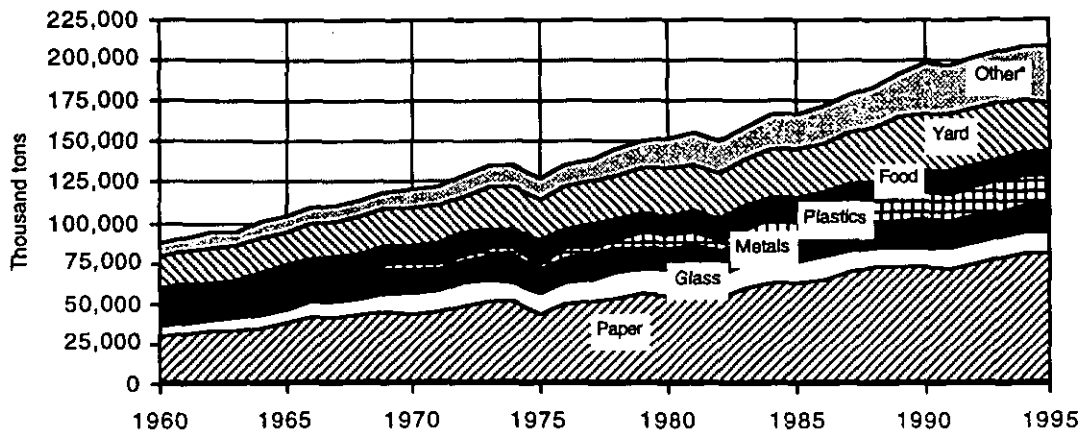
**Generation, Recovery, and Discards.** This category contributed an estimated 3.2 million tons of MSW in 1995. No recovery of these products was identified; discards are the same as generation.

### 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 208.1 million tons in 1995.

Over the years paper and paperboard has been the dominant material generated in MSW, accounting for 39.2 percent of generation in 1995. Yard trimmings, the second largest material component of MSW (14.3 percent of

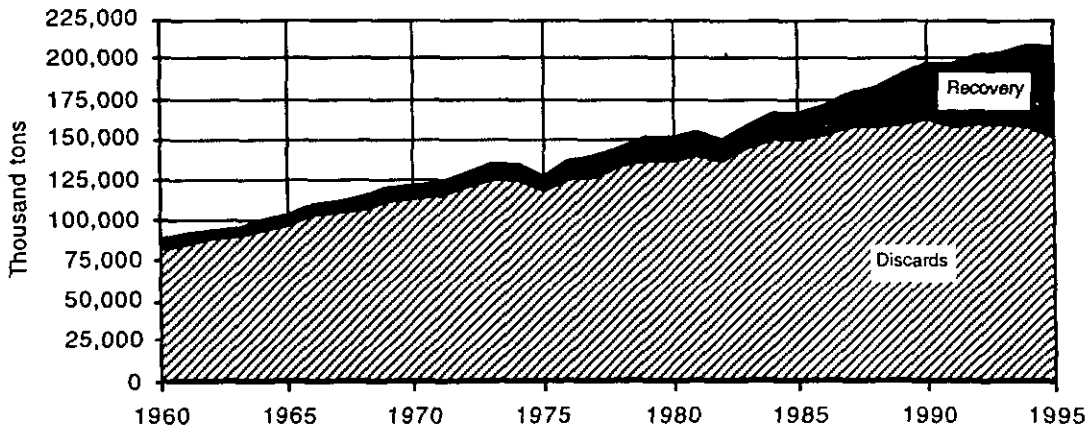
**Figure 10. Generation of materials in MSW, 1960 to 1995**




* All other primarily includes wood, rubber and leather, and textiles.

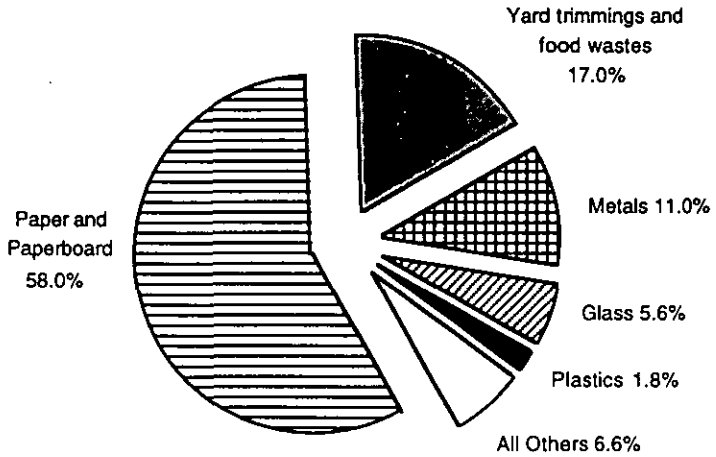
MSW generation) have been declining as a percentage of MSW in recent years due to state and local legislated landfill bans and increased emphasis on backyard composting and other source reduction measures such as the use of mulching mowers. Metals account for 7.6 percent of MSW generation and have remained fairly constant as a source of MSW, while glass increased until the 1980s and has since declined or shown a slower rate of increase. In 1995 glass represented 6.2 percent of MSW generation. Food wastes have remained fairly constant in terms

**Figure 11. Materials recovery and discards of MSW*, 1960 to 1995**




* Generation = recovery + discards

**Figure 12. Materials recovery*, 1995**




* In percent by weight of total recovery.

of MSW tonnage (6.7 percent of generation). 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 third in 1995 (behind paper and yard trimmings) and account for 9.1 percent of MSW generation.

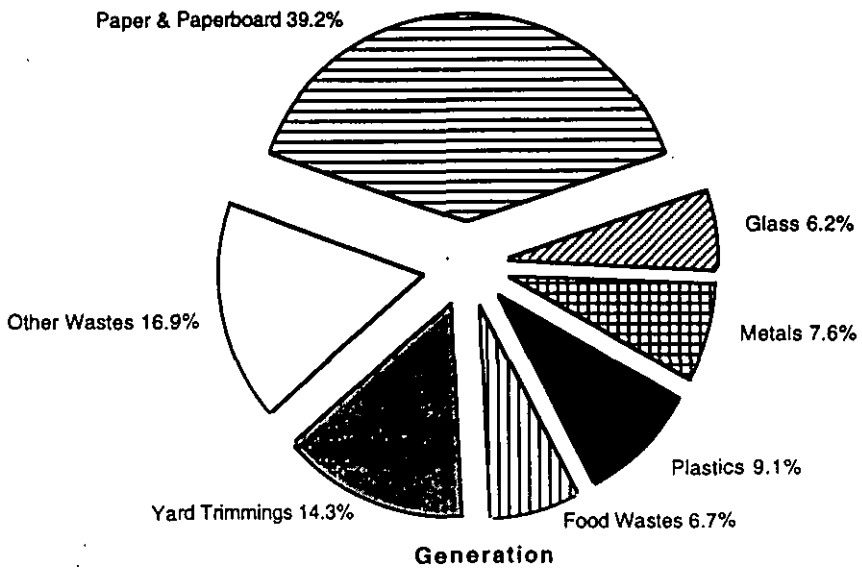
**Recovery and Discards.** The effect of recovery on MSW discards is illustrated in Figure 11. Recovery of materials for recycling grew at a rather slow pace during most of the historical period covered by this data series, increasing only from 6.4 percent of generation in 1960 to 10.9 percent in 1985. 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 17.2 percent of generation, increasing to 27.0 percent in 1995.

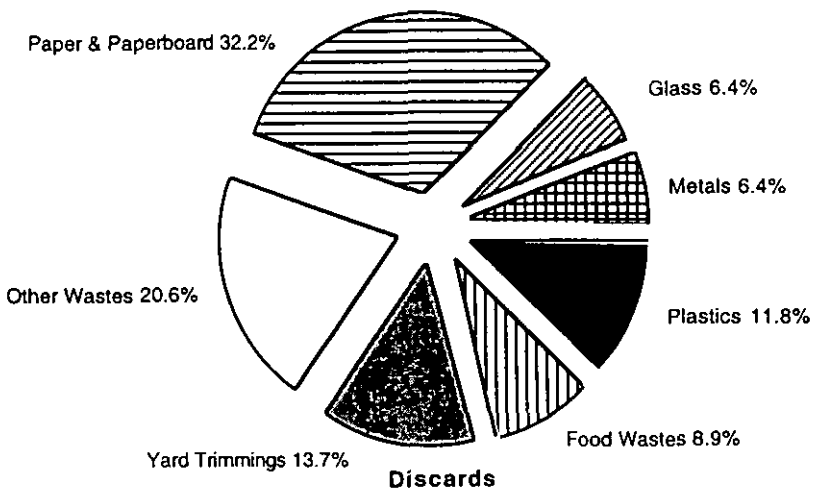
Estimated recovery of materials (including composting) are shown in Figure 12. In 1995, recovery of paper and paperboard dominated materials recovery at 58.0 percent of total tonnage recovered. Recovery of other materials, while generally increasing, contributes much less tonnage, reflecting in part the relatively smaller amounts of materials generated in those categories.

Figure 13 illustrates the effect of recovery of materials for recycling, including composting, on the composition of MSW discards. For example, paper and paperboard were 39.2 percent of MSW generated in 1995, but after recovery, paper and paperboard were 32.2 percent of discards.

Materials that have little or no recovery exhibit a larger percentage of MSW discards compared to generation. For instance, food wastes were 6.7 percent of MSW generation in 1995, but 8.9 percent of discards.

**Figure 13. Materials generated and discarded in municipal solid waste, 1995**
**(In percent of total generation and discards)**



## PRODUCTS IN MUNICIPAL SOLID WASTE

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

### Durable Goods

Durable goods generally are defined as products having a lifetime of three years or more, although there are some exceptions. In this report, durable goods include large and small appliances, furniture and furnishings, carpets and rugs, rubber tires, lead-acid automotive batteries, and miscellaneous durables (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 1995, these include: ferrous metals, plastics, rubber and leather, wood, textiles, other nonferrous metals (e.g., lead, copper), glass, and aluminum.

Generation of durable goods in MSW totaled 31.2 million tons in 1995 (15.0 percent of total MSW generation). After recovery for recycling, 25.9 million tons of durable goods remained as discards in 1995.

**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 Annual Report. 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 these products in MSW has increased very slowly; it was estimated to be 3.4 million tons in 1995 (1.6 percent of total MSW). In general, appliances have increased in quantity but not in average weight over the years. Ferrous metals are the predominant materials in major appliances, but other metals, plastics, glass, and other materials are also present.

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* Automobiles and other transportation equipment are not included in this report.

Table 9

**CATEGORIES OF PRODUCTS GENERATED***
**IN THE MUNICIPAL WASTE STREAM, 1960 TO 1995**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** *(Detail in Table 12)* | 9,920 | 14,660 | 21,800 | 29,810 | 30,360 | 30,430 | 30,260 | 31,120 | 31,230 |
| **Nondurable Goods** *(Detail in Table 15)* | 17,330 | 25,060 | 34,420 | 52,170 | 50,570 | 52,780 | 54,900 | 56,850 | 57,040 |
| **Containers and Packaging** *(Detail in Table 18)* | 27,370 | 43,560 | 52,670 | 64,220 | 64,340 | 67,440 | 70,220 | 73,190 | 72,860 |
| ***Total Product** Wastes*** | 54,620 | 83,280 | 108,890 | 146,200 | 145,270 | 150,650 | 155,380 | 161,160 | 161,130 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 12,200 | 12,800 | 13,000 | 13,200 | 13,660 | 13,560 | 13,720 | 13,870 | 14,020 |
| Yard Trimmings | 20,000 | 23,200 | 27,500 | 35,000 | 35,000 | 35,000 | 33,250 | 31,500 | 29,750 |
| Miscellaneous Inorganic Wastes | 1,300 | 1,780 | 2,250 | 2,900 | 2,950 | 3,000 | 3,050 | 3,100 | 3,150 |
| ***Total Other Wastes*** | 33,500 | 37,780 | 42,750 | 51,100 | 51,610 | 51,560 | 50,020 | 48,470 | 46,920 |
| ***Total MSW Generated - Weight*** | 88,120 | 121,060 | 151,640 | 197,300 | 196,880 | 202,210 | 205,400 | 209,630 | 208,050 |
| | **Percent of Total Generation** | | | | | | | | |
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** *(Detail in Table 12)* | 11.3% | 12.1% | 14.4% | 15.1% | 15.4% | 15.0% | 14.7% | 14.8% | 15.0% |
| **Nondurable Goods** *(Detail in Table 15)* | 19.7% | 20.7% | 22.7% | 26.4% | 25.7% | 26.1% | 26.7% | 27.1% | 27.4% |
| **Containers and Packaging** *(Detail in Table 19)* | 31.1% | 36.0% | 34.7% | 32.5% | 32.7% | 33.4% | 34.2% | 34.9% | 35.0% |
| ***Total Product** Wastes*** | 62.0% | 68.8% | 71.8% | 74.1% | 73.8% | 74.5% | 75.6% | 76.9% | 77.4% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 13.8% | 10.6% | 8.6% | 6.7% | 6.9% | 6.7% | 6.7% | 6.6% | 6.7% |
| Yard Trimmings | 22.7% | 19.2% | 18.1% | 17.7% | 17.8% | 17.3% | 16.2% | 15.0% | 14.3% |
| Miscellaneous Inorganic Wastes | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% |
| ***Total Other Wastes*** | 38.0% | 31.2% | 28.2% | 25.9% | 26.2% | 25.5% | 24.4% | 23.1% | 22.6% |
| ***Total MSW Generated - %*** | 100.0% | 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 1995**
**(In thousands of tons and percent of generation of each category)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** *(Detail in Table 13)* | 350 | 940 | 1,360 | 3,810 | 3,980 | 4,150 | 4,460 | 5,230 | 5,320 |
| **Nondurable Goods** *(Detail in Table 16)* | 2,390 | 3,730 | 4,670 | 8,800 | 10,390 | 11,070 | 11,080 | 12,610 | 13,520 |
| **Containers and Packaging** *(Detail in Table 20)* | 2,870 | 3,350 | 8,490 | 17,040 | 18,520 | 20,800 | 22,400 | 25,650 | 27,780 |
| ***Total Product** Wastes* | 5,610 | 8,020 | 14,520 | 29,650 | 32,890 | 36,020 | 37,940 | 43,490 | 46,620 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | 480 | 570 |
| Yard Trimmings | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,000 | 9,000 |
| Miscellaneous Inorganic Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Other Wastes*** | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,480 | 9,570 |
| ***Total MSW Recovered - Weight*** | 5,610 | 8,020 | 14,520 | 33,850 | 37,690 | 41,420 | 44,840 | 51,970 | 56,190 |
| | **Percent of Generation of Each Category** | | | | | | | | |
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** *(Detail in Table 13)* | 3.5% | 6.4% | 6.2% | 12.8% | 13.1% | 13.6% | 14.7% | 16.8% | 17.0% |
| **Nondurable Goods** *(Detail in Table 16)* | 13.8% | 14.9% | 13.6% | 16.9% | 20.5% | 21.0% | 20.2% | 22.2% | 23.7% |
| **Containers and Packaging** *(Detail in Table 21)* | 10.5% | 7.7% | 16.1% | 26.5% | 28.8% | 30.8% | 31.9% | 35.0% | 38.1% |
| ***Total Product** Wastes* | 10.3% | 9.6% | 13.3% | 20.3% | 22.6% | 23.9% | 24.4% | 27.0% | 28.9% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | 3.5% | 4.1% |
| Yard Trimmings | Neg. | Neg. | Neg. | 12.0% | 13.7% | 15.4% | 20.8% | 25.4% | 30.3% |
| Miscellaneous Inorganic Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Other Wastes*** | Neg. | Neg. | Neg. | 8.2% | 9.3% | 10.5% | 13.8% | 17.5% | 20.4% |
| ***Total MSW Recovered - %*** | 6.4% | 6.6% | 9.6% | 17.2% | 19.1% | 20.5% | 21.8% | 24.8% | 27.0% |

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Other than food products.
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 1995**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 9,570 | 13,720 | 20,440 | 26,000 | 26,380 | 26,280 | 25,800 | 25,890 | 25,910 |
| *(Detail in Table 14)* | | | | | | | | | |
| **Nondurable Goods** | 14,940 | 21,330 | 29,750 | 43,370 | 40,180 | 41,710 | 43,820 | 44,240 | 43,520 |
| *(Detail in Table 17)* | | | | | | | | | |
| **Containers and Packaging** | 24,500 | 40,210 | 44,180 | 47,180 | 45,820 | 46,640 | 47,820 | 47,540 | 45,080 |
| *(Detail in Table 22)* | | | | | | | | | |
| ***Total Product** Wastes* | 49,010 | 75,260 | 94,370 | 116,550 | 112,380 | 114,630 | 117,440 | 117,870 | 114,510 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 12,200 | 12,800 | 13,000 | 13,200 | 13,660 | 13,560 | 13,720 | 13,390 | 13,450 |
| Yard Trimmings | 20,000 | 23,200 | 27,500 | 30,800 | 30,200 | 29,600 | 26,350 | 23,500 | 20,750 |
| Miscellaneous Inorganic Wastes | 1,300 | 1,780 | 2,250 | 2,900 | 2,950 | 3,000 | 3,050 | 3,100 | 3,150 |
| ***Total Other Wastes*** | 33,500 | 37,780 | 42,750 | 46,900 | 46,810 | 46,160 | 43,120 | 39,990 | 37,350 |
| ***Total MSW Discarded - Weight*** | 82,510 | 113,040 | 137,120 | 163,450 | 159,190 | 160,790 | 160,560 | 157,660 | 151,860 |
| | **Percent of Total Discards** | | | | | | | | |
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 11.6% | 12.1% | 14.9% | 15.9% | 16.6% | 16.3% | 16.1% | 16.4% | 17.1% |
| *(Detail in Table 14)* | | | | | | | | | |
| **Nondurable Goods** | 18.1% | 18.9% | 21.7% | 26.5% | 25.2% | 25.9% | 27.3% | 28.1% | 28.7% |
| *(Detail in Table 17)* | | | | | | | | | |
| **Containers and Packaging** | 29.7% | 35.6% | 32.2% | 28.9% | 28.8% | 29.0% | 29.8% | 30.2% | 29.7% |
| *(Detail in Table 23)* | | | | | | | | | |
| ***Total Product** Wastes* | 59.4% | 66.6% | 68.8% | 71.3% | 70.6% | 71.3% | 73.1% | 74.6% | 75.4% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 14.8% | 11.3% | 9.5% | 8.1% | 8.6% | 8.4% | 8.5% | 8.5% | 8.9% |
| Yard Trimmings | 24.2% | 20.5% | 20.1% | 18.8% | 19.0% | 18.4% | 16.4% | 14.9% | 13.7% |
| Miscellaneous Inorganic Wastes | 1.6% | 1.6% | 1.6% | 1.8% | 1.9% | 1.9% | 1.9% | 2.0% | 2.1% |
| ***Total Other Wastes*** | 40.6% | 33.4% | 31.2% | 28.7% | 29.4% | 28.7% | 26.9% | 25.4% | 24.6% |
| ***Total MSW Discarded - %*** | 100.0% | 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.

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 2.1 million tons in 1995, leaving 1.3 million tons of appliances to be discarded.

**Small Appliances.** This category includes items such as toasters, hair dryers, electric coffeepots, and the like. Information on shipments of small appliances was obtained from Department of Commerce data. Information on weights and materials composition of small appliances was obtained through interviews. It was estimated that 710,000 tons of small appliances were generated in 1995. A small amount of ferrous metals in small appliances may be recovered through magnetic separation, but no specific data on recovery were found.

**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.

Generation of furniture and furnishings in MSW has increased from 2.2 million tons in 1960 to 7.2 million tons in 1995 (3.4 percent of total MSW). No significant recovery of materials from furniture was identified. Wood is the largest material category in furniture, with ferrous metals second. Plastics, glass, and other materials 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 2.2 million tons of carpets and rugs were generated in MSW in 1995, which was 1.1 percent of total generation.

A small amount of recycling of carpet fiber was identified—estimated to be less than one percent recovery in 1995.

**Vehicle Tires.** The methodology for estimating generation of rubber tires for automobiles and trucks are 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 3.8 million tons in 1995 (1.8 percent of total MSW).

Data on 1995 recovery of rubber tires are based on data from the Scrap Tire Management Council. Previous years were based on an EPA scrap tire market study, updated with information from *Scrap Tire News*. Rubber recovery from tires has been small, but increasing in recent years. In 1995, an estimated 17.5 percent of tire rubber generated was recovered for recycling, leaving 3.1 million tons to be discarded. (Tires going to combustion facilities are included in the combustion estimates in Chapter 3.)

**Lead-Acid Batteries**. The methodology for estimating generation of lead-acid batteries is similar to the methodology for rubber tires as described above. An estimated 1.9 million tons of lead-acid batteries from automobiles, trucks, and motorcycles were generated in MSW in 1995 (0.9 percent of total generation).

Data on recovery of batteries are provided by the Battery Council International. 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 combustors. In 1995, 95.8 percent of the lead in these batteries was recovered for recycling as well as substantial quantities of the polypropylene battery casings; so discards after recycling of these batteries were decreased to 80,000 tons in 1995. (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 Durables**. Miscellaneous durable goods include consumer electronics such as television sets, video cassette recorders, personal computers, luggage, sporting equipment, and the like. (Small appliances were included with miscellaneous durables in previous reports in this series, but are estimated separately in this report.) An estimated 12.0 million tons of these goods were generated in 1995, amounting to 5.8 percent of MSW generated. Small amounts of ferrous metals are estimated to be recovered from this category, decreasing discards to 11.3 million tons. In addition to ferrous metals, this category includes plastics, glass, rubber, wood, and other metals.

Table 12

**PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1995**
**(WITH DETAIL ON DURABLE GOODS)**
**(In thousands of tons and percent of total generation)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | | | | | | | | | |
| Major Appliances | 1,630 | 2,170 | 2,950 | 3,310 | 3,310 | 3,280 | 3,260 | 3,280 | 3,420 |
| Small Appliances** | | | | 460 | 490 | 520 | 570 | 650 | 710 |
| Furniture and Furnishings | 2,150 | 2,830 | 4,760 | 6,790 | 6,930 | 6,940 | 6,920 | 6,980 | 7,160 |
| Carpets and Rugs** | | | | 1,660 | 1,740 | 1,820 | 2,000 | 2,120 | 2,230 |
| Rubber Tires | 1,120 | 1,890 | 2,720 | 3,610 | 3,500 | 3,610 | 3,410 | 4,080 | 3,770 |
| Batteries, lead acid | Neg. | 820 | 1,490 | 1,510 | 1,540 | 1,530 | 1,530 | 2,010 | 1,910 |
| Miscellaneous Durables | 5,020 | 6,950 | 9,880 | 12,470 | 12,850 | 12,730 | 12,570 | 12,000 | 12,030 |
| ***Total Durable Goods*** | 9,920 | 14,660 | 21,800 | 29,810 | 30,360 | 30,430 | 30,260 | 31,120 | 31,230 |
| **Nondurable Goods** | 17,330 | 25,060 | 34,420 | 52,170 | 50,570 | 52,780 | 54,900 | 56,850 | 57,040 |
| *(Detail in Table 15)* | | | | | | | | | |
| **Containers and Packaging** | 27,370 | 43,560 | 52,670 | 64,220 | 64,340 | 67,440 | 70,220 | 73,190 | 72,860 |
| *(Detail in Table 18)* | | | | | | | | | |
| ***Total Product Wastes†*** | 54,620 | 83,280 | 108,890 | 146,200 | 145,270 | 150,650 | 155,380 | 161,160 | 161,130 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 12,200 | 12,800 | 13,000 | 13,200 | 13,660 | 13,560 | 13,720 | 13,870 | 14,020 |
| Yard Trimmings | 20,000 | 23,200 | 27,500 | 35,000 | 35,000 | 35,000 | 33,250 | 31,500 | 29,750 |
| Miscellaneous Inorganic Wastes | 1,300 | 1,780 | 2,250 | 2,900 | 2,950 | 3,000 | 3,050 | 3,100 | 3,150 |
| ***Total Other Wastes*** | 33,500 | 37,780 | 42,750 | 51,100 | 51,610 | 51,560 | 50,020 | 48,470 | 46,920 |
| ***Total MSW Generated - Weight*** | 88,120 | 121,060 | 151,640 | 197,300 | 196,880 | 202,210 | 205,400 | 209,630 | 208,050 |
| | **Percent of Total Generation** | | | | | | | | |
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | | | | | | | | | |
| Major Appliances | 1.8% | 1.8% | 1.9% | 1.7% | 1.7% | 1.6% | 1.6% | 1.6% | 1.6% |
| Small Appliances** | | | | 0.2% | 0.2% | 0.3% | 0.3% | 0.3% | 0.3% |
| Furniture and Furnishings | 2.4% | 2.3% | 3.1% | 3.4% | 3.5% | 3.4% | 3.4% | 3.3% | 3.4% |
| Carpets and Rugs** | | | | 0.8% | 0.9% | 0.9% | 1.0% | 1.0% | 1.1% |
| Rubber Tires | 1.3% | 1.6% | 1.8% | 1.8% | 1.8% | 1.8% | 1.7% | 1.9% | 1.8% |
| Batteries, Lead-Acid | Neg. | 0.7% | 1.0% | 0.8% | 0.8% | 0.8% | 0.7% | 1.0% | 0.9% |
| Miscellaneous Durables | 5.7% | 5.7% | 6.5% | 6.3% | 6.5% | 6.3% | 6.1% | 5.7% | 5.8% |
| ***Total Durable Goods*** | 11.3% | 12.1% | 14.4% | 15.1% | 15.4% | 15.0% | 14.7% | 14.8% | 15.0% |
| **Nondurable Goods** | 19.7% | 20.7% | 22.7% | 26.4% | 25.7% | 26.1% | 26.7% | 27.1% | 27.4% |
| *(Detail in Table 15)* | | | | | | | | | |
| **Containers and Packaging** | 31.1% | 36.0% | 34.7% | 32.5% | 32.7% | 33.4% | 34.2% | 34.9% | 35.0% |
| *(Detail in Table 19)* | | | | | | | | | |
| ***Total Product Wastes†*** | 62.0% | 68.8% | 71.8% | 74.1% | 73.8% | 74.5% | 75.6% | 76.9% | 77.4% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 13.8% | 10.6% | 8.6% | 6.7% | 6.9% | 6.7% | 6.7% | 6.6% | 6.7% |
| Yard Trimmings | 22.7% | 19.2% | 18.1% | 17.7% | 17.8% | 17.3% | 16.2% | 15.0% | 14.3% |
| Miscellaneous Inorganic Wastes | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% |
| ***Total Other Wastes*** | 38.0% | 31.2% | 28.2% | 25.9% | 26.2% | 25.5% | 24.4% | 23.1% | 22.6% |
| ***Total MSW Generated - %*** | 100.0% | 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.
† 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 1995**
**(WITH DETAIL ON DURABLE GOODS)**
**(In thousands of tons and percent of generation of each product)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | | | | | | | | | |
| Major Appliances | 10 | 50 | 130 | 1,070 | 1,230 | 1,450 | 1,840 | 1,910 | 2,070 |
| Small Appliances** | | | | 10 | 10 | 10 | 10 | 10 | 10 |
| Furniture and Furnishings | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Carpets and Rugs** | | | | Neg. | 10 | 10 | 10 | 10 | 20 |
| Rubber Tires | 330 | 250 | 150 | 440 | 460 | 470 | 450 | 620 | 660 |
| Batteries, lead acid | Neg. | 620 | 1,040 | 1,480 | 1,490 | 1,450 | 1,420 | 1,980 | 1,830 |
| Miscellaneous Durables | 10 | 20 | 40 | 810 | 780 | 760 | 730 | 700 | 730 |
| ***Total Durable Goods*** | 350 | 940 | 1,360 | 3,810 | 3,980 | 4,150 | 4,460 | 5,230 | 5,320 |
| **Nondurable Goods** | 2,390 | 3,730 | 4,670 | 8,800 | 10,390 | 11,070 | 11,080 | 12,610 | 13,520 |
| *(Detail in Table 16)* | | | | | | | | | |
| **Containers and Packaging** | 2,870 | 3,350 | 8,490 | 17,040 | 18,520 | 20,800 | 22,400 | 25,650 | 27,780 |
| *(Detail in Table 20).* | | | | | | | | | |
| ***Total Product Wastes†*** | 5,610 | 8,020 | 14,520 | 29,650 | 32,890 | 36,020 | 37,940 | 43,490 | 46,620 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | 480 | 570 |
| Yard Trimmings | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,000 | 9,000 |
| Miscellaneous Inorganic Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Other Wastes*** | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,480 | 9,570 |
| ***Total MSW Recovered - Weight*** | 5,610 | 8,020 | 14,520 | 33,850 | 37,690 | 41,420 | 44,840 | 51,970 | 56,190 |
| | **Percent of Generation of Each Product** | | | | | | | | |
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | | | | | | | | | |
| Major Appliances | 0.6% | 2.3% | 4.4% | 32.3% | 37.2% | 44.2% | 56.4% | 58.2% | 60.5% |
| Small Appliances** | | | | 2.2% | 2.0% | 1.9% | 1.8% | 1.5% | 1.4% |
| Furniture and Furnishings | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Carpets and Rugs** | | | | Neg. | 0.6% | 0.5% | 0.5% | 0.5% | 0.9% |
| Rubber Tires | 29.5% | 13.2% | 5.5% | 12.2% | 13.1% | 13.0% | 13.2% | 15.2% | 17.5% |
| Batteries, Lead-Acid | Neg. | 75.6% | 69.8% | 98.0% | 96.8% | 94.8% | 92.8% | 98.5% | 95.8% |
| Miscellaneous Durables | 0.2% | 0.3% | 0.4% | 6.5% | 6.1% | 6.0% | 5.8% | 5.8% | 6.1% |
| ***Total Durable Goods*** | 3.5% | 6.4% | 6.2% | 12.8% | 13.1% | 13.6% | 14.7% | 16.8% | 17.0% |
| **Nondurable Goods** | 13.8% | 14.9% | 13.6% | 16.9% | 20.5% | 21.0% | 20.2% | 22.2% | 23.7% |
| *(Detail in Table 16)* | | | | | | | | | |
| **Containers and Packaging** | 10.5% | 7.7% | 16.1% | 26.5% | 28.8% | 30.8% | 31.9% | 35.0% | 38.1% |
| *(Detail in Table 21)* | | | | | | | | | |
| ***Total Product Wastes†*** | 10.3% | 9.6% | 13.3% | 20.3% | 22.6% | 23.9% | 24.4% | 27.0% | 28.9% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | 3.5% | 4.1% |
| Yard Trimmings | Neg. | Neg. | Neg. | 12.0% | 13.7% | 15.4% | 20.8% | 25.4% | 30.3% |
| Miscellaneous Inorganic Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Other Wastes*** | Neg. | Neg. | Neg. | 8.2% | 9.3% | 10.5% | 13.8% | 17.5% | 20.4% |
| ***Total MSW Recovered - %*** | 6.4% | 6.6% | 9.6% | 17.2% | 19.1% | 20.5% | 21.8% | 24.8% | 27.0% |

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Not estimated separately prior to 1990.
† 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 1995**
**(WITH DETAIL ON DURABLE GOODS)**
**(In thousands of tons and percent of total discards)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | | | | | | | | | |
| Major Appliances | 1,620 | 2,120 | 2,820 | 2,240 | 2,080 | 1,830 | 1,420 | 1,370 | 1,350 |
| Small Appliances** | | | | 450 | 480 | 510 | 560 | 640 | 700 |
| Furniture and Furnishings | 2,150 | 2,830 | 4,760 | 6,790 | 6,930 | 6,940 | 6,920 | 6,980 | 7,160 |
| Carpets and Rugs** | | | | 1,660 | 1,730 | 1,810 | 1,990 | 2,110 | 2,210 |
| Rubber Tires | 790 | 1,640 | 2,570 | 3,170 | 3,040 | 3,140 | 2,960 | 3,460 | 3,110 |
| Batteries, lead acid | Neg. | 200 | 450 | 30 | 50 | 80 | 110 | 30 | 80 |
| Miscellaneous Durables | 5,010 | 6,930 | 9,840 | 11,660 | 12,070 | 11,970 | 11,840 | 11,300 | 11,300 |
| ***Total Durable Goods*** | 9,570 | 13,720 | 20,440 | 26,000 | 26,380 | 26,280 | 25,800 | 25,890 | 25,910 |
| **Nondurable Goods** | 14,940 | 21,330 | 29,750 | 43,370 | 40,180 | 41,710 | 43,820 | 44,240 | 43,520 |
| *(Detail in Table 17)* | | | | | | | | | |
| **Containers and Packaging** | 24,500 | 40,210 | 44,180 | 47,180 | 45,820 | 46,640 | 47,820 | 47,540 | 45,080 |
| *(Detail in Table 22)* | | | | | | | | | |
| ***Total Product Wastes†*** | 49,010 | 75,260 | 94,370 | 116,550 | 112,380 | 114,630 | 117,440 | 117,670 | 114,510 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 12,200 | 12,800 | 13,000 | 13,200 | 13,660 | 13,560 | 13,720 | 13,390 | 13,450 |
| Yard Trimmings | 20,000 | 23,200 | 27,500 | 30,800 | 30,200 | 29,600 | 26,350 | 23,500 | 20,750 |
| Miscellaneous Inorganic Wastes | 1,300 | 1,780 | 2,250 | 2,900 | 2,950 | 3,000 | 3,050 | 3,100 | 3,150 |
| ***Total Other Wastes*** | 33,500 | 37,780 | 42,750 | 46,900 | 46,810 | 46,160 | 43,120 | 39,990 | 37,350 |
| ***Total MSW Discarded - Weight*** | 82,510 | 113,040 | 137,120 | 163,450 | 159,190 | 160,790 | 160,560 | 157,660 | 151,860 |
| | **Percent of Total Discards** | | | | | | | | |
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | | | | | | | | | |
| Major Appliances | 2.0% | 1.9% | 2.1% | 1.4% | 1.3% | 1.1% | 0.9% | 0.9% | 0.9% |
| Small Appliances** | | | | 0.3% | 0.3% | 0.3% | 0.3% | 0.4% | 0.5% |
| Furniture and Furnishings | 2.6% | 2.5% | 3.5% | 4.2% | 4.4% | 4.3% | 4.3% | 4.4% | 4.7% |
| Carpets and Rugs** | | | | 1.0% | 1.1% | 1.1% | 1.2% | 1.3% | 1.5% |
| Rubber Tires | 1.0% | 1.5% | 1.9% | 1.9% | 1.9% | 2.0% | 1.8% | 2.2% | 2.0% |
| Batteries, Lead-Acid | Neg. | 0.2% | 0.3% | 0.0% | 0.0% | 0.0% | 0.1% | 0.0% | 0.1% |
| Miscellaneous Durables | 6.1% | 6.1% | 7.2% | 7.1% | 7.6% | 7.4% | 7.4% | 7.2% | 7.4% |
| ***Total Durable Goods*** | 11.6% | 12.1% | 14.9% | 15.9% | 16.6% | 16.3% | 16.1% | 16.4% | 17.1% |
| **Nondurable Goods** | 18.1% | 18.9% | 21.7% | 26.5% | 25.2% | 25.9% | 27.3% | 28.1% | 28.7% |
| *(Detail in Table 17)* | | | | | | | | | |
| **Containers and Packaging** | 29.7% | 35.6% | 32.2% | 28.9% | 28.8% | 29.0% | 29.8% | 30.2% | 29.7% |
| *(Detail in Table 23)* | | | | | | | | | |
| ***Total Product Wastes†*** | 59.4% | 66.6% | 68.8% | 71.3% | 70.6% | 71.3% | 73.1% | 74.6% | 75.4% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 14.8% | 11.3% | 9.5% | 8.1% | 8.6% | 8.4% | 8.5% | 8.5% | 8.9% |
| Yard Trimmings | 24.2% | 20.5% | 20.1% | 18.8% | 19.0% | 18.4% | 16.4% | 14.9% | 13.7% |
| Miscellaneous Inorganic Wastes | 1.6% | 1.6% | 1.6% | 1.8% | 1.9% | 1.9% | 1.9% | 2.0% | 2.1% |
| ***Total Other Wastes*** | 40.6% | 33.4% | 31.2% | 28.7% | 29.4% | 28.7% | 26.9% | 25.4% | 24.6% |
| ***Total MSW Discarded - %*** | 100.0% | 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.

† Other than food products.

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

Source: Franklin Associates, Ltd.

## 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 57.0 million tons in 1995 (27.4 percent of total generation). Recovery of paper products in this category is quite significant, resulting in 13.5 million tons of nondurable goods recovered in 1995 (23.7 percent of nondurables generation). This means that 43.5 million tons of nondurable goods were discarded in 1995 (28.7 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 1995 was shown earlier in Table 4. 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 13.1 million tons generated in 1995 (6.5 percent of total MSW). In 1995, 53.0 percent of newspapers generated were recovered for recycling, leaving 6.2 million tons discarded (4.1 percent of total MSW discarded). Estimates of newspaper generation are broken down into newsprint (the majority of the weight of newspapers) and the groundwood* 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 1.2 million tons, or 0.6 percent of total MSW generation, in 1995. Recovery of books is not well documented, but it was estimated that approximately 220,000 tons of books were recovered in 1995. Books are made of both groundwood and chemical pulp.

- Magazines accounted for an estimated 2.4 million tons, or 1.1 percent of total MSW generation, in 1995. Like books, recovery of magazines is not

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

well documented. It was estimated that 670,000 tons of magazines were recovered in 1995. 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. (7.1 million tons, or 3.3 percent of total MSW generation, in 1995). 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 3.0 million tons of office-type papers were recovered in 1995.

- Telephone directories were estimated to generate 490,000 tons (0.2 percent of total MSW) in 1995. These directories are made of groundwood. It was estimated that 60,000 tons of directories were recovered in 1995. The Yellow Pages Publishers Association (YPPA) has instituted a programs to encourage recovery of directories and has begun to collect and publish data on generation. Beginning in 1993 the generation data in this report are taken from YPPA data; therefore, there is some discontinuity with the data published for earlier years, which was estimated. YPPA has discontinued its practice of estimating recovery of directories.

- Third-class mail includes catalogs and other direct bulk mailings; these amounted to 4.6 million tons, or 2.2 percent of MSW generation, in 1995. Both groundwood and chemical pulps are used in these mailings. It was estimated that 710,000 tons were recovered in 1995. The U.S. Postal Service is implementing a program to increase recovery of bulk mail in the future.

- Other commercial printing includes a wide range of paper items: brochures, reports, menus, invitations, etc. Both groundwood and chemical pulps are used in these varied items. Generation was estimated at 7.1 million tons, or 3.4 percent of MSW generation, in 1995, with recovery at 1.1 million tons.

- Tissue paper and towels include facial and sanitary tissues and napkins, but not bathroom tissue, which is nearly all diverted from MSW into the wastewater treatment system. Tissue products amounted to 2.9 million tons (1.4 percent of total MSW generation) in 1995. No significant recovery of tissue products was identified.

- 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 970,000 tons (0.5 percent of total MSW generation) in 1995. No significant recovery of these products was identified.

- Other nonpackaging papers—including posters, photographic papers, cards and games, etc.—accounted for 3.8 million tons (2.4 percent of total MSW generation) in 1995. No significant recovery of these papers was identified.

Overall, generation of paper and paperboard products in nondurable goods was 43.5 million tons in 1995 (Table 4). While newspapers were recovered at the highest rate, other paper products, such as books, magazines, and office papers, were also recovered for recycling, and the overall recovery rate for paper in nondurables was 29.3 percent in 1995. Thus 30.8 million tons of paper in nondurables were discarded in 1995.

**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 790,000 tons of these products were generated in 1995, or 0.4 percent of total MSW (see Table 15). An estimated 13,000 tons of these products were recovered for recycling in 1995.

**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 3.0 million tons of disposable diapers were generated in 1995, or 1.4 percent of total MSW generation. (This tonnage includes an adjustment for the urine and feces contained within the discarded diapers.) The materials portion of the diapers includes wood pulp, plastics (including the super-absorbent materials now present in most diapers), and tissue paper.

There has been some investigation of recycling/composting of disposable diapers, but no significant recovery was identified for 1995.

**Clothing and Footwear.** Generation of clothing and footwear was estimated to be 5.1 million tons in 1995 (2.4 percent of total MSW). Textiles, rubber, and leather are major materials components of this category, with some plastics present as well. Generation estimates for these products are based on sales data from the Department of Commerce along with data on average weights for each type of product included. Adjustments are made for net imports of these products based on Department of Commerce data.

The Council for Textile Recycling has reported on recovery of textiles for exports, reprocessing, and reuse. Based on their data, it was estimated that 660,000 tons of textiles in clothing were recovered for export or recycling in 1995. (Reuse is not counted as recycling and is discussed in Chapter 3.)

**Towels, Sheets, and Pillowcases.** An estimated 740,000 tons of towels, sheets, and pillowcases were generated in 1995. Generation was estimated using a methodology similar to that for clothing. An estimated 120,000 tons of these textiles were recovered for export or recycling in 1995.

**Other Miscellaneous Nondurables.** Generation of other miscellaneous nondurables was estimated to be 3.3 million tons in 1995 (1.6 percent of MSW). The primary material component of miscellaneous nondurables is plastics, although some aluminum, rubber, and textiles are also present. Typical products in miscellaneous nondurables include shower curtains and other household items, disposable medical supplies, novelty items, and the like.

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.

Table 15

**PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1995**
**(WITH DETAIL ON NONDURABLE GOODS)**
**(In thousands of tons and percent of total generation)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 9,920 | 14,660 | 21,800 | 29,810 | 30,360 | 30,430 | 30,260 | 31,120 | 31,230 |
| *(Detail in Table 12)* | | | | | | | | | |
| **Nondurable Goods** | | | | | | | | | |
| Newspapers | 7,110 | 9,510 | 11,050 | 13,430 | 12,480 | 12,680 | 12,940 | 13,680 | 13,130 |
| Books and Magazines | 1,920 | 2,470 | 3,390 | | | | | | |
| Books** | | | | 970 | 870 | 930 | 1,070 | 1,180 | 1,170 |
| Magazines** | | | | 2,830 | 2,200 | 2,370 | 2,240 | 2,250 | 2,370 |
| Office Papers | 1,520 | 2,650 | 4,000 | 6,410 | 6,320 | 6,660 | 6,610 | 6,970 | 6,800 |
| Telephone Directories** | | | | 610 | 630 | 680 | 480 | 470 | 490 |
| Third Class Mail** | | | | 3,820 | 3,690 | 3,560 | 4,000 | 4,400 | 4,620 |
| Other Commercial Printing | 1,260 | 2,130 | 3,120 | 4,460 | 4,710 | 5,500 | 6,500 | 6,080 | 7,110 |
| Tissue Paper and Towels | 1,090 | 2,080 | 2,300 | 2,960 | 2,690 | 2,750 | 2,870 | 2,860 | 2,950 |
| Paper Plates and Cups | 270 | 420 | 630 | 650 | 660 | 680 | 800 | 870 | 970 |
| Plastic Plates and Cups† | | | 190 | 650 | 640 | 680 | 700 | 810 | 790 |
| Trash Bags** | | | | 780 | 770 | 840 | 890 | 940 | 750 |
| Disposable Diapers | Neg. | 350 | 1,930 | 2,700 | 2,810 | 2,870 | 2,910 | 2,980 | 2,960 |
| Other Nonpackaging Paper | 2,700 | 3,630 | 4,230 | 3,840 | 3,800 | 4,120 | 4,250 | 4,470 | 3,800 |
| Clothing and Footwear | 1,360 | 1,620 | 2,170 | 4,010 | 4,230 | 4,400 | 4,580 | 4,870 | 5,070 |
| Towels, Sheets and Pillowcases** | | | | 710 | 710 | 720 | 730 | 750 | 740 |
| Other Miscellaneous Nondurables | 100 | 200 | 1,410 | 3,340 | 3,360 | 3,340 | 3,330 | 3,270 | 3,320 |
| ***Total Nondurable Goods*** | 17,330 | 25,060 | 34,420 | 52,170 | 50,570 | 52,780 | 54,900 | 56,850 | 57,040 |
| **Containers and Packaging** | 27,370 | 43,560 | 52,670 | 64,220 | 64,340 | 67,440 | 70,220 | 73,190 | 72,860 |
| *(Detail in Table 18)* | | | | | | | | | |
| ***Total Product Wastes‡*** | 54,620 | 83,280 | 108,890 | 146,200 | 145,270 | 150,650 | 155,380 | 161,160 | 161,130 |
| **Other Wastes** | 33,500 | 37,780 | 42,750 | 51,100 | 51,610 | 51,560 | 50,020 | 48,470 | 46,920 |
| ***Total MSW Generated - Weight*** | 88,120 | 121,060 | 151,640 | 197,300 | 196,880 | 202,210 | 205,400 | 209,630 | 208,050 |
| | **Percent of Total Generation** | | | | | | | | |
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 11.3% | 12.1% | 14.4% | 15.1% | 15.4% | 15.0% | 14.7% | 14.8% | 15.0% |
| *(Detail in Table 12)* | | | | | | | | | |
| **Nondurable Goods** | | | | | | | | | |
| Newspapers | 8.1% | 7.9% | 7.3% | 6.8% | 6.3% | 6.3% | 6.3% | 6.5% | 6.3% |
| Books and Magazines | 2.2% | 2.0% | 2.2% | | | | | | |
| Books** | | | | 0.5% | 0.4% | 0.5% | 0.5% | 0.6% | 0.6% |
| Magazines** | | | | 1.4% | 1.1% | 1.2% | 1.1% | 1.1% | 1.1% |
| Office Papers | 1.7% | 2.2% | 2.6% | 3.2% | 3.2% | 3.3% | 3.2% | 3.3% | 3.3% |
| Telephone Directories** | | | | 0.3% | 0.3% | 0.3% | 0.2% | 0.2% | 0.2% |
| Third Class Mail** | | | | 1.9% | 1.9% | 1.8% | 1.9% | 2.1% | 2.2% |
| Other Commercial Printing | 1.4% | 1.8% | 2.1% | 2.3% | 2.4% | 2.7% | 3.2% | 2.9% | 3.4% |
| Tissue Paper and Towels | 1.2% | 1.7% | 1.5% | 1.5% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% |
| Paper Plates and Cups | 0.3% | 0.3% | 0.4% | 0.3% | 0.3% | 0.3% | 0.4% | 0.4% | 0.5% |
| Plastic Plates and Cups† | | | 0.1% | 0.3% | 0.3% | 0.3% | 0.3% | 0.4% | 0.4% |
| Trash Bags** | | | | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% |
| Disposable Diapers | Neg. | 0.3% | 1.3% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% | 1.4% |
| Other Nonpackaging Paper | 3.1% | 3.0% | 2.8% | 1.9% | 1.9% | 2.0% | 2.1% | 2.1% | 1.8% |
| Clothing and Footwear | 1.5% | 1.3% | 1.4% | 2.0% | 2.1% | 2.2% | 2.2% | 2.3% | 2.4% |
| Towels, Sheets and Pillowcases** | | | | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% |
| Other Miscellaneous Nondurables | 0.1% | 0.2% | 0.9% | 1.7% | 1.7% | 1.7% | 1.6% | 1.6% | 1.6% |
| ***Total Nondurables*** | 19.7% | 20.7% | 22.7% | 26.4% | 25.7% | 26.1% | 26.7% | 27.1% | 27.4% |
| **Containers and Packaging** | 31.1% | 36.0% | 34.7% | 32.5% | 32.7% | 33.4% | 34.2% | 34.9% | 35.0% |
| *(Detail in Table 19)* | | | | | | | | | |
| ***Total Product Wastes‡*** | 62.0% | 68.8% | 71.8% | 74.1% | 73.8% | 74.5% | 75.6% | 76.9% | 77.4% |
| **Other Wastes** | 38.0% | 31.2% | 28.2% | 25.9% | 26.2% | 25.5% | 24.4% | 23.1% | 22.6% |
| ***Total MSW Generated - %*** | 100.0% | 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 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 1995**
**(WITH DETAIL ON NONDURABLE GOODS)**
**(In thousands of tons and percent of generation of each product)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 350 | 940 | 1,360 | 3,810 | 3,980 | 4,150 | 4,460 | 5,230 | 5,320 |
| *(Detail in Table 13)* | | | | | | | | | |
| **Nondurable Goods** | | | | | | | | | |
| Newspapers | 1,820 | 2,250 | 3,020 | 5,110 | 5,740 | 6,000 | 5,670 | 6,250 | 6,960 |
| Books and Magazines | 100 | 260 | 280 | | | | | | |
| Books** | | | | 100 | 120 | 140 | 180 | 220 | 220 |
| Magazines** | | | | 300 | 340 | 380 | 450 | 630 | 670 |
| Office Papers | 250 | 710 | 870 | 1,700 | 2,270 | 2,440 | 2,650 | 2,940 | 3,010 |
| *Telephone Directories*** | | | | 40 | 50 | 50 | 50 | 50 | 60 |
| Third Class Mail** | | | | 200 | 330 | 350 | 440 | 690 | 710 |
| Other Commercial Printing | 130 | 340 | 350 | 700 | 850 | 1,000 | 900 | 1,050 | 1,100 |
| Tissue Paper and Towels | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Paper Plates and Cups | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Plastic Plates and Cups† | | | Neg. | 10 | 20 | 20 | 20 | 10 | 10 |
| Trash Bags** | | | | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Disposable Diapers | | | | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Other Nonpackaging Paper | 40 | 110 | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Clothing and Footwear | 50 | 60 | 150 | 520 | 550 | 570 | 600 | 640 | 660 |
| Towels, Sheets and Pillowcases** | | | | 120 | 120 | 120 | 120 | 130 | 120 |
| Other Miscellaneous Nondurables | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Nondurable Goods*** | 2,390 | 3,730 | 4,670 | 8,800 | 10,390 | 11,070 | 11,080 | 12,610 | 13,520 |
| **Containers and Packaging** | 2,870 | 3,350 | 8,490 | 17,040 | 18,520 | 20,800 | 22,400 | 25,650 | 27,780 |
| *(Detail in Table 20)* | | | | | | | | | |
| ***Total Product Wastes‡*** | 5,610 | 8,020 | 14,520 | 29,650 | 32,890 | 36,020 | 37,940 | 43,490 | 46,620 |
| **Other Wastes** | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,480 | 9,570 |
| ***Total MSW Recovered - Weight*** | 5,610 | 8,020 | 14,520 | 33,850 | 37,690 | 41,420 | 44,840 | 51,970 | 56,190 |
| | **Percent of Generation of Each Product** | | | | | | | | |
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 3.5% | 6.4% | 6.2% | 12.8% | 13.1% | 13.6% | 14.7% | 16.8% | 17.0% |
| *(Detail in Table 13)* | | | | | | | | | |
| **Nondurable Goods** | | | | | | | | | |
| Newspapers | 25.6% | 23.7% | 27.3% | 38.0% | 46.0% | 47.3% | 43.8% | 45.7% | 53.0% |
| Books and Magazines | 5.2% | 10.5% | 8.3% | | | | | | |
| Books** | | | | 10.3% | 13.8% | 15.1% | 16.8% | 18.6% | 18.8% |
| Magazines** | | | | 10.6% | 15.5% | 16.0% | 20.1% | 28.0% | 28.3% |
| Office Papers | 16.4% | 26.8% | 21.8% | 26.5% | 35.9% | 36.6% | 40.1% | 42.2% | 44.3% |
| Telephone Directories** | | | | 6.6% | 7.9% | 7.4% | 10.4% | 10.6% | 12.2% |
| Third Class Mail** | | | | 5.2% | 8.9% | 9.8% | 11.0% | 15.7% | 15.4% |
| Other Commercial Printing | 10.3% | 16.0% | 11.2% | 15.7% | 18.0% | 18.2% | 13.8% | 17.3% | 15.5% |
| Tissue Paper and Towels | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Paper Plates and Cups | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Plastic Plates and Cups† | | | Neg. | 1.5% | 3.1% | 2.9% | 2.9% | 1.2% | 1.3% |
| Trash Bags** | | | | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Disposable Diapers | | | | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Other Nonpackaging Paper | 1.5% | 3.0% | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Clothing and Footwear | Neg. | Neg. | Neg. | 13.0% | 13.0% | 13.0% | 13.1% | 13.1% | 13.0% |
| Towels, Sheets and Pillowcases** | | | | 16.9% | 16.9% | 16.7% | 16.4% | 17.3% | 16.2% |
| *Other Miscellaneous Nondurables* | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Nondurables*** | 13.8% | 14.9% | 13.6% | 16.9% | 20.5% | 21.0% | 20.2% | 22.2% | 23.7% |
| **Containers and Packaging** | 10.5% | 7.7% | 16.1% | 26.5% | 28.8% | 30.8% | 31.9% | 35.0% | 38.1% |
| *(Detail in Table 21)* | | | | | | | | | |
| ***Total Product Wastes‡*** | 10.3% | 9.6% | 13.3% | 20.3% | 22.6% | 23.9% | 24.4% | 27.0% | 28.9% |
| **Other Wastes** | Neg. | Neg. | Neg. | 8.2% | 9.3% | 10.5% | 13.8% | 17.5% | 20.4% |
| ***Total MSW Recovered - %*** | 6.4% | 6.6% | 9.6% | 17.2% | 19.1% | 20.5% | 21.8% | 24.8% | 27.0% |

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Not estimated separately prior to 1990.
† 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 1995**
**(WITH DETAIL ON NONDURABLE GOODS)**
**(In thousands of tons and percent of total discards)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 9,570 | 13,720 | 20,440 | 26,000 | 26,380 | 26,280 | 25,800 | 25,890 | 25,910 |
| *(Detail in Table 14)* | | | | | | | | | |
| **Nondurable Goods** | | | | | | | | | |
| Newspapers | 5,290 | 7,260 | 8,030 | 8,320 | 6,740 | 6,680 | 7,270 | 7,430 | 6,170 |
| Books and Magazines | 1,820 | 2,210 | 3,110 | | | | | | |
| Books** | | | | 870 | 750 | 790 | 890 | 960 | 950 |
| Magazines** | | | | 2,530 | 1,860 | 1,990 | 1,790 | 1,620 | 1,700 |
| Office Papers | 1,270 | 1,940 | 3,130 | 4,710 | 4,050 | 4,220 | 3,960 | 4,030 | 3,790 |
| Telephone Directories** | | | | 570 | 580 | 630 | 430 | 420 | 430 |
| Third Class Mail** | | | | 3,620 | 3,360 | 3,210 | 3,560 | 3,710 | 3,910 |
| Other Commercial Printing | 1,130 | 1,790 | 2,770 | 3,760 | 3,860 | 4,500 | 5,600 | 5,030 | 6,010 |
| Tissue Paper and Towels | 1,090 | 2,080 | 2,300 | 2,960 | 2,690 | 2,750 | 2,870 | 2,860 | 2,950 |
| Paper Plates and Cups | 270 | 420 | 630 | 650 | 660 | 680 | 800 | 870 | 970 |
| Plastic Plates and Cups† | | | 190 | 640 | 620 | 660 | 680 | 800 | 780 |
| Trash Bags** | | | | 780 | 770 | 840 | 890 | 940 | 750 |
| Disposable Diapers | Neg. | 350 | 1,930 | 2,700 | 2,810 | 2,870 | 2,910 | 2,980 | 2,960 |
| Other Nonpackaging Paper | 2,660 | 3,520 | 4,230 | 3,840 | 3,800 | 4,120 | 4,250 | 4,470 | 3,800 |
| Clothing and Footwear | 1,310 | 1,560 | 2,020 | 3,490 | 3,680 | 3,830 | 3,980 | 4,230 | 4,410 |
| Towels, Sheets and Pillowcases** | | | | 590 | 590 | 600 | 610 | 620 | 620 |
| Other Miscellaneous Nondurables | 100 | 200 | 1,410 | 3,340 | 3,360 | 3,340 | 3,330 | 3,270 | 3,320 |
| ***Total Nondurable Goods*** | 14,940 | 21,330 | 29,750 | 43,370 | 40,180 | 41,710 | 43,820 | 44,240 | 43,520 |
| **Containers and Packaging** | 24,500 | 40,210 | 44,180 | 47,180 | 45,820 | 46,640 | 47,820 | 47,540 | 45,080 |
| *(Detail in Table 22)* | | | | | | | | | |
| ***Total Product Wastes‡*** | 49,010 | 75,260 | 94,370 | 116,550 | 112,380 | 114,630 | 117,440 | 117,670 | 114,510 |
| **Other Wastes** | 33,500 | 37,780 | 42,750 | 46,900 | 46,810 | 46,160 | 43,120 | 39,990 | 37,350 |
| ***Total MSW Discarded - Weight*** | 82,510 | 113,040 | 137,120 | 163,450 | 159,190 | 160,790 | 160,560 | 157,660 | 151,860 |
| | **Percent of Total Discards** | | | | | | | | |
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 11.6% | 12.1% | 14.9% | 15.9% | 16.6% | 16.3% | 16.1% | 16.4% | 17.1% |
| *(Detail in Table 14)* | | | | | | | | | |
| **Nondurable Goods** | | | | | | | | | |
| Newspapers | 6.4% | 6.4% | 5.9% | 5.1% | 4.2% | 4.2% | 4.5% | 4.7% | 4.1% |
| Books and Magazines | 2.2% | 2.0% | 2.3% | | | | | | |
| Books** | | | | 0.5% | 0.5% | 0.5% | 0.6% | 0.6% | 0.6% |
| Magazines** | | | | 1.5% | 1.2% | 1.2% | 1.1% | 1.0% | 1.1% |
| Office Papers | 1.5% | 1.7% | 2.3% | 2.9% | 2.5% | 2.6% | 2.5% | 2.6% | 2.5% |
| Telephone Directories** | | | | 0.3% | 0.4% | 0.4% | 0.3% | 0.3% | 0.3% |
| Third Class Mail** | | | | 2.2% | 2.1% | 2.0% | 2.2% | 2.4% | 2.6% |
| Other Commercial Printing | 1.4% | 1.6% | 2.0% | 2.3% | 2.4% | 2.8% | 3.5% | 3.2% | 4.0% |
| Tissue Paper and Towels | 1.3% | 1.8% | 1.7% | 1.8% | 1.7% | 1.7% | 1.8% | 1.8% | 1.9% |
| Paper Plates and Cups | 0.3% | 0.4% | 0.5% | 0.4% | 0.4% | 0.4% | 0.5% | 0.6% | 0.6% |
| Plastic Plates and Cups† | | | 0.1% | 0.4% | 0.4% | 0.4% | 0.4% | 0.5% | 0.5% |
| Trash Bags** | | | | 0.5% | 0.5% | 0.5% | 0.6% | 0.6% | 0.5% |
| Disposable Diapers | Neg. | 0.3% | 1.4% | 1.7% | 1.8% | 1.8% | 1.8% | 1.9% | 1.9% |
| Other Nonpackaging Paper | 3.2% | 3.1% | 3.1% | 2.3% | 2.4% | 2.6% | 2.6% | 2.8% | 2.5% |
| Clothing and Footwear | 1.6% | 1.4% | 1.5% | 2.1% | 2.3% | 2.4% | 2.5% | 2.7% | 2.9% |
| Towels, Sheets and Pillowcases** | | | | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% |
| Other Miscellaneous Nondurables | 0.1% | 0.2% | 1.7% | 2.0% | 2.1% | 2.1% | 2.1% | 2.1% | 2.2% |
| ***Total Nondurables*** | 18.1% | 18.9% | 21.7% | 26.5% | 25.2% | 25.9% | 27.3% | 28.1% | 28.7% |
| **Containers and Packaging** | 29.7% | 35.6% | 32.2% | 28.9% | 28.8% | 29.0% | 29.8% | 30.2% | 29.7% |
| *(Detail in Table 23)* | | | | | | | | | |
| ***Total Product Wastes‡*** | 59.4% | 66.6% | 68.8% | 71.3% | 70.6% | 71.3% | 73.1% | 74.6% | 75.4% |
| **Other Wastes** | 40.6% | 33.4% | 31.2% | 28.7% | 29.4% | 28.7% | 26.9% | 25.4% | 24.6% |
| ***Total MSW Discarded - %*** | 100.0% | 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 1980.
‡ Other than food products.
Neg. = Less than 5,000 tons or 0.05 percent.
Source: Franklin Associates, Ltd.

## Containers and Packaging

Containers and packaging make up a major portion of MSW, amounting to 72.9 million tons of generation in 1995 (35.0 percent of total generation). 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 1995, 38.1 percent of containers and packaging generated was recovered for recycling. Because of this recovery, containers and packaging comprised 29.7 percent of total MSW discards in 1995.

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

**Glass Containers.** Glass containers include beer and soft drink bottles, 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 these glass containers was 11.5 million tons in 1995, or 5.5 percent of MSW generation (Tables 18 and 19). This is a slight decrease in generation compared to 1994.

The Glass Packaging Institute (GPI) reports a recovery rate for glass containers, but includes reuse of refillable bottles in the figure. Since refilling is defined as reuse rather than recycling in this report, the refilled bottles are not counted as recovery here. An estimated 3.1 million tons of glass containers were recovered for recycling in 1995, or 27.2 percent of generation. After recovery for recycling, glass container discards were 8.4 million tons in 1995, or 5.5 percent of total MSW discards.

**Steel Containers and Packaging.** Steel beer and soft drink cans, food and other cans, and other steel packaging (e.g., strapping), totaled 2.9 million tons in 1995 (1.4 percent of total MSW generation), with most of that amount being "tin" cans for food (Tables 18 and 19). Generation estimates are based on data supplied by the Steel Recycling Institute (SRI), the American Iron and Steel Institute (AISI), and the Can Manufacturers Institute (CMI). Generation estimates include adjustments for imports and exports.

Recovery data for steel containers and packaging were provided by the Steel Recycling Institute. An estimated 1.6 million tons of steel packaging were recovered in 1995, or 54.4 percent of generation. The SRI estimates include both

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 annual plastic recovery survey. Adjustments are made for imports and exports based on Department of Commerce data.

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 7.7 million tons in 1995 (3.7 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 and base cups were estimated to have been recovered at a 45.5 percent rate in 1995 (300,000 tons). Recovery of plastic milk and water bottles was estimated to have been 185,000 tons, or 30.2 percent of generation. Overall, recovery of plastic containers and packaging was estimated to be 750,000 tons, or 9.7 percent in 1995. Discards of plastic containers and packaging were thus 7.0 million tons in 1995, or 4.6 percent of total discards.

**Wood Packaging.** Wood packaging includes wood crates and pallets (mostly pallets). Data on production of wood packaging (in units) is obtained from the Wooden Pallet and Container Association, and converted to weight using converting factors for wood. In 1995, 10.6 million tons of wood packaging were estimated to have been generated. Wood packaging was thus 5.1 percent of total MSW generation in 1995.

There is increasing recovery of wood pallets, mostly by chipping to make products like mulch. Recovery of wood pallets was estimated based on data from the Wooden Pallet and Container Association. It was estimated that 1.4 million tons of wood were recovered in this manner in 1995, or 13.5 percent of generation. This left 9.2 million tons discarded in 1995, or 6.0 percent of discards.

There is considerable reuse of wood pallets. Reuse was not counted as recycling in this chapter, but is accounted for when calculating wood pallet generation. Reuse of pallets is discussed further in the section on source reduction in Chapter 3.

**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, but were estimated to amount to 160,000 tons generated in 1995.

recovery from residential sources and magnetic separation of steel cans and other products at waste-to-energy facilities.

**Aluminum Containers and Packaging.** Aluminum containers and packaging include beer and soft drink cans, other cans, and foil and closures. Aluminum can generation is estimated based on data from the Can Manufacturers Institute and the Aluminum Association, while data on other aluminum packaging is based on Department of Commerce data. Total aluminum container and packaging generation in 1995 was 2.0 million tons, or 0.9 percent of total MSW generation.

Aluminum can recovery data comes from the Aluminum Association. Aluminum beer and soft drink cans were recovered at an estimated 62.7 percent rate in 1995. Recovery of all aluminum packaging was estimated to be 51.8 percent of total generation in 1995. After recovery for recycling, 950,000 tons of aluminum packaging were discarded in 1995. This represented 0.6 percent of MSW discards.

**Paper and Paperboard Containers and Packaging.** Corrugated boxes are the largest single product category of MSW at 28.8 million tons generated, or 13.8 percent of total generation, in 1995. Corrugated boxes also represent the largest single category of product recovery, at 18.5 million tons of recovery in 1995 (64.2 percent of boxes generated were recovered). After recovery, 10.3 million tons of corrugated boxes were discarded, or 6.8 percent of MSW discards in 1995.

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 38.1 million tons of MSW generation in 1995, or 18.3 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 1.4 million tons in 1995). The overall recovery rate for paper and paperboard packaging in 1995 was 52.3 percent. Other paper packaging like 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 (PET) soft drink bottles—some with high-density polyethylene (HDPE) base cups, HDPE milk jugs, film products (including bags and sacks) made of low-density polyethylene (LDPE and LLDPE), and 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 annual plastic recovery survey. Adjustments are made for imports and exports based on Department of Commerce data.

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 7.7 million tons in 1995 (3.7 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 and base cups were estimated to have been recovered at a 45.5 percent rate in 1995 (300,000 tons). Recovery of plastic milk and water bottles was estimated to have been 185,000 tons, or 30.2 percent of generation. Overall, recovery of plastic containers and packaging was estimated to be 750,000 tons, or 9.7 percent in 1995. Discards of plastic containers and packaging were thus 7.0 million tons in 1995, or 4.6 percent of total discards.

**Wood Packaging.** Wood packaging includes wood crates and pallets (mostly pallets). Data on production of wood packaging (in units) is obtained from the Wooden Pallet and Container Association, and converted to weight using converting factors for wood. In 1995, 10.6 million tons of wood packaging were estimated to have been generated. Wood packaging was thus 5.1 percent of total MSW generation in 1995.

There is increasing recovery of wood pallets, mostly by chipping to make products like mulch. Recovery of wood pallets was estimated based on data from the Wooden Pallet and Container Association. It was estimated that 1.4 million tons of wood were recovered in this manner in 1995, or 13.5 percent of generation. This left 9.2 million tons discarded in 1995, or 6.0 percent of discards.

There is considerable reuse of wood pallets. Reuse was not counted as recycling in this chapter, but is accounted for when calculating wood pallet generation. Reuse of pallets is discussed further in the section on source reduction in Chapter 3.

**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, but were estimated to amount to 160,000 tons generated in 1995.

Table 18

**PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1995**
**(WITH DETAIL ON CONTAINERS AND PACKAGING)**
**(In thousands of tons)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** *(Detail in Table 12)* | 9,920 | 14,660 | 21,800 | 29,810 | 30,360 | 30,430 | 30,260 | 31,120 | 31,230 |
| **Nondurable Goods** *(Detail in Table 15)* | 17,330 | 25,060 | 34,420 | 52,170 | 50,570 | 52,780 | 54,900 | 56,850 | 57,040 |
| **Containers and Packaging** | | | | | | | | | |
| **Glass Packaging** | | | | | | | | | |
| Beer and Soft Drink Bottles | 1,400 | 5,580 | 6,740 | 5,640 | 5,270 | 5,480 | 5,480 | 5,250 | 5,120 |
| Wine and Liquor Bottles | 1,080 | 1,900 | 2,450 | 2,030 | 1,810 | 1,930 | 1,960 | 1,800 | 1,790 |
| Food and Other Bottles & Jars | 3,710 | 4,440 | 4,780 | 4,160 | 4,110 | 4,350 | 4,830 | 5,000 | 4,620 |
| ***Total Glass Packaging*** | 6,190 | 11,920 | 13,970 | 11,830 | 11,190 | 11,760 | 12,270 | 12,050 | 11,530 |
| **Steel Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | 640 | 1,570 | 520 | 150 | 90 | 80 | 70 | 10 | Neg. |
| Food and Other Cans | 3,760 | 3,540 | 2,850 | 2,540 | 2,990 | 2,730 | 2,710 | 2,990 | 2,640 |
| Other Steel Packaging | 260 | 270 | 240 | 200 | 190 | 170 | 210 | 220 | 210 |
| ***Total Steel Packaging*** | 4,660 | 5,380 | 3,610 | 2,890 | 3,270 | 2,980 | 2,990 | 3,220 | 2,850 |
| **Aluminum Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | Neg. | 100 | 850 | 1,550 | 1,580 | 1,580 | 1,610 | 1,710 | 1,580 |
| Other Cans | Neg. | 60 | 40 | 20 | 30 | 30 | 30 | 40 | 40 |
| Foil and Closures | 170 | 410 | 380 | 330 | 320 | 330 | 350 | 340 | 350 |
| ***Total Aluminum Packaging*** | 170 | 570 | 1,270 | 1,900 | 1,930 | 1,940 | 1,990 | 2,090 | 1,970 |
| **Paper & Paperboard Pkg** | | | | | | | | | |
| Corrugated Boxes | 7,330 | 12,760 | 17,080 | 24,010 | 24,100 | 25,400 | 26,650 | 28,140 | 28,800 |
| Milk Cartons** | | | 790 | 500 | 500 | 480 | 470 | 520 | 510 |
| Folding Cartons** | | | 3,820 | 4,300 | 4,590 | 4,590 | 4,880 | 5,150 | 5,310 |
| Other Paperboard Packaging | 3,840 | 4,830 | 230 | 290 | 270 | 280 | 300 | 300 | 260 |
| Bags and Sacks** | | | 3,380 | 2,440 | 2,280 | 2,320 | 2,180 | 2,300 | 1,990 |
| Wrapping Papers** | | | 200 | 110 | 80 | 80 | 90 | 80 | 70 |
| Other Paper Packaging | 2,940 | 3,810 | 850 | 1,020 | 1,050 | 1,120 | 1,040 | 1,070 | 1,120 |
| ***Total Paper & Board Pkg*** | 14,110 | 21,400 | 26,350 | 32,670 | 32,870 | 34,270 | 35,610 | 37,560 | 38,060 |
| **Plastics Packaging** | | | | | | | | | |
| Soft Drink Bottles** | | | 260 | 430 | 450 | 510 | 560 | 600 | 660 |
| Milk Bottles** | | | 230 | 530 | 490 | 520 | 540 | 580 | 630 |
| Other Containers | 60 | 910 | 890 | 1,430 | 1,440 | 1,540 | 1,610 | 1,380 | 1,250 |
| Bags and Sacks** | | | 390 | 940 | 930 | 970 | 1,050 | 1,320 | 1,170 |
| Wraps** | | | 840 | 1,530 | 1,700 | 1,820 | 1,820 | 1,770 | 1,720 |
| Other Plastics Packaging | 60 | 1,180 | 790 | 2,040 | 2,020 | 2,160 | 2,280 | 2,250 | 2,270 |
| ***Total Plastics Packaging*** | 120 | 2,090 | 3,400 | 6,900 | 7,030 | 7,520 | 7,860 | 7,900 | 7,700 |
| Wood Packaging | 2,000 | 2,070 | 3,940 | 7,880 | 7,900 | 8,810 | 9,340 | 10,210 | 10,590 |
| Other Misc. Packaging | 120 | 130 | 130 | 150 | 150 | 160 | 160 | 160 | 160 |
| ***Total Containers & Pkg*** | 27,370 | 43,560 | 52,670 | 64,220 | 64,340 | 67,440 | 70,220 | 73,190 | 72,860 |
| ***Total Product Wastes†*** | 54,620 | 83,280 | 108,890 | 146,200 | 145,270 | 150,650 | 155,380 | 161,160 | 161,130 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 12,200 | 12,800 | 13,000 | 13,200 | 13,660 | 13,560 | 13,720 | 13,870 | 14,020 |
| Yard Trimmings | 20,000 | 23,200 | 27,500 | 35,000 | 35,000 | 35,000 | 33,250 | 31,500 | 29,750 |
| Miscellaneous Inorganic Wastes | 1,300 | 1,780 | 2,250 | 2,900 | 2,950 | 3,000 | 3,050 | 3,100 | 3,150 |
| ***Total Other Wastes*** | 33,500 | 37,780 | 42,750 | 51,100 | 51,610 | 51,560 | 50,020 | 48,470 | 46,920 |
| ***Total MSW Generated - Weight*** | 88,120 | 121,060 | 151,640 | 197,300 | 196,880 | 202,210 | 205,400 | 209,630 | 208,050 |

* Generation before materials recovery or combustion.
Details may not add to totals due to rounding.
** 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 19

**PRODUCTS GENERATED* IN THE MUNICIPAL WASTE STREAM, 1960 TO 1995**
**(WITH DETAIL ON CONTAINERS AND PACKAGING)**
**(In percent of total generation)**

| | Percent of Total Generation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 11.3% | 12.1% | 14.4% | 15.1% | 15.4% | 15.0% | 14.7% | 14.8% | 15.0% |
| *(Detail in Table 12)* | | | | | | | | | |
| **Nondurable Goods** | 19.7% | 20.7% | 22.7% | 26.4% | 25.7% | 26.1% | 26.7% | 27.1% | 27.4% |
| *(Detail in Table 15)* | | | | | | | | | |
| **Containers and Packaging** | | | | | | | | | |
| **Glass Packaging** | | | | | | | | | |
| Beer and Soft Drink Bottles | 1.6% | 4.6% | 4.4% | 2.9% | 2.7% | 2.7% | 2.7% | 2.5% | 2.5% |
| Wine and Liquor Bottles | 1.2% | 1.6% | 1.6% | 1.0% | 0.9% | 1.0% | 1.0% | 0.9% | 0.9% |
| Food and Other Bottles & Jars | 4.2% | 3.7% | 3.2% | 2.1% | 2.1% | 2.2% | 2.4% | 2.4% | 2.2% |
| ***Total Glass Packaging*** | 7.0% | 9.8% | 9.2% | 6.0% | 5.7% | 5.8% | 6.0% | 5.7% | 5.5% |
| **Steel Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | 0.7% | 1.3% | 0.3% | 0.1% | Neg. | Neg. | Neg. | Neg. | Neg. |
| Food and Other Cans | 4.3% | 2.9% | 1.9% | 1.3% | 1.5% | 1.4% | 1.3% | 1.4% | 1.3% |
| Other Steel Packaging | 0.3% | 0.2% | 0.2% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% |
| ***Total Steel Packaging*** | 5.3% | 4.4% | 2.4% | 1.5% | 1.7% | 1.5% | 1.5% | 1.5% | 1.4% |
| **Aluminum Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | Neg. | 0.1% | 0.6% | 0.8% | 0.8% | 0.8% | 0.8% | 0.8% | 0.8% |
| Other Cans | Neg. | 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% | 0.2% |
| ***Total Aluminum Packaging*** | 0.2% | 0.5% | 0.8% | 1.0% | 1.0% | 1.0% | 1.0% | 1.0% | 0.9% |
| **Paper & Paperboard Pkg** | | | | | | | | | |
| Corrugated Boxes | 8.3% | 10.5% | 11.3% | 12.2% | 12.2% | 12.6% | 13.0% | 13.4% | 13.8% |
| Milk Cartons** | | | 0.5% | 0.3% | 0.3% | 0.2% | 0.2% | 0.2% | 0.2% |
| Folding Cartons** | | | 2.5% | 2.2% | 2.3% | 2.3% | 2.4% | 2.5% | 2.6% |
| Other Paperboard Packaging | 4.4% | 4.0% | 0.2% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% |
| Bags and Sacks** | | | 2.2% | 1.2% | 1.2% | 1.1% | 1.1% | 1.1% | 1.0% |
| Wrapping Papers** | | | 0.1% | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Other Paper Packaging | 3.3% | 3.1% | 0.6% | 0.5% | 0.5% | 0.6% | 0.5% | 0.5% | 0.5% |
| ***Total Paper & Board Pkg*** | 16.0% | 17.7% | 17.4% | 16.6% | 16.7% | 16.9% | 17.3% | 17.9% | 18.3% |
| **Plastics Packaging** | | | | | | | | | |
| Soft Drink Bottles** | | | 0.2% | 0.2% | 0.2% | 0.3% | 0.3% | 0.3% | 0.3% |
| Milk Bottles** | | | 0.2% | 0.3% | 0.2% | 0.3% | 0.3% | 0.3% | 0.3% |
| Other Containers | 0.1% | 0.8% | 0.6% | 0.7% | 0.7% | 0.8% | 0.8% | 0.7% | 0.6% |
| Bags and Sacks** | | | 0.3% | 0.5% | 0.5% | 0.5% | 0.5% | 0.6% | 0.6% |
| Wraps** | | | 0.6% | 0.8% | 0.9% | 0.9% | 0.9% | 0.8% | 0.8% |
| Other Plastics Packaging | 0.1% | 1.0% | 0.5% | 1.0% | 1.0% | 1.1% | 1.1% | 1.1% | 1.1% |
| ***Total Plastics Packaging*** | 0.1% | 1.7% | 2.2% | 3.5% | 3.6% | 3.7% | 3.8% | 3.8% | 3.7% |
| Wood Packaging | 2.3% | 1.7% | 2.6% | 4.0% | 4.0% | 4.4% | 4.5% | 4.9% | 5.1% |
| Other Misc. Packaging | 0.1% | 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% | 32.5% | 32.7% | 33.4% | 34.2% | 34.9% | 35.0% |
| ***Total Product Wastes†*** | 62.0% | 68.8% | 71.8% | 74.1% | 73.8% | 74.5% | 75.6% | 76.9% | 77.4% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 13.8% | 10.6% | 8.6% | 6.7% | 6.9% | 6.7% | 6.7% | 6.6% | 6.7% |
| Yard Trimmings | 22.7% | 19.2% | 18.1% | 17.7% | 17.8% | 17.3% | 16.2% | 15.0% | 14.3% |
| Miscellaneous Inorganic Wastes | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% | 1.5% |
| ***Total Other Wastes*** | 38.0% | 31.2% | 28.2% | 25.9% | 26.2% | 25.5% | 24.4% | 23.1% | 22.6% |
| ***Total MSW Generated - %*** | 100.0% | 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.
† 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 1995
(WITH DETAIL ON CONTAINERS AND PACKAGING)
(In thousands of tons)

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 350 | 940 | 1,360 | 3,810 | 3,980 | 4,150 | 4,460 | 5,230 | 5,320 |
| *(Detail in Table 13)* | | | | | | | | | |
| **Nondurable Goods** | 2,390 | 3,730 | 4,670 | 8,800 | 10,390 | 11,070 | 11,080 | 12,610 | 13,520 |
| *(Detail in Table 16)* | | | | | | | | | |
| **Containers and Packaging** | | | | | | | | | |
| **Glass Packaging** | | | | | | | | | |
| Beer and Soft Drink Bottles | 90 | 140 | 730 | 1,890 | 1,360 | 1,530 | 1,600 | 1,650 | 1,670 |
| Wine and Liquor Bottles | 10 | 10 | 20 | 210 | 380 | 430 | 450 | 470 | 470 |
| Food and Other Bottles & Jars | Neg. | Neg. | Neg. | 520 | 820 | 930 | 960 | 990 | 1,000 |
| ***Total Glass Packaging*** | 100 | 150 | 750 | 2,620 | 2,560 | 2,890 | 3,010 | 3,110 | 3,140 |
| **Steel Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | 10 | 20 | 50 | 40 | 40 | 40 | 40 | Neg. | Neg. |
| Food and Other Cans | 20 | 60 | 150 | 590 | 930 | 1,090 | 1,300 | 1,550 | 1,500 |
| Other Steel Packaging | Neg. | Neg. | Neg. | 60 | 50 | 50 | 50 | 60 | 50 |
| ***Total Steel Packaging*** | 30 | 80 | 200 | 690 | 1,020 | 1,180 | 1,390 | 1,610 | 1,550 |
| **Aluminum Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | Neg. | 10 | 310 | 990 | 990 | 1,080 | 1,010 | 1,120 | 990 |
| Other Cans | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Foil and Closures | Neg. | Neg. | Neg. | 20 | 20 | 30 | 30 | 30 | 30 |
| ***Total Aluminum Pkg*** | Neg. | 10 | 310 | 1,010 | 1,010 | 1,110 | 1,040 | 1,150 | 1,020 |
| **Paper & Paperboard Pkg** | | | | | | | | | |
| Corrugated Boxes | 2,520 | 2,760 | 6,390 | 11,530 | 12,110 | 13,310 | 13,970 | 16,210 | 18,480 |
| Milk Cartons** | | | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Folding Cartons** | | | Neg. | 340 | 450 | 460 | 770 | 1,010 | 1,070 |
| Other Paperboard Packaging | | | 520 | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Bags and Sacks** | | | Neg. | 200 | 250 | 340 | 400 | 420 | 340 |
| Wrapping Papers** | | | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Other Paper Packaging | 220 | 350 | 310 | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Paper & Board Pkg*** | 2,740 | 3,110 | 7,220 | 12,070 | 12,810 | 14,110 | 15,140 | 17,640 | 19,890 |
| **Plastics Packaging** | | | | | | | | | |
| Soft Drink Bottles** | | | 10 | 140 | 160 | 210 | 230 | 320 | 300 |
| Milk Bottles** | | | Neg. | 20 | 70 | 110 | 130 | 170 | 190 |
| Other Containers | Neg. | Neg. | Neg. | 20 | 70 | 80 | 90 | 140 | 160 |
| Bags and Sacks** | | | Neg. | 30 | 10 | 20 | 20 | 30 | 40 |
| Wraps** | | | Neg. | 30 | 10 | 20 | 30 | 30 | 40 |
| Other Plastics Packaging | Neg. | Neg. | Neg. | 20 | 10 | 10 | 10 | 20 | 20 |
| ***Total Plastics Packaging*** | Neg. | Neg. | 10 | 260 | 330 | 450 | 510 | 710 | 750 |
| Wood Packaging | Neg. | Neg. | Neg. | 390 | 790 | 1,060 | 1,310 | 1,430 | 1,430 |
| Other Misc. Packaging | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Containers & Pkg*** | 2,870 | 3,350 | 8,490 | 17,040 | 18,520 | 20,800 | 22,400 | 25,650 | 27,780 |
| ***Total Product Wastes†*** | 5,610 | 8,020 | 14,520 | 29,650 | 32,890 | 36,020 | 37,940 | 43,490 | 46,620 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | 480 | 570 |
| Yard Trimmings | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,000 | 9,000 |
| Miscellaneous Inorganic Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Other Wastes*** | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,480 | 9,570 |
| ***Total MSW Recovered - Weight*** | 5,610 | 8,020 | 14,520 | 33,850 | 37,690 | 41,420 | 44,840 | 51,970 | 56,190 |

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Not estimated separately prior to 1980.
† 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 1995**
**(WITH DETAIL ON CONTAINERS AND PACKAGING)**
**(In percent of generation of each product)**

| | Percent of Generation of Each Product | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 3.5% | 6.4% | 6.2% | 12.8% | 13.1% | 13.6% | 14.7% | 16.8% | 17.0% |
| *(Detail in Table 13)* | | | | | | | | | |
| **Nondurable Goods** | 13.8% | 14.9% | 13.6% | 16.9% | 20.5% | 21.0% | 20.2% | 22.2% | 23.7% |
| *(Detail in Table 16)* | | | | | | | | | |
| **Containers and Packaging** | | | | | | | | | |
| **Glass Packaging** | | | | | | | | | |
| Beer and Soft Drink Bottles | 6.4% | 2.5% | 10.8% | 33.5% | 25.8% | 27.9% | 29.2% | 31.4% | 32.6% |
| Wine and Liquor Bottles | Neg. | Neg. | Neg. | 10.3% | 21.0% | 22.3% | 23.0% | 26.1% | 26.3% |
| Food and Other Bottles & Jars | Neg. | Neg. | Neg. | 12.5% | 20.0% | 21.4% | 19.9% | 19.8% | 21.6% |
| ***Total Glass Packaging*** | 1.6% | 1.3% | 5.4% | 22.1% | 22.9% | 24.6% | 24.5% | 25.8% | 27.2% |
| **Steel Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | 1.6% | 1.3% | 9.6% | 26.7% | 44.4% | 50.0% | 57.1% | Neg. | Neg. |
| Food and Other Cans | Neg. | 1.7% | 5.3% | 23.2% | 31.1% | 39.9% | 48.0% | 51.8% | 56.8% |
| Other Steel Packaging | Neg. | Neg. | Neg. | 30.0% | 26.3% | 29.4% | 23.8% | 27.3% | 23.8% |
| ***Total Steel Packaging*** | Neg. | 1.5% | 5.5% | 23.9% | 31.2% | 39.6% | 46.5% | 50.0% | 54.4% |
| **Aluminum Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | Neg. | 10.0% | 36.5% | 63.9% | 62.7% | 68.4% | 62.7% | 65.5% | 62.7% |
| Other Cans | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Foil and Closures | Neg. | Neg. | Neg. | 6.1% | 6.3% | 9.1% | 8.6% | 8.8% | 8.6% |
| ***Total Aluminum Pkg*** | Neg. | 1.8% | 24.4% | 53.2% | 52.3% | 57.2% | 52.3% | 55.0% | 51.8% |
| **Paper & Paperboard Pkg** | | | | | | | | | |
| Corrugated Boxes | 34.4% | 21.6% | 37.4% | 48.0% | 50.2% | 52.4% | 52.4% | 57.6% | 64.2% |
| Milk Cartons** | | | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Folding Cartons** | | | Neg. | Neg. | 9.8% | 10.0% | 15.8% | 19.6% | 20.2% |
| Other Paperboard Packaging | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Bags and Sacks** | | | Neg. | Neg. | 11.0% | 14.7% | 18.3% | 18.3% | 17.1% |
| Wrapping Papers** | | | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Other Paper Packaging | 7.5% | 9.2% | 36.5% | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Paper & Board Pkg*** | 19.4% | 14.5% | 27.4% | 36.9% | 39.0% | 41.2% | 42.5% | 47.0% | 52.3% |
| **Plastics Packaging** | | | | | | | | | |
| Soft Drink Bottles** | | | 3.8% | 32.6% | 35.6% | 41.2% | 41.1% | 53.3% | 45.5% |
| Milk Bottles** | | | Neg. | 3.8% | 14.3% | 21.2% | 24.1% | 29.3% | 30.2% |
| Other Containers | Neg. | Neg. | Neg. | 1.4% | 4.9% | 5.2% | 5.6% | 10.1% | 12.8% |
| Bags and Sacks** | | | Neg. | 3.2% | 1.1% | 2.1% | 1.9% | 2.3% | 3.4% |
| Wraps** | | | Neg. | 2.0% | 0.6% | 1.1% | 1.6% | 1.7% | 2.3% |
| Other Plastics Packaging | Neg. | Neg. | Neg. | 1.0% | 0.5% | 0.5% | 0.4% | 0.9% | 0.9% |
| ***Total Plastics Packaging*** | Neg. | Neg. | Neg. | 3.8% | 4.7% | 6.0% | 6.5% | 9.0% | 9.7% |
| Wood Packaging | Neg. | Neg. | Neg. | 4.9% | 10.0% | 12.0% | 14.0% | 14.0% | 13.5% |
| Other Misc. Packaging | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Containers & Pkg*** | 10.5% | 7.7% | 16.1% | 26.5% | 28.8% | 30.8% | 31.9% | 35.0% | 38.1% |
| ***Total Product Wastes†*** | 10.3% | 9.6% | 13.3% | 20.3% | 22.6% | 23.9% | 24.4% | 27.0% | 28.9% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | 3.5% | 4.1% |
| Yard Trimmings | Neg. | Neg. | Neg. | 12.0% | 13.7% | 15.4% | 20.8% | 25.4% | 30.3% |
| Miscellaneous Inorganic Wastes | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| ***Total Other Wastes*** | Neg. | Neg. | Neg. | 8.2% | 9.3% | 10.5% | 13.8% | 17.5% | 20.4% |
| ***Total MSW Recovered - %*** | 6.4% | 6.6% | 9.6% | 17.2% | 19.1% | 20.5% | 21.8% | 24.8% | 27.0% |

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
** Not estimated separately prior to 1980.
† 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 1995**
**(WITH DETAIL ON CONTAINERS AND PACKAGING)**
**(In thousands of tons)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** | 9,570 | 13,720 | 20,440 | 26,000 | 26,380 | 26,280 | 25,800 | 25,890 | 25,910 |
| *(Detail in Table 14)* | | | | | | | | | |
| **Nondurable Goods** | 14,940 | 21,330 | 29,750 | 43,370 | 40,180 | 41,710 | 43,820 | 44,240 | 43,520 |
| *(Detail in Table 17)* | | | | | | | | | |
| **Containers and Packaging** | | | | | | | | | |
| **Glass Packaging** | | | | | | | | | |
| Beer and Soft Drink Bottles | 1,310 | 5,440 | 6,010 | 3,750 | 3,910 | 3,950 | 3,880 | 3,600 | 3,450 |
| Wine and Liquor Bottles | 1,080 | 1,900 | 2,450 | 1,820 | 1,430 | 1,500 | 1,510 | 1,330 | 1,320 |
| Food and Other Bottles & Jars | 3,710 | 4,440 | 4,780 | 3,640 | 3,290 | 3,420 | 3,870 | 4,010 | 3,620 |
| ***Total Glass Packaging*** | 6,090 | 11,770 | 13,220 | 9,210 | 8,630 | 8,870 | 9,260 | 8,940 | 8,390 |
| **Steel Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | 640 | 1,570 | 520 | 110 | 50 | 40 | 30 | 10 | Neg. |
| Food and Other Cans | 3,760 | 3,480 | 2,700 | 1,950 | 2,060 | 1,640 | 1,410 | 1,440 | 1,140 |
| Other Steel Packaging | 260 | 270 | 240 | 140 | 140 | 120 | 160 | 160 | 160 |
| ***Total Steel Packaging*** | 4,660 | 5,300 | 3,410 | 2,200 | 2,250 | 1,800 | 1,600 | 1,610 | 1,300 |
| **Aluminum Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | Neg. | 100 | 540 | 560 | 590 | 500 | 600 | 590 | 590 |
| Other Cans | Neg. | 60 | 40 | 20 | 30 | 30 | 30 | 40 | 40 |
| Foil and Closures | 170 | 410 | 380 | 310 | 300 | 300 | 320 | 310 | 320 |
| ***Total Aluminum Pkg*** | 170 | 560 | 960 | 890 | 920 | 830 | 950 | 940 | 950 |
| **Paper & Paperboard Pkg** | | | | | | | | | |
| Corrugated Boxes | 4,810 | 10,000 | 10,690 | 12,480 | 11,990 | 12,090 | 12,680 | 11,930 | 10,320 |
| Milk Cartons** | | | 790 | 500 | 500 | 480 | 470 | 520 | 510 |
| Folding Cartons** | | | 3,820 | 3,960 | 4,140 | 4,130 | 4,110 | 4,140 | 4,240 |
| Other Paperboard Packaging | 3,840 | 4,830 | 230 | 290 | 270 | 280 | 300 | 300 | 260 |
| Bags and Sacks** | | | 3,380 | 2,240 | 2,030 | 1,980 | 1,780 | 1,880 | 1,650 |
| Wrapping Papers** | | | 200 | 110 | 80 | 80 | 90 | 80 | 70 |
| Other Paper Packaging | 2,720 | 3,460 | 850 | 1,020 | 1,050 | 1,120 | 1,040 | 1,070 | 1,120 |
| ***Total Paper & Board Pkg*** | 11,370 | 18,290 | 19,130 | 20,600 | 20,060 | 20,160 | 20,470 | 19,920 | 18,170 |
| **Plastics Packaging** | | | | | | | | | |
| Soft Drink Bottles** | | | 250 | 290 | 290 | 300 | 330 | 280 | 360 |
| Milk Bottles** | | | 230 | 510 | 420 | 410 | 410 | 410 | 440 |
| Other Containers | 60 | 910 | 890 | 1,410 | 1,370 | 1,460 | 1,520 | 1,240 | 1,090 |
| Bags and Sacks** | | | 390 | 910 | 920 | 950 | 1,030 | 1,290 | 1,130 |
| Wraps** | | | 840 | 1,500 | 1,690 | 1,800 | 1,790 | 1,740 | 1,680 |
| Other Plastics Packaging | 60 | 1,180 | 790 | 2,020 | 2,010 | 2,150 | 2,270 | 2,230 | 2,250 |
| ***Total Plastics Packaging*** | 120 | 2,090 | 3,390 | 6,640 | 6,700 | 7,070 | 7,350 | 7,190 | 6,950 |
| Wood Packaging | 2,000 | 2,070 | 3,940 | 7,490 | 7,110 | 7,750 | 8,030 | 8,780 | 9,160 |
| Other Misc. Packaging | 120 | 130 | 130 | 150 | 150 | 160 | 160 | 160 | 160 |
| ***Total Containers & Pkg*** | 24,500 | 40,210 | 44,180 | 47,180 | 45,820 | 46,640 | 47,820 | 47,540 | 45,080 |
| ***Total Product Wastes†*** | 49,010 | 75,260 | 94,370 | 116,550 | 112,380 | 114,630 | 117,440 | 117,670 | 114,510 |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 12,200 | 12,800 | 13,000 | 13,200 | 13,660 | 13,560 | 13,720 | 13,390 | 13,450 |
| Yard Trimmings | 20,000 | 23,200 | 27,500 | 30,800 | 30,200 | 29,600 | 26,350 | 23,500 | 20,750 |
| Miscellaneous Inorganic Wastes | 1,300 | 1,780 | 2,250 | 2,900 | 2,950 | 3,000 | 3,050 | 3,100 | 3,150 |
| ***Total Other Wastes*** | 33,500 | 37,780 | 42,750 | 46,900 | 46,810 | 46,160 | 43,120 | 39,990 | 37,350 |
| ***Total MSW Discarded - Weight*** | 82,510 | 113,040 | 137,120 | 163,450 | 159,190 | 160,790 | 160,560 | 157,660 | 151,860 |

* 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.

† 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 1995**
**(WITH DETAIL ON CONTAINERS AND PACKAGING)**
**(in percent of total discards)**

| | Percent of Total Discards | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Products** | **1960** | **1970** | **1980** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** |
| **Durable Goods** *(Detail in Table 14)* | 11.6% | 12.1% | 14.9% | 15.9% | 16.6% | 16.3% | 16.1% | 16.4% | 17.1% |
| **Nondurable Goods** *(Detail in Table 17)* | 18.1% | 18.9% | 21.7% | 26.5% | 25.2% | 25.9% | 27.3% | 28.1% | 28.7% |
| **Containers and Packaging** | | | | | | | | | |
| **Glass Packaging** | | | | | | | | | |
| Beer and Soft Drink Bottles | 1.6% | 4.8% | 4.4% | 2.3% | 2.5% | 2.5% | 2.4% | 2.3% | 2.3% |
| Wine and Liquor Bottles | 1.3% | 1.7% | 1.8% | 1.1% | 0.9% | 0.9% | 0.9% | 0.8% | 0.9% |
| Food and Other Bottles & Jars | 4.5% | 3.9% | 3.5% | 2.2% | 2.1% | 2.1% | 2.4% | 2.5% | 2.4% |
| ***Total Glass Packaging*** | 7.4% | 10.4% | 9.6% | 5.6% | 5.4% | 5.5% | 5.8% | 5.7% | 5.5% |
| **Steel Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | 0.8% | 1.4% | 0.4% | 0.1% | Neg. | Neg. | Neg. | Neg. | Neg. |
| Food and Other Cans | 4.6% | 3.1% | 2.0% | 1.2% | 1.3% | 1.0% | 0.9% | 0.9% | 0.8% |
| Other Steel Packaging | 0.3% | 0.2% | 0.2% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% | 0.1% |
| ***Total Steel Packaging*** | 5.6% | 4.7% | 2.5% | 1.3% | 1.4% | 1.1% | 1.0% | 1.0% | 0.9% |
| **Aluminum Packaging** | | | | | | | | | |
| Beer and Soft Drink Cans | Neg. | 0.1% | 0.4% | 0.3% | 0.4% | 0.3% | 0.4% | 0.4% | 0.4% |
| Other Cans | Neg. | 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% | 0.2% |
| ***Total Aluminum Pkg*** | 0.2% | 0.5% | 0.7% | 0.5% | 0.6% | 0.5% | 0.6% | 0.6% | 0.6% |
| **Paper & Paperboard Pkg** | | | | | | | | | |
| Corrugated Boxes | 5.8% | 8.8% | 7.8% | 7.6% | 7.5% | 7.5% | 7.9% | 7.6% | 6.8% |
| Milk Cartons** | | | 0.6% | 0.3% | 0.3% | 0.3% | 0.3% | 0.3% | 0.3% |
| Folding Cartons** | | | 2.8% | 2.4% | 2.6% | 2.6% | 2.6% | 2.6% | 2.8% |
| Other Paperboard Packaging | 4.7% | 4.3% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% |
| Bags and Sacks** | | | 2.5% | 1.4% | 1.3% | 1.2% | 1.1% | 1.2% | 1.1% |
| Wrapping Papers** | | | 0.1% | 0.1% | 0.1% | 0.0% | 0.1% | 0.1% | 0.0% |
| Other Paper Packaging | 3.3% | 3.1% | 0.6% | 0.6% | 0.7% | 0.7% | 0.6% | 0.7% | 0.7% |
| ***Total Paper & Board Pkg*** | 13.8% | 16.2% | 14.0% | 12.6% | 12.6% | 12.5% | 12.7% | 12.6% | 12.0% |
| **Plastics Packaging** | | | | | | | | | |
| Soft Drink Bottles** | | | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% | 0.2% |
| Milk Bottles** | | | 0.2% | 0.3% | 0.3% | 0.3% | 0.3% | 0.3% | 0.3% |
| Other Containers | 0.1% | 0.8% | 0.6% | 0.9% | 0.9% | 0.9% | 0.9% | 0.8% | 0.7% |
| Bags and Sacks** | | | 0.3% | 0.6% | 0.6% | 0.6% | 0.6% | 0.8% | 0.7% |
| Wraps** | | | 0.6% | 0.9% | 1.1% | 1.1% | 1.1% | 1.1% | 1.1% |
| Other Plastics Packaging | 0.1% | 1.0% | 0.6% | 1.2% | 1.3% | 1.3% | 1.4% | 1.4% | 1.5% |
| ***Total Plastics Packaging*** | 0.1% | 1.8% | 2.5% | 4.1% | 4.2% | 4.4% | 4.6% | 4.6% | 4.6% |
| Wood Packaging | 2.4% | 1.8% | 2.9% | 4.6% | 4.5% | 4.8% | 5.0% | 5.6% | 6.0% |
| Other Misc. Packaging | 0.1% | 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% | 28.9% | 28.8% | 29.0% | 29.8% | 30.2% | 29.7% |
| ***Total Product Wastes†*** | 59.4% | 66.6% | 68.8% | 71.3% | 70.6% | 71.3% | 73.1% | 74.6% | 75.4% |
| **Other Wastes** | | | | | | | | | |
| Food Wastes | 14.8% | 11.3% | 9.5% | 8.1% | 8.6% | 8.4% | 8.5% | 8.5% | 8.9% |
| Yard Trimmings | 24.2% | 20.5% | 20.1% | 18.8% | 19.0% | 18.4% | 16.4% | 14.9% | 13.7% |
| Miscellaneous Inorganic Wastes | 1.6% | 1.6% | 1.6% | 1.8% | 1.9% | 1.9% | 1.9% | 2.0% | 2.1% |
| ***Total Other Wastes*** | 40.6% | 33.4% | 31.2% | 28.7% | 29.4% | 28.7% | 26.9% | 25.4% | 24.6% |
| ***Total MSW Discarded - %*** | 100.0% | 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.

† Other than food products.

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

Source: Franklin Associates, Ltd.

## Summary of Products in Municipal Solid Waste

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

The materials composition of nondurable goods in 1995 is shown in Figure 15. Paper and paperboard made up 76.2 percent of nondurables in MSW generation, with plastics contributing 8.9 percent, and textiles 8.7 percent. Other materials contributed lesser percentages. After recovery for recycling, paper and paperboard were 70.7 percent of nondurable discards, with plastics being 11.6 percent, and textiles 9.7 percent.

The materials composition of containers and packaging in MSW in 1995 is shown in Figure 16. By weight, paper and paperboard products made up 52.2 percent of containers and packaging generation, with glass second at 15.8 percent of containers and packaging generation. Wooden pallets accounted for 14.5 percent of containers and packaging generation, while plastics were 10.6 percent.

Recovery for recycling makes a significant change, with paper and paperboard being 40.3 percent of containers and packaging discards after recovery takes place. Wood accounted for 20.4 percent of discards of containers and packaging, glass containers was 18.6 percent, and plastics comprised 15.4 percent.

Some additional perspectives on products in municipal solid waste are included in other chapters of this report.

**Figure 14. Generation of products in MSW, 1960 to 1995**

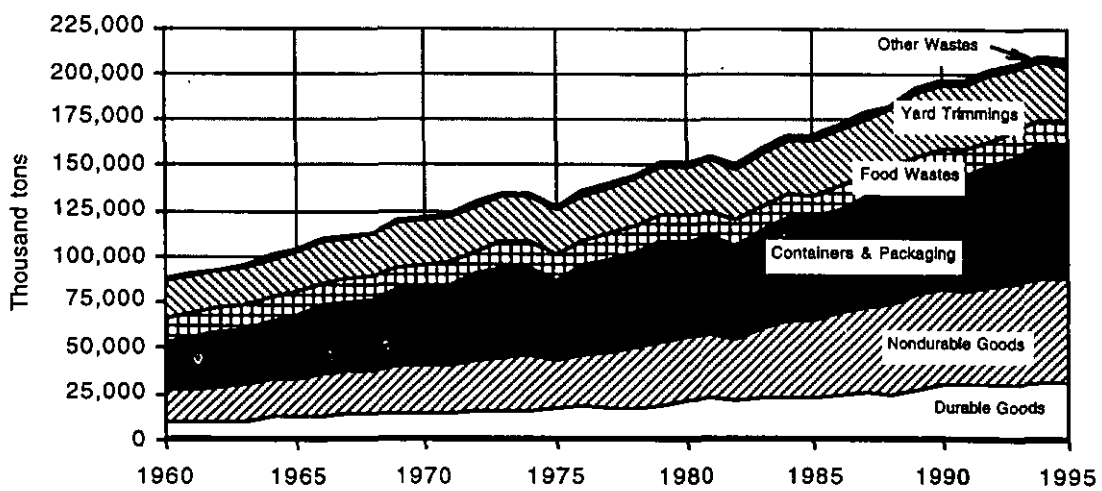
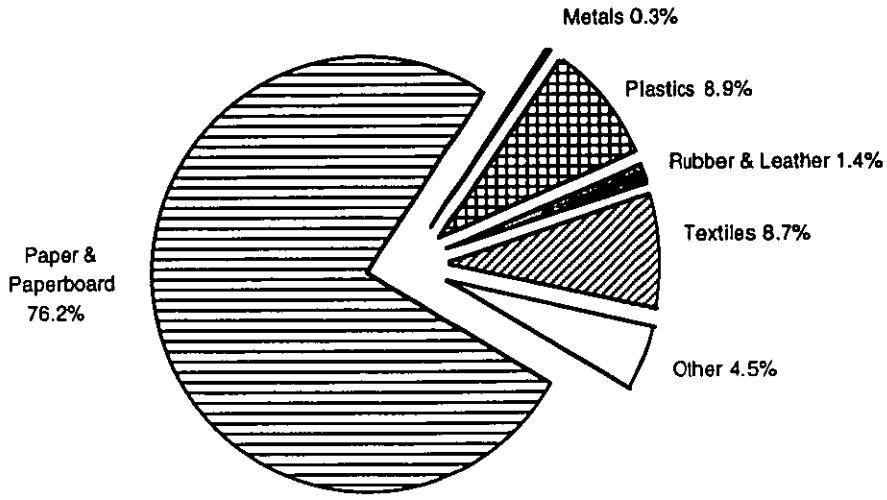
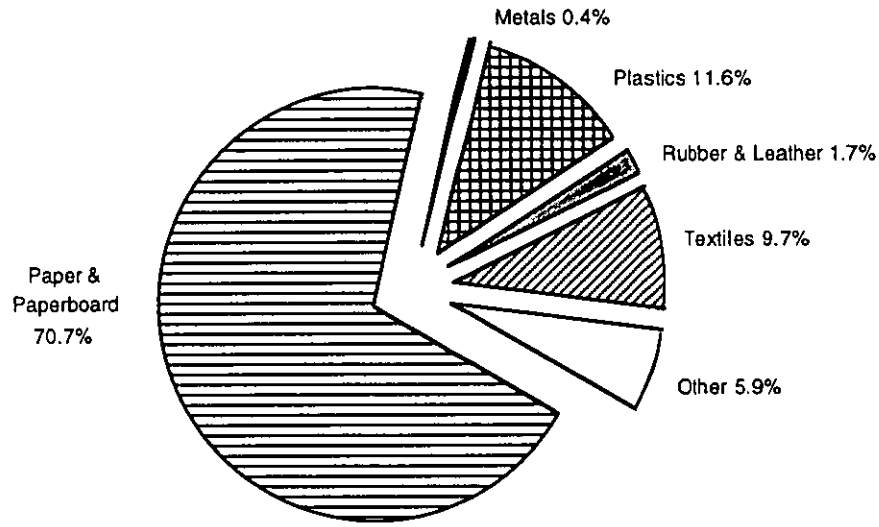


**Figure 15. Nondurable goods generated and discarded in municipal solid waste, 1995**
**(in percent of total generation and discards)**

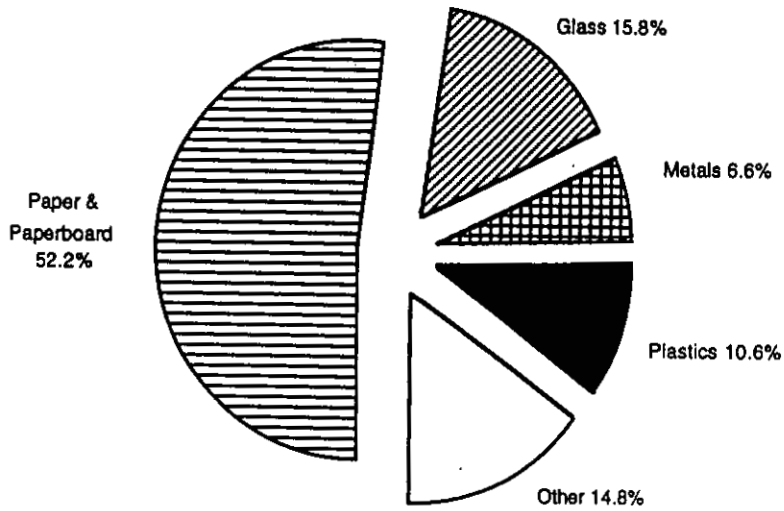



**Generation**

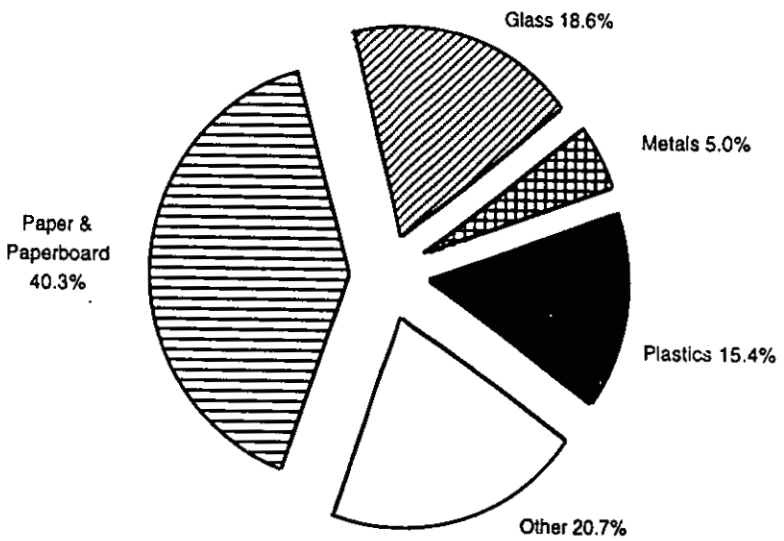



**Discards**

**Figure 16. Containers and packaging generated and discarded in municipal solid waste, 1995**
**(in percent of total generation and discards)**




**Generation**




**Discards**

## SUMMARY

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

### MSW Generation

- Total generation of municipal solid waste in 1995 was 208.1 million tons, which was less than MSW generation of 209.6 million tons in 1994.
- Paper and paperboard products made up the largest percentage of all the materials in MSW—81.5 million tons, or 39.2 percent of total generation.
- Yard trimmings comprised the second largest material category, at 29.8 million tons, or 14.3 percent of total generation, in 1995. This compared to 31.5 million tons (15.0 percent of generation) in 1994.
- Total materials in products declined by 30,000 tons from 1994 to 1995. The only materials in products that increased in tonnage were paper and paperboard, textiles, and wood.
- Other materials (yard trimmings, food wastes, and miscellaneous inorganic wastes) declined by 1.6 million tons from 1994 to 1995. Yard trimmings accounted for all of this decline, due to source reduction measures such as backyard composting and leaving grass trimmings on the yard.
- Between 1994 and 1995, generation of durable goods and nondurable goods increased in tonnage, while generation of containers and packaging decreased in tonnage. Each major product category increased in percentage of MSW generated, while generation of yard trimmings was declining in percentage.

### MSW Recovery

- Recovery of materials in MSW increased from 52.0 million tons in 1994 (24.8 percent of total generation) to 56.2 million tons in 1995 (27.0 percent of generation).
- Recovery of most materials in MSW increased in both tonnage and percent of total generation.
- Recovery of products in MSW increased by over 3 million tons, from 27 percent to 29 percent of generation. Recovery of other wastes (yard trimmings and food wastes) increased by over one million tons, from 17.5 percent to 20.4 percent of generation.

- Containers and packaging led the major product categories in tonnage and percentage recovery, increasing from 25.7 million tons (35.0 percent of generation) in 1994 to 27.8 million tons (38.1 percent of generation). Nondurable goods had the second highest recovery in 1995—13.5 million tons, or 23.7 percent of generation.

- Measured by tonnage, the most-recovered products in 1995 were corrugated boxes (18.5 million tons), yard trimmings (9.0 million tons), newspapers (7.0 million tons), glass containers (3.1 million tons), and office papers (3.0 million tons).

- Measured by percentage of generation, products with the highest recovery rates in 1995 were lead-acid batteries (95.8 percent), corrugated boxes (64.2 percent), aluminum beverage cans (62.7 percent), major appliances (60.5 percent), steel cans (56.8 percent), and newspapers (53.0 percent).

**Long Term Trends**

- Generation of MSW has increased steadily (except in recession years), from 88.1 million tons in 1960 to 208.1 million tons in 1995.

- Generation of paper and paperboard, the largest material component of MSW, has increased in almost every year. Yard trimmings, the second largest component, have been declining recently due to source reduction measures at residences. Generation of other materials is generally on an upward trend, although generation of glass in 1995 was lower than in 1980, and generation of metals in 1995 was about the same as in 1980.

- In percentage of total MSW generation, recovery for recycling (including composting) did not exceed 20 percent until 1992. The increase reflects a rapid increase in the infrastructure for recovery starting in the late 1980s (see Chapter 3).

- Recovery (as a percent of generation) of most materials in MSW has increased dramatically over the 35 years for which statistics have been tabulated. Some examples:

| | 1980 | 1995 |
|---|---|---|
| Paper and paperboard | 21% | 40% |
| Glass | 5% | 25% |
| Metals | 8% | 39% |
| Plastics | 2% | 5% |
| Yard trimmings | – | 30% |

## Chapter 2

## REFERENCES

### GENERAL

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1995 Update.*** EPA/530-R-96-001. November 1995.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1994 Update.*** EPA/530-R-94-042. November 1994.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1992 Update.*** EPA/530-R-92-019. July 1992.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1990 Update.*** EPA/530-SW-90-042. June 1991.

Franklin, M.A. ***Characterization of Municipal Solid Waste in the United States, 1960 to 2000 (Update 1988).*** U.S. Environmental Protection Agency. EPA/530-SW-88-033. NTIS PB88-232780/WEP. March 1988.

Franklin, M.A. ***Characterization of Municipal Solid Waste in the United States, 1960 to 2000.*** U.S. Environmental Protection Agency. REPT-15-3490-00. NTIS PB87-178323/WEP. July 1986.

### ALUMINUM CONTAINERS AND PACKAGING

The Aluminum Association. ***Aluminum Statistical Review.*** Various years.

Can Manufacturers Institute. ***Can Shipments Report.*** Various years.

**Resource Recycling's Bottle/Can Recycling Update.** Various issues.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports.*** "Closures for Containers." MQ34H. Various years.

### CARPETS AND RUGS

The Carpet and Rug Institute. ***Carpet & Rug Industry Review.*** Various years.

Personal communication with a representative of the Carpet and Rug Institute. February 14, 1992.

Rauch Associates, Inc. ***The Rauch Guide to the U.S. Adhesives and Sealants Industry.*** ISBN O-932157-05-X.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports.*** "Carpets and Rugs." MA22Q. Various years.

**FERROUS METAL CONTAINERS AND PACKAGING**

American Iron and Steel Institute. ***Annual Statistical Report.*** Various years.

Can Manufacturers Institute. ***Can Shipments Report.*** Various years.

Personal communication with a representative of the Association of Container Reconditioning. June 1994.

Personal communication with a representative of the Steel Recycling Institute. April 1996.

Smith, F.L. ***A Solid Waste Estimation Procedure: Material Flows Approach.*** U.S. Environmental Protection Agency. EPA/530-SW-147. May 1974.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports.*** "Closures for Containers." MQ34H. Various years.

**FOOD WASTE**

Food Manufacturers Institute. ***Composting Workbook.*** "Reducing Waste Disposal Costs: How to Evaluate the Benefits of Composting in the Supermarket Industry." Food Marketing Institute. 1994.

Grocery Committee on Solid Waste. ***Composting Task Force Report.*** October 24, 1991.

Hinshaw, Jane, and Ivan Braun. "Targeting Commercial Businesses for Recycling." ***Resource Recycling.*** November 1991.

Kunzler, Conni, and Molly Farrell. "Food Service Composting Projects Update." ***BioCycle.*** May 1996.

Kunzler, Conni, and Rebecca Roe. "Food Service Composting Projects on the Rise." ***BioCycle.*** April 1995.

Luboff, Christine, and Karen May. "Measuring Generation of Food Residuals." July 1995.

Marion, James, New York State Department of Corrections. Presentation at the ***BioCycle*** conference. Philadelphia, Pennsylvania. 1994.

Newell, Ty, Elizabeth Markstahler, and Matthew Snyder. "Commercial Food Waste from Restaurants and Grocery Stores." ***Resource Recycling.*** February 1993.

Savage, George M. "The History and Utility of Waste Characterization Studies." ***MSW Management.*** May/June 1994.

U.S. Department of Commerce, Bureau of the Census. "Combined Annual and Revised Monthly Retail Trade." ***Current Business Reports. BR/94-RV.***

U.S. Department of Commerce, Bureau of the Census. ***Current Population Reports.*** Various years.

U.S. Department of Commerce, Bureau of the Census. ***Statistical Abstract of the United States.*** Various years.

U.S. Department of Commerce. "Trends and Forecasts: Retail Sales." ***U.S. Industrial Outlook 1994.***

Walsh, Patrick, Wayne Pferdehirt, and Phil O'Leary. "Collection of Recyclables from Multifamily Housing and Businesses." ***Waste Age.*** April 1993.

## FURNITURE AND FURNISHINGS

Smith, F.L. ***A Solid Waste Estimation Procedure: Material Flows Approach.*** U.S. Environmental Protection Agency. EPA/530-SW-147. May 1974.

U.S. Department of Commerce, Bureau of the Census. ***Census of Manufactures and Annual Survey of Manufactures.*** Various years.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports.*** "Average Weight and Width of Broadwoven Fabrics (Gray)." MC-22T. November 1977.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports.*** "Office Furniture." MA-25H. Various years.

## GLASS CONTAINERS

***Brewers Almanac.*** Various years.

Resource Recycling. ***Bottle/Can Recycling Update.*** Various issues.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports.*** "Glass Containers." M32G. Various years.

U.S. Department of Commerce. ***U.S. Exports, Schedule B Commodity by Country - Domestic Merchandise.*** FT 447.

U.S. Department of Commerce. ***U.S. Imports for Consumption.*** FT 247.

U.S. Department of Commerce. ***U.S. Imports of Merchandise for Consumption.*** FT 110 and FT 125.

**LEAD-ACID BATTERIES**

American Automobile Manufacturers Association. ***AAMA Motor Vehicle Facts and Figures.*** Various years.

Battery Council International. ***Industry Statistics.*** Various years.

Battery Council International. ***National Recycling Rate Study.*** March 1995.

Franklin Associates, Ltd. ***Characterization of Products Containing Lead and Cadmium in Municipal Solid Waste in the United States, 1970 to 2000.*** U.S. Environmental Protection Agency. EPA/530-SW-89-015A. NTIS PB89-151039/WEP. January 1989.

Motorcycle Industry Council, Inc. ***Motorcycle Statistical Annual.*** Various years.

U. S. Department of Commerce. ***Statistical Abstract of the United States.*** Various years.

U.S. Department of Commerce. ***U.S. Imports By Commodity..*** Various years.

U.S. Department of Commerce. ***U.S. Industrial Outlook*** "Metals." Various years.

**MAJOR APPLIANCES**

American Iron and Steel Institute ***Annual Statistical Report.*** Various years.
***Appliance Magazine.*** Corcoran Communications. September 1983.

***Appliance Manufacturer.*** Annual Industry Marketing Guide, March issue of various years.

Appliance Manufacturer. ***Market Profile.*** Various years.

Association of Home Appliance Manufacturers. ***Trends and Forecasts.*** 1971 to 1988.
***Electrical Merchandising.*** January 1951.

Gas Appliance Manufacturers Association. ***Statistical Highlights.*** Various years.

National Industrial Pollution Control Council. ***The Disposal of Major Appliances***. June 1971.

Personal communication with a representative of Amana, Inc. November 1991.

Personal communication with a representative of Steel Recycling Institute April 1996.

Sears, Roebuck and Co. Spring and Fall Retail Catalogs. Various years.

U.S. Department of Commerce, Bureau of the Census. ***Census of Manufactures***. Various years.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports***. "Major Household Appliances." MA36F. Various years.

U.S. Department of Commerce, Bureau of the Census. ***Statistical Abstract of the United States***. Various years.

**PAPER AND PAPERBOARD**

American Forest & Paper Association, Paper Recycling Group. ***1996 Annual Statistical Summary Waste Paper Utilization***. April 1996.

American Forest & Paper Association. ***1996 Statistics of Paper, Paperboard & Wood Pulp***. November 1996.

American Forest & Paper Association. ***Paper, Paperboard, Pulp Capacity and Fiber Consumption, 1995-1999***. December 1996.

American Forest & Paper Association. ***Monthly Statistical Report***. Various issues.

Franklin Associates, Ltd. ***Evaluation of Proposed New Recycled Paper Standards and Definitions***. Special Task Force on Standards and Definitions, Recycled Paper Committee, Recycling Advisory Council. January 27, 1992.

U.S. Postal Service. ***Annual Report of the Postmaster General: Fiscal Year 1995.***

Yellow Pages Publishers Association. ***Yellow Pages Publishers Environmental Network: Progress Report for the Year 1995***. March 1996.

**PLASTICS**

***Modern Plastics***. Resin Statistics. January issue, various years.

R.W. Beck and Associates. "Postconsumer Plastics Recycling Rate Study for the American Plastics Council." Various years.

U.S. Department of Commerce. ***1994 U.S. Industrial Outlook.***

**RUBBER**

American Automobile Manufacturers Association. ***AAMA Motor Vehicle Facts and Figures.*** Various years.

International Tire and Rubber Association, Inc. *formerly* American Retreader's Association, Inc. Louisville, Kentucky.

McRee, Robert E. "Recap – Recapture: Incineration of Rubber for Energy Recovery" Presented at the Joint NTDRA/RMA International Symposium. Washington, DC. October 22, 1982.

***National Petroleum News Market Facts.*** Mid-June issue. Various years.

Personal communication with the Scrap Tire Management Council. September 1996.

***Retreaders Journal.*** April 1987.

Scrap Tire Management Council. ***"1994 Scrap Tire Use/Disposal Study".*** Results published in ***Scrap Tire News.*** March 1995.

U.S. Department of Commerce, Bureau of the Census. ***Census of Manufactures.*** Industry series 30A-30. Various years.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports.*** "Rubber Mechanical Goods." MA30C. Various years.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports.*** "Rubber: Production, Shipments, and Stocks." MA30A. Various years.

U.S. Department of Commerce, Bureau of the Census. ***Statistical Abstract of the United States.*** Various editions.

U.S. Department of Commerce, Bureau of the Census. ***U.S. Imports for Consumption.*** FT 247. Table 1. Various years.

U.S. Department of Commerce. ***U.S. Industrial Outlook.*** "Plastics and Rubber." Also earlier editions. Various years.

U.S. Environmental Protection Agency. ***Markets for Scrap Tires***. EPA/530-SW-90-074A. October 1991.

**TEXTILES AND FOOTWEAR**

Council for Textile Recycling. ***Textile Recycling Fact Sheet.***

J.C. Penney's Catalog. 1990.

National Association of Hosiery Manufacturers. ***Fact Sheets***. Various years.

Riggle, David. "Tapping Textile Recycling." ***BioCycle***. February 1992.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports***. "Apparel." MA23A, MA23E, MA23G. Various years.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports***. "Sheets, Towels and Pillowcases." MQ23X. Various years.

U.S. Department of Commerce, Bureau of the Census. ***Current Industrial Reports***. MA31A, MA23E, MA23G, and MA23A. Various years.

U.S. Department of Commerce, Bureau of the Census. ***Statistical Abstract of the United States***. Various years.

**WOOD PACKAGING**

Eshbach, Ovid, Ed. ***Handbook of Engineering Fundamentals***. Second Edition. John Wiley & Sons, Inc.

Personal communication with representative of the National Wooden Pallet and Container Association. September 1996.

Personal communication with representative of the U.S. Forestry Service Laboratory, Princeton, WV. December 1991.

Personal communication with representative of U.S. Department of Agriculture Forest Service, Forest Products Laboratory. December 1991.

Personal communication with representative of Virginia Polytechnical Institute. December 1991.

U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. ***Wood Used in U.S. Manufacturing Industries, 1977***. December 1983.

U.S. Department of Commerce. ***U.S. Industrial Outlook*** . "Wood Products." Various year.

**YARD TRIMMINGS**

Franklin Associates, Ltd. Survey of Selected State Officials. October 1996.

Raymond Communications. "State Recycling Laws Update." 1994.

Raymond Communications. "State Recycling Laws Update." Year-end Edition 1996.

Savage, George M. "The History and Utility of Waste Characterization Studies." ***MSW Management.*** May/June 1994.

Steuteville, Robert. "The State of Garbage in America, Part I." ***BioCycle.*** April 1995.

Steuteville, Robert. "The State of Garbage in America, Part II." ***BioCycle.*** May 1995.

Steuteville, Robert. "The State of Garbage in America, Part II." ***BioCycle.*** May 1996.

***The Role of Recycling in Integrated Solid Waste Management to the Year 2000.*** Franklin Associates, Ltd. Appendix J and Appendix K. Keep America Beautiful, Inc. September 1994.

"Yard Waste Legislation: Disposal Bans and Similar Bills as of July, 1993." Composting Council. Fact Sheet. July 1993.

## Chapter 3

# MANAGEMENT OF MUNICIPAL SOLID WASTE

## INTRODUCTION

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

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

Characterization of historical municipal solid waste (MSW) management is a component of this report (overview in Figure 17). Estimates of historical recovery of materials for recycling, including yard trimmings for composting, are presented in Chapter 2. Estimates of MSW combustion are presented in this chapter, and quantities of waste landfilled are estimated by subtracting combustion and recovery for recycling (including composting) from total MSW generation.

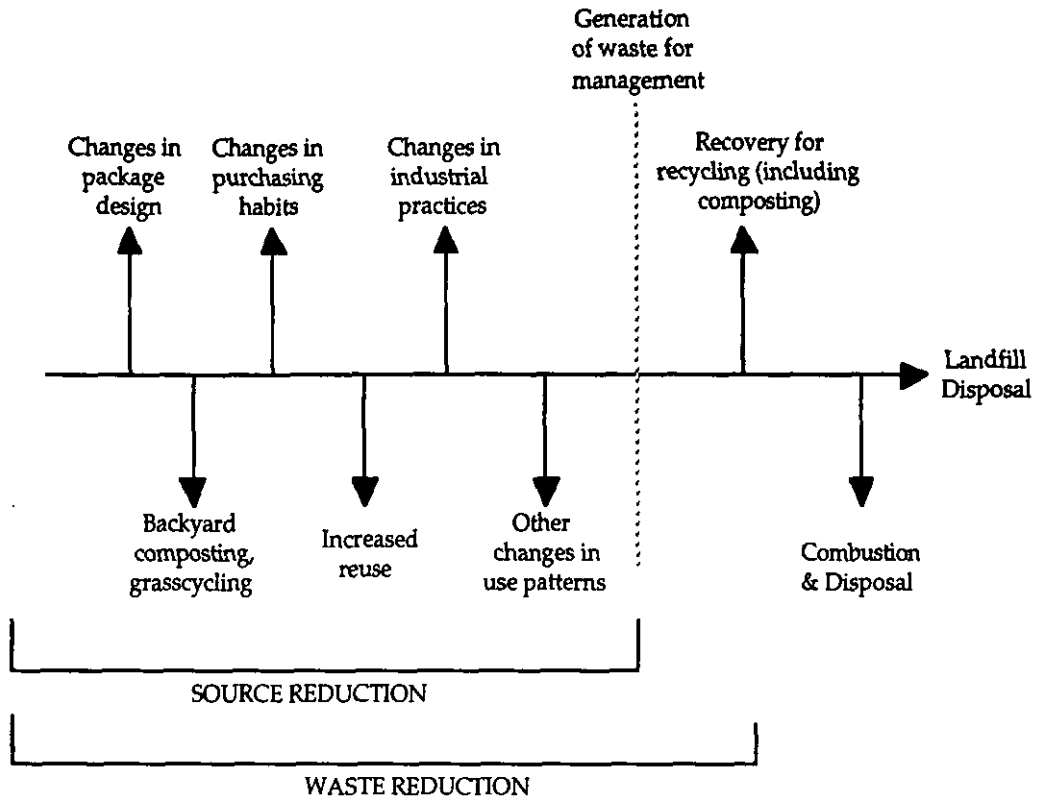
A new feature of this report is a discussion of the current MSW management infrastructure. Current solid waste collection, processing, and disposal programs and facilities are highlighted with tables and figures.

While source reduction is not quantified as a line item in this report, a discussion of source reduction activities is included in this chapter. Source reduction activities have the effect of reducing MSW generation, while the other management alternatives deal with MSW once it is generated.

## SOURCE REDUCTION

Source reduction is gaining more attention as an important solid waste management option. Source reduction, often called "waste prevention," is defined by EPA as "any change in the design, manufacturing, purchase, or use of materials or products (including packaging) to reduce the 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 disposal or other management alternative.

**Figure 17. Diagram of Solid Waste Management**




Source: Franklin Associates, Ltd. based on EPA hierarchy.

Source reduction measures encompass a very broad range of activities by private citizens, communities, commercial establishments, institutional agencies, and manufacturers and distributors. In general, source reduction activities 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.

**Table 24**

**SELECTED EXAMPLES OF SOURCE REDUCTION PRACTICES**

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

Source: Franklin Associates, Ltd.

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

Example source reduction actions in these areas are shown in Table 24. These principles are further discussed in this chapter and are portrayed in case studies. There is a case study for each of the major product categories—durables, nondurables, and containers and packaging—as well as several case studies for reuse and source reduction industries. Although not all-inclusive, these case studies demonstrate the broad spectrum of ongoing activities that can result in measurable reductions in materials usage and disposal of MSW.

## Source Reduction Through Redesign

Since source reduction of products and packages can save money through reducing materials and energy costs, manufacturers and packaging designers have been pursuing these activities for many years. 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 may also 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 products enter the municipal waste stream. The responsibility for lengthening product life lies partly with manufacturers and partly with consumers. Products can be designed 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 must also be willing to care for and repair products.

Combined with other source reduction measures, redesign can have a significant effect on material use and eventual discards. The following case study, ***Refrigerators***, exemplifies source reduction for a durable good through redesign over a 30 year period.

### SOURCE REDUCTION CASE STUDY: REFRIGERATORS

Over a period of 30 years, refrigerators have increased in size, but their weight per unit of usable space has decreased. This decrease in weight per cubic foot is a form of source reduction. Using department store catalogs from 1965, 1975, and 1985, we identified refrigerators of similar size and use. Data for 1995 were available from computer on-line sources. Shipping weights, inside dimensions, outside dimensions, and energy usage were collected for a 12 cubic foot storage space refrigerator in each year.

Many more sizes of refrigerators were available for purchase as we approach 1995. The largest size available, as well as the average size sold each year, increased from 1965 to 1995. The weight per cubic foot of usable space for a 12 cubic foot refrigerator, however, decreased from 24 pounds per cubic foot to 11.9 pounds per cubic foot during the same period, as shown in Table 25. The outer dimensions of 12 cubic foot refrigerators also decreased from 30.6 cubic feet to 24.8 cubic feet.

A 50 percent reduction in the weight per cubic foot from 1965 to 1995 exemplifies how some durable products, specifically appliances, have been source reduced. This source reduction came about primarily as an effort to reduce material costs. However, some changes not only reduced the overall weight of the refrigerator, but increased the energy efficiency and convenience.

## SOURCE REDUCTION CASE STUDY: REFRIGERATORS (continued)

**Table 25**

**REFRIGERATOR SOURCE REDUCTION, 1965 TO 1995**
**(Based on 12 cubic foot size refrigerator)**

| | Weight (lbs) | Weight per Unit Size (1) (lb/cu ft) | Outer Dimensions (cu ft) | Energy Consumption (kwh/mo) |
|---|---|---|---|---|
| 1965 | 295 | 24.0 | 30.6 | N/A |
| 1975 | 188 | 15.7 | 24.5 | 136.0 |
| 1985 | 167 | 13.9 | 24.5 | 97.2 |
| 1995 | 144 | 11.9 | 24.8 | 45.0 |

(1) Refrigerators varied from 11.9 cu. ft. to 12.4 cu. ft.

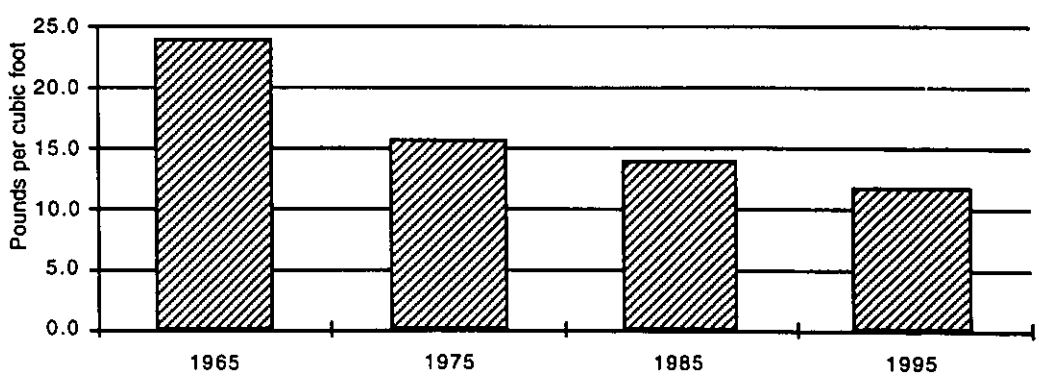
Reference: Sears, Roebuck & Co. catalogs and other sales information.

Source: Franklin Associates, Ltd.

Certain plastics allowed refrigerators to become lighter and more energy efficient. Early refrigerators used rock wool and later fiberglass to insulate the inner liner (food compartment) and the freezer compartment. Urethane foam, which has a R9 insulating value per inch, replaced fiberglass insulation. The foam insulates better due to its greater R-value per inch and also because it fills corners and tiny crevices, even further sealing off air flow. A 1975 refrigerator required approximately 136 kwh per month to operate. A 1985 model required approximately 97 kwh per month, whereas the 1995 12 cubic foot model required 45 kwh per month. Energy data were not available for 1965.

Acrylonitrile butadiene styrene (ABS), high impact polystyrene (HIPS) and polycarbonate replaced porcelain enameled steel in many interior applications, including inner doors, pans, and covers. These plastics allowed for more functional shapes, see-through compartments, and lighter refrigerators. Stronger steel has been used for the outer cabinet, reducing the thickness and the weight required to maintain the structural integrity of the refrigerator.

**Figure 18. Refrigerator Source Reduction, 1965 To 1995**
**(In lbs. per cu. ft. of usable space for 12 cu. ft. refrigerator)**




Source: Franklin Associates, Ltd.

## Modifying Practices to Reduce Materials Use

Businesses and individuals can often 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).

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 can also reduce packaging requirements; some of these products, such as fabric softeners and powdered detergent, are designed to be used with refillable containers.

Modifying practices can be combined with other source reduction measures to reduce generation and limit material use. Two additional case studies, ***Plastic Bags*** and ***Newspapers***, explore different ways that modifying practices, combined with redesign efforts, will produce marked source reduction in a nondurable product and a packaging product.

## 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, clothing, etc.). 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. Other goods are resold by individuals at garage sales, flea markets, and the like. Borrowing and sharing items like tools can also reduce the number of products to be discarded ultimately. 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. In this section, case studies on electronics reuse, textiles reuse, etc., demonstrate the breadth of the reuse infrastructure in the U.S.

## SOURCE REDUCTION CASE STUDY: PLASTIC GROCERY SACKS

Plastic grocery sacks were introduced in the early 1970s and began to have measurable market share in the early 1980s. Now, in most grocery stores, both paper and plastic grocery sacks are available. Grocery sacks are made from high density, low density, and linear low density polyethylene resins (HDPE, LDPE, and LLDPE). LDPE was the dominant resin for grocery sacks in the 1980s. However, HDPE has become the resin most used in the 1990s. The typical grocery sack is 1/6 barrel, or approximately seven gallons in size. In 1985, typical grocery sacks weighed approximately 9.2 grams, as shown in Table 26. Their weight was reduced to 7.5 grams in 1990 by downgauging the film thickness. Further downgauging or source reduction allowed typical bags to weigh only 5.8 grams in 1995. This is a 37 percent reduction over a 10-year period. Figure 19 shows the weight reduction from 1985 to 1995.

**Table 26**

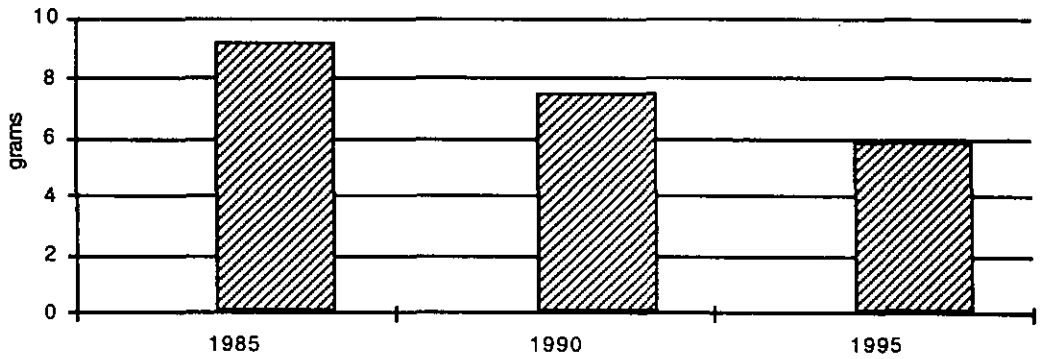
**PLASTIC SACK SOURCE REDUCTION, 1985 TO 1995 (1)**

| | Weight (grams) | Gauge | Weight Reduction (from 1985) |
|---|---|---|---|
| 1985 | 9.2 | 0.86 | |
| 1990 | 7.5 | 0.71 | 18% |
| 1995 | 5.8 | 0.55 | 37% |

(1) Includes HDPE, LDPE, and LLDPE 1/6 barrel size grocery sacks.

References: Private industry contacts
Source: Franklin Associates, Ltd.

**Figure 19. Plastic Sack Source Reduction, 1985 to 1995 (In grams per grocery sack)**




Source: Franklin Associates, Ltd. based on sampled weights.

In 1985, an estimated 132 million pounds of polyethylene were used in the U.S. in the fabrication of grocery sacks. That amount grew dramatically, to 461 million pounds in 1990 and to 686 million pounds in 1995. In 1990, the source reduction of 18 percent allowed the industry to keep 101 million pounds of resin from being used in grocery bag fabrication. In 1995, using 1985 as the base year, 396 million pounds of resin were source reduced.

## SOURCE REDUCTION CASE STUDY: NEWSPAPERS

In the past several decades, newspapers across the U.S. have tried to minimize resource requirements, including newsprint. Before 1974, the standard basis weight for newspapers (the typical thickness of the newsprint, excluding inserts, measured in weight per unit area) was 32 pounds per 3,000 square feet. Now, 30 pounds per 3,000 square is the standard basis weight for newsprint. Other basis weights are as low as 24 pounds, and there appears to be a trend towards lower basis weight production. Reduced basis weight and other activities have enabled newspapers to reduce material consumption, referred to as newsprint conservation in the industry.

Newsprint conservation varies from newspaper to newspaper because of local competition, local newsprint prices, and the size of the operation. Two competing newspapers in a metropolitan area will view newsprint conservation differently than a newspaper without competition, or a newspaper in a smaller town.

To analyze newsprint source reduction, data on several individual newspapers were compiled from **Editor & Publisher YearBook**. Circulation, newsprint consumption, number of pages printed, and page width were collected for four large newspapers across the U.S. for 1985, 1990, and 1995. The average number of pages per pound over the 10-year period provided documentation to support the assertion of source reduction, as shown in Table 27.

From 1985 to 1995, the average number of news pages per pound increased from approximately 93 to 118, as shown in Figure 20. This is nearly a 27 percent increase in the number of pages printed per pound of newsprint. The results calculated from data in **Editor & Publisher YearBook** correspond with actual newspapers counted and weighed. The actual page size also decreased more than a half inch over the same period. Several actions responsible for the source reduction are discussed below.

Higher prices for newsprint have influenced source reduction efforts in the newspaper publishing industry. Based on information from the Newspaper Association of America, newspapers publishers have reduced material requirements by addressing conservation in five areas: management, marketing and advertising, news and editorial, production, and circulation.

Newsprint waste management essentially is managing the newsprint in ways that minimize wastes by getting more out of each roll and the most out of each newspaper. Many of the actions newspaper publishers have taken or are taking to conserve newsprint are shown in Table 28.

**Table 27**

**NEWSPAPER SOURCE REDUCTION, 1985 TO 1995 (1)**

| | 1985 | 1990 | 1995 |
|---|---|---|---|
| Average Circulation (papers/day) | 593,861 | 615,079 | 688,924 |
| Newsprint Consumption (tons) | 206,445 | 211,198 | 196,861 |
| Number of Pages per Pound | 93 | 97 | 118 |

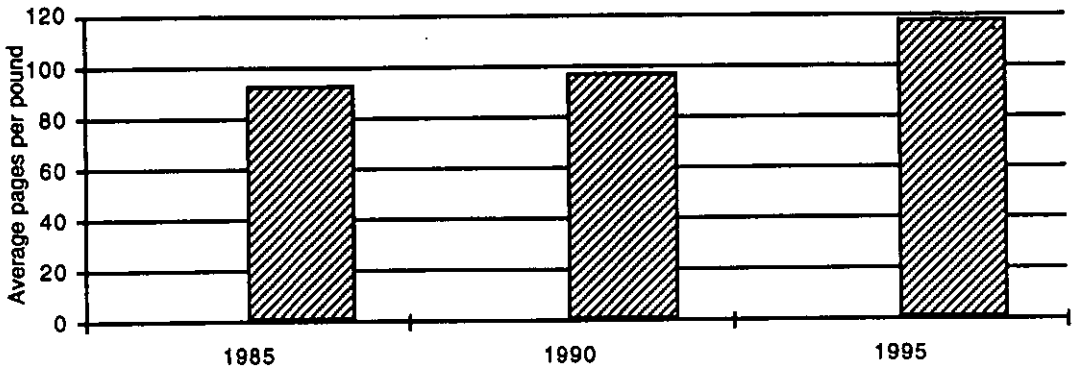
(1) Average of four newspapers (Los Angeles Times, Rocky Mountain News, Boston Globe, Dallas Morning News) across the U.S.

Reference: Editor & Publisher YearBook, 1985, 1990, 1995.

Source: Franklin Associates, Ltd.

SOURCE REDUCTION CASE STUDY: NEWSPAPERS
(continued)

**Figure 20. Newsprint Source Reduction, 1985 to 1995 (In average pages per pound)**




Source: Franklin Associates, Ltd. based on selected weighing.

Table 28

NEWSPAPER PUBLISHER NEWSPRINT CONSERVATION MEASURES

**Management**

- communicate conservation measures to staff
- standardize paper configuration, where possible
- trimming fractional rolls by a fraction of an inch (1/16)
- delivering minimum number of copies of the necessary section to each dept. for review
- reduce the number of editions

**Marketing and Advertising**

- restrict the use of house ads
- reduce advertising in outlying area editions
- go to nine columns for classified pages
- increase depth of classified columns to 21 from 20 inches, reduce copy 5 percent

**News and Editorial**

- optimize space by reducing unpaid space
- examine news content for potential news hole and page jump reductions and
- tighten up the white space

**Production**

- switch to a lower basis weight
- reduce web widths

**Circulation**

- use returns for mailed copies
- reduce or eliminate circulation beyond the advertisers' needs
- track number of returns by box and carrier routes for possible reductions

Reference: "Newsprint Conservation" prepared by the Newspaper Association of America, June 1995.

**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 are often 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, etc. 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, reconditioned printer cartridges, etc.

**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 these have largely been replaced by single-use glass bottles, plastic bottles, and aluminum cans. Considerable numbers of beer bottles are collected for refilling, often by restaurants and taverns, where the bottles can easily be collected and returned by the distributor. The Glass Packaging Institute estimates that refillable glass bottles achieve a rate of 8 trips (refillings) per bottle.

Another example in this category is the use of refurbished wood pallets for shipping palletized goods. The National Wooden Pallet & Container Association estimates that over 50 percent of wood pallets produced are reusable.

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

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

## Reuse Infrastructure

Many new industries are incorporating reuse concepts as a business practice. The next four case studies, ***Durable Goods Reuse, Electronics Reuse, Textiles Reuse,*** and ***Pallet Repair and Reuse,*** summarize a few industries that emphasize reuse. Reuse and repair of computers, durables, textiles, and pallets extend the life of products, delaying their disposal, and may curtail the production of new products, reducing material consumption.

### REUSE CASE STUDY: DURABLE GOODS

For decades, reuse of some type has been practiced by many individuals and organizations. Reuse has routinely occurred through shops that repair, recondition, rent, remanufacture, and then resell or give away the surplus or used goods. Similarly operations include garage sales, flea markets, and auctions. Large operations are well-known and have a national presence, such as Goodwill Industries and the Salvation Army. Others are smaller and operate locally. Despite the efforts of these organizations, most of the durable goods generated in the U.S. are disposed in landfills.

Table 29 profiles several reuse operations and collection programs across America. The items and materials they collect, refurbish, and resell vary widely. Some operations collected anything from magazines and records to lawnmowers and bathtubs. Replicating the reuse programs now in operation will help expand the reuse infrastructure in the U.S.

Operations of this type benefit the community in many ways. They reduce waste management costs, divert discards to their highest and best use, reclaim high-value materials, often for the poor and needy, support many individuals and enterprises, and create decent jobs. In addition, sale of refurbished items helps support community rehabilitation and job training programs.

Table 29

SELECTED COLLECTION AND REUSE PROGRAMS FOR DURABLE GOODS

| Community/Operation | Location | Operation Type | Customer | Tons Per Year | Percent Reused | Start Date |
|---|---|---|---|---|---|---|
| Calaveres Co. Salv. Army | CA | Salv. Army trailer at landfill | Sal. Army | 48 | 90% | 1992 |
| Chatham Co Swap Shops | NC | Co.-run Swap Shops at drop-off | Public | na | 90% | 1993 |
| Int'l Furniture & Bedding | Balt. MD | Mattress remanufacturing | Mattress retail | 800 | 90% | 1984 |
| L.A. Shares | LA, CA | NP reuse operation | Nonprofits, schls | 270 | 99% | 1993 |
| Materials for the Arts | NY, NY | Govt.-run reuse operation | Arts/cult. comm | 428 | 95% | 1979 |
| Montgomery County | MD | Co. drop-off & retail reuse op. | Varies | 368 | 100% | 1990 |
| Recycletown | Rio Nido, CA | NP drop-off and retail reuse op. | Public | 273 | 11% | 1992 |
| ReStore | Montpelier, VT | NP retail reuse op. | Public | 35 | 97% | 1990 |
| St. Paul/Goodwill | MN | Curbside for text. and HH items | Goodwill Ind. | 168 | 92% | 1992 |
| Surplus Exchange | KC, MO | NP reuse and repair op. | Nonprofits | 1,030 | 70% | 1984 |
| Urban Ore, Inc. | Berkeley, CA | For-profit reuse/recycle retail op. | Public | 3,500 | 73% | 1980 |
| Wooden Artifacts Cons. | Stone Co., AR | NP furniture repair workshop | Needy | 5 | 100% | 1989 |

HH=Household NP=Nonprofit text.=textiles Co.=county op.=operation
Salv.=Salvation cult.=cultural comm.=community Ind.=Industries.

Source: Institute for Local Self-Reliance, 1996.

## REUSE CASE STUDY: ELECTRONICS

Due to innovative technology and mass manufacturing, electronics quickly become obsolete. They often are discarded with many or all working components. According to several research studies and electronic recycling experts, approximately 6 to 13 million computers are taken out of service each year in the United States. Only 10 percent are reused or recycled, about 15 percent are landfilled, and the remaining 75 percent are stockpiled. An estimated 10 million more sit in storage. A tremendous amount of other electronics (such as audio equipment, televisions, telecommunications equipment, and electronic appliances) are discarded too; figures not available.

In the past few years individuals and organizations have begun to realize the enormous potential for discarded electronics. Many items are in good working order and can be adapted for owners whose capacity needs are different than the previous owners. Other items need repair and still others have valuable parts which can be used to rebuild other electronic items or other lower tech products, like video games.

Aside from the usable components of an unusable computer (e.g., printed circuit boards, disc drives, print heads, chips, keyboards) there are valuable materials that can be recycled. Printed circuit boards have lead, copper, platinum, palladium, and gold. There is a demand for these precious metals and the market for used circuit boards is strong. Also, lead can be recovered from the cathode ray tube, copper from the wires, and thermoplastics, steel, and aluminum from the housings.

Electronic reuse operations can create good jobs, enhance technical skills, make technology available to the low income sector, equip schools and other not-for-profit agencies with computer technology, and are a low-overhead alternative for economic development. Table 30 shows several companies that specialize in electronics reuse.

Table 30

SELECTED ELECTRONICS REUSE OPERATIONS

| Organization | Location | Type | Percent of Incoming Reused | Amount of Electronics Handled | |
|---|---|---|---|---|---|
| | | | | items per year | tons per year |
| Computers 4 Kids | Middletown, CT | not-for-profit | 70% | 2,000 | 22 |
| Detwiler Computers for Schools | La Jolla, CA | not-for-profit | 70% | 15,000 | 188 |
| DRAGnet | Mnneapolis, MN | not-for-profit | 60% | 6,800 | 85 |
| East West Foundation | Boston, MA | not-for-profit | 90% | 7,000 | 88 |
| Electronic Recovery Inc. | Mnneapolis, MN | for-profit | 40% | 136,000 | 1,700 |
| Goodwill Computer Recycling Ctr. | Pittsburgh, PA | not-for-profit | 60% | 9,750 | 122 |
| Materials for the Arts | New York, NY | public | 95% | na | na |
| National Cristina Foundation | Greenwich, CN | not-for-profit | 95% | 40,000 | 500 |
| The Surplus Echange | Kansas City, MO | not-for-profit | 35% | 104,000 | 1,300 |

Source: Institute for Local Self-Reliance, 1996.

Nonprofit reuse operations handle primarily computers and related equipment. They are generally small scale and community based. For-profit operations usually add the recycling dimension to their business, and by nature, are larger scale and regional. Electronics other than computer equipment (stereos, TVs, etc.) are typically not handled by most of these operations due to their lack of value. The supply generally comes from businesses, who are constantly updating their equipment. Some also come from households and universities.

## REUSE/RECYCLING CASE STUDY: TEXTILES

The use and reclamation of products made from textile fibers is an old and well established industry. Textile products are diverted from the waste stream by more than 350 recycling companies in the U.S. Less than half of the textiles recovered are reclaimed for clothing reuse. About 20 percent becomes wiping and polishing cloths; the remainder is converted into fiber for new products.

Local thrift stores, churches, charities, and consignment stores are the backbone of the recovery system. Most textile recovery is collected at or by one of these facilities, which use, give away, or sell what they can and sell what's left to "rag graders" or textile MRFs (material recovery facilities).

**Table 31**

**SELECTED COMMUNITIES WITH MUNICIPAL TEXTILE RECYCLING PROGRAMS**

| Community | Population | Program Type | Tons per Year | Start-up Date | Textiles Source |
|---|---|---|---|---|---|
| Calvert Co., MD | 63,000 | drop-off, weekly curbside | 93 | 1995 | Residents and charities |
| Carroll Co., IA | 21,430 | weekly curbside | 60 | 1990 | Residents in 6 counties |
| Chatham Co., NC | 42,000 | drop-off | na | 1993 | Residents |
| City of LA, CA | 10,700 | pilot weekly curbside | 40 | 1994 | West Valley residents |
| Cobb Co., GA | 509,400 | drop-off/pilot curbside | 9 | 1996 | Residents |
| Montgomery Co. MD | 750,000 | drop-off, weekly curbside | 156 | 1993 | Residents and charities |
| New Threads, Phil., PA | na | drop-off, scheduled pickup | 100 | 1995 | Residents |
| San Jose, CA | 840,000 | weekly curbside | 150 | 1993 | Residents |
| Somerset Co., NJ | 265,000 | biweekly curbside | 170 | 1992 | Residents |
| St. Paul, MN | 272,000 | biweekly curbside | 168 | 1992 | Residents |

Source: Institute for Local Self-Reliance, 1996.

As shown in Table 31, the scope and breadth of the programs are wide. Every textile recovery program is different. The programs are enjoying relatively stable end user prices, ranging from $80 to $160 per ton. Capital investments in textile recycling are very low if some recycling infrastructure already exists. Existing equipment, such as trucks, sheds, and sorting conveyors, can be used in textile recycling.

Actual tonnages of collected textiles, however, appear to be much less than expected for many new programs. Residents may not participate in public sector programs for fear of diverting materials from local charities. Many programs, however, work with and can complement charities. Additionally, a textile recycling program can help create sustainable employment opportunities, get more clothing to the needy, and divert materials from waste disposal.

Textile programs include both curbside and drop-off programs. A critical element of collection programs is keeping textiles dry and free of mildew. Most programs ask that textiles be placed in secured bags. Drop-off programs are perhaps the easiest way to integrate textiles into existing recycling infrastructures. One county, for example, operates a "swap shop" where both textiles and household items can be left and other residents can take what they want.

## REUSE/REPAIR CASE STUDY: WOODEN PALLETS

Most industries and businesses that handle commodities use pallets for storage and transportation. Over 400 million pallets are produced in the U.S. each year. About 50 percent of the U.S. hardwood timber harvested each year goes into new pallet manufacturing. In the past, new pallets in the industry were preferred and manufactured in some 2,000 designs. Tipping fees were low, so there was little reason to refurbish the pallets.

Today, disposal costs are higher and lumber is more expensive. The Grocery Manufacturers of America, Inc. instituted a standard 48 inch by 40 inch pallet. This pallet size now represents about 70 percent of the pallet market. These factors have influenced the increase in pallet repair, reuse, and recycling.

Businesses accept pallets, sort them for reuse and repairability, repair them, then sell the refurbished pallets back to the user or another buyer. Workers dismantle those pallets that cannot be repaired and cut to size salvageable parts for reuse. In many plants, remaining wooden pieces are ground into wood fiber or mulch.

A 1993 survey by the Center for Forest Products Marketing found that 90 percent of all pallets that arrive at a repair operation are either reused, rebuilt, or reclaimed for repair. Chipping and burning are the favored utilization methods for handling the remaining 10 percent. Table 32 profiles several pallet repair operations throughout the U.S.

**Table 32**

**SELECTED PALLET REUSE OPERATIONS**

| Organization | Location | Percent Reused | Pallets Handled Number | TPY |
|---|---|---|---|---|
| AAA Pallet & Lumber Co. | Phoenix AZ | 70% | 1,600,000 | 32,000 |
| Allegheny Recycled Products | Pittsburgh PA | 85% | 52,300 | 1,046 |
| Big City Forest Inc. | Bronx NY | Majority | 180,000 | 3,600 |
| Clymer Bag Co., Inc. | Clymer NY | 90% | 125,000 | 2,500 |
| Continental Pallet Co. | Lubbock TX | 95% | 360,000 | 7,200 |
| Direct Wood Products | West Point VA | 100% | 1,250,000 | 25,000 |
| Madison Co. Wood Products | St. Louis MO | 90% | 500,000 | 10,000 |
| Michigan Pallet Recycling, Inc. | Charlotte MI | 99% | 1,500,000 | 30,000 |
| Pallet Pallet Chicago | Chicago IL | 95% | 1,000,000 | 20,000 |
| Pallet Resource of NC. Inc. | Lexington NC | 85% | 1,250,000 | 25,000 |
| Quality Pallet, Inc. | Seymour WI | 100% | 600,000 | 12,000 |
| Rainier Pallet Corp. | Auburn WA | 90% | 356,100 | 7,122 |

Source: Institute for Local Self-Reliance, 1996.

Other pallet waste reduction includes diverting pallets for other uses, such as compost bins, fences, furniture, flooring, etc. Source reduction is yet another alternative. Pallets can be eliminated with lighter loads, replacing them with plastic slip sheets, corrugated cardboard pallets, or some other conveyance system.

### Management of Organic Materials

Food wastes and yard trimmings combined made up 21.0 percent of MSW generation in 1995, so source reduction measures aimed at these products can have an important effect on waste generation. Composting is the usual method for recovering these organic materials. As defined in this report, composting of organic materials after they are taken to a central composting facility is a waste management activity comparable to recovery for recycling. Estimates for these composting activities are included in this Chapter 3.

Composting or other reduction management measures that take place at the point of generation (e.g., the yard of a home or business) is source reduction. Backyard composting of yard trimmings and some food discards is not a new practice, but in recent years publicity and education programs have encouraged more people to participate. There also is a trend toward leaving grass clippings on lawns, sometimes through the use of mulching mowers. Other actions that will complement the increase in yard trimmings management include establishment of variable rates, improved technology (mulching mowers), and legislative regulations.

Part of the impetus for source reduction of yard trimmings is the large number of state regulations discouraging landfilling or other disposal of yard trimmings. The Composting Council and other sources report that in 1992, 12 states (amounting to over 28 percent of the nation's population) had in effect legislation affecting management of yard trimmings. By 1997, nearly two dozen states (amounting to approximately 50 percent of the nation's population) were to have in effect legislation affecting disposal of yard trimmings. While data on amounts of yard trimmings received at disposal facilities is limited, there is considerable anecdotal evidence indicating that when these bans go into effect, people find ways to source reduce. This is discussed in more depth in Chapter 4.

## 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. Most collection of commercial recyclables includes corrugated boxes and office-type papers. The collection programs available across the U.S. can be described and quantified into the four geographical regions used by the U.S. Bureau of the Census (i.e., North, South, Midwest, and West).

**Curbside Recyclables Collection.** In 1995, there were over 7,000 curbside recyclables collection programs in the U.S., as shown in Table 33 and Figure 21.

Table 33

NUMBER AND POPULATION SERVED BY CURBSIDE RECYCLING PROGRAMS, 1995

| Region | Number of Programs | Population (in millions) | Population Served (1) (in thousands) | (%) |
|---|---|---|---|---|
| NORTHEAST | 2,210 | 51,466 | 37,256 | 72% |
| SOUTH | 1,281 | 91,890 | 31,521 | 34% |
| MIDWEST | 2,985 | 61,804 | 25,487 | 41% |
| WEST | 899 | 55,806 | 27,071 | 49% |
| *Total* | 7,375 | 260,965 | 121,335 | 46% |

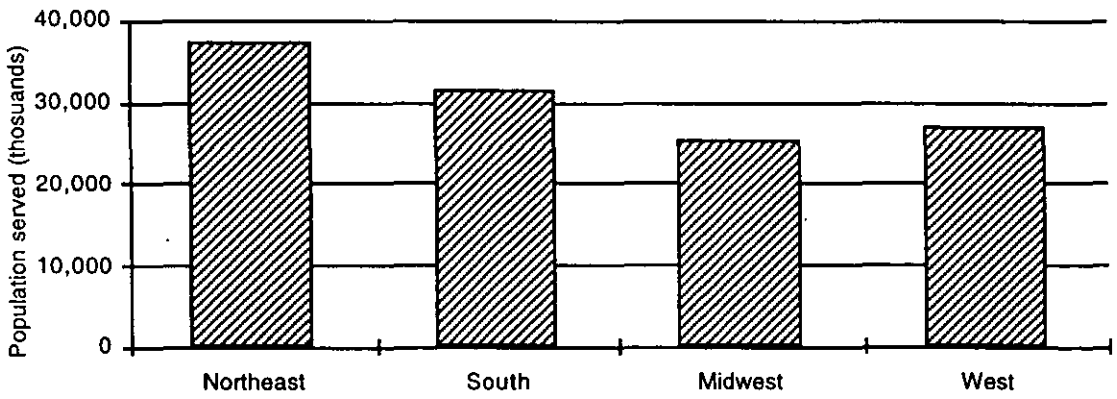
(1) Percent of population served by curbside programs was calculated using population of states reporting data.

References: Statistical Abstract 1995; Bureau of Census 1995, Steuteville 1996.

Source: Franklin Associates, Ltd.

Most of the programs (40 percent) were in the Midwest region. However the Northeast region had the largest population served, 37 million persons. Approximately 47 percent of the U.S. population, or 121 million persons, had access to curbside recyclables collection. In the Northeast 72 percent of the population had access to curbside recyclables collection, while in the South only 34 percent of the population had access to curbside recycling.

Figure 21. Population Served in Curbside Programs, 1995 (In thousands)




Source: Franklin Associates, Ltd.

**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 U.S. It is estimated that there were 8,773 in 35 states reporting in 1995, according to the ***BioCycle*** survey (Steuteville 1996). 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.

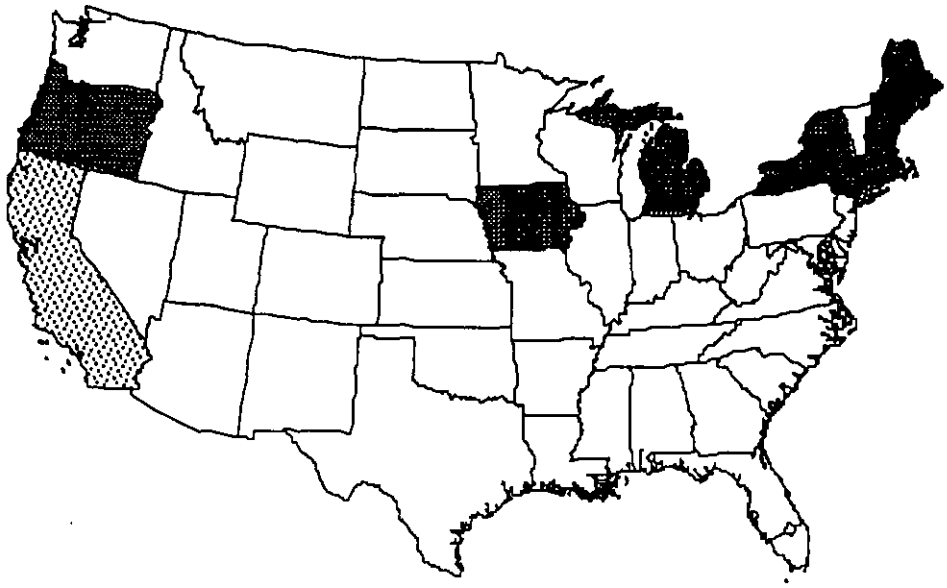
**Deposit Systems.** Nine states have container deposit systems: Connecticut, Delaware, Iowa, Maine, Massachusetts, Michigan, New York, Oregon, and Vermont. In these programs, the consumer pays a deposit on beverage containers at the point of purchase, which is redeemed on return of the empty containers. California has a similar system where containers can be redeemed, but the consumer pays no deposit.

It is estimated that about 35 percent of all recovery of beverage containers comes from the 9 traditional deposit states mentioned above, as shown in Figure 22. An estimated additional 20 percent of beverage containers recovered come from California. However, there are deposit containers that flow through curbside and drop-off recycling programs that eventually make it back to the distributor and are counted towards the redemption rate. With the exception of California, no new deposit laws have been enacted since the early 1980s, due in part to the convenience and economics of curbside recycling.

**Commercial Recyclables Collection.** The greatest 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, 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

Figure 22. States With Deposit/Redemption Legislation



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. It is also the same waste hauler that makes recycling available to multi-family dwellings (typically 5 or more units), which could resemble a drop-off center.

**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 streams at the curb, such as a paper stream and a container stream, 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 U.S., depending on the incoming materials and the technology and labor used to sort the materials. There were 310 MRFs in the U.S in 1995. Like curbside programs, they were not heavily concentrated in any one part of the U.S., as shown in Figure 23.

In 1995, most MRFs (196) were low technology, meaning the materials are predominantly sorted manually, as shown in Table 34. About 114 MRFs were

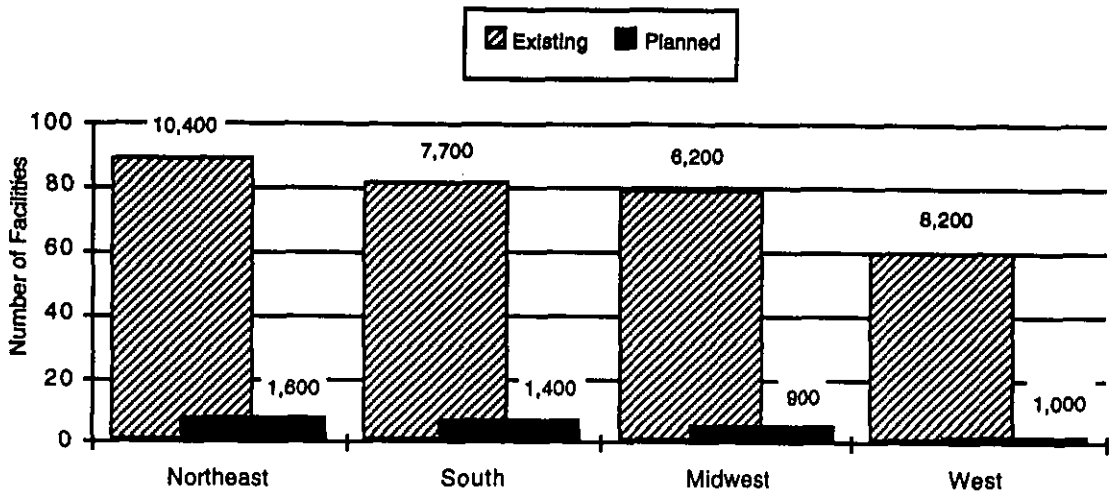



**Figure 23. Existing and Planned MRFs, 1995**
**(MRF capacity in tons per day indicated above bars)**

Source: Governmental Advisory Associates.

high technology, with eddy currents, magnetic pulleys, optical sensors, and air classifiers doing most of the sorting. As MRFs change and grow, many low technology MRFs add high tech features and high technology MRFs include manual sorting, making the difference between high and low technology MRFs less definitive.

**Table 34**

MATERIALS RECOVERY FACILITIES, 1995 (1)

| | 1995 Facilities | | | | | | | Planned Facilities | |
|---|---|---|---|---|---|---|---|---|---|
| | Technology | | Ownership | | Operation | | Capacity | Number | Capacity |
| Region | Low | High | Public | Private | Public | Private | (tpd) | | (tpd) |
| NORTHEAST | 37 | 52 | 37 | 52 | 25 | 64 | 10,373 | 8 | 1,597 |
| SOUTH | 64 | 18 | 16 | 66 | 9 | 73 | 7,721 | 7 | 1,361 |
| MIDWEST | 50 | 29 | 24 | 55 | 12 | 67 | 6,159 | 5 | 903 |
| WEST | 45 | 15 | 4 | 56 | 2 | 58 | 8,244 | 2 | 1,005 |
| *U.S. Total* | 196 | 114 | 81 | 229 | 48 | 262 | 32,497 | 22 | 4,866 |

(1) Includes operational MRFs and those in shakedown.
(2) Co-owned MRFs are counted with private MRFs.

Reference: Governmental Advisory Associates 1995.

Source: Franklin Associates, Ltd.

**Mixed Waste Processing.** Mixed waste processing facilities are less common than conventional MRFs, but there are several facilities in operation in the U.S., as shown in Figure 24. Mixed waste processing facilities receive waste just as if it were going to a landfill. The mixed waste is loaded on conveyors and, using both mechanical and manual (high and low technology) sorting, recyclable materials are removed for further processing. In 1995, there were 34 mixed waste processing facilities in the U.S., handling about 20,000 tons of waste per day (Governmental 1995).

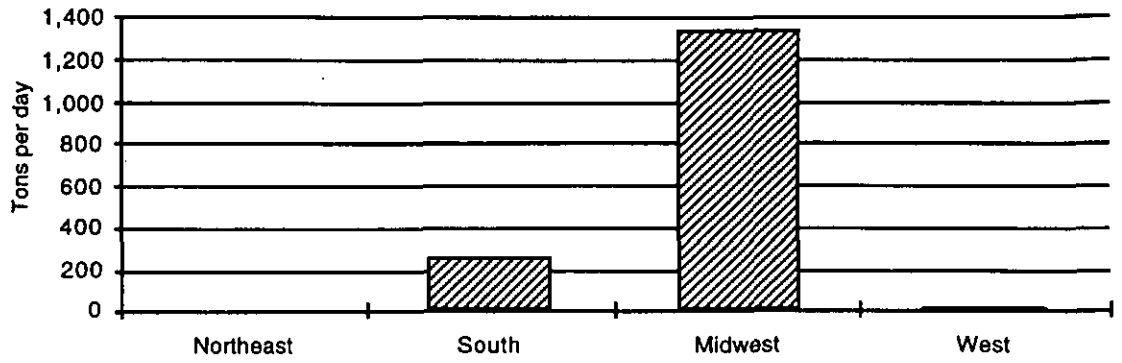
**Figure 24. Mixed Waste Processing Capacity, 1995**
**(In tons per day)**

Source: Governmental Advisory Associates.

**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 biologically organic components of MSW, such as paper, food wastes and yard trimmings, wood, and other materials. In 1995, there were 18 mixed waste composting facilities, predominantly in the Midwest, as shown in Figure 25. These facilities handle about 900 tons per day in total.

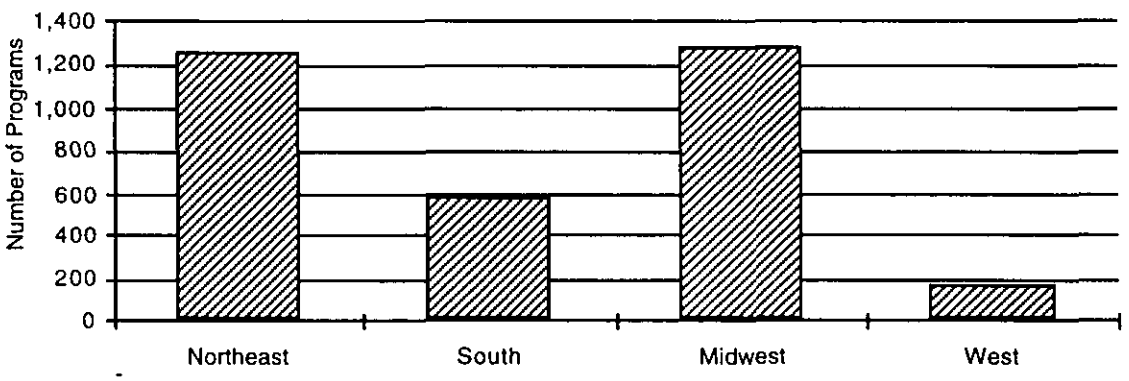
**Yard Trimmings Composting.** Yard trimmings composting is much more prevalent than mixed waste composting. On-site management of yard trimmings is not included in this section, but is discussed in the source reduction section. There were over 3,300 yard trimmings programs in 1995. More than half of these programs are in the Northeast region, as shown in Figure 26. Yard trimmings composting facilities handled approximately 25,000 tons per day.

**Figure 25. MSW Composting Capacity, 1995**
**(In tons per day)**




Source: The Composting Council, 1995.

**Figure 26. Yard Trimmings Composting Programs, 1995**
**(In number of programs)**




Source: Steuteville 1996.

## COMBUSTION

Most of the municipal solid waste combustion currently practiced in this country incorporates recovery of an energy product (generally steam or electricity). The resulting energy reduces the amount needed from other sources, and the sale of the energy helps to offset the cost of operating the facility. In past years, it was common to burn municipal solid waste in incinerators as a volume reduction practice; energy recovery became more prevalent in the 1980s.

Table 35

MUNICIPAL WASTE COMBUSTORS 1995 (1)(2)

| | WTE (2) | | | | RDF Processing (3) | | Incinerator (4) | |
|---|---|---|---|---|---|---|---|---|
| Region | No. existing | Design Capacity (tpd) | No. planned & under construction | Design Capacity (tpd) | No. | Design Capacity (tpd) | No. | Design Capacity (tpd) |
| NORTHEAST | 43 | 45,836 | 4 | 6,740 | 1 | 450 | 12 | 434 |
| SOUTH | 39 | 35,818 | 3 | 1,025 | 4 | 1,575 | 2 | 95 |
| MIDWEST | 22 | 12,369 | 2 | 3,400 | 6 | 3,463 | 3 | 2,000 |
| WEST | 8 | 4,710 | 2 | 145 | 1 | 500 | 2 | 222 |
| *U.S. Total* | 112 | 98,733 | 11 | 11,310 | 12 | 5,988 | 19 | 2,751 |

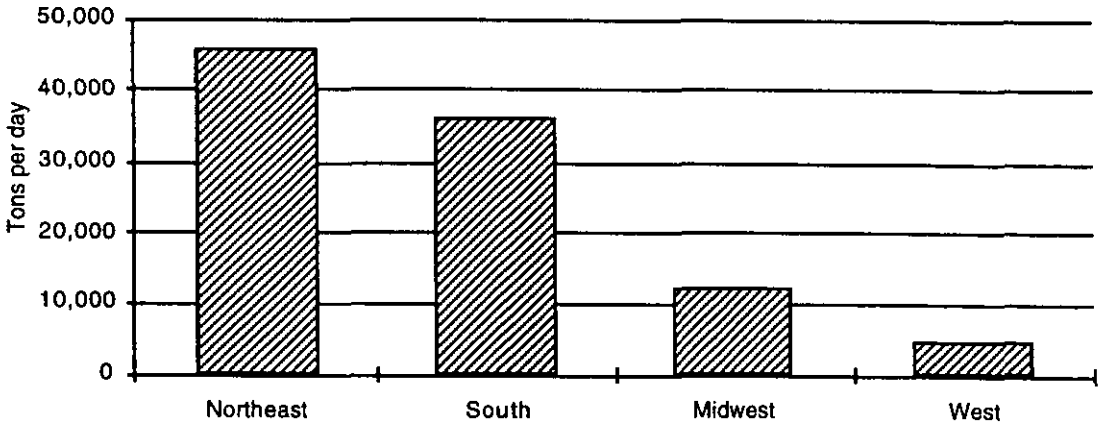
(1) WTE projects on hold or inactive were not included.
(2) WTE includes mass burn, modular, refuse-derived fuel, RDF-Combustion.
(3) RDF processing = waste processing facility generating a prepared fuel for off-site combustion. Includes existing and planned sites.
(4) Facilities without energy recovery.

References: Integrated Waste Services Association, 1996.

Source: Franklin Associates, Ltd.

Total U.S. MSW combustion with energy recovery, referred to as waste-to-energy (WTE) combustion, had a 1995 design capacity of 99,000 tons per day. There were 112 WTE facilities in 1995 (Table 35). The Northeastern and Southern regions had most of the MSW combustion capacity in 1995 (Figure 27). In addition to WTE combustion, 6,000 tons per day of refuse-derived fuel (RDF) were prepared, and there was an additional 3,500 daily tons of capacity for incineration without energy recovery.

Figure 27. Municipal Waste Combustion Capacity, 1995




Source: Integrated Waste Services Association, 1996.

In addition to facilities combusting mixed MSW (processed or unprocessed), there is a small but growing amount of combustion of source-separated MSW. In particular, there is considerable interest in using rubber tires as fuel in dedicated facilities or as fuel in cement kilns. In addition, there is combustion of wood wastes and some paper and plastic wastes, usually in boilers that already burn some other type of solid fuel. For this report, it was estimated that about 1.9 million tons of MSW were combusted in this manner in 1995, with tires contributing a majority of the total.

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 85 percent of rated capacity. While this is a conservative assumption, it has proven to be reasonably accurate over the years. (While new facilities are reporting operation at very high utilization rates, other facilities do not meet the same standards for annual throughput as compared to rated capacity.)

The total throughput of MSW through all combustion facilities was an estimated 33.5 million tons, or 16 percent of MSW generation, in 1995.

## 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 must be managed separately. (There are a number of efforts underway to reuse ash.) As a general "rule of thumb," MSW combustor ash amounts to about 25 percent (dry weight) of unprocessed MSW input. This percentage will vary from facility to facility depending upon the types of waste input and the efficiency and configuration of the facility.

## LANDFILL

Although the number of landfills is decreasing, the capacity has remained relatively constant. In 1995, there were about 2,500 landfills in the U.S. New landfills are now much larger than in the past.

Table 36 and Figure 28 show the number of landfills in each region. The Southeast and West had the greatest number of landfills. Thirty-seven states had more than 10 years of capacity left, while only two had less than 5 years of capacity remaining.

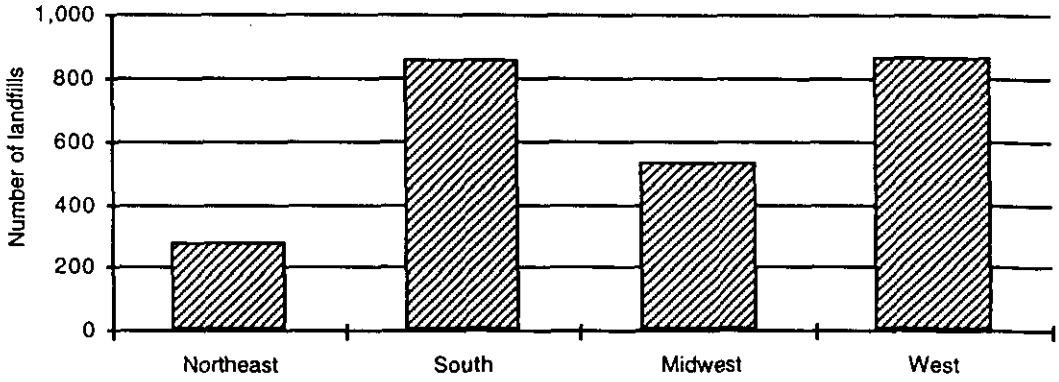
**Table 36**

**LANDFILLS IN THE UNITED STATES BY REGION, 1995**

| Region | Number of Landfills | Number of States with Years Capacity Remaining > 10 | 10—5 | < 5 |
|---|---|---|---|---|
| NORTHEAST | 280 | 4 | 3 | 2 |
| SOUTHEAST | 856 | 13 | 3 | 0 |
| MIDWEST | 529 | 9 | 3 | 0 |
| WEST | 870 | 11 | 0 | 0 |
| *U.S. Total* * | 2,535 | 37 | 9 | 2 |

* Excludes Alaska and Hawaii.
References: Waste Age, May 1996.

**Figure 28. Landfill Capacity in the U.S., 1995 (In number of landfills)**




Source: Waste Age, May 1996.

## SUMMARY OF HISTORICAL AND CURRENT MSW MANAGEMENT

Municipal solid waste generation has grown steadily (except for occasional decreases during recession years) from 88.1 million tons in 1960 to 208 million tons in 1995. The data presented in this chapter and Chapter 2 provide a perspective on the historical management of municipal solid waste. The study results are summarized in Table 37 and Figure 29.

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

**Table 37**

**GENERATION, MATERIALS RECOVERY, COMPOSTING, COMBUSTION, AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 TO 1995**
**(In thousands of tons and percent of total generation)**

| | Thousands of Tons | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1960 | 1970 | 1980 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
| Generation | 88,120 | 121,060 | 151,640 | 197,300 | 196,880 | 202,210 | 205,400 | 209,630 | 208,050 |
| Recovery for recycling | 5,610 | 8,020 | 14,520 | 29,650 | 32,890 | 36,020 | 37,940 | 43,490 | 46,620 |
| Recovery for composting* | Neg. | Neg. | Neg. | 4,200 | 4,800 | 5,400 | 6,900 | 8,480 | 9,570 |
| *Total Materials Recovery* | 5,610 | 8,020 | 14,520 | 33,850 | 37,690 | 41,420 | 44,840 | 51,970 | 56,190 |
| Discards after recovery | 82,510 | 113,040 | 137,120 | 163,450 | 159,190 | 160,790 | 160,560 | 157,660 | 151,860 |
| Combustion** | 27,000 | 25,100 | 13,700 | 31,900 | 33,330 | 32,690 | 32,920 | 32,490 | 33,470 |
| Discards to landfill, other disposal† | 55,510 | 87,940 | 123,420 | 131,550 | 125,860 | 128,100 | 127,640 | 125,170 | 118,390 |

| | Percent of Total Generation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1960 | 1970 | 1980 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
| Generation | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Recovery for recycling | 6.4% | 6.6% | 9.6% | 15.0% | 16.7% | 17.8% | 18.5% | 20.7% | 22.4% |
| Recovery for composting* | Neg. | Neg. | Neg. | 2.1% | 2.4% | 2.7% | 3.4% | 4.0% | 4.6% |
| *Total Materials Recovery* | 6.4% | 6.6% | 9.6% | 17.2% | 19.1% | 20.5% | 21.8% | 24.8% | 27.0% |
| Discards after recovery | 93.6% | 93.4% | 90.4% | 82.8% | 80.9% | 79.5% | 78.2% | 75.2% | 73.0% |
| Combustion** | 30.6% | 20.7% | 9.0% | 16.2% | 16.9% | 16.2% | 16.0% | 15.5% | 16.1% |
| Discards to landfill, other disposal† | 63.0% | 72.6% | 81.4% | 66.7% | 63.9% | 63.3% | 62.1% | 59.7% | 56.9% |

* Composting of yard trimmings and food wastes. Does not include mixed MSW composting or backyard composting. MSW composting estimated to be less than 500 thousand tons per year.

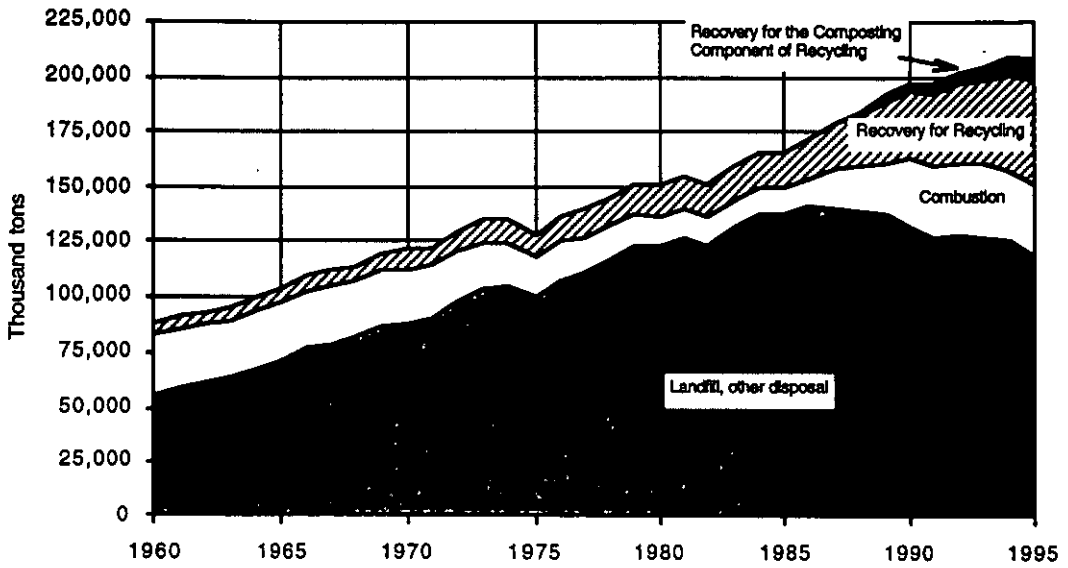
** Includes combustion of MSW in mass burn or refuse-derived fuel form, incineration without energy recovery, and combustion with energy recovery of source separated materials in MSW.

† Discards after recovery minus combustion.

Details may not add to totals due to rounding.

Source: Franklin Associates, Ltd.

**Figure 29. Municipal Solid Waste Management, 1960 to 1995**




Historically, 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 29 graphically shows, discards of MSW to landfill or other disposal apparently peaked in the 1986-1987 period, then began to decline as materials recovery and combustion increased.

Generation of MSW declined in 1991 (a recession year), but then continued to increase until 1995, when it decreased again slightly. Recovery of products and yard trimmings increased steadily, while combustion stayed nearly constant. As a result, discards to landfills were lower each year from 1992 to 1995. Landfilling accounted for 118.4 million tons, or 56.9 percent of total generation in 1995. As a percent of total generation, landfilling has consistently decreased—from 83.2 percent of generation in 1986 to 56.9 percent in 1995.

## Chapter 3

## REFERENCES

### GENERAL

Franklin Associates, Ltd. ***The Future of Solid Waste Management and Recycling.*** Multi-client study. November 1996. Draft.

Governmental Advisory Associates, ***The Materials Recycling and Processing Industry in the United States: 1995-96 Yearbook, Atlas, and Directory. 1995.***

U.S. Environmental Protection Agency, Municipal Solid Waste Task Force, Office of Solid Waste. ***The Solid Waste Dilemma: An Agenda for Action.*** February 1989.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1990 Update.*** EPA/530-SW-90-042. June 1991.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1992 Update.*** EPA/530-R-92-019. July 1992.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1994 Update.*** EPA/530-R-94-042. November 1994.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1995 Update.*** EPA/530-R-945-001. March 1996.

### SOURCE REDUCTION

American Plastics Council. ***Plastics: Key Materials for Innovation and Productivity in Major Appliances.*** Prepared by Ralph Hagan, Technology Laboratories Manager, G.E. Appliances, Ret., et al. February 1994.

Brown, Kenneth. ***Source Reduction Now.*** Minnesota Office of Waste Management. February 1993.

Christopher, C. "Waste Not, Need Not." ***TechNews.*** January/February 1995.

Compost Council. "Yard Waste Legislation: Disposal Bans and Similar Passed Bills as of July, 1993." Fact Sheet. July 1993.

Congress of the United States, Office of Technology Assessment. ***Green Products by Design: Choices for a Cleaner Environment.*** OTA-E-541. October 1992.

Council on Packaging in the Environment. "COPE Backgrounder: Source Reduction." March 1995.

Fishbein, Bette K., and Caroline Gelb. ***Making Less Garbage: A Planning Guide for Communities***. INFORM. 1992.

Franklin Associates, Ltd. ***The Role of Recycling in Integrated Solid Waste Management to the Year 2000***. Keep America Beautiful, Inc. 1994.

Institute for Local Self-Reliance. ***Creating Wealth from Everyday Household Items.*** June 1996.

Institute for Local Self-Reliance. ***Plug Into Electronics Reuse.*** June 1996.

Institute for Local Self-Reliance. ***Sustaining Businesses & Jobs Through Pallet Repair & Reuse.*** June 1996.

Institute for Local Self-Reliance. ***Weaving Textile Reuse into Waste Reduction.*** June 1996.

Miller, C. "Source Reduction: Less of More." ***Waste Age.*** February 1995.

Miller, C. "The Business of Source Reduction." ***Waste Age's Recycling Times.*** October 29, 1996.

Minnesota Office of Environmental Assistance. "Source Reduction Now" February 1993.

Newspaper Association of America. ***Newsprint Conservation.*** June 1995.

Personal communication between Franklin Associates, Ltd. and Bob Householder, Sonoco Products. November 1996.

Personal Communication between Franklin Associates, Ltd. and Larry Forrsberg, Association of Household Appliance Manufacturers. November 1996.

Rattray, Tom. "Source Reduction—An Endangered Species?" ***Resource Recycling***. November 1990.

Raymond Communications. ***State Recycling Laws Update.*** 1994.

Sears, Roebuck & Co. Spring and fall catalogs. 1985 and earlier years.

Selke, Susan E. "Evaluating a Source Reduction Opportunity." ***Solid Waste & Power***. June 1991.

Steuteville, Robert. "The State of Garbage in America. Part II." ***BioCycle.*** May 1995.

U.S. Environmental Protection Agency. ***The Consumer's Handbook for Reducing Solid Waste.*** EPA/530-K-92-003. August 1992.

U.S. Environmental Protection Agency. ***Waste Prevention Pays Off: Companies Cut Waste in the Workplace.*** EPA/530-K-92-005. November 1993.

U.S. Environmental Protection Agency. ***Waste Wise: Second Year Progress Report.*** EPA/530-R-96-016. September 1996.

**RECOVERY FOR RECYCLING AND COMPOSING**

Governmental Advisory Associates. ***The Materials Recycling and Processing Industry in the United States: 1995-1996 Yearbook.*** 1996.

Kreith, Frank. ***Handbook of Solid Waste Management.*** McGraw-Hill, Inc. 1994.

Steuteville, Robert. "The State of Garbage in America." ***BioCycle.*** May 1996.

The Composting Council. "MSW Composting Facilities." Fall 1995.

U.S. Department of Commerce, Bureau of the Census. ***Statistical Abstract of the United States.*** 1996.

**COMBUSTION**

"1991-1992 Energy-from-Waste Report." ***Solid Waste & Power.*** HCI Publications. October 1991, December 1990.

Integrated Waste Services Association. "High Court Rules Ash Not Exempt from Subtitle C Regulation." ***Update.*** Summer 1994.

Kiser, Jonathan V.L. "A Comprehensive Report on the Status of Municipal Waste Combustion." ***Waste Age.*** November 1990.

Kiser, Jonathan V.L. "Municipal Waste Combustion in North America: 1992 Update." ***Waste Age.*** November 1992.

Kiser, Jonathan V.L. "The 1992 Municipal Waste Combustion Guide." National Solid Wastes Management Association. February 1992.

Kiser, Jonathan V.L. "The IWSA Municipal Waste Combustion Directory: 1993." Integrated Waste Services Association. February 1994.

Kiser, Jonathan V.L., and John Menapace. "The 1995 IWSA Municipal Waste Combustion Directory Of United States Facilities." Integrated Waste Services Association. March 1995.

Kiser, Jonathan V.L., and John Menapace. "The 1996 IWSA Municipal Waste Combustion Directory Of United States Facilities." Integrated Waste Services Association. March 1996.

Levy, Steven J. ***Municipal Waste Combustion Inventory***. U.S. Environmental Protection Agency, Office of Solid Waste, Municipal & Industrial Solid Waste Division. November 22, 1991.

National Solid Wastes Management Association. "The 1992 Municipal Waste Combustion Guide." ***Waste Age***. November 1992.

"The 1991 Municipal Waste Combustion Guide." ***Waste Age***. November 1991.

**LANDFILL**

Franklin Associates, Ltd. unpublished data and estimates, 1996.

Repa, Edward and Allen Blakey. "Municipal Solid Waste Disposal Trends: 1996 Update." ***Waste Age***. May 1996.

Steuteville, Robert. "The State of Garbage in America." ***BioCycle***. May 1996.

## Chapter 4

# PROJECTIONS OF MSW GENERATION AND MANAGEMENT AND ADDITIONAL PERSPECTIVES

## INTRODUCTION

This chapter includes projections of municipal solid waste generation and management for the years 2000 and 2010. *It should be emphasized that these projections are not predictions.* Recent efforts at source reduction are difficult to measure at a national level, but almost certainly are affecting MSW generation. No one can foresee with accuracy changes in the economy (e.g., booms and recessions), which also affect the municipal waste stream. In addition, it is difficult to predict which innovations and new products will affect the amounts and types of MSW discards.

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

## OVERVIEW OF THIS CHAPTER

This chapter includes projections of municipal solid waste generation, recovery for recycling (including composting), combustion, and landfill through the year 2010. Projections of total MSW recovery for recycling (including composting) are presented as scenarios—30 percent, and 35 percent for the year 2000; and 30 percent, 35 percent, and 40 percent for the year 2010. In making these projections, it was assumed that overall, products in MSW would continue to grow at a rate higher than population growth and lower than growth of Gross Domestic Product (GDP). (See Chapter 5 of EPA report 530-R-94-042, ***Characterization of Municipal Solid Waste in the United States: 1994 Update***, for an explanation of the correlation of MSW generation with these demographic and economic factors.)

It should be noted that some trend projections in this report, particularly MSW generation for the year 2010, are notably different than previously projected. The relatively flat growth in the generation of many products from 1994 to 1995 had the effect of decreasing trend projections of MSW generation previously reported.

It is also important to note that the projections in this series of tables are also based on the assumption that there will continue to be a reduction in the generation of yard trimmings that enter the solid waste management system. These assumptions are explained later in this chapter. One result of this assumption is that the percentages of other products and materials in MSW are higher in future years than they would be if yard trimmings generation stayed constant or increased.

A summary table showing projected MSW generation, recovery at the mid-range scenario, and discards of MSW to combustion and landfill in 2000 and 2010 is included at the end of the chapter.

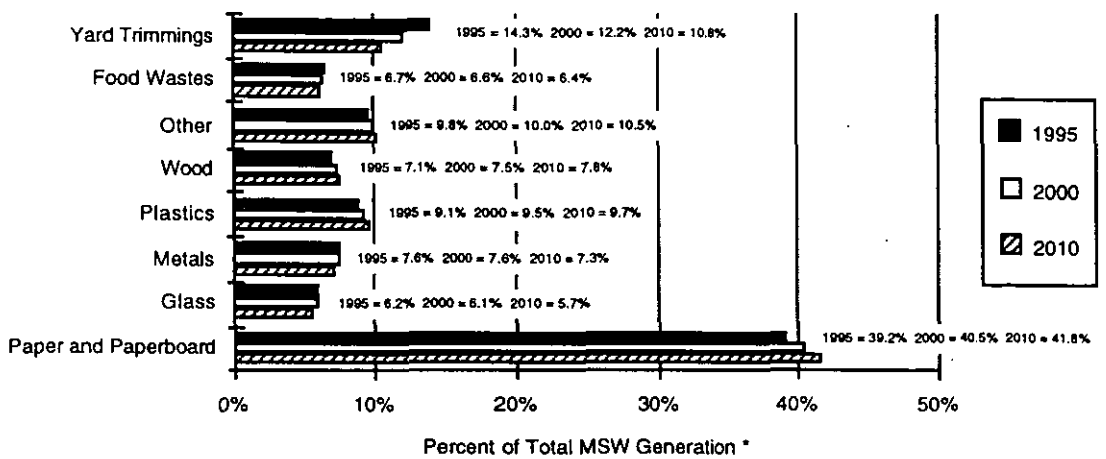
## MATERIALS GENERATION IN MUNICIPAL SOLID WASTE

Projections of materials generated in MSW (by weight) are summarized in Figure 30 and Table 38, and a discussion of each material category follows.

### Paper and Paperboard

Previous projections of paper and paperboard generation were revised using the following information: revised data for 1994 and new data for 1995 from the American Forest & Paper Association, historical and projected per capita consumption of paper and paperboard products, and the ratio of total paper and paperboard to real Gross Domestic Product (GDP).

**Figure 30. Materials generated in MSW: 1995, 2000, and 2010 (In percent of total MSW generation*)**




* Total MSW generation (in thousand tons) for 1995 = 208,050 2000 = 221,670 2010 = 253,000.

**Table 38**

**PROJECTIONS OF MATERIALS GENERATED***
**IN THE MUNICIPAL WASTE STREAM: 1995, 2000, AND 2010**
**(In thousands of tons and percent of total generation)**

| | Thousands of tons | | | % of total | | |
|---|---|---|---|---|---|---|
| **Materials** | **1995** | **2000** | **2010** | **1995** | **2000** | **2010** |
| Paper and Paperboard | 81,540 | 89,740 | 105,690 | 39.2% | 40.5% | 41.8% |
| Glass | 12,830 | 13,510 | 14,540 | 6.2% | 6.1% | 5.7% |
| Metals | | | | | | |
| Ferrous | 11,590 | 12,250 | 13,330 | 5.6% | 5.5% | 5.3% |
| Aluminum | 2,950 | 3,170 | 3,570 | 1.4% | 1.4% | 1.4% |
| Other Nonferrous | 1,310 | 1,430 | 1,580 | 0.6% | 0.6% | 0.6% |
| *Total Metals* | *15,850* | *16,850* | *18,480* | *7.6%* | *7.6%* | *7.3%* |
| Plastics | 18,990 | 20,960 | 24,660 | 9.1% | 9.5% | 9.7% |
| Rubber and Leather | 6,030 | 6,640 | 7,860 | 2.9% | 3.0% | 3.1% |
| Textiles | 7,400 | 8,420 | 10,720 | 3.6% | 3.8% | 4.2% |
| Wood | 14,860 | 16,550 | 19,610 | 7.1% | 7.5% | 7.8% |
| Other | 3,630 | 3,900 | 4,340 | 1.7% | 1.8% | 1.7% |
| *Total Materials in Products* | 161,130 | 176,570 | 205,900 | 77.4% | 79.7% | 81.4% |
| **Other Wastes** | | | | | | |
| Food Wastes | 14,020 | 14,700 | 16,100 | 6.7% | 6.6% | 6.4% |
| Yard Trimmings** | 29,750 | 27,100 | 27,400 | 14.3% | 12.2% | 10.8% |
| Miscellaneous Inorganic Wastes | 3,150 | 3,300 | 3,600 | 1.5% | 1.5% | 1.4% |
| *Total Other Wastes* | 46,920 | 45,100 | 47,100 | 22.6% | 20.3% | 18.6% |
| *Total MSW Generated* | 208,050 | 221,670 | 253,000 | 100.0% | 100.0% | 100.0% |

* Generation before materials recovery or combustion.
** Yard trimmings based on source reduction scenario #2 described in Table 44.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Several factors contributed to a lowering of previous projections of paper and paperboard. New supply (consumption) of paper and paperboard increased by less than one percent between 1994 and 1995, in contrast to increases of 3 to 5 percent for the previous three years. (Consumption per person actually declined slightly between 1994 and 1995.) Population growth as projected by the Bureau of the Census was also lower than projections used in the previous report. Finally, the ratio of new supply to GDP has been generally declining, and this decline is projected to continue.

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

Paper and paperboard is projected to continue to be the dominant material in MSW, growing from a generation of 81.5 million tons in 1995 to 89.7 million tons and 105.7 million tons in 2000 and 2010, respectively. This would be 40.5 percent of MSW generation in 2000.

**Glass**

Glass products were a declining percentage of municipal solid waste during the 1970s and 1980s, with the 1990s showing a leveling off at 6.0 to 6.5 percent of MSW generation. This recent trend is projected to continue, with the percentage of glass in MSW remaining fairly constant. Glass generation is projected to grow from 12.8 million tons in 1995 to 13.5 million tons and 14.5 million tons in 2000 and 2010, respectively. For 2000 this represents 6.1 percent of projected total MSW generation.

**Ferrous Metals**

Cans made of steel declined as a percentage of MSW in the 1970s and 1980s due to material substitution and light-weighting practices of can manufacturers. Since 1990, steel cans have been a relatively constant percent of MSW generation (approximately 1.5 percent). On the other hand, more ferrous metals enter MSW as a component of durable goods than as containers. Since durable goods are an increasing component of MSW, total ferrous metals in MSW were projected to increase from 11.6 million tons in 1995 to 12.3 million tons and 13.3 million tons in 2000 and 2010, respectively. The percentage of ferrous metals in MSW is projected to account for 5.5 percent of total generation in 2000 and 5.3 percent in 2010.

**Aluminum**

Containers and packaging represent the primary source of aluminum in MSW, although some aluminum is present in durables and nondurables. Aluminum in MSW has grown, and the growth is projected to continue, to 3.2 million tons and 3.6 million tons in 2000 and 2010, respectively. Because of its light weight, aluminum represents a small percentage of MSW generation—1.4 percent in 1995, and a projected 1.4 percent in 2000 and 2010.

**Other Nonferrous Metals**

Other nonferrous metals (e.g., lead, copper, and zinc) are found in durable goods like appliances, furniture, and batteries. Lead-acid (automotive) batteries comprise the majority of this category. Generation of lead-acid batteries is projected to continue to increase, along with small increases in other nonferrous metals. Other nonferrous metals were estimated to be 1.3 million tons in 1995 and are projected to be 1.4 million tons and 1.6 million tons in 2000 and 2010,

respectively. These metals are expected to continue to be less than one percent of total MSW generation (0.6 percent).

### Plastics

Generation of plastics in MSW has grown very rapidly, with average annual growth rates of over 9 percent experienced during the 1970s and 1980s. Growth in plastics generation has continued in the 1990s—however, the annual growth rate has slowed to approximately 2 percent per year during this decade. Based on this historical trend, plastics in MSW are expected to continue to increase in tonnage, but at a projected rate closer to the 1990s. Plastics in MSW are projected to continue to increase both in tonnage (from 19.0 million tons in 1995 to 20.9 million tons and 24.7 million tons in 2000 and 2010, respectively) and in percentage of total MSW generation (from 9.1 percent of MSW in 1995 to 9.7 percent in 2010).

### Wood Wastes

Wood wastes (in furniture and other durables and in pallets and other packaging) have been increasing in MSW. The tonnage of wood wastes generated is projected to grow from 14.9 million tons in 1995 to 16.6 million tons and 19.6 million tons in 2000 and 2010, respectively. The percentage of wood wastes is projected to increase from 7.1 percent in 1995 to 7.8 percent of total MSW generation in 2010.

### Other Materials

Other materials in MSW—including rubber, leather, and textiles—are projected to have modest growth in tonnage and percentages of total MSW generation. Tonnage is projected to increase from 17.1 million tons in 1995 to 19.0 million tons and 22.9 million tons in 2000 and 2010, respectively. As a percentage these materials collectively account for 8.2 percent of total MSW in 1995, increasing to 9.0 percent in 2010.

### Food Wastes

Historical MSW sampling studies over a long period of time show food wastes to be a declining percentage of the waste stream. Per capita discards of food wastes have also been declining over time—due to the increased use of preprocessed food in homes, institutions, and restaurants, eating away from home, improved packaging, and the increased use of garbage disposals (which put food wastes into wastewater systems rather than MSW). Therefore, the generation of food wastes was projected to grow at a slightly lower rate than population. The tonnage of food wastes is projected to increase from 14.0 million tons in 1995 to 14.7 million tons and 16.1 million tons in 2000 and 2010,

respectively. The percentage of food wastes in total MSW would decline slightly, from 6.7 percent to 6.4 percent of total MSW generation.

However, as was noted in Chapter 2, recent residential food waste sampling studies in Seattle, Washington and Crawford County, Illinois indicate higher per capita residential food waste generation rates than are used in this study. As additional sampling data become available, increasing future projections of food waste generation may be warranted.

**Yard Trimmings**

In earlier versions of this report, generation of yard trimmings* was estimated based on sampling studies, which showed a more or less constant generation on a per capita basis. (The definition of generation used here is the amount of yard trimmings that enter the solid waste management system, e.g., they are placed at the curb for collection or taken to a drop-off site.) Projections were made on the same basis. This methodology has now been revised because of changing trends in the management of yard trimmings in many parts of the country.

Although not well documented, there is evidence that where communities have charged separately for pickup of yard trimmings, or where disposal of yard trimmings in landfills has been banned, or other regulatory/educational measures have been taken, the amount of yard trimmings entering the system has greatly declined. In other words, source reduction at the site of generation (e.g., residences) has been accomplished through backyard composting, grasscycling, and the like.

As indicated in Chapter 2, a tabulation of existing legislation shows that by 1996-97, over two dozen states—accounting for over 50 percent of the nation's population—will have legislation requiring source separation or banning of yard trimmings from landfills. Also, several additional states have passed solid waste diversion and waste reduction legislation effective by the year 2000 and beyond.

Therefore, it was projected that 1996 yard trimmings generation (assuming no source reduction) would be reduced by half in those states having legislation, a 25 percent reduction overall (i.e., 50 percent reduction x 50 percent of U.S. population = 25 percent total reduction). For the year 2000, it was assumed that the additional legislation affecting yard trimmings generation would be implemented and yard trimmings generation (assuming no source reduction) would be reduced by half in those states having source reduction/diversion

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* Although there are limited data 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.

legislation. Assuming these states account for 60 percent of the U.S. population, this has the effect of reducing U.S. yard trimmings generation (assuming no source reduction) by 30 percent (i.e., 50 percent reduction x 60 percent of U.S. population = 30 percent total reduction). Finally, it was assumed that additional source reduction efforts would reduce yard trimmings generation by 35 percent in the year 2010. For 2000 and 2010 projections, yard trimmings generation was adjusted to account for population growth rates (less than one percent annually) projected by the U.S. Bureau of the Census.

These assumptions yield a projection that generation of yard trimmings would decline from 29.8 million tons in 1995 to 27.1 million tons in 2000, and 27.4 million tons in 2010. The slight increase in generation from 2000 to 2010 is the result of the population growing more rapidly than the projected source reduction efforts. In 1995 yard trimmings accounted for 14.3 percent of total MSW generation. Based on projected generation, this will decline to 12.2 percent and 10.8 percent of total MSW generation in 2000 and 2010, respectively.

**Projected Growth Rates for Materials in MSW**

Projected growth rates by decade for the various materials generated in MSW are shown in Table 39. Projected population growth rates (from the Bureau of the Census) are included as well; the Bureau of the Census forecasts an approximate one percent annual growth of population from 1990 to 2000 with a decline in the growth rate (0.81 percent annual growth rate) from 2000 to 2010.

**Table 39**

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

| | 1960-1970 | 1970-1980 | 1980-1990 | 1990-2000 | 2000-2010 |
|---|---|---|---|---|---|
| Paper & Paperboard | 4.0% | 2.2% | 2.8% | 2.1% | 1.6% |
| Glass | 6.6% | 1.7% | -1.4% | 0.3% | 0.7% |
| Metals | 2.5% | 1.2% | 0.6% | 0.2% | 0.9% |
| Plastics | 22.2% | 8.9% | 9.6% | 2.0% | 1.6% |
| Wood | 2.1% | 6.5% | 5.4% | 3.3% | 1.7% |
| All Other Materials** | 4.3% | 4.3% | 4.4% | 2.3% | 1.8% |
| Food Wastes | 0.5% | 0.2% | 0.2% | 1.1% | 0.9% |
| Yard Trimmings | 1.5% | 1.7% | 2.4% | -2.5% | 0.1% |
| *Total MSW* | 3.2% | 2.3% | 2.7% | 1.2% | 1.3% |
| Population† | 1.3% | 1.1% | 0.9% | 1.0% | 0.8% |

* Annual rates of increase or decrease calculated on 10-year end points.
** Rubber and leather, textiles, electrolytes in batteries, wood pulp and moisture in disposable diapers, miscellaneous inorganics.
† Based on population estimates from U.S. Dept. of Commerce, Bureau of the Census.
Source: Franklin Associates, Ltd.

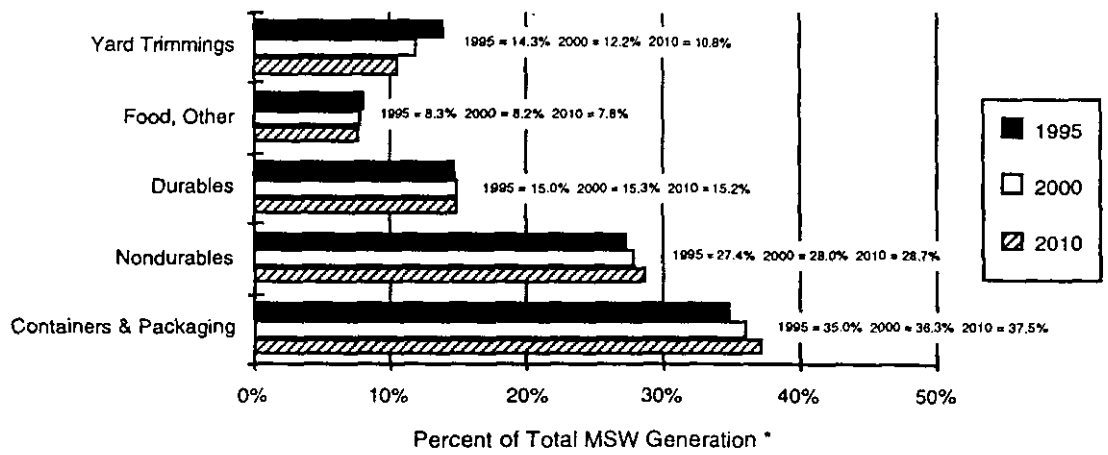
Paper and paperboard, plastics, and wood are all projected to increase faster than population, while glass, metals, and food wastes are projected to increase at about the same rate as population. Yard trimmings are projected to decline through 2000 due to source reduction efforts and landfill bans and then increase slightly after 2000 due to population increases.

Overall, municipal solid waste generation is projected to increase at a rate of 1.2 percent annually between 1990 and 2000. This rate would be higher if the projected decline in yard trimmings does not occur. For the period 2000 through 2010, the annual growth rate for municipal solid waste is projected to be 1.3 percent annually.

## PRODUCT GENERATION IN MUNICIPAL SOLID WASTE

Projected generation of products in MSW (by weight) is summarized in Figure 31 and Table 40. All categories (except for yard trimmings) are projected to grow in tonnage. Containers and packaging are projected to remain the largest single category at over 36 percent of total generation, with nondurables being the second largest category, at 28 percent of total MSW generation. More detailed observations on the projected growth in the individual product categories follow.

**Figure 31. Products generated in MSW: 1995, 2000, and 2010 (In percent of total MSW generation*)**




* Total MSW generation (in thousand tons) for 1995 = 208,050 2000 = 221,670 2010 = 253,000.

**Table 40**

**PROJECTIONS OF CATEGORIES OF PRODUCTS GENERATED***
**IN THE MUNICIPAL WASTE STREAM: 1995, 2000, AND 2010**
**(In thousands of tons and percent of total generation)**

| | Thousands of tons | | | % of total | | |
|---|---|---|---|---|---|---|
| **Products** | **1995** | **2000** | **2010** | **1995** | **2000** | **2010** |
| **Durable Goods** *(Detail in Table 41)* | 31,230 | 33,940 | 38,290 | 15.0% | 15.3% | 15.1% |
| **Nondurable Goods** *(Detail in Table 42)* | 57,040 | 62,140 | 72,720 | 27.4% | 28.0% | 28.7% |
| **Containers and Packaging** *(Detail in Table 43)* | 72,860 | 80,490 | 94,890 | 35.0% | 36.3% | 37.5% |
| ***Total Product Wastes***** | 161,130 | 176,570 | 205,900 | 77.4% | 79.7% | 81.4% |
| **Other Wastes** | | | | | | |
| Food Wastes | 14,020 | 14,700 | 16,100 | 6.7% | 6.6% | 6.4% |
| Yard Trimmings^ | 29,750 | 27,100 | 27,400 | 14.3% | 12.2% | 10.8% |
| Miscellaneous Inorganic Wastes | 3,150 | 3,300 | 3,600 | 1.5% | 1.5% | 1.4% |
| ***Total Other Wastes*** | 46,920 | 45,100 | 47,100 | 22.6% | 20.3% | 18.6% |
| ***Total MSW Generated*** | 208,050 | 221,670 | 253,000 | 100.0% | 100.0% | 100.0% |

* Generation before materials recovery or combustion.
** Other than food products.
^ Yard trimmings based on source reduction scenario #2 described in Table 44.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

## Durable Goods

Overall, durable goods are projected to increase in both tonnage and percent of total MSW generation (Table 41). The trends in generation of major appliances, carpet and rugs, and furniture and furnishings are well established by production numbers, since lifetimes of up to 20 years are assumed. Generation of rubber tires and lead-acid batteries is projected based on historical trends, which are generally exhibiting average rates of growth. Durable goods are projected to account for about 15 percent of MSW generation and are projected to increase to 33.9 million tons and 38.3 million tons in 2000 and 2010, respectively. This represents a growth rate of about 1.4 percent annually for durable goods.

## Nondurable Goods

Similar to durable goods, nondurable goods are projected to increase in both tonnage and percent of total MSW generation (Table 42). Generation of nondurable goods is projected to be 62.1 million tons and 72.7 million tons in 2000 and 2010, respectively. Generation of nondurable goods is projected to grow approximately 1.6 percent annually, accounting for about 29 percent of total MSW generation in 2010.

**Table 41**

**PROJECTIONS OF PRODUCTS GENERATED***
**IN THE MUNICIPAL WASTE STREAM: 1995, 2000, AND 2010**
**(WITH DETAIL ON DURABLE GOODS)**
**(In thousands of tons and percent of total generation)**

| | Thousands of tons | | | % of total | | |
|---|---|---|---|---|---|---|
| **Products** | **1995** | **2000** | **2010** | **1995** | **2000** | **2010** |
| **Durable Goods** | | | | | | |
| Major Appliances | 3,420 | 3,450 | 3,600 | 1.6% | 1.6% | 1.4% |
| Small Appliances | 710 | 860 | 1,100 | 0.3% | 0.4% | 0.4% |
| Furniture and Furnishings | 7,160 | 7,600 | 8,400 | 3.4% | 3.4% | 3.3% |
| Carpets and Rugs | 2,230 | 2,830 | 4,040 | 1.1% | 1.3% | 1.6% |
| Rubber Tires | 3,770 | 4,000 | 4,500 | 1.8% | 1.8% | 1.8% |
| Batteries, Lead-Acid | 1,910 | 2,100 | 2,350 | 0.9% | 0.9% | 0.9% |
| Miscellaneous Durables | 12,030 | 13,100 | 14,300 | 5.8% | 5.9% | 5.7% |
| *Total Durable Goods* | 31,230 | 33,940 | 38,290 | 15.0% | 15.3% | 15.1% |
| **Nondurable Goods** *(Detail in Table 42)* | 57,040 | 62,140 | 72,720 | 27.4% | 28.0% | 28.7% |
| **Containers and Packaging** *(Detail in Table 43)* | 72,860 | 80,490 | 94,890 | 35.0% | 36.3% | 37.5% |
| *Total Product Wastes*** | 161,130 | 176,570 | 205,900 | 77.4% | 79.7% | 81.4% |
| **Other Wastes** | | | | | | |
| Food Wastes | 14,020 | 14,700 | 16,100 | 6.7% | 6.6% | 6.4% |
| Yard Trimmings^ | 29,750 | 27,100 | 27,400 | 14.3% | 12.2% | 10.8% |
| Miscellaneous Inorganic Wastes | 3,150 | 3,300 | 3,600 | 1.5% | 1.5% | 1.4% |
| *Total Other Wastes* | 46,920 | 45,100 | 47,100 | 22.6% | 20.3% | 18.6% |
| *Total MSW Generated* | 208,050 | 221,670 | 253,000 | 100.0% | 100.0% | 100.0% |

* Generation before materials recovery or combustion.
** Other than food products.
^ Yard trimmings based on source reduction scenario #2 described in Table 44.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Most of the nondurable paper products are projected to continue to grow at rates higher than population growth. Strong growth rates are projected for paper products such as office paper, paper used in commercial printing, and other nonpackaging paper. Newspaper generation is projected to increase to over 13.9 million tons in 2010, although the growth rate is expected to be lower than other paper products comprising nondurable goods—less than 0.5 percent annually.

Clothing and footwear and other textiles also are projected to increase in tonnage, to 8.5 million tons by 2010. Finally, other miscellaneous nondurables, which include many items made of plastics, is expected to continue to increase, although slower than historical rates of growth.

Table 42

**PROJECTIONS OF PRODUCTS GENERATED***
**IN THE MUNICIPAL WASTE STREAM: 1995, 2000, AND 2010**
**(WITH DETAIL ON NONDURABLE GOODS)**
**(In thousands of tons and percent of total generation)**

| Products | Thousands of tons | | | % of total | | |
|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2010 | 1995 | 2000 | 2010 |
| **Durable Goods** *(Detail in Table 41)* | 31,230 | 33,940 | 38,290 | 15.0% | 15.3% | 15.1% |
| **Nondurable Goods** | | | | | | |
| Newspapers | 13,130 | 13,350 | 13,860 | 6.3% | 6.0% | 5.5% |
| Books | 1,170 | 1,300 | 1,560 | 0.6% | 0.6% | 0.6% |
| Magazines | 2,370 | 2,700 | 3,430 | 1.1% | 1.2% | 1.4% |
| Office Papers | 6,800 | 7,510 | 8,900 | 3.3% | 3.4% | 3.5% |
| Telephone Directories | 490 | 540 | 650 | 0.2% | 0.2% | 0.3% |
| Third Class Mail | 4,620 | 5,380 | 7,200 | 2.2% | 2.4% | 2.8% |
| Other Commercial Printing | 7,110 | 7,550 | 8,370 | 3.4% | 3.4% | 3.3% |
| Tissue Paper and Towels | 2,950 | 3,140 | 3,430 | 1.4% | 1.4% | 1.4% |
| Paper Plates and Cups | 970 | 1,170 | 1,650 | 0.5% | 0.5% | 0.7% |
| Plastic Plates and Cups | 790 | 850 | 970 | 0.4% | 0.4% | 0.4% |
| Trash Bags | 750 | 900 | 1,200 | 0.4% | 0.4% | 0.5% |
| Disposable Diapers | 2,960 | 3,150 | 3,500 | 1.4% | 1.4% | 1.4% |
| Other Nonpackaging Paper | 3,800 | 4,500 | 5,600 | 1.8% | 2.0% | 2.2% |
| Clothing and Footwear | 5,070 | 5,800 | 7,600 | 2.4% | 2.6% | 3.0% |
| Towels, Sheets, & Pillowcases | 740 | 800 | 900 | 0.4% | 0.4% | 0.4% |
| Other Misc. Nondurables | 3,320 | 3,500 | 3,900 | 1.6% | 1.6% | 1.5% |
| *Total Nondurable Goods* | 57,040 | 62,140 | 72,720 | 27.4% | 28.0% | 28.7% |
| **Containers and Packaging** *(Detail in Table 43)* | 72,860 | 80,490 | 94,890 | 35.0% | 36.3% | 37.5% |
| *Total Product Wastes*** | 161,130 | 176,570 | 205,900 | 77.4% | 79.7% | 81.4% |
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| Yard Trimmings^ | 29,750 | 27,100 | 27,400 | 14.3% | 12.2% | 10.8% |
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| *Total MSW Generated* | 208,050 | 221,670 | 253,000 | 100.0% | 100.0% | 100.0% |

* Generation before materials recovery or combustion.
** Other than food products.
^ Yard trimmings based on source reduction scenario #2 described in Table 44.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

## Containers and Packaging

Containers and packaging is the largest single category of MSW, and this is projected to continue through 2010 (Table 43). Generation was 72.9 million tons in 1995, with an increase to 80.5 million tons and 94.9 million tons in 2000 and 2010, respectively. In percentage of total MSW, containers and packaging were 35.0 percent in 1995, with a projected increase to 37.5 percent in 2010. The average growth rate for containers and packaging through 2010 is projected to be 1.8 percent annually.

**Table 43**

**PROJECTIONS OF PRODUCTS GENERATED***
**IN THE MUNICIPAL WASTE STREAM: 1995, 2000, AND 2010**
**(WITH DETAIL ON CONTAINERS AND PACKAGING)**
**(In thousands of tons and percent of total generation)**

| Products | Thousands of tons | | | % of total | | |
|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2010 | 1995 | 2000 | 2010 |
| **Durable Goods** *(Detail in Table 41)* | 31,230 | 33,940 | 38,290 | 15.0% | 15.3% | 15.1% |
| **Nondurable Goods** *(Detail in Table 42)* | 57,040 | 62,140 | 72,720 | 27.4% | 28.0% | 28.7% |
| **Containers and Packaging** | | | | | | |
| **Glass Packaging** | | | | | | |
| Beer and Soft Drink Bottles | 5,120 | 5,380 | 5,780 | 2.5% | 2.4% | 2.3% |
| Wine and Liquor Bottles | 1,790 | 1,870 | 2,010 | 0.9% | 0.8% | 0.8% |
| Food and Other Bottles & Jars | 4,620 | 4,850 | 5,210 | 2.2% | 2.2% | 2.1% |
| *Total Glass Packaging* | 11,530 | 12,100 | 13,000 | 5.5% | 5.5% | 5.1% |
| **Steel Packaging** | | | | | | |
| Beer and Soft Drink Cans | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| Food and Other Cans | 2,640 | 2,780 | 3,060 | 1.3% | 1.3% | 1.2% |
| Other Steel Packaging | 210 | 220 | 240 | 0.1% | 0.1% | 0.1% |
| *Total Steel Packaging* | 2,850 | 3,000 | 3,300 | 1.4% | 1.4% | 1.3% |
| **Aluminum Packaging** | | | | | | |
| Beer and Soft Drink Cans | 1,580 | 1,680 | 1,880 | 0.8% | 0.8% | 0.7% |
| Other Cans | 40 | 40 | 50 | 0.0% | 0.0% | 0.0% |
| Foil and Closures | 350 | 380 | 420 | 0.2% | 0.2% | 0.2% |
| *Total Aluminum Pkg* | 1,970 | 2,100 | 2,350 | 0.9% | 0.9% | 0.9% |
| **Paper & Paperboard Pkg** | | | | | | |
| Corrugated Boxes | 28,800 | 32,300 | 39,280 | 13.8% | 14.6% | 15.5% |
| Milk Cartons | 510 | 490 | 450 | 0.2% | 0.2% | 0.2% |
| Folding Cartons | 5,310 | 6,160 | 7,450 | 2.6% | 2.8% | 2.9% |
| Other Paperboard Packaging | 260 | 260 | 240 | 0.1% | 0.1% | 0.1% |
| Bags and Sacks | 1,990 | 2,030 | 2,090 | 1.0% | 0.9% | 0.8% |
| Wrapping Papers | 70 | 80 | 90 | 0.0% | 0.0% | 0.0% |
| Other Paper Packaging | 1,120 | 1,200 | 1,360 | 0.5% | 0.5% | 0.5% |
| *Total Paper & Board Pkg* | 38,060 | 42,520 | 50,960 | 18.3% | 19.2% | 20.1% |
| **Plastics Packaging** | | | | | | |
| Soft Drink Bottles | 660 | 730 | 900 | 0.3% | 0.3% | 0.4% |
| Milk Bottles | 630 | 710 | 860 | 0.3% | 0.3% | 0.3% |
| Other Containers | 1,250 | 1,390 | 1,700 | 0.6% | 0.6% | 0.7% |
| Bags and Sacks | 1,170 | 1,310 | 1,600 | 0.6% | 0.6% | 0.6% |
| Wraps | 1,720 | 1,920 | 2,340 | 0.8% | 0.9% | 0.9% |
| Other Plastics Packaging | 2,270 | 2,540 | 3,100 | 1.1% | 1.1% | 1.2% |
| *Total Plastics Packaging* | 7,700 | 8,600 | 10,500 | 3.7% | 3.9% | 4.2% |
| Wood Packaging | 10,590 | 12,000 | 14,600 | 5.1% | 5.4% | 5.8% |
| Other Misc. Packaging | 160 | 170 | 180 | 0.1% | 0.1% | 0.1% |
| *Total Containers & Pkg* | 72,860 | 80,490 | 94,890 | 35.0% | 36.3% | 37.5% |
| *Total Product Wastes*** | 161,130 | 176,570 | 205,900 | 77.4% | 79.7% | 81.4% |
| **Other Wastes** | | | | | | |
| Food Wastes | 14,020 | 14,700 | 16,100 | 6.7% | 6.6% | 6.4% |
| Yard Trimmings^ | 29,750 | 27,100 | 27,400 | 14.3% | 12.2% | 10.8% |
| Miscellaneous Inorganic Wastes | 3,150 | 3,300 | 3,600 | 1.5% | 1.5% | 1.4% |
| *Total Other Wastes* | 46,920 | 45,100 | 47,100 | 22.6% | 20.3% | 18.6% |
| *Total MSW Generated* | 208,050 | 221,670 | 253,000 | 100.0% | 100.0% | 100.0% |

* Generation before materials recovery or combustion.
** Other than food products.
^ Yard trimmings based on source reduction scenario #2 described in Table 44.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Tonnage of glass containers generated is projected to increase at a low rate—less than one percent annually. Glass containers are projected to increase to 12.1 million tons and 13.0 million tons in 2000 and 2010, respectively. Glass containers are projected to continue to be a declining percentage of MSW generation (5.1 percent of total generation in 2010).

Since 1990, steel cans have been a relatively constant percentage of MSW generation. Generation of steel containers and packaging is projected to increase about one percent annually through 2010. Steel packaging generation is expected to increase to 3.0 million tons and 3.3 million tons in 2000 and 2010, respectively. As a percentage of MSW generation, steel packaging is projected to be constant at about 1.4 percent of total generation.

Tonnage of aluminum packaging has been increasing steadily over the historical period, and this trend is projected to continue. Aluminum packaging is projected to increase to 2.1 million tons and 2.4 million tons in 2000 and 2010, respectively. Tonnage of other materials also increases, however, so aluminum stays at 0.9 percent of total generation in the projections.

Like other paper and paperboard products, overall generation of paper and paperboard packaging has been increasing rapidly. The increase is mostly in corrugated boxes, which are mainly used for shipping other products. Continued increases in generation of corrugated boxes are projected; tonnage of these boxes is projected to be 32.3 million tons in 2000, or 14.6 percent of total MSW generation. Other paper packaging is also projected to increase in tonnage, but as a percent of total MSW generation remain constant. All paper and paperboard packaging is projected to be 51.0 million tons, or 20.1 percent of total generation in 2010.

Plastics packaging has exhibited rapid historical growth from 1960 to 1980, with a slower growth rate experienced during the 1990s. The slower growth rate of the 1990s is projected to continue. Collectively—soft drink bottles, milk bottles, other containers, bags and sacks, wraps, and other plastic packaging—are projected to increase approximately 2.0 percent annually. Generation of all plastics packaging is projected to be 8.6 million tons and 10.5 million tons in 2000 and 2010, respectively. This accounts for about four percent of total MSW generation.

### The Effects of Yard Trimmings Source Reduction

As discussed earlier in this chapter, the apparent trend toward lower generation of yard trimmings (that is, a lower tonnage of yard trimmings entering the waste management system to go to composting facilities, landfill, or combustion facilities) has a marked effect on projections of total generation of MSW. As discussed earlier, over half of the U.S. population will live in states having regulations affecting disposal of yard trimmings by 1996-97. Also, several

additional states have passed solid waste diversion and waste reduction legislation effective by the year 2000 and beyond.

Since dramatic source reduction of yard trimmings is a comparatively new phenomenon, data to support these projections are limited, although the data that are available tend to support the assumptions used. Due to limited hard data, three different scenarios for yard trimmings generation projections are shown to present a range of possible outcomes for MSW generation (Table 44). The mid-range scenario (Scenario 2) is used for projections in this report.

For Scenario 1, it was assumed that there would be no further reduction in yard trimmings generation compared to generation in 1995 (i.e., yard trimmings remain at 29.8 million tons for 2000 and 2010). Scenario 2 was developed using the assumptions described earlier in this chapter. Assuming that generation of all other products and materials would not change from scenario to scenario, total projected MSW generation in 2000 would be 224.3 million tons under Scenario 1 compared to 221.7 million tons under Scenario 2. Yard trimmings would comprise 13.3 percent of total generation in Scenario 1, compared to 12.2 percent in Scenario 2. For 2010, total projected MSW generation would be 255.4 million tons under Scenario 1 compared to 253.0 million tons under Scenario 2: Under Scenario 2 yard trimmings are projected to be 10.8 percent of total MSW generation in 2010.

Table 44

COMPARISON OF THREE SCENARIOS FOR SOURCE REDUCTION OF YARD TRIMMINGS: 2000 AND 2010
(In thousands of tons and percent of total generation)

| | 2000 | | | 2010 | | |
|---|---|---|---|---|---|---|
| | Generation (Thousand Tons) | % of Total MSW Generation | Avg. Annual % Increase in MSW Generation 1995-2000 | Generation (Thousand Tons) | % of Total MSW Generation | Avg. Annual % Increase in MSW Generation 1995-2010 |
| Scenario 1 | | | | | | |
| Yard trimmings constant since 1995 | | | | | | |
| Yard trimmings | 29,750 | 13.3% | - | 29,750 | 11.7% | - |
| Total MSW generation | 224,320 | 100.0% | 1.52% | 255,350 | 100.0% | 1.38% |
| Scenario 2 | | | | | | |
| Yard trimmings reduced* | | | | | | |
| Yard trimmings | 27,100 | 12.2% | - | 27,400 | 10.8% | - |
| Total MSW generation | 221,670 | 100.0% | 1.28% | 253,000 | 100.0% | 1.31% |
| Scenario 3 | | | | | | |
| Yard Trimmings reduced further** | | | | | | |
| Yard trimmings | 22,300 | 10.3% | - | 22,300 | 9.0% | - |
| Total MSW generation | 216,870 | 100.0% | 0.83% | 247,900 | 100.0% | 1.18% |

* Assumes 9 percent reduction in yard trimmings from 1995 generation for 2000, and 8 percent reduction in yard trimmings from 1995 generation for 2010. (See previous text for assumptions.)

** Assumes a 25 percent reduction in yard trimmings from 1995 generation for 2000 and 2010.

Source: Franklin Associates, Ltd.

For a more optimistic scenario for yard trimmings reduction, it was assumed that yard trimmings generation could be reduced by 25 percent between 1995 and 2000 and remain at that level through 2010 (Scenario 3). Under this assumption, yard trimmings generation would be 22.3 million tons in both 2000 and 2010. Yard trimmings would be 10.3 percent and 9.0 percent of total MSW generation for 2000 and 2010, respectively.

For another perspective, Table 44 also shows the annual rates of increase of MSW generation for the time periods 1995-2000 and 1995-2010 under the various scenarios. If yard trimmings do not decrease (Scenario 1), MSW generation would increase an average of 1.52 percent annually from 1995 to 2000 and 1.38 percent annually from 1995 to 2010. Under Scenario 2 for yard trimmings reduction, the average annual rate of increase in MSW generation would be 1.28 percent from 1995 to 2000 and 1.31 percent from 1995 to 2010. Finally, under a 25 percent reduction in yard trimmings scenario, the increase in MSW generation would be 0.83 percent annually for 1995 to 2000 and 1.18 percent for 1995 to 2010. (Each scenario assumes that generation of other materials would increase by the amount shown in Table 38.)

It should be noted that a marked reduction in yard trimmings causes the percentages of all other products in the MSW stream to increase, even if their tonnages remain constant or decrease modestly.

## PROJECTIONS OF MSW RECOVERY

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

Because of the rapidly changing situation and uncertainty in the available data, projections of materials recovery were made in scenarios that could achieve different rates of recovery in 2000 and 2010. Scenarios were developed for 30 and 35 percent recovery rates in 2000, and 30, 35, and 40 percent recovery rates in 2010 (see Appendix B). These scenarios are based on recovery of postconsumer MSW and do not include industrial scrap. Also, composting of only food wastes and yard trimmings is included in these scenarios; estimates of composting of mixed MSW were not made for this report.

The recovery scenarios developed for this report describe sets of conditions that could achieve the selected range of recovery rates. The scenarios are not intended to predict exact recovery rates for any particular material; there are many ways in which a targeted overall recovery rate could be achieved. Especially at the state and local levels, differing circumstances mean that recovery rates of a particular material could be higher or lower than those used to develop these scenarios.

**Discussion of Assumptions**

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

- Recovery for recycling includes composting. Recovered materials are assumed to have been removed from the municipal waste stream.
- It was assumed that local, state, and federal agencies will continue to emphasize recycling, including composting, as MSW management alternatives.
- It was assumed that present state deposit laws will remain in place, but that no additional deposit legislation for containers would be enacted.
- It was assumed that affected industries will continue to emphasize recovery and recycling programs, and will make the necessary investments to achieve higher recycling rates.
- It was assumed that the current trend toward diverting certain yard trimmings in landfills will continue to 2000 and beyond, providing stimulus for composting programs and for source reduction of yard trimmings by citizens.
- Based on available data, it was assumed that, for most materials, there will be adequate end-user capacity to utilize all recovered materials that could reasonably be recovered. In the instance of paper and paperboard, however, there is a "flattening" of projected capacity for recovered material by the year 2000. Thus, recovery projections for paper and paperboard are not as optimistic as those of previous years. Additional new mill capacity, increased exports, or increased composting of unrecycled paper and paperboard could result in higher than projected recovery after 2000.
- Based on the preceding assumptions, most U.S. citizens will have access to recovery options before 2000, which will often, in fact, be mandated. These options will include curbside collection, drop-off and buy-back centers, and, in some instances, mixed waste processing facilities. Recovery will continue to increase as more recovery systems come on-line.

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

## Scenarios for 2000

The range of projected recovery rates for materials in MSW under the recovery scenarios (30 and 35 percent) in the year 2000 is shown in Table 45. (Details of the assumptions for individual products in MSW are in Appendix B.)

**Table 45**

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

| Materials | 2000 MSW Generation (thous tons) | Recovery: Thousand tons 30% | Recovery: Thousand tons 35% | Recovery: % of generation 30% | Recovery: % of generation 35% | 1995 MSW Recovery (%***) |
|---|---|---|---|---|---|---|
| Paper and Paperboard | 89,740 | 38,150 | 41,320 | 42.5% | 46.0% | 40.0% |
| Glass | 13,510 | 3,620 | 4,880 | 26.8% | 36.1% | 24.5% |
| Metals | | | | | | |
| Ferrous | 12,250 | 5,110 | 6,730 | 41.7% | 54.9% | 36.5% |
| Aluminum | 3,170 | 1,450 | 1,510 | 45.7% | 47.6% | 34.6% |
| Other Nonferrous** | 1,430 | 1,010 | 1,020 | 70.6% | 71.3% | 69.5% |
| *Total Metals* | 16,850 | 7,570 | 9,260 | 44.9% | 55.0% | 38.9% |
| Plastics | 20,960 | 1,460 | 2,140 | 7.0% | 10.2% | 5.3% |
| Rubber & Leather | 6,640 | 800 | 1,000 | 12.0% | 15.1% | 8.8% |
| Clothing, Other Textiles | 8,420 | 1,190 | 1,320 | 14.1% | 15.7% | 12.2% |
| Wood | 16,550 | 2,150 | 3,000 | 13.0% | 18.1% | 9.6% |
| Yard Trimmings† | 27,100 | 10,840 | 13,550 | 40.0% | 50.0% | 30.3% |
| Food Wastes | 14,700 | 810 | 1,120 | 5.5% | 7.6% | 4.1% |
| Other Materials‡ | 7,200 | Neg. | Neg. | Neg. | Neg. | Neg. |
| *Totals* | 221,670 | 66,590 | 77,590 | 30.0% | 35.0% | 27.0% |

* Recovery of postconsumer wastes; does not include converting/fabrication scrap. Does not include recovery for mixed MSW composting.
** Includes some nonferrous metals other than battery lead.
† Yard trimmings generation based on source reduction scenario #2 described in Table 44.
‡ Miscellaneous inorganic wastes, electrolytes in batteries, other miscellaneous.
*** From Table 2.
Neg. = Negligible (less than 5,000 tons or 0.05 percent)
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

Continued increases in recovery in every category will be required to reach the scenarios shown. To reach a recovery rate of 30 percent nationwide in 2000, 43 percent of all paper and paperboard, 27 percent of all glass, 45 percent of metals, and 7 percent of all plastics in MSW would be recovered under this scenario. Forty percent of all yard trimmings would be recovered for composting under this scenario (not including backyard composting and other source reduction measures), and 6 percent of food wastes would be recovered for composting.

To achieve a recovery rate of 35 percent nationwide in 2000, approximately 46 percent of all paper and paperboard, 36 percent of all glass, 55 percent of all metals, and 50 percent of yard trimmings would need to be recovered. Recovery of rubber, clothing and other textiles, and wood would each be at least 15 percent of generation. Increased composting of food waste would also be required to reach this level of recovery nationwide.

**Scenarios for 2010**

The range of projected recovery rates for materials in MSW under three recovery scenarios (30, 35, and 40 percent) in the year 2010 is shown in Table 46. (Details of the assumptions for individual products in MSW are in Appendix B.) For the 35 percent recovery rate scenario, paper and paperboard would be recovered at a 47 percent rate, glass at a 36 percent rate, metals at a 55 percent rate, and rubber, textiles, and wood at rates of 14 to 19 percent. Yard trimmings would be recovered at a 50 percent rate, and food wastes and plastics at an 8 percent rate.

To reach the 40 percent recovery scenario nationwide in 2010, 48 percent of all paper and paperboard, 49 percent of all glass, 67 percent of metals, and 20 percent or more of rubber, textiles, and wood would be recovered. Yard trimmings would be recovered at a 60 percent rate, and 19 percent of food wastes would be recovered for composting.

## PROJECTIONS OF MSW DISCARDS AFTER RECOVERY

Discards of municipal solid waste as defined for this report are those wastes remaining after recovery of materials for recycling, including composting of yard trimmings. The remaining discards must be managed by combustion, landfilling, or some other means. The effects of projected recovery rates on the amounts and characteristics of municipal solid waste discards are illustrated in Table 47. (A 30 percent recovery scenario for 2000 and 35 percent recovery scenario for 2010 are shown in this example.)

This projected scenario of discards, which is based on substantial source reduction of yard trimmings and a 30 percent recovery rate for materials and products generated in 2000, shows a 2 percent increase in MSW discards in 2000

**Table 46**

**PROJECTED GENERATION AND RANGES OF RECOVERY,* 2010**
**(In thousands of tons and percent of generation of each material)**

| Materials | 2010 Generation (thous tons) | Recovery: Thousand tons 30% | Thousand tons 35% | Thousand tons 40% | % of generation 30% | % of generation 35% | % of generation 40% | 1995 MSW Recovery (%***) |
|---|---|---|---|---|---|---|---|---|
| Paper and Paperboard | 105,690 | 42,700 | 49,630 | 50,750 | 40.4% | 47.0% | 48.0% | 40.0% |
| Glass | 14,540 | 4,550 | 5,200 | 7,150 | 31.3% | 35.8% | 49.2% | 24.5% |
| Metals | | | | | | | | |
| Ferrous | 13,320 | 5,880 | 7,440 | 9,430 | 44.1% | 55.9% | 70.8% | 36.5% |
| Aluminum | 3,570 | 1,530 | 1,660 | 1,760 | 42.9% | 46.5% | 49.3% | 34.6% |
| Other Nonferrous** | 1,590 | 1,150 | 1,150 | 1,150 | 72.3% | 72.3% | 72.3% | 69.5% |
| *Total Metals* | 18,480 | 8,560 | 10,250 | 12,340 | 46.3% | 55.5% | 66.8% | 38.9% |
| Plastics | 24,660 | 1,570 | 1,970 | 2,630 | 6.4% | 8.0% | 10.7% | 5.3% |
| Rubber & Leather | 7,860 | 900 | 1,120 | 1,570 | 11.5% | 14.2% | 20.0% | 8.8% |
| Clothing, Other Textiles | 10,720 | 1,530 | 1,700 | 2,130 | 14.3% | 15.9% | 19.9% | 12.2% |
| Wood | 19,610 | 2,770 | 3,800 | 5,110 | 14.1% | 19.4% | 26.1% | 9.6% |
| Yard Trimmings† | 27,400 | 12,330 | 13,700 | 16,440 | 45.0% | 50.0% | 60.0% | 30.3% |
| Food Wastes | 16,100 | 920 | 1,260 | 3,060 | 5.7% | 7.8% | 19.0% | 4.1% |
| Other Materials‡ | 7,940 | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| *Totals* | 253,000 | 75,830 | 88,630 | 101,180 | 30.0% | 35.0% | 40.0% | 27.0% |

* Recovery of postconsumer wastes; does not include converting/fabrication scrap.
Does not include recovery for mixed MSW composting.
** Includes some nonferrous metals other than battery lead.
† Yard trimmings generation based on source reduction scenario #2 described in Table 44.
‡ Miscellaneous inorganic wastes, electrolytes in batteries, other miscellaneous.
*** From Table 2.
Neg. = Negligible (less than 5,000 tons or 0.05 percent)
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

as compared to 1995. Assuming a 35 percent recovery rate for materials and products generated in 2010, discards from 2000 to 2010 are projected to increase another 2 percent.

This projected scenario of discards, which is based on substantial source reduction of yard trimmings and a 30 percent recovery rate for materials and products generated in 2000, shows a 2 percent increase in MSW discards in 2000 as compared to 1995. Assuming a 35 percent recovery rate for materials and products generated in 2010, discards from 2000 to 2010 are projected to increase another 2 percent.

The materials composition of MSW discards is quite different from the materials composition of MSW generation (see Table 38), especially for materials that are recovered at higher rates. For example, paper and paperboard are

Table 47

**PROJECTIONS OF MATERIALS DISCARDED* IN MSW: 1995, 2000, AND 2010**
**(RECOVERY SCENARIOS ASSUMED: 30% IN 2000, 35% IN 2010)**
**(In thousands of tons and percent of total discards)**

| | Thousand tons | | | % of discards | | |
|---|---|---|---|---|---|---|
| **Materials** | **1995** | **2000**** | **2010^** | **1994** | **2000**** | **2010^** |
| Paper and Paperboard | 48,920 | 51,590 | 56,060 | 32.2% | 33.3% | 34.1% |
| Glass | 9,690 | 9,890 | 9,340 | 6.4% | 6.4% | 5.7% |
| Metals | | | | | | |
| Ferrous | 7,360 | 7,140 | 5,880 | 4.8% | 4.6% | 3.6% |
| Aluminum | 1,930 | 1,720 | 1,910 | 1.3% | 1.1% | 1.2% |
| Other Nonferrous | 400 | 420 | 440 | 0.3% | 0.3% | 0.3% |
| *Total Metals* | *9,690* | *9,280* | *8,230* | *6.4%* | *6.0%* | *5.0%* |
| Plastics | 17,990 | 19,500 | 22,690 | 11.8% | 12.6% | 13.8% |
| Rubber & Leather | 5,500 | 5,840 | 6,740 | 3.6% | 3.8% | 4.1% |
| Clothing, Other Textiles | 6,500 | 7,230 | 9,020 | 4.3% | 4.7% | 5.5% |
| Wood | 13,430 | 14,400 | 15,810 | 8.8% | 9.3% | 9.6% |
| Yard Trimmings† | 20,750 | 16,260 | 13,700 | 13.7% | 10.5% | 8.3% |
| Food Wastes | 13,450 | 13,890 | 14,840 | 8.9% | 9.0% | 9.0% |
| Other Materials‡ | 5,940 | 7,200 | 7,940 | 3.9% | 4.6% | 4.8% |
| *Totals* | 151,860 | 155,080 | 164,370 | 100.0% | 100.0% | 100.0% |

* Discards after recovery for recycling and composting of yard trimmings.
** 30 percent recovery scenario assumed for 2000 (Table 45).
^ 35 percent recovery scenario assumed for 2010 (Table 46).
† Yard trimmings generation based on source reduction scenario #2 described in Table 44.
‡ Miscellaneous inorganic wastes, electrolytes in batteries, other miscellaneous.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

projected to comprise 40.5 percent of MSW generation, but 33.3 percent of MSW discards, in 2000. Yard trimmings would decline from 12.2 percent of MSW generation to 9.0 percent of discards under this scenario in 2000. The percentages of other materials discards would likewise increase or decrease, depending upon their projected recovery rates.

## PROJECTIONS OF MSW COMBUSTION

Making projections of MSW combustion is somewhat difficult because of the many uncertainties affecting the planning and construction of new facilities. Several years are required to site and obtain permits for construction of new MSW combustion facilities. Projections of future waste-to-energy combustion capacity were based on facilities operating or reported under construction or in planning. Conversely, estimates were made to account for capacity that will be retired from service after 1995. Based on this analysis, MSW sent to waste-to-energy combustion facilities was projected to be 33 million tons and 36 million tons for the years 2000 and 2010, respectively.

While substantial amounts of MSW were burned without energy recovery in past years, most of these older facilities have been closed due to the costs of implementing air pollution requirements. MSW destined for incinerators is projected to continue to decrease through 2010. Less than one million tons of MSW is projected to be managed through incinerators in 1995 and beyond.

Since there is increasing interest in combustion of certain source-separated components of MSW—especially tires, but also wood pallets, paper, and plastics—it was assumed that combustion of these materials would continue to increase.

Accounting for waste-to-energy combustion, incinerators, and combustion of source-separated components of MSW, combustion of MSW is projected to increase from 33.5 million tons in 1995 to 36 million tons of MSW in 2000. By 2010 MSW combustion is projected to increase to 39 million tons.

## SUMMARY OF PROJECTED MSW MANAGEMENT

A summary of the projections is presented, with similar figures for 1995 included for contrast (Table 48). For the summary, a mid-range recovery scenario of 30 percent in 2000 and 35 percent in 2010 was used. A graphical illustration of the long-term trends are shown in Figure 32 and Figure 33.

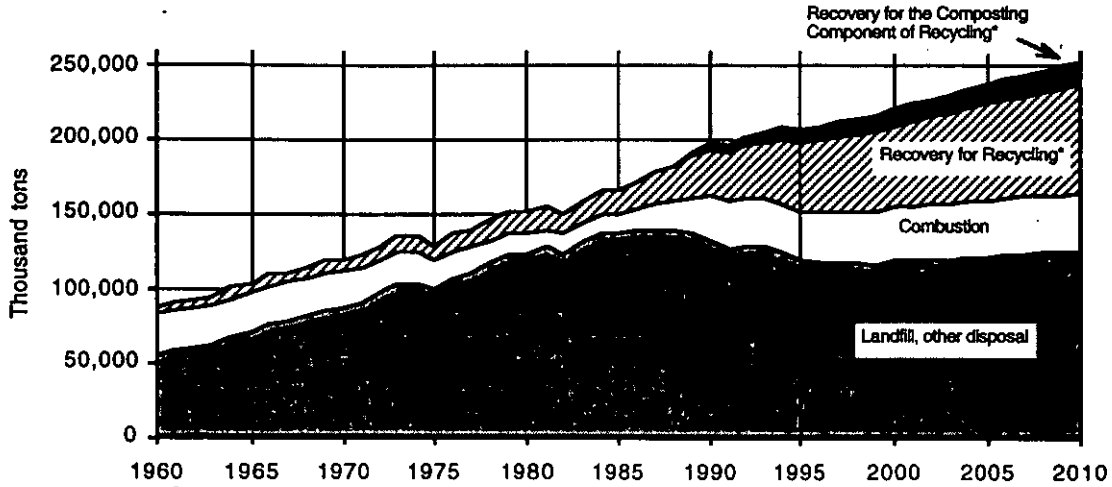
**Table 48**

**GENERATION, RECOVERY, COMBUSTION, AND DISPOSAL OF MUNICIPAL SOLID WASTE: 1995, 2000, AND 2010 (RECOVERY SCENARIOS ASSUMED: 30% IN 2000, 35% IN 2010) (In thousands of tons and percent of total generation)**

| | Thousands of tons | | | % of generation | | |
|---|---|---|---|---|---|---|
| | 1995 | 2000 | 2010 | 1995 | 2000 | 2010 |
| Generation | 208,050 | 221,670 | 253,000 | 100.0% | 100.0% | 100.0% |
| Recovery for recycling | 46,620 | 54,940 | 73,670 | 22.4% | 24.8% | 29.1% |
| Recovery for composting* | 9,570 | 11,650 | 14,960 | 4.6% | 5.3% | 5.9% |
| *Total materials recovery* | 56,190 | 66,590 | 88,630 | 27.0% | 30.0% | 35.0% |
| Discards after recovery | 151,860 | 155,080 | 164,370 | 73.0% | 70.0% | 65.0% |
| Combustion** | 33,470 | 36,000 | 39,000 | 16.1% | 16.2% | 15.4% |
| Landfill, other disposal | 118,390 | 119,080 | 125,370 | 56.9% | 53.7% | 49.6% |

* Composting of yard trimmings and food wastes. Does not include backyard composting.
** Combustion of MSW in mass burn or refuse derived form, incineration without energy recovery, and combustion with energy recovery of source separated materials in MSW.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

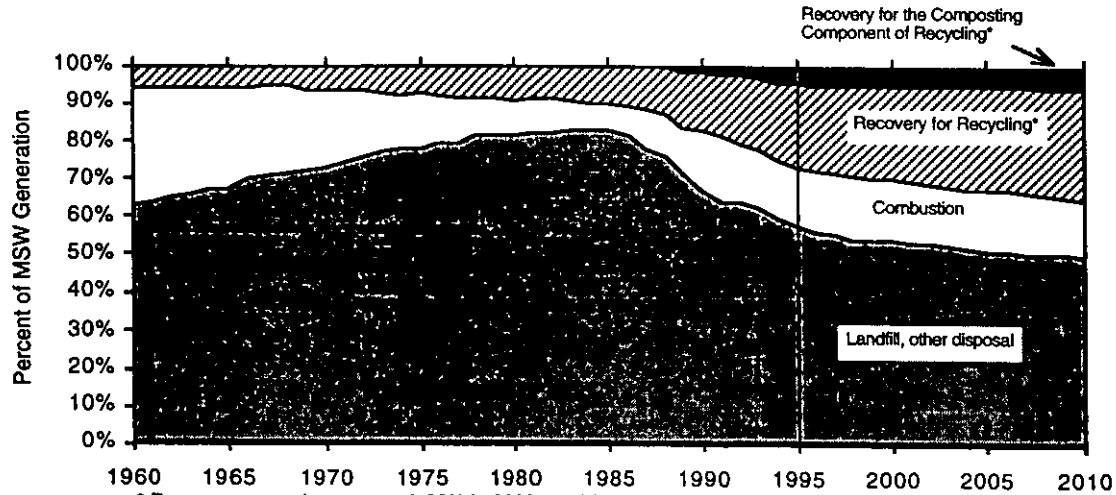
**Figure 32. Municipal Solid Waste Management, 1960 to 2010 (In thousand tons)**




* Recovery scenarios assumed: 30% in 2000, 35% in 2010.

From 1995 to 2000, generation of MSW is projected to increase by 1.1 percent per year compared to 2.7 percent per year between 1980 and 1990. The generation of MSW is projected to increase by 1.3 percent per year between 2000 and 2010. As described earlier, source reduction of yard trimmings accounts for most of the decrease from 1995 to 2000 under the selected scenario.

**Figure 33. Municipal Solid Waste Management, 1960 to 2010 (In percent of MSW generation)**




* Recovery scenarios assumed: 30% in 2000, 35% in 2010.

The effect of assuming the mid-range scenario for materials recovery for recycling (including yard trimmings composting) causes discards—as a percent of MSW generation—to decline to 70 percent of MSW generation in 2000 (i.e., 30 percent recovery rate), and 65 percent of MSW generation in 2010 (i.e., 35 percent recovery rate. After deductions for combustion, discards to landfill and other disposal were 118.4 million tons in 1995, with projections of 119.1 million tons and 125.4 million tons in 2000 and 2010, respectively. Based on these projections, the percent of MSW generation discarded to landfills and other disposal is 53.7 percent in 2000 and will fall below 50 percent of MSW generation for the first time in 2010 (49.6 percent).

## ADDITIONAL PERSPECTIVES ON MUNICIPAL SOLID WASTE

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

- Historical and projected MSW generation and management on a pounds per person per day basis
- Historical and projected MSW generation by material on a pounds per person per day basis
- A classification of 1995 MSW generation into residential and commercial components
- Historical and projected discards of MSW classified into organic and inorganic fractions
- A ranking of products and materials in 1995 MSW by tonnage generated, recovered for recycling, and discarded.

### Generation and Discards by Individuals

Municipal solid waste planners often think in terms of generation and discards on a per capita (per person) basis. Data on historical and projected MSW generation and management are presented on the basis of pounds per person per day in Table 49. The top line shows a steady increase in per capita generation of MSW, from 2.7 pounds per person per day in 1960 to 4.3 pounds per person per day in 1995, with a projection of 4.4 and 4.7 pounds per person per day in 2000 and 2010, respectively. The primary reason for the projected decline in growth of MSW generation is a decrease in yard trimmings entering the MSW management system.

The per capita discards represent the amount remaining after recovery for recycling (including composting). Discards after recovery for recycling grew from

Table 49

**PER CAPITA GENERATION, MATERIALS RECOVERY, COMBUSTION, AND DISCARDS OF MUNICIPAL SOLID WASTE, 1960 TO 2010**
**(In pounds per person per day; population in thousands)**

| | 1960 | 1970 | 1980 | 1990 | 1995 | 2000 | 2010 |
|---|---|---|---|---|---|---|---|
| Generation | 2.68 | 3.25 | 3.66 | 4.33 | 4.34 | 4.42 | 4.66 |
| Recovery for recycling & composting | 0.17 | 0.22 | 0.35 | 0.74 | 1.17 | 1.33 | 1.63 |
| Discards after recovery | 2.51 | 3.04 | 3.31 | 3.59 | 3.17 | 3.09 | 3.03 |
| Combustion | 0.82 | 0.67 | 0.33 | 0.70 | 0.70 | 0.72 | 0.72 |
| Discards to landfill, other disposal | 1.69 | 2.36 | 2.98 | 2.89 | 2.47 | 2.38 | 2.31 |
| Resident Population (thousands) | 179,979 | 203,984 | 227,255 | 249,402 | 262,755 | 274,634 | 297,716 |

Projections assume a substantial reduction of yard trimmings generation from 1992 to 2000, a 30% recovery scenario for 2000, a 35% recovery scenario for 2010, and a slight increase in net combustion of MSW.
Details may not add to totals due to rounding.
Population figures from Bureau of the Census, Current Population Reports.
Source: Franklin Associates, Ltd.

2.5 pounds per person per day in 1960 to 3.6 pounds per person per day in 1990. Between 1990 and 1995, discards declined to 3.2 pounds per person per day due to increased recovery for recycling (including composting). Under a 30 percent recovery scenario for 2000 and a 35 percent recovery scenario for 2010, this decline is projected to continue, to 3.1 pounds per person per day in 2000 and 3.0 pounds per person per day in 2010.

In 1995, an estimated 0.7 pounds per person per day of discards were managed through combustion, while the remainder—2.5 pounds per person per day—went to landfill or other disposal. The projection for 2000 and 2010 is that 0.7 pounds per person per day would continue to be combusted, and MSW destined for landfills would decrease to less than 2.4 pounds per person per day.

In Table 50, per capita generation of each material category characterized in this study is shown. Paper, plastics, textiles, and wood in MSW have grown on a per capita basis throughout the 35-year historical period, and this growth is projected to continue. Glass generation grew on a per capita basis during the earlier decades, but declined in the 1980s. Generation in the 1990s was lower on a per capita basis, and is projected to remain constant. Generation of metals and rubber and leather on a per capita basis also grew, then declined somewhat. Some growth in the per capita generation of these materials is projected to 2010.

Generation of food wastes has declined on a per capita basis due to improved packaging and increased processing of food before it enters the residential or commercial waste streams. Per capita generation of food wastes is projected to remain constant—approximately 0.3 pounds per person per day.

**Table 50**

**PER CAPITA GENERATION* OF MUNICIPAL SOLID WASTE, BY MATERIAL, 1960 TO 2010**
**(In pounds per person per day)**

| Materials | 1960 | 1970 | 1980 | 1990 | 1995 | 2000 | 2010 |
|---|---|---|---|---|---|---|---|
| Paper and paperboard | 0.91 | 1.19 | 1.33 | 1.60 | 1.70 | 1.79 | 1.95 |
| Glass | 0.20 | 0.34 | 0.36 | 0.29 | 0.27 | 0.27 | 0.27 |
| Metals | 0.33 | 0.37 | 0.37 | 0.36 | 0.33 | 0.34 | 0.34 |
| Plastics | 0.01 | 0.08 | 0.16 | 0.38 | 0.40 | 0.42 | 0.45 |
| Rubber and leather | 0.06 | 0.08 | 0.10 | 0.13 | 0.13 | 0.13 | 0.14 |
| Textiles | 0.05 | 0.05 | 0.06 | 0.13 | 0.15 | 0.17 | 0.20 |
| Wood | 0.09 | 0.10 | 0.17 | 0.26 | 0.31 | 0.33 | 0.36 |
| Other | 0.00 | 0.02 | 0.06 | 0.07 | 0.08 | 0.08 | 0.08 |
| ***Total Nonfood Products*** | 1.66 | 2.24 | 2.63 | 3.21 | 3.36 | 3.52 | 3.79 |
| Food wastes | 0.37 | 0.34 | 0.31 | 0.29 | 0.29 | 0.29 | 0.30 |
| Yard trimmings | 0.61 | 0.62 | 0.66 | 0.77 | 0.62 | 0.54 | 0.50 |
| Miscellaneous inorganic wastes | 0.04 | 0.05 | 0.05 | 0.06 | 0.07 | 0.07 | 0.07 |
| ***Total MSW Generated*** | 2.68 | 3.25 | 3.66 | 4.33 | 4.34 | 4.42 | 4.66 |
| Resident Population (thousands) | 179,979 | 203,984 | 227,255 | 249,402 | 262,755 | 274,634 | 297,716 |

* Generation before materials or energy recovery.
Details may not add to totals due to rounding.
Source: Tables 1 and 38. Population figures from the Bureau of the Census, Current Population Reports.

Generation of yard trimmings on a per capita basis increased over a 30-year period, but has begun to decline for reasons discussed elsewhere in this report. Generation of yard trimmings was 0.6 pounds per person per day in 1995 and—because of expected source reduction efforts—is projected to decline to 0.5 pounds per person per day by 2010.

Overall, per capita generation of MSW increased throughout the 35-year study period. This increase is projected to continue, but at a much slower rate of growth, primarily because of the projected source reduction of yard trimmings.

## Residential and Commercial Generation of MSW

The sources of MSW generation are of considerable interest to management planners. The material flows methodology does not lend itself well to a distinction as to sources of the materials because the data used are national in scope. However, a classification of products and materials by residential and commercial sources was first made for the 1992 update of this series of reports.

For purposes of this classification, residential waste was considered to come from both single family and multi-family residences. This is somewhat

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

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

The classification of MSW generation into residential and commercial fractions was made on a product-by-product basis (see Appendix C of EPA report 530-R-94-042, ***Characterization of Municipal Solid Waste in the United States: 1994 Update***). The 1995 tonnage generation of each product was allocated to residential or commercial sources on a "best judgment" basis; then the totals were aggregated. These are estimates for the nation as a whole, and should not be taken as representative of any particular region of the country.

A few revisions to the methodology were subsequently made based on estimates made in a 1994 report for Keep America Beautiful, which was extensively reviewed by public and private sector experts in municipal solid waste management. Discards of major appliances and rubber tires were reassigned to the commercial sector rather than the residential sector because, while these products may be used in a residential setting, they tend to be collected and managed through the commercial sector.

**Table 51**

**CLASSIFICATION OF MSW GENERATION INTO RESIDENTIAL AND COMMERCIAL FRACTIONS, 1995**
**(In thousands of tons and percent of total)**

| | Thousand tons | Percent of total |
|---|---|---|
| Residential Wastes | 114,430 – 135,230 | 55.0% – 65.0% |
| Commercial Wastes | 72,820 – 93,620 | 35.0% – 45.0% |

Estimates are presented as a range because of wide variations across the country.
Source: Franklin Associates, Ltd.

Based on this analysis, a reasonable range for residential wastes would be 55 to 65 percent of total MSW generation, while commercial wastes probably range between 35 to 45 percent of total generation (Table 51).

## Organic/Inorganic Fractions of MSW Discards

The composition of MSW in terms of organic and inorganic fractions is of interest to planners of waste management facilities and others working with MSW. This characterization of MSW discards is shown in Table 52. (Discards were used instead of generation because discards enter the solid waste management system after recovery for recycling, including composting.) The organic fraction of MSW has been increasing steadily since 1970, from 75 percent organics in 1970 to 85 percent in 1995.

It is interesting to note, however, that the percentage of MSW that is organics began to "level off" after 1990 because of the projected decline in yard trimmings discarded. This trend is projected to continue through 2000, with organics comprising 85 percent of total MSW discards in 2000. After 2000 projected increases in yard trimmings and other organic components of MSW, such as paper, are expected to cause the organic fraction to increase to approximately 87 percent of total MSW discards.

Table 52

COMPOSITION OF MSW DISCARDS*
BY ORGANIC AND INORGANIC FRACTIONS,
1960 TO 2010
(In percent of total discards)

| Year | Organics** | Inorganics† |
|---|---|---|
| 1960 | 77.3% | 22.7% |
| 1970 | 75.5% | 24.5% |
| 1980 | 77.5% | 22.5% |
| 1990 | 84.3% | 15.7% |
| 1995 | 85.2% | 14.8% |
| 2000 | 85.5% | 14.5% |
| 2010 | 87.1% | 12.9% |

* Discards after materials recovery has taken place, and before combustion.

** Includes paper, plastics, rubber and leather, textiles, wood, food wastes, and yard trimmings.

† Includes glass, metals, and miscellaneous inorganics. Details may not add to totals due to rounding.

Source: Tables 3 and 47.

## Ranking of Products in MSW by Weight

About 50 categories of products and materials are characterized as line items in the tables in Chapter 2. It is difficult when examining that set of tables to see in perspective the relative tonnages generated or discarded by the different items. Therefore, Tables 53, 54, and 55 were developed to illustrate this point.

In Table 53, the various MSW products and materials are arranged in descending order by weight generated in 1995. Subtotals in the right-hand column group components together for further illustration. For example, only yard trimmings and corrugated boxes stand at the top of the list, with each generating over 10 percent of total MSW. Together these two items totaled 28.1 percent of MSW generated in 1995. The next seven components, each comprising 3 to 10 percent of total MSW generation, accounted for 34.1 percent of generation. Together these nine components accounted for over 62 percent of total MSW generated. The 20 items at the bottom of the list each amounted to less than one percent of generation in 1995; together they amounted to only 9.0 percent of total MSW generation.

Table 54 ranks products in descending order by weight recovered in 1995. Three products—corrugated boxes, yard trimmings, and newspapers—each account for over 10 percent of total recovery, and collectively account for over 60 percent of MSW recovery. The next four components, each comprising 3 to 10 percent of total MSW recovery, accounted for 15.2 percent of generation. The bottom 14 items each amounted to less than one percent of generation in 1995; together they amounted to only 3.6 percent of total MSW recovery.

A different perspective is provided in Table 55, which ranks products in MSW by weight discarded after recovery for recycling (including composting). This table illustrates how recovery alters the products' generation rankings. For example, corrugated boxes, which ranked second highest in generation, ranked fourth in discards in 1995.

Yard trimmings accounted for 13.7 percent of total MSW discards in 1995. Seven components, each representing 3 to 10 percent of total MSW discards, accounted for over 41 percent of discards. These components included; food wastes, miscellaneous durables, corrugated boxes, wood packaging, furniture and furnishings, newspapers, and other commercial printing. Together these eight components made up 56 percent of MSW discards in 1995. Twenty-one categories of discards were each less than one percent of the total; together these items totaled 10.1 percent of 1995 discards.

Table 53

## GENERATION OF MUNICIPAL SOLID WASTE, 1995 ARRANGED IN DESCENDING ORDER BY WEIGHT
(In thousands of tons)

| | Thousand tons | Percent of total | Percent subtotals |
|---|---|---|---|
| Components comprising > 10% of total MSW generation | | | |
| Yard trimmings | 29,750 | 14.3% | |
| Corrugated boxes | 28,800 | 13.8% | 28.1% |
| Components comprising 3-10% of total MSW generation | | | |
| Food wastes | 14,020 | 6.7% | |
| Newspapers | 13,130 | 6.3% | |
| Miscellaneous durables | 12,030 | 5.8% | |
| Wood packaging | 10,590 | 5.1% | |
| Furniture and furnishings | 7,160 | 3.4% | |
| Other commercial printing | 7,110 | 3.4% | |
| Office-type papers | 6,800 | 3.3% | 34.1% |
| Components comprising 2-3% of total MSW generation | | | |
| Paper folding cartons | 5,310 | 2.6% | |
| Glass beer & soft drink bottles | 5,120 | 2.5% | |
| Clothing and footwear | 5,070 | 2.4% | |
| Glass food & other bottles | 4,620 | 2.2% | |
| Third class mail | 4,620 | 2.2% | 11.9% |
| Components comprising 1-2% of total MSW generation | | | |
| Other nonpackaging paper | 3,800 | 1.8% | |
| Rubber tires | 3,770 | 1.8% | |
| Major appliances | 3,420 | 1.6% | |
| Miscellaneous nondurables | 3,320 | 1.6% | |
| Miscellaneous inorganic wastes | 3,150 | 1.5% | |
| Disposable diapers | 2,960 | 1.4% | |
| Tissue paper and towels | 2,950 | 1.4% | |
| Steel cans and other packaging | 2,850 | 1.4% | |
| Magazines | 2,370 | 1.1% | |
| Other plastic packaging | 2,270 | 1.1% | |
| Carpets and rugs | 2,230 | 1.1% | |
| Paper bags and sacks | 1,990 | 1.0% | 16.9% |
| Components comprising < 1% of total MSW generation | | | |
| Aluminum cans and other packaging | 1,970 | 0.9% | |
| Lead-acid batteries | 1,910 | 0.9% | |
| Glass wine & liquor bottles | 1,780 | 0.9% | |
| Plastic wraps | 1,720 | 0.8% | |
| Plastic other containers | 1,250 | 0.6% | |
| Plastic bags and sacks | 1,170 | 0.6% | |
| Books | 1,170 | 0.6% | |
| Other paper packaging | 1,120 | 0.5% | |
| Paper plates and cups | 970 | 0.5% | |
| Plastic plates and cups | 790 | 0.4% | |
| Trash bags | 750 | 0.4% | |
| Towels, sheets, and pillowcases | 740 | 0.4% | |
| Small appliances | 710 | 0.3% | |
| Plastic soft drink bottles | 660 | 0.3% | |
| Plastic milk bottles | 640 | 0.3% | |
| Paper milk cartons | 510 | 0.2% | |
| Telephone directories | 490 | 0.2% | |
| Other paperboard packaging | 260 | 0.1% | |
| Other miscellaneous packaging | 160 | 0.1% | |
| Paper wraps | 70 | <0.1% | 9.0% |
| *Total MSW Generation* | 208,050 | 100.0% | 100.0% |

Source: Chapter 2.

## Table 54

### RECOVERY OF MUNICIPAL SOLID WASTE, 1995
### ARRANGED IN DESCENDING ORDER BY WEIGHT
### (In thousands of tons)

| | Thousand tons | Percent of total | Percent subtotals |
|---|---|---|---|
| Components comprising > 10% of total MSW recovery | | | |
| Corrugated boxes | 18,480 | 32.9% | |
| Yard trimmings | 9,000 | 16.0% | |
| Newspapers | 6,960 | 12.4% | 61.3% |
| Components comprising 3-10% of total MSW recovery | | | |
| Office-type papers | 3,010 | 5.4% | |
| Major appliances | 2,070 | 3.7% | |
| Lead-acid batteries | 1,830 | 3.3% | |
| Glass beer & soft drink bottles | 1,660 | 3.0% | 15.2% |
| Components comprising 2-3% of total MSW recovery | | | |
| Steel cans and other packaging | 1,560 | 2.8% | |
| Wood packaging | 1,430 | 2.5% | 5.3% |
| Components comprising 1-2% of total MSW recovery | | | |
| Other commercial printing | 1,090 | 1.9% | |
| Paper folding cartons | 1,070 | 1.9% | |
| Aluminum cans and other packaging | 1,020 | 1.8% | |
| Glass food & other bottles | 1,010 | 1.8% | |
| Miscellaneous durables | 720 | 1.3% | |
| Third class mail | 710 | 1.3% | |
| Magazines | 670 | 1.2% | |
| Rubber tires | 660 | 1.2% | |
| Clothing and footwear | 660 | 1.2% | |
| Food wastes | 570 | 1.0% | 14.6% |
| Components comprising < 1% of total MSW recovery | | | |
| Glass wine & liquor bottles | 470 | 0.8% | |
| Paper bags and sacks | 350 | 0.6% | |
| Plastic soft drink bottles | 300 | 0.5% | |
| Books | 220 | 0.4% | |
| Plastic milk bottles | 190 | 0.3% | |
| Plastic other containers | 150 | 0.3% | |
| Towels, sheets, and pillowcases | 130 | 0.2% | |
| Telephone directories | 60 | 0.1% | |
| Plastic bags and sacks | 40 | 0.1% | |
| Plastic wraps | 40 | 0.1% | |
| Carpets and rugs | 25 | <0.1% | |
| Other plastic packaging | 21 | <0.1% | |
| Plastic plates and cups | 13 | <0.1% | |
| Small appliances | 11 | <0.1% | 3.6% |
| *Total MSW Recovery* | 56,200 | 100.0% | 100.0% |

Source: Chapter 2.

Table 55

## DISCARDS OF MUNICIPAL SOLID WASTE, 1995 ARRANGED IN DESCENDING ORDER BY WEIGHT

(In thousands of tons)

| | Thousand tons | Percent of total | Percent subtotals |
|---|---|---|---|
| Components comprising > 10% of total MSW discards | | | |
| Yard trimmings | 20,750 | 13.7% | 13.7% |
| Components comprising 3-10% of total MSW discards | | | |
| Food wastes | 13,450 | 8.9% | |
| Miscellaneous durables | 11,300 | 7.4% | |
| Corrugated boxes | 10,320 | 6.8% | |
| Wood packaging | 9,160 | 6.0% | |
| Furniture and furnishings | 7,160 | 4.7% | |
| Newspapers | 6,170 | 4.1% | |
| Other commercial printing | 6,020 | 4.0% | 41.9% |
| Components comprising 2-3% of total MSW discards | | | |
| Clothing and footwear | 4,410 | 2.9% | |
| Paper folding cartons | 4,240 | 2.8% | |
| Third class mail | 3,910 | 2.6% | |
| Other nonpackaging paper | 3,800 | 2.5% | |
| Office-type papers | 3,790 | 2.5% | |
| Glass food & other bottles | 3,610 | 2.4% | |
| Glass beer & soft drink bottles | 3,460 | 2.3% | |
| Miscellaneous nondurables | 3,320 | 2.2% | |
| Miscellaneous inorganic wastes | 3,150 | 2.1% | |
| Rubber tires | 3,110 | 2.0% | 24.2% |
| Components comprising 1-2% of total MSW discards | | | |
| Disposable diapers | 2,960 | 1.9% | |
| Tissue paper and towels | 2,950 | 1.9% | |
| Other plastic packaging | 2,250 | 1.5% | |
| Carpets and rugs | 2,210 | 1.5% | |
| Magazines | 1,690 | 1.1% | |
| Plastic wraps | 1,680 | 1.1% | |
| Paper bags and sacks | 1,640 | 1.1% | 10.1% |
| Components comprising < 1% of total MSW discards | | | |
| Major appliances | 1,350 | 0.9% | |
| Glass wine & liquor bottles | 1,310 | 0.9% | |
| Steel cans and other packaging | 1,290 | 0.8% | |
| Plastic bags and sacks | 1,130 | 0.7% | |
| Other paper packaging | 1,120 | 0.7% | |
| Plastic other containers | 1,090 | 0.7% | |
| Paper plates and cups | 970 | 0.6% | |
| Books | 960 | 0.6% | |
| Aluminum cans and other packaging | 950 | 0.6% | |
| Plastic plates and cups | 780 | 0.5% | |
| Trash bags | 750 | 0.5% | |
| Small appliances | 700 | 0.5% | |
| Towels, sheets, and pillowcases | 610 | 0.4% | |
| Paper milk cartons | 510 | 0.3% | |
| Plastic milk bottles | 450 | 0.3% | |
| Telephone directories | 440 | 0.3% | |
| Plastic soft drink bottles | 360 | 0.2% | |
| Other paperboard packaging | 260 | 0.2% | |
| Other miscellaneous packaging | 160 | 0.1% | |
| Lead-acid batteries | 90 | 0.1% | |
| Paper wraps | 70 | <0.1% | 10.1% |
| *Total MSW Discards* | 151,860 | 100.0% | 100.0% |

Source: Chapter 2.

## Chapter 4

## REFERENCES


Composting Council. "Yard Waste Legislation: Disposal Bans and Similar Passed Bills as of July, 1993." Fact Sheet. July 1993.

Composting Council. "MSW Composting Facilities." Fall 1995.

Conversation with a representative of a waste hauler. August 10, 1994.

Franklin Associates, Ltd. ***The Role of Recycling in Integrated Solid Waste Management to the Year 2000.*** Keep America Beautiful, Inc. September 1994.

Franklin Associates, Ltd. ***The Future of Solid Waste Management and Recycling.*** Multi-client study. November 1996. *Draft*.

Harrison-Ferris, Pamela. "Letters to the Editor." ***BioCycle***. July 1992.

Kiser, Jonathan V.L., and John Menapace. "The 1996 IWSA Municipal Waste Combustion Directory Of United States Facilities." Integrated Waste Services Association. March 1996. Also earlier editions of the same *IWSA* survey.

Monk, Randall. "After the Ban." ***MSW Management***. September/October 1992.

Raymond Communications. "State Recycling Laws Update." 1994.

Raymond Communications. "State Recycling Laws Update." Year-end Edition 1996.

Repa, Edward and Allen Blakley. "Municipal Solid Waste Disposal Trends: 1996 Update." ***Waste Age***. May 1996.

Sheehan, Kathleen. "Yard Waste Composting—A Legislative Update." ***Waste Age***. February 1994.

Steuteville, Robert. "Measuring the Impact of Disposal Bans." ***BioCycle***. September 1994.

Steuteville, Robert. "The State of Garbage in America." ***BioCycle***. May 1996. Also earlier editions of the same ***BioCycle*** survey.

U.S. Department of Commerce. ***1996 Statistical Abstract of the United States.***

U.S. Department of Commerce, Bureau of the Census. ***Current Population Reports, National and State Population Estimates: 1990 to 1994.*** P25-1127. Issued July 1995.

U.S. Department of Commerce, Bureau of the Census. ***Current Population Reports, Population Projections of the U.S. by Age, Sex, Race, and Hispanic Origin: 1993 to 2050.*** P25-1104. Issued November 1993.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1994 Update.*** EPA/530-R-94-042. November 1994.

U.S. Environmental Protection Agency. ***Characterization of Municipal Solid Waste in the United States: 1995 Update.*** EPA/530-R-945-001. March 1996.

## Appendix A

## MATERIAL FLOWS METHODOLOGY

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

### DOMESTIC PRODUCTION

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

### CONVERTING SCRAP

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

### ADJUSTMENTS FOR IMPORTS/EXPORTS

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

### DIVERSION

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

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

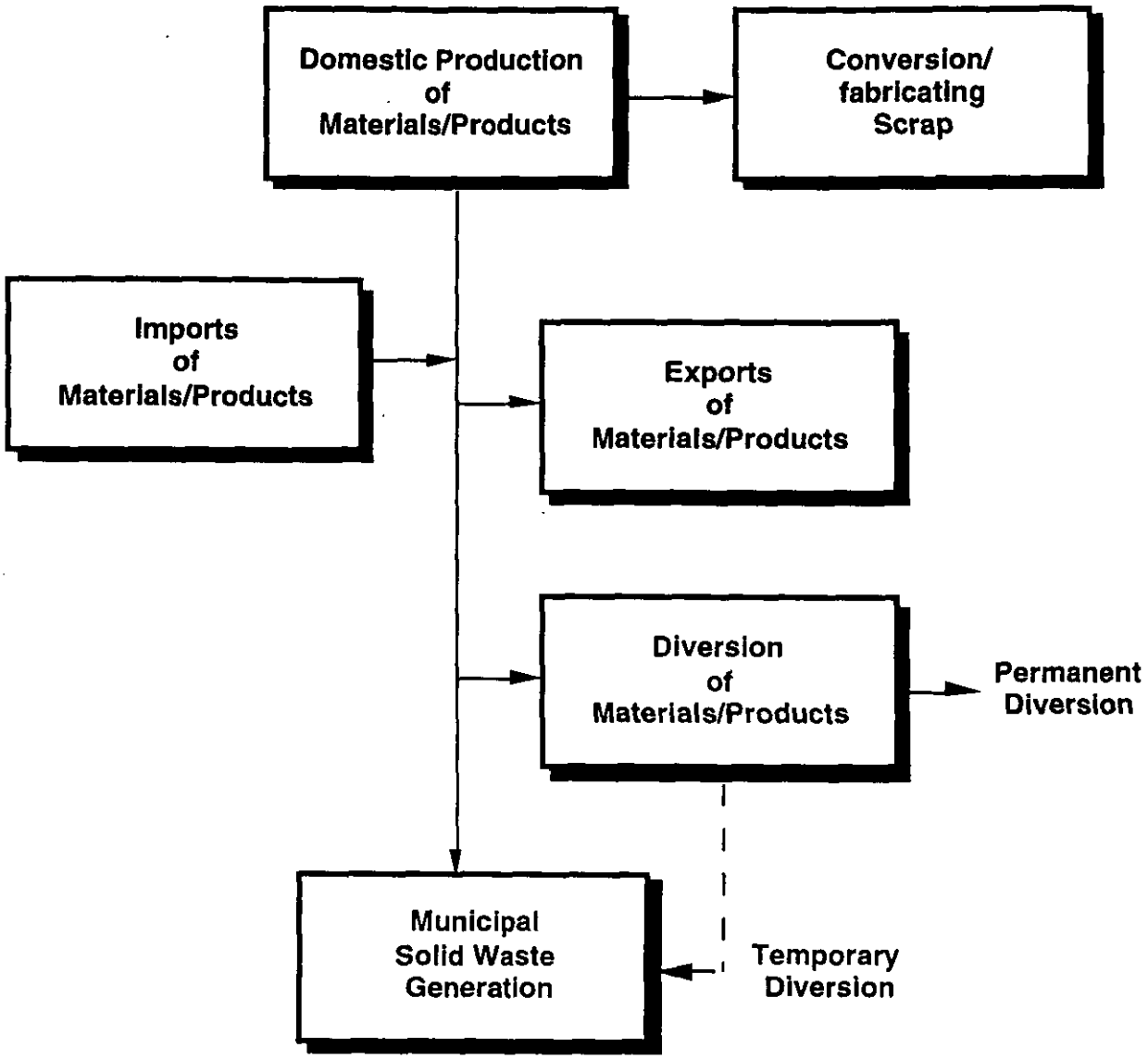



Figure A-1. Material flows methodology for estimating generation of products and materials in municipal solid waste.

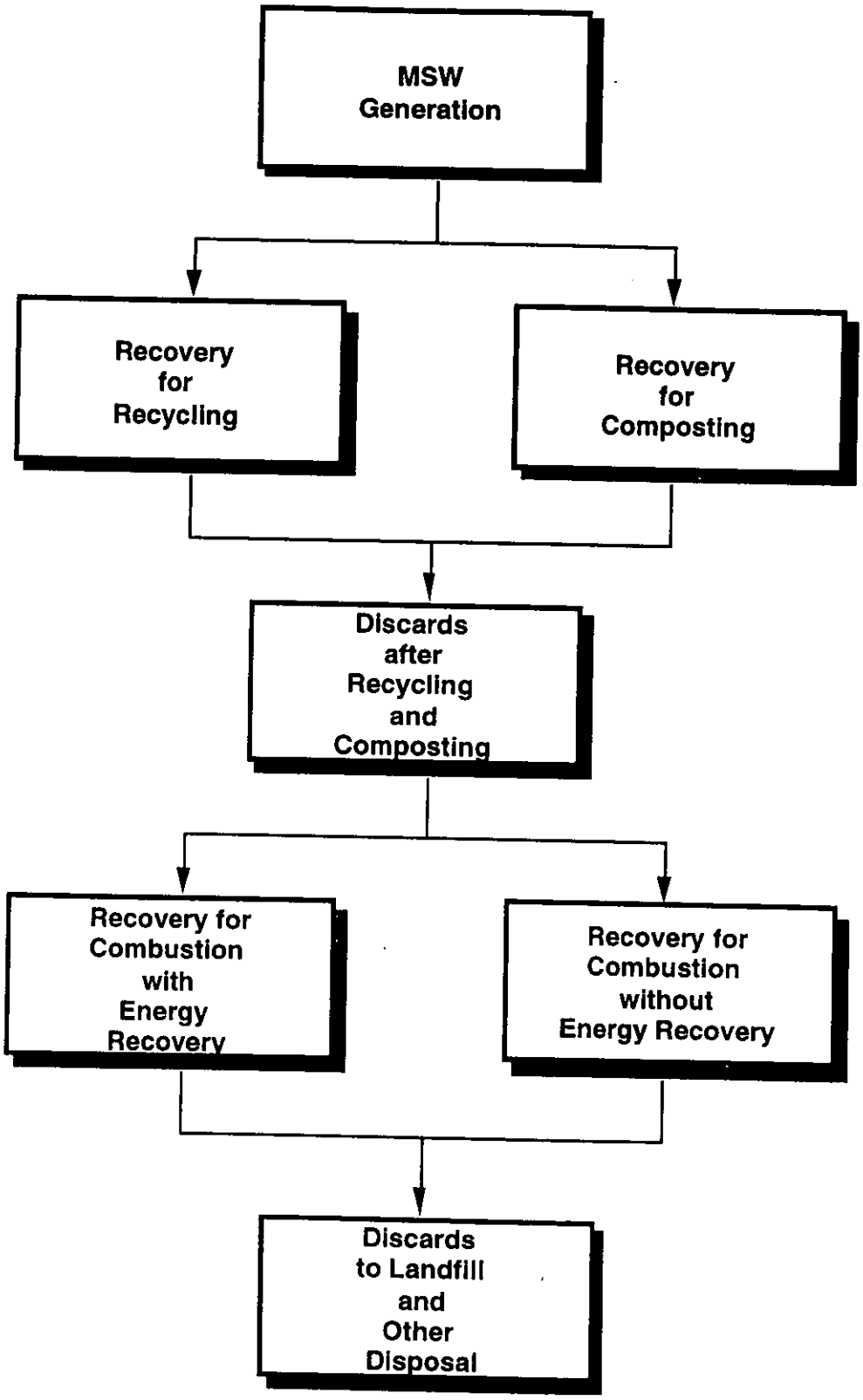



Figure A-2. Material flows methodology for estimating discards of products and materials in municipal solid waste.

## ADJUSTMENTS FOR PRODUCT LIFETIME

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

## MUNICIPAL SOLID WASTE GENERATION AND DISCARDS

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

## Appendix B

## RECOVERY SCENARIOS FOR 2000 AND 2010

Because of the rapidly changing situation and uncertainty in the available data, projections of materials recovery were made in scenarios that could achieve different rates of recovery in 2000 and 2010. Scenarios were developed for total MSW recovery rates of 30 and 35 percent recovery rates in 2000; and 30, 35, and 40 percent recovery rates in 2010. These scenarios are based on recovery of postconsumer MSW and do not include industrial scrap. Also, estimates for composting of food wastes and yard trimmings are including in these scenarios.

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

### Discussion of Assumptions

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

- Recovery for recycling includes composting. Recovered materials are assumed to have been removed from the municipal waste stream.

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

- It was assumed that there will be no new deposit laws for beverage containers, but that the present state deposit laws will remain in place.

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

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

- Based on the preceding assumptions, most U.S. citizens will have access to recovery options by 2000, which will often, in fact, be mandated. These options will include curbside collection, drop-off and buy-back

centers, and composting facilities. Recovery will continue to increase as more recovery systems come on-line.

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

The ranges of projected recovery assumptions for the various materials in MSW are shown for 2000 and 2010 in Table B-1 and Table B-2, respectively. Assumed recovery rates were based on existing recovery rates in 1995, with projected growth that seemed reasonably achievable nationwide for the period of time under consideration. Projections for each product in MSW were made separately, and the results were aggregated, with some minor adjustments to achieve the three selected scenarios for each year. Assumptions as to the projected recovery rates for specific products and materials were made in ranges. It is certainly possible (indeed, probable) that any given material will be recovered at higher or lower rates than those given here, but the scenarios illustrate how the selected recovery rates could be reached.

## Table B-1

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

| Products | Generation | 30% Recovery Tons | 30% Recovery % | 35% Recovery Tons | 35% Recovery % |
|---|---|---|---|---|---|
| **Durable Goods** | | | | | |
| Major Appliances (ferrous metals only) | 2,620 | 1,965 | 75.0% | 2,020 | 77.1% |
| Rubber Tires | 4,000 | 800 | 20.0% | 1,000 | 25.0% |
| Batteries, lead acid | | | | | |
| Nonferrous metals | 1,045 | 1,014 | 97.0% | 1,024 | 98.0% |
| Plastics | 90 | 86 | 95.0% | 86 | 95.0% |
| Misc. Durables (ferrous metals only) | 4,135 | 414 | 10.0% | 620 | 15.0% |
| Other Durables | 22,050 | 882 | 4.0% | 2,000 | 9.1% |
| ***Total Durable Goods*** | 33,940 | 5,160 | 15.2% | 6,750 | 19.9% |
| **Nondurable Goods** | | | | | |
| Newspapers | 13,350 | 7,210 | 54.0% | 7,610 | 57.0% |
| Books | 1,300 | 240 | 18.5% | 298 | 22.9% |
| Magazines | 2,700 | 760 | 28.1% | 895 | 33.1% |
| Office- type Papers | 7,510 | 3,290 | 43.8% | 3,650 | 48.6% |
| Directories | 540 | 65 | 12.0% | 81 | 15.0% |
| Third Class Mail | 5,380 | 840 | 15.6% | 1,300 | 24.2% |
| Other Commercial Printing | 7,550 | 1,160 | 30.0% | 1,510 | 20.0% |
| Textiles, Footwear | 6,600 | 1,188 | 18.0% | 1,320 | 20.0% |
| Other Nondurables | 17,210 | 172 | 1.0% | 516 | 3.0% |
| ***Total Nondurable Goods*** | 62,140 | 14,925 | 24.0% | 17,180 | 27.6% |
| **Containers and Packaging** | | | | | |
| **Glass Containers** | 12,100 | 3,625 | 30.0% | 4,880 | 40.3% |
| **Steel Containers & Pkg** | 3,000 | 1,845 | 61.5% | 2,091 | 68.0% |
| **Aluminum Packaging** | 2,100 | 1,450 | 69.0% | 1,512 | 72.0% |
| **Paper & Paperboard Packaging** | | | | | |
| Corrugated Containers | 32,300 | 22,960 | 71.1% | 24,000 | 74.3% |
| Other Packaging | 10,225 | 1,630 | 15.9% | 1,972 | 19.3% |
| ***Total Paper & Board Pkg*** | 42,525 | 24,590 | 57.8% | 25,972 | 61.1% |
| **Plastics Packaging** | | | | | |
| Soft Drink Bottles | 735 | 404 | 55.0% | 441 | 60.0% |
| Milk Bottles | 710 | 249 | 35.0% | 284 | 40.0% |
| Other Containers | 1,395 | 209 | 15.0% | 349 | 25.0% |
| Other Plastics Packaging | 5,760 | 346 | 6.0% | 461 | 8.0% |
| ***Total Plastics Packaging*** | 8,600 | 1,208 | 14.0% | 1,535 | 17.8% |
| Wood Packaging | 12,000 | 2,150 | 17.9% | 3,000 | 25.0% |
| Other Misc. Packaging | 165 | 0 | 0.0% | 0 | 0.0% |
| ***Total Containers & Packaging*** | 80,490 | 34,868 | 43.3% | 38,990 | 48.4% |
| ***Total Product Waste**** | 176,570 | 54,952 | 31.1% | 62,920 | 35.6% |
| **Other Wastes** | | | | | |
| Yard Trimmings† | 27,100 | 10,840 | 40.0% | 13,550 | 50.0% |
| Food Wastes | 14,700 | 809 | 5.5% | 1,117 | 7.6% |
| Other Wastes | 3,300 | 0 | 0.0% | 0 | 0.0% |
| ***TOTAL MSW*** | 221,670 | 66,601 | 30.0% | 77,587 | 35.0% |

* Does not include recovery for mixed waste composting.
** Other than food products.
† Yard trimmings substantially reduced in this scenario.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

## Table B-2

## SCENARIOS FOR RECOVERY* OF MSW, 2010
(In thousands of tons and percent of generation)

| Products | Generation | 30% Recovery Tons | 30% Recovery % | 35% Recovery Tons | 35% Recovery % | 40% Recovery Tons | 40% Recovery % |
|---|---|---|---|---|---|---|---|
| **Durable Goods** | | | | | | | |
| Major Appliances (ferrous metals only) | 2,736 | 2,052 | 75.0% | 2,107 | 77.0% | 2,161 | 79.0% |
| Rubber Tires | 4,500 | 900 | 20.0% | 1,125 | 25.0% | 1,575 | 35.0% |
| Batteries, lead acid | | | | | | | |
| Nonferrous metals | 1,169 | 1,146 | 98.0% | 1,146 | 98.0% | 1,146 | 98.0% |
| Plastics | 100 | 95 | 95.0% | 95 | 95.0% | 95 | 95.0% |
| Misc. Durables (ferrous metals only) | 4,513 | 677 | 15.0% | 812 | 18.0% | 1,354 | 30.0% |
| Other Durables | 25,272 | 1,011 | 4.0% | 2,274 | 9.0% | 3,538 | 14.0% |
| ***Total Durable Goods*** | 38,290 | 5,880 | 15.4% | 7,559 | 19.7% | 9,869 | 25.8% |
| **Nondurable Goods** | | | | | | | |
| Newspapers | 13,860 | 8,316 | 60.0% | 8,880 | 64.1% | 9,425 | 68.0% |
| Books | 1,560 | 281 | 18.0% | 320 | 20.5% | 390 | 25.0% |
| Magazines | 3,430 | 858 | 25.0% | 1,000 | 29.2% | 1,201 | 35.0% |
| Office- type Papers | 8,900 | 4,005 | 45.0% | 4,200 | 47.2% | 4,628 | 52.0% |
| Directories | 645 | 65 | 10.0% | 80 | 12.4% | 97 | 15.0% |
| Third Class Mail | 7,200 | 1,080 | 15.0% | 1,495 | 20.8% | 1,800 | 25.0% |
| Other Commercial Printing | 8,375 | 1,256 | 15.0% | 1,500 | 17.9% | 1,675 | 20.0% |
| Textiles, Footwear | 8,500 | 1,530 | 18.0% | 1,700 | 20.0% | 2,125 | 25.0% |
| Other nondurable paper | 10,753 | 108 | 1.0% | 350 | 3.3% | 538 | 5.0% |
| Other Nondurables | 9,497 | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| ***Total Nondurable Goods*** | 72,720 | 17,498 | 24.1% | 19,525 | 26.8% | 21,878 | 30.1% |
| **Containers and Packaging** | | | | | | | |
| **Glass Containers** | 13,000 | 4,550 | 35.0% | 5,200 | 40.0% | 7,150 | 55.0% |
| **Steel Containers & Pkg** | 3,300 | 2,145 | 65.0% | 2,244 | 68.0% | 2,376 | 72.0% |
| **Aluminum Packaging** | 2,350 | 1,528 | 65.0% | 1,669 | 71.0% | 1,763 | 75.0% |
| **Paper & Paperboard Packaging** | | | | | | | |
| Corrugated Containers | 39,280 | 24,746 | 63.0% | 29,600 | 75.4% | 27,496 | 70.0% |
| Other Packaging | 11,680 | 1,986 | 17.0% | 2,205 | 18.9% | 3,504 | 30.0% |
| ***Total Paper & Board Pkg*** | 50,960 | 26,732 | 52.5% | 31,805 | 62.4% | 31,000 | 60.8% |
| **Plastics Packaging** | | | | | | | |
| Soft Drink Bottles | 896 | 493 | 55.0% | 538 | 60.0% | 582 | 65.0% |
| Milk Bottles | 866 | 303 | 35.0% | 346 | 40.0% | 390 | 45.0% |
| Other Containers | 1,700 | 255 | 15.0% | 425 | 25.0% | 510 | 30.0% |
| Other Plastics Packaging | 7,038 | 422 | 6.0% | 563 | 8.0% | 1,056 | 15.0% |
| ***Total Plastics Packaging*** | 10,500 | 1,473 | 14.0% | 1,872 | 17.8% | 2,538 | 24.2% |
| Wood Packaging | 14,600 | 2,774 | 19.0% | 3,800 | 26.0% | 5,110 | 35.0% |
| Other Misc. Packaging | 180 | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| ***Total Containers & Packaging*** | 94,890 | 39,202 | 41.3% | 46,590 | 49.1% | 49,936 | 52.6% |
| ***Total Product Waste**** | 205,900 | 62,580 | 30.4% | 73,674 | 35.8% | 81,683 | 39.7% |
| **Other Wastes** | | | | | | | |
| Yard Trimmings† | 27,400 | 12,330 | 45.0% | 13,700 | 50.0% | 16,440 | 60.0% |
| Food Wastes | 16,100 | 918 | 5.7% | 1,256 | 7.8% | 3,059 | 19.0% |
| Other Wastes | 3,600 | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| ***TOTAL MSW*** | 253,000 | 75,827 | 30.0% | 88,630 | 35.0% | 101,182 | 40.0% |

* Does not include recovery for mixed waste composting.
** Other than food products.
† Yard trimmings substantially reduced in this scenario.
Details may not add to totals due to rounding.
Source: Franklin Associates, Ltd.

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