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Clean Energy

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Municipal Solid Waste

Electricity from Municipal Solid Waste

Municipal solid waste (MSW) refers to the stream of garbage collected through community sanitation services. Medical wastes from hospitals and items that can be recycled are generally excluded from MSW used to generate electricity. Paper and yard wastes account for the largest share of the municipal waste stream,¹ and much of this can be recycled directly or composted.

Currently, over 30 percent of MSW generated in the United States is recycled annually. While not producing this waste in the first place is the preferred management strategy for this material, recycling is preferred over any method of disposal. The majority of MSW that is not recycled is typically sent to landfills after it is collected. As an alternative, MSW can be directly combusted in waste-to-energy facilities to generate electricity. Because no new fuel sources are used other than the waste that would otherwise be sent to landfills, MSW is often considered a renewable power source. Although MSW consists mainly of renewable resources such as food, paper, and wood products, it also includes nonrenewable materials derived from fossil fuels, such as tires and plastics.

At the power plant, MSW is unloaded from collection trucks and shredded or processed to ease handling. Recyclable materials are separated out, and the remaining waste is fed into a combustion chamber to be burned. The heat released from burning the MSW is used to produce steam, which turns a steam turbine to generate electricity.

The United States has about 89² operational MSW-fired power generation plants, generating approximately 2,500 megawatts, or about 0.3 percent of total national power generation. However, because construction costs of new plants have increased, economic factors have limited new construction.

Environmental Impacts

Although power plants are regulated by both federal and state laws to protect human health and the environment, there is a wide variation of environmental impacts associated with power generation technologies. The purpose of the following section is to give consumers a better idea of the specific air, water, land, and solid waste impacts associated with MSW-fired electricity generation.



Electricity Generation Technologies

- Natural Gas
- Coal
- Oil
- Nuclear Energy
- Municipal Solid Waste
- Hydroelectricity
- Non-Hydroelectric Renewable Energy

Air Emissions Impacts

Burning MSW produces nitrogen oxides and sulfur dioxide as well as trace amounts of toxic pollutants, such as mercury compounds and dioxins. Although MSW power plants do emit carbon dioxide, the primary greenhouse gas, the biomass-derived portion is considered to be part of the Earth's natural carbon cycle. The plants and trees that make up the paper, food, and other biogenic waste remove carbon dioxide from the air while they are growing, which is returned to the air when this material is burned. In contrast, when fossil fuels (or products derived from them such as plastics) are burned, they release carbon dioxide that has not been part of the Earth's atmosphere for a very long time (i.e., within a human time scale).

The average air emission rates in the United States from municipal solid waste-fired generation are: 2988 lbs/MWh of carbon dioxide, (it is estimated that the fossil fuel-derived portion of carbon dioxide emissions represent approximately one-third of the total carbon emissions) 0.8 lbs/MWh of sulfur dioxide, and 5.4 lbs/MWh of nitrogen oxides.³

The variation in the composition of MSW affects the emissions impact. For example, if MSW containing batteries and tires are burned, toxic materials can be released into the air. A variety of air pollution control technologies are used to reduce toxic air pollutants from MSW power plants.

There can be significant greenhouse gas reduction benefits from recycling and source reduction when compared to other management options. Note also that over 1.6 million ton of ferrous and non-ferrous metals, plastics, glass and combustion ash are recycled annually.⁴

Water Resource Use

Power plants that burn MSW are normally smaller than fossil fuel power plants but typically require a similar amount of water per unit of electricity generated. When water is removed from a lake or river, fish and other aquatic life can be killed, affecting those animals and people who depend on these resources.

Water Discharges

Similar to fossil fuel power plants, MSW power plants discharge used water. Pollutants build up in the water used in the power plant boiler and cooling system. In addition, the cooling water is considerably warmer when it is discharged than when it was taken. These water pollutants and the higher temperature of the discharged water can upon its release negatively affect water quality and aquatic life. This discharge usually requires a permit and is monitored. For more information about these regulations, visit [EPA's Office of Water Web site](#).

Solid Waste Generation

The combustion of MSW reduces MSW waste streams, reducing the creation of new landfills. MSW combustion creates a solid waste called ash, which can contain any of the elements that were originally present in the waste. MSW power plants reduce the need for landfill capacity because disposal of MSW ash requires less land area than does unprocessed MSW. However, because ash and other residues from MSW operations may contain toxic materials, the power plant wastes must be tested regularly to assure that the wastes are safely disposed to prevent toxic substances from migrating into ground-water supplies. Under current

regulations, MSW ash must be sampled and analyzed regularly to determine whether it is hazardous or not.⁵ Hazardous ash must be managed and disposed of as hazardous waste. Depending on state and local restrictions, non-hazardous ash may be disposed of in a MSW landfill or recycled for use in roads, parking lots, or daily covering for sanitary landfills.

Land Resource Use

MSW power plants, much like fossil fuel power plants, require land for equipment and fuel storage. The non-hazardous ash residue from the burning of MSW is typically deposited in landfills.

Fuel Reserves

U.S. residents, businesses, and institutions produced more than 229 million tons of MSW in 2001, which is equivalent to approximately 4.4 pounds of waste per person per day. In 2001, 33.6 million tons (14.7 per cent) of MSW were combusted.⁶

1. U.S. EPA, Office of Solid Waste, [Basic Facts](#).
2. A Look at Waste-to-Energy/Maria Zannes, IWSA; presented at the NAWTEC Fall 2004 Meeting, Columbia University, NYC.
3. U.S. EPA, Compilation of Air Pollutant Emission Factors (AP-42).
4. Kiser, Jonathan V. L., [Recycling and Waste-to-Energy: The Ongoing Compatibility Success Story](#) [EXIT Disclaimer](#), MSW Management, May/June 2003.
5. U.S. EPA, Office of Solid Waste, [MSW Disposal](#).
6. [Municipal Solid Waste in the United States: 2001 Facts and Figures](#). EPA530-S--011.