

MSW CHARACTERIZATION METHODOLOGY

INTRODUCTION

This fact sheet and these data tables are the most recent in a series of reports and data tables sponsored by the U.S. Environmental Protection Agency to characterize municipal solid waste (MSW) in the United States. Together with the previous reports, this fact sheet and data tables provide a historical database for a 46-year characterization (by weight) of the materials and products in MSW. For brevity, the fact sheet and data tables are both implied when data tables are referred to in this methodology.

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 methods description provides background on integrated waste management and the 2006 data tables, followed by a brief overview of the methodology. Next is a section on the variety of uses for the information in these data tables. Then, more detail on the methodology is provided.

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 (or waste prevention), including reuse of products and on-site (or backyard) composting of yard trimmings.
- Recycling, including off-site (or community) composting.

- Combustion with energy recovery.
- Disposal through landfilling or combustion without energy recovery.

As done in previous versions of this report, combustion with energy recovery is shown as discards in the tables and figures.

Overview of the Methodology

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 methodology*, which relies heavily on a mass balance approach. Using data gathered from industry associations, key businesses, and similar 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 methods description, municipal solid waste as defined here does *not* include construction and demolition debris, biosolids (sewage sludges), industrial process wastes, or a number of other wastes that, 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 these data tables. EPA has addressed several of these materials separately, for instance, in *Biosolids Generation, Use, and Disposal in the United States*, EPA530-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, including automobile bodies, municipal sludges, combustion ash, and industrial process wastes that might also be disposed in municipal waste landfills or combustion units.

HOW THESE DATA TABLES CAN BE USED

Nationwide. The data in these tables 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 methodology and scope aids in the use of the data tables for reporting over time. The data tables are, 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 these data tables 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 these data tables 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 these data tables address 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 these tables, 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. These data tables are based on the materials flow approach.

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

A disadvantage of sampling studies based on a limited number of samples is that they may be skewed and misleading if, for example, atypical circumstances were experienced during the sampling. These circumstances could include an unusually wet or dry season, delivery of some unusual wastes during the sampling period, or errors in the sampling methodology. Any errors of this kind will be greatly magnified when a limited number of samples are taken to represent a community's entire waste stream for a year. Magnification of errors could be even more serious if a limited number of samples 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 consistent manner 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 methodology 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. These data tables represent the latest version of this database that has been evolving for over 30 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 for each material and product category. Adjustments are made for imports and exports and for diversions from MSW (e.g., for building materials made of plastic and

paperboard that become construction and demolition debris.) Adjustments are also made for the lifetimes of products. Finally, food scraps, 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 these data tables, 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 these data tables into the following categories: durable goods, nondurable goods, containers and packaging, food scraps and yard trimmings, and miscellaneous inorganic wastes.

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

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

The materials flow methodology used in these data tables does not readily lend itself to the quantification of wastes according to their sources. For example, corrugated boxes may be unpacked and discarded from residences, commercial establishments such as grocery stores and offices, institutions such as schools, or factories. Similarly, office papers are mostly generated in offices, but they also are generated in residences and institutions. The methodology estimates

only the total quantity of products 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 these data tables.

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

Subtitle D Wastes	
The Subtitle D Waste included in these data tables is Municipal Solid Waste, which includes:	
Containers and packaging such as soft drink bottles and corrugated boxes	
Durable goods such as furniture and appliances	
Nondurable goods such as newspapers, trash bags, and clothing	
Other wastes such as food scraps and yard trimmings.	
Subtitle D Wastes not included in these data tables are:	
Municipal sludges	Agricultural wastes
Industrial nonhazardous wastes	Oil and gas wastes
Construction and demolition debris	Mining wastes

Figure 1-A: Definition of Terms

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

The term **generation** as used in these data tables 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 to be source reduction, not recycling.

Recovery of materials as estimated in these data tables 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 these data tables. 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 with energy recovery, often called “waste-to-energy,” is estimated in these data tables. Combustion of separated materials—wood and rubber from tires—is included in the estimates of combustion with energy recovery in these data tables.

Discards include MSW remaining after recovery for recycling (including composting). These discards presumably would be combusted without energy recovery 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 these data tables. Transportation parts and equipment (including automobiles and trucks) are not included in the wastes characterized in these data tables.

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 these data tables to account for packaging of imported goods, but there is little available documentation of these amounts.

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. *Characterization of Municipal Solid Waste in the United States: 1996 Update*. EPA/530-R-97-015. June 1997.

U.S. Environmental Protection Agency. *Characterization of Municipal Solid Waste in the United States: 1997 Update*. EPA/530-R-98-007. May 1998.

U.S. Environmental Protection Agency. *Characterization of Municipal Solid Waste in the United States: 1998 Update*. EPA/530-R-99-021. September 1999.

U.S. Environmental Protection Agency. *Municipal Solid Waste Generation, Recycling and Disposal in the United States: Facts and Figures for 1998*. EPA/530-F-00-024. April 2000.

U.S. Environmental Protection Agency. *Municipal Solid Waste in The United States: 1999 Facts and Figures*. EPA/530-R-01-014. July 2001.

U.S. Environmental Protection Agency. *Municipal Solid Waste in The United States: 2000 Facts and Figures*. EPA/530-R-02-001. June 2002.

U.S. Environmental Protection Agency. *Municipal Solid Waste in The United States: 2001 Facts and Figures*. EPA/530-R-03-011. October 2003.

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.