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

INTRODUCTION

This report is the most recent in a series of reports sponsored by the U.S. Environmental Protection Agency to characterize municipal solid waste (MSW) in the United States. Together with the previous reports, this report provides a historical database for a 41-year characterization (by weight) of the materials and products in MSW.

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

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

BACKGROUND

The Solid Waste Management Hierarchy

EPA’s 1989 Agenda for Action endorsed the concept of integrated waste management, by which municipal solid waste is reduced or managed through several different practices, which can be tailored to fit a particular community’s needs. The components of the hierarchy are:
• source reduction (including reuse of products and backyard composting of yard trimmings).
• recycling of materials (including composting).
• waste combustion (preferably with energy recovery) and landfilling.

Each component of the hierarchy is addressed in this report.

Overview of the Method

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

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

To estimate MSW generation, production data are adjusted by imports and exports from the United States, where necessary. Allowances are made for the average lifespans of different products. Information on amounts of disposed MSW managed by combustion comes from industry sources as well. MSW not managed by recycling (including composting) or combustion is assumed to be landfilled.
In any estimation of MSW generation, it is important to define what is and is not included in municipal solid waste. EPA includes those materials that historically have been handled in the municipal solid waste stream—those materials from municipal sources, sent to municipal landfills. In this report, MSW includes wastes such as product packaging, newspapers, office and classroom papers, bottles and cans, boxes, wood pallets, food scraps, grass clippings, clothing, furniture, appliances, automobile tires, consumer electronics, and batteries.

A common error in using this report is to assume that all nonhazardous wastes are included. As shown later in this chapter, municipal solid waste as defined here does not include construction and demolition wastes, biosolids (sewage sludges) industrial process wastes, or a number of other wastes that, in some cases, may go to a municipal waste landfill. These materials, over time, have tended to be handled separately and are not included in the totals in this report. EPA has addressed several of these materials separately, for instance in Biosolids Generation, Use, and Disposal in the United States, EPA 530-R-99-009, September 1999, and Characterization of Building-Related Construction and Demolition Debris in the United States, EPA530-R-98-010, May 1998. Recycling (including composting) is encouraged for these materials as well.

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

**HOW THIS REPORT CAN BE USED**

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

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

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

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

- Variations in climate and local waste management practices, which greatly influence generation of yard trimmings. For instance, yard trimmings exhibit strong seasonal variations in most regions of the country. Also, the level of backyard composting in a region will affect generation of yard trimmings.
- Differences in the scope of waste streams. That is, a local landfill may be receiving construction and demolition wastes in addition to MSW, but this report addresses MSW only.
- Variance in the per capita generation of some products, such as newspapers and telephone directories, depending upon the average size of the publications. Typically, rural areas will generate less of these products on a per person basis than urban areas.
- Level of commercial activity in a community. This will influence the generation rate of some products, such as office paper, corrugated boxes, wood pallets, and food scraps from restaurants.
- Variations in economic activity, which affect waste generation in both the residential and the commercial sectors.
- Local and state regulations and practices. Deposit laws, bans on landfilling of specific products, and variable rate pricing for waste collection are examples of practices that can influence a local waste stream.

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

- Develop approximate estimates of total MSW generation in an area.
- Check locally developed MSW data for accuracy and consistency.
- Account for trends in total MSW generation and the generation of individual components.
- Help set goals and measure progress in source reduction and recycling (including composting).

CHARACTERIZATION OF MUNICIPAL SOLID WASTE: IN PERSPECTIVE

The Two Methodologies for Characterizing MSW: Site-Specific versus Materials Flow

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

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

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

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

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

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

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

**Municipal Solid Waste Defined in Greater Detail**

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

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

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

The materials flow methodology used in this report does not readily lend itself to the quantification of wastes according to their source. For example, corrugated boxes may be
unpacked and discarded from residences, commercial establishments such as grocery stores, institutions such as schools, or factories. The methodology estimates only the total quantity of such boxes generated, not their places of disposal or recovery for recycling.

**Other Subtitle D Wastes**

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

**Figure 1: Municipal Solid Waste in the Universe of Subtitle D Wastes**

<table>
<thead>
<tr>
<th>Subtitle D Wastes not included in this report are:</th>
</tr>
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<tbody>
<tr>
<td>Municipal sludges</td>
</tr>
<tr>
<td>Industrial nonhazardous wastes</td>
</tr>
<tr>
<td>Construction and demolition debris</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subtitle D Wastes included in this report is Municipal Solid Waste, which includes:</th>
</tr>
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<tbody>
<tr>
<td>Containers &amp; packaging such as soft drink bottles and cardboard boxes</td>
</tr>
<tr>
<td>Durable goods such as furniture and appliances</td>
</tr>
<tr>
<td>Nondurable goods such as newspapers, trash bags, and clothing</td>
</tr>
<tr>
<td>Other wastes such as food scraps and yard trimmings.</td>
</tr>
</tbody>
</table>
Figure 1-A: Definition of Terms

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

The term generation as used in this report refers to the weight of materials and products as they enter the waste management system from residential, commercial, institutional, and industrial sources and before materials recovery or combustion takes place. Preconsumer (industrial) scrap is not included in the generation estimates. Source reduction activities (e.g., backyard composting of yard trimmings) take place ahead of generation.

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

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

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

Discards include MSW remaining after recovery for recycling (including composting). These discards presumably would be combusted or landfilled, although some MSW is littered, stored or disposed onsite, or burned onsite, particularly in rural areas. No good estimates for these other disposal practices are available, but the total amounts of MSW involved are presumed to be small.
Materials and Products Not Included in These Estimates

As noted earlier, other Subtitle D wastes (illustrated in Figure 1) are not included in these estimates, even though some may be managed along with MSW (e.g., by combustion or landfilling). Household hazardous wastes, while generated as MSW with other residential wastes, are not identified separately in this report. Transportation equipment (including automobiles and trucks) is not included in the wastes characterized in this report.

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

Some adjustments are made in this report to account for packaging of imported goods, but there is little available documentation of these amounts.

OVERVIEW OF THIS REPORT

Following this introductory chapter, Chapter 2 presents the results of the municipal solid waste characterization (by weight). Estimates of MSW generation, recovery, and discards are presented in a series of tables, with discussion. Detailed tables and figures summarizing 2001 MSW generation, recovery, and discards of products in each material category are included.

In Chapter 3 of the report, estimates of 2001 MSW management by the various alternatives are summarized. These include recovery for recycling (including composting), combustion, and landfilling. Also presented is a discussion of source reduction practices, incorporating a summary of the most recent (year 2001) estimates of source reduction for the nation. Summaries of the infrastructure currently available for each waste management alternative are also included in Chapter 3.
A brief discussion of the materials flow methodology, for estimating generation, recycling, and disposal is presented in Appendix A. Appendix B provides the methodology and detailed results for source reduction for the year 2000. Appendix C provides the methodology and results for estimates of generation, recovery, and discards of selected consumer electronics.
APPENDIX A

MATERIALS FLOW METHODOLOGY

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

DOMESTIC PRODUCTION

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

CONVERTING SCRAP

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

ADJUSTMENTS FOR IMPORTS/EXPORTS

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

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

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

ADJUSTMENTS FOR PRODUCT LIFETIME

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

RECOVERY

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

DISCARDS

Mathematically, discards equal that portion of generation remaining after recovery for recycling and composting.
MUNICIPAL SOLID WASTE GENERATION, RECOVERY, AND DISCARDS

The result of these estimates and calculations is a material-by-material and product-by-product estimate of MSW generation, recovery, and discards.
Figure A-1. Material flows methodology for estimating generation of products and materials in municipal solid waste.
Figure A-2. Material flows methodology for estimating discards of products and materials in municipal solid waste.