The Economic Benefits of Recycling

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INSTITUTE FOR LOCAL SELF-RELIANCE

Environmentally Sound Economic Development

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by
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The Institute for Local Self-Reliance (ILSR) is a nonprofit research and educational organization that provides technical assistance and information to city and state government, citizen organizations, and industry.

Since 1974, the ILSR has researched the technical feasibility and commercial viability of environmentally sound, state-of-the-art technologies with a view to strengthening local economies. The Institute works to involve citizens, government, and private enterprise in the development of a comprehensive materials policy oriented towards efficiency, recycling, and maximum utilization of renewable energy sources.

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Table of Contents

List of Charts

List of Tables

Introduction

A flurry of articles criticizing recycling as a high-cost way of handling our solid waste has been sweeping the country since mid-1991.[1] This adverse publicity, coming at a time when an economic recession is forcing cities to reduce their spending, encourages local policy makers to view "high-cost" recycling programs as attractive candidates for cutbacks.

In fact, recycling and composting are often cheaper than conventional garbage collection and disposal. Where they are more expensive, the reason has more to do with startup costs, low levels of materials recovered in a program's initial phases, system design, or temporarily low costs of landfills than with the inherent costs of recycling.

For many communities, expanding recycling and composting programs can reduce municipal budgets and cut business and household operating expenses. A city of one million whose landfill costs equal the national average of $26 a ton can save its government, businesses, and households $7 million a year by aggressively expanding its materials recovery and reuse efforts. Where landfill costs are high, such a city can save as much as $30 million a year.[2]

Yet the benefits of recycling go beyond reducing waste management costs. Recycling, on a per ton or per dollar invested basis, creates more jobs than incineration or landfilling. And, if the community is large enough, it can recover sufficient discarded materials to attract new scrap-based manufacturing enterprises.

Thus, recycling wins three ways: it lowers operating costs, employs more people, and offers the potential for high-wage manufacturing employment.

The costs of recycling have rarely been compared to the costs of other forms of waste management in a fair and realistic way.[3] In the early 1980s, recycling programs were expected to pay for themselves through the sale of materials. If they did not, critics labeled the expenditures on recycling "subsidies." Yet solid waste management does not and should not be expected to pay for itself. The more appropriate question to ask is whether recycling and composting programs are cheaper or more expensive than alternative waste management strategies.

First-Order Economics

Let us look at the first-order economics of recycling; that is, the cost per ton of recycling versus the cost per ton of landfilling or incineration. Nowadays the cost of curbside recycling is often compared with the cost of conventional disposal alone, even though the cost of recycling displaces collection as well as disposal costs. The average cost of collection and disposal should be compared to the overall average cost of collection and recovery. When this comparison is made, the economics of recycling and composting often look very impressive.

Chart 1 compares the per ton costs of materials recovery (through source-separation recycling and composting programs) to those of conventional garbage collection and disposal in fifteen communities. For most of the communities shown, recycling and composting cost less than the disposal alternative, resulting in savings of as much as $173 per ton. West Palm Beach, Florida, for example, a city of 63,000 people, saves $43 for each ton recovered—about $700,000 a year. Data from a nationwide survey of 264 recycling programs suggest that recycling is cost-effective once landfill tip fees reach $33 a ton.[4] Many recycling and composting programs remain cost-effective at much lower fees. The survey, for instance, found that mandatory programs—which have lower per ton costs than their voluntary counterparts as a result of higher participation and higher amounts of materials collected—are cost competitive with landfill tipping fees of $15 a ton.[5] Perkasie, Pennsylvania's materials recovery program would remain cost-effective with landfill tip fees as low as $4 a ton.[6]

Some communities pay their refuse collection and curbside recycling contractors on a per household basis. Lafayette, Louisiana,

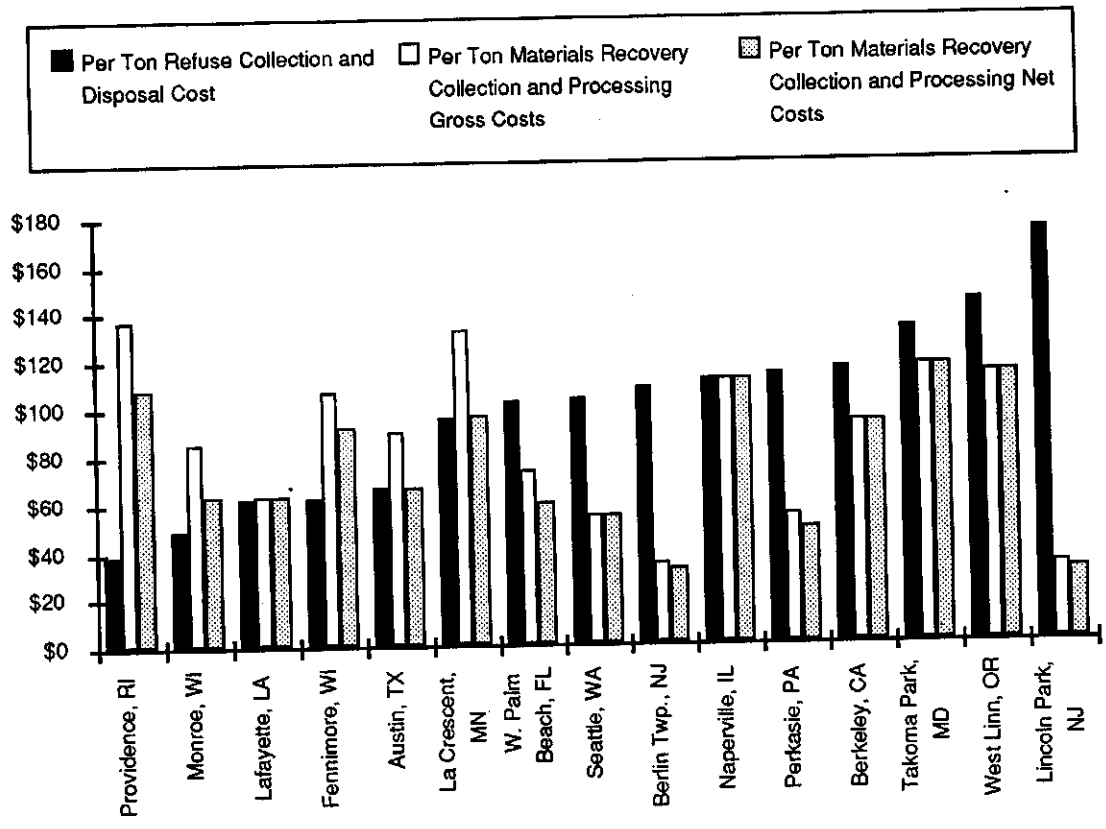
considers its recycling program quite cost-effective. Its costs for garbage handling are $73 per household per year; collection and marketing of recyclables costs $11.[7] Naperville, Illinois, another city that pays its haulers on a per household basis, claims its per ton recycling costs continue to decrease as the tonnage recovered increases but the charges remain the same.[8] The city incurs $97 per household per year for refuse collection and disposal and $40 per household per year for recycling collection and marketing. Recycling is almost always cheaper than refuse collection and disposal on a cost per household basis.[9]

Factors Affecting Costs of Materials Recovery Programs

Amount of Material Recovered

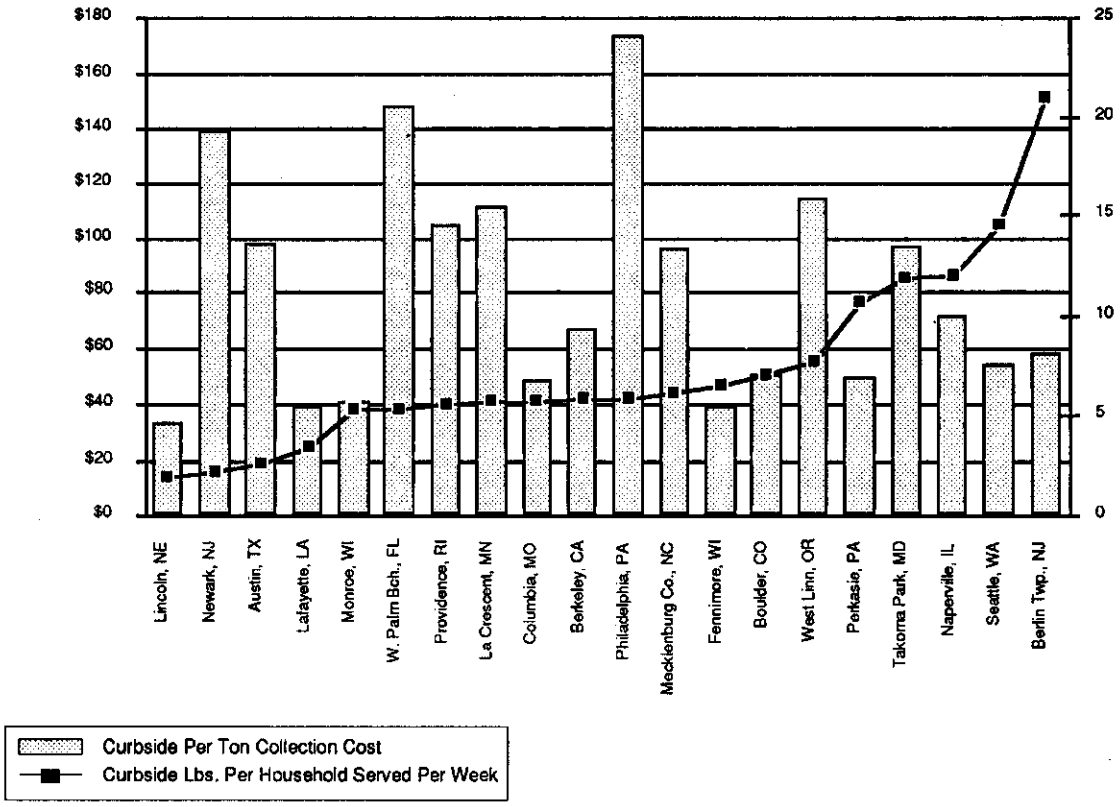
Chart 2 shows the relationship between the cost of collecting recyclables and the amount of material recycled per household. Not surprisingly, the cost per ton handled goes down as the amount of material collected goes up. Six of the eleven programs with costs lower than $80 per ton are recycling more than six pounds per household per week. In contrast, six of the nine communities with costs above $80 per ton

Chart 1
Costs for Materials Recovery Collection and Processing Versus Refuse Collection and Disposal



Source: Brenda A. Platt et al., *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results* (Institute for Local Self-Reliance, Washington, DC: 1992).

Chart 2
O&M Collection Costs for Curbside Recycling Programs and Pounds Per Household Per Week



Source: Brenda A. Platt et al., *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results* (Washington, DC: Institute for Local Self-Reliance, 1992).

are also those that recover fewer than six pounds per household per week. Critics of recycling, who often cite the astronomical costs of programs such as Chicago's and New York City's, fail to mention that these represent minimal recycling efforts in which very little has been collected for recovery.[10]

Three strategies in particular help communities to maximize the quantities of material recovered: targeting a wide range of materials for collection (particularly items that comprise a significant percentage of the waste stream, such as residential mixed paper); raising participation rates; and composting yard waste. Cities and towns with high participation rates like Seattle, Washington; Fennimore, Wisconsin; Berlin Township, New Jersey; and Perkasie, Pennsylvania, also have low per ton recycling and composting costs.[11] Composting yard waste helps increase the tonnage recovered and can reduce overall materials recovery costs. Yard waste is more homogeneous than recyclables, can be compacted, and can be collected in one vehicle.

Newark, New Jersey, incurs a cost of $25 a ton to collect and compost leaves, grass clippings, and brush at curbside. Collection and processing of recyclables costs the city $147 a ton; refuse disposal costs alone are $97 per ton. Yet, because more yard waste is recovered than recyclables and at a lower per ton cost, the city's overall materials recovery program costs $84 a ton on average.[12] Yard waste collection and composting programs have lowered the average per ton costs of materials recovery by $18 to $30 in Berlin Township and Lincoln Park, New Jersey; Takoma Park, Maryland; Fennimore, Wisconsin; and La Crescent, Minnesota.

Integrated Systems

As communities attain ever higher recovery levels, planners and public works administrators are beginning to realize that recycling and

Table 1
Record-Setting Recycling and Composting Programs

Community		Population	Year Data Collected	Residential Recovery Rate	Commercial Recovery Rate	MSW Recovery Rate
Lincoln Pk	NJ	10,980	1990	49%	70%	62%
Berlin Twp.	NJ	5,630	1990	56%	61%	57%
Bowdoinham	ME	2,190	FY90	NA	NA	54%
West Linn	OR	16,560	1990	NA	NA	50%
Longmeadow	MA	16,310	1989	45%	53%	49%
Perkasie	PA	7,880	1990	52%	NA	NA
Haddonfield	NJ	12,150	1989	51%	24%	49%
Rodman	NY	850	1989	NA	NA	43%
Upper Township	NJ	10,860	1990	50%*	34%†	NA
Wellesley	MA	26,590	1989	NA	NA	41%
Seattle	WA	516,260	1990	45%	40%	40%
Hamburg	NY	11,000	1989	39%	18%	40%
Wilton	WI	470	1989	40%	38%	40%
Fennimore	WI	2,380	1990	51%	25%	38%
Woodbury	NJ	10,450	1989	49%	11%	32%
Newark	NJ	275,220	1989	10%*	46%†	NA

Key: FY = fiscal year MSW = municipal solid waste NA = not available

Notes: Recovery rates represent proportions by weight and include material recycled and composted. MSW Recovery Rate may take into account tonnages that cannot be broken down into commercial and residential, such as bottle bill tonnages or landscapers' waste. Residential and commercial recovery rates are not available in those communities that do not track these wastes separately. Perkasie does not track commercial waste; only residential waste data are available.
*Publicly collected waste.
†Privately collected waste.

Sources: Brenda Platt et al., *Beyond 40 Percent: Record-Setting Recycling and Composting Programs* (Washington, DC: Institute for Local Self-Reliance, 1990); and Brenda Platt et al., *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results* (Washington, DC: Institute for Local Self-Reliance, 1992).

composting can be the primary strategy for handling our solid wastes, rather than a supplement to the conventional system. Table 1 lists some of the country's record-setting recycling and composting programs, with materials levels near or above fifty percent. The economics of materials recovery improves when, instead of adding the costs of recycling and composting onto the costs of conventional collection and disposal, the two are integrated. Berlin Township, New Jersey, which boasts one of the highest recovery rates in the nation, uses the same staff and much of the same equipment for refuse and recycling activities. Perkasie, Pennsylvania; Naperville, Illinois; and Takoma Park, Maryland, have each replaced one of their two weekly refuse collection days with collection of recyclables and/or yard waste. As a result, Naperville paid twenty percent less to collect and dispose of refuse in 1991 than in 1990.

When Takoma Park started its curbside program, it reorganized the Sanitation Division in order to avoid hiring additional employees to collect recyclables. The city reduced the number of trucks collecting refuse and converted one of its three-person refuse collection crews to a recycling crew. After reaching a thirty-six percent residential recovery rate in 1990, Takoma Park further reduced its refuse collection infrastructure in 1991, and split sanitation crews evenly between recycling and refuse collection.

Some communities use co-collection systems, in which refuse and source-separated recyclables are collected simultaneously in the same vehicles, in order to more fully integrate recycling into existing solid waste management systems. Loveland, Colorado, projects that its citywide co-collection program will cost $79 a ton—well below the costs estimated for separate trash and recycling collection systems.[13] Baltimore, Maryland, uses the same conventional trash trucks to collect bagged recyclables and garbage, but does so separately at different times. This minimized its upfront costs and allowed it to add a recycling program with no increase in its solid waste management budget.[14]

Revenues Received

Revenues from the sale of materials can reduce the net costs of materials recovery. However, prices for scrap materials fluctuate dramatically; in times of economic recession they can drop to zero. Some towns have had to pay to get rid of their newsprint. Yet even when scrap prices are low, recycling operations can remain cost-effective.

The only true barrier to materials recovery is the total disappearance of the market for recycled materials; in such a case, these materials must be disposed in conventional incinerators or landfills. Yet even in the four years of recession from 1988 to 1992, this has been a rare and temporary occurrence.

About a dozen states, understanding that market development must be a key element in solid waste management programs, have enacted minimum recycled-content laws covering newsprint, glass and plastic containers, and/or telephone books. Thanks to recycled-content laws for newsprint, new recycled paper mills are under construction during the current recession. Ten new newsprint deinking facilities started up in the U.S. and Canada in 1991; another eight are expected to begin operation in 1992.[15] Some industry experts predict that this new capacity will result in a deficiency of old newspapers that could reach more than 600,000 tons a year by 1995.[16]

Increased market demand for recycled material can significantly reduce the cost of recycling. Recycling Corp. of America, which is building a 300 ton-per-day newsprint deinking mill in New York City, will start buying old newsprint from the City for $25 to $35 per ton in January 1993. This is a dramatic change from the situation in 1992, when New York City had to pay $20 a ton to market its old newspapers.[17]

Comparison with Other Strategies

The costs of collecting recyclables and yard waste vary, as do conventional refuse collection costs. In fact, communities with high recycling costs often have high refuse collection costs.

One reason is that labor costs have the same effect on refuse collection as on collection of recyclables and compostables. In West Linn, Oregon, where hourly wages are almost $15, the private hauler spends $114 per ton (75 percent of which represents labor costs) on curbside collection of recyclables, and $144 per ton on refuse collection and disposal. Philadelphia pays $173 per ton for curbside recycling, and about $170 per ton for conventional collection and disposal.

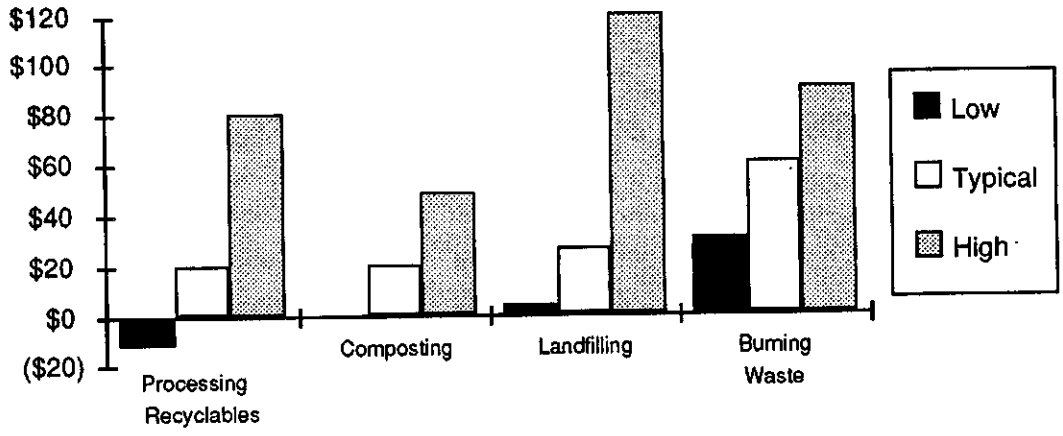
The comparative cost-effectiveness of materials recovery programs depends on the current cost of regular garbage disposal. Providence, Rhode Island, uses a state-operated landfill that charged only $13.98 per ton in 1990. That same year, Providence's per ton recycling costs were three times the cost of conventional collection and disposal.

Landfills

Even when landfill disposal costs—called "tip" or "tipping" fees in garbage lingo—are low, recycling and composting may still be preferable to disposal options. We are running out of landfills, and new ones may cost far more than existing ones. Tipping fees at new landfills in New York, New Jersey, and Pennsylvania are well above $40 a ton.[18] Even in the South, new landfills have tip fees above $40; a "state-of-the-art" landfill in Palm Beach, Florida, charges $43.50 a ton.[19] While no accurate assessment of nationwide capacity has been made, at least 22 states have less then ten years of landfill capacity left.[20] Southern states reportedly average five years of remaining capacity.[21]

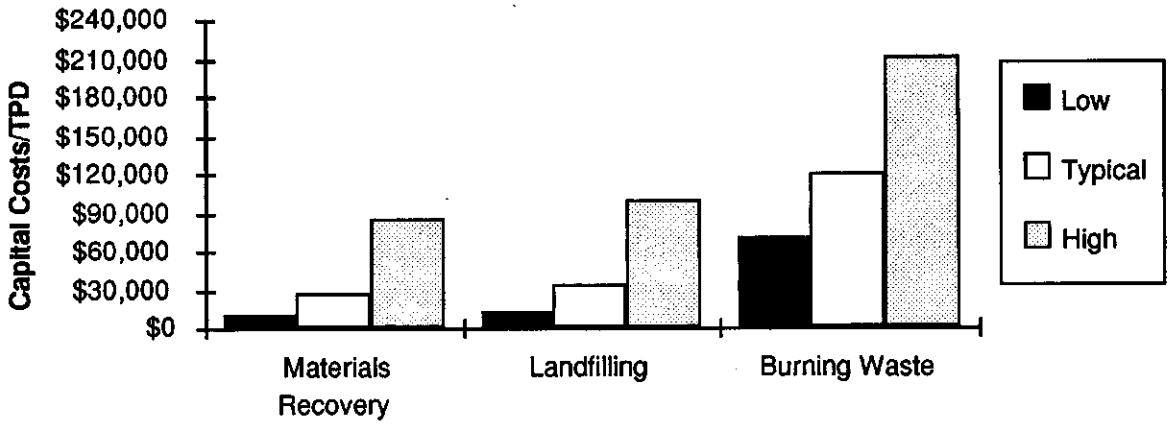
New U.S. Environmental Protection Agency (EPA) rules requiring the nation's 6,500 municipal dumps to install liners and leachate

Chart 3
Per Ton Tipping Fees at Processing and Composting Facilities, Landfills, and Incinerators



Sources: *1991 Resource Recovery Yearbook* (New York, New York: Governmental Advisory Associates, Inc., 1991); *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results* (Washington, DC: Institute for Local Self-Reliance, 1992); *1992-93 Materials Recovery and Recycling Yearbook* (New York, New York: Governmental Advisory Associates, Inc., 1992); and *1990 Landfill Tipping Fee Survey* (Washington, DC: National Solid Waste Management Association, 1991).

Chart 4
Capital Costs of Different
Solid Waste Management Options



Note: Costs for materials recovery are based on tons per day (TPD) recovered and include collection equipment. Costs for incineration and landfilling are based on TPD of design capacity.

Sources: Capital costs for materials recovery programs are based on cost data reported in *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results* (Washington, DC: Institute for Local Self-Reliance, 1992); and *1992-93 Materials Recovery and Recycling Yearbook* (New York, New York: Governmental Advisory Associates, Inc., 1992). Landfill cost data are based on personal communication with operators of seven "state-of-the-art" landfills and on data reported by James Walsh in "Sanitary Landfill Costs, Estimated," *Waste Age* (March and April 1990). Capital cost data for incineration are based on personal communication with plant operators at 22 incinerators in 10 states, 1992; and *1991 Resource Recovery Yearbook* (New York, New York: Governmental Advisory Associates, Inc., 1991).

collection systems within two years are expected to close hundreds of landfills.[22] Enforcement of these standards could reduce Kansas' thirty years of landfill capacity to five years or fewer. Mississippi estimates that sixty of its seventy-five operating landfills will not be upgraded.[23]

Fewer landfills will mean increased transportation costs. Longhauling and disposing municipal solid waste at distant landfills is already costing some cities on the West and East Coasts between $40 and $70 a ton.[24]

In a word, landfills are becoming a precious possession. Recycling extends their lives. Projected as well as current costs and availability of landfills should be taken into account in any evaluation of the cost-effectiveness of waste reduction and recovery options.

Incineration

Many communities have turned to incineration as an alternative to landfills. But incinerators are expensive. Tip fees at incinerators built since 1989 average $60 a ton and range from $30 to $90 per ton.[25] Moreover, thirty percent by weight of the garbage that enters incinerators exits as ash, a waste product that may contain high levels of toxic residues.[26]

Chart 3 compares high, low, and typical per ton tipping fees charged at landfills, incinerators, recycling processing facilities, and composting

operations around the country. Costs vary widely for each. Tipping fees at incinerators tend to be the highest.

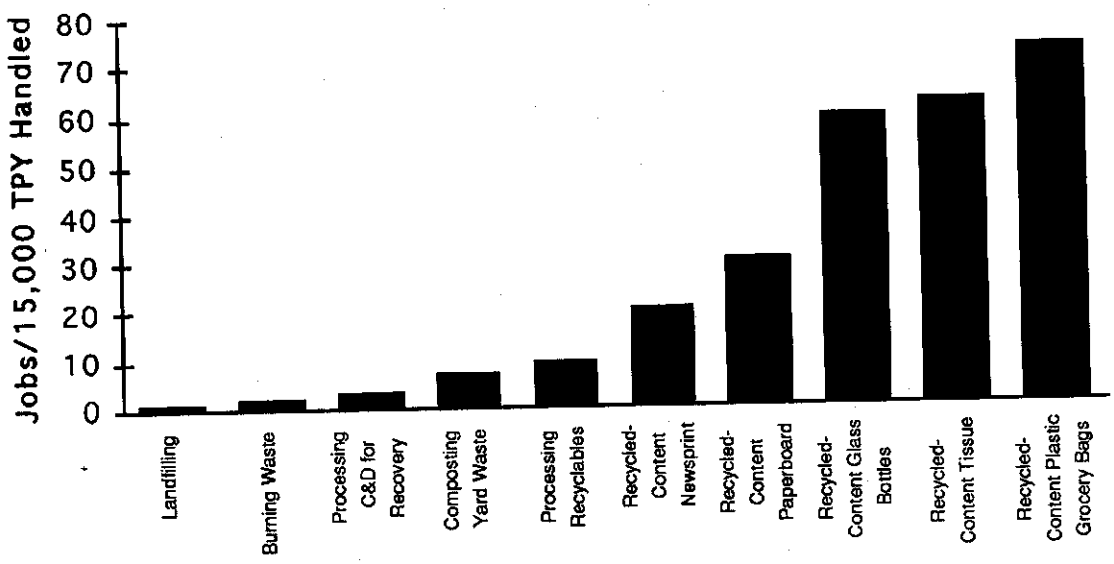
Chart 4 compares the capital costs of different solid waste management systems. The higher the capital costs, the more debt a community may have to assume, and the more costs will fluctuate with changes in interest rates. Incinerators are always the most capital-intensive option; materials recovery can be the least.

Incineration has another drawback—it competes with recycling and composting programs for the same materials. A recent study evaluating Florida's seven largest incinerators found that these facilities regularly burn significant amounts of highly recyclable materials.[27] "Put-or-pay" contracts, which require local governments to deliver a guaranteed tonnage of waste to incinerators, are a major disincentive to maximizing recycling or waste reduction, and thus an obstacle to low-cost materials recovery programs.

Second-Order Economics

Let us now turn to the second-order effects of recycling; that is, the impact on local

Chart 5
Job Creation At Different Waste Handling Facilities



Note: Employment will vary according to the technology installed and the size of the facility. See Note 28.

Sources: *1992-93 Materials Recovery and Recycling Yearbook* (New York, New York: Governmental Advisory Associates, Inc., 1992); *1991 Resource Recovery Yearbook* (New York, New York: Governmental Advisory Associates, Inc., 1991); David Morris, et al., *Getting the Most from Our Materials: Making New Jersey the State of the Art* (Washington, DC: Institute for Local Self-Reliance, 1991); personal communication with operators of fifteen landfills in eight states, 1992; personal communication with compost site operators or community recycling coordinators at twenty-six yard waste composting facilities in ten states, 1991 and 1992; and personal communication with scrap-based manufacturers using high levels of scrap content in their feedstock, 1992.

Table 2
Potential Benefits from Local Scrap-Based Manufacturing
(for a population of one million)

Products From	Number of Plants	Local Post-consumer Scrap Used (TPY)	Jobs	Annual Revenue
asphalt & concrete	2	60,000	25	$4,200,000
auto batteries	1	6,500	120	$210,000,000
glass	4	46,400	335	$78,800,000
metals	3	25,000	110	$301,900,000
paper	6	188,000	635	$160,000,000
plastics	6	7,800	305	$11,600,000
rubber	1	1,700	25	$1,200,000
textiles	1	10,000	120	$3,000,000
wood	5	44,500	140	$14,000,000
total	29	389,900	1,815	$784,700,000

Note: Annual revenue represents plants' gross revenue from product sales.

Source: Mike R. Lewis et al., *Economic Development Through Scrap-Based Manufacturing* (Washington, DC: Institute for Local Self-Reliance, pending publication). Based on personal communication with scrap-based manufacturers, 1992.

economies beyond municipal solid waste budgets. Materials recovery creates more jobs than do disposal options. For example, for every 15,000 tons of solid waste recycled in a year, nine jobs are created preparing materials to meet end-user specifications. For the same amount of yard waste composted a year, seven jobs are created. In contrast, only two jobs are created for every 15,000 tons of waste incinerated a year and only one job for the same amount of waste landfilled a year.[28] See Chart 5.

For larger communities, recycling can offer another economic benefit: the attraction of new industry. Indeed, big cities and urbanized states should make recycling an integral part of their local economic development programs. By diverting forty-three percent of its waste, a city of 1 million can generate sufficient discarded materials to supply up to 29 factories employing over 1,800 people and realizing overall sales of over $700 million a year. See Table 2.

Typically, public works, streets, and highway departments oversee solid waste collection and disposal. They have experience in building and maintaining a reliable infrastructure, but not in evaluating a project based on its return on investment or multiplier effect. Our ability to capture the maximum value from our solid waste will depend on our willingness to undertake the more complex financial and logistical processes needed to create successful business ventures.

Scrap-based manufacturing already plays a significant role in several states. Five glass manufacturing plants in New Jersey utilize thirty percent scrap glass or cullet in their feedstock. Thirteen New Jersey paper mills use 100 percent waste paper as their feedstock. Eight steel mills and foundries in the state use almost 100 percent scrap metal. These plants alone employ 9,000 people and generate over $1 billion in sales annually.[29]

Table 3a
Value Added by Recycling Industries in Massachusetts

Type of Recycling Operation	Value Added, 1991	Number of Plants (minimum)	Tonnage of Scrap Handled, 1991	Value Added /Ton
Waste Paper Processors	$42,909,000	45	657,000	$65
Recycled Paper Manufacturers	$475,307,000	23	656,000	$725
Glass Processors	$2,429,000	25	41,000	$59
Recycled Glass Manufacturers	$20,010,000	1	87,000	$230
Scrap Plastic Processors	$2,891,000	38	12,000	$241
Recycled Plastic Processors	$58,000	2	60	$967
Metal Processors	$44,022,000	70	256,000	$172
Recycled Metal Manufacturers	$3,000	NA	15	$200
Compost	$400,000	NA	40,000	$10
Total	**$588,029,000**	**204**		
By Processors	$92,251,000	178	966,000	$95
By Manufacturers	$495,378,000	26	743,075	$667
By Composting	$400,000	NA	40,000	$10

Massachusetts employs more than 9,000 people in recycling enterprises. About half of these jobs are in the scrap-based manufacturing sector.[30] See Table 3. Currently, four paper mills, a glass processing plant, and several materials recovery facilities are under development in New England.[31]

Across the country, in the state of Washington, private investment in manufacturing facilities using secondary materials totaled $380 million between 1989 and 1992. While almost 15,000 residents of the state have lost manufacturing jobs in the last three years, the scrap-based manufacturing sector has added 2,050 jobs.[32]

Table 3b
Jobs Sustained by Recycling Industries in Massachusetts

Type of Recycling Job	Estimated Number of Jobs	% of Total
Manufacturing	4,640	49%
Scrap Processing	2,327	25%
Recycling Retail	600	6%
Construction & Equipment	1,000	11%
Transportation & Service	200	2%
Government & Nonprofits	300	3%
Custodial	400	4%
Total	**9,467**	**100%**

Source: Robin Ingenthron, *Value Added by Recycling Industries in Massachusetts* (Boston, Massachusetts: Dept. of Environmental Protection, July 1992).

Conclusion

Unlike incineration or landfilling, recycling must be approached as a system. Conventional waste management strategies allow everyone to dump everything into a single container; the waste is then compacted and either sent to a landfill or to an incinerator. Recycling and waste reduction programs must use a comprehensive approach, combining public education, careful attention to the mechanics of collection, and market development by material. Approaching solid waste management in this fashion can reap the benefits of lower costs, job creation, and new enterprise development.

Cities facing economic recession and ever-tightening budgets may be tempted to cut back on their recycling programs. Such cutbacks may save money in the short run, but they will cost money in the long run. Unless a community is located near high-capacity, low-cost landfills, waste reduction, recycling, and composting are the cost-effective strategy. The per-ton costs of start-up and pilot programs may be higher than those of conventional solid waste management alternatives. This is to be expected. But as the programs expand, the costs will come down. Communities around the country have experienced a dramatic learning curve in the last five years, learning how to pick up and process materials more efficiently, and how to identify new markets for these materials.

In good times and in times of hardship, we need to extract the maximum value from our raw materials. Materials recovery and scrap-based manufacturing do exactly that.

Notes

[1] *A Consumer's Guide to Environmental Myths and Realities* (Dallas: National Center for Policy Analysis, September 1991); Lynn Scarlett, "Recycling's Invisible Costs," *Wall Street Journal*, 3 March 1992, A14; Clark Wiseman, "Impediments to Economically Efficient Solid Waste Management," *Resources for the Future*, no. 105 (Fall 1991); Clark Wiseman, "Dumping: Less Wasteful than Recycling," *Wall Street Journal*, 18 July 1991, A10; Marcia Berss, "No One Wants to Shoot Snow White," *Forbes*, 14 October 1991, 40-42; Catherine Cooney, "Cato's Taylor Takes Aim at Myth of Recycling," *Environment Week*, 12 December 1991, 7; Doug Bandow, "What a Waste: Recycling Makes No Ecological or Economic Sense," *Washington Post*, 28 June 1992; and J. Winston Porter, *Status Report on Municipal Solid Waste Recycling* (New York: The Solid Waste Task Force, American Institute of Chemical Engineers, July 1992).

This report does not provide a detailed evaluation of the studies critical of recycling. Much of the cost analyses in these studies suffer from one or more of the following shortcomings: (1) recycling costs tend to include the cost of collection, while refuse disposal costs exclude the collection component; (2) the costs used for recycling typically highlight such cities as Chicago's or New York's, which have minimal recycling efforts; (3) the high costs cited typically only cover residential curbside collection of discarded paper, bottles, and cans, thus ignoring the beneficial impact yard waste collection and drop-off programs can have on overall average materials recovery costs; (4) no acknowledgment that many communities are saving money through recycling; and (5) the costs cited are sometimes unsubstantiated. For example, in the *Status Report On Municipal Solid Waste Recycling*, the author states that "recycling usually costs several times that of more traditional waste management methods." But he excludes the cost of collecting refuse destined for incinerators, and his "educated guesses" for recycling public education costs are three to seven times what communities around the country are actually incurring.

[2] These figures are based on data reported in U.S. EPA, *Characterization of Municipal Solid Waste in the United States: 1992 Update*, Office of Solid Waste, EPA/530-R-92, July 1992; David Folz, "The Economics of Municipal Recycling: A Preliminary Analysis," Department of Political Science, University of Tennessee, Knoxville, TN, paper presented at the Southeastern Conference on Public Administration, Montgomery, Alabama, October 7-9, 1992; and *1990 Landfill Tipping Fee Survey* (Washington, DC: National Solid Waste Management Association, 1991). The $30 million savings figure is based on a landfill tipping fee of $65 per ton. This is the average tipping fee in the Northeast.

[3] See note 1.

[4] David Folz, "The Economics of Municipal Recycling: A Preliminary Analysis."

[5] Ibid.

[6] Brenda A. Platt et al., *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results* (Washington, DC: Institute for Local Self-Reliance, 1992).

[7] Mary Miller (Recycling Coordinator, Lafayette, Louisiana), personal communication, November 23, 1992. Garbage handling costs include yard waste collection as well.

[8] Kristina Karr (Resource Recovery Manager, City of Naperville, Illinois), personal communication, December 3, 1992.

[9] A recent statewide survey of New Jersey municipalities found that garbage collection costs average $220 per household per year but recycling collection costs average $29. See New Jersey League of Municipalities and Richard Bishop Consulting, Ltd., *Recycling & Garbage Collection Manual: Profile of Municipal, County, and Statewide Practices and Costs for Recycling and Garbage Collection* (Trenton, New Jersey: New Jersey League of Municipalities, June 1992), 37, 65.

[10] An independent fiscal analysis of New York City's solid waste management options found recycling to be the least-cost alternative. It also found that the City's recycling programs cost $141 a ton—a cost competitive with landfill disposal and less than half the cost the City estimates. Citing that recycling trucks are often half empty because only a small portion of the waste stream is recycled, two trucks are used for each pick-up, and outreach programs are abysmal, the report determined that recycling program cost efficiency could be greatly improved. See Arthur S. Kell, *Setting the Record Straight: A Fiscal Analysis of City of New York's Solid Waste Management Programs and the Proposed Brooklyn Navy Yard Incinerator* (New York: NY Public Interest Research Group, Inc., May 1992).

[11] Participation rates in these communities are 83, 100, 97, and 100 percent respectively. In contrast, Newark, New Jersey; Austin, Texas; Providence, Rhode Island; and La Crescent, Minnesota, which have participation rates of 16, 40, 74, and 74 percent respectively, have higher recycling costs. Also see David Folz, "The Economics of Municipal Recycling: A Preliminary Analysis."

[12] Costs cited represent 1989 costs. See Brenda A. Platt et al., *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results, Volume III: Urban Areas* (Washington, DC: Institute for Local Self-Reliance, 1992), 93.

[13] Mick Mercer (Superintendent of Streets and Refuse), Loveland, Colorado, personal communication, December 14, 1992. Also see Brenda Platt and Jill Zachary, *Co-Collection of Recyclables and Mixed Waste: Problems and Opportunities* (Washington, DC: Institute for Local Self-Reliance, 1992).

[14] Steve Apotheker, "Finding a Formula for Successful Recycling Collection," *Resource Recycling* (October 1992): 32, 36.

[15] Jim Glenn, "Paper Recycling Approaches Prime Time," *BioCycle* (October 1992): 48.

[16] Ibid., 49-50.

[17] "Paper 'Minimill' Set for NYC," *Scrap Processing and Recycling* 49 (no. 6, November/December 1992):28; and Jim Glenn, "Paper Recycling Approaches Prime Time," *BioCycle* (October 1992): 50.

[18] Personal communication with landfill operators in Palm Beach, FL; Cumberland County and Burlington County, NJ; Fulton County, NY; and Penn Argyle and Taylor, PA, 1992.

[19] Reggie Bokes (Palm Beach County Landfill, West Palm Beach, Florida), personal communication, November 10, 1992. "State-of-the-art" landfills have a double-liner system, leachate collection tanks, on-site groundwater contaminant monitoring wells, and gas control systems to vent, flare, or recover the buildup of methane gas that results from decaying trash.

[20] Edward Repa and Susan Sheet, "Landfill Capacity in North America," *Waste Age* (May 1992): 26.

[21] Jim Glenn, "The State of Garbage in America," *BioCycle* (April 1992): 46-55.

[22] *Federal Register*, 9 October 1991, 50,978-51,119.

[23] Glenn, "The State of Garbage in America," 46-55.

[24] Brian Ketcham, "Exporting Commercial Waste from New York City," *Waste Age* (August 1991); Sarah Lyall, "From L.I. to Angry Illinois: A 5-Day Trash Odyssey," *New York Times*, 26 December 1991; and Randy Woods, "Railhaul: In the Long Run," *Waste Age* (December 1991).

[25] Personal communication with plant operators at twenty-two incinerators in ten states, 1992; and *1991 Resource Recovery Yearbook* (New York: Governmental Advisory Associates, Inc., 1991).

[26] For an in-depth discussion of the pollution from waste incineration, see David Littell, "The Omission of Materials Separation Requirements from Air Standards for Municipal Waste Incinerators: EPA's Commitment to Recycling Up in Flames," *Harvard Environmental Law Review* 15 (1991): 601-635.

[27] Bill Wood, *Going Up in Smoke: The Incineration of Highly Recyclable Materials in Florida* (Tallahassee: The Florida Public Interest Research Education Fund, November 1992).

[28] Figures for jobs created at landfills are based on employment figures at fifteen landfills in eight states obtained through telephone conversations with landfill operators. These landfills handle approximately seven million tons a year (TPY) and employ 354 full-time people (employment at each facility ranges from 0.3 to 3.0 jobs per 15,000 TPY landfilled).

Jobs created at intermediate processing facilities are based on employment figures at 151 facilities in thirty states as reported in the *1992-93 Materials Recovery and Recycling Yearbook* (New York: Governmental Advisory Associates, Inc., 1992). These facilities employ a total of 2,758 people and process approximately 4.6 million tons a year (TPY); jobs per 15,000 TPY processed at each facility range from 1 to 120. The number of jobs at processing centers depends on the technology employed and the size of the plant. Smaller facilities employ more people for every ton processed. At the twenty-four plants processing 60,000 or more TPY, an average of six people are employed for every 15,000 TPY processed. At the 105 facilities processing less than 30,000 TPY, an average of twenty-five people are employed for every 15,000 TPY processed.

Figures for jobs created through composting are based on employment figures at twenty-six yard waste composting facilities in ten states obtained through telephone conversations with compost site operators or community recycling coordinators. These sites compost a total of 233,800 TPY and employ 111 full-time people; jobs per 15,000 TPY at each site range from 2 to 77. The number of people employed at a composting site depends on the compost system in place as well as the size of the operation. At six facilities composting 10,000 TPY or more, an average of six people are employed for every 15,000 TPY. Those composting less than 10,000 TPY employ on average an equivalent of twenty-one full-time people for every 15,000 TPY composted.

Figures for jobs created at incinerators are based on employment figures at twenty-two incinerators in seventeen states as reported in the *1991 Resource Recovery Yearbook* (New York: Governmental Advisory Associates, Inc., 1991). These facilities employ a total of 1,116 people and burn approximately 8.3 million tons a year; jobs per 15,000 TPY burned at each facility range from 0.8 to 5. The eleven incinerators burning 300,000 TPY or more employ on average 1.8 people per 15,000 TPY burned. The other eleven incinerators employ on average 3.4 people per 15,000 TPY burned.

[29] David Morris et al., *Getting the Most from Our Materials: Making New Jersey the State of the Art* (Washington, DC: Institute for Local Self-Reliance, 1991), 66-68.

[30] Robin F. Ingenthron, *Value Added by Recycling Industries in Massachusetts* (Boston: Department of Environmental Protection, July 1992).

[31] Ibid.

[32] Deirdre Grace, "Recycling is Working," *The ReMarketable News* (Seattle: Clean Washington Center, November 1992): 1; and Deirdre Grace (Clean Washington Center, Seattle, Washington), personal communication, December 1, 1992.

Annotated Bibliography

Beyond 40 Percent: Record-Setting Recycling and Composting Programs. Washington, DC: Institute for Local Self-Reliance, 1990. 258 pages. In case study format, this report documents the operating experience of seventeen communities—rural, suburban, and urban—fourteen of which have total, residential, or commercial recovery rates at or above forty percent.

Capturing the Local Economic Benefit of Recycling: A Strategy Manual for Local Governments. Sacramento, CA: Local Government Commission, 1992. 144 pages. The report reviews forty-three case studies of community-based companies, local government agencies, and small private firms that have successfully implemented cost-effective recycling operations.

Creating Local Jobs from Environmental Protection: Focus on Recycling and Small Business. Austin: Paul Robbins, March 1992. 95 pages. This report looks at a variety of recycling business opportunities with a focus on their value in creating small, locally owned enterprises. While it focuses on Austin, other cities and environmental business owners should find it useful.

Economic Development Through Scrap-Based Manufacturing. Washington, DC: Institute for Local Self-Reliance, forthcoming. This document presents case studies of state-of-the-art scrap-based manufacturing plants and companies that utilize asphalt, glass, metal, paper, plastics, wood, and rubber. It includes an analysis of economsic development issues including jobs, value added, and effective policy.

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Engines of Recycling: Strategies for Using Recycling to Drive Community Economic Development. Sacramento: Californians Against Waste Foundation, 1992. 45 pages. This booklet provides tools for maximizing the local economic development potential of recycling. It discusses key issues and strategies in the field, and describes a step-by-step process to bring a market-driven approach to community recycling programs.

Garbage—A Reusable Asset: Changing the Way We Think About Garbage. Louisville: Bingham Fellows II/Leadership Louisville Foundation, 1992. 32 pages. This is a concise policy guide for cities and counties interested in establishing community and economic development components to their municipal solid waste management systems.

Getting the Most from Our Materials: Making New Jersey the State of the Art. Washington, DC: Institute for Local Self-Reliance, 1991. 85 pages. By addressing energy, water, sewage sludge, and solid waste issues, this report presents a comprehensive, environmentally sound materials management policy that will result in a revitalized economy in New Jersey and other states.

In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results. Washington, DC: Institute for Local Self-Reliance, 1992. 500 pages. This collection of recycling and composting case studies is designed to aid local officials and advocacy groups seeking to optimize their recycling programs. Many of the localities featured in the study have developed state-of-the-art programs and are achieving high recovery rates; others are implementing experimental or noteworthy recycling techniques.

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Recycling Entrepreneurship: Creating Local Markets for Recycled Materials. Arcata: Gainer & Associates/ Arcata Community Recycling Center, 1990. 120 pages. This report is a business planning guide for recycling enterprises. The guide is useful for developing both processing and manufacturing enterprises.

Waste Not: Garbage as an Economic Resource for the Northeast. Boston: Conservation Law Foundation, 1991. 40 pages. This booklet identifies obstacles to increased use of secondary materials, discusses how recycling could stimulate the economy in the Northeast, and makes local and state policy recommendations.

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