



## Note on the Trash Crisis

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As the volume of municipal solid waste (MSW) produced in this country continues to grow, communities are finding it increasingly difficult to dispose of the garbage and sludge produced by business and industry, institutions, and individuals. Differing definitions about what constitutes MSW leads to different estimates of volume. The EPA estimates that each American produces 4 pounds of trash per day; *BioCycle* magazine estimates 6.6 pounds per day. In general, estimates vary according to whether both pre-consumer and post-consumer waste are included or just post-consumer.

According to the EPA, approximately 73 percent of our trash was landfilled in 1988. Yet, over the past 10 years the number of operating landfills has decreased by 60 percent, with the majority of the closings occurring in New England. Today, the highest percentage of new closings are in the western states. The rate of landfill closings is a serious issue as past dumping practices, characterized by unsanitary conditions, methane explosions, and releases of hazardous substances into groundwater and the atmosphere, have made it increasingly difficult to site new landfills.

New EPA regulations, which require controls such as groundwater monitoring, may force many small landfills to close. The opening of several large facilities may offset the loss of the small sites, making capacity a more meaningful measure. It typically requires at least five years to permit and develop new landfill facilities. According to a 1988 EPA study, eight states had less than five years of remaining capacity, and 15 states had five to ten years of capacity.<sup>1</sup> This capacity constraint, coupled with cleanup costs, has caused an increase in "tipping fees" (charges to use landfills). For example, in Wisconsin it is estimated that a sixfold increase in the state's tipping fees may be necessary to cover pollution problems at licensed landfills over the next 30

years.<sup>2</sup> Further, the incentive to minimize tipping fees has caused the waste-hauling industry to grow rapidly as waste is transported to regions with higher capacities and correspondingly lower fees.

As of 1991, 20 states had enacted some type of waste reduction plan; 22 have enacted some requirements that local government provide some sort of recycling program. In addition, 29 states have enacted more than 100 disposal bans, prohibiting certain bulky or toxic items from landfills or incinerators.<sup>3</sup>

A growing recycling infrastructure and improved incineration methods, combined with constrained landfill capacity, are changing the way waste is disposed of in the United States. By 1995, the EPA estimates that 53 percent of waste will be landfilled, 23 percent incinerated, 19 percent recycled, and 5 percent composted.

### Landfills

Municipal solid waste (MSW) comprises 90 percent of the materials that are landfilled. The remaining 10 percent consists of construction debris, sewage sludge, incinerator ash, medical waste, etc. In 1976, the Resource Conservation and Recovery Act (RCRA) was enacted, thereby prohibiting uncontrolled dumping and assuring that operating landfills were sanitary. EPA regulations forbid open burning and require all landfills to have a clay or a synthetic liner as well as alternate layers of plastic or dirt between layers of trash. Only 25 percent of operating landfills had groundwater monitoring equipment prior to 1986.<sup>4</sup> Now, mandatory leachate systems use pipes to collect and treat water that seeps through a landfill to the liner.

State-of-the-art regional landfills with multiple liners and environmental controls are estimated to cost

\$400,000 per acre. The expected lifetime of a landfill is ten years. Once a landfill is full, it is allowed to settle for a few years before it may be used for a park, athletic field, or golf course.

Landfills must be carefully managed in order to reduce their inherent drawbacks. For example, each day's deposit of trash must be covered so that litter and ash are not scattered by the wind. In addition, organic wastes that are landfilled partially decompose under certain conditions to produce carbon dioxide, methane, ammonia, water, and other chemicals, which, unless recovered, may be released into the atmosphere. Further, during decomposition, liquids may percolate through the landfill and carry chemicals into the soil and groundwater. Finally, until alternative means of disposal are determined, landfills contain many common items such as glass, plastics, and metals that will never biodegrade.

Landfill disposal costs in the United States are estimated to be \$40–60 per ton and rising.

## Incineration

In 1988, the United States had 164 incinerators operating in 36 states with a design capacity of 70,000 tons per day. Vendors estimate that municipal incinerators typically operate at 85 percent capacity due to occasional shutdowns.<sup>5</sup> Incineration handles solid waste by burning combustible materials and melting non-combustibles. There are two processes for incineration: mass burning and refuse-derived fuel (RDF). Mass burning systems burn unseparated municipal waste on a moving grate that helps agitate the waste in order to mix it with air. RDF separates materials such as steel or glass, and shreds the remaining materials before burning to produce cleaner emissions.

Many mass-burn and RDF systems are designed to recover energy by transferring the thermal energy to water in a boiler. The steam that is produced can be used to produce electricity or distributed by pipeline to buildings and industry. Combustion "upsets" can cause temporary increases in emissions due to changes in MSW composition, or failures in plant power, instrumentation, or controls.

As MSW burns, flue gas is created that may contain carbon monoxide, dioxins, acid gases and metals. Older incinerators without computerized combustion or pollution controls have higher emissions than modern

facilities. Today, scrubbers, filters, and continuous monitoring devices control emissions.

Incineration produces ash that includes minerals, metals, unburned organic carbon, and dirt, which constitutes 10–20 percent of the original material's volume. Fly ash consists of light particles that are blown off the grate and form in the flue gas. Fly ash typically contains volatile metals such as mercury, lead, and cadmium as well as dioxins and PCBs. Bottom ash consists of the uncombusted or partially uncombusted materials remaining on the grate after burning. Less volatile metals such as aluminum, iron, and tin as well as hydrocarbons are typical components of bottom ash. In some cases, this ash could be highly toxic, because the heat of the incinerator may increase the toxic properties of the materials burned.

Ash creates potential hazards, as it can be blown into the air during transport or contaminate groundwater after disposal. The main method for controlling blowing ash is to collect it, spray it with water, and combine it with bottom ash to produce a sludge. The EPA estimates that 36 percent of ash is disposed in landfills containing only ash, 17 percent is disposed with MSW, and the rest is undetermined.<sup>6</sup> Research is being conducted to determine how to stabilize the ash chemically before transport and disposal.

Although incineration has been performed successfully in Europe and Japan for decades, in the 1970s domestic incinerators were plagued by problems due to inadequate technology and less stringent safeguards.

Building incinerators is risky business. Not only is siting difficult because of community opposition, but laws that affect construction and operating costs can vary greatly between a project's start and finish. However, incinerator construction, maintenance, and operating costs are somewhat offset by the sale of energy produced in the process.

Plastics release four times more energy during incineration than average MSW as they "borrow" energy from the petroleum that is released during burning.<sup>7</sup> However, plastics that are incinerated can also be a valuable source of income to recycling programs that pay as much as \$300 per ton for separated post-consumer plastics. Incineration is currently more expensive than landfilling — \$90–110 per ton — making it an economical choice only for communities that would have to transport waste long distances before disposal.

## Recycling

Recycled materials are either pre-consumer or post-consumer. "Pre-consumer" refers to both materials and by-products that have been recovered during the manufacturing process. "Post-consumer" materials are derived from products that have already fulfilled their original purpose and were separated from MSW.

Recyclability refers to the actual rate at which materials are recycled in a given geographical area. Although some materials can be recycled into products similar to the original product ("closed-loop" recycling), the recycling process generally weakens or changes the composition of the original material. Therefore, most products are "open-loop"-recycled into materials that require less strength or different properties. In addition, the U.S. Food and Drug Administration does not allow packaging that has direct contact with food to be made from recycled plastics, which may have absorbed toxins from oil, pesticides, or other hazardous materials.

Although recycling holds potential for relieving some of the waste burden, the complexities of building an infrastructure to support the process are cumbersome. Materials are collected either by drop-off programs or curbside pickups. Drop-off programs may be centrally located or may require driving many miles. These facilities may or may not have on-site workers, but do generate revenue from the sale of collected materials. Many drop-off programs were started by the beverage industry as an alternative to bottle deposits, and are more common in the western United States. More than 2,700 curbside programs are currently operating in the United States, 45 percent of which are mandatory; these are primarily in the Northeast.<sup>8</sup> Curbside services typically operate similarly to garbage services, using trucks that consume fuel and contribute to air pollution.

Sorting materials is a critical step in the recycling process, because contamination can jeopardize an entire batch of materials. The process starts by previewing the materials to remove any oversized or explosive items. In many cases, materials are carried along conveyor belts for manual separation; however, some materials such as broken glass are dangerous to remove and may be done mechanically. Plastics are particularly hard to separate due to their visually similar physical properties. The industry is searching for ways to automate this process. One practice currently being used to separate plastics is to float the materials, since containers of differing materials have differing densities.

Once materials have been sorted, they are usually ground or chopped, washed and dried, and sometimes remelted for purification and to achieve similar color and consistency throughout the melt.

The recycling industry faces several economic barriers. Manual separation is an expensive process, but contamination makes an entire batch worthless, and the recycler must pay the cost of disposal. Large differences in the weight-to-volume ratio may reduce incentives to recycle as hauling fees are based on the number of trucks used, but recycling allowances are based on weight. Options such as increasing monetary incentives for recycling or taxing products that use virgin materials may realign economic incentives. Finally, there does not yet exist a consistent supply of inputs or a consistent demand for recycled products to stabilize prices. Many materials are currently recycled to avoid disposal rather than to earn revenue from actual material value.

## Composting

Composting is the biological decomposition of organic material by microorganisms such as bacteria and fungi. It has been used for years to improve soil quality but is gaining popularity because it diverts waste from landfills and incinerators. With proper temperature and moisture controls, composting can quickly reduce the original volume of some materials by 50 percent. Biodegradable organic materials such as leaves, grass, food wastes, and paper can be composted.

Composting occurs either in static piles or vessels. In-vessel systems often co-compost sewage sludge with organic municipal waste. This process increases moisture and speeds decomposition but increases odors. Once the compost is complete, the material is "cured" for several months to assure stabilization. It is then pulverized, crumbled, or pelletized to specification.

Composting faces similar challenges to those of recycling, in that organic materials must be separated from non-biodegradable materials (e.g., glass or metal). Compost products are used by landscapers, farmers, golf courses, etc. Most composting is done for local markets, as the weight of compost makes transportation expensive. Composting does not appear to be a profitable venture for municipalities, since the cost of collection offsets revenue from the sale of compost. However, it may offer a "break-even" method for disposal of organic solid waste.

There are currently approximately 1,400 composting programs in 44 states. Most programs start with autumn leaf harvests and expand to include grass clippings. Thirteen municipal facilities are operating, 10 are under construction, and 82 more are in planning stages.<sup>9</sup> In addition, some companies are experimenting with composting for their biodegradable products (e.g., Proctor & Gamble and its disposable diapers).

#### END NOTES:

1 U. S. Congress, Office of Technology Assessment. *Facing America's Trash*, p. 271.

2 *Ibid.*, p. 335.

3 J. Walter Thompson. *JWT Greenwatch*, no. 4 (Spring 1991).

4 EPA Report to Congress: *Solid Waste Disposal in the United States*. Volume II, October 1988.

5 U. S. Congress, p. 221.

6 *Ibid.*, p. 219

7 J. Stilwell, C. Contz, P. Kopf, and M. Montrone. *Packaging for the Environment*. New York: American Management Association, 1991.

8 J. Walter Thompson, p. 12.

9 *Ibid.*, p. 16.



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