Appendix II
BEYOND CASE STUDIES: COMPARATIVE STUDIES OF RECYCLING RATES

Table AII-1 shows the costs per ton and diversion rates for DSNY-managed waste for fiscal years 2001, 2002, and 2003.

Table AII-1
Performance Statistics for the Department of Sanitation

	FY 01	*FY 02*	*FY 03*
Refuse cost per ton (fully loaded)	$243	$257	$242
Disposal cost per ton	$91	$106	$95
Recycling cost per ton (fully loaded)	$323	$305	$381
Paper recycling revenue per ton	$7	$7	$7
Annual tons recycled in total (000)	2,083	1,869	1,557
Annual tons disposed (000)	3,516	3,360	3,799
Curbside and containerized recycling diversion rate	20.10%	19.80%	11.40%
Total diversion rate	37.20%	35.70%	31.80%

Source: *Mayor's Management Report Preliminary Fiscal Year 2004*
www.nyc.gov/html/ops/downloads/pdf/2004_mmr/0104_mmr.pdf.

An obvious question is how do these costs and rates compare to those in other U.S. cities. The discussion of waste management in San Francisco, Los Angeles, Chicago, and Seattle in Chapter Three of this report covers some of the difficulties in making such comparisons. However, a number of studies have been conducted that use quantitative techniques to compare costs and diversion among large numbers of U.S. municipalities. This Appendix presents a review of three of the most important studies.

Cautions About Comparisons

Before reviewing any comparison, it is important to point out that there are serious limitations to comparing costs for recycling and waste disposal. These limitations have been acknowledged by a wide range of experts in the solid-waste–management field:

Editor of *Resource Recycling*, Jerry Powell

> There's a big lack of top-quality information on the net benefits of recycling, in particular, a dearth of well-researched cost data.[1]

City of Tucson, Recycling Coordinator

> We don't really report on costs per ton. We talk big numbers in big circles. Per ton collection costs aren't everyday information. They are hard to track, and usually vary with the administrator who calculates them at the time, as opposed to the private collection costs which are always known.[2]

City of Los Angeles, Joint Labor-Management Committee, Collections Planning Group, writing in 2000:

> …regional economic variations [do] not permit credible comparisons [among cities' waste management systems]. Disposal costs, which vary regionally, significantly influence total costs. Some agency resources come primarily from their City's general fund, while others rely only on enterprise funds.…Some agencies [use] cost data based upon 1988 data, while in other cases...information is more current.…Most importantly, there is no template guaranteeing that the financial information from the agencies is collected and/or computed in the same manner as to permit credible comparisons.[3]

Waste News, February 14, 2000, "Apples and Kumquats"

> Cities' recycling programs vary as widely as the cities themselves.…Municipalities are figuratively as well as literally all over the map when it comes to recycling…the apples-to-apples comparison of city recycling rates remains elusive.[4]

The three studies reviewed present program costs comparatively, but should be interpreted with these limitations in mind.

The Research of David Folz

Political scientist David Folz uses quantitative techniques to assess the cost-effectiveness of municipal recycling programs in the United States, analyzing survey data on large numbers of municipalities over time. Folz takes into account a wide range of variables that reflect demographic, political, economic, fiscal, technological, and participatory aspects of solid-waste management in cities and towns.[5] Using statistical techniques, he isolates factors that explain variation in a number of program outcomes—including participation and cost-effectiveness of recycling in comparison to landfilling.

One of Folz's more recent works is a 1999 article in *Public Administration Review* in which he argues against recycling's "perennial critics [who] challenge the economic prudence and environmental benefits of recycling."[6] This article goes on to identify features associated with high diversion, as well as to determine circumstances in which recycling is more cost-effective for municipalities than disposal.

Diversion

Comparing survey results from 1989 to 1996, Folz finds that diversion rates in U.S. municipalities rose across the board from an average of close to 16 percent in 1989 to 33 percent in 1996—confirming the widely observed trend of escalating diversion rates throughout the U.S. during the 1990s. Folz observes that this increase was higher among mandatory programs (close to 23 to 36 percent) than voluntary ones (nearly 13 to 30 percent). More marked increases have also occurred among programs that collected "tin" (bimetal) and other metals, and had a full-time recycling program coordinator.

Folz's results confirm the importance of composting in boosting diversion. He observes that diversion increased more among localities "that composted yard wastes instead of disposing of these in the landfill or incinerator."[7] Diversion rates have increased in cities all over the nation since the late 1980s. In recent years, most of the increase has come from yardwaste diversion.

Moreover, he notes an inverse relationship between density and diversion, writing that "cities with high population densities experienced less improvement in diversion. This suggests that local officials in these cities faced special challenges in collecting recyclables from high-rise residential...generators."[8] This research confirms the difficulties of attaining high diversion in high-rise residential buildings.

Costs

Folz also looks at changes in solid-waste–program costs over time, finding that in large cities, overall waste-management costs for disposal, composting, and recycling combined have fallen. Folz cites an overall decrease in costs per ton for recycling, composting, and refuse combined from $109 per ton in 1989 to $95 per ton in 1996 (in constant dollars).[9] In cities with populations over 100,000, furthermore, this drop has been more marked—total costs fell from $164 to $81 per ton, on average.[10] He also gives evidence to show that over this period, average recycling costs have become competitive with disposal. Cities earned an average of $36 per ton of recyclables in 1996, which rendered their net costs for recycling/composting collection, processing, and other associated items (administration, education, etc.) on average $68 per ton. In contrast, refuse collection and landfilling averaged $134 per ton for that same year.

However, Folz finds that in very large cities, recycling is not as cost-competitive as in smaller jurisdictions. In the largest cities surveyed (those with populations over 100,000), revenues from recycling were lower than average—around $15 per ton (Table AII-2, page 130).

Key Findings in the Research of David Folz

Diversion Rates 1989 to 1996

Diversion rates have increased

- More in cities with mandatory programs
- More in cities that collect bimetal cans
- More in cities that have a full-time coordinator
- Mostly due to the additional diversion from yard-waste composting

Diversion and Density

- Cities with high density experience lower diversion rates
- Cities with concentration of multifamily apartment buildings experience lower diversion rates

Waste-Management Costs in the Largest Cities

Cities with populations over 100,000

- Saw more of a drop in *total* waste-management costs over time than smaller cities
- Earn less revenue per ton on recyclables than smaller cities
- Have higher unit costs for recycling due to presence of multi-unit households

What Drives Recycling Costs

Recycling costs are lower when

- The recycling program is voluntary, not mandatory
- The recycling program includes yard-waste collection

Recycling costs are higher when

- Refuse is collected the same day as recycling
- Multifamily generators are included in the recycling program
- Cities have a population over 100,000

Diversion-rate increases have tiny effects on recycling costs.

Population and Housing Density Mitigate Economies of Scale

Diversion rates are lower and recycling costs are higher

- In large, high-density cities
- When multifamily dwellings are included in a city's recycling program

Folz does not measure large savings from increases in tons diverted

Research Note

Folz notes that there are serious limits to even the most careful comparative research on recycling costs.

Table AII-2
Mean Net Recycling Costs Per Ton and Mean Costs Per Ton for Refuse Collection and Disposal in 1996 (actual dollars)

Population	*Recycling costs/ton*	*Recycling revenue/ton*	*Net recycling costs/ton*	*Refuse collection costs/ton*	*Refuse disposal costs/ton*	*Total refuse costs/ton*
Under 5,000	$158.14	$24.46	$133.68	$81.51	$68.82	$150.33
5,000–10,000	$119.02	$12.84	$106.18	$145.45	$57.96	$203.41
10,001–25,000	$92.86	$19.31	$73.55	$48.50	$52.75	$101.25
25,001–50,000	$48.10	$16.16	$31.94	$120.05	$40.79	$160.84
50,001–100,000	$48.77	$17.51	$31.26	$46.11	$43.37	$89.48
100,000 plus	$88.02	$14.75	$73.27	$53.54	$34.96	$88.50
All cities	**$103.63**	**$35.67**	**$67.96**	**$81.99**	**$51.83**	**$133.82**

Source: David H. Folz, "Municipal Recycling: A Public Sector Environmental Success Story," *Public Administration Review,* July/August 1999, Vol. 59, No. 4.

The discrepancy between net recycling costs ($73) and refuse collection/disposal ($89) was less in large cities as well. Further analysis leads Folz to suggest that "the inclusion of multi-family households appeared to contribute to higher unit costs [for recycling]."[11]

Using regression analysis, Folz identifies factors that explain variation in recycling costs across cities. Programs with voluntary recycling pay about $59 dollars less for recycling collection and processing per ton than do mandatory programs. When a program includes yard waste, its recycling/composting costs average about $53 lower than when the program only collects recyclables. Collecting recycling on the same day as refuse—a factor that he stresses is important to boosting diversion—increases per ton costs by an average of $57 per ton. Including multifamily generators in a city's curbside program (all or some) increases recycling costs by $39 a ton.

Folz also observes that with each ton recycled, per ton costs fall by an average of 2 cents. The total tonnage a city recycles, of course, depends on its population. Depending on the size of the city, this savings will add up differently, but the effect is tiny in all cases. For instance, if New York City were to double its pre-suspension tonnage of residential recycling (665,000 tons per year in Fiscal Year 02), this model predicts it would save a total of only $13,000 per year.[12]

Research Limitations

Overall, Folz's research suggests that in certain circumstances, a municipality's net costs for collection and processing recycling may be less than those for refuse collection and disposal, although on average less so for large cities. But he also acknowledges limitations to his method of generating cost estimates, in which:

> …recycling program costs were measured by the recycling coordinator's response to the question, 'What was your city's *total cost* (all direct and indirect costs) for the recycling program, excluding any revenue from material sales.'[13]

> …accurate, precisely comparable, and centrally collected cost data are not readily available.…Larger cities [may] collect and maintain extensive records on recycling costs. By contrast, some jurisdictions may not even have a separate line-item for recycling in their solid waste collection budget. Still another problem is the reluctance of some jurisdictions to share this information because they fear unfair comparisons in the absence of a standard, widely used method to calculate costs.[14]

Folz describes the uncomfortable choice that researchers in this area face: they must "neglect any cost comparisons, or employ reasonable measures, no matter how imperfect."[15] He stresses that "ascertaining the costs of recycling is...difficult," because "there is considerable variation in the extent to which local officials track recycling expenditures."[16] In fact, "total program cost" for recycling is an extremely variable measure because it depends very much on which items are included in the recycling budget. Some jurisdictions count collection as part of their overall solid-waste budget and calculate recycling costs as processing and public education only. Some track the very minor spending on contract administration and publicity overseen by the city as the "recycling budget." Many costs may never be officially recorded. And the fact that only 105 out of 158 cities surveyed in 1996 supplied financial data at all suggests it may be possible that "*some* coordinators may not know what their recycling program actually costs,"[17] while others keep these costs in their heads only.[18]

Furthermore, Folz explains that he was not able to consider a number of program design parameters that affect a city's collection, processing, and marketing operations, including the specific materials collected, crew sizes/configuration, types of collection vehicles and routes, collection frequency and schedule, and types of generators included in the program.[19] "All of these factors merit analysis," he observes, even if the limits of his study preclude consideration.[20]

Folz concludes that although recycling should not be expected to "pay for itself," there are different circumstances in which recycling will be more or less expensive. He also observes that despite the fact that recycling, under the right conditions, can be less expensive than disposal, recycling in general "is not cheap."[21] Thus this research by no means settles the matter of comparative costs—even though it does provide an interesting analysis of the program factors that are significantly correlated with reported program costs.

What Can We Learn from Folz's Research?

With good reason, Folz's research is widely cited in the policy advocacy literature to argue for recycling program development and expansion. For example, a Year 2000 report issued by the Consumers Union summarized the results of his work, saying:

> A recent study of municipal recycling performance in 158 cities compared recycling costs to solid waste collection and disposal costs and found that 'the cost per ton declined as city size and number of tons increased' (Folz, 1999, p. 343). Such economy of scale clearly benefits NYC recycling programs.[22]

It is important to assess Folz's work in its entirety, and not just cite parts of it that sustain a particular argument. Folz's overall work clearly shows that very large, high-density cities with multifamily dwellings will incur higher costs than other demographic areas—mitigating economies of scale. And while his research bears out the assumed inverse relationship between diversion and overall costs, it shows the magnitude of such a relationship to be tiny in dollar terms. Thus it invites a reconsideration of the conventional wisdom that envisions large savings potential from increasing the diversion rate in New York City.

The EPA/U.S. Conference of Mayors Report on Multifamily Recycling

In 2001, the United States Conference of Mayors, working in collaboration with the EPA, released a comprehensive, national study *Multifamily Recycling*. Unlike other studies of this topic, the EPA report paid close attention to costs and diversion. As the report pointed out, "multifamily recycling is often overlooked by public sector planners,"[23] and when it is examined, attention is usually focused on case studies of successful buildings, without regard to costs or diversion for a city's total housing stock of this type.[24]

According to this report, multifamily recycling receives less attention than programs serving single- and two-family houses because "multiple dwelling units are often considered part of the commercial sector, and many local governments have little control over [this] sector."[25] Furthermore, "where refuse is collected under individual contracts between landlords and competing private firms, recycling is often similarly unregulated."[26] This trend in categorization means that "at present, no universal definition of what constitutes a multifamily recycling program exists."[27] It may also explain, say the report's authors, why there is a perception that apartment dwellers are less likely to participate in recycling programs than are single-family dwellers.[28]

"Nonetheless," observes the EPA, "many communities have established and maintained successful multifamily recycling programs."[29] The EPA measures success using a dual criteria of effectiveness and efficiency, noting that "a program can be very effective (i.e. high diversion rate) and not very efficient (i.e. high unit costs). Obviously, the most successful programs are those that are both effective and efficient, or those characterized by high diversion rates and low unit costs."[30]

Data for this report was gathered via a survey in 1997 administered to recycling program managers of cities belonging to the U.S. Conference of Mayors with populations over 25,000. Among the 227 cities who responded, approximately half (118) had a multifamily recycling program in place for at least 12 months. The analytical portion of the study focused on a sample of 40 communities taken from the 118, selected to be representative of the U.S. as a whole in terms of geography and size.[31] Using data from these 40, the EPA calculated summary statistics on diversion rate, program costs, and other features, and ran tests to determine statistically significant relationships among these variables. For the purposes of the study, multifamily dwellings were defined as having three or more units.[32]

New York City was one of the 40 cities included in the analysis. This posed a problem for some of the statistical calculations, because of New York's disproportionately huge population. The report explained that "in some cases, where averages are calculated for all 40 communities, NYC's statistics are omitted to avoid skewing the data."[33] In fact, the report observed that out of a total of 11.5 million multifamily households in the entire U.S., 28 percent were in New York.[34]

Diversion

The overall diversion rate is one of the most widely reported statistics on municipal-solid-waste management, but multifamily diversion is rarely tracked separately. As the EPA notes, "multifamily refuse is frequently collected in the same trucks and on the same service routes as large commercial customers.…Indeed, many communities did not have data on their collected amounts of multifamily refuse or recyclables."[35] Thus, much of the data used for the analysis was drawn from recycling coordinators' *estimates* of the multifamily fraction. The

EPA notes that in "only a minority of cases are separate data available for multifamily recycling tonnages."[36]

Using these estimates, the report calculated an average diversion rate of 14.6 percent for multifamily-dwelling curbside programs, with a range of 5 to 37 percent. When drop-off recycling was included, the average multifamily rate increased to 15.7. Among the 40 cities, the distribution across rates was roughly even: thirteen (13) had rates lower than 10 percent; sixteen (16) diverted between 10 and 20 percent; and eleven (11) exceeded 20 percent. (It should be noted that unlike many other diversion-rate comparisons, this report separated composting, as well as construction and demolition material out, focusing on metal, glass, plastics, paper, and other "traditional" recyclables as diversion from the residential stream to make comparisons.)

The study examined differences in costs and program characteristics among these samples to determine relationships between diversion and other factors. It noted that among high-diversion, multifamily recycling programs, 61 percent used dual-bin refuse/recycling trucks; 90 percent made recycling mandatory; 64 percent provided bins; and 63 percent charged for refuse and recycling collection, with volume-based incentives for refuse minimization.[37]

The authors also found several surprising results. The first was that:

> …there is a positive relationship between number of setouts (i.e. sorts) required and the diversion rates achieved. The programs with the highest diversion rates

Key Findings in the EPA/U.S. Conference of Mayors Report on Multifamily Recycling

Population

- In 1997, only half of U.S. cities with populations of 25,000 or more even had a multifamily recycling program
- New York City is home to 28 percent of the nation's multi-unit housing

Diversion

- In the year of the EPA study (1997), multifamily diversion averaged 14.6 percent nationwide
- Multifamily recycling is more complicated, more expensive, and tends to have lower diversion rates and higher contamination rates than single-family recycling...*nationwide*
- Over 80 percent of multifamily recycling programs were managed privately. Those programs reported higher diversion rates than publicly run programs.
- Surprisingly, this study found that multifamily generators achieved higher diversion rates when they were required to sort materials into more separate categories

Diversion rates are higher in multifamily programs that

- Use dual-bin trucks to collect refuse and recycling
- Have mandatory recycling programs
- Charge building owners volume-based fees for refuse and recycling collection

Contamination

Contamination is a frequent problem in multifamily recycling

- 80 percent of multifamily recycling coordinators consider it a "problem they have to live with"
- Methods to address contamination include suspending service, writing letters, installing surveillance cameras, and issuing fines

Costs

- Recycling costs are higher for programs serving multifamily units by an average of $50 per ton
- In programs that serve multifamily units, as well as those that don't, it costs more to recycle than to dispose of refuse
- Recycling costs were about $64 per ton higher in cities that had diversion rates under 20 percent; refuse disposal costs in those cities were about $23 per ton lower
- The larger the total quantity of materials to collect, the higher the program costs

Research Note

Multifamily recycling is an understudied area of research. In fact, many cities include multifamily buildings with commercial generators, and focus only on single- and two-family dwellings.

> average 3.2 setouts, while programs with the lowest diversion rates average 2 setouts…it appears requiring multifamily households to place their recyclables in 3 or more containers…is positively associated with increased diversion.[38]

This result was counterintuitive. In most studies, the number of setouts is inversely related to diversion because it makes recycling more complicated. The report ventured that there might be "a correlation between the number of materials collected and the number of setouts, and accepting many materials is a key element of achieving a high-diversion rate."[39]

The EPA also observed that "contamination...is a frequent problem in multifamily recycling."[40] A full 80 percent of all multifamily recycling program coordinators reported that they considered contamination as a problem to be lived with.[41] Most often, multifamily programs suspended service or left materials at curbside when contamination was especially bad, although among high-diversion communities, none refrained from collecting recycling when workers noticed contamination.[42] Instead, high-diversion communities used methods such as sorting samples of recycling materials to identify offenders, writing letters to "problem" apartment complexes, and even placing cameras in problem areas (methods reported among 11 percent, 11 percent , and 22 percent, respectively). In addition, 60 percent of high-diversion communities issued fines, as opposed to only 20 percent of low- and medium-diversion groups.[43]

The report also found that low multifamily participation rates were more frequently cited as a problem in communities with high overall diversion rates, than in low-diversion communities.[44] This counterintuitive result may have been due to increased sensitivity to low participation among high-diversion communities.

A final finding of the study was that multifamily programs with higher reported diversion rates were more likely to rely on a private firm to collect recyclables, and to award one private firm the exclusive right to collection.[45] Noted the authors, "there is a basic differentiation between services provided by employees of local government…and services provided by employees of a private firm."[46] In fact, among the multifamily programs examined, a full 82 percent had at least some form of private collection.[47] In contrast, only 32.5 percent of the communities provided any form of public sector recycling collection for multifamily complexes.[48]

Costs

The report's authors calculated the following mean, minimum, and maximum per-ton costs for recycling and refuse collection among multifamily and single-family programs (Table AII-3).

Table AII-3
Single vs. Multifamily Collection Costs

	Recycling collection costs per ton			***Refuse collection costs per ton***		
	Minimum	***Mean***	***Maximum***	***Minimum***	***Mean***	***Maximum***
Multifamily	$62	$177	$622	$16	$63	$171
Single family	$11	$127	$420	$16	$69	$286

Source: Multifamily Recycling: *A National Study,* EPA-530-R-01-018, November 2002, conducted by the U.S. Conference of Mayors and Ecodata, Inc.

Multifamily recycling costs exceeded single-family recycling costs by an average of $50 per ton. And in comparison to refuse collection, both multifamily and single-family recycling were more expensive. Unlike other studies of overall costs, this report found recycling collection to consistently outweigh refuse collection by substantial amounts.

Furthermore, the analysis revealed that "in multifamily recycling, collection costs per ton tend to decrease as the tons to collect at each stop increases."[49] On average, per-ton recycling-collection costs were $113 for cities with greater than 20-percent diversion, as opposed $177 in low-diversion groups."[50] Such savings were, however, partially offset by greater refuse-collection costs in high-diversion cities ($66 per ton, on average) as opposed to low-diversion ones ($43 per ton.)

The amount of material present at each stop on a collection route was documented as one of five factors determining overall program costs. These five factors, according to the report's literature review, account for 85 percent of the variation in costs of refuse- or recycling-collection programs nationwide (Table AII-4).

Table AII-4
Major Determinants of Cost Variation

Factor	*If a city has*	*Overall program costs will be*
Economic	higher prevailing wages	higher
Geographic	denser housing per curb mile (if this results in less time travelling between stops)	lower
Demographic/income	greater amount of material set out	lower
Scale of operations	larger the total quantity of materials	higher
Frequency	more often	higher

Source: Multifamily Recycling: *A National Study,* EPA-530-R-01-018, November 2002, conducted by the U.S. Conference of Mayors and Ecodata, Inc.

As the amount of recycling or refuse collected at each stop goes up, collection costs per ton for that material tend to go down. In addition, housing density may decrease collection costs *if* it means decreased travel time for collection trucks. However, this effect may not be seen when housing density translates to increased local traffic and street parking. It is notable that an overall larger scale of operations does not yield economies; "the larger the total quantity of materials to collect, the higher the program costs."[51]

What Can We Learn from the EPA's Multifamily Recycling Report?

The EPA findings suggest that, on average, multifamily costs for recycling collection outweigh those for single-family service. This discrepancy is compounded when the scale of the program is large, and when the prevailing wage is higher. Higher diversion rates do tend to drive recycling collection costs down for both multifamily and single-family dwellings, but in such cases multifamily still remains a more costly undertaking.

Multifamily diversion is, in fact, most economical when collection is privatized. However, this effectiveness comes at a price:

> …multifamily recycling programs can present a challenge for funding. In those communities where multifamily refuse collection is considered a service to be paid for by the apartment complex, typically through a contract between the property manager and a private hauler, there is no governmental expenditure for solid waste services to this category of customers. Implementing a recycling program to these customers, via any system except mandated subscription service, typically requires government funding.[52]

To offset this burden, governments may charge recycling fees to consumers directly or indirectly through contracts. The report states that "higher fees and a greater likelihood of a fee for multifamily recycling is associated with higher diversion rates."[53] But there are tradeoffs to such an approach since "charging units to recycle is often politically difficult to justify."[54]

Overall, the report finds that multifamily recycling is more complicated, more expensive, and tends to have lower diversion rates and higher contamination rates than single-family recycling. Multifamily buildings use common recycling areas, lack storage space in apartments, and possess an anonymity that single-family houses do not. Moreover, "costs of a program…are dependent upon factors that are both within and beyond the control of local government officials. Population density, prevailing wages, weather patterns, and income levels can affect travel times between collections stops, quantities of materials set out at each stop, operation of vehicles…and the basic cost of a collection crew."[55]

As with Folz's research, this report suggests that self-reported survey data on program costs and diversion has limitations, and should be regarded as an indicator of general tendencies rather than a precise quantification of program efficiency or effectiveness. This is true even when quantitative methods are used. The EPA used survey estimates of program costs, and were not able to check the determinants or comparability of such estimates. Recycling coordinators in many instances estimated multifamily diversion without recorded tonnages. Overall, the report's authors cautioned that because "no universal definition of what constitutes a multifamily recycling program exists," the very concept under study was somewhat indeterminate.[56]

EPA Report "Cutting the Waste Stream in Half: Community Record Setters Show How"

In contrast to the two survey studies profiled above, the EPA's 1999 report entitled *Cutting the Waste Stream in Half: Community Record Setters Show How* profiles a series of localities that have achieved high-diversion rates (45 to 60 percent), drawing overall conclusions about what constitutes a blue-ribbon waste-reduction program. This report, which was based on research by the Institute for Local Self-Reliance (ILSR), profiles 18 localities, chosen to represent a demographic cross-section of the United States. Populations range from 1,900 persons to 873,000; densities vary as well. The 16 municipalities and two counties range from urban to suburban to rural. They are spread throughout the U.S., representing 12 states. They exhibit different mixes of public vs. private-sector service provision, as well as variation in how service is funded (including 11 instances of pay-as-you-throw arrangements). While all but one consider curbside collection the "heart" of their program,[57] they differ in terms of the use of carts vs. bags; truck compartments and sizes; and manual, semi-automated, or fully automated collection. While most collect the standard array of recyclables and yard waste, some include additional materials. The programs vary in terms of how many segregations are used, how often recyclables are

collected, whether the program is voluntary or mandatory, as well as whether and how multifamily households are served (Table AII-5).

Diversion

The ILSR examines residential diversion separately from commercial diversion. In addition, it treats diversion through yard-waste composting and diversion through recycling of paper, metal, glass, and plastic as distinct. While the report's authors do count Bottle Bill redemptions in this "recycling diversion" rate (unlike NYC), they exclude "non-municipal waste items such as construction and demolition debris and used motor oil," from the diversion-rate calculation, as in NYC.[58] Source reduction is calculated as adding to the diversion rate only in cases in which "creditable data on the amount of material recovered through these programs were available,"

Table AII-5
Comparison of Record-Setters' Programs

Cities	*Participation rate*	*Materials targeted*	*Collection frequency for recycling*	*Segregations required*	*Participation mandatory*	*Fines*	*Pay as you throw*	*Average fee per year (as of mid-1997)*	*Private/public collection*	*Recycling collection crew size*	*Bins provided*
Visalia, CA	100%	20	weekly	1	no	no	no	N/A	public	1	yes
Fitchburg, WI	98%	25	weekly	4	yes	yes	yes	$82	both	1	yes
Madison, WI	97%	17	weekly	4	yes	yes	no	N/A	public	1	no
Loveland, CO	97%	19	weekly	3	no	no	yes	$52	public	2	yes
Ann Arbor, MI	93%	31	weekly	3	yes	yes	no	N/A	both	1	yes
Bellevue, WA	90%	29	weekly	4	no	no	yes	$156	private	1	yes
Seattle, WA	90%	23	varies	2 to 3	yes	no	yes	$192	private	1	yes
Falls Church, VA	90%	21	weekly	4	no	no	no	N/A	both	1	yes
Crockett, TX	80-90%	25	weekly	3	yes	yes	no	N/A	public	2	no
Clifton, NJ	80-85%	20	1x/3 weeks	7	yes	yes	no	N/A	both	3	no
San Jose, CA	83%	23	weekly	5	no	no	yes	$168	private	1	yes
Portland, OR	81%	22	weekly	varies	no	no	yes	$210	private	varies	yes
Chatham, NJ	80%	24	2x/month	5	yes	yes	yes	$117	both	3	no
Dover, NH	74%	28	weekly	3	no	no	yes	$57	private	1	yes
Ramsey Co., MN	62%	varies	2x/month	5	yes	varies	yes	$156	private	1	yes
Bergen Co., NJ	varies	N/A	varies	varies	no	varies	some	N/A	varies	N/A	varies
Leverett, MA	N/A	25	no curbside	N/A	yes	no	yes	$72	public	0	no
Worcester, MA	N/A	24	weekly	3	yes	no	yes	$26	both	1	yes

Source: Institute for Local Self-Reliance for the Environmental Protection Agency, *Cutting the Waste Stream in Half: Community Record Setters Show How,* EPA-530-R-99-013, June 1999.

and even then adding it to the composting rate, not the recycling rate.[59] Given the way that diversion is usually reported, these are important adjustments. As the report authors note, using these methods "lowered calculated waste reduction levels, ensuring our reported recovery levels would not be considered inflated."[60]

Using this methodology, the *recycling* rate (i.e., diversion of metal, glass, plastic, paper, textiles, and other materials but excluding yard waste) among the "Beyond Fifty-Percent" record-setters turns out to range from *16 to 40 percent,* with both a mean and median of 24 percent (Table AII-6).

Costs

The authors of the ILSR report acknowledge the difficulty of examining capital expenditures, operating costs, and materials revenues comparatively across jurisdictions:

> Evaluating the economics of community materials recovery programs is a challenging task. Reliable and consistent data are often lacking. Publicly funded programs may underestimate their costs by

Table AII-6
Comparison of Record-Setters' Diversion Rates

Cities	*Waste stream*	*Annual waste tonnage*	*Reported waste reduction*	*Yard-waste diversion*	*Reported recycling diversion*
Ramsey Co., MN	Combined	673,398	47%	8%	40%
Dover, NH	Residential	9,462	52%	17%	35%
Leverett, MA	Residential	652	53%	23%	31%
Ann Arbor, MI	Residential	47,943	52%	23%	30%
Fitchburg, WI	Residential	4,147	50%	21%	29%
Seattle, WA	Combined	288,106	49%	20%	29%
Worcester, MA	Residential	57,573	54%	27%	27%
Bellevue, WA	Residential	39,186	60%	34%	26%
Falls Church, VA	Residential	6,665	65%	40%	25%
Portland, OR	Combined	172,830	40%	17%	23%
Chatham, NJ	Residential	8,007	65%	43%	22%
Crockett, TX	Residential	2,711	52%	32%	20%
Loveland, CO	Residential	17,973	56%	37%	19%
San Jose, CA	Combined	433,576	45%	26%	19%
Bergen Co., NJ	Combined	353,815	49%	32%	17%
Madison, WI	Residential	88,583	50%	34%	16%
Visalia, CA	Residential	50,806	50%	33%	16%
Clifton, NJ	Combined	54,211	44%	28%	16%

Source: Institute for Local Self-Reliance for the Environmental Protection Agency, *Cutting the Waste Stream in Half: Community Record Setters Show How,* EPA-530-R-99-013, June 1999.

> including large volunteer efforts or excluding expenditures made by other public agencies, while private operations' data are often unavailable for public scrutiny.[61]
>
> …we have made a concerted effort to use a uniform methodology for documenting and assessing costs. Yet, due to the difficulty in gathering reliable and consistent cost information, the figures presented have some limitations.…Differences in local costs of living and market conditions, and service levels offered by programs all have financial consequences. Local factors affect fuel costs, labor costs, and tip fees.[62]

With these problems, the authors are extremely cautious about the application of their data, even going so far as to say that:

> …We do not believe cost data presented in this report should be used to make comparisons among communities regarding the relative cost-effectiveness of their programs.[63]

Key Findings in the EPA Report "Cutting the Waste Stream in Half"

Even "record-setting" communities have a diversion rate around 25 percent for paper, metal, glass, and plastic. The rest of diversion comes from other sources

The report by the Institute for Local Self-Reliance shows that "cutting the waste stream in half" depends mainly on the degree of yard-waste composting a municipality conducts.

Research Notes

- Unlike most studies, the ILSR report looks at paper, metal, glass, and plastic diversion separately from yard waste, other organics, or C&D.
- Even the most painstaking research on costs yields incomplete numbers that are not comparable across localities.

Nonetheless, the report does compare costs among municipalities by examining the change in overall solid-waste–management costs for a municipality before, and several years after, introducing recycling and composting in constant dollars. Authors calculate the total costs of each municipality's refuse, recycling and composting operations, including expenditures on administration, education and publicity, enforcement, collection, processing and marketing (for recyclables and compost, net of revenue), transfer and tipping (for refuse), and transportation, then divide this total by the number of households to get a per household cost for waste management.

Using this method, they find that in half of the municipalities for which there were adequate data, overall solid-waste–management costs *rose* as a result of the introduction of recycling, although in four of the seven cases of rising costs, landfill tip fees escalated during the same period in which recycling was phased in.[64] Thus, they argue, when the introduction of a recycling program coincides with increasing costs for solid waste management in general, the increasing expenses of refuse disposal, and not recycling, are often to blame. Furthermore, they find several cases in which overall solid-waste–management costs went down after the implementation of a recycling and composting program.

The ILSR's method of cost estimation surpasses that of Folz or the Conference of Mayors Report in that it entails more than a survey question about the "overall recycling budget," addressed to the municipality's recycling coordinator. Instead, the ILSR gathers separate estimates of capital and operating expenses, offsetting them with data on revenues from materials sales.[65] Whenever possible, they categorize costs for recycling and composting among administration, education/publicity, collection, and processing; and break down refuse costs into administrative, collection, transfer, and tip fee categories. Still, the authors concede that there are limitations on the data:

> …the costs documented focus on the costs of trash management and waste reduction incurred by the local government or community profiled or fees for services paid by…residents. [They do not include] the value of services, such as technical assistance, provided to localities by counties and states.…In addition, costs of capital equipment are reflected in debt service or depreciation costs, regardless of the source of funds used to purchase equipment.[66]

The authors explain that full-cost accounting techniques, in which each and every direct and indirect cost of all aspects of a solid-waste–management program are quantified, would be required to accurately "document and compare these record-setting communities," but recognize that "such research and analysis were beyond the scope of this report."[67] Thus the cost data in this study, as in all others, must be viewed as, at best, a general indicator of tendencies, and not a precise calculation:

> Communities account for and track their costs very differently. Some expend much effort to include all indirect and administrative overhead costs; others exclude these entirely. Some use accrual accounting techniques, others rely on cash-flow accounting.[68]

The ILSR reports the costs of recycling, composting, and refuse management separately on a per-ton basis. When feasible, overall costs are broken out into collection, processing/disposal, administrative, education-related, and other *ad hoc* categories. This exercise reveals a number of instances in which recycling costs are reported as lower than refuse disposal costs, as well as other cases where the reverse is true (Table AII-7).

Yet the methods with which each municipality tracks and reports costs differ so widely that the comparisons presented in this chart do not convey most of the information needed to interpret them. All of these communities have high overall diversion rates, and good recycling rates—yet their costs vary widely. Regional differences in the landfill market may explain why tip fees are higher for some cities than others, but clearly a much larger panoply of factors is at play in causing this variation.

What Can We Learn from the ILSR's "Cutting the Waste Stream in Half"?

The ILSR report shows that "cutting the waste stream in half" depends mainly on the degree of yard-waste composting a municipality conducts. With few exceptions, the "community record setters" profiled have recycling diversion for paper, metal, glass, and plastic that are in the 20- to 30-percent range. The report furthermore confirms that the costs of waste management—including refuse collection and disposal; and recycling collection and processing—vary widely even among the best performing programs, confirming the findings of Folz and the Conference of Mayors.

Table AII-7
Comparison of Record-Setters' Program Costs

Cities	*Refuse collection & transport per ton*	*Landfill tip fees per ton*	*Recycling collection per ton*	*Recycling total costs per ton**	*Recycling revenues per ton*
San Jose, CA	$59	$28	$62	$206	$0
Portland, OR	$58	$63	$124	$196	$0
Crockett, TX	$25	$13	$14	$189	$17
Madison, WI	$104	$34	$115	$160	$13
Bellevue, WA	$106	$66	$129	$139	$0
Loveland, CO	$68	$10	$112	$128	$11
Seattle, WA	$86	$45	$91	$121	$0
Fitchburg, WI	$64	$36	$81	$117	$0
Ramsey Co., MN	N/A	$28	$81	$115	$0
Visalia, CA	$61	$33	$61	$114	$0
Ann Arbor, MI	$46	$27	$73	$102	$9
Dover, NH	$48	$46	$67	$75	$0
Falls Church, VA	$92	$45	$41	$62	$0
Clifton, NJ	$30	$112	$46	$55	$13
Worcester, MA	$33	$31	$49	$54	$0
Leverett, MA	$20	$58	$7	$51	$17
Chatham, NJ	$51	$102	$38	$39	$8
Bergen Co., NJ	N/A	$103	N/A	N/A	N/A

* including collection, processing, administration, and other costs

Source: Institute for Local Self-Reliance for the Environmental Protection Agency, *Cutting the Waste Stream in Half: Community Record Setters Show How,* EPA-530-R-99-013, June 1999.