Issue Brief

Unintended Consequences:

Municipal Solid Waste Management and the Throwaway Society

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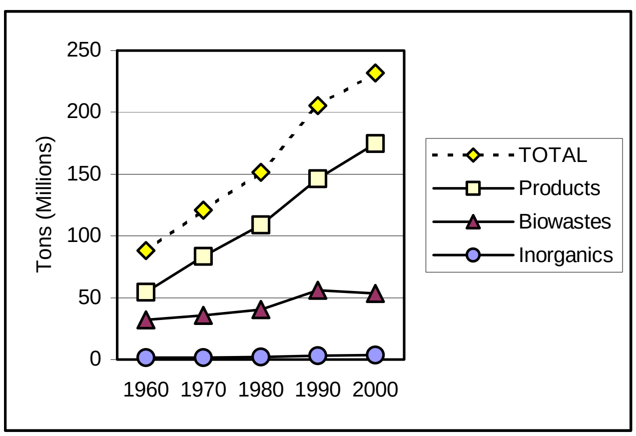
EXECUTIVE SUMMARY

The Municipal Solid Waste Management (MWSM) system was established a century ago to protect public health. It has been modified during the past 40 years in pursuit of public policy objectives of pollution control, resource conservation and, most recently, sustainable development. This report examines the successes and failures of "integrated waste management" in reaching those public policy objectives.

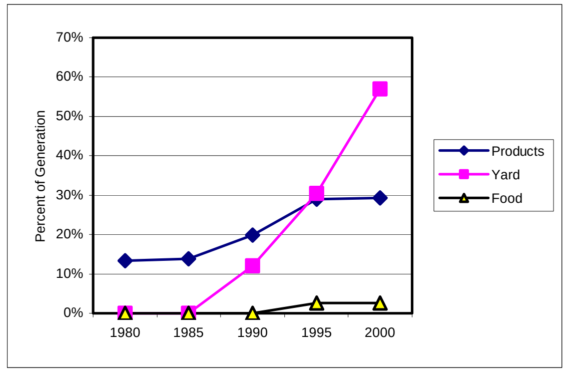
The key finding is that the MSWM system has been least effective in reducing manufactured product wastes, and most successful in managing certain community-generated biowastes. The waste stream managed by local governments changed from one dominated by coal ashes and relatively homogeneous food wastes a century ago, to one dominated by product wastes today. Currently, product wastes comprise 75 percent of MSW by weight, and 89 percent by volume. We suggest that the emerging policy approach known as Extended Producer Responsibility (EPR) may be more effective for product wastes and that the MSWM system should shift its focus to non-product wastes. Policy approaches within the MSWM system are proposed that support and complement EPR.

As the 20th Century advanced, product waste presented unforeseen challenges to the MSWM system. During the 1960s, 1970s, and 1980s polluted, overflowing municipal landfills began to be perceived by the public as a "crisis." Citizen pressure and senior government mandates compelled thousands of local governments across North America to decommission local landfills and build or find new ones that adhered to design criteria intended to contain contaminants. Local governments also invested public resources in recycling programs that would reduce the flow of MSW to landfills and incinerators. To find out how effective these efforts have been, we analyzed U.S. Environmental Protection Agency's waste characterization data over the 41-year period from 1960 to 2001 to compare patterns in the generation, recovery and discards of product and non-product wastes.

Waste Generation: The dramatic growth in MSW generation over the last 40 years of the 20th Century was driven almost entirely by the growth of product wastes, both in total tonnage and on a per-capita basis. In total tonnage, generation of product wastes more than tripled, from 54.6 to 174.8 MT/yr, while generation of biowastes and inorganics grew slowly, increasing at about the rate of population growth, from 34 to 58 MT/yr.



Recycling: Recovery of discarded products experienced a surge in growth between 1985 and 1995 as municipalities took on responsibility for recycling collection. The product recycling rate has plateaued since then at around 30 percent of product waste generated. Recovery of yard trimmings is the big success story of MSWM. Although it did not begin until 1988, it has risen steadily to a recovery rate of 56.5 percent of the amount entering the MSWM system. Food scraps recovery is in its infancy, with less than 3 percent collected.



Waste Disposal: Despite significant public investment in product recycling and biowaste composting, the MSWM system continues to bury or burn most of the materials and products that enter the system. In 2001, 70.3 percent of U.S. MSW generated was disposed in landfills or waste incinerators, with four-fifths of that buried in landfills.

MSWM has been ineffective in reducing product waste generation and disposal, and in sustaining increases in product recycling, because waste prevention lies outside of the MSWM system. Instead, the provision of universal collection and disposal of product wastes created conditions that made the Disposable Society a natural response to the laws of the market. Over the course of the 20th Century, MSWM provided services that acted as a perverse subsidy to the production of short-lived products and facilitated the excessive material flows that characterize our consumer society. The MSWM system, originally configured to manage a waste stream made up of relatively homogeneous materials such as ash and biowastes, lacks the capability to effect reverse logistics for complex products. With product waste recovery stalled and the proportion of waste discarded still at around 70 percent, MSWM practitioners are increasingly focusing on optimizing waste disposal systems. By pursuing energy recovery from mixed waste, MSW practitioners are conceding defeat in the goals established in the 1980s to stem materials flows and conserve resources.

Extended Producer Responsibility (EPR) has emerged as a promising alternative to MSWM for product wastes. In EPR systems, products do not enter the MSWM system at the end of their lives but are managed through an infrastructure arranged by the producers and provided to consumers as an expected customer service.

Recommendations: Over time, product wastes should increasingly be managed through infrastructure provided and funded by producers as an extension of the production and consumption system, while MSWM should focus on environmentally sound management of biowastes and other biodegradable materials. Governments at both the senior and local levels can assist industries to prepare for EPR by sending clear policy signals, such as bans on use of MSWM system for products for which EPR programs exist. Government policy in North America should direct the MSWM system to provide separate collection and treatment of organic materials and encourage research and development in this area.

1. INTRODUCTION

It is widely accepted that the world's economies are using natural resources at a rate that is not sustainable. Sustainability was put on the public policy agenda in 1987 when the World Commission on Environment and Development formulated "sustainable development" as a public policy goal, defining it as development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs (WCED 1987). Proponents of sustainable development have suggested that a four-fold reduction in per capita material flows world-wide will be necessary, but that advanced economies such as those of Canada and the United States will need to achieve a ten-fold reduction in per capita material flows, reflecting their higher current levels of resource use (IISD 2005). Athough municipal solid waste management (MSWM) is usually considered a local problem, it has national and even global implications, due to excessive flows of resources that are associated with "disposable" products, especially in advanced industrial economies. Accordingly, in 1989 US EPA adopted a recommended MSWM approach referred to as "integrated waste management", which establishes a hierarchy of preferred practices. These are, in order: source reduction of wastes before they enter the waste stream (including reuse of products and backyard composting of yard trimmings); recovery of generated wastes for recycling (including composting); and environmentally sound disposal through combustion facilities and landfills that meet current standards (US EPA 2003).

This paper provides insights into the role of MSWM in modulating material flows associated with production and consumption. We begin with historical context, outlining the public policy objectives that gave rise to MSWM in the late 19th Century We provide U.S. data about the generation, recovery and discards of two classes of MSW, product wastes and non-product wastes, between 1960 and 2001. We conclude with a discussion of why the MSWM system may be incapable of reducing product-related material flows beyond current levels and identify advantages of the emerging policy approach called Extended Producer Responsibility (EPR). Finally, we suggest measures for using public policy to modify the MSWM system so that it supports and complements EPR.

2. THE ORIGIN OF MSWM AND CHANGES IN WASTES IN THE 20TH CENTURY

Historically, the MSWM system has managed wastes from residential, commercial, institutional and industrial sources, excluding industrial process wastes (US EPA 2003). These wastes are termed “municipal solid waste” (MSW). As the word “municipal” suggests, local governments play a key role in the MSWM system, both in delivering services (either directly or through contractors) and in planning and regulation.

MSWM is little more than a century old in North America. Historians associate its origin with the urbanization that occurred as a result of the Industrial Revolution (Melosi 1981, 2000; Louis 2004). Crowding in industrial cities gave rise to repeated epidemics of contagious disease. Fear of these epidemics created political support for public investment in municipal sanitation infrastructure first to provide clean water and sewerage and later, at the turn of the 20th Century, to provide for the collection and disposal of municipal refuse (Louis 2004). Municipal refuse included not only household waste but massive quantities of manure and urine generated by horses and other animals in the city. Pressure from citizens’ groups like the Ladies Health Protective Association in New York City and the Municipal Order League in Chicago compelled cities to replace or supplement the private “cart men” who provided refuse collection services with uniformed garbage collectors working for the city or for city contractors. By 1914 half of 150 cities surveyed were providing municipal refuse collection and by 1930 MSWM “had been transformed into an institutionally organized, technology focused, municipally operated service” (*ibid.).*

Technical studies carried out by waste management professionals during the early part of the 20th Century provide information on the materials that were managed when the MSWM system was first being established. The studies typically characterized MSW into three categories (not including street-sweepings and manure): ashes (mostly coal ash from furnaces), garbage (mostly food scraps), and rubbish (miscellaneous products such as paper, old clothes and the like). A much-cited study sampled refuse collected in New York City between 1903 and 1905 and found that per-capita annual generation of municipal refuse was 1,234 lbs; of this, 75 percent (955 lbs) was ashes, 15 percent (187 lbs) was garbage, and 8 percent (92 lbs) was rubbish (Parsons 1906, Morse 1908, Hering & Greeley 1921) (**Figure 1**).[1]

The United States Environmental Protection Agency (US EPA) has characterized MSW generated, recovered and discarded annually in the United States since 1960, with the most recent update being for 2001 (US EPA 2003). "Generation" is defined as the weight of materials and products as they enter the MSWM system (called "arisings" in Europe); "recovery" includes recycling and composting; and "discards" (or "disposal") refers to materials buried in landfills or burned in incinerators (*Ibid*.). Rather than the site-specific waste sampling approach used in many local waste studies (including the 1903-05 study), US EPA uses a materials flow methodology to estimate the generation of products in MSW nation-wide.[2] US EPA's waste typology corresponds well with the typology used in the 1903-05 study. US EPA's "products" corresponds with "rubbish", "food scraps" corresponds with "garbage", and "miscellaneous inorganic wastes" corresponds with "ashes." EPA identifies an additional category of non-product MSW not reported in the 1903-05 study, yard trimmings, which we have grouped with food scraps as "biowastes." **Figure 1** shows per-capita generation of MSW in New York City in 1905 compared with per-capita MSW generation in the United States in 2001.

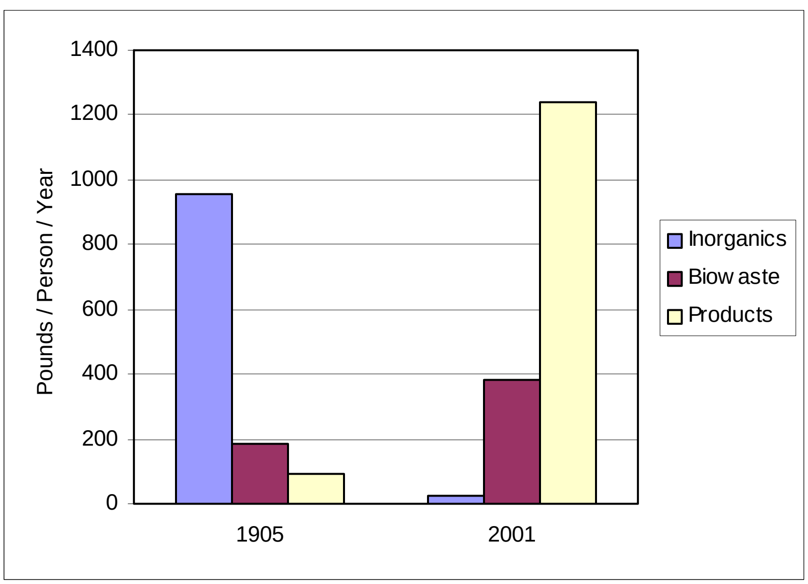


Figure 1. Changes in per capita municipal solid waste generation, by weight: New York City, 1906; USA, 2001. **Inorganics** = "ashes" (1905), "miscellaneous inorganic wastes (2001); **Biowaste** = "garbage" (1905), "food scraps" plus "yard trimmings" (2001); **Products** = "rubbish" (1905), "products" (2001). (Data sources: Morse 1908; US EPA 2003, p.64)

The key changes over the 20th Century are the dramatic reduction of inorganic wastes and the equally dramatic rise in product wastes. Inorganic wastes have been reduced as a class of MSW mainly because coal ash is now treated as an industrial rather than a municipal waste. Product wastes, meanwhile, have increased more than tenfold over the course of the 20th Century, from 92 to 1,242 lbs/person/year.

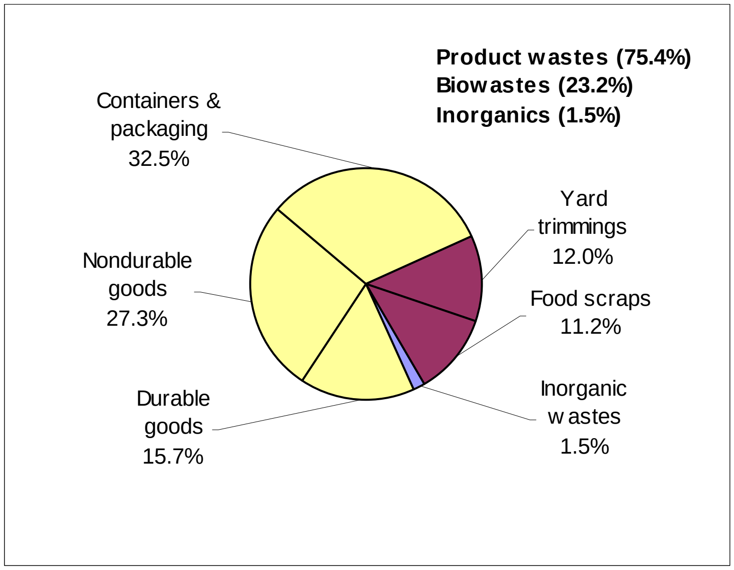


Figure 2. Compostion of U.S. municipal solid waste by product and non-product categories, 2001 (Data source: US EPA 2003)

Figure 2 provides greater detail on sub-categories of product and non-product wastes in 2001. As a proportion of total MSW generated, product wastes are now 75 percent by weight.[3] The remaining 25 percent of MSW is non-product waste, primarily biowastes. Note that food scraps and yard trimmings occurred in roughly equal proportions in 2001. The doubling of biowastes since 1905 reflects the addition of yard trimmings in MSW, while food scraps generation has stayed constant. Product wastes have become greatly diversified compared with a century ago. The kinds of items set out as “rubbish” in 1905 included glass bottles, paper, pasteboard, rags, mattresses, old clothes, old shoes, leather and leather scrap, carpets, tobacco stems, straw and excelsior (Morse 1908). By comparison, today’s product wastes are classified by US EPA into three major groups, each one containing a large number and variety of products and materials. Product wastes include: containers and packaging (32 percent of total MSW generation), nondurable goods (defined as products used less than three years; 27

percent), and durable goods (defined as products having a lifetime of three years or more; 16 percent).

3. MSWM IS CHALLENGED TO PREVENT POLLUTION AND CONSERVE RESOURCES

As the 20th Century advanced, product waste presented unforeseen challenges to the MSWM system. Many products contained hazardous substances. MSW was typically disposed in local landfills that were little more than open dumps. Municipal landfills were frequently used for co-disposal of growing quantities of industrial process wastes as well as MSW.[4] During the 1960s, 1970s, and 1980s polluted, overflowing municipal landfills began to be perceived by the public as a "crisis." In 1987 the findings of the World Commission on Development and the Economy identified excessive material flows in advanced economies as an ethical dilemma and ultimately a global environmental threat (WCED 1987).

As they had done a century earlier, citizens demanded that their communities do something about waste. Citizen pressure and senior government mandates compelled thousands of local governments across North America to decommission local landfills and build or find new ones that adhered to design criteria intended to contain contaminants (the third component of "integrated waste management" strategy). Local governments also invested public resources in recycling programs that would reduce the flow of MSW to landfills and incinerators (the second component). And all levels of government invested public resources in educating citizens and businesses about waste prevention (the first component).

How effective has MSWM been in meeting the public waste management objectives of pollution control, resource conservation and sustainable development? We analyzed US EPA's waste characterization data over the 41 year period from 1960 to 2001 to compare patterns in the generation, recovery and discards of product and non-product wastes. We used published data to examine the larger trends from 1960 to 2000 (US EPA 2003) and annual data from 1980 to

2001 to examine recent trends in more detail (Franklin Associates 2005).

3.1 MSW Generation: Product waste increases more than non-product waste

Growth in MSW generation over the last 40 years of the 20th Century has been dramatic, from 88 to 230 MT/yr.[5] This growth was driven almost entirely by the growth of product wastes, both in total tonnage and on a per-capita basis (**Figure 3**). In total tonnage, generation of product wastes more than tripled, from 54.6 to 174.8 MT/yr, while generation of biowastes and inorganics grew slowly, increasing at about the rate of population growth, from 34 to 58 MT/yr (**Figure 3A**). Growth in per capita waste generation slowed in the last decade of the 20th Century (1990 to 2000), but this was primarily due to negative growth in per capita non-product waste generation, rather than to product waste generation, which continued to increase, albeit at a slower rate (**Figure 3B**).

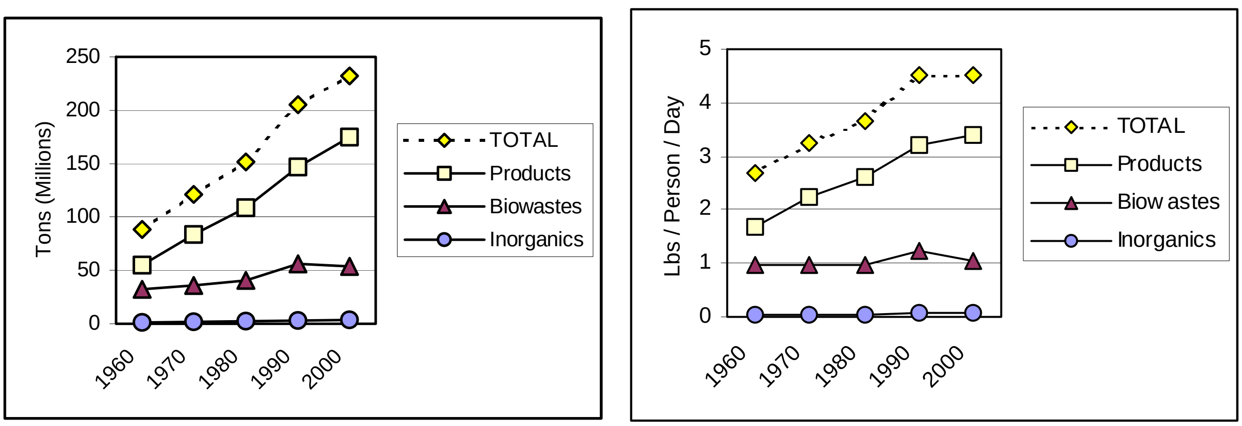
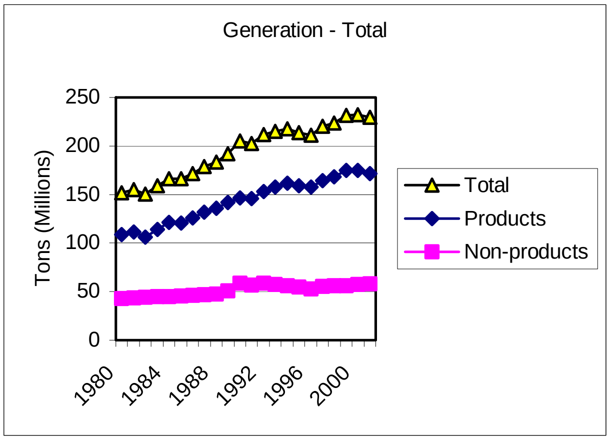


Figure 3. Generation of products, biowastes and inorganic wastes, at the start of each decade from 1960 to 2000. **A.** Total tons generated. **B.** Per capita waste generation. (Data source: US EPA 2003)

Examination of annual data from 1980 to 2001 shows that product waste generation grew faster than biowaste generation. Total product waste generation grew 37.6 percent from 1980 to 1990 (from 108.9 to 146.5 MT/yr) and 25.0 percent from 1990 to 2001 (to 171.5 MT/yr). Total non-product waste generation grew 16.0 percent from 1980 to 1990 (from 42.8 to 58.7 MT/yr) and declined 1.0 percent from 1990 to 2001 (to 57.7 MT/yr) (**Figure 4A**). Per capita product waste generation grew 22.5 percent from 1980 to 1990 (from 2.62 to 3.29 lbs/person/yr) and 2.5 percent from 1990 to 2001 (to 3.29 lbs/person/yr). Per capita non-product waste generation grew 25.0 percent from 1980 to 1990 (from 1.03 to 1.29 lbs/person/yr) and declined 13.9 percent from 1990 to 2001 (to 1.11 lbs/person/yr) (**Figure 4B**).



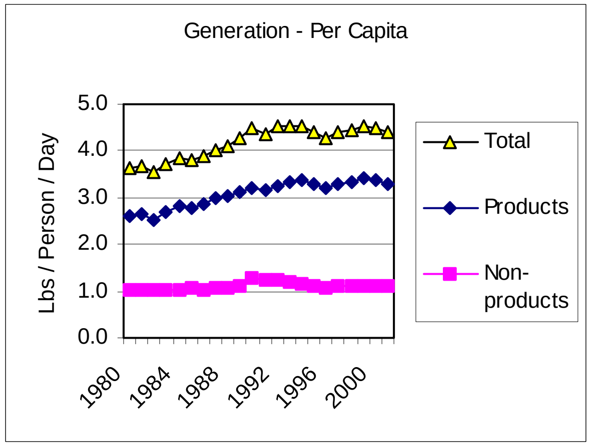


Figure 4. Generation of products and non-products (biowastes and inorganic wastes), 1980 to 2001. **A.** Total tons generated. **B.** Per capita waste generation. (Data source: Franklin Associates 2005)

3.2 MSW Recovery : Product recovery slows down, non-product recovery just getting started

A limited amount of product recycling occurred in the 1960s and 1970s, before widespread municipal involvement beginning in the 1980s.[6] Private industry ran scrap metal recycling operations as they had done for decades, while churches and other nonprofit organizations collected newspapers and aluminum cans (Ackerman 1997). Starting in the mid-1980s, the quantities of MSW recovered for recycling and composting increased as municipalities took on responsibility for recycling collection. However product and non-product waste recovery increased differently (**Figure 5**). The period for peak product waste recycling was 1985 and 1995, with tonnage recovered increasing from 18.7 to 46.2 MT/yr, or an average increase of 2.6 MT/yr. Recovery increased before and after this period, but at a slower pace: between 1980 to 1985 the annual increase was 0.44 MY/yr and between 1995 and 2001 the annual increase was 0.72 MT/yr. For biowaste, by comparison, recovery did not start until 1988 and has risen steadily at an average of 1.18 MT/yr since then.

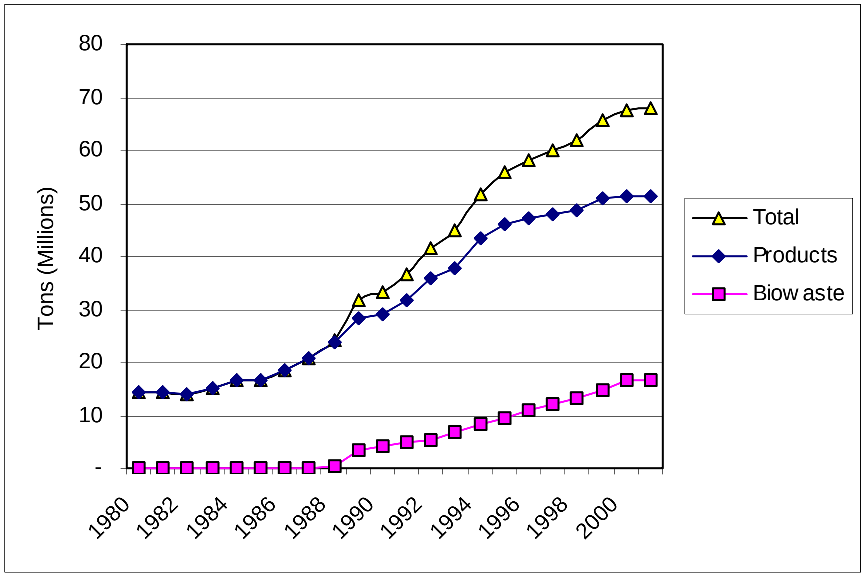


Figure 5. Waste recovery as a function of product recycling and non-product composting, 1980 to 2001. (Data Source: Franklin Associates 2005.)

While the overall recovery rate for all wastes generated (recovery divided by generation) is around 30 percent, this figure masks signifcant differences in recovery rates for the two classes of non-product wastes, yard trimmings and food scraps. Despite a later start (1988) than product waste recovery, yard trimmings achieved a recovery rate of 56.5 percent (of total yard trimmings entering the MSWM system) in 2000, compared with the 29.3 percent recovery rate for product waste (**Figure 6**). Food scraps, which did not show measurable recovery until 1990, showed a 2.6 percent recovery rate in 2000.

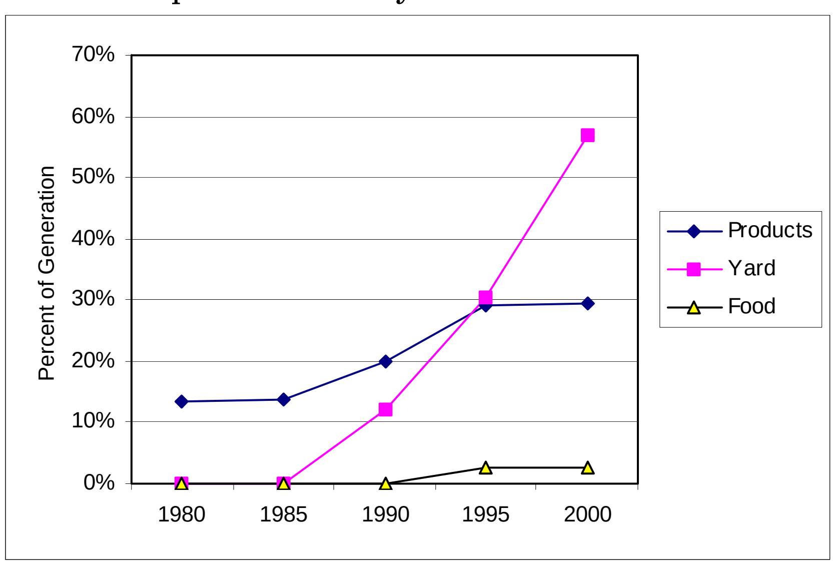


Figure 6. Recovery rates for product waste, yard trimmings and food scraps, 1980 to 2000. (Data Source, EPA 2003, p.35)

3.3 MSW Discards: Most MSW – both products and non-products – are still landfilled or incinerated

Despite significant public investment in product recycling and biowaste composting, the MSWM system continues to bury or burn most of the materials and products that enter the system. In 2001, 70.3 percent of U.S. MSW generated was disposed in landfills or waste incinerators (**Figure 7**), with four-fifths of that buried in landfills (US EPA 2003).[7] The greatest reduction in MSW disposal – reflecting increases in recycling and composting -- occurred between 1987 and 1996 (**Figure 7**). Expressed as a percent of total MSW generation, the disposal rate was constant at around 90 percent between 1960 and 1987. From 1987 to 1996 the disposal rate decreased from 88.5 to 72.5 percent. The average annual decrease in the disposal rate between 1987 and 1996 was 6.3 times greater than the average of the previous eight years, and 4.1 times greater than the average of the following five years. Since 1996 the MSW disposal rate has plateaued, declining only slightly each year.

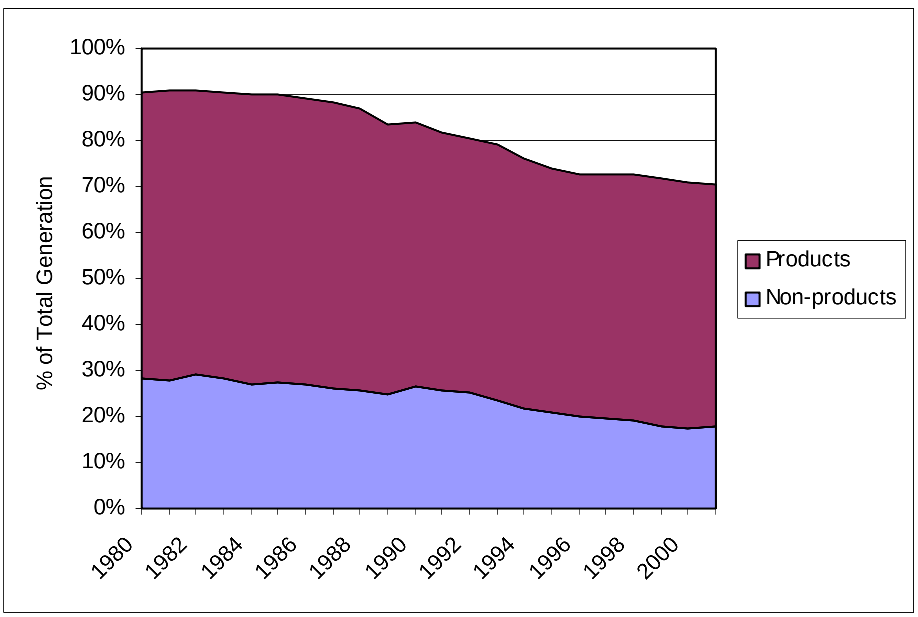


Figure 7. Waste disposal as a percent of MSW generation, 1980-2001. (Data Source: Franklin Associates 2005.)

Total weight of discards increased steadily from 1960 to 1990 then declined slightly (**Figure 8A**). However, product discards continued to increase during from 1990 to 2000 (albeit at a slower rate than before), while biowaste discards declined substantially (**Figure 8A**). On a per-capita basis, both product and non-product discards declined between 1990 and 2000, but the decline was greater for biowastes: 6.6 percent for product wastes compared with 36.0 percent for biowastes (**Figure 8B**). These two trends have had the effect of increasing the overall proportion of product wastes in the discards going to landfills and incinerators. In 1960, only 59 percent of discards were products, while in 2000 the proportion was 75 percent.

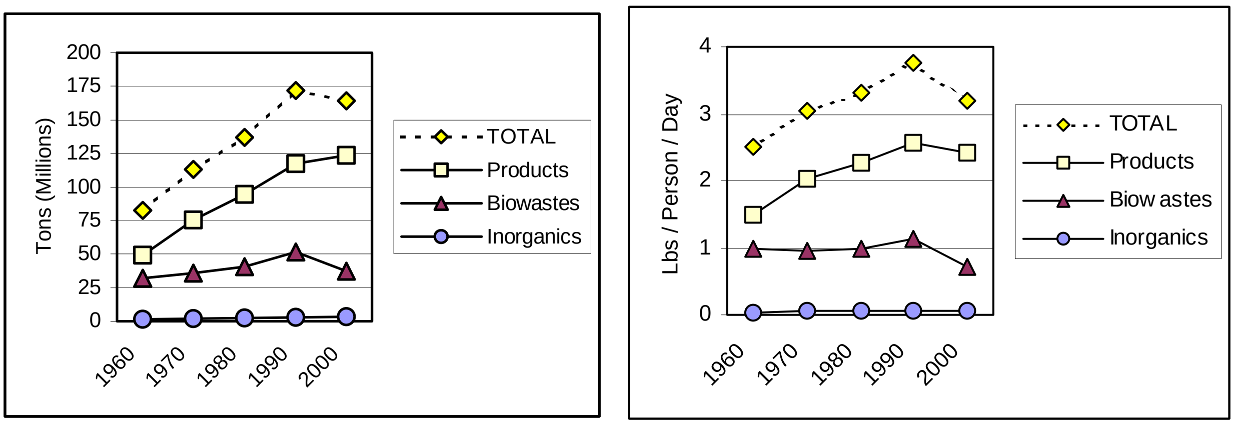


Figure 8. Discards of product, biowastes and inorganic wastes at the beginning of each decade from 1960 to 2000. **A.** Total tons disposed. **B.** Per capita disposal. (Data source: US EPA 2003)

4. THE LIMITS OF MSWM

Is there a reason that product wastes have responded to MSWM differently than non-product wastes? Why does product waste generation continue to grow while the growth of product recycling is stalling? Why are such large quantities of MSW, both product and non-product waste, ending up in the discard stream? We suggest that the answers to these questions lie in an inherent limitation of MSWM as a system for managing product wastes. For product wastes, factors critical to the success of US EPA's "integrated waste management" strategy – source reduction, recovery for recycling, and environmentally safe disposal – are either wholly (source reduction) or partially (design for recycling and safe disposal) beyond the control of the MSWM system.

US EPA notes that per-capita waste generation has nearly doubled since 1960, from 2.7 to 4.41 pounds per day and tells us that "[t]he most effective way to stop this trend is by preventing waste from being generated in the first place" (US EPA 2003, p.114). US EPA defines waste prevention (also known as source reduction) as "any change in the design, manufacturing, purchase, or use of materials or products (including packaging) to reduce their amount or toxicity *before they become solid waste.* …Thus source reduction activities often affect the waste stream *before the point of generation" (Ibid.*; emphasis added).[8] Put another way, source reduction activities occur outside the boundaries of the MSWM system. And outside the boundaries of the MSWM system there is no benefit conferred by source reduction – just as there is no benefit within the MSWM system to design features like consumer convenience, product functionality and attractive appearance.

In 1999 US EPA identified a number of challenges facing MSWM waste recovery efforts, including the lack of market demand for collected materials and product design that makes materials difficult to recycle (US EPA 1999, p.125 ff). Both of these circumstances are beyond the control – outside the boundaries – of the MSWM system. For product manufacturers, buying recycled materials there is no benefit to buying recycled material except cost (they buy when it is to their advantage), while for the MSWM system selling recycled materials is not discretionary: Waste managers must continue to offer the materials for sale even when oversupply gluts the market and suppresses prices because the MSWM system must continue to collect them.

The environmentally sound disposal of product wastes in landfills and incinerators is also impaired by decisions that are made outside the MSWM system. Product manufacturers derive no benefits from designing products that are easy to manage in MSW landfills and mass-burn incinerators, nor do they incur any costs when their products cause environmental damage there.

If management of product wastes was an extension of the production and consumption system, and the costs and benefits of waste management accrued to producers, all of these problems would begin to find solutions. Product manufacturers would have an incentive to design for recycling, use recycled materials, prevent waste, and ensure that products did not cause environmental harm during disposal. Instead, what has happened is that MSWM has enabled the marketing of "disposable" convenience products, whose convenience is provided not by the production and consumption system, but by the public MSWM system, at public expense. The provision of universal collection and disposal of product wastes created conditions that made the Disposable Society a natural response to the laws of the market. Over the course of the 20th Century, MSWM provided services that acted as a perverse subsidy to the production of short-lived products and facilitated the excessive material flows that characterize our consumer society.

There are historical reasons that MSWM is not able to optimize efficient product recovery. If MSWM were to be successful in optimizing the value of product wastes collected from many small generators in the community, it would need to mirror the exquisitely complex marketing and distribution system that gets products to consumers in the first place. But the MSWM system, originally configured to manage a waste stream made up of relatively homogeneous materials such as ash and biowastes, lacks that capability. MSW managers tend naturally to favor large scale, capital intensive waste facilities for mixed waste because they appear easier to control and are more predictable in their cost, relative to the complex and diverse systems required for maximizing value from product waste recovery (Murray 1999).

The practice of managng mixed MSW containing product and non-product wastes has prevented the MSWM system from developing effective management solutions for non-product food scrap wastes. As shown in Figure 6, nearly all (97.2 percent) of the food scraps generated in the United States are being discarded, mainly in landfills. In landfills, these materials, along with other biodegradable materials in MSW such as yard trimmings and unrecycled paper products, are significant contributors to the global production of greenhouse gases (GHGs). Methane is a GHG more than 20 times more potent than carbon dioxide, and landfills are the largest anthropogenic source of methane in the United States (US EPA 1996). New work suggests that landfill gas collection systems may be far less efficient in reducing *lifetime* gas emissions than previously thought, and that the new generation of proposed "bioreactor" landfills may actually exacerbate the problem (Anderson 2005). Also, organic materials in MSW are implicated in the toxic releases from landfills such as the methylated forms of mercury that are created by microbial action in landfills (Lindberg 2001). These materials, however, are well suited to management in the MSWM system through composting and other controlled technologies, being relatively homogeneous and amenable to commingled collection and bulk processing compared to product wastes.

With product waste recovery stalled and the proportion of waste discarded still at around 70 percent, MSWM practitioners are increasingly focusing on optimizing waste disposal systems. The Solid Waste Association of North America (SWANA), the association for public sector waste mangers, is directing its attention to the "recovery" of energy from a mixed discard stream through thermal technologies and also landfill gas utilization (SWANA 2003). SWANA's emphasis on energy recovery from mixed MSW raises issues that are beyond the scope of this paper. However, ample evidence suggests that from a full system perspective, recycling saves far more energy than that gained during incineration with energy recovery or that captured from landfill gas (Denison 1996, ETC/WMF 2004, Morris 2005).[9] By pursuing energy recovery from mixed waste, MSW practitioners are conceding defeat in the goals established in the 1980s to stem materials flows and conserve resources.

5. EXTENDED PRODUCER RESPONSIBILITY: AN ALTERNATIVE FOR PRODUCT WASTES

Extended Producer Responsibility (EPR) has emerged as a promising alternative to MSWM for product wastes. The approach was introduced in Germany in 1991, when product brand-owners were required to provide for the recycling of the packaging associated with their products. In EPR systems, products do not enter the MSWM system at the end of their lives but are managed through an infrastructure arranged by the producers and provided to consumers as an expected customer service. When products stay within the production and consumption system "from cradle to cradle", the producer benefits from changes in product design and marketing practices that prevent waste and facilitate recycling. The precursor to EPR was the refillable container system developed a century ago by the beverage industry. Ironically, this EPR approach is all but extinct now in North America[10] because of two public policies. One was public investment in the national highway system which made it more economical to ship one-way from distant production facilities than to operate local bottling plants. The other was the MSWM system, which took care of the growing numbers of empties.

Since 1990, EPR has become established in Canada as a policy approach for many products and all provinces have one or more legislated EPR programs in place (Sheehan and Spiegelman, 2005). In the US, eleven states have EPR programs for beverage containers, requiring bottlers to take back empties for recycling, and the state of Maine adopted legislation in 2004 that requires computer makers to finance the recycling of computers and TVs collected in the MSWM system (*ibid.*). EPR faces challenges not only because of understandable reluctance by producers to assume costs that have long been externalized, but also because of continuing competition from the MSWM system. Long established public attitudes and expectations, to say nothing of sunk costs and administrative and commercial arrangements between local governments and their MSWM suppliers, are additional barriers to EPR.

SWANA has a policy on product stewardship that provides a role for waste managers in the MSWM system "working in cooperation with the product manufacturers to develop the most workable and cost-effective solutions" (SWANA 2001). The Canadian provinces of Ontario and Quebec are testing this approach by introducing a form of EPR that relies on MSWM to recover product waste for recycling, with partial reimbursement by industry. However this approach removes control by the producer over the costs of product management. Other Canadian provinces are taking a different approach, allowing producers to form their own product return and recycling systems, while government sets performance standards and ensures compliance. The comparisons over time between the two approaches will provide guidance for future public policy on EPR.

6. HOW MSWM CAN SUPPORT EPR

It is the view of the authors that public policy, both at the senior government and local government levels, should expedite a transition to separate and complementary EPR and MSWM approaches. Over time, product wastes should increasingly be managed through infrastructure provided and funded by producers as an extension of the production and consumption system, while MSWM should focus on environmentally sound management of biowastes and other biodegradable materials. Below are several suggested public policy instruments.

Enhance source-separated biowaste processing within the MSWM system. Government policy in North America should direct the MSWM system to provide separate collection and treatment of organic materials and encourage research and development in this area. Landfill regulations in North America should set a date for the prohibition of landfill disposal of biowastes, as has been done in the European Union (EU 1999). Municipal biowaste management programs might also target specific classes of non-recyclable fiber products (e.g. waxed cardboard, food-contact paper products, sanitary products, and other low-grade paper products). If the MSWM system is used for these products, public policy should ensure that the products are certified safe for such processing using recognized certification systems. Public policy should also ensure that these products pay their way through the MSWM system rather than becoming a publicly subsidized service that would encourage abuse.

Send clear policy signals that EPR is the direction for the future. Governments at both the senior and local levels can assist industries to prepare for EPR by sending clear policy signals. These can be communicated in policy resolutions and white papers. They can also be embodied in regulatory instruments such EPR regulation, bans on disposal of products for which recycling exists, and bans on use of MSWM system for products for which EPR programs exist. They can also be embodied in economic instruments such as disposal surcharges.

CONCLUSION

The MSWM system was adopted a century ago as part of a public policy to protect public health and safety. In the intervening years MSWM contributed to the unsustainable growth of material flows in advanced industrial economies and it is not configured to provide effective management of either product wastes or non-product wastes. EPR has emerged as a promising alternative policy approach for product wastes. However the MSWM system must be adapted to support EPR. MSWM must gradually withdraw its service for product wastes and expand treatment of source-separated organics. The outcome of these combined policies will be progress towards the ultimate outcome of sustainable production and consumption and protection of public health.

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NOTES

[1] For consistency with data sources, non-metric units are used throughout.
[2] *BioCycle* magazine uses state-reported statistics based on measurement or sampling in its annual "State of Garbage in America" reports. By contrast, US EPA uses industry and government data on domestic production of materials and products, making adjustments for imports and exports and for product lifetime (US EPA 2003, p.142 ff).
[3] Product wastes are over 89 percent of MSW by volume, because of their high volume-to-weight ratio compared with non-product wastes. See US EPA 1999, Table B-2
[4] Twenty percent of the contaminated sites on the US Superfund National Priority List are municipal landfills (Steinway, 1999).
[5] MT = million short tons.
[6] More than 100 municipalities started some form of recycling collection in the early 1970s, but a mid-1970s slump in demand for recycled paper brought many of these programs to an end (Ackerman 1997, p.17)
[7] The figures for Canada are even higher, with Statistics Canada reporting that 78 percent of Canada's MSW was discarded in 2002, almost all in landfills (Statistics Canada 2004).
[8] In fact, MSWM lacks the tools even to measure waste prevention: "the goal of actually measuring how much source reduction has taken place – how much waste prevention there has been – has proved elusive. Unlike recycling, where

there are actual materials to weigh all through the process, measuring source reduction means trying to measure something that no longer exists" (*ibid.*).

[9] J. Morris (2005) notes: "[T]he energy grid offsets and associated reductions in environmental burdens yielded by generation of energy from landfill gas or from waste combustion are substantially smaller then the upstream energy and pollution offsets attained by manufacturing products with processed recyclables, even after accounting for energy usage and pollutant emissions during collection, processing and transportation to end-use markets for recycled materials … [E]nergy conservation and pollution prevention engendered by using recycled rather than virgin materials as feedstocks for manufacturing new products tends to be an order of magnitude greater than the additional energy and environmental burdens imposed by curbside collection trucks, recycled material processing facilities, and transportation of processed recyclables to end-use markets."

[10] The exception is domestically produced Canadian beer, which is still marketed in refillable bottles.

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