



Solid Waste Management in the United States

| Harvey W. Gershman |

**Almost 40 years
after Earth Day,
AND STILL
MORE TO DO.**



IN APRIL 1970, THE FIRST EARTH DAY drew national attention to the environment. Sponsored by Senator Gaylord Nelson (D) of Wisconsin and Congressman Paul McCloskey (R) of California, the event drew an estimated 20 million demonstrators. Prompted by the publication of Rachel Carson's *Silent Spring*, rampant air and water pollution, the view of earth from the first moon landing and the widespread support for Earth Day, Congress established the U.S. Environmental Protection Agency in December 1970 with the mission of protecting human health and the environment.

In 1971 while a senior mechanical engineering college student, I, too, was inspired by Earth Day and led a project team to investigate reclamation of solid waste for a town of 20,000 people (Saugus, MA). The project won a national award, and I made the decision to focus my career on waste management. The changes I have witnessed in the solid waste industry over the past 40 years have been, for the most part, exhilarating and encouraging. Public policymakers who once never gave waste management issues a second look, now grant solid waste directors considerable time and attention. Once overlooked and bureaucratically isolated solid waste operators now receive the training and support necessary to deliver high level customer service as well as management accountability. Waste managers provide services to meet waste management needs now deemed important and manage budgets that are a growing percentage of a jurisdiction's budget. Planning has moved beyond anticipating next week's issues to preparing for the next generation—and increasingly, to awareness of the need

to create integrated, sustainable solid waste management systems. This article shares some observations about changes in solid waste management since the first Earth Day and suggests what may lie ahead.

A Change in Public Perception

The perception of waste has changed over the past 40 years. Instead of being considered as having no value, there is now widespread public awareness that waste is comprised of multiple commodities with value—even as those market values tend to fluctuate. Perhaps even more important, source reduction—altering the design, manufacture, or use of products and materials to reduce the amount and toxicity of what gets thrown away—has also gained attention. Despite the inherent difficulties in measuring source reduction, it is positioned at the top of U.S. EPA's waste management hierarchy, and has led to materials substitution and changes in packaging design as well as changes in practices both at home and in the office to reduce waste. In addition, calls for product stewardship and sustainability have focused attention on the harmful effects of consumer waste and the need to reduce the environmental impact of products over their lifecycle. In its November 2009 decision to promote product stewardship, the National League of Cities adopted a resolution calling for producer responsibility for managing discarded products and packaging, urging local and state governments to establish producer responsibility legislation.¹

Recycling

In 1970, we relied almost entirely on local scrap yards to recycle. Today, there are more than 560 material recovery facilities with an estimated total daily throughput of more than 91,000 tons per day² that process a wide range of recyclable materials for re-entry into the marketplace as raw material feedstock for new products. These facilities vary widely across the

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nation, depending on the materials they process and the technology and labor used to sort materials. Today, we also collect and process yard debris. In 2004, there were 3,474 yard trimmings facilities across the nation,³ whereas in 1970 we had very few. More than half the nation's population now lives in states where legislation has discouraged the disposal of yard trimmings in the trash.⁴

Residential recycling collection services have evolved as well. The word "recycling" was hardly part of the popular lexicon in the 1970s. But during the 1980s and 1990s, many communities built a recycling collection and processing infrastructure that included curbside collection programs. More recently, communities have added single stream collection where no sorting is required. By 2007, more than 8,600 curbside recycling collection programs were reported, with the most extensive curbside collection occurring in the Northeast.⁵ About 50 percent of curbside programs were single stream in 2007, according to one industry survey, which estimated that 62 percent of the U.S. population is now served by curbside recyclables collection.⁶ For residents without curbside collection, drop-off centers collect residential recyclables. One report estimated that more than 20,000 communities have drop-off centers, including some communities that also have curbside collection.⁷

In 1970, only 6.6 percent of municipal solid waste (MSW) was recovered for recycling, a number that rose to 9.6 percent in 1980 and 16.2 percent in 1990.⁸ During the last decade, recovery of recyclable materials from MSW has increased from 69.3 million tons in 2000 (29 percent of total generation) to 85 million tons in 2007 (33.4 percent of generation).⁹ However, in recent years, this national recycling rate has reached a plateau, compared with major increases in the 1990s when many communities built or expanded their recycling infrastructure.¹⁰ Much of this plateau can be attributed either directly or indirectly to economic factors. Budget pressures on state and local governments have led to their inability to sustain high levels of public education, resulting in less consumer participation in recycling programs, especially in the growing number of multifamily housing complexes¹¹ and in communities that do not offer single stream recycling collection. Many public places and offices do not offer recycling, even though the number of beverage containers and other recyclables is a significant portion of the waste stream in parks, event venues and offices.

Energy Recovery from Solid Waste

In addition to recycling and composting, waste is being converted to beneficial use for its energy content, about half the value of coal on a weight basis. Burning MSW with energy recovery, generally steam or electricity, (referred to as waste-to-energy or WTE) has matured into a safe, effective and environmentally acceptable technology. The proven, basic types of MSW combustion technologies include mass-burn/waterwall combustion, mass-burn/starved air combustion, refuse-derived fuel/dedicated boiler and refuse-derived fuel/fluidized bed. Today, there are about 90 WTE facilities in the United States handling approximately 13 percent of our waste stream and generating more than 17 billion kilowatts of electricity a year, enough to power 2 million homes.¹²

The most recently built MSW-processing WTE facility in the U.S. commenced operations in 1996. Meanwhile, existing WTE facility expansions are occurring in Baltimore, MD; Hillsborough County, FL; Lee County, FL; Honolulu, HI; Olmsted County, MN; and Pope/Douglas Counties, MN. New projects are being developed in Frederick County, MD; Harford County, MD; Palm Beach County, FL; and the U.S. Virgin Islands.

Ando Torrax Gasifier in Niagara, NY

Black Clawson Hydropulper in Franklin, OH

CEA Eco-Fuel in Bridgeport, CT

GarbOil in San Diego, CA

Monsanto Pyrolysis in Baltimore, MD

Union Carbide Oxygen Pyrolysis in Charleston, WVA

Refuse-Derived Fuel (RDF) for electric utility boilers in St. Louis, MO; Milwaukee, WI; Rochester, NY; and Chicago, IL

Table 1

Alternative technologies in the 1970s and early 1980s.
Gershman, Brickner & Bratton, Inc. December 2009.

Landfilling

In addition to waste that is recycled, composted or converted to steam or electricity, 54 percent of the nation's waste is buried in the more than 1,700 highly engineered and regulated sanitary landfills in the United States, with the South and West having the largest number.¹³ Another MSW disposal method is mixed-waste composting, which starts with unsorted MSW, removes large items as well as ferrous and other metals, and composts the remaining, mostly organic materials, such as paper, food scraps, yard trimmings, wood and other materials. In 2007, there were 16 mixed waste composting facilities in the United States.¹⁴

Given how far we have come since that first Earth Day, what does the future hold for solid waste management?

Back to the Future: Alternative Technologies

A number of alternative technologies are currently under development for the treatment and disposal of MSW. Most of these involve thermal processing, but others use biological or chemical decomposition of the organic fraction of the waste to produce compost, chemical feedstocks or energy products. These technologies include pyrolysis, gasification, anaerobic digestion, mixed waste composting, plasma arc and chemical decomposition.¹⁵

A word or two of caution before we get too excited about these developments: the late 1970s and 1980s saw the emergence of "dream technologies" that many hoped would revolutionize solid waste management. Many of us studied pyrolysis, gasification and plasma arc. We carefully watched as facility after facility attempting to use these technologies in a cost-efficient manner failed (see Table 1). These projects failed for various reasons. For example, in St. Louis, significant erosion in the coal-fired boilers from introducing inert material from the RDF caused additional erosion in the air feeders and excess ash in the suspension-fired boilers. In San Diego, the pilot unit that had demonstrated an ability to produce oil from waste did not scale up successfully and the oil produced contained excess water that lowered the heating value to about 40 percent of what the pilot showed. In Baltimore, the pyrolysis facility never functioned as designed and again the attempt to scale up from a small pilot plant to 1,000 TPD was unsuccessful.¹⁶

Recently, New York City and Los Angeles County cumulatively evaluated 22 conversion technologies and found their service fee requirements to range from \$136 to \$900 per ton. These responses also included WTE technologies, which in comparison to the conversion technology responses were at the low end of the cost per ton spectrum. Since 1996 when the last green field WTE facility broke ground, no new commercial scale conversion technology facility has been implemented in the U.S. However, I am optimistic that a conversion technology will be brought to market successfully in the next three to five years.

Looking to the Future

As for recycling, the collection, processing and remanufacture of recyclable materials clearly has important economic and environmental benefits. The cost to collect and process a ton of recyclable materials is about 20 percent less than the cost to collect and dispose of a ton of MSW.¹⁷ In addition, recycling creates jobs and increases revenues that benefit U.S. communities and their residents. According to the most recent data available, the U.S. hosts 56,061 recycling and reuse establishments that employ approximately 1.1 million people, generate an annual payroll of \$37 billion and gross \$236 billion in annual revenues.¹⁸ Recycling has significant energy and environmental benefits; it is simply the best method to manage a majority of waste materials. It is now possible to document in a direct and quantifiable way that recycling saves energy and reduces greenhouse gas (GHG) emissions from primary production and

disposal, including virgin materials extraction, product manufacture and waste disposal.

Yet, recycling is not living up to its full potential. For many years, a wide range of industry groups have been separately engaged in the issues of recycling and product stewardship. While many companies and industries have taken leadership roles in building awareness of recycling, supporting educational and sponsorship efforts, and promoting and investing in the efficient and effective recovery of recyclable materials, these efforts have been fragmented. If recycling of municipal waste is to realize its full potential, now is the time for industry, businesses, government and consumers to come together to develop a unified national recycling policy framework with legislative initiatives at the national, state and local levels. This legislation must identify appropriate policy goals, incentives, funding mechanisms and accountability to realize the benefits of recycling. There is also a need to

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Today, there are more than 560 material recovery facilities with an estimated total daily throughput of over 91,000 tons per day that process a wide range of recyclable materials for re-entry into the marketplace as raw material feedstock for new products. Photo courtesy of GBB.

motivate consumers, businesses, organizations and governments to recycle—and recycle more—through education, promotion and incentives. WTE is an issue that divides our profession creating, at times, more friction than energy to recover. Some believe that recycling and WTE cannot coexist. Others see WTE as a menace to life and planet. Then there are those, such as myself, who regard recycling and WTE as complementary, relying on data showing that recycling rates are higher in communities with WTE facilities¹⁹ and that WTE emissions are controllable and controlled, and that such plants can provide reliable disposal and renewable energy.²⁰

This WTE debate is taking place more frequently in solid waste and political circles for several reasons. First, the Supreme Court has allowed local governments to apply flow control for publicly owned/controlled waste management assets such as WTE plants and landfills. Second, there is heightened interest in lessening the nation's dependence on imported oil and increasing domestic production of renewable energy. Third, we are increasingly concerned about decreasing our carbon footprint and lessening emissions of greenhouse gases to avert global warming.

The U.S. EPA reports that each person generates about 4.5 pounds of trash per day, or about 1,643 pounds per year.²¹ The costs for 'cradle to grave' management of this waste, including costs for solid waste services and facilities, range from \$100 to \$400 per ton, or \$82 to \$329 per person per year. At the low end of this range is the cost for limited services, such as self-hauling waste and recyclables to a convenience center, while at the high end is the cost per person of a fully integrated solid waste management system. Is \$300 per person per year too much to spend, given the environmental benefits of reusing or recycling waste materials and recovering its energy value too? To put that cost into perspective—that is about the equivalent of one fast-food meal per week.

Managing Waste

We need to manage our wastes better, including doing more to reduce the amount of waste generated in the first place and boosting our recycling rate. Current legislative initiatives are a step in the right direction. The Waxman Markey Bill-American Clean Energy and Security Act of 2009 (ACESA)²² indirectly promotes recycling as a means to address global warming. Executive Order 13514 – Federal Leadership in Environmental, Energy, and Economic Performance (2009)²³ calls on government agencies to study their greenhouse gas emissions and set targets to reduce them by 2020. In addition, the Executive Order establishes a 50 percent recycling goal, 50 percent diversion

of non-hazardous solid waste by the end of 2015 and using paper containing a minimum of 30 percent post-consumer content

But we must do more. We need to work collaboratively to establish national goals such as recycling at least 50 percent of our waste, say by 2015; using the remaining waste for its energy value; and establishing economic incentives to encourage the domestic use of recyclable resources. Failure to act will result in a continuation of fragmented policies, recycling plateaus, and too much waste transported and buried in landfills that get further and further away from where waste is generated in the first place. It is only through a focused, joint effort that the vision of those first Earth Day demonstrators will be fully realized. | **WA**

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