The Costs of Curbside Recycling

Today's strengthening markets may improve cost effectiveness of recycling curbside-collected materials, but most municipalities are still dealing with programs that add to their bottom line costs of waste management.

By Roger W. Powers

Recyclables are now collected at curbsides of roughly one-third of all single family households in America. Residents are sorting, municipalities are collecting, and, to a large extent, manufacturers are reprocessing the recyclables into new products for sale. Recycling began in America as a money-making proposition, with a premium paid for recovered newspapers, cans, and scrap material sold to paper and scrap dealers. But with the advent of convenient curbside collection, the expense began to outweigh the revenues—a surprise to the general public, but not to solid waste planners across the nation. In fact, curbside collection of materials for recycling usually adds costs to a solid waste system, according to "The Role of Recycling in Integrated Solid Waste Management to the Year 2000," a recent study sponsored by Keep America Beautiful, Inc. (KAB) and conducted by Franklin Associates, Ltd. Before presenting data from this study, however, it must be noted that the market value of some recyclables has changed dramatically in the period since the study was conducted. While it is not known whether these higher prices will continue, the current result is a substantial improvement in recycling economics.

The study provides statistics on the generation and diversion from landfills of MSW, characterizes MSW by commercial and residential waste, provides an analysis on the costs, infrastructure, markets, energy/environmental implications and future of curbside recycling. While it provides only national data, the study can serve as one of the preliminary planning tools needed when developing local solid waste management systems. It can also be of use to policy makers and analysts at state and national levels, especially when contemplating the feasibility and cost-benefits of recycling goals above 35 percent diversion.

While much of the report's analysis focusses on residential curbside recycling, it is important to relate that the main study also reports that most of the materials being recycled today do not come from residential/curbside programs. Instead, commercial sector recycling is the leading source of recyclables materials and will remain so at least through the year 2000. While the U.S. recycled 21 percent of its MSW in 1992, only 2.5 percent was attributable to curbside recycling, and commercial recycling for 11 percent.

Some of the most important new data contained in the study reflects the costs of residential recycling, compared to other options. Data is provided on a per household and per ton basis for various recycling scenarios in a metropolitan statistical area (MSA), and in non-MSAs. While this information is vital to anyone involved in solid waste management, the study's finding underscores the need for an integrated approach to solid waste management, and in that context, suggests that cost-efficiency of recycling must be considered in terms of an entire system that may include landfill, waste-to-energy and yard waste components.
The study looks at seven scenarios:

Landfilling Only. Collection and landfilling of all non-bulky single-family residential municipal solid waste (MSW).

Waste-to-Energy. Collection and waste-to-energy combustion of all non-bulky single-family residential MSW; landfilling of residue. The collection and transportation costs are assumed to be the same as for landfilling only. The costs are based on a WTE plant handling 850 tons per day of waste.

Yard Trimmings Composting. Curbside collection and composting of yard trimmings from single-family residential MSW; collection and landfilling of remaining non-bulky MSW. This sce-

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The report from which material for this article was drawn, "The Role of Recycling in Integrated Solid Waste Management to the Year 2000" is available for $75 from the same offices.

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√This article has been evaluated and edited in accordance with reviews conducted by two or more professionals who have relevant expertise. These peer reviewers judge manuscripts for technical accuracy, usefulness, and overall importance within the field of solid waste management.

nario assumes that yard trimmings are collected separately from refuse.

Base Case Curbside Recycling. Curbside collection and processing of single-family residential base case recyclables (newspapers; glass, steel, aluminum containers; PET soft drink bottles; HDPE bottles); collection and landfilling of remaining non-bulky MSW.

Expanded Case Curbside Recycling. Curbside collection and processing of single-family residential expanded case recyclables (base case recyclables; corrugated containers; office paper; magazines; mixed paper; other plastic bottles and aluminum packaging); collection and landfilling of remaining non-bulky MSW.

Expanded Case Curbside Recycling Plus Yard Trimmings Composting. Curbside collection and processing of single-family residential expanded case recyclables; curbside collection and composting of single-family yard trimmings; collection and landfilling of remaining non-bulky single-family MSW.

Co-collection Base Case Recycling. Curbside co-collection of single-family residential base case recyclables and refuse; landfilling of remaining non-bulky MSW.

All costs are in 1994 dollars and were developed for once per week collection of MSW at curbside. It was estimated that an average single-family MSA household generates 46 pounds per week of non-bulky waste, and a non-MSA household generates 43 pounds per week. Non-MSA labor costs were estimated to be at 70 percent of MSA labor costs. The cost estimates were developed assuming new infrastructure, including new recycling facilities and modern landfills and WTE facilities meeting current regulations. The cost estimates developed for each scenario are national averages, they are not a substitute for an area-specific economic analysis because regional variances impact costs greatly. They can be however, a guide for solid waste planners in setting priorities about analyses that need to be conducted in order to create efficient recycling systems.

Total System Costs

System costs were developed for both MSAs and non-MSAs. The MSA assumed in the analysis was an urban/suburban area with a population of 500,000 persons, an estimated 155,200 single-family homes, 2.9 persons per single family household; the single-family household population generates 185,600 tons of household, non-bulky MSW per year. In calculating total system costs for each of the scenarios, the study assumes comparatively high overall recovery rate for base case curbside recycling (18.8 percent of non-bulky, single-family MSW, or 34,900 tons as shown in the middle column of Table 1). Lower recyclables recovery results in higher costs per ton for curbside recycling.

The study defines recovery rate as the percentage of materials removed from the waste stream for the purpose of recycling out of total generated waste materials; in some cases, the recovery rate does not account for process residues that are not recycled. The high recovery rate assumed may be achievable in areas with methods to divert waste from disposal (e.g., volume-based fees on refuse collection) and thorough public education programs.

Total system costs show that residential curbside recycling programs usually create additional expense for local solid waste systems. Tables 1 and 2 shows that costs actually increase progressively as more items are added for recycling.

For instance, total system costs change

Table 1: Comparing Total System Costs for Various Scenarios (MSA)

	Landfill Only	Compost	Base Case Recovery	Expanded Recovery	Expanded Recycling & Composting
Refuse generated (tons)	185,600	185,600	185,600	185,600	185,600
Material recovered (tons)	—	—	34,900	55,200	55,200
Yard waste recovered (tons)	—	64,600	—	—	64,600
Tons not landfilled	0	64,600	34,900	55,200	119,800
Tons landfilled	185,600	121,000	150,700	130,400	65,800
Total System Cost (millions)	$16.1	$19.0	$18.5	$19.2	$21.5
Increase over Landfill Only (millions)	—	$ 2.9	$ 2.4	$ 3.1	$ 5.4
Increase over Landfill Only (%)	—	18.0	14.9	19.3	33.5
Increase cost per household/month	—	$1.55	$1.31	$1.68	$2.87

from $16.1 million annually for landfilling only in an MSA to $18.5 million for base case recycling plus landfilling, and $21.5 million for expanded case recycling, composting, and landfilling. These increases represent 15 to 33 percent over the cost of conventional landfilling, and a range of $1.31 to $2.87 more per home per month.

MSA Costs

Costs developed apply to a large urban community. The landfilling only scenario assumed a landfill averaging 1,000 tons per day, six days per week, with a 10-mile distance between the service area and the landfill. The total cost for collecting, transporting and landfilling household MSW for this scenario is between $65-$108 per ton, or about $6.50-$10.80 per household per month. More than 70 percent of these costs are collection and transportation.

For the waste-to-energy scenario, total costs were estimated to be between $100 and $167 per ton, or $10.00 to $16.70 per household per month. This represents a greater than 50 percent increase over landfilling only. Just over one-half of the total cost is for combustion in the waste-to-energy facility. The recovery of energy and the revenues from that energy are considered in this calculation.

For the yard trimmings composting scenario, it is important to know that an estimated 35 million tons of this waste was generated nationally in 1992, and that between 85 and 90 percent of it was generated from single-family and other households. This would equate to 16 pounds of yard trimmings per single-family household per week in areas where there is no incentive to reduce yard trimmings. This scenario also assumes that yard trimmings are collected separately, and the remaining non-bulky MSW is landfilled. In this case, total costs in an MSA are $77-$128 per ton or $7.65-$12.75 per household, per month. This adds $1.15-$1.95 to the monthly household costs for landfilling only.

For the base case curbside recycling scenario, it was assumed that an average MSA has separate commingled collection of bottles and containers with sorting taking place at a materials recovery facility (MRF). Revenues from the sale of recyclables was assumed to be $46 a ton. Table 3 lists the assumed quantities of recyclables generated in each MSA household. It is interesting to note that the study found essentially the same total MSW management costs per household in areas with 85 percent household participation in curbside recycling (19 percent recovery rate) as in areas with 50 percent participation. Although curbside recycling costs were less with lower recyclables recovery, refuse collection and landfilling costs were higher. The net result was no significant difference in total system costs.

This scenario estimated a cost of $75 to $125 per ton or $7.45 to $12.45 per household per month when basic recycling was added to refuse collection and landfilling for an MSA. This adds $0.95 to $1.65 to monthly household costs over landfilling only.

For the expanded case curbside recycling scenario, it was assumed that recovered newspapers, other paper, and commingled containers were each placed in separate truck compartments in the MSA. In the non-MSA, all paper grades were assumed to be placed in the same compartment. Again, high recovery rates were assumed—30 percent of non-bulky, single-family MSW for an MSA. Total costs for this scenario are $78 to $129 per ton or $7.75 to $12.90 per household per month. This curbside recycling program adds $1.25 to $2.10 to monthly household costs over landfilling.

The expanded case curbside recycling plus yard trimmings composting scenario would achieve the maximum amount of diversion from disposal and recovery. A 64 percent overall recovery rate for MSAs was assumed, which means 13.6 pounds of waste including mixed paper, newspaper and containers as well as 16 pounds of yard waste were collected for recycling or composting weekly. Total costs were estimated to be $87 to $144 per ton, or $8.65 to $14.40 per household per month. This adds $2.15 to $3.60 per month to household costs over landfilling.

Because collection and transportation costs dominate, the co-collection scenario where refuse and recyclables are collected and transported in the same vehicle is of interest. It is thought that if the landfill and MRF are located next to one another, collection and transportation costs can be reduced significantly. In fact, the true costs of co-collection are impacted by many of the same parameters as other collection systems—distance between set outs, the frequency of collection, the type and size of collection vehicle, and the locations where the refuse and recyclables are unloaded. Co-collection adds the distance to an additional facility after the recyclables are unloaded. Dual drive cab vehicles, where a driver can provide loading assistance, were found to reduce collection costs by nine percent.

The co-collection scenario analyzed in this study assumes the use of a packer truck retrofitted with two compartments for recyclables. Refuse would be placed in a packer compartment, paper in one of the recyclable compartments, and commingled containers in the other. The analysis further assumed that the collected refuse and recyclables would be unloaded at a landfill and MRF, respectively, located next to one another. The assumed system is distinct from blue-bag type systems, where residents put all recyclables in blue-bags, which collection crews then place in the same packer compartment with refuse. While blue bag systems may save on collection of curbside recyclables, processing costs are usually higher due to the added step of sorting blue bags from refuse, and liberating recyclables from the blue bags. There are also additional handling costs from reloading refuse for transport to another facility, even if near one another.

In general, the study found that any savings in collection are usually offset by increased processing costs, and hence, that costs were, on average, no different for co-collection than with separate collection. A community-specific assessment is required to accurately gauge costs. Also, it should be noted that no

types of co-collection have a substantial operating history, so cost and efficiency factors may change dramatically in coming years, as experience grows. [Evaluation of the systems now underway by the Solid Waste Association of North America and R.W. Beck and Associates (as part of EPA's MITE program) will provide some needed cost information on no-collection programs. A report is due to be published during the Fall of 1995. —Ed]

Non-MSA Costs

Costs developed for non-MSAs apply to a small community. The non-MSA assumed in the analysis was a community of 25,000 residents. Non-MSAs were assumed to have relatively high recovery rates (at 14 percent of non-bulky, single-family MSW). However, unique factors experienced by non-MSAs were taken into account, such as lower labor costs and longer transportation distances. For the landfilling only scenario, a much smaller landfill operation was assumed for a rural area, averaging 75 tons per day, six days per week. The total cost for collecting, transporting and landfilling household MSW was found to be between $78 and $130 per ton, or $7.25 to $12.10 per household per month—higher than landfilling only costs in an MSA. Just over one-half of these costs is for collection and transportation.

Table 2: Summary of Costs for Various Management Systems ($/ton)*

	Landfill Only	Curbside Recycling w/Landfill	Expanded Recycling w/Landfill	Composting w/Landfill	WTE w/Ash Landfill **
MSW collection	63	71	78	85	63
Landfill disposal	24	25	25	25	93
Total disposal costs	87	96	103	110	156
Recyclables collection	—	114	91	67	—
Recyclables processing	—	50	44	21	—
Total recycling costs	—	164	135	88	—
Recycling revenue	—	46	29	—	22
Net recycling cost	—				
Total System Costs	87	100	104	102	134
Incremental cost over Landfill Only	—	13	17	15	47

*In metro area with population of 500,000; costs are averages of assumed ranges.
**WTE revenue is for energy sales; processing costs include ash disposal

For the waste-to-energy scenario, total costs for non-MSA were between $93 and $155 per ton, or $8.65 to $14.40 per household per month. These costs are lower than for an MSA because of the lower labor costs involved in collection and transportation and the assumption that smaller waste-to-energy facility costs per ton were no higher than for larger facilities.

For the yard trimmings composting scenario, total costs were found to be $92 to $154 per ton, or $8.60 to $14.30 per household per month. These costs are higher than for an MSA because of smaller landfill and composting operations in a smaller area, which results in higher costs per ton. The increase over landfilling only was estimated at $1.35 to $2.20 per household per month.

For the base case curbside recycling scenario, a different collection approach was assumed for the non-MSA than the MSA. To avoid high processing costs, truckside sorting of recyclables was taken into account, and a 14 percent recovery rate was estimated. The lower recovery rate reflected the fact there is less newspaper in a non-MSA. Separate collection of recyclables from refuse was still considered. Revenue from the sale of recyclables was assumed to be $60 a ton. Waste composition for single family

households in non-MSAs is assumed to be the same as in MSAs, except that non-MSA households discard only about 2.15 pounds per week of newspapers, instead of 5.33. Total costs were $91 to $152 per ton, or $8.45 to $14.10 per household per month. Costs for this scenario were higher than for an MSA because collection of recyclables with truckside sorting is costly due to the additional labor necessary to sort the materials into seven truck compartments. The increase over landfilling only was estimated at $1.20 to $2.00 per household per month.

For the expanded case curbside recycling scenario, aluminum packaging other than beverage and food containers and non-PET/HDPE plastic bottles were excluded due to truckside sorting in the non-MSA. In addition, all paper grades were assumed to be placed in the same truck compartment and sold as mixed paper. A 25 percent recovery rate was assumed for the non-MSA. Total costs were estimated at $96 to $161 per ton, or $8.95 to $14.95 per household per month. Again, curbside recycling is more costly in a non-MSA, and the difference is more evident on a per ton basis because of the lower recovery rates experienced in rural areas. These costs represent $1.70 to $2.85 per household per month over landfilling only.

Table 3: Recyclables Generated in each MSA Household

Material	Weight (lbs/week)
ONP	5.33
PET	0.20
HDPE, natural	0.22
HDPE, color	0.27
Steel cans	0.97
Aluminum	0.58
Glass	3.83

A very high overall recovery rate of 63 percent of MSW was estimated for the expanded case curbside recycling plus yard trimmings composting scenario. Total costs for a non-MSA were $107 to $179 per ton, or $10.00 to $16.65 per household per month. The increase over landfilling only was estimated at $2.75 to $4.55 for household monthly costs.

No costs were estimated for the co-collection scenario for non-MSAs. Because of the need to sort recyclables at truckside, co-collection of refuse and recyclables would be complicated in some non-MSAs.

The cost estimates for the study assume a mix of household recyclable materials. Costs were developed for collecting and processing these materials together. The study made no attempt to allocate costs to each material or to estimate the incremental costs (or savings) of adding or subtracting a material in an existing system, even though such an analysis can be important in individual programs.

Regional Costs

While the above cost estimates are national averages and may be a useful barometer for planning purposes, it should be noted that there are significant differences in waste management costs from one region of the country to another. The study provided an analysis of regional costs for two MSA scenarios: landfilling only and base case curbside recycling.

The total system costs for landfilling only average about $87/ton, and range from a low of $68/ton in the Mountain Region to $104/ton in the Northeast. The differences clearly illustrate variances in labor rates and vast difference in landfill tipping fees.

Total system costs for base case curbside recycling with landfilling average $99/ton. Again, the costs ranged from a low of $81/ton in the Mountain Region to a high of $116/ton in the Northeast.

For other scenarios discussed in the

study, these regional breakouts may provide a similar order of costs and percentage cost differences. For instance, the regional cost differences for the yard trimmings composting scenario may closely resemble those for the landfilling only scenario, since substantial land is needed for composting. And the cost differences for expanded case curbside recycling would be close to those for base case curbside recycling.

Conclusion

It is a rarity today that municipalities have the luxury of additional dollars for new programs. Most are looking to maximize a shrinking bottom line and curbside recycling often is an area that increases the bottom line. For most communities, curbside collection and processing of materials for recycling is an area that needs analysis to make it more efficient. It is evident that recycling typically adds cost to waste management systems, and that the costs can increase progressively as additional materials are added to the recycling stream.

It should be noted, however, that prices paid for recyclables can fluctuate widely based on supply and demand and therefore affect overall costs. It is clear, too, that collection and transportation costs dominate in overall waste management system costs. Well over one-half of household costs (70 percent on average) are attributed to this area. The only exception to this is where landfill tipping fees are very expensive, such as in the Northeast region. The study shows that labor costs, type of equipment, and distance to the MRF and landfill affect the overall costs, and are a net expense to local budgets. Single-vehicle collection of recyclables and refuse, an attractive option for some communities, may be cost efficient only when it does not increase processing costs or reduce the quality of recovered materials. Multiple service vehicles, currently in development, may increase efficiency if recovered materials can meet market specifications.

The study points to some broad cost-effective approaches, such as yard trimmings composting. Here, system costs are the least expensive in terms of recycling approaches. Depending on a community's waste management objectives, however, yard trimmings composting may not provide the needed savings in terms of landfill volume. Because yard trimmings are by nature heavy rather than voluminous, the landfill volume savings over other recyclables must be considered.

The study also suggests that for rural (non-MSA) areas, drop-off and other citizen-based collection and separation systems may be the most cost effective approach, as long as the quality of materials recovered can be assured and there is a means for processing the recyclables.

While municipal recycling programs must be cost efficient for long term viability, cost is not the only consideration for solid waste planners. Recycling programs must also make sense from environmental and public health perspectives. And, they must be designed to meet other local waste management objectives. It is up to individual communities, states, and program managers to determine which objectives and values to pursue, such as saving energy, achieving a recycling goal or conserving material resources, reducing use of toxics, saving landfill space, reducing air emissions, and providing for local economic development. These factors should also be incorporated into the decision making process. It is evident that as costs rise to meet increasing recycling goals, difficult decisions will have to be made on how curbside recycling fits into overall waste management programs. ◆▶

Retrofit Delays Continue For New York WTE Plant

Disagreements between the city of Glen Cove, N.Y. and both the New York State Department of Environmental Conservation and Island Recycling Environmental Co., the operator of the city's idle 250-tpd waste-to-energy facility, continue to delay the retrofit and reopening of the plant.

The $34 million plant opened in 1983 and served to dispose of MSW from several Long Island communities before it closed in August 1991 for air pollution control upgrades. After the plant was shutdown, new city officials began raising concerns about the plant's environmental performance.

Adjudicatory hearings on a number of safety issues were underway in April, but a resolution was not in sight. According to attorneys for the city Dan Deegan and Steve Latham, the city is concerned about whether the state has conducted sufficient analysis of the project and about whether the new pollution control equipment is adequate. Deegan said the hearings likely will last until late spring.

The facility originally had electrostatic precipitators for particulate control, meeting air quality requirements at the time it was built. Interel Environmental Technologies, Inc., of Englewood, Colo., was hired to install new equipment, including new economizers, heat exchangers and dry scrubbers (featuring lime and activated carbon injection). Interel began work and installed the economizer, but was forced to halt work until several issues raised by the city could be resolved.

Atlantic County, N.J. Plans C&D Recycling Facility

The Atlantic County, N.J., Utilities Authority is planning a $3 million construction and demolition waste recycling facility to be located in Egg Harbor Township at an existing landfill. The plant will process 200-tons per day (60,000 tons per year) of waste, primarily from reconstruction and redevelopment in Atlantic City, including the expansion of hotels and a new convention center.

Authority spokesman James Rutala said the C&D plant also will process waste from the surrounding counties of Somerset, Hunterdon, Mercer, and Cape May. Rutala said the design will be completed by the end of 1995 and that permits are being sought from the New Jersey Department of Environmental Protection. Construction is expected to begin in mid-1996.

The plant is expected to recover about 51 percent of the waste stream.

Tires-to-Fuel Contracts Signed by Illinois, Indiana

National Tire Service (NTS), of Chicago, has won contracts to clean up tire piles in Indiana and Illinois. Michael Kennedy, NTS vice president, said Illinois will pay $250,000 and Indiana will pay $350,000 in each year of the two-year contracts.

Kennedy said each state has identified a number of piles that are an environmental or health hazard. Indiana estimates the number of tires at 50 to 60 million and Illinois has identified about 30 million. Most of the piles are located in semi-rural areas, though they are scattered throughout the two states. One specific urban location is in downtown Gary, Ind.

NTS will transport the tires by truck to one of its three processing facilities, near Milwaukee, Chicago, or Toledo. The tires will be shredded to 1-inch chips and sold for fuel for cement kilns, paper mills, and utility boilers.

Chicago Firm Consultants For Giant Illinois Facility

The West Suburban Recycling and Energy Center (WSREC) has named Consoer Townsend Envirodyne Engineers, Inc. (CTE), of Chicago, to design a waste transfer station that will be the first stop for about 1,800-tpd of MSW from McCook and Summit, Illinois. Ultimately, the single waste management complex is planned to include a WTE plant, recycling center, and possibly a composting facility. Bechtel Power Corporation has a contract to design the WTE facility.

Startup Expected This Month For Minnesota RDF Facility

An expanded refuse-derived fuel