Reason Foundation
Policy Study 193

SOLID WASTE RECYCLING COSTS

By Lynn Scarlett

Executive Summary

By the late 1980s, concern that the United States was "running out of landfill space" had reached crisis dimensions. In addition, some environmental commentators forecast that we would "run out of resources" if present consumption patterns persisted. These twin concerns prompted a dramatic shift toward increased recycling. By 1995, nearly all states had implemented laws requiring or encouraging household and commercial recycling. The number of curbside recycling programs in the United States jumped from a few hundred to over 7,000 in a five-year period from 1989 to 1994.

The advent of these curbside recycling programs generated both applause and controversy. Few observers of the changing waste management scene opposed the basic concept of recycling; however, many critics raised the specter that curbside recycling programs were costly. Some local government officials, already facing financial constraints, began to claim that recycling programs cost more than traditional waste collection and disposal. Claims that recycling was costly escalated when a rapid influx of materials collected in the new recycling programs resulted in steep declines in scrap values of materials.

Instead of receiving as much as $60 or more per ton of recycled materials (in the aggregate), they began receiving as little as $15 or $20 per ton. This decline in receipts from sale of recyclables meant local recyclers received much lower revenues to offset program costs than had been anticipated. The result? A vigorous debate over the costs and merits of the new-fangled recycling programs. Just four years after the rapid increase in curbside recycling programs, the cost picture has undergone a fairly dramatic shift. The aggregate scrap value of a typical ton of municipal waste brought in as much as $100 per ton in some instances. Thus, instead of a meager $15 to $20, program operators were receiving four-to fivefold higher revenues from the sale of materials.

This hefty increase in revenues has -- at least temporarily -- changed the cost picture for curbside recycling. Where programs had generated net costs of, say, $150 per ton of materials collected, they were costing well under $100 per ton by 1995. The very low costs of traditional waste collection and landfilling in some areas still made recycling the more-expensive option for some communities. However, in other communities recycling became increasingly competitive -- from a cost standpoint -- as a waste-management alternative. This brief saga demonstrates the pitfalls of answering the question: "what does recycling cost?"

Recycling costs vary over time, depending on scrap values as well as on a learning curve in providing recycling services. They also vary significantly depending on demographics, program design, whether service is publicly or privately provided, and what materials are collected. Despite the vagaries of recycling costs, several basic comments about recycling costs and the dynamics that drive those costs can help policymakers -- and citizens -- sort out facts from fancy.

If anything conclusive can be said in response to the question"what does recycling cost?," it is that "it all depends." Recycling costs depend on time, place, and circumstance. The following series of questions were posed as part of a Paper Task Force project conduced by the Environmental Defense Fund and several private-sector firms and institutions. The responses were prepared in the context of that project.

I. Introduction

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Despite the vagaries of recycling costs, several basic comments about recycling costs and the dynamics that drive those costs can help policymakers—and citizens—sort out facts from fancy. If anything conclusive can be said in response to the question "what does recycling cost?", it is that "it all depends." Recycling costs depend on time, place, and circumstance.

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Question 1:

What factors are driving solid waste management costs (including regional variances and short- and long-term trends)?

Over the past 10 years, a number of factors have influenced waste management costs. Two sets of interrelated factors have played a particularly significant role in driving waste management costs upward:

- new regulations (federal, state, and local); and
- changing local values.
- **New Regulations**

Three sets of regulations have had notable impacts on waste management. These include: a) state-level and RCRA Subtitle D regulations regarding landfill siting, construction, and operations; b) federal Clean Air Act regulations, especially as they relate to operation of waste incineration facilities; and c) state-level integrated waste management acts requiring waste diversion activities.

Landfill Regulations

Landfill regulations, most especially those promulgated under RCRA's Subtitle D, now include requirements that all Subtitle D landfills have liners, leachate collection and treatment systems, groundwater monitoring, methane control, and pre-funding of post-closure activities. In addition, these regulations (along with state regulations) place restrictions on landfill siting.

These regulations have influenced landfill costs in two ways: 1) they have resulted in the closure of a number of existing, noncompliant landfills; thereby reducing available landfill capacity, with the expected upward impact on "price" in the form of tipping fees; and 2) they have increased actual construction and operating costs of landfills.

Capacity and Closures

Consider first the impact on capacity resulting from the RCRA Subtitle D (and similar state) regulations. The impact of landfill regulations (federal and state) has been location-specific; that is, some localities (and private landfill owners), anticipating such regulations, moved early to introduce liners, leachate collection systems, etc. These areas were relatively unaffected by the advent of the Subtitle D regulations.

Other states and local regions with large numbers of noncompliant landfills saw landfill closures occur at a pace more rapid than historical rates. In addition, these closures occurred more rapidly than did siting of new capacity. In these areas, capacity shortfalls drove tipping fee prices upward. However, this trend is likely to reflect a one-time adjustment.

Indeed, there is evidence that capacity constraints are abating, as are associated pressures on price. The January 1994 issue of *Solid Waste Digest* showed an actual slight decrease in the weighted average landfill tipping fee nationwide over previous months. This downward trend continued through March, when the weighted national average climbed. Two regions continued to see tip fee declines in March, one saw a very small increase, and two saw increases over 5 percent (see Table 1).

Table 1: Tipping Fees

Region	**January**	**March**
Northeast	$64.57	$67.25
Southeast	29.83	31.47
Mid-central	29.24	28.83
Rocky Mountain	15.59	15.78
West	35.08	33.24

SOURCE = Source: *Solid Waste Digest*

The regional variation on available landfill capacity can be seen in Table 2. Note the positive correlation between available capacity and tipping fees: the Northeast, with an average landfill life expectancy of four years, has the highest tipping fees, at over $64 per ton (more than double most other U.S. regions). The Rocky Mountain region, with average landfill life expectancies of over 50 years, has tipping fees at around $16 per ton that are under half of those elsewhere in the United States.

Table 2: Landfill Life Expectancy by Region and Population

Region	**Landfill Years**

Northeast	4
Midwest	12
Southeast Central	14.5
Mid-Atlantic	15
South Atlantic	15.6
Pacific West	16
Mountain West	54

SOURCE = Source: *Solid Waste Digest*

Landfill closures over the past decade have resulted in capacity constraints in some areas, constraints that did drive prices upward. However, these constraints should not be overstated. A 1986 survey by Westat showed that around 8 percent of landfills handled 73.3 percent of municipal waste; 69.1 percent of municipal landfills handled just 4.9 percent of the municipal waste stream. Thus, large numbers of small landfills can be closed, as University of Pennsylvania solid waste analyst Iraj Zandi points out, "without much impact on the total receiving capacity of the whole system."

Regulations and Cost

More enduring than the temporary effect of short-term capacity constraints brought on by landfill closure rates that outpaced siting of new capacity are the effects on landfill costs of the regulations themselves. While actual costs are a function of location, planned capacity, and other variable factors, the general impact of increased regulations on landfill costs is considerable. In Scottsdale, Arizona, for example, landfill costs to the city of a noncompliant landfill were $8 per ton; costs at compliant facilities to which the city's waste now goes range from $14 to $17 per ton, an increase of 75 to over 100 percent. (Though it must be noted that total costs, relative to other U.S. regions, remain low).

Several estimates of total costs to build and operate landfills that meet all existing regulations range from $25 to $30 per ton. These figures are for landfills of 100 acres, that take in 250 to 550 tons per day. The regulations can result in a doubling of annual operating costs (exclusive of capital costs) over pre-Subtitle D conditions. It should be noted, however, that these figures can be misleading for several reasons: 1) economies of scale in operating large, regional facilities bring down per ton costs; and 2) many existing facilities already had in place some, or all elements now required by Subtitle D regulations; hence, their current cost structure already reflects the added costs of regulatory compliance. Many of the increased landfill costs experienced over the past decade are the result of trends toward introducing construction and operating measures to address existing or anticipated regulations. One should not, therefore, expect costs to climb over the next decade at a pace comparable to that of the last several years.

Clean Air and Other Regulations

Clean air regulations have had an impact on incineration operation, to date, though landfills are also subject to some air emission regulations. Like other industrial facilities, incinerators are required to mitigate the criteria pollutants identified in the Clean Air Act and subsequent amendments. These include nitrogen oxides, sulfur dioxide, carbon monoxide, volatile organic compounds, and particulate matter. In addition, regulations of heavy metal emissions have been implemented. The extent of emission abatement varies by location and by state, depending in part on the overall air quality of a particular area.

Costs associated with existing air regulations are already reflected in current incinerator operations. However, possibilities for increased air regulations still exist, particularly for heavy metals.

The impact of the Supreme Court's May 1994 ruling on incinerator ash disposal remains could have resulted in increased costs to some facilities. The ruling states that incinerator ash was not exempt from consideration as hazardous waste, therefore testing of the ash was required. Again, because many facilities already were testing ash (and disposing it in a manner appropriate for hazardous waste) actual cost impacts were not significant across-the-board. In any event, the status of ash management is an evolving one, with uncertain cost implications.

Waste Diversion Regulations

Virtually all states having implemented since 1988 some form of waste diversion or recycling mandates or goals. Achieving these goals has resulted in the implementation of curbside recycling, compost, waste reduction, hazardous waste pick-up, and other special programs by local governments. Indeed, some 6,000 or more communities now have curbside recycling programs, in contrast to a few hundred in the mid-1980s

For the most part, the move to integrate waste management systems with recycling and other waste-diversion programs initially resulted in increased total waste management system costs over the past five years. (These costs will be discussed in more detail later). Total system cost increases ranged from 5 to 15 percent or more, depending on specific location, amount of waste diverted through the new programs, program design, recycling revenues, and other variables. In some cities with high disposal costs (for example, in parts of the Northeast and Northwest), these diversion programs may have resulted in some small total system cost reductions.

The future impact of these waste diversion regulations are uncertain and depend on implementation specifics. In those areas that implemented modest (25 percent) diversion goals and have already established recycling and composting programs to meet those goals, total program costs have stabilized or even come down. The "learning curve" for operating these programs appears to be fairly steep, with significant productivity improvements over the short term possible. Some cities should begin to experience the effects of this learning curve and at least stabilize, if not lower, waste diversion costs as a result. In addition, high scrap values in 1994–1995 also brought net costs down.

On the other hand, those states faced with high diversion goals (35 percent and over), may experience further significant increases in total program costs as they put in place additional programs, or more aggressive programs to capture and divert more waste. The first 20 to 30 percent of waste diversion (through recycling and composting) appears to be reasonably achievable at modest costs. It is unclear what costs will be associated with pushing for rates beyond the 30 to 35 percent level.

In addition, the long-term impact of these diversion programs will depend in part on the cost trends for landfilling and incineration. As noted above, the cost escalations experienced in the 1980s may slow in the 1990s, or may even trend slightly downward. In this case, expected longer term savings from composting and recycling programs may not materialize.

Changing Local Values

Increased waste management costs are also, in part, the consequence of changing local values. Specifically, many local communities are reluctant to have waste disposal facilities sited, resulting in the oft-described NIMBY (not-in-my-backyard) syndrome. It is not an absence of available space per se that has constrained the siting of waste disposal facilities; rather, it is opposition to the siting of such facilities.

Such opposition ultimately makes facility siting more costly, both directly and indirectly. Indirectly, such opposition often results in permitting delays and increased legal costs. Directly, such opposition often results in the negotiation of benefit packages offered to the "hosting" community in exchange for the siting of a waste facility. These benefit packages can include direct per ton payments to the host community; creation of special amenities—for example, parks, buffer zones, etc.—paid for by the facility owner; and environmental protections that exceed basic regulatory requirements.

This trend toward use of host-benefit packages for the siting of facilities deemed by communities to have some negative impacts is likely to continue in future years. This trend, and the opposition to disposal facility siting that lies behind this trend, will likely continue to add to basic waste disposal costs.

Other Comments

Regulations and political opposition to the siting of waste management facilities have had a perceptible impact on costs. However, by far the most significant waste management costs derive from collection rather than disposal costs. Collection costs often comprise over 60 percent of total waste management costs. And labor costs make up the largest portion of total collection costs. Thus, as labor costs rise, through increased salaries, increased workers' compensation costs, and so on, total collection costs rise. Indeed, rising labor costs are largely responsible for the industry move toward increased automation of collection service over the past decade.

Over the past decade, disposal costs have climbed at a more rapid pace than collection costs, largely due to the factors listed above. However, because labor costs represent a larger overall portion of total costs, small changes can have visible impacts on per household costs.

Question 2:

Compare the costs of different solid waste management alternatives: waste reduction, recycling, incineration, and landfilling. What accounts for the differences?

Caveats

Establishing and defining solid waste costs for different handling options is fraught with peril for a number of reasons. First, costs tend to be highly location specific; hence, comparative costs in one setting may not be relevant in others.

Second, defining costs is itself difficult. Because many cities use budget-based, rather than activity-based cost accounting, their published budget figures for different waste management activities do not reflect actual total direct and indirect costs. For example, such costs as fleet maintenance, pension and benefit costs, or legal expenses do not show up in sanitation department budgets.

Third, comparative units of measurement can be misleading. For example, on a per household monthly basis, recycling may cost around $1.50; trash collection and disposal may cost around $8.00. These figures do not, however, translate into a savings of $6.50 per household to engage in recycling. The more relevant question is how much material is handled respectively by the two systems, and what are the impacts on total system costs of adding new programs to the system.

Fourth, there is much confusion over the concepts of "price" and "cost." What a city pays to a private hauler in the form of a curbside recycling contract on a per household or per ton basis tells us little about the costs of implementing a recycling program. Though such a fee represents the out-of-pocket cost to the city, this is not the same as the total cost of recycling. One must add to that figure any in-house costs for recycling coordinators, education materials, and equipment contributed by the public sector (state and local). In addition, the fees paid to the hauler do not necessarily relate to the waste hauler's costs of providing service. This is true in the case of recycling in particular for two reasons. First, the hauler may also receive revenues from the sale of recyclables. As aggregate scrap values fell in 1990 and 1991, the net costs of recycling increased. Yet, contract fees in cities served by multi-year contracts might not necessarily reflect this change in net costs. Second, to the degree that haulers cover their costs (and profits) through a combination of contract fees and anticipated revenues from material sales, the contract fee may not be set to cover total costs. Rather, the fee may be set such that the fee plus the material revenues cover total costs, plus expected profits. A number of reports on recycling costs, including one by the Institute for Local Self Reliance, equated contract fees with costs, with resultant misleading cost comparisons.

Finally, the concept of "avoided costs" is often grossly misapplied. Avoided costs cannot be determined by taking a current landfill (or incinerator) tip fee and multiplying it by the tonnage diverted through recycling, composting, or waste reduction. The avoided disposal costs should, instead, be determined by estimating the amount of time the landfill "life" will be extended as a consequence of the diversion program. That extension in essence represents a delay in expenditures on new capacity. Avoided costs are appropriately calculated by determining the difference in current landfill costs versus expected costs of new capacity, and calculating the net present value of the future savings that result from delaying the onset of higher disposal costs. Using this methodology, one can comprehend that "avoided costs" will be higher for landfills near the end of their useful life, but will diminish for landfills that have many years of remaining capacity.

Cost Comparisons

Notwithstanding the above caveats, several studies do allow for some general cost comparisons to be made for the 1990 to 1994 period.

Recycling Costs

Four recent studies have attempted to carefully define and calculate curbside recycling costs. These four studies show costs that vary by program design and location. Nonetheless, the four studies significantly narrow the range of reported costs, thereby serving as a crude "reality check" on expected costs.

The following description summarizes the results of those four studies. The National Solid Wastes Management Association (NSWMA) modeled costs for curbside recycling under several scenarios. The models were developed using known cost variables and cost information from actual programs. The study modeled costs for two truck sizes (23 cubic yards and 31 cubic yards); for both one- and two-person crews; for three different set-out rates by households; and for different capture rates of materials. Total costs per route ranged from $104,000 for a one-person crew on a 23-yard truck to a high of $148,000 for a two-person crew on a 31-yard truck. On a per ton basis, costs ranged from $103 per ton with a 75-percent set out rate, using a two-person crew in a 23-yard vehicle to $158 per ton with a 25-percent set-out rate, using a one-person crew with a 31-yard vehicle. Note that these are gross collection costs; they do not include processing costs nor deductions for sale of materials.

To establish total net cost estimates from these figures, one could add the estimated average of $50 per ton for processing costs, less an estimated $30 per ton for aggregate revenues from sales of recyclables. For the NSWMA figures, this would result in total net recycling costs ranging from $123 per ton to $178 per ton. NOTE THAT THESE FIGURES ARE MODELED ESTIMATES ONLY.

Though these figures are modeled estimates, they track reasonably with a five-city study of curbside recycling programs undertaken by the Reason Foundation. The Reason Foundation study looked at five programs, four of which used one-person crews and one of which used a combination of one- and two-person crews. Truck sizes ranged from 28 to 30 cubic yards. Weekly set-out rates ranged from a low of 33 percent to a high of 45 percent. Tonnage collected per household per pick-up ranged from 8.7 to 18 pounds. All data were collected for each program on a weekly basis over a six- to twelve-month period.

Net recycling costs (collection and processing costs less revenues from sale of recyclables) for the five programs examined by the Reason Foundation ranged from $97.84 to $138.50 per ton. It should be noted that collection costs generally represented 75 percent of total costs in each of these cities; aggregate revenues from sale of recyclables ranged between $28 and $39 per ton, which is relatively high in contrast to some U.S. regions.

The Clean Washington Center examined recycling program costs in four Washington cities. The study may slightly misstate costs, since actual budgeted costs or contract costs were used to develop cost estimates. Adjustments were not made for contract monitoring costs, nonallocated city costs, and so on. Nonetheless, the costs appear to be reasonably reliable.

The Clean Washington Center study showed net recycling costs in Table 3.

Table 3: Net Recycling Costs

Net costs/ton	Seattle	Spokane	Bellingham	Vancouver
Collection/overhd.	89	199	91	137
Processing	42	0	25	0
Total	131	199	116	137
Revenues	41	24	0	6
Net costs	90	175	116	131

Source: Clean Washington Center

Finally, a major national study of integrated waste management costs is under way. Preliminary data show recycling costs ranging from $133 to $182 per ton. Note that the high-end costs are for a city in the Southwest that has a relatively low population density and is far from recycling markets, resulting in low net revenues from sale of materials.

In summary, these four studies show recycling costs ranging between $90 per ton and $182 per ton. Cost variations are a function primarily of program design (to be discussed later) and location (with differences in demographics, densities, access to markets, and so on).

Landfill and Incinerator Costs

Reported landfill and incinerator costs are subject to some of the same problems as recycling costs. First, there are large regional and facility variations in landfill and incinerator costs. Second, tipping fees of publicly owned facilities do not necessarily represent actual capital and operating costs. However, tipping fees at privately owned landfills will generally reflect total costs (plus profits) to the owner/operator. Surveys of such fees do, therefore, provide some indication of landfill costs. In addition, several models of landfill costs exist, one developed by the International City/County Management Association and the other by Browning Ferris Industries. Finally, two recent studies identify landfill costs for several cities.

Solid Waste Digest reports tipping fees in March 1994 as follows:

Table 4: Landfill Tipping Fees -Weighted Index (adjusted for capacity)

Region	Fee
West	$33.24
Rocky Mountain	15.78
North Central	28.83
Southeast	31.47
Northeast	67.25

SOURCE = Source: *Solid Waste Digest*

The Municipal Waste Management Association and the U.S. Conference of Mayors have also reported weighted average tipping fees for all disposal fees, including landfills, by region, using somewhat more refined regions than *Solid Waste Digest.* These reported fees are as follows in Table 5:

Table 5: Weighed Average Tipping Fees for all Disposal Fees

Region	Landfill	WTE	MRF	Compost
Midwest, N.E.	$25.71	$33.62	$28.29	$61.36
Midwest, N.W.	21.16	83.10	35.59	13.31
Mid-Atlantic	70.23	73.01	14.48	18.17
Northeast	52.78	53.11	12.13	7.00
S.E. Central	18.24	NA	NA	10.00
S. Atlantic	34.33	41.27	11.52	22.43
S.W. Central	13.78	NA	11.60	6.01
Mountain West	11.44	NA	NA	NA
Pacific West	28.61	47.50	20.22	18.39

SOURCE = Source: *Solid Waste Digest*

Landfill and incinerator tipping fees do not represent total costs to handle trash. To these fees must be added trash collection costs, which generally range between $45 and $80 per ton, depending on demographics, density, program design, degree of competition, and other variables. Thus, given the above reported tipping fees, total trash handling costs for waste that is landfilled generally range between $55 and $150 per ton. It should be noted that there are some communities with tipping fees over $120 per ton. In these exceptionally high-cost disposal areas, total trash handling costs can be over $160 per ton.

The Clean Washington Center reports net disposal system costs per ton (1992) for four cities in Table 6:

Table 6: Net Disposal System Costs per Ton

Cost Component	Seattle	Spokane	Bellingham	Vancouver
Collect/Overhead	$67	$101	$90	$85
Transfer/Disposal	$70	$97	$91	$71
Total Costs	$137	$198	$181	$156
Cost-Revenues	$137	$188	$181	$156

SOURCE = Source: Clean Washington Center

Another study now in progress that is examining integrated waste management system costs, breaks down the system costs of garbage collection and disposal in three cities as follows in Table 7:

Table 7: Program Costs (per ton)

City	Garbage (collect/dispose)	Recycling (collect/process)
City A	$121	$133
City B	$63	$182
City C	$134	$218

SOURCE = Source: SWANA

Finally, two landfill cost models report estimated total capital and operating costs for landfills. In its 1990 cost model, the International City/County Management Association estimates costs for a 250-tons-per-day facility, with 100 acres, operating at a 30-foot depth over a 20-year life, with 30-year post-closure plans and using a double liner, leachate collection and treatment systems, and gas control systems. Land costs are modeled at $5,000 per acre. With these assumptions, ICMA estimates total costs at $25.77 to $28.89 per ton. These figures do not include any host-benefit payments, taxes, or imputed profits. These costs translate into a monthly per household cost of $5.88 to $6.58.

BFI undertook a similar modeling exercise, based on a facility that handles 550 tons per day, with a land area of 150 acres (at $3,000 per acre), actual landfill operations on 100 acres, with a lifespan of 20 years, post-closure period of 30 years, a composite liner, and initial operating cell of 10 acres. Using the BFI cost model, landfill costs came to $23.28 per ton, excluding taxes and profits.

Waste Reduction

Programs that reduce the amount of waste actually being generated fall into a number of categories, making cost assessments difficult. In thinking about the costs (or savings) associated with such programs, however, several points are worth keeping in mind.

First, some waste-reduction programs actually result in some cost-shifting from a hauler (public or private) to the individual household. For example, backyard composting programs represent a diversion of waste away from organized collection programs and therefore will result in reductions in these program costs. However, the waste itself has not disappeared, but is being handled by the household. At least one study imputes average hourly costs of an individual's time at over $14 per hour. Though no one actually pays for this time, from an economic perspective it is a societal cost. Mulch mower programs have a similar shifting effect, since mower purchasing costs are paid by the consumer. However, in this case, it is assumed the household would be mowing the lawn with or without a mulch mower, so the only actual cost shifting would be the expense to the homeowner of acquiring a different mower.

It should be noted that though some cost shifting occurs, total waste-handling costs from such waste-reduction efforts as backyard composting and use of mulch mowers are likely to be relatively low.

Second, some waste reduction programs such as use of variable rate (unit-based) fees may have some adverse consequences (societal costs). For example, while unit-pricing fees do appear to divert as much as 40 percent of waste away from municipal collection programs, only a portion of this diversion appears to occur through composting, recycling, and changed purchasing habits resulting in reduced waste generation. Some portion of the diversion appears to occur through shifting of household waste to commercial trash bins, through illegal dumping, through backyard burning, or through personal hauling of waste to disposal facilities of other jurisdictions. Insufficient information is currently available to estimate the scope of these potential adverse consequences.

Third, waste reduction programs that involve changing product production—for example, through changes in packaging—may, or may not result in total reductions in social costs. Again, reductions in amount of consumption or amount of packaging (and therefore waste generated) will result in reductions in waste-handling costs. However, such efforts are often themselves not cost-free; that is, they may entail capital investments to change production processes, they may shift costs (including environmental impacts) to other activities, or they may result in changes in consumer satisfaction. For example, less food packaging may result in more food waste. As ecologist John Muir has pointed out, there is an "interconnectedness of all things." Muir made this reflection of the natural world; the same can be said of economic systems.

Question 3:

Are we accurately measuring the full costs of different solid waste management options?

Waste management costs may diverge from both reported costs and from system pricing along two distinct dimensions. First, "hard costs"—that is, actual capital and operating costs—may be understated for a variety of reasons. Second, "soft costs"—costs associated with the spillover effects of operating a particular waste management program—may not be reflected in the costs borne by transacting parties (producers and users of waste management services).

Hard Costs

Consider first the issue of "hard costs." Reported costs of municipally owned and operated collection and disposal systems often do not reflect actual costs of service. For example, economist E.S. Savas of Baruch College, City University, New York, found that "public officials themselves are...ignorant of the true cost of a particular municipal program." In a 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." In subsequent studies of other cities, Savas confirmed this general finding that municipal budgets understate service costs—on average, by some 22 percent. Reason Foundation studies examining budget-based costing of municipal services has likewise found similar results.

Typical costs not represented in city budget figures for solid waste include, for example: 1) fleet maintenance costs; 2) pension and benefit liabilities; 3) legal service costs; 4) insurance or self-insurance costs; and 5) costs associated with overhead shared with other city departments—for example, office space, nonsanitation department management costs, shared yard space, etc.

In addition to these general costs, local governments also tend to understate some costs specific to landfills. City budgets typically report capital costs either in terms of yearly actual outlays, or they report asset depreciation. Neither method adequately takes into account the opportunity costs of capital. Nor do cities include landfill replacement costs in annualized cost figures. Likewise, many cities have historically failed to include any annual calculation for future post-closure costs. Failure to include the above costs has resulted in an underpricing of landfills in many local jurisdictions.

Note that this underpricing is not relevant at facilities owned by the private sector, since the private sector uses business-based accounting practices that reflect total system costs, including replacement costs, liability costs, and so on.

Externalities

Most economic transactions involve both positive and negative externalities, that is, activities for which the costs or benefits are not reflected in the price of a transaction between two or more parties. Most pollution problems are, in fact, a form of negative externalities. A critical issue is whether such "costs" should be incorporated into the costs of a particular activity, and, if so, how this should be accomplished.

This issue is complex, and warrants an entire separate discussion. However, one should begin with several key observations.

First, emissions per se do not represent "costs." The critical issue, from an economic standpoint, is whether any "harm" occurs as a result of a particular emission. For example, if waste in a landfill generates leachates that are, in turn, treated and rendered harmless, no externality can be said to exist. The costs of leachate treatment will be included in the total system costs. Accidental harms associated with a failure of the leachate system to operate properly may also already be reflected in existing facility performance bonds, insurance premiums, and so on.

Second, one must be cautious of double-counting of potential harms. For example, if air emission regulations have been established based on some estimation of "harmful" levels of emissions, costs of complying with those regulations will be reflected in capital and operating costs. Placing an additional "pollution charge" on either hypothetical pre-regulation emissions would represent a kind of double-counting of emissions. Placing a charge on those emissions remaining after implementation of the regulations would only be warranted if those remaining levels created third-party harms. Existing liability insurance may already adequately anticipate such harms, thereby reflecting them in insurance costs.

Third, attempts to set "shadow prices" for externalities—for example, some form of pollution charges or environmental fees—are fraught with peril. Discussions about establishing such shadow prices often suffer from what economist Thomas Sowell describes as the "physical fallacy" of prices. There is, fundamentally, no such thing as an "intrinsic" price of any good—environmental or otherwise. Prices simply provide a common denominator for making commensurate incommensurates. Prices essentially express a dynamic relationship between available means (resources) and ends at a particular moment in time. Thus the "cost" of a particular emission depends on how much people value the clean-up of a marginal additional unit of the particular emission at a point in time, given the multiple other ends toward which resources could be expended.

Because prices are essentially a reflection of relative values, externalities are particularly troublesome. By definition, the values—for example, clean air or water—associated with mitigating certain pollutants are not "traded." Thus, to understand the "price" of such pollutants, one must essentially establish proxy ways of estimating how much people value an additional unit of clean air or water, how much they value additional protection of a wildlife species, and so on. Methods to develop "prices" for environmental goods include: 1) contingent valuation, which uses survey methods to determine individuals' willingness to pay for some environmental good, or willingness to accept payment as compensation against some perceived environmental loss; or 2) some assessment of harm based on estimated health costs or other losses associated with a particular externality. For our purposes here, it should be underscored that such methodologies are at best highly imperfect and at worst can be highly distorting of the actual degree to which people value certain environmental goods.

The Case of Waste Management Systems

Waste systems do have associated with them some externalities. However, these systems are now, for the most part, highly regulated. Recent implementation of RCRA landfill regulations should significantly lessen prospects of groundwater contamination from landfills; methane collection systems should reduce problems associated with such gases. In addition, liability provisions and performance bonds provide strong incentives to owner/operators to prevent harms from occurring. The costs associated with such anticipation of harm are now increasingly part of the solid waste management cost picture. It is appropriate to remain vigilant with respect to the implementation of existing environmental regulations, and to continue to hold waste management owners/operators liable for harms associated with their facilities. On the other hand, attempts to set "shadow prices" for externalities are more likely to distort rather than correct any incomplete "costing" of waste management facilities.

Question 4:

How can recycling collection and processing costs be reduced, for both municipal and commercial programs?

U.S. local governments and private haulers have implemented a wide variety of different recycling collection/processing systems. Curbside collection programs essentially fall into three types, though within each of these three categories wide variations exist. The three types vary primarily in terms of how and where sorting of materials occur: 1) at the household; 2) curbside during pick-up by the hauler; and 3) at a material recovery facility.

Costs for programs vary widely, depending on program design, location, and competitive environment. Adjusting recycling programs to local conditions, improving program participation and capture rates, and creative conditions for flexible and competitive hauler responses can reduce costs.

Six factors can significantly affect costs:

- population density;
- crew size on collection vehicles;
- vehicle selection;
- program design (frequency of collection, types of materials, etc.);
- route structure; and
- "capture" and "set-out" rates.

Several studies have shown that on-site (at the truckside) sorting can result in costs some 27 percent higher than in commingled collection programs. However, commingled programs typically result in higher processing costs and more contamination of materials. Generally, however, because collection costs make up as much as 75 percent of total recycling costs, bringing collection costs down may yield greater benefits than improving processing efficiency.

Collection frequency can also impact costs, with a slight apparent advantage for alternate-week collection programs having been demonstrated, though this may result in a reduction in the amount of materials collected. Use of some compaction in commingled programs can result in savings of some $16 per ton, according to one estimate. Reduction in crew size from a two-person to a single-person crew can result in savings of 27 percent, according to one study. However, the NSWMA recycling cost model suggested that increased productivity of two-person crews could actually exceed the labor cost savings from having single-person crews. Reason Foundation research seems to counter the NSWMA report, with losses in productivity from single-person crews not exceeding the reductions in costs. Finally, larger vehicle capacity may also reduce costs, depending on route structures and location.

Amount of material collected per household depends both on the number of materials collected and the "set-out" rates, or percentage of households that set recyclables out for collection during any given pick-up period. Sustained set-out rates for curbside programs examined by the Reason Foundation appear to range from 33 to 45 percent, though some programs achieve considerably higher rates. These rates can influence program costs and are related to program convenience, demographics, dissemination of program information, fee structures for trash collection programs, and so on. The NSWMA recycling cost model, for example, estimates that as set-out rates rise from 25 percent to 75 percent, the cost of recycling per ton drops by 33 percent.

While adding materials to a program can result in more material collected, the addition of low-density, large-volume materials such as plastics can increase marginal program costs.

Finally, the Reason Foundation has found significant differences in program costs and productivity between municipal programs and private programs operated in a competitive environment (through competitive contracting, for example). Reason Foundation studies comparing public and private-service delivery show costs for private service running as much as 20 to 30 percent lower than municipal programs. There are exceptions to this pattern, with some public programs achieving productivity rates similar to the private sector (in terms of numbers of households served per route, amount of tonnage collected per crew, and so on). However, there are broader diversions away from the mean within the public sector.

Question 5:

How do different solid waste management options compare in terms of economic development and job opportunities?

In considering economic impacts of different waste management options it is important to underscore that the critical measure is that of opportunity costs, not job creation per se. Opportunity costs essentially refer to the investments foregone by virtue of allocating resources to a particular activity. Put another way, in terms of overall economic benefit, the fundamental issue is not whether a particular activity creates jobs, but whether the same funds, invested elsewhere, would have generated more "wealth" from an economy-wide perspective.

What are the implications of the concept of opportunity costs for waste management? Debates about whether recycling creates more jobs than traditional collection and disposal service are really irrelevant to an understanding of total economic impacts. To illustrate this point, note that one could "create" jobs simply by mandating that all individuals use hand-clippers to mow their lawn. Would this be the best (most efficient) use of resources (defined to include time and tangible inputs)? Very likely not. The real issue for waste management, from an economic perspective, is whether a particular waste handling system represents the most-efficient use of resources: does it cost less than alternatives? If a particular system costs more than alternatives, such a system is diverting more funds away from other economic opportunities: that is, opportunity costs are greater.

Given current conditions, it is likely that recycling activities are, in fact, more costly than alternative waste-handling systems. From a purely economic standpoint, these efforts (in some instances) do not represent an efficient allocation of resources. However, it should also be noted that, to the degree that consumers prefer to handle their waste through recycling programs, the issue of economic efficiency becomes moot (at least up to that point where consumers are no longer willing to pay for such programs).

It should also be underscored that, though recycling represents opportunities for manufacturing new goods, such activity generally represents a shifting away from other manufacturing activity, not net new jobs. Analysis of this particular point is too complex for discussion in this brief report. However, those examining the economic impacts of recycling and other materials-handling options should keep this broader picture of economic wealth creation in mind.

About the Author

Lynn Scarlett

Lynn Scarlett is Vice President of Research at Reason Foundation, a non-profit public policy research organization in Los Angeles, California. Ms. Scarlett has written a number of policy studies on solid waste management and recycling issues.