

## Refuse and Recycling: Comparing the Costs

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Appendix to  
Refuse and  
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Comparing the  
Costs

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### SUMMARY

With the city set to resume its full recycling program in April, IBO has examined the comparative costs of the two main components of New York's waste stream: refuse and recycling. In 2002, the last year the recycling program was in full operation, the city's Department of Sanitation handled over 3 million tons of refuse and nearly 800,000 tons of recycling. According to sanitation department figures, the cost per ton for managing the city's refuse was \$257; IBO estimates that the cost for the curbside and containerized recycling program was \$291 per ton—about 13 percent more. This report provides a full description of what goes into the cost-per-ton figures.

The cost-per-ton approach is useful in determining the total amount of resources spent on handling the city's waste, but it is not a budgetary tool. To evaluate the budgetary effects of refuse and recycling we use an incremental cost analysis, which measures the cost of the recycling program less the *avoided* cost of not collecting and disposing of that material as refuse. IBO estimates that the incremental cost of recycling in 2002 was \$46 per ton, or \$33.7 million total.

Among the other key findings in this report:

- The cost of recycling paper, for which the city receives revenue, was on average less per ton than that of refuse. Metal, glass, and plastic continue to be more costly, however.
- The main reason for the higher cost of recycling is that a truck on average picks up less recycling than refuse—although the cost of operating that truck on either a recycling or refuse run is the same. The collection cost for recycling is \$80 per ton more than that for refuse, when adjusted for certain costs unique to recycling.
- As the amount of recyclables diverted from regular refuse increased, the incremental cost for recycling has decreased. The incremental cost per ton of recycling in 1994 was \$275 and dropped to \$144 in 1997 and \$46 in 2002 as the program expanded. It will fall further in 2005 as the cost of export continues to rise and the city reduces the fees its pays recyclers to take metal, glass, and plastic.
- A greater volume of recycling and higher collection productivity would drive the incremental cost down toward zero.

While the cost of exporting the city's refuse is growing, the restoration of the full recycling program should lower the cost per ton of collecting recyclables, narrowing the cost gap between refuse and recycling. In addition, as the amount of material diverted to recycling grows, the incremental cost will shrink. But short-term cost should not be the only basis for deciding recycling's future. Preserving the natural environment may be worth the price until recycling becomes more cost effective.

In 2002, the Department of Sanitation (DOS) handled roughly 3.8 million tons of the city's waste stream: 3 million tons of general refuse and 800,000 tons of recyclables. The department reported in the *Mayor's Management Report* for 2003 that each ton of refuse collected and disposed of in 2002 cost taxpayers \$257—nearly \$800 million total—including \$152 per ton for collection and \$105 per ton for disposal costs, which have escalated steeply since the city closed the Fresh Kills landfill and began exporting its waste. On a per-ton basis, recycling was almost 20 percent more expensive than refuse, costing \$305 per ton. The cost of simply collecting recyclables, according to the management report, was \$280 per ton, or 84 percent greater than that for refuse. Until now, however, how these figures were derived was not well understood outside the department.

In this fiscal brief IBO takes a closer look at the cost of collecting and disposing of the city's refuse and recycling. Using data provided by DOS, we begin by describing how the department arrived at its cost-per-ton figures. This analysis will provide some important insights into the costs of refuse management and recycling in New York City.

The cost-per-ton figures reported by the department, although useful for understanding the total city budgetary resources consumed in handling the city's waste, are less useful for comparing the cost of the recycling program with those of refuse management, however. A better approach is to measure the so-called *incremental cost* of recycling, which we do in the second section of this brief. The incremental cost approach, a method DOS has utilized in the Solid Waste Management Plan (SWMP), measures the direct cost of the recycling program, less the avoided costs of treating the recycled tonnage as refuse.

The analysis of DOS's 2002 costs provides the best reference point for understanding the economics of the city's garbage disposal and recycling as the city looks towards restoration of the full recycling program in 2005. Fiscal year 2002 was the last time that the city's curbside and containerized recycling program operated in full. In 2003, the collection of glass and plastic recyclables was suspended. More recently, collection of plastic recyclables has resumed, although collection is now on an alternate-week basis, rather than weekly. The Bloomberg Administration has announced its intention to fully restore the recycling program this coming April and resume weekly collection of paper and metal, glass, and plastic. The 2002 cost-per-ton figures therefore provide a snapshot of the costs of refuse and recycling the last time that the city's recycling program was fully in effect, providing a better understanding of the cost dynamics of refuse and recycling and of the impact of the rising cost of exporting garbage and new contracts for recycling.

## THE COST PER TON OF REFUSE AND RECYCLING

The Department of Sanitation reported that on average each ton of refuse collected and disposed of in 2002 cost taxpayers \$257, including \$152 per ton for collection and \$105 per ton for disposal. The nearly 800,000 tons of recycled materials cost an average of \$305 per ton, including \$280 for collection. The Department did not report a recycling processing/disposal figure comparable to the \$105 per ton disposal cost for refuse.

The calculation of the per-ton costs are based on an activity-based costing (ABC)

methodology used by the department, which they shared with IBO for purposes of this analysis. This

Cost per Ton of Refuse and Recycling, 2002		
	Refuse	Recycling
Collection	\$152	\$280
Disposal	105	n/a
<b>Total</b>	<b>\$257</b>	<b>\$305</b>

SOURCES: IBO; *Mayor's Management Report* Fiscal Year 2003.

methodology accounts for the total city budgetary resources consumed for all DOS functions, both from the budget of the Department of Sanitation, as well as costs attributable to the DOS functions that are borne elsewhere in the city budget, including fringe benefits of department employees and debt service payable on department capital assets.<sup>1</sup> Activity-based costing results in figures which are *fully loaded*; that is, it includes the *direct* costs of collection and disposal or processing, and allocates *indirect* costs such as vehicle and building maintenance, legal affairs, and other support and administrative overhead expenditures, based on direct costs. The appendix provides further detail on this costing methodology and the cost-per-ton calculation.

There are two basic components to the management of both refuse and recyclables: collection and disposal (we use the term disposal here to refer to what happens to material after it is collected, which, in the case of recycling, is processing into new products). These functions are driven by different inputs, and their costs are therefore calculated differently.

**Collection.** The cost of collection of both refuse and recycling consists primarily of labor. The wages, salaries, and fringe benefits of uniformed sanitation workers account for approximately 99 percent of the direct cost of collection, with non-labor costs such as truck parts and gasoline making up the small remainder. Collection costs are based on the number of *posts*—or worker shifts—used to run daily collection truck shifts. In 2002, DOS ran an average of about 5,000 truck shifts for refuse collection each week, and 2,175 average weekly truck

shifts for recycling.

In DOS's cost-per-ton analysis, administrative and other overhead costs associated with collection are allocated proportionally on the basis of the direct—mostly labor—costs. That is, the number of posts for refuse collection and for recycling collection is used to assign indirect costs associated with collection between the two functions. Although the volume of recycling—796,511 tons—was equal to just over 25 percent of the volume of refuse collected—3,088,104 tons—the number of recycling collection posts equaled 43 percent of the number of refuse collection posts, for reasons that will be explained in the next section. In calculating the fully loaded cost per ton of collection, therefore, most overhead costs of the department are allocated based on the ratio of recycling collection posts to refuse collection posts, rather than on the basis of tonnage.

**Disposal and Processing.** In contrast to collection, the cost of disposal of garbage and processing of recyclables is directly determined on a per-ton basis. The city enters into contracts with private firms to dispose of refuse or process recyclables into new materials. These contracts are written on the basis of a cost per ton. Therefore, it is tonnage, rather than labor, that drives

the costs of refuse disposal and recycling processing. Accordingly, DOS allocates administrative and other overhead costs associated with disposal and processing on the basis of tons, rather than on the basis of labor input costs.

### COMPARING REFUSE AND RECYCLING COSTS

The chart detailing 2002 collection costs shows the breakdown of the costs of managing New York City's refuse and recycling based on DOS's cost-per-ton data, as described above (see the appendix for a detailed explanation of the various cost categories developed by IBO for this report). Total costs were divided by tonnage to calculate the per ton cost.

**Why is Recycling More Expensive to Collect?** It is evident from the table of the sanitation department's 2002 costs that the direct cost to collect a ton of recyclables—\$142.60—is substantially greater than that to collect a ton of refuse—\$85.53. This may at first blush appear counterintuitive. The reason for the disparity lies in the productivity of collection, measured as tons collected per truck shift. In 2002, the department collected on average 10.3 tons of refuse per truck shift, compared to 6.3 tons per recycling truck shift. This lower productivity is due in

turn to the lower total volume of recycling. Since the volume of recycling set out at curbside is less than that of garbage, a truck shift of the same—or even greater—distance will collect less in recycling than it will in garbage. Simply put, the cost of paying two uniformed sanitation workers to drive an eight-hour shift collecting recyclables is the same as the cost of paying them for an eight-hour shift collecting trash, but yields fewer tons of recyclables than the same shift would yield tons of refuse. The result is a higher average cost of collection per ton.

2002 Sanitation Costs				
	Refuse		Recycling	
Tons collected	3,088,104		796,511	
	Total Cost	Average Cost per Ton	Total Cost	Average Cost per Ton
<b>Collection</b>				
Direct collection	\$264,138,573	\$85.53	\$113,547,579	\$142.60
Collection field support	46,141,751	14.94	19,705,682	24.74
Administration	43,727,553	14.16	15,818,708	19.86
Collection technical support	65,683,972	21.27	23,242,191	29.18
Non-collection tech support	--	--	7,925,284	9.95
Enforcement	--	--	8,602,319	10.80
SWP/BWPRR	--	--	11,270,631	14.15
Debt service	48,575,876	15.73	23,058,993	28.95
<b>Subtotal, collection</b>	<b>\$468,267,725</b>	<b>\$152</b>	<b>\$223,206,277</b>	<b>\$280</b>
<b>Disposal/Processing</b>				
Contract fees	\$200,154,840	\$64.81	\$19,412,339	\$24.36
Non C&C recyclables disposal	--	--	267,751	0.34
Export contract administration	8,103,430	2.62	--	--
Admin & technical support	60,966,793	19.74	--	--
Fresh Kills closure	14,554,114	4.71	--	--
Debt service	43,172,350	13.98	--	--
<b>Subtotal, disposal/processing</b>	<b>\$326,951,527</b>	<b>\$105</b>	<b>\$19,680,090</b>	<b>\$25</b>
<b>Total</b>	<b>\$795,219,252</b>	<b>\$257</b>	<b>\$242,886,367</b>	<b>\$305</b>

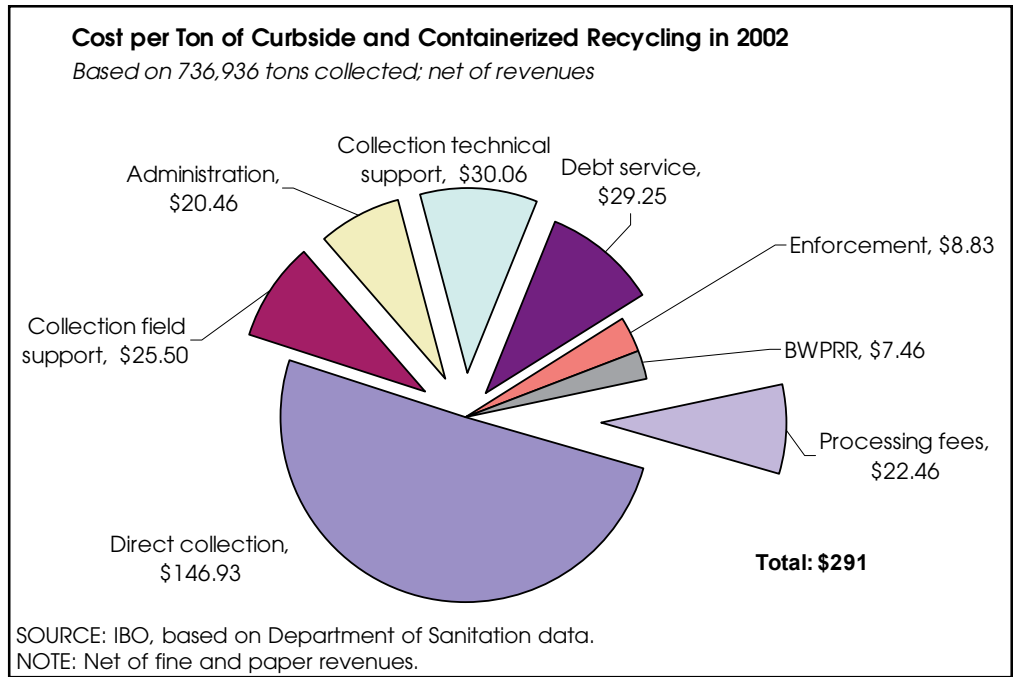
SOURCES: IBO; Department of Sanitation.  
NOTES: Individual items may not add to total due to rounding. SWP/BWPRR: Solid Waste Planning; Bureau of Waste Prevention, Reuse, and Recycling. C&C: Curbside and containerized.

**Comparable Collection Costs.** Also evident from the table is that certain costs are unique to either recycling or refuse. It is fitting to include these costs in the total recycling and refuse costs of \$305 per ton and \$257 per ton, respectively. However, the classification of several unique recycling costs as recycling *collection* costs warrants further consideration. The costs of recycling enforcement, certain non-collection technical support costs, and expenditures of the Bureau of Waste Prevention, Reuse, and Recycling (BWPRR) are all attributed by the department to recycling collection.<sup>2</sup> The addition of these costs further raises the cost per ton of recycling collection. In addition, collection-related debt service was calculated differently for refuse and for recycling, assigning proportionately more debt service expense to recycling collection by including none on the processing side.

Does the inclusion of these extra categories contribute significantly to recycling's higher collection cost? When only the first four collection cost categories are summed, the resulting costs per ton are \$136 for refuse and \$216 for recycling. The refuse/recycling cost gap narrows somewhat (from \$128 per ton to \$80 per ton), but does not disappear. The remaining difference is due entirely to the productivity differential between refuse and recycling; that is, due to the fewer tons picked up on a recycling shift than on a refuse shift.

**Cost of the Curbside and Containerized Recycling Program.** DOS calculated the figures discussed above based on a total 2002 recycling tonnage of 796,511 tons. DOS collects paper and metal, glass, and plastic (MGP) through its curbside and containerized program for residents and institutions. The curbside and containerized program volume was 736,967 tons in 2002, including 406,540 tons of paper and 330,427 MGP tons. In addition to curbside and containerized program recyclables, almost 60,000 tons of other materials were not picked up at the curb, including yard waste, leaves, Christmas trees, and abandoned vehicles.

We estimated the 2002 cost of the curbside and containerized recycling program at \$291 per ton (\$14 per ton less than the cost presented by DOS for all recycled material). Certain cost categories are eliminated or reduced when measuring only the



curbside and containerized program. For example, about half the spending of BWPRR is for non-curbside and containerized recycling programs, and those costs are therefore not included here.

DOS did not include in recycling's cost per ton the revenue earned through the sale of recycled paper, and the collection of fines from recycling enforcement. Inclusion of paper and fine revenues reduces the cost per ton by \$6.71, compared to the unadjusted \$305 per ton figure. In 2002, the city received an average of \$7 per ton for its paper, amounting to sales revenue of \$2.8 million. The city also received fine revenue of \$2.1 million.<sup>3</sup>

Most other costs, however, show some increase on a per-ton basis. This is because the curbside and containerized program consumes proportionately more labor and non-labor inputs than the other components of the city's recycling program on a per-ton basis. Curbside and containerized collection, for example,

<b>Paper and MGP Recycling Cost per Ton, Fiscal Year 2002</b>		
	Paper	MGP
Tons collected	406,540	330,427
Collection	\$193	\$215
BWPRR & other admin	27	30
Enforcement	8	9
Debt service	28	31
Processing fees/(revenue)	-7	59
<b>Total</b>	<b>\$248</b>	<b>\$343</b>

SOURCE: IBO, based on Department of Sanitation data.  
NOTE: Numbers may not add to totals due to rounding.

accounted for 95 percent of total recycling posts in 2002, although it represented 92 percent of total recycling tonnage.

*Paper and MGP.* A principal reason why the administration sought in 2003 to eliminate metal, glass, and plastic recycling, but not paper, is that the economics of recyclable materials are different. In 2002, the city paid recyclers an average of \$59 per ton to take combined metal, glass and plastic. In contrast, the city *received* an average of \$7 per ton in revenue for paper. The \$22.46 per ton in “processing fees” shown in the cost breakout chart therefore conflates these two quite separate markets into a single figure.

IBO isolated the costs of MGP and paper to estimate the average per-ton cost of each program. We allocated costs of the full curbside and containerized recycling program to MGP recycling and to paper recycling based on the percentage of posts assigned to each.

By nearly \$100 per ton, paper is a more cost-effective material to recycle than MGP, and is even cheaper than refuse. Two-thirds of the difference can be attributed to paper’s revenue-generating market position. But the tons of paper collected on an average truck shift were also greater than the amount of MGP collected, resulting in slightly lower per-ton collection and other costs.

## THE INCREMENTAL COST OF RECYCLING

The cost-per-ton analysis is useful for understanding the total city budgetary resources consumed in handling the city’s refuse and recycling. But it cannot be used to measure the net budgetary cost of the recycling program.

One way to estimate the net cost of recycling is to use an incremental cost approach. The incremental cost method measures the cost of the recycling program, less the *avoided* cost of not collecting and disposing of that material as refuse. The avoided cost can be thought of as the amount saved because the ton of material was recycled. If the cost of recycling the ton exceeds the cost of throwing it away, then the incremental cost is positive; recycling is more expensive than refuse. Conversely, a negative incremental cost indicates that the cost of recycling the ton is less than that of throwing it away.

DOS has previously presented incremental cost calculations in the Solid Waste Management Plan. Through the mid-1990s the

incremental cost of recycling fell, from \$275 per ton in 1994, to \$171 in 1996, and \$144 per ton in 1997. Throughout this period, the city’s recycling program was expanding in both materials collected and frequency of collection. The higher “diversion rate”—the percentage of the total waste stream recycled—led to greater productivity in recycling collection, and hence, lower per-ton costs. In addition, the market for selling our recyclables was improving, increasing the competitiveness of the recycling program overall. Using their best estimates at the time, the Department of Sanitation projected in 2000 that, if these trends continued, the 2002 incremental cost of recycling would fall to \$13 per ton.

<b>Incremental Cost of Curbside &amp; Containerized Recycling Program in 2002</b>	
<i>Based on 736,967 tons collected</i>	
<b>Costs Directly Related to the Program</b>	
BWPRR Administration	\$1,733,810
Collection (including relays)	135,249,188
Net Processing and Marketing (net of revenues)	14,321,552
Public Education and Outreach	2,957,400
Community Services	2,008,531
Enforcement (net of fine revenues)	5,436,695
<b>Total Costs Directly Related to the Program</b>	<b>\$161,707,176</b>
<b>Average Direct Costs per Ton</b>	<b>\$219</b>
<b>Avoided Refuse Collection, Transfer, &amp; Disposal Costs</b>	
Avoided Refuse Collection Costs	(\$78,291,535)
Avoided Refuse Transfer and Disposal Costs	(49,700,208)
<b>Total Avoided Costs</b>	<b>(\$127,991,742)</b>
<b>Average Avoided Cost per Ton</b>	<b>(\$174)</b>
<b>Incremental Cost of the Recycling Program</b>	<b>\$33,715,434</b>
<b>Average Incremental Cost per Ton</b>	<b>\$46</b>
SOURCES: IBO; Department of Sanitation.	

*IBO’s Incremental Cost Estimate.* IBO estimates that the incremental cost of recycling was \$46 per ton in 2002. We used the model for calculating incremental cost provided by DOS’s Solid Waste Management Plan, with certain modifications described below.

The incremental cost of recycling is calculated as the difference between the cost of the curbside and containerized recycling program and the hypothetical cost of treating the recycling tonnage as garbage. Expenses incurred for non-curbside and containerized recycling are not included, as these would occur independently of the curbside and containerized program. For instance, the costs of waste prevention, composting, Christmas tree collection, CFC removal, and operating self-help recycling facilities are all excluded, as are the BWPRR administrative expenditures on these programs.

*Costs Directly Related to the Recycling Program.*

- *BWPRR administrative* costs were included based on the number of personnel directly assigned to the curbside and containerized recycling program, plus a proportionate allocation of general and administrative personnel.
- *Collection* costs include labor and non-labor expenses for direct collection and relays, as well as a share of vehicle maintenance and debt service based on vehicles used, for a total collection cost of \$135.2 million.
- *Net processing and marketing* includes the \$19.4 million paid in processing fees to recyclers in 2002, less \$5.1 million in revenues received for paper recyclables and fees from Visy for the operation of the 59<sup>th</sup> Street transfer station used to barge paper recyclables to Visy’s Staten Island processing plant.
- *Public education and outreach* includes certain non-labor BWPRR administration costs.
- We allocate the full cost of *community service* for the recycling program in our incremental cost calculation. Prior to the creation of the citywide 311 call center, this was where calls were received for sanitation-related questions.
- Finally, we include the full cost of recycling enforcement, less fine revenues received (about \$2.1 million in 2002).

*Avoided Refuse Collection, Transfer, & Disposal Costs.* If the 736,967 tons of MGP and paper recycled in 2002 had been disposed of as refuse, IBO estimates the cost would have been \$128 million. The collection component of this avoided cost is based on the 2002 productivity and expense of refuse collection and relays. As with recycling, the costs of vehicle maintenance and debt service are included in this figure. The avoided transfer

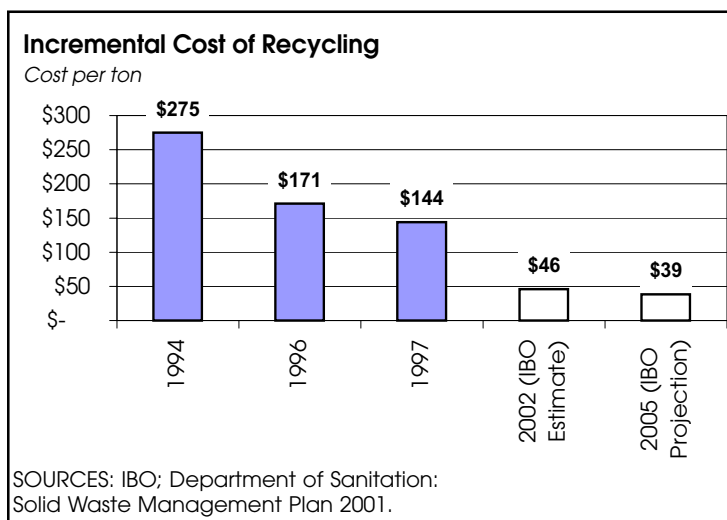
<b>Projected 2005 Incremental Cost of Recycling</b>				
	Baseline	Scenario 1	Scenario 2	Scenario 3
Diversion Rate	19%	25%	25%	25%
TPTS, Refuse	10.3	10.3	10.3	10.2
TPTS, Recycling	6.3	6.9	7.4	7.7
Program Incremental Cost/(Savings) (\$ millions)	\$28.40	\$12.00	\$2.50	(\$6.40)
Per Ton	\$39	\$13	\$3	(\$7)

SOURCE: IBO projection based on Department of Sanitation data.  
NOTE: All scenarios assume \$71 per ton waste export cost and \$51 per ton MGP processing cost. TPTS: Tons per truck shift.

and disposal cost was calculated based on the per-ton export cost of curbside and containerized refuse in 2002, plus the per-ton cost of administering those contracts.

Based on DOS’s 2002 data, IBO estimates the incremental cost of curbside and containerized recycling to have been \$33.7 million in 2002, or \$46 per ton.<sup>4</sup> The cost has come down substantially since 1997, due to a rising diversion rate and the cost of exporting the city’s garbage for disposal. But it is far higher than the sanitation department’s earlier estimate of \$13 per ton, in part because DOS had anticipated a diversion rate of 25 percent. The actual diversion rate was closer to 20 percent.

Based on the 2002 analysis and projected costs of refuse export and recycling processing fees, we also projected the incremental cost for 2005, when the recycling program is fully restored. We project a slightly lower incremental cost in 2005 of \$39 per ton—\$28.4 million total. Our estimate incorporates an increase in export contract costs to an average of \$71 per ton from a 2004 average of \$69 per ton (a change in avoided costs), and a reduction of the MGP processing cost from \$59 per ton in 2002 to \$51 per ton in 2005, based on the most recent publicized bid the city has received for its MGP. It also assumes a diversion rate similar to that in 2002 and no change in productivity or other costs.



We also examined some alternative scenarios incorporating a higher recycling diversion rate, and varying assumptions about how the greater volume of recycling could affect collection productivity, measured in tons per truck shift. These results are summarized in the table on the projected 2005 cost of recycling. Our findings confirm DOS’s earlier analysis, that a higher diversion rate would reduce the incremental cost of recycling substantially. Depending on the level of collection productivity achieved, recycling could even result in net savings to the city.

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## WHAT DOES THE FUTURE HOLD?

Unless recycling diversion rates go up substantially, recycling collection will continue to be less efficient on a per ton basis compared with refuse collection. Even in 2002, when the city achieved its highest ever diversion rate, the collection cost per ton of recycling was substantially higher than that of refuse. Historically, significant increases in the diversion rate have only been achieved when new materials were added to the recycling stream, or when the frequency of recycling pick up increased.<sup>5</sup> However, because of the disruptions to the recycling program over the last year-and-a-half, when the full program resumes this spring the city will not immediately return to recycling diversion rates comparable to those that prevailed in 2002, while city residents get back into the habit of recycling metal, glass, plastic, and paper on a weekly basis. In the short term, the comparative costs of refuse and recycling are not likely to change substantially.

Over the longer term, there are a number of ideas for boosting the amount of waste that is recycled that merit consideration. More efficient truck routing, single-stream collection, increasing the “capture rate” (the share of potentially recyclable material that actually gets recycled, currently only about 35 percent),

exploring potential new materials markets, and adding other materials—notably food waste—to the recycling program, are among the ideas that have been put forward by advocates. If for no other reason than that the cost of exporting garbage continuing to rise, the incremental cost of recycling will eventually come down.

But while budget impacts are important, near-term cost are not the sole basis for evaluating the city’s recycling program. The longer-term benefits of preserving the natural environment—both locally and nationwide—must also be considered.

*Written by Elisabeth Franklin*

## END NOTES

<sup>1</sup> The Department of Sanitation’s six primary functions are Refuse Collection, Refuse Disposal, Recycling, Cleaning, Paid/Free Disposal, and Snow. Our analysis focuses solely on the first three functions.

<sup>2</sup> The remaining costs of enforcement are assigned by DOS to the Cleaning function. Adding them to the Refuse Collection function would add about \$2 per ton on average.

<sup>3</sup> We attribute all the costs and revenues of recycling enforcement to the curbside and containerized program.

<sup>4</sup> IBO’s incremental cost calculation differs slightly from the methodology used by DOS in the Solid Waste Management Plan.

<sup>5</sup> See Independent Budget Office, *Overview of the Waste Stream Managed by the NYC Department of Sanitation*, February 2001.