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Policy Study

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Integrated Waste Management: Rethinking Solid Waste Problems and Policy Options*

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Executive Summary

What shall we do with our waste? As it reviews the Resource Conservation and Recovery Act (RCRA), Congress will likely consider product bans, recycling mandates, recycling content legislation, disposal fees, and restrictions on interstate transport of solid waste.

Yet these proposed measures misconstrue the nature of our solid waste problem, or they will impose high costs without promoting efficient resource use and conservation. The current problem is not fundamentally the result of a profligate "throwaway" American society--for example, per capita waste generation remained almost constant from 1970 through the 1980s. And the garbage "crisis" is not the result of insufficient space suitable for siting landfills. Rather, the garbage problem stems from two key factors:

- U.S. cities and counties have typically not charged residential and some commercial consumers for the full costs of garbage collection and disposal services; and
- Environmental impacts of different disposal options have, until recently, not been systematically addressed, and the costs of mitigating impacts have not been incorporated into fees charged for solid waste service.

As a result, American consumers have had little incentive to recycle, request waste-minimizing packaged products, compost yard waste, and so on. And industry, in turn, has had little incentive to develop waste-reducing products and packaging.

The challenge for solid waste management policy is how to remove those distortions to the marketplace that encourage waste and how to ensure that waste is disposed of in ways that do not pose health and environmental hazards. Five policies are central to this process: 1) implementation of volume- or weight-based refuse collection fees; 2) introduction of full-cost accounting and increased privatization or corporatization of solid waste collection and disposal to facilitate the use of full-cost accounting; 3) elimination of product bans not based on health and safety concerns; 4) payment of compensation or distribution of other benefits to households in proximity to solid waste facilities and/or to communities that agree to host such facilities in order to promote integrated waste management; and 5) mitigation of environmental impacts through development of disposal facility impact standards.

The understatement of costs, coupled with failure until recently to mitigate environmental impacts of disposal facilities, has in effect meant that landfilling has been underpriced and thus other options, like recycling or composting, have often not appeared to be cost-effective. Full-cost pricing, which can be facilitated by privatization or corporatization of public services (requiring that public solid waste services be funded through user fees and independent of general tax revenues) will level the playing field among various collection and disposal alternatives.

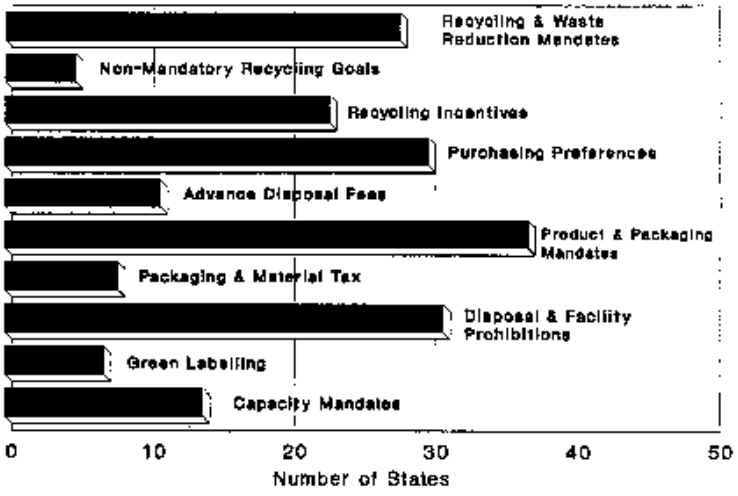
These policies will ensure that use of landfill space is not subsidized and that environmental impacts are incorporated into the costs of different disposal options. Variable can rates will likewise ensure that residents and businesses pay fees that reflect full collection and disposal costs, which in turn will encourage resource conservation.

I. Introduction

A 1987 *Newsday* article reported that each American household discards an average of 13,000 paper items, 500 aluminum cans, and 500 glass bottles annually. And in the preface to a 1989 book on the garbage crisis, *War on Waste*, former Texas Commissioner of Agriculture John Hightower cautioned: "we have been taught to be wasteful. Today, our durable goods are anything but durable, designed as they are for planned obsolescence, and nearly all our nondurable goods are sold in throwaway packaging. We produce enormous quantities of waste, then try to bury it or burn it and forget it."

These impressions of "wasteful behavior," coupled with closures of landfills and escalating landfill disposal costs, have inspired a host of legislation regarding solid waste management. Forty states and the District of Columbia passed recycling legislation in 1989 and 1990. At least twenty-six states and the District of Columbia now have comprehensive recycling laws that require recycling as a component of state, regional, or local waste management plans. And over 2,000 cities and towns have initiated curbside collection for recycling (see Figure 1).

Figure 1
States' Solid Waste Policies



The federal government, too, is stepping up its attention to solid waste matters. In 1991 Congress was scheduled to review the Resource Conservation and Recovery Act (RCRA), which was initially passed in 1976 and includes regulations regarding municipal solid waste. In addition to tightening up regulations relating to landfill and incinerator operations, Congress is likely to consider a number of other solid waste regulations, including: 1) requirements that manufacturers include certain levels of recyclable materials in their products; 2) mandates that states achieve specified recycling levels; 3) beefed up government procurement preferences for products containing recycled materials; 4) restrictions on the interstate flow of solid waste; 5) front-end disposal fees--either imposed at the manufacturing or retail level; and 6) product bans or packaging and materials usage regulations.

Before embarking on new solid waste legislation, both Congress and state legislators need to better understand what solid waste problems we face and whether various policy proposals actually address those problems. Many proposed solid waste regulatory and legislative measures are ill-conceived. At worst, some proposed policies would actually be counterproductive, generating more costs (and problems) than they actually solve. At best, they are only symbolic or misconstrue the nature of our solid waste problem. The current solid waste problem is not fundamentally the result of profligate American consumption and production patterns. And the problem is not the result of insufficient space suitable for landfill siting. Nor is the problem that we are "running out of resources" and therefore must recycle and reduce consumption without regard to cost or impact on quality of life.

Rather, the garbage problem stems from three factors:

1) The growing hostility to siting disposal facilities in communities;
2) The failure by many local governments to charge residential and some commercial consumers for the full costs of garbage collection and disposal services;
3) The failure systematically to incorporate the costs of mitigating environmental impacts of different disposal options into fees charged for solid waste service.

Consider the first issue--that Americans are now less willing to live in proximity to their waste. University of Arizona archaeologist William Rathje, who has studied garbage in landfills for over a decade, points out: "Ever since governments began facing up to their responsibilities, the story of the garbage problem in the West has been one of steady amelioration, of bad giving way to less bad and eventually to not too bad. To be able to complain about the garbage problems that persist is, by past standards, something of a luxury."(1) As a result of this increased concern about environmental impacts of solid waste disposal, it has become increasingly difficult to site facilities.

Yet the problem is more than just the result of an increasingly finicky public. In many localities garbage collection and disposal *charges do not reflect the real costs of collecting and disposing of waste.* The practice of subsidizing garbage collection and disposal has distorted signals to individual garbage "producers," giving them little incentive to recycle, change buying habits, compost yard waste, and so on. And the failure to mitigate against environmental impacts, such as air and groundwater pollution for disposal facilities, has made garbage disposal appear to be less costly relative to source reduction and recycling than it in fact is.

The key challenge for solid waste management policy is how to remove those distortions to the marketplace that encourage waste and how to ensure that waste is disposed of in ways that do not pose health and environmental hazards.(2)

Five policies are central to this process:

1) implementation of volume- or weight-based collection fees;
2) introduction of full-cost accounting and increased privatization or corporatization of solid waste collection and disposal to facilitate the use of full-cost accounting;
3) elimination of product bans not based on health and safety concerns;
4) payment of compensation or distribution of other benefits to households in proximity to solid waste facilities and/or to communities that agree to host such facilities;
5) mitigation of environmental impacts, particularly from air emissions and water pollutants, through development of disposal facility impact standards.

These approaches offer potentially efficient and effective solutions to current solid waste problems. Development of standardized recycling specifications and improved information about solid waste composition should complement these policies.

By contrast, many other proposed solutions to the garbage problem--for example, recycling mandates, product bans, product disposal restrictions, and interstate waste transport restrictions--can entail high economic and environmental costs. The old adage, "There ain't no such thing as a free lunch," holds true. All methods to handle and dispose of products entail some costs and environmental impacts. For example, recycling efforts that conserve landfill space may require higher energy use and resource consumption in some instances. Moreover, collection and disposal costs differ significantly from one location to another as a result of varying availability of landfill space, population densities, and so on. Consequently, location-specific factors and economic costs should play a key role in determining how different communities respond to solid waste problems.

In addressing solid waste policy, one final point is worth underscoring. *Solid waste policy should focus on the management of solid waste, an undertaking distinct from attempts to manage the overall use of materials and products in the U.S. economy*. The latter concept has emerged as central to some recent discussions of solid waste policy as a result of an increased emphasis on "source reduction" and "waste prevention." Recent publications by the Environmental Protection Agency and the Office of Technology Assessment have both underscored the importance of materials management in order to reduce the amount of waste requiring disposal. In its 1988 report, *Facing America's Trash*, the Office of Technology Assessment notes, for example, that "*a clear national policy on MSW [municipal solid waste] that addresses the use of materials is essential for providing a broader context in which specific MSW programs can be developed and implemented (emphasis in original).*"(3)

Materials usage does influence waste production. However, determining materials usage primarily on the basis of how much waste or residuals result from the manufacture and use of particular products will likely result in less- rather than more-efficient overall resource use. This is because such an approach fails to consider cost, resource trade-offs, or the multiple values and preferences that influence consumption choices.

In sum, *the key to including the full costs of waste collection and disposal in materials usage decisions is to ensure that consumers fully pay for these services*. Full costs include those required to meet environmental standards, including standards for air and water emissions, noise abatement, habitat protection, and so on. Market pricing in the context of meeting environmental and safety standards will percolate up through the production chain to influence materials usage. In this context, marketplace competition among manufacturers will generate private-sector efforts to reduce materials usage--both in response to consumer demands and in the search for cost-reductions.

This approach, unlike explicit product bans or attempts to itemize "good" and "bad" products, acknowledges that we consume resources in order to meet a variety of perceived needs. We should ensure that in meeting these needs we do so in the most efficient and resource-conserving way. That is a different proposition than the concept of "waste prevention" currently entwined in some discussions of solid waste policy in which an absolute reduction in per capita consumption or an elimination of specific products underpins some policy proposals.

Thus, federal, state, and local officials should seek policies that will result in cost-effective management of solid waste collection and disposal, while ensuring that public health and safety are maintained and that efficient use of resources is promoted. Designing policies that achieve full-cost pricing are the key public policy challenge. Better materials management will flow from
this achievement.

The following discussion elaborates on why full-cost pricing lies at the heart of addressing solid waste management problems, and explores five policies that can best introduce such pricing: 1) use of full-cost accounting and increased privatization or corporatization of public services; 2) use of variable can rates for collection charges; 3) elimination of product bans and packaging restrictions; 4) development of policies to facilitate payment of host-community compensation and other benefits to encourage siting of solid waste facilities; and 5) development of standards regarding environmental impacts from solid waste facilities.

II. Garbage: What Is the Problem?

Disposal Capacity. Approximately 73 percent of all municipal solid waste in the United States now goes to landfills (See Figure 2). The number of landfills is declining, with more than half of the 18,500 landfills that existed in 1979 having closed in the past 10 years. By 1990, some 6,600 municipal waste landfills were operating in the United States (see Figure 3).(4) The Environmental Protection Agency (EPA) estimated in 1986 that the median remaining "lifespan" of municipal landfills was 12.4 years.

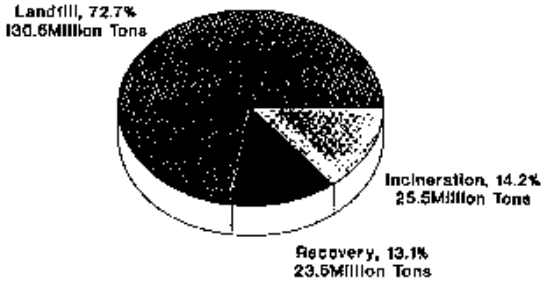
Garbage expert William Rathje, commenting on landfill closures, notes, "the customary formulation of the problem we face...is that 50 percent of the landfills now in use will close down within five years. As it happens, that has always been true--it was true in 1970 and 1960--because most landfills are designed to be in use for only about ten years....The problem is that old landfills are not being replaced."(5) For example, the number of landfills being sited dropped 25 percent in the mid-80s over previous siting rates. And by the late 80s, it took five to eight years to site the average landfill.(6)

Recent landfill closures have occurred for two reasons. First, some landfills are simply reaching full capacity. Second, recent enactment of stricter landfill regulations has resulted in closure of some old landfills that posed potential health hazards, though the sites still had remaining capacity.

Political forces have also contributed to the current landfill shortage. The much-publicized NIMBY (not-in-my-backyard) syndrome has stalled or prevented the opening of new landfills to replace those now reaching capacity.

Figure 2

Management of Municipal Solid Waste in the U.S., 1988

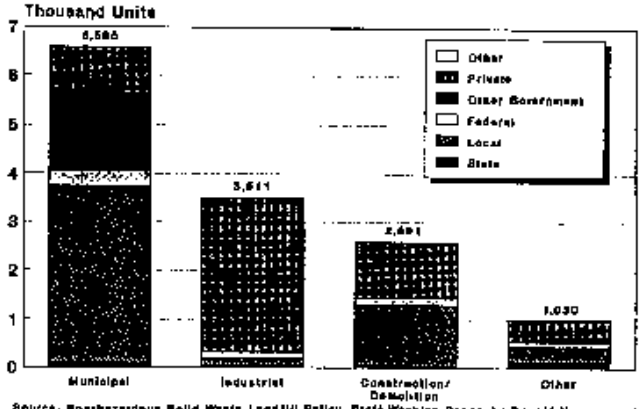


TOTAL WEIGHT = 179.6 million tons

Source: Environmental Protection Agency, *Characterization of Municipal Solid Waste in the United States: 1990 Update (Washington, D.C., 1990).*

Figure 3

Ownership of U.S. Subtitle D Landfill Units

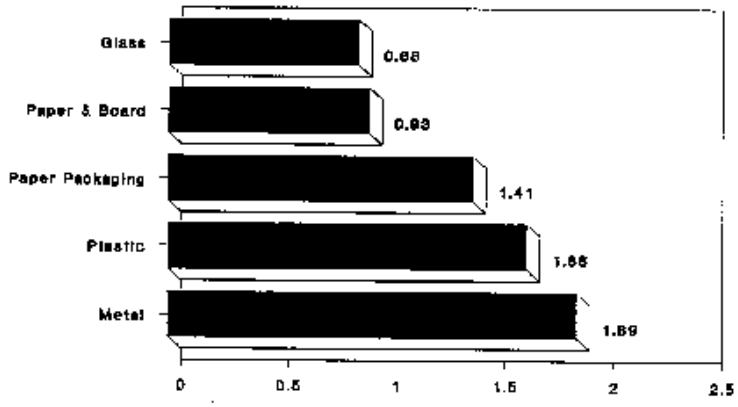


Source: Non-Hazardous Solid Waste Landfill Policy, Draft Working Paper, by Donald Norman and Jody Perkins, prepared for the American Petroleum Institute, Dec. 1990.

Other policies have also exacerbated the landfill shortage. For example, in New Jersey legislators passed in 1976 the Solid Waste Utility Control Act, which in effect treated solid waste collection and disposal as a public utility, thereby resulting in the imposition of rate regulation similar to that applied to electric utilities. Rate-setting procedures "allow only for recovering *past* costs," according to Neil Hamilton and Robert Wasserstrom, which has deterred private operators from investing in new facilities, including landfills.(7) The policy has resulted in mounting disposal costs for New Jersey municipalities that now must haul garbage out of state, with disposal costs reaching over $150 per ton, compared to a nationwide average of just over $28 per ton.

Though landfill closures have contributed to current solid waste disposal problems, their impact should not be overstated. The number of closures does not accurately convey the net loss in landfill space, since most new landfills are much larger than the older ones they have replaced. The EPA noted in 1986, for example, that the average size of landfills closed was 9.1 acres, while the average size of new landfills was 32.5 acres, with a capacity to hold four times the volume of waste as that for closed landfills.

Figure 4
Relative Reduction in Food Waste From Packaging



Source: Dr. H. Alter, "The Origins of Municipal Waste: *The Relation Between Residues from Packaging And Food*," Waste Management and Research, 1988

Nonetheless, Jerry Taylor, in his report, "Municipal Solid Waste Management–An Integrated Approach," points out that overall net capacity is declining, while solid waste disposal needs are increasing. He notes that the United States is losing about 9 million tons of landfill capacity each year, while new landfills are providing only 4 million tons of additional capacity.(8). Still, this net loss of 5 million tons of capacity represents about 2 percent of total MSW capacity, while numbers showing that a third to half of all existing landfills will close over the next decade inaccurately give an impression that the United States will soon have lost half of its landfill capacity.

A second point is relevant to understanding landfill capacity problems: availability of landfill space varies substantially by state. According to the EPA, five states hold 34 percent of the active landfills. Some communities have landfill space sufficient to accommodate waste over the next 25 to 30 years, while others have only a few remaining years of capacity. Fees to "tip" solid waste at landfill sites reflect this wide variation in capacity, ranging from near zero to well over $150 per ton of waste disposed.

This variation in capacity by state has prompted state and federal proposals to prohibit transfer of solid waste across state lines. States that have sufficient capacity have been concerned that they will use up that space by receiving out-of-state garbage shipments from areas that have not adequately planned for solid waste capacity needs. Yet currently at least 47 states both export and import waste, primarily the result of regional interstate landfill systems and variations among states in the amount of space and land suitable for landfills. Thus, preventing the flow of garbage across state lines could actually worsen environmental impacts from disposal.

It is nonetheless true that difficulties in siting landfills have limited capacity in some areas, leaving some communities and states with insufficient space to receive existing supplies of solid waste. This capacity shortfall is a product of politics and public policy, not physical shortages of land suitable for waste disposal. A. Clark Wiseman, in a study of wastepaper recycling, calculates that "*all* municipal solid waste for the next thousand years would require [a landfill 120 feet deep in] a square area having 44-mile length sides."(9) To put this into perspective, the contiguous United States has a land area of 3 million square miles. The hypothetical landfill that would accommodate 1,000 years of U.S. waste would thus take up less than .1 percent of the land space of the continental United States.

That land suitable for landfills exists does not eliminate the solid waste policy problems now facing state and local communities. It does, however, mean that policies to assist communities in overcoming the NIMBY syndrome in order to site landfills or other waste facilities should be an important component of state and local government solid waste policy agendas. Indeed, a report sponsored by Sens. Timothy Wirth and John Heinz entitled *Project 88: Round Two* concludes that landfill siting policy should be a key focus of solid waste legislation in the '90s.(10)

Waste Generation. However, even if the landfill shortage could be alleviated, another question remains: are we "overproducing" waste? A 1990 Franklin Associates study prepared for the EPA estimated that Americans throw away 179.6 million tons of solid waste annually--about 4 pounds of trash per day per person--compared to 81.7 million tons in 1960 in the municipal waste stream, which includes not only residential but also commercial and some light-industrial wastes.(11) Other developed countries, according to several reports, produce less garbage per person than the United States, though comparisons are typically not useful since different countries measure their wastestream differently.

Yet do these reports confirm that Americans "overproduce" waste? And do they confirm that specific products or packaging have unduly contributed to our garbage problem? A number of factors suggest that drawing conclusions from these garbage statistics is problematic.

For example, comparing U.S. waste production with that of other nations poses problems, since resource availability varies country-by-country and methods of counting waste differ. Jerry Taylor, a policy analyst formerly with the American Legislative Exchange Council and now at the Cato Institute, points out that "we are comparing apples and oranges when we contrast American vs. European or Japanese waste data."(12) In *Facing America's Trash*, the Office of Technology Assessment spells out why foreign data cannot be directly compared with U.S. data: "In the United States, post-consumer materials that are recycled are generally included in the definition of MSW. In contrast, Japan and many European countries...define MSW as including only those materials sent to waste treatment or disposal facilities."(13) Japan's MSW per capita is around 3 pounds per day (*after* recycling). As the Office of Technology Assessment report points out, this is similar to the U.S. rate of 3.2 pounds per day after recycling.

Other factors contribute to different recycling and waste disposal rates among countries. Some countries, like Japan, with fewer timber resources for paper production, have a greater incentive to reuse and conserve paper because it is a relatively expensive product. And in high-density urban settings in Japan, individual residents produce little yard waste, an important component of suburban U.S. waste.

"Garbage" expert William Rathje, reviewing U.S. solid waste generation rates, concludes that "Americans are wasteful, but to some degree we have been conditioned to think of ourselves as more wasteful than we truly are."(14)

U.S. Chamber of Commerce solid waste policy expert Harvey Alter, analyzing U.S. solid waste generation, looks at the intensity of waste generation--that is, waste generation per capita in relationship to gross national product. He finds that as per capita income has increased in the United States, the intensity of waste generation has declined.(15) Alter also finds that based on 1986 estimates, "*per capita* generation

from 1970 through 1984 was statistically constant. The average change over this period is .004 kg per person each day."(16) Current projections regarding future waste generation rates are likely to overstate MSW amounts, given what Alter has shown regarding declining intensities of waste generation. Indeed, 1970s EPA projections of waste generation in the 1980s have proven to be far off target. In the '70s, EPA was projecting per capita rates of around 2.12 kg per person per day for 1985. Actual rates are closer to 1.6 kg per person.

Widely varying reported rates of generation among different U.S. cities illustrate the lack of standardization in methods of estimating waste, as well as highlighting potential significant variations among different sizes of cities, urban versus rural areas, and areas with different climates and vegetation. One report of daily per capita waste generation in 37 cities revealed estimates ranging from .9 kg per person to 4.3 kg per person.

There is another problem with much recent analysis of U.S. garbage production. Garbage statistics, which focus on actual waste collected and disposed of, fail to reveal what waste has been avoided through the use of modern packaging and products. Modern packaging often extends the shelf-life of foods, thereby reducing food waste and ensuring higher quality, uncontaminated food. Again, the work of Harvey Alter is illuminating (see Figure 4). In examining trends in the use of packaging materials, Alter finds that "as the use of packaging materials is increased, the fraction of food waste in MSW decreases over the range examined....this correlation holds for data from many countries, over a considerable range of waste composition, and perhaps a broad period of time."(17)

Moreover, modern packaging is not necessarily more cumbersome and wasteful than past forms of packaging. For example, the Council for Solid Waste Solutions points out that a plastic milk jug weighed 95 grams in the early '70s, while the same jug today weighs 60 grams. Likewise, plastic grocery bags, which were 2.3 mils thick in 1976, were only .7 mils thick by 1989, the result of new technology that enabled the bags to have the same durability and strength for less thickness. In fact, containers and packaging represent a smaller portion of the waste stream today than two decades ago. A 1988 Franklin Associates study reveals that containers and packaging represented 30.3 percent of the solid waste stream in 1986 compared to 33.5 percent in 1970.

The "Good" vs. "Bad" Products Debate. Nor can specific products neatly be categorized as "environmentally good" or "environmentally bad." In the 1970s, the Midwest Research Institute compared reusable (glass) and plastic beverage containers, concluding that the oft-maligned plastic containers use fewer raw materials, consume less energy, and use less water to produce than their glass counterparts. More recent studies by Franklin Associates also suggest that plastics may provide resource-conserving packaging relative to other common alternatives.(18)

Nonetheless, public perceptions of plastics are that they are contaminating the environment more than other materials.

Other "cradle-to-grave" studies that attempt to evaluate the resource uses of various products show equally ambiguous results. One study by Arthur D. Little, Inc., compares cloth and disposable diapers, concluding, "neither disposable nor reusable diapers are clearly superior in the various resource and environmental impact categories considered in the analysis."(19) And analysis of the aseptic drink package (rectangular, multi-materials boxes often used for juice drinks), shows that this product conserves on energy and results in fewer air and water emissions than alternative drink packaging products. On the other hand, the package is less frequently recycled than alternative packages.

Cradle-to-grave studies (sometimes called product life-cycle analysis), by attempting to look at the resource use associated with specific products from the harvesting and transformation of original materials, through production, distribution, sale, and finally disposal of the products, highlight the complexities and trade-offs involved in all production activities. These studies illustrate that some products may use significantly more energy than others, but produce less solid waste. Or they may be readily recyclable, but produce high amounts of water waste and require more water consumption than alternative products. As such, cradle-to-grave analyses illustrate the shortcomings of assessing products only with regard to whether they are being widely recycled.

Such analysis does, however, have its own limitations, largely because of the very complexities involved in comparing the relative resource uses and environmental impacts of different production processes. For example, one product may have fewer overall air emissions than another competing product, yet the composition of those emissions may be potentially more harmful to human health. Moreover, the overall energy resource use of a given product depends significantly on the actual consumption and disposal path that it takes. A glass bottle compared with a plastic bottle may require higher energy consumption if the glass is not recycled, but less energy if it is recycled. Or even when recycled the glass bottle may require more energy if the transportation distance from the point of collection to the point of remanufacture is significant.

Categorizing products according to whether or not they are biodegradable is also problematic. Proponents of regulations requiring biodegradable packaging argue that nonbiodegradables contribute significantly to the refuse problem, especially given the U.S. heavy reliance on landfills for disposal. Yet William Rathje notes that "the notion that much biodegradation occurs inside lined landfills is largely a popular myth. Making discards out of theoretically biodegradable materials, such as paper, or plastic made with cornstarch, is often proposed as a solution to our garbage woes (as things biodegrade, the theory goes, there will be more room for additional

refuse)....Some food and yard debris does degrade, but at a very, very slow rate (by 25 to 50 percent over ten to fifteen years). The remainder of the refuse in landfills seems to retain to its original weight, volume, and form."(20) Rathje's findings, however, may be more relevant to landfill conditions in the drier southwest than in other parts of the country.

The focus on biodegradability has generated considerable debate about whether some products, for example, special plastics designated as biodegradable, are, in fact degradable. But this debate is largely irrelevant to current solid waste management practices, since most products degrade only very slowly, if at all, in many modern landfills. The Office of Technology Assessment report, *Facing America's Trash*, concludes that "there is evidence...that decomposition rates of organic materials in landfills are so slow that the space-saving benefits may not be important."(22)

The Pricing Problem. The solid waste problem is not one of scarcities of landfill sites per se, nor of historically high rates of garbage production per person, nor is it the result of "environmentally bad" products. However, efficient and effective solid waste management and waste reduction goals have been hampered by: 1) subsidies of waste collection and disposal; and 2) externality problems associated with some waste disposal. Tax and regulatory policies that have favored use of virgin raw materials may also provide some bias against use of recyclable materials, though this bias may be too small to be of much real consequence.

Consider, for example, charges for waste collection and disposal. Though municipalities have begun to apply cost-based user fees for garbage collection and disposal, this is a relatively new phenomenon. Historically, as Peter Menell notes, refuse removal and disposal services "are typically borne only indirectly by way of a fixed disposal charge on an annual property tax assessment."(23) Even where user fees are charged, frequently rates are unrelated to the amount of garbage actually collected at each household.

A 1990 survey of 246 cities with populations ranging from 5,000 to 1.75 million showed that 39 percent of the cities did not charge any user fees for garbage collection.(24) Of those that did have fees, about half charged flat rates regardless of garbage volume or weight collected. Thus, over two-thirds of the cities surveyed had no pricing mechanism by which to convey to individual households the marginal costs of each unit of garbage they produced.

Garbage rates have also typically been unrelated to actual cost of service. In a seminal study of municipal refuse collection, E.S. Savas found that "public officials themselves are also ignorant of the true cost of a particular municipal program."(25) In a 1971 study of refuse collection in New York City, Savas found "that the full cost [of service] was 48 percent greater than the cost indicated in the city's budget."(26)

In subsequent studies of other cities Savas confirmed this finding that municipal budgets understated service cost by an average of 22 percent.

Among the reasons for this understatement of costs were the failure of some cities to include in refuse budgets such items as: 1) the capital costs of refuse-collection vehicles; 2) cost of interest on bonds; 3) cost of fuel, oil, tires, and other vehicle supplies; 4) labor costs for vehicle maintenance; 5) cost of employee fringe benefits; 6) building costs; and 7) liability cost. In 1977 Savas conducted a nationwide study that also examined actual and budgeted costs of refuse collection. He found that "for the average city in the sample, the actual cost exceeded the budgeted cost by 30 percent," with the differential actually varying widely among cities."(27)

This failure to charge fully for garbage collection and disposal costs gives consumers little incentive to recycle their refuse or to take into account refuse disposal costs in their purchasing decisions, which in turn gives manufacturers little incentive to develop products that are readily recyclable or less expensive to dispose of. Menell summarizes this problem noting that, "because disposal is free, consumers favor products with *more* packaging so as to reduce the risk of breakage (e.g., more insulation) or increase convenience (e.g., smaller size units). While reducing breakage and increasing convenience are worthwhile product design objectives, so is reducing disposal cost. But the traditional incentive structure ignores the costs of disposal."(28)

III. Rethinking Solid Waste Management Policy

Most solid waste management policies fall into three main categories: 1) regulatory policies regarding collection service or waste generation, including recycling mandates, product bans or special fees and taxes, and preferential procurement mandates; 2) full-cost and direct-pricing policies, including variable can rates (per can or per weight charges), full-cost landfill pricing policies, and resource subsidy reductions; and 3) environmental and safety policies, including primarily landfill and incineration standards.

Regulatory policies regarding collection service and waste generation generally assume that the garbage "crisis" results from the wasteful habits of American consumers and that landfills and incineration offer relatively undesirable disposal options. The full-cost pricing approach, in contrast, assumes that wasteful behavior results from underpricing of garbage collection and disposal. This approach underscores the importance of price signals, coupled with environmental standards, as a means of reflecting the values, including environmental values, and relative scarcity of different resources.

Recent discussion of solid waste policy has focused attention on how to integrate the four basic trash reduction and disposal options--burning, burying, recycling, or reducing amounts of garbage produced--into a comprehensive plan. For example, the

National Solid Waste Management Association has called for an integrated waste management approach that combines source reduction, recycling, incineration in waste-to-energy plants, and landfilling. By contrast, some policy analysts and legislators have pushed for "front-end" management, which focuses primarily on waste reduction and recycling and opposes or minimizes the role of landfills and waste-to-energy incineration.

Increasingly, solid waste management legislation is moving away from an integrated approach and instead establishing a regulatory hierarchy of the four options that favors source reduction and recycling. Thus, a number of municipalities and states have set mandatory recycling goals. And at the federal level, several legislators have proposed bills that would set specific recycling goals for the states.

The case for front-end management, which sets forth a single hierarchy of options for all circumstances, rests on a number of assumptions. First, the front-end management perspective implicitly endorses the notion that American consumers are particularly wasteful, an assumption that has already been challenged.

Second, proponents of front-end management assume that landfills and waste-to-energy plants pose significant environmental problems that cannot be adequately mitigated, such that these should be disposal options of last resort. Third, arguments for front-end management often assume that source reduction and recycling are sufficient to handle our solid waste disposal needs with little reliance on landfilling or incineration, and should be pursued regardless of costs relative to other disposal options. Finally, this perspective generally assumes that continued use of landfilling and incineration diminishes incentives to recycle or undertake source reduction.

The latter three assumptions merit further scrutiny. Consider first the safety of landfills and incinerators.

Landfill and Incinerator Safety. Until the 1980s, "open dumping" was fairly common, and landfills used few pollution controls. These older landfills did create hazardous conditions, including methane explosions, releases of pollutants into groundwater, and unsanitary surface conditions. Understandably, public perceptions of landfills have been in part shaped by concern over the problems that these older landfills posed.

Yet new landfills increasingly incorporate a variety of design and operational controls to: 1) prevent leachate from entering groundwater or surface water supplies; 2) control air emissions on the site; 3) control other problems such as odors and noise; and 4) ensure post-closure monitoring. In addition, removing some items from the waste stream entering landfills can reduce potential hazards. These measures can ensure safe and environmentally sound landfills, provided that landfill sites are monitored during operation and for a number of years (possibly several decades)

after closure. The OTA notes, for example, that "a well-designed, constructed, and operated landfill might exhibit high rates of leachate and gas generation because it usually would be designed to decompose degradable MSW. However, such a landfill also should be designed to be highly efficient in collecting that leachate and gas. A landfill that exhibits these features and is sited properly thus should not be a major source of contamination of groundwater, surface water, or the air."(29)

Like landfills, incineration can pose environmental and health hazards. But hazards from incinerator air emissions and ash residues, according to a 1989 report of the U.S. Conference of Mayors, can be alleviated through use of state-of-the-art construction, operation, and control technologies and practices. The report concludes, "the technology exists to carry out, monitor, and control the processes of incineration of municipal solid waste (inclusive of ash residue management) in such a way as to confidently ensure that potentially harmful constituents are not expected to pose risks to humans and/or the environment which would normally be of regulatory concern."(30)

Though incineration plants do generate some air emissions, it is possible to control emissions of criteria pollutants and trace gases, reducing them to nonhazardous levels. For example, use of dry scrubbers, electrostatic precipitators, and fabric filters can eliminate 95 percent of particulates and trace gases from air emissions. The EPA has advanced new, stricter regulations regarding incinerator emissions that should increasingly minimize the health or environmental threats from any emissions.

Dioxins and furans, considered carcinogens, can also be eliminated from air emissions by combusting municipal solid waste at high temperatures that destroy these compounds, breaking them up into less harmful components.(31) A World Health Organization report concluded that the natural "background" presence of dioxins and furans in the atmosphere exceeded the concentrations in the emissions from incinerators.(32)

The potential hazards of incinerator ash depend partly on its composition and partly on how it is actually handled and disposed of. The U.S. Conference of Mayors' report on resource recovery concludes that "ash residue can be presently managed in a manner which is safe from the point of view of the protection of human health and/or the environment."(33) The report also notes that safe alternatives to ash disposal are being used. Ash is used for secondary road construction. Or it can be treated through methods that extract metals from the residue or stabilize the ash. Vitrification, which turns the ash into nonhazardous glass, has been utilized in Europe, though it is currently not cost-effective in the United States relative to other disposal options.

In short, disposal of incinerator ash does not pose sufficient problems to warrant eliminating incineration as a satisfactory disposal alternative in some instances. Other factors, especially cost (including high costs associated with meeting stringent

regulatory standards), may limit the practicality of incineration in some communities, but opponents of incineration have focused primarily on environmental not cost concerns. It's also important to underscore that waste-to-energy facilities actually make use of waste--that is, such facilities capture the fuel value of waste. Fuel derived from waste can replace other energy sources, including primarily fossil fuels.

Recycling: Prospects and Problems. The third assumption of some front-end management proponents is that recycling and source reduction can accommodate most of our waste disposal needs. Yet how much waste minimization can we realistically expect from recycling and source reduction? And to what extent are such efforts cost-effective?

Estimates of the amount of the solid waste stream that could be diverted through recycling vary from less than 25 percent to as much as 80 or 90 percent. However, the lower range of 25 to 35 percent is likely to be most realistic. The median estimate of a group of U.S. governors was that 34 percent of the municipal solid waste stream could be eliminated through recycling.(34) And a 1990 Franklin Associates report suggests that "based on current trends and information, EPA projects that 20 to 28 percent of MSW will be recovered annually by 1995. Exceeding this projected range will require fundamental changes in government programs, technology, and corporate and consumer behavior."(35) Harvey Alter suggests the rate may even be much lower--near 16 percent, if experience regarding participation rates, even in areas with aggressive programs, is considered) Moreover, economic and environmental costs required for such changes would likely be higher than costs for more reliance on landfilling and incineration.

Expectations regarding recycling rates must take into account not only the theoretical potential of certain materials to be recycled, but also, as Harvey Alter notes, participation rates, practical limitations on collection systems, and yields of materials that actually meet buyer specifications.

Reports of high recycling rates (for example, over 30 percent) in some areas should be viewed with caution, primarily because of use of nonstandard methodologies for measuring recycling. For example, cities in New Jersey have reported recycling rates of over 50 percent. However, this includes recycling of automobile scrap and ferrous and nonferrous scrap. Both of these sources of recycled materials are not typically considered part of the municipal waste stream and have been recycled for decades. Recycling rates of components typically part of the municipal waste stream in New Jersey are more like 14 to 18 percent.

In other instances, reported wastes may be based on a particular community with single-family residences. There, recycling rates may approach 40 percent, but for an entire city, with significant amounts of waste from commercial and multi-family

dwellings, the overall rates could be substantially lower, netting out citywide to rates more like 15 to 20 percent.

Participation rates can be equally problematic. Noting participation rates of 80 or 90 percent may mean that many households at least once in a particular survey period might have placed some recyclables out for collection. Participation can vary not only by frequency but also according to numbers of different materials set out and amounts of materials set out.

Undoubtedly, from a technical standpoint, a number of materials--glass, plastics, paper, aluminum, ferrous metals, and yard waste--can be recycled. And some of this recycling makes unequivocal economic and environmental sense. However, mandating recycling rates or requiring specific recyclable content in products may sometimes actually result in resource waste and inefficiencies.

Aluminum. In 1972, Americans recycled some 1.2 billion aluminum cans. By 1987, 36.6 billion cans were being recycled, representing over 50 percent of all aluminum cans used. Aluminum recycling has been successful in large part because it makes economic sense. Thus, for example, a 1988 report on a California conference on recycling points out that "aluminum recycling exists today as a viable industry not because the aluminum industry is interested in saving landfill space, but because it has had a variety of economic motivations to recycle aluminum--namely, that the energy required to produce aluminum from used beverage containers (UBC) is only 5 percent of the energy required to produce aluminum from bauxite ore."(36) Indeed, the Aluminum Association reported in 1987 that the United States saved some 10 billion kilowatt hours of electricity--enough for New York City's residential needs for six months--by using recycled cans.

This cost-effectiveness of aluminum recycling has meant that in many instances industry demand for recyclables has actually outstripped supplies. In this context, industry is likely to be able to absorb additional supplies that result from expanded residential recycling programs.

Iron and Steel. Virtually all steel products can be remelted and refashioned into new products. In fact, more steel is currently recycled than any other material. The Steel Can Recycling Institute noted that by 1987 51 million tons of steel were recycled annually, which is double the total combined amount of all other materials recycled. And nationwide by 1988 a total of 80 million tons of ferrous metals (steel and iron combined) were processed annually, much of which was exported.

However, recent environmental regulations had a somewhat dampening effect on recycling of ferrous metals, especially in California where the laws are more stringent than federal laws. In particular, laws regarding the disposal of toxic substances made recycling of scrap metal from automobiles difficult. A 1988 report on recycling in

California, describing comments by Harry Faversham, President of National Metal and Steel Corporation, notes "only when certain industries closed their doors temporarily, unable to meet the toxics disposal criteria, and old cars backed up, did government agencies form task forces to address the problem."(37)

More recently, California automobile shredders have been able to stabilize toxic substance residues and meet the disposal standards.

Mandatory recycling legislation likewise may have a perverse effect on ferrous materials recycling. Such programs target residential ferrous materials like steel cans and other small items. Steel producers may purchase this new source of recycled steel, but, as one 1988 report notes, "they will do so at the expense of purchasing the existing ferrous stream. This means that not only would the existing private collection and processing infrastructure be severely damaged, but no real volume increases in recycling would be accomplished."(38)

Glass. Recycled glass, or cullet, has notable advantages over using virgin materials in some circumstances. Because it melts at lower temperature than is required to make glass from scratch, use of recycled glass conserves both energy and reduces particulate and other air emissions. Between 1976 and 1986, recycled glass collection increased over fourfold, with some 1.25 million tons (or 5 billion containers) recycled each year. Recycled glass is used in both new glass containers as well as in fiberglass manufacturing. The Glass Packaging Institute claims that most glass containers currently manufactured contain at least 25 percent recycled glass.

Use of cullet requires removing contaminants--for example, food residues and other nonglass matter--from the recycled glass. Because of difficulties in removing such contaminants from ceramics, ceramics cannot be effectively recycled and must be se[arated from other recyclable glass.

It is not certain that recent regulatory mandates, including, for example, California's AB 2020--which initially in effect set minimum prices for glass containers--have improved glass recycling prospects. In a 1988 conference on recycling markets in California, glass industry representatives noted that AB 2020 created an artificial scrap value of $84 per ton on glass. The conference synopsis reported that this pushed "cullet prices higher than they normally would be, and, according to [California Glass Recycling Corp. president Lee Weigant], three times higher than the cost Mexican manufacturers pay for their cullet. At the current official redemption value of one cent per container, industry has been able to maintain profitability; however, they caution that if the rate jumps to two or even three cents per container, the price of cullet will become so high that Mexican manufacturers will have an increased advantage."(39) A 1990 *Los Angeles Times* article made a similar point, noting that the 1990 price manufacturers paid for recycled glass, at $94 per ton, was "much higher than the $60 a ton they would pay for the equivalent raw

material."(40) While the California law changed in 1991, this example illustrates a potential problem of manipulating recycling through bottle deposits or processing fees.

Plastics. Plastics comprise about 8 percent of the municipal solid waste stream by weight. And plastic packaging makes up about 5.5 percent of the waste stream. Until the late 1980s, this packaging had been largely neglected in local residential and commercial recycling efforts. Indeed, the absence of plastics recycling even prompted laws against some plastics products. Yet the perception that plastics are not recyclable is erroneous and based more on some constraints on collecting and separating plastics than with inherent difficulties in actually reusing some plastics. Indeed, some 312 communities had begun recycling plastics by 1990, according to the Council for Solid Waste Solutions.

Still, some problems in recycling plastics persist. For example, plastic resins generally need to be separated into discrete types in order to obtain the highest value and allow for reuse in applications similar to their initial use, though some systems for recycling mixed plastics exist. Secondly, consumers have had some difficulty identifying which plastics are readily recyclable and which are not, with the result that plastics collection often fails to capture a large portion of recyclable plastics. Or plastics collections include a large portion of contaminants, including plastic resins not wanted in a particular recycling program, among the materials collected. The special coding of plastics now being required in many states allows consumers to identify the resins desired in particular recycling programs and simplifies further processing and upgrading of the recycled plastics into new products.

Recent voluntary coding of resins by manufacturers should also facilitate future recycling. In addition, the Center for Plastics Recycling Research at Rutgers University reports that some manufacturers are experimenting with commingled collection and processing of plastics into dense plastic material that can be used to manufacture fence posts, benches, and other heavy plastic products.

Despite these collection and separation difficulties, some plastics are actually highly recyclable from a technological standpoint. In fact, a number of manufacturers have for decades been recycling plastic waste generated during the manufacturing process. Such recycling faces fewer problems than recycling post-consumer plastics, since the waste is generally uniform in composition, and the waste is already assembled in the manufacturing plant, eliminating collection and transfer costs.

More recently, recycling of post-consumer plastics has also increased, with three types of plastics being targeted. First, some 28 percent of all polyethylene terephthalate (PET) soft drink containers was being recycled by early 1991. Current federal law requires prior FDA approval of any material that comes into contact with food. Because of concerns about meeting stringent specifications for food contact, recycled

PET has not been used in food packaging, but it is now used in fiberfill for sleeping bags, ski jackets, and so on.

Both Coca Cola and Pepsi announced in 1991 that they would recycle soft drink bottles into new soft drink bottles. However, the process involves depolymerization and repolymerizing, so the FDA gave an opinion that the material could be used and argued that it is not in effect recycled material. PET is also converted into polyols, chemicals from which is produced urethane foam for refrigerator insulation, furniture, and automobile bumpers.

In 1989, *Waste Age* magazine reported that PET "is the plastic bottle market's fastest growing item, representing about 25 percent of the market."(41) The recycling market for PET is strong, with demand outstripping supply in many instances. In 1989, baled, recycled PET commonly sold for as high as $180 to $220 per ton in some areas. Green PET sold for as high as $140 per ton in 1989. Moreover, the price for baled, clear PET remained relatively stable in the '80s, and demand in the export market increased 500 percent between 1987 and 1988 alone.

High-density polyethylene (HDPE), the plastic used for water, milk, and other containers and the base cups of PET bottles, is also now being recycled, primarily into new base cups, trash cans, traffic cones, plastic lumber, and so on. Like PET, federal regulations require approval of the use of recycled HDPE in food containers. However, the FDA is reevaluating its regulations with regard to use of recycled materials in food contact applications.

Polystyrene packaging and containers, which comprises not more than .25 percent of all municipal solid waste, has been the focus of particular attention from opponents of plastic packaging who have argued that such packaging is particularly wasteful and not recyclable. Yet small amounts of such plastics are now being recycled and several demonstration recycling projects are now underway.

A major polystyrene recycling facility was opened by the National Polystyrene Recycling Company in September 1990 in Southern California. The firm, formed by eight U.S. polystyrene resin manufacturers, has the capacity to recycle 13 million pounds of the resin per year, representing over 6 percent of the 206 million pounds of polystyrene used in Southern California annually. While this represents a modest start, the industry has set forth a goal of recycling 250 million pounds per year of polystyrene by 1995. This figure represents 25 percent of the polystyrene used in foodservice and packaging applications in the United States. To meet this goal, 20 plants the size of the California facility will be required; four will be operational by mid-year 1991.

Since recycled polystyrene currently sells for 20 percent less, in some instances, than the virgin resins, the recycled material can be cost-effectively used by industry. The

two key current constraints on polystyrene recycling are collection costs and problems associated with removing all contaminants from the collected materials.

In light of the surge in plastics recycling several communities, including Suffolk County, New York, and the Twin Cities in Minnesota, are reconsidering the plastics bans they have imposed.

Tires. Tires have posed persistent problems for landfill operators because they are difficult to shred or compress. Thus, a number of states have banned placing tires in landfills, which has resulted in a stockpiling of over 1 billion tires in the United States, and annually some 240 million tires are scrapped. Yet stockpiling tires also poses significant problems, because they accumulate water, serve as a bacterial and insect breeding ground, and are flammable.

To avoid stockpiling and landfilling, a number of options for tire disposal or recycling are now being used. These include retreading, incineration (using tire-derived fuel), reclaiming of tire rubber, grinding and shredding, creation of tire "reefs", and shredding tires into crumb for use in other products.

Over 10 million tires annually are reclaimed and reformulated into sheet rubber, which is then turned into molded rubber products. Retreading of 20 million truck tires and 17 million passenger tires takes place annually, saving 30 percent on the energy requirements needed to produce new tires. Incineration, whether in a mass burn or refuse-derived fuel facility, is also increasingly used for tire disposal, particularly since tires provide a high-energy source of fuel. Indeed, some burn facilities operate solely on fuel from shredded tires. However, this option is unlikely to offer an attractive disposal option in most instances, since scrap tire fuel is not cost competitive with other fuels and only becomes competitive when oil, for example, trades at $60 per barrel.

New technology has improved the process for shredding rubber, facilitating separation of the rubber from metal fibers in tires. Shredded rubber from tires is now added to concrete to produce a resilient asphalt that reduces crack formation and pavement deterioration. Though more expensive than traditional asphalt, its use is cost-effective because it outlasts traditional asphalt. Using a patented process called "tirecycle," scrap tires have also been used to form a rubber compound that in turn can be processed into a variety of rubber products at cost competitive rates, according to the manufacturer.

Oil. Some 57 percent of used oil, reprocessed by removing water and particulates, is reused for fuel. Another 26 percent is reprocessed, converted into base oil stock, and combined with additives to produce lubrication oil. Another 17 percent of used oil is placed on roads for dust control, or used as a wood preservative. Despite the high

potential for recycling oil, some states--for example, California--have required that used oil be treated as a hazardous waste, thus inhibiting the recycling of oil.

Paper. Some 21 million tons of recycled waste paper were consumed in 1989, with estimates that consumption will rise to 25 million tons by 1992, according to the American Paper Institute. Put another way, about 25 percent of paper now used comes from recycled waste paper. Between 1970 and 1988, collection of paper for recycling grew from 12.5 million tons to 26 million tons, with over 2,000 dealers brokering waste paper and 200 U.S. paper mills now processing waste paper.

Recycled paper falls into four main categories: old newspapers (ONP), old corrugated containers (OCC), mixed office waste, and high-grade waste paper generated mainly in paper plants and by publishing companies. Of these, all but ONP are actually in short supply. By 1986, 30 percent of all newsprint and 42 percent of OCC were being recycled.

Despite the ease with which most paper can be recycled, several problems currently constrain recycling efforts. First, supply in some areas outstrips demand, or capacity to reprocess recycled paper into new products. The result has been plummeting prices, particularly for recycled newsprint. In some areas such as Wisconsin, Minnesota, and some East Coast cities, newsprint collected in recycling program has ended up in landfills, with no buyer available. Or municipalities have ended up paying brokers to accept the paper rather than receiving any payment for it. For example, on the East Coast, some cities were paying over $20 per ton to dealers to accept ONP.

This supply/demand imbalance may change, especially as state and local legislators respond to the EPA's guidelines proposing that governments implement recycled product procurement programs, though even these procurement programs may not increase the demand for ONP. The guidelines propose a 50-percent minimum waste paper content for standard writing paper, with exceptions allowed for computer paper, high-speed copy paper, and carbonless forms, all of which have exacting technical requirements to ensure adequate performance. These requirements have deterred many paper mills from using recycled paper to produce high-performance papers. As a result, the EPA has "declined to recommend a minimum recovered material content for high-speed copier paper because it found insufficient production of this paper with recycled content to assure adequate competition."(42)

Second, though the public generally perceives recycling to be an environmentally sound undertaking, the process for deinking recycled paper can involve the use of toxics, which requires monitoring and careful management. In addition, the effects on forest preservation are ambiguous. For example, proponents of paper recycling argue that recycling a ton of newsprint will save 17 trees. While that may be accurate, the trees saved are not virgin forests, but trees planted explicitly for the purpose of

manufacturing paper--that is, the trees saved are commercially grown trees. An analogy is the assertion that outlawing Christmas trees would save trees. Yet the bulk of Christmas trees now purchased were grown explicitly for that purpose and would not otherwise exist. The net effect of widespread paper recycling, according to a study by A. Clark Wiseman, would actually be a decline in tree planting and tree coverage as lands now devoted to tree-growing for paper production would be converted into other uses.

Third, the quality of recyled paper has generated some complaints, especially from the printing industry. Judy Usherson, implementation coordinator for the EPA Procurement Guidelines Program, noted in the July 1989 *Waste Age* magazine that "user complaints have ranged from jamming and curling to more frequent press cleanings and lower productivity (i.e., slower press runs)."(43) She goes on to note, however, that these complaints may actually be no greater for recycled paper than for virgin paper. Notwithstanding these complaints, she claims that recycled paper can be used successfully in high-quality, four-color printing jobs.

Recycling: Cost Constraints. Until the recent wave of policies mandating recycling, most recycling was driven by cost considerations. Yet costs are often dismissed by proponents of increased recycling and source reduction as less important than achieving environmental goals, including changing consumption patterns in a world of limited resources. This perspective overlooks the role that prices play in conveying information about the relative scarcities of different resources, including labor, time, natural resources, and environmental values.

Thus, mandated recycling in some circumstances would make sense if conserving landfill space were the only policy goal. But such efforts may consume more overall resources (environmental and commercial) than if waste were simply landfilled. Or, in some instances, recycling may make sense for manufacturers, both in internal production processes and in purchasing recyclables for reformulation into products when such efforts are cost-effective. These economies have stimulated demand for recycled materials such as aluminum, which in turn has prompted a number of entrepreneurs and communities to collect some recyclables in order to receive revenues from their sale to dealers and manufacturers.

That collection of recyclables can be profitable and use of some recycled materials can be cost-effective does not mean that recycling, combined with source reduction, can eliminate most of our solid waste disposal needs. Nor does it mean all curbside or residential household recycling programs make economic and environmental sense. Harvey Alter also notes that "forcing recycling of materials from MSW may merely displace other materials that are now recycled"--for example, scrap produced in manufacturing processes.(44) In other words, if legislators require products to contain a certain amount of postconsumer waste to meet recycling content goals,

manufacturers may simply replace recycled industrial waste already used in product content with recycled postconsumer waste.

Collecting and brokering specific recyclables primarily from drop-off centers may be less costly than citywide curbside recycling services. Or collecting solid waste and then separating out the recyclables may prove more cost-effective than curbside programs if problems of contamination can be overcome. Curbside programs may, depending on local conditions, impose high costs for a variety of reasons. For example, such programs may require separate sets of collection vehicles--one for recyclables and one for other waste--and a net increase in collection trips. A survey of Rhode Island communities, for example, found that curbside recycling collection costs ranged from $49 to $162 per ton. Processing can cost an additional $30 to $60 per ton, net of revenues from sale of recycled materials, often bringing total recycling costs to over $180 per ton. By contrast, collection and disposal of waste typically costs around $120 to $150 per ton. Other program surveys show even higher costs for curbside programs.

For example, a report on recycling programs in Chicago showed costs in some wards running from $625 per ton to over $1,100 per ton of materials collected. The value of materials collected averaged $110 per ton, and avoided tipping fees came to around $38 per ton.

Economist Mark Berkman, assessing the costs of meeting a 40 percent recycling goal nationwide, would increase overall waste management costs by nearly 24 percent on the West Coast and by a more modest 5 percent on the East Coast. He suggests that optimal disposal methods based on economic considerations would yield recycling rates of some 8 percent on the East Coast and only 4 percent on the West Coast.(45)

Matthew Goldman noted in a February 1991 article in *Waste Age* magazine that avoided costs from recycling are often miscalculated by use of improper methodology. He notes:

> *System costs should be calculated on a total annual budget basis. Thus, to calculate the true costs of implementing a recycling program, the total annual costs of the solid waste management system should be calculated without recycling, and then with recycling, incorporating any and all effects recycling may have on other costs. These two annual costs can then be compared to determine the true incremental costs or savings associated with recycling. Even with a lot of assumptions, this approach provides a much more accurate picture than assembling system costs using dollars per ton costs for each component.*(46)

Even taking into account those costs avoided by reducing the amount of garbage disposed of in landfills, recycling programs often fail to save money for municipalities. As a result, cities are actually consuming more of other scarce resources in their

recycling programs--including, for example, fuel (and hence creating more air pollution)--than in the absence of recycling. Even where there may be some environmental gains from such programs, these may be offset by other costs. If recycling increases a community's overall solid waste costs, that will mean fewer funds available for other programs such as education.

Economist Charles Van Eaton examined a scenario in which landfill tipping fees were $35 per ton and explored potential cost savings from recycling, using available data on recycling program costs and potential revenues from sale of recycled materials. He finds that savings might occur after the tenth year.(47) However, he claims that even these savings may not materialize if landfill tipping fees decline (as less waste is landfilled) or if materials markets weaken as curbside programs generate more and more supplies of such materials. Van Eaton notes that already, in New York City, tipping fees on at least one landfill did decline in 1990 by 37.5 percent as a result of reduced tonnage being sent there.(48)

Yet high-profile waste disposal problems in some parts of the country have generated numerous mandatory recycling programs, despite local conditions that make mandatory recycling a costly option. Thus, between 1988 and 1989, the number of local curbside recycling programs increased by 46 percent from 1,042 to 1,518.

Reductions in collection costs and high recovery rates for clean recyclables might be possible in curbside programs through modifications in collection methods. For example, if consumers put their garbage in plastic bags and their recyclables in separate open containers, waste collectors might use one vehicle, be able to protect recyclables from contamination, and quickly inspect recyclables in order to reject unwanted items at a processing facility. Various local experiments are already underway along these lines, but cost and quality results are not yet available.

The key policy questions are how to promote cost-effective recycling and how to ensure that program innovations can take place. Full-cost pricing of collection and disposal services, and privatization (or corporatization) of service, in combination with variable can rates (or other full-cost user fees), are most likely to achieve these ends.

Several studies looking at privatization of collection, disposal, and recycling services have shown that competitive contracting can achieve significant savings--as high as 30 percent. Much of these savings have been achieved through innovation and increases in productivity as private service providers have sought ways of cutting costs to remain competitive.

BioCycle magazine, reporting in July 1990 on a survey of curbside recycling programs in 22 cities, found that the 13 programs using private contractors had greater efficiency than the 9 publicly operated programs. For example, the private operators

made an average of 528 stops per day, while the public crews made 415 stops per day. In addition, the private contractors typically used smaller crews—often using only single-person crews compared to public-sector crews of two or three persons.

Some publicly operated curbside programs may make it difficult for the private sector to implement large-scale recycling programs, because curbside programs essentially divide up the waste stream, making it no longer cost-effective for waste haulers to separate out recyclables. DuPont and Waste Management, Inc., for example, have been developing pilot projects around the nation in which consumers separate PET (soda bottle) and HDPE (primarily milk jug) plastic containers and put them with other recyclables. Waste Management, Inc. then collects these materials and diverts them to Dupont to be recycled. In states with publicly operated curbside programs or "bottle bills," such projects become less feasible because such programs divert higher-value recyclables, leaving little revenue available from the sale of items collected at the curbside to offset program costs.

Federally mandated recycling goals that would require 25 percent (or greater) decreases in solid waste through recycling and source reduction ignore the enormous variation in solid waste collection, recycling, and disposal costs not only among different states but among urban and rural areas within a given state. If recycling is deemed important for symbolic or other reasons, consumers of recycling services should pay for those programs to the extent that they result in increased solid waste management costs. Otherwise, local governments will find themselves saddled with high-cost solid waste management programs and no revenues to fund them.

Indeed, the high costs of recycling programs are now prompting a variety of legislative efforts to fund such programs. Typically, these efforts are focusing on some form of manufacturing fee. However, such fees are likely to be both costly to administer and inefficient. Instead, recycling program payment should be incorporated into solid waste service user fees (or recycling program costs can be included in benefits offered by landfill (or waste-to-energy) facility operators to hosting communities).

Given the above discussion, it is difficult to conclude that front-end management uniformly makes good policy sense. However, one final concern raised by advocates of front-end management deserves further scrutiny. Do landfilling and incineration actually inhibit recycling, even when it makes economic sense?

In the absence of mandates, recycling is likely to be lower than the 25 to 50 percent goals set forth most often by proponents of front-end management in areas where landfilling costs less than $40 to $50 per ton. This is, however, not a negative outcome but rather reflects the importance of efficiently using all resources, not just those consumed by landfilling systems. The key question is whether landfilling limits recycling of products such as aluminum, for which recycling makes economic sense

and represents a net conservation of resources, though it may have little effect on disposal capacity.

One factor suggests that even when landfilling is inexpensive, recycling efforts may continue to expand. Even without widespread recycling mandates prior to the late '80s, 11 percent of the U.S. municipal waste stream was recycled. And for high-value recyclables the rate was much higher, with half of all aluminum cans, for example, being recycled by 1987.

Some of this activity is the result of state bottle bills. For example, in California after implementation of its "bottle bill," the recovery rate for aluminum cans rose from 55 percent to 58 percent and may now be as high as 70 percent, with further rises anticipated if the scrap value of aluminum increases. Though bottle bills may have stimulated some recycling (at very high cost), much recycling occurred as entrepreneurs sought out economic opportunities by collecting aluminum cans that generated revenues of over $900 per ton of materials. Even without recycling mandates, in California recycling rates for newspaper exceeded 55 percent and were nearly 70 percent for corrugated paper.

In contrast to landfilling, incineration already costs nearly as much as recycling, with tipping fees often ranging from $40 to $90 per ton. As a result, recycling at least some solid waste prior to incineration could generate cost savings. A March 1990 *Waste Age* magazine article concludes that recycling prior to incineration can be cost-effective: "the economic advantage of the integrated approach, in disposal costs only, ranges from a high of $11 per ton to $0 per ton." In addition, the Community Environmental Council reports that the State of Rhode Island determined that recycling in conjunction with incineration "yielded a net economic benefit of $1.3 million per year to the state economy as a whole, including a $500,000 annual benefit to the incinerator operation. The incinerator savings resulted from an increase in the heating value due to removal of cans and glass and was realized even though the incinerator lost $11 for each ton of newspaper that was recycled."(49) This raises the question of trade-offs involved with recycling paper or using it as a fuel. Both options may have value--the question is which use has the highest value and when. Current mandates to recycle paper assume that the highest value always lies in reuse, which may not, in fact, be the case.

As the above discussion suggests, emphasizing recycling and source reduction as absolute goals in a hierarchy ahead of other disposal options is not warranted for several reasons:

- First, the U.S. solid waste problem is not primarily the result of "excessive" waste production.
- Second, landfilling and incineration do not pose insurmountable health and environmental problems.

- Third, recycling and source reduction are not likely to absorb more than 30 percent of solid wastes produced in the near term for most communities--higher figures are possible, but at substantially higher economic and environmental cost.
- Fourth, landfilling and incineration do not necessarily inhibit, and may even require, recycling in order to achieve maximum efficiencies and resource conservation in solid waste disposal systems.

If the front-end management regulatory approaches are not appropriate, what alternative policy approaches should the federal, state, and local governments be taking with respect to solid waste management?

IV. Future Policy: Regulations or Market-Pricing?

Many federal, state, and local policies that emerged in the '80s have taken a regulatory approach to solid waste management, including: 1) mandated recycling levels; 2) mandatory recycling participation; 3) product bans; 4) deposit refund legislation; 5) landfill disposal restrictions; 6) trash hauling restrictions; 7) recycling product subsidies or mandates; and so on. Peter Menell has succinctly summarized the problems with such approaches: "Although these policies respond to some symptoms of the solid waste 'crisis,' they fail to systematically remedy the distorted incentives that underlie consumer and manufacturer behavior."(50)

A preferable approach would be to utilize market-oriented policy tools as key elements in solid waste management policy. At the very least, *this approach would require that all costs, including costs of mitigating environmental impacts, be included as a basis for determining the pricing of solid waste collection and disposal service.* The appropriate set of policies would include:

1) Introduction of variable (weight- or volume-based) can rates when feasible;
2) Development of standard cost-accounting methodologies for solid waste systems so that full costs can be accurately determined. Encouragement of privatization or corporatization of solid waste systems may be a key way to achieve potential cost savings and ensure full-cost accounting;
3) Elimination of product restrictions for reasons not related to health and safety. The marketplace, provided that full disposal and other environmental costs are incorporated into pricing systems, will conserve scarce resources.
4) Implementation of host-benefit fees paid to communities in exchange for their agreement to site solid-waste facilities;
5) Implementation of environmental performance standards to ensure the providers of solid waste services mitigate against environmental impacts.

1) Variable can rates

Pricing schemes should ensure that consumers pay based on the amount of waste they actually generate. Such schemes could include either: 1) front-end disposal fees on all products; or 2) per can or per volume disposal charges at the point of collection. Both approaches theoretically would give consumers information about solid waste disposal costs associated with their purchases. Consumers would continue to have multiple purchasing and disposal options. However, by paying the full disposal costs, individuals would have an incentive to alter their buying habits, recycle, compost, and buy items in less bulky packaging.

While the front-end fee approach is theoretically sound, it is likely to be highly impractical, since disposal costs of different products vary from area to area depending upon landfill availability, housing density, distance from disposal sites, and a number of other variables. Consequently, front-end fees would have to be highly localized. The information gathering and analysis necessary to establish the fees would be extremely expensive and cumbersome. Several analyses of a California study on advance disposal fees highlight the potential product pricing distortions that would result from making simplified assumptions about product disposal costs.

Regarding advance disposal fees, University of Cincinnati economist Haynes Goddard notes that "downstream interventions [charges at the point of disposal] are in general better suited to the solid waste management problem...Simple extrapolations of cost-effective incentive mechanisms from the air pollution field should not be facilely extended to the solid waste problem, as there exist several distinctions between these waste types that suggest that public policy should treat them differently."(51)

In particular, air pollution and "garbage" both represent wastes, but in general solid waste can be contained at a landfill (or incineration facility) for which property rights can readily be established. This means that environmental control costs are transmitted directly to waste facility operators, who in turn can pass these costs on to waste generators. As Goddard notes, "this means that the scarce 'assimilative' capacity of the environment is allocated within the price mechanism,"--or, more accurately, these costs can be allocated if local governments (or private-sector contractors) actually charge fully for waste collection and disposal.

In contrast to advance disposal fees, per-can or per-weight collection charges offer significant potential as a policy tool for overcoming the neglect of disposal costs in consumer purchasing decisions. Recent evidence from selected cities suggests that voluntary recycling programs associated with per can (or per weight) rates, generate high levels of participation in recycling, suggesting that such pricing does in fact influence consumer consumption habits.

Variable can rates have thus far been implemented primarily to stimulate recycling, either as a response to high landfill disposal costs or to statewide mandates that local

recycling programs be put into place. For example, under Seattle's volume-based system, curbside collection of recyclables is free, while the consumer pays by the can for regular trash. Though variable rates have primarily been used to foster recycling, variable can (or variable weight) rates could be implemented at local levels regardless of specific recycling goals so that customers pay for the amount of garbage they toss out.

Such rates give "garbage producers" price signals about the costs of disposing of their garbage. And there is considerable evidence that such charges do alter waste "consumption" habits, leading to more recycling, altered buying habits, composting, garbage compacting, and other consumer responses to reduce solid waste costs.

In Seattle, for example, which has a system of volume-based rates accompanied by a recycling program, over 85 percent of residents now participate in the recycling program, and the city recycles 18 to 35 percent, depending on which set of waste is included for base calculations.

Economist Lisa Skumatz, reviewing the Seattle program, concludes that "volume-based rates have proven to be an extremely effective recycling incentive. Since Seattle's introduction of variable can rates in 1981, Seattle's customers, eager to reduce their bi-monthly garbage bills, have reduced the average number of cans subscribed from 3.5 down to just over 1 can. And the recycling percentage in terms of actual tons of waste diverted... was over 24 percent *before the introduction of any City-sponsored recycling program.*"(52)

This effect has also been noted in Perkasie, Pennsylvania after it introduced per bag charges. The city experienced a 35 to 45 percent decline in tonnage brought to its transfer stations in the first year after the introduction of their bag system and recycling program.

At least one EPA study also has shown the price sensitivity of solid waste collection and disposal service. In its 1990 report, "Unit Pricing: Providing an Incentive to Reduce Waste," the EPA found that a 10 percent increase in the cost of getting rid of garbage resulted in a 1 to 2 percent reduction in household waste.

It is useful to put this into perspective. Robert Glebs has estimated that the total cost per ton for internalizing the environmental costs of landfills--that is, bringing them into conformity with modern regulatory requirements–is about $25 per ton (as compared with $5 per ton in 1975). How does this relate to household costs? According to a Resources for the Future report, "the landfill disposal cost of waste from a standard 32-gallon trash container, the contents which average around 21 pounds in weight, would rise from about 5 cents to 25 cents under this scenario....households on average pay a disposal fee equivalent to roughly $1 per container," which means incorporating full environmental protection costs alone into

current charges would increase them some 20 percent.(53) According to an EPA unit charge study, this would result in a 2 to 4 percent reduction in waste.

Lest this seem relatively small, it is important to note that the above figures include only the incorporation of environmental costs into disposal charges. But since most cities also do not currently charge the full direct costs of collection and disposal, actual increases to eliminate garbage subsidies are likely to be higher, with the result that more waste will be diverted from landfills.

2) Full-cost accounting and privatization or corporatization

At a minimum, all solid waste service rates should be based on full-cost accounting methods. This enables better cost comparisons between public and private service provision and may highlight the efficiencies of the latter, strengthening the case for privatization or corporatization of publicly owned and operated solid waste systems.

At least one state--Maine--has moved to prohibit private ownership of all new incinerators. Yet good public policy should move disposal operations in the opposite direction--that is, toward private landfill and incineration operations.

There are both efficiency and environmental reasons for doing so. Private operators, facing competition and liability, are more lily to utilize accounting practices that incorporate full facility costs, including replacement and environmental costs, into tipping fee calculations. Moreover, as Marion Chertow points out in a report published by the U.S. Conference of Mayors and the National Resource Recovery Association, potential cost savings from introducing a recycling program, for example, are "much simpler to calculate in the case where the city pays a per ton charge at a private landfill, since the whole per ton amount is saved each time a ton is diverted for recycling. In the case where the city or county owns the landfill, disposal costs may seem very low if the city is paying only labor and materials to operate it. Most of the costs are fixed, and there are few cost savings to work with to justify recycling economically."(54)

In addition, the environmental record of private operators is better than that of public operators. As Neil Hamilton and Robert Wasserstrom note in their study of solid waste disposal, "experience shows that private operators have been far more willing than their public-sector counterparts to install liners, leachate collection systems and groundwater monitoring equipments."(55) The OTA writes that "data from the mid-1980s show that privately owned MSW landfills were designed more frequently with leachate collection systems than were publicly owned landfills (62 percent v. 35 percent for county-owned and 35 percent for city-owned). Privately owned landfills are also more likely to conduct groundwater monitoring (30 percent v. about 15 percent for county- and city-owned), and surface water monitoring (31 percent v. 24 percent for county and 13 percent for city)."(56)

In the absence of privatization, corporatization offers a means to ensure that city- or county-operated solid waste programs use full-cost accounting principles. Corporatization means that local public solid waste services would be operated without subsidies and financed solely through user fees, including collection charges and tipping fees.

3) Elimination of product bans not based on health and safety factors

Many of the federal and state policies now proposed are misconceived and inappropriate. The American Legislative Exchange Council notes that "the level of federal micromanagement and ignorance of the widely disparate conditions and circumstances of solid waste management from state to state have lead officials from the National League of Cities, the National Association of Counties, the National Association of Towns & Townships, and the U.S. Conference of Mayors to seriously question whether any of these proposals [for product bans, packaging restrictions, recycling mandates, etc.] would contribute to alleviating the solid waste crisis facing many localities."(57)

Specifically, product bans, whether at the federal, state, or local levels are ill-advised. For the most part, such bans focus on products that make up only a minor part of the solid waste stream. Nor is it clear that alternatives to banned products such as plastic containers have significant, if any, environmental advantages over the products they would replace. Bans may increase costs to consumers without yielding real benefits for solid waste management. For similar reasons, subsidizing certain categories of recyclables or products with recyclable content is counterproductive, as is selective taxation of some products like disposable diapers or plastics.

In its review of product bans, the OTA noted that "two problems associated with these bans are that they do not consider whether the replacements will be improvements, and they rarely consider the economic implications to retail stores. For example, polystyrene is used in many single-use products. The costs of banning polystyrene foam cups include not only the costs of replacements, but also the labor and energy needed to wash or reuse cups, and the costs of washing equipment...."(58).

State- and local-level bans create significant costs and inefficiencies for industry, and hence, consumers. For example, one company, analyzing the effects of state-level packaging bans, noted that "state-specific laws would: 1) increase the number of stockkeeping units which, in turn would 2) increase inventories which, in turn would 3) increase the need for warehousing space, which in turn would 4) increase both working and fixed capital requirements. As stockkeeping units increased, production runs would shorten, downtime would increase, forecasting would be substantially complicated, and out-of-code problems for short-life products like yogurt and other dairy products, juices, and juice-drinks would increase, and waste would increase." Another industry report noted that state-by-state product requirements could result

in stockkeeping unit increases of 200 to 400 percent, depending on the number of different regulations.

The U.S. Supreme Court has upheld a 1981 Minnesota law prohibiting the retail of milk in plastic, nonreturnable, nonrefillable containers but permitted the sale of milk in other nonreturnable, nonrefillable containers. The Court relied on a "rational basis test" of the regulation to determine "whether the legislative classification between the plastic and non-plastic returnable milk containers is rationally related to the achievement of the statutory purpose."(59) William Kovacs, summarizing the Court's findings, noted that the "legislature had advanced three reasons for the ban: (1) elimination of an undesirable container and the promotion of a more environmentally desirable container, (2) the conservation of energy and renewable resources, and (3) the reduction of the state's solid waste problem. The Court found the ban on plastic containers was rationally related to these purposes and therefore did not violate the equal protection clause."(60)

Kovacs points out, however, that certain facts "may undercut the 'rational relationship' between the legislative classification of plastic and nonplastic products and the legislative goal. The nonplastic container may be no more recyclable than the plastic container....Second, comparing plastic to nonplastic products to determine which conserves more energy or is made from a renewable resource is a factual question whose answer is not clear....Finally, and most importantly, it is unclear whether banning a plastic product reduces the state's solid waste disposal problem."(61)

Kovacs's assessment suggests that future court tests could conceivably find unconstitutional state product or packaging bans. However, the arguments that Kovacs sets forth still put the government (or the courts) in the position of making determinations about the desirability of some products and packaging over others.

Product regulation regarding health and safety may be appropriate. And it may be appropriate for the government to set environmental standards, including standards that ensure the safe disposal of products. But to the degree that a specific product does not itself pose health and safety hazards when used properly, it should not be banned.

Consider tires. In their appropriate application–as tires on vehicles--they pose no environmental hazard. It is their disposal, or the difficulty of disposing of them, that can entail potentially high disposal costs relative to other materials. It would be inappropriate to ban tires because their disposal was problematic. Rather, appropriate action would be to ensure that they are properly disposed and that full disposal costs are paid by those who throw away tires. This same logic applies to other products and packaging.

Product bans, whether federal, state, or local, are not likely to produce significant reductions in solid waste or improve the environment, in part because of the environmental trade-offs involved in the manufacture and disposal of all products, and in part because such bans have typically targeted products or packaging that composes a small percentage of the waste stream (for example, less than one percent as in the case of polystyrene food packaging). The marketplace allows individual consumers to make their own trade-offs among different values, needs, and preferences, as long as all costs, including environmental costs are incorporated into the decision process. Environmental impacts can be internalized into that decision process through the setting of standards and the application of full-cost pricing. Key legislative responsibility thus lies in ensuring that all manufacturers abide by the same rules of the game--that is, that they meet all appropriate environmental standards in their manufacturing and transportation activities.

Because of the very high costs of state-by-state product bans or restrictions, some private-sector organizations have begun to seek some federal relief from individual state action, perhaps through federal product and packaging guidelines. However, a federal materials policy invites many of the same conceptual problems that state-level bans and restrictions pose. More importantly, federal product restrictions might not prevent states from developing stricter standards. A better approach would be for federal legislation to reaffirm the principles of the interstate commerce clause and underscore that state product bans violate those principles.

4) Host-community fees

Federal, state, and local officials should not confine their focus to pricing and cost-accounting measures. As the above discussion has indicated, waste-to-energy facilities and landfilling will continue to play a key role in solid waste management. In addition to promulgating the environmental performance standards for these facilities, federal and state governments must consider ways of ensuring: 1) that facilities can be sited by overcoming the NIMBY syndrome; and 2) that interstate transfer of waste can continue. To a large extent, providing for the first task will overcome pressures to prohibit waste hauling across state lines.

One possible mechanism to encourage the siting of waste facilities is the use of host-community benefit fees. Such fees operate as a reverse auction concept in which a community agreeing to site a facility receives recompense for any potential perceived or actual impacts of that facility.

Robert Glebs of Creative Resource Ventures, who has successfully sited solid waste facilities using host community fees, notes that these community benefits, offered in exchange for an agreement to site a facility, can include: 1) provision of waste disposal service at no, or reduced, cost; 2) property value guarantees; 3) cash paid directly to affected individuals or communities; 4) private well guarantees or replacements; 5) tax revenue compensation; 6) road improvements; 7) improvements in emergency planning; 8) community improvement project; and 9) recycling funds

and program operation.(62) In addition to the provision of fees or benefits to the receiving community, Glebs notes that those providing facilities must protect communities from all environmental impacts, physical harms, and nuisances.

States should play a key role in ensuring that regulatory barriers do not prevent the siting of otherwise safe and environmentally sound disposal facilities, or ensuring that cities use full-cost accounting and full-cost pricing for waste collection and disposal services. Minnesota, for example, has passed an amendment to the state solid waste act requiring haulers to offer volume-based rates to customers. This particular amendment involves more state micromanagement than is desirable. For example, volume-based rates are not necessarily preferable to weight-based rates, particularly as new technologies are beginning to make the latter more feasible. However, the policy concept may have some merit, particularly if applied to municipally owned and operated landfills where full-cost fees have often not been charged.

At least one state--Wisconsin--has passed a law requiring mandatory negotiation and arbitration to override local zoning decisions against the siting of solid waste facilities when the site is otherwise technically suitable for such use. This override law poses some problems. That a site may be technically suitable for a landfill does not necessarily make it the most desirable location if other suitable sites also exist. Moreover, the law fundamentally assumes that each community must have its own disposal site.

A preferable state-level policy would be to remove any state regulatory and legal barriers that may stand in the way of private landfill and incinerator operators offering host communities benefits as a quid quo pro for approving and receiving such facilities. Recently, some communities have begun accepting landfills and waste-to-energy facilities, even ones that would dispose of waste from other jurisdictions. This has been made possible in large part by project developers offering host communities financial benefits in exchange for accepting the "costs" of hosting a facility. As *Waste Age* magazine puts it, the solid waste industry is overcoming the NIMBY syndrome and replacing it with a new phenomenon, YIMBY/FAP, or "Yes, in my backyard...for a price."(63)

Thus, for example, Charles City County, Virginia accepted a regional landfill in exchange for a host benefit fee of at least $1.1 million per year. As one local administrator remarked, "There's money in garbage. The state-of-the-art is such that trash will have to be landfilled for many years to come. If we can gain an advantage by using our resources, that's certainly an option to be considered."

5) Environmental standards

The EPA and the states have set forth a number of standards regarding landfill and waste-to-energy operations. Nonetheless, standards remain undefined for a number of areas, resulting in uncertainty that has inhibited in some instances the siting of

facilities. Clarification and development of standards relating to the health, safety, and environmental impacts of solid waste systems could facilitate private and public sector efforts to develop such systems.

Other areas where standard-setting (perhaps developed by the private sector) would be useful are in the definition of what constitutes municipal solid waste, development of appropriate standard methodologies for calculating recycling rates, and clarification of what constitutes recycled content in products. Such definitions would help eliminate misconceptions about what recycling levels certain cities are actually achieving and could facilitate recycling marketing.

Conclusion

Though a variety of state and some federal laws and regulations on solid waste management were enacted in the late '80s, solid waste disposal is, and should remain, primarily a local government concern. Conditions vary substantially even within individual states. For policies to reflect local differences, they are best enacted at the local level. The key to sound local government policymaking is for officials to "get their prices right"--that is, to ensure that use of landfill space is not subsidized and to ensure, through variable rates, that residents and businesses pay fees that reflect full collection and disposal costs. The key focus of federal and state legislators should be in ensuring that environmental impacts are mitigated. The states should also act to facilitate the siting of solid waste disposal projects, primarily by creating conditions in which host-community benefit transactions can be accomplished. Both state and federal officials should remove barriers to privatization of collection and disposal, and to the introduction of public-private partnerships in building and operating solid waste infrastructure. Recycling mandates and recyclable content legislation should be viewed with caution, since both measures can force uneconomic (and therefore often resource-wasting) activity. "Getting the prices right," by contrast, can create conditions to stimulate sustainable recycling that makes economic sense.

About the Author

Lynn Scarlett is Vice President of Research of the Reason Foundation, a public policy think tank based in Santa Monica, California. Ms. Scarlett has written several articles on solid waste management policy. She served on an advisory panel for a Rose Institute survey on solid waste management. She also served as a panelist on a symposium to review the Lee County, Florida Solid Waste Master Plan. She participated in two 1991 national workshops on solid waste--one administered by the Institute for Resource Management in Sundance, Utah, and one sponsored by the Rene Dubos Center in New York City.

Notes

1. William Rathje, "Rubbish!," *The Atlantic Monthly*, Dec. 1989, p. 100.
2. For a theoretical discussion of this issue, see Haynes Goddard, "Economic Incentives for Managing Household Solid Waste: Upstream versus Downstream Policies," unpublished paper, Department of Economics, University of Cincinnati, March 1991. Goddard writes that "markets do allocate wastes, but with third party effects, the well-known 'externalities.' It is notable, however, that in the case of solid waste management landfill property rights *are* assigned; this fact facilitates finding a solution to the solid waste problem..." (p.2).
3. Office of Technology Assessment Facing America's Trash: What Next for Municipal Solid Waste? (Washington, D.C.: U.S. Government Printing Office, October 1989), p. 6.
4. See "Nonhazardous Solid Waste Landfill Policy," by Donald A. Norman and Jody M. Perkins, unpublished draft working paper, December 1990. Municipal landfills are only one of four types of landfills. The others are industrial, demolition, and other miscellaneous landfills. Municipal (public and private) landfills represent 48 percent of the total nonhazardous landfills in the nation.
5. Rathje, "Rubbish"|, p. 101.
6. Norman and Perkins, "Nonhazardous Solid Waste Landfill Policy," p. 25.
7. Neil Hamilton and Robert Wasserstrom, "Solid Waste Disposal in the United States: Rate Regulation Is Not the Answer" (Washington, D.C.: National Solid Waste Management Association, 1989), p. 2.
8. Jerry Taylor, "Municipal Solid Waste Management: An Integrated Approach" (Washington, D.C.: American Legislative Exchange Council, 1991), p. 3.
9. A. Clark Wiseman, "U.S. Wastepaper Recycling Policies: Issues and Effects" (Washington, D.C.: Resources for the Future, August 1990), p. 2.
10. *Project 88: Round Two--Incentives for Action: Implementing Market-Based Environmental Policies and Programs*, sponsored by Sen. Timothy Wirth and Sen. John Heinz, draft report, 1991.
11. I use in this study the definition of municipal solid waste applied by Franklin Associates: "*Municipal solid waste* includes wastes such as durable goods, nondurable goods, containers and packaging, food wastes, yard wastes, and miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources....MSW does not include wastes from other sources, such as municipal sludges, combustion ash, and industrial nonhazardous process wastes that might also be disposed of in municipal waste landfills or incinerators." (See, *Characterization of Municipal Solid Waste in the United States: 1990 Update* (Washington, D.C.: Environmental Protection Agency, June 1990), p. ES-2.
12. Taylor, "Municipal Solid Waste Management," pp. 6-7.
13. Office of Technology Assessment, *Facing America's Trash*, p. 78.
14. Rathje, p. 102.
15. Harvey Alter, "The Future Course of Solid Waste Management in the U.S.," *Waste Management & Research* 9 (1991).

16. Ibid., p. 7.
17. Harvey Alter, "The Origins of Municipal Solid Waste: The Relations between Residues from Packaging Materials and Food," *Waste Management & Research* 7 (1989), p. 110.
18. Franklin Associates, *Characterization of Municipal Solid Waste in the United States, 1960 to 2000--Update* 1988 (Washington, D.C.: Environmental Protection Agency, March 1988).
19. See, for example, Franklin Associates, *Resource and Environmental Profile Analysis of High-Density Polyethylene and Bleached Paperboard Gable Milk Containers* (Prairie Village, Kan.: Franklin Associates, Feb. 1991), and *Resource and Environmental Profile Analysis of Foam Polystyrene and Bleached Paperboard Containers* (Prairie Village, Kan.: Franklin Associates, June 1990).
20. Reported by John Holusha in "Diaper Debate: Cloth or Disposable," *Los Angeles Times*, 14 July, 1990.
21. Rathje, Ibid., p. 102.
22. Office of Technology Assessment, *Facing America's Trash*, p. 275.
23. Peter Menell, "An Incentive Approach to Regulating Municipal Solid Waste," John M. Olin Law and Economics Seminar, Washington, D.C., Georgetown University Law Center, Feb. 22, 1990, p. 3.
24. "Survey of Solid Waste Charges," City of Worcester, Mass., February, 1990.
25. E.S. Savas, "How Much Do Government Services Really Cost?" *Urban Affairs Quarterly* (Sept. 1979), p.24.
26. E.S. Savas, "Municipal Monopolies versus Competition in Delivering Urban Services," in W.D. Hawley and D. Rogers (eds.), *Improving the Quality of Urban Management* (Beverly Hills: Sage, 1974).
27. Savas,~"How Much Do Government Services Really Cost?", p. 28.
28. Menell, "An Incentive Approach," p. 4.
29. Office of Technology Assessment, *Facing America's Trash*, ch. 7.
30. U.S. Conference of Mayors, *Incineration of Municipal Solid Waste: Scientific and Technical Evaluation of the State-of-the-Art*, Report of the Expert Panel (Washington, D.C.: U.S. Conference of Mayors, February 1, 1990), p. 8.
31. "Resource Recovery in the United States," Special Report (Washington, D.C.: National Solid Waste Management Association, Sept. 1, 1989).
32. "The State Solid Waste Dilemma: Front-End vs. Integrated Waste Management" (Washington, D.C.: American Legislative Exchange Council, February, 1990).
33. U.S. Conference of Mayors, *Incineration of Municipal Solid Waste*, p. 7.
34. See *Waste Age*, January 1990, report by Thomas Hemphill, New Jersey Dept. of Environmental Protection.
35. Franklin Associates, *Characterization of Municipal Solid Waste*. Harvey Alter suggests that the rate may even be much lower--nearer 16 percent, if experience regarding participation rates, even in areas with aggressive programs, is considered. See Alter, "The Future Course of Solid Waste Management."

36. Jennifer Gitlitz and Paul Relis, *Recycling Markets: California and the Pacific Rim*, Conference Synopsis (Santa Barbara: Community Environmental Council, 1988), p. 17.
37. Ibid., p. 26.
38. Ibid., p. 27.
39. Ibid., p. 10.
40. *Los Angeles Times*, February 18, 1990. A38.
41. *Waste Age*, July 1989, p. 80.
42. *Waste Age*, July 1989, p. 132.
43. Judy Ushershon, in *Waste Age*, July 1989.
44. Alter, "The Future Course," p. 9.
45. Mark Berkman, "Recycling and Solid Waste Management: Market vs. Regulatory Approaches," presentation at Reason Foundation conference, "Fresh Thinking on Urban Issues," Los Angeles, Sept. 1990.
46. Matthew Goldman, "What Do Those Numbers Mean?" *Waste Age*, February 1991, p. 58.
47. Charles Van Eaton, "Managing the Michigan Solid Waste Stream: Markets or Mandates?" (Midland, Mich.: Mackinac Center for Public Policy, Jan. 1991).
48. Ibid.
49. Paul Relis, *Beyond the Crisis: Integrated Waste Management* (Santa Barbara: Community Environmental Council, January 1990), p. 9. It is not clear, however, whether the state used recycling cost estimates in this report that have since proven to be lower than actual costs.
50. Menell, "An Incentive Approach," p. 4-5.
51. Goddard, "Economic Incentives for Managing Household Solid Waste."
52. Lisa Skumatz, *Variable Rates in Solid Waste*, Vol. I--Executive Summary (prepared for U.S. Environmental Protection Agency, Region 10, and City of Seattle Solid Waste Utility, June 1990), p. 3-4.
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54. Marian R. Chertow, *Garbage Solutions: A Public Official's Guide to Recycling and Alternative Solid Waste Management Technologies* (Washington, D.C.: National Resource Recovery Association and U.S. Conference of Mayors, 1989), pp. 11-12.
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56. Office of Technology Assessment, *Facing America's Trash*, p. 283.
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58. Office of Technology Assessment, *Facing America's Trash*, p. 316.
59. William Kovacs, "The Coming Era of Conservation and Industrial Utilization of Recyclable Materials," *Ecology Law Quarterly* 15 (1988), p. 584.
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