



In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results

Volume III: Urban Areas



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This work was performed for USEPA by the Institute for Local Self-Reliance. The Institute for Local Self-Reliance (ILSR), a nonprofit research and educational organization, provides technical information and assistance to city and state government, citizen and neighborhood organizations, and industry.

In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results; Volume I - Rural Communities, Volume II - Suburbs and Small Cities, and Volume III - Urban Areas is part of an ongoing series of technical reports prepared by the ILSR staff. For more information on the Institute's philosophy, publications, and practice, write:

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ILSR made dozens of phone calls to state and local recycling coordinators, solid waste professionals, recyclers, and local decision makers in order to identify communities to document. The assistance of these individuals was invaluable in getting this project off the ground. Approximately 100 surveys were sent to key contact people.

Although most information for the report came from municipal recycling coordinators and Superintendents of Public Works, ILSR also made calls to local landfills, private refuse haulers, processing centers, composting facilities, county and state solid waste officials, and local political leaders to fill in our knowledge about various communities' recycling and composting programs.

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Abbreviations

ANJR — Association of New Jersey Recyclers
BFI — Browning Ferris Industries
CCA — Container Corporation of America
CCC — Community Conservation Centers, Inc.
C&D — construction and demolition
C-E — Combustion Engineering
CEI — Citizens for Environmental Improvement
CFC's — chlorofluorocarbons
comm — commercial
CRC — Community Rehabilitation Center
CSWMB — California Solid Waste Management Board
CSWMP — Comprehensive Solid Waste Management Plan
DEM — Department of Environmental Management
DEQ — Department of Environmental Quality
DO — drop-off
DPW — Department of Public Works
EC — Ecology Center
EDF — Environmental Defense Fund
ENCORE — Environmental Container Reuse
EPA — Environmental Protection Agency
F — Fahrenheit
FCR — Fairfield County Recycling
FY — fiscal year
HANC — Haight-Ashbury Neighborhood Council
HDPE — high density polyethylene
ILSR — Institute for Local Self-Reliance
instit/inst — institutional
IPC — intermediate processing center
IPF — intermediate processing facility
lb — pound
LDPE — low density polyethylene
MRF — materials recovery facility
MSW — municipal solid waste
NA — not available
NEED — New England Ecological Development
NoCAL — Northern California
OC — Occupational Center
O&M — operating and maintenance
OSCAR — Ocean State Cleanup and Recycling Program
PCB — polychlorinated biphenyl
PET — polyethylene terephthalate
PP — polypropylene

PRO — Philadelphia Recycling Office
PROS — Portland Recycling Refuse Operators
PS — polystyrene
PSE&G — Public Service Electric and Gas
PSU — Portland State University
PVC — polyvinyl chloride
RCC — Recyclables Collection Center
REA — Richmond Environmental Action
REI — Recycling Enterprises Inc.
RFP — request for proposal
RRT — Resource Recycling Technologies
SFCR — San Francisco Community Recyclers
SFRP — San Francisco Recycling Program
SLUG — San Francisco League of Urban Gardeners
SRMG — Sound Resource Management Group
SWA — Solid Waste Authority
SWAC — Solid Waste Advisory Commission
SWMA — Solid Waste Management Authority
SWMC — Solid Waste Management Center (Berkeley)
Solid Waste Management Corporation (Providence)
SWMP — Solid Waste Management Plan
TURF — Total Urban Recycling Facility
UC — University of California
WMI — Waste Management, Inc.
WUTC — Washington Utility Transportation Commission

Sample Conversion Factors

Waste generation rates used in this report are based on tonnage figures provided by recycling coordinators and other local officials, who may have estimated the data or relied on other sources, such as private haulers. In a few instances, ILSR staff obtained tonnage data directly from the private sector. Communities, in several cases, measure materials in cubic yards and use conversion factors to calculate tonnage figures. When local conversion factors were unavailable, ILSR staff estimated tonnage recovered using commonly accepted conversion factors. Sample conversion factors utilized in this report are listed below.

MIXED MSW (compacted)

Conversions Used By Communities:

785 lbs/cy (0.39 tons/cy) or 2.55 cy/ton

Source: *Solid Waste Management Plan Revision*, Sonoma Co., CA, May 1990.

667 lbs/cy (0.33 ton/cy)

Source: Naperville, IL

Conversions Found in the Literature:

500 - 700 lbs/cy (0.25 - 0.35 tons/cy) or 2.8 - 4 cy/ton

Source: *Solid Waste Data: A Compilation of Statistics on Solid Waste Management Within the United States*, US EPA, August, 1981.

600 lbs/cy (0.3 tons/cy) or 3.3 cy/ton

Source: *Association of New Jersey Recyclers (ANJR), Directory*, 1987.

MIXED MSW (uncompacted)

200 lbs/cy

Source: *Solid Waste Data: A Compilation of Statistics on Solid Waste Management Within the United States*, US EPA, August 1981.

MIXED YARD WASTE (average compaction)

Conversions Found in the Literature:

600 lbs/cy

Source: *Yard Waste Composting*, US EPA, April 1989.

Conversions Used By Communities:

620 lbs/cy

Source: *Recycled Wood Products*, Berkeley, CA

650-750 lbs/cy

Source: Portland, OR

660 lbs/cy

Source: West Palm Beach, FL

MIXED YARD WASTE (loose)

200-250 lbs/cy or 9 cy/ton

Source: Portland, OR

LEAVES (average compaction)

500 lbs/cy (320 - 500 lbs/cy)

Source: *Yard Waste Composting - A Study of Eight Programs*, US EPA, April 1989.

450 lbs/cy

Source: *ANJR Directory*, 1987.

1,000 lbs/cy

Source: New Jersey Department of Environmental Protection

LEAVES (vacuumed)

700 lbs

Source: New Jersey Department of Environmental Protection

LEAVES (loose)

250 - 350 lbs/cy

Source: *ANJR Directory*, 1987.

CHIPPED BRUSH

500 lbs/cy

Source: National Recycling Coalition, 1989

COMPOST (finished)

1,500 lbs/cy

Source: *Yard Waste Composting*, US EPA, April, 1989.

CHRISTMAS TREES

20 lbs/tree

Source: *Summary of County-Wide Christmas Tree Recycling Project 1990-1991*, Garbage Reincarnation, Inc., Sonoma Co., CA.

15.1 lbs/tree

Source: Dakota County, MN

FOOD WASTE

500 lbs/cy (residential)

800 - 1000 lbs/cy (commercial)

Source: Suhr, J.L., Higgins, A.J. and Derr, D.A., *Feasibility of Food Waste Recycling in New Jersey: Fourth Quarterly Report to the Office of Recycling*, 1984.

900 lbs/cy (commercial)

Source: *Asheville/Buncombe County Solid Waste Alternatives: Planning Workbook*, ILSR, March 1985.

WATER

8.345 lbs/gal

Source: Lindeburg, Michael R., *Engineering Unit Conversions*, 2nd ed., 1990.

USED MOTOR OIL

7 lbs/gal (6.5 - 7.5 lbs/gal)

Source: *ANJR Directory*, 1987. Range was arrived at by converting API gravity for 25-50% crude oil to specific gravity (*Perry's Chemical Engineers' Handbook*, 6th ed.).

CONCRETE/ASPHALT (broken)

1.5 tons/cy

Source: American Rock and Asphalt, Richmond, CA.

Introduction

The Institute for Local Self-Reliance (ILSR) prepared this report of 30 U.S. recycling and composting programs under a grant from the U.S. Environmental Protection Agency (U.S. EPA). Under Phase I of this project, the ILSR gathered data on source-separation recycling and composting programs of 30 communities. This included program characteristics, waste generation and recovery tonnages, materials recovery rates, and equipment and operating and maintenance costs.

As the performance of established recycling and composting programs improves, and as newer programs benefit from their experience, the country's learning curve on materials recovery is accelerating. Nevertheless, communities continue to need detailed information about the quantities of waste they generate, how much of this they can recover, and the costs this entails. Such data are useful not only to evaluate one's own performance and progress, but also as a way to compare oneself to others.

The Institute has been working to fill this information gap. Our reports *Beyond 25 Percent: Materials Recovery Comes of Age* (1989) and *Beyond 40 Percent: Record-Setting Recycling and Composting Programs* (1990) detail how 24 communities are recovering between 24 and 57 percent of their waste streams. We produced these reports for two reasons: (1) to share the experience of the pioneers with those just starting up programs, and (2) to encourage communities to refine our methodology and improve their own data gathering. This report, *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results*, continues to meet these objectives, while expanding our data base of outstanding recycling programs.

During fall 1990, Institute staff surveyed hundreds of recycling coordinators and solid waste managers by telephone and mailed nearly 100 written questionnaires. Based on the responses we received, the ILSR and EPA staff selected 26 municipalities and 4 counties to document for this study. Seven of these localities had been included in *Beyond 40 Percent*.

Almost half of the communities in this compendium were chosen because of their high recovery levels (either in the residential, commercial, or construction and demolition debris sector). Other communities were selected on the basis of location, population density, or model program characteristics such as source reduction initiatives, food waste recovery, or salvage/reuse operations. To facilitate comparisons and discussion of the factors that have led to successful programs, we also included several communities whose recovery levels had remained low over a number of years. Communities selected for study represent a balance of program characteristics: public and private collection, segregated and

commingled set-out, sorting en route and sorting at an intermediate processing center, curbside and drop-off, bottle bill locales, mandatory and voluntary participation, volume-based and flat refuse rates.

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The table on the following page lists the 30 communities documented in this report, their populations, and their residential, commercial/institutional, municipal solid waste, and total waste recovery levels. We gathered and documented data using a uniform methodology so as to facilitate comparison and make the information accessible. (See section on Data Definitions and Case Study Format.) This report presents detailed data in case study format in three volumes: *I: Rural Communities*; *II: Suburbs and Small Cities*; and *III: Urban Areas*.

Volume I: Rural Communities details the characteristics of eight rural recycling and composting programs, including one county program. It presents information for planning and evaluating rural programs such as descriptions of model drop-off centers, salvage/re-use operations, co-collection (collecting refuse and recyclables together), small-scale/low technology processing centers, food waste recovery programs, and collective marketing techniques.

Volume II: Suburbs and Small Cities documents 12 programs in suburbs and cities with populations under 100,000, including two county programs. It describes successful residential curbside recycling programs, comprehensive composting programs (including backyard composting), commercial and institutional recycling initiatives, and multi-unit collection programs.

Volume III: Urban Areas covers 10 urban locales, including one county program. It provides information for designing successful recycling and composting programs in high-density urban areas. These include residential curbside collection programs that target multi-unit and apartment buildings, commercial and institutional recycling and composting, food waste collection, construction and demolition debris recovery, and materials processing and marketing.

Under Phase II of this project, the ILSR is producing a report summarizing and analyzing the data gathered and documented under Phase I. This accompanying report will detail how communities can maximize recovery rates by integrating the best features of the best programs.

Selected Recycling and Composting Programs

Community	Population	Year Data Collected	Residential Recovery Rate	Commercial Recovery Rate	MSW Recovery Rate	Total Recovery Rate
Volume I: Rural Communities						
Bowdoinham, ME	2,189	FY90	NA	NA	54%	53%
Fennimore, WI	2,378	1990	51%	25%	38%	NA
La Crescent, MN	4,305	1990	41%	9%	29%	41%
Monroe, WI	10,220	1989	32%	27%	28%	50%
Peterborough, NH	5,239	1990	42%	4%	19%	18%
Sonoma County, CA	388,222	1990	15%	10%	11%	11%
Upper Township, NJ	10,861	1990	50%*	34%†	NA	43%
Wapakoneta, OH	9,214	9/89-8/90	NA	NA	20%	NA
Volume II: Suburbs/Small Cities						
Berlin Twnshp, NJ	5,620	1990	56%	61%	57%	NA
Boulder, CO	88,000	1990	33%	12%	22%	16%
Columbia, MO	69,101	FY90	11%	NA	NA	13%
Dakota County, MN	274,016	1990	29%	24%	28%	NA
King County, WA	991,060	1990	19%	36%	30%	NA
Lafayette, LA	90,000	FY90	13%	8%	11%	NA
Lincoln Park, NJ	10,978	1990	49%	70%	62%	NA
Naperville, IL	85,351	1990	32%	NA	NA	NA
Perkasie, PA	7,878	1990	52%	NA	NA	NA
Takoma Park, MD	16,900	1990	36%	NA	NA	NA
West Linn, OR	16,557	1990	NA	NA	50%	46%
West Palm Beach, FL	62,530	4/90-3/91	22%	0%	13%	12%
Volume III: Urban Areas						
Austin, TX	465,622	FY89	7%	NA	NA	15%
Berkeley, CA	102,724	FY91	NA	NA	22%	38%
Lincoln, NE	191,972	1990	3%	25%	12%	52%‡
Mecklenburg Co., NC	511,433	1990	7%	22%	16%	NA
Newark, NJ	275,221	1989	10%*	46%†	NA	30%
Philadelphia, PA	1,633,826	FY90	6%*	16%†	12%	11%
Portland, OR	440,000	1990	NA	NA	33%	NA
Providence, RI	160,728	1990	10%	13%	11%	NA
San Francisco, CA	723,959	1990	37%	18%	26%	27%
Seattle, WA	516,259	1990	45%	40%	40%	NA

Key: FY = fiscal year

MSW = municipal solid waste

NA = not available

Notes: Total waste is the sum of municipal solid waste and construction and demolition (C&D) debris. Recovery rate 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. All recovery rates represent proportions by weight.

* Publicly collected waste.

† Privately collected waste.

‡ Based on 133,167 tons of C&D utilized as landfill cover. If this tonnage is excluded from waste recovered and disposed, recovery rate drops to 30%.

Case Study Format and Data Definitions

Each ^{where} case study in this report is divided into several parts: Demographics, Solid Waste Generation and Recovery, Materials Recovery Overview, Recycling Activities, Composting Activities, Amount and Breakdown of Materials Recovered, Education and Publicity, Economics, and Future Solid Waste Management Plans. While tonnage and economic data are generally based on 1990, descriptions of program characteristics may reflect changes made since. This section's figures explain the data that we have gathered and documented, and how we define certain terms. The first part of this section defines terms used throughout these case studies. These definitions apply to this report only. The second part of this section explains what information is contained in each section of the case studies.

Data Definitions

Collection Capital Costs — costs of acquiring equipment used to collect recyclable or compostable materials.

Commercial/Institutional Waste Recovered, Disposed, and Generated — the annual tonnage of waste recovered, disposed, and generated by the commercial and institutional sectors (excluding medical wastes). The commercial sector includes theaters, retail establishments, hotels, and restaurants. The institutional sector includes hospitals and schools.

Composted Waste — discarded organic materials processed into a soil amendment, fertilizer, and/or mulch.

Composting — recovering discarded organic materials for processing into a soil amendment, fertilizer, and/or mulch.

Construction and Demolition (C&D) Debris Recovered, Disposed, and Generated — the annual tonnage of waste recovered, disposed, and generated as a result of construction and demolition activities. This waste may include concrete, asphalt, tree stumps and other wood wastes, metal, and bricks. (While C&D waste often burdens municipal solid waste collection and disposal systems, the U.S. EPA and the National Recycling Coalition and this report exclude C&D debris from the definition of municipal solid waste.)

Deposit Containers Recycled — the annual tonnage of beverage containers recycled as a result of state or local bottle bills.

Disposed Waste — waste landfilled or incinerated.

Generated Waste — sum of waste recovered and waste disposed.

Intermediate Processing — preparing collected recyclable materials for end-use manufacturing. Processing typically includes sorting, contaminant removal, and crushing or baling.

Mandatory — whether citizens are required to source-separate materials for recycling. In several communities, citizens may be required to set out certain materials at curbside for recycling. In others it may simply be illegal to set these out with refuse. Not all materials collected are designated as mandatory.

Municipal Solid Waste (MSW) Recovered, Disposed, and Generated — sum of residential and commercial/institutional wastes recovered, disposed, and generated. In some cases, MSW also includes deposit containers recovered, yard waste composted from landscapers, and waste self-hauled to disposal and recovery facilities. MSW excludes construction and demolition debris.

Participation Rate (%) — the portion of households served that take part in the curbside collection program for recyclable materials. Refer to the case studies for an explanation of the specific method of calculation.

Private Sector Waste — waste collected by private haulers independent of the public sector.

Processing Capital Costs (Composting) — costs of acquiring equipment used to process—compost, chip, or mulch—organic materials. Processing or composting equipment typically includes shredders or chippers and front-end loaders.

Processing Capital Costs (Recycling) — costs of acquiring equipment used to process recyclable materials in preparation for marketing to end users. Processing typically includes sorting, contaminant removal, and crushing or baling.

Public Sector Waste — waste collected by public crews or by private haulers under public contract.

Recovered Waste — sum of waste recycled and waste composted.

Recycled Waste — discarded products and packaging materials recovered for reuse and/or processing into new products.

Recycling — recovering discarded products and packaging materials for reuse and/or processing into new products. In this report, recycling does not include composting.

Refuse — waste destined for disposal facilities (incinerators or landfills).

Residential Waste Recovered, Disposed, and Generated — the annual tonnage of waste recovered, disposed, and generated from single-family and multi-unit residences and their yards. In Bowdoinham and Wapakoneta, residential waste cannot be separated from commercial/institutional waste. The definition of residential waste generated differs for Wapakoneta.

Self-hauled Waste — waste brought to recovery or disposal sites by residents or business/institutional establishments. This waste cannot be divided into residential and commercial/institutional.

Source Reduction — waste prevention; that is, avoiding waste generation.

Source Separation — segregation of recyclable materials or yard waste from mixed waste to facilitate recycling and composting of these materials.

Tipping Fees — the fees charged to haulers for delivering materials at recovery or disposal facilities.

Total Waste Recovered, Disposed, and Generated — the sum of MSW and C&D recovered, disposed, and generated.

Information in Case Studies

Demographics

The first page of each case study contains basic demographic information on the community: 1990 population, area, number of households, and number of businesses and institutions. Also included is a brief description of each community detailing, when information is available, its location; whether it is urban, rural, or suburban; per capita income; median household income; and major industries.

Solid Waste Generation and Recovery

This section provides tonnage data on waste recycled, waste composted, and waste generated; tipping fees at disposal facilities; and a description of how waste destined for disposal (refuse) is collected and disposed, and the costs of doing so.

Tonnage data, reported in table format, generally represent 1990 annual figures, unless noted otherwise, and are usually broken down into three sectors: residential, commercial/institutional, and construction and demolition (C&D) debris. In some cases, tonnage figures cannot be broken down by these sectors, and data are presented in a modified format.

In Berkeley and Portland municipal solid waste is presented as a single sum because it cannot be broken down into residential and commercial.

In Newark and Philadelphia figures are broken down into public sector and private sector, where public sector denotes waste collected by public crews or private haulers under public contract, and private sector denotes waste collected by private haulers independent of the public sector. In Newark, privately collected waste includes C&D debris; as a result, MSW figures cannot be reported separately.

In Austin, San Francisco, and Seattle waste self-hauled to disposal or recovery facilities is listed separately from residential and commercial wastes, since this tonnage cannot be broken down by sector. In several case studies, deposit containers recovered as a result of bottle bills and landscapers' waste composted are listed separately, since these wastes cannot be divided into residential and commercial tonnages.

C&D tonnage figures are not tracked and thus not available in Providence. In Portland, C&D disposed is available, but C&D recovered is not. In Seattle, C&D recovered is available, but C&D disposed is not.

Footnotes accompanying tables clarify how numbers are calculated or estimated, where applicable, what numbers represent, and what, if any, waste may be excluded. Tonnage figures for waste recycled and composted are based on those reported in the Amount and Breakdown of Materials Recovered section.

Materials Recovery Overview

This section provides an overview of the community's recycling and composting activities, including history and development of programs, and state and local legislative requirements.

Recycling Activities

This section details curbside and drop-off collection programs for recyclable materials for both the residential and commercial/institutional sectors, and details how these materials are set out, processed, and marketed. Where applicable, information on salvage/reuse activities, construction and demolition debris recovery, market development, and recycled product procurement initiatives are also included.

Composting Activities

This section details curbside and drop-off collection programs for yard waste and other organic materials, and how these collected materials are composted, chipped, mulched, or otherwise processed into a soil amendment. Where applicable, information on backyard composting programs is also included.

Amount and Breakdown of Materials Recovered

This section lists, in table format, a tonnage breakdown of residential, commercial/institutional, and construction and demolition materials recycled and composted by type. The tables list subtotals for MSW recycled and composted, totals for MSW recovered and C&D debris recovered, and finally total materials recycled, composted, and recovered. Where available, several years' worth of data are provided.

Footnotes accompanying tables clarify, where applicable, how numbers are calculated or estimated, what numbers represent, and what, if any, waste may be excluded.

Source Reduction Activities

This section describes, where applicable, any initiatives undertaken to reduce the amount of waste generated. Generally, initiatives include volume-based refuse rates, "environmental shopping" programs, and backyard composting.

Publicity and Education

This section details what programs are in place to educate citizens and/or commercial/institutional establishments about recycling services—how and where to recycle—and to motivate them to do so.

Economics

This section primarily provides information on capital equipment and operating and maintenance costs. The **Costs Cover** subsection explains what costs are provided, who incurs these costs, and the programs and tonnages these costs cover. Materials revenues, source of funding, and the number of full- and part-time employees working on recycling and composting activities are also detailed.

Capital costs are generally listed in two tables: one lists equipment used for collection, and the other lists equipment used for processing. (Processing recyclables typically includes sorting, contaminant removal, and crushing or baling. Processing yard waste and other organic materials consists of composting, chipping, or mulching; equipment for this purpose typically includes shredders or chippers and front-end loaders.) Both these tables indicate the year equipment costs were incurred and the purpose for which equipment is used—whether recycling or composting. If equipment is used for several purposes, an estimated percentage of its time spent on recycling or composting is indicated; costs listed represent the total cost of this equipment. Footnotes accompanying tables clarify who owns equipment, whether equipment has been paid off, whether it was amortized, and/or whether it was owned prior to implementation of recovery programs.

Operating and maintenance (O&M) costs represent annual costs as provided by each community and are broken down into recycling costs and composting costs. These costs generally represent the costs incurred by the local government of the community documented, and do not always reflect all the costs spent for recycling and composting activities. For example, the State of Rhode Island, not the City of Providence, pays for processing costs in Providence. Additional costs are often listed in table footnotes. In some of the county case studies, we cannot calculate per ton costs for recycling or composting because these counties incur costs only for certain aspects of the program, such as planning and education/publicity.

Communities were asked to provide total O&M costs for their recycling and composting operations, including collection, processing, administration and overhead, all labor, and education and publicity costs. Where available, these breakdowns are provided. In many instances, curbside collection costs are separated from drop-off costs, so these two can be compared. The costs for curbside collection, drop-off collection, and processing often cover different tonnages. The tons covered by the costs are listed in the operating and maintenance cost table, and are used to calculate per ton O&M costs. Because costs for different activities cover different tonnages, the provided breakdowns of per ton costs cannot necessarily be added together. Footnotes accompanying O&M cost tables clarify who incurs costs, on what cost figures are based, what costs, if any, are excluded, and, where applicable, how costs are calculated.

Future Solid Waste Management Plans

This section describes solid waste management initiatives that each community plans to undertake in the future.

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Contacts, References, and Endnotes

The names, titles, organizations, addresses, and phone/fax numbers are listed for those people who were the primary sources of information on the community's recycling and composting activities. Under References, we list any written materials that we used as general sources of information. Endnotes give sources of information or clarifications for a particular statement.

Austin, Texas

Demographics

Jurisdiction:	City of Austin
Population:	465,622 in 1990
Area:	185 square miles
Total Households:	198,464 (112,376 single-family households, 11,476 two-unit buildings, and 9,960 three- to four-unit buildings; 64,652 households are in buildings with more than four units)
Total Businesses and Institutions:	Not available
Brief Description:	Austin, the capital of Texas, is home to federal, state, and local agencies. Other major employers are educational institutions including the University of Texas, the military (Bergstrom Air Force Base and Camp Maybry), and computer and electronics firms. The City's annual per capita income is \$16,000; median household income is \$29,700.

Solid Waste Generation and Recovery

Annual Tonnages (October 1988 to September 1989)

	Residential	Commercial/ Institutional*	Self Haul†	Total MSW	Construction & Demolition‡	Total Waste
Recovered	17,573	13,312	45,612	76,497	0	76,497
Recycled	13,387	13,312	41,380	68,079	0	68,079
Composted	4,186	0	4,232	8,418	0	8,418
Disposed§	236,891	NA	NA	NA	NA	450,294
Incinerated	0	0	0	0	0	0
Landfilled	236,891	NA	NA	NA	NA	450,294
Generated	254,464	NA	NA	NA	NA	526,791

Percent by Weight Recovered

Recovered	7 %	NA	NA	NA	0 %	15 %
Recycled	5%	NA	NA	NA	0%	13%
Composted	2%	NA	NA	NA	0%	2%

Notes: Due to rounding, numbers may not add up to total.

Residential waste disposed does not include bulky items such as furniture and tires.

* Commercial/institutional tonnages are materials collected at curbside by private haulers and nonprofit groups.

† Self-haul tonnages include recyclables brought to private (for-profit) buy-back sites and scrap yards, and yard waste brought to the Austin Community Gardens, as well as brush collected through the City's tree trimming program. This includes material generated from both the residential and commercial sectors.

‡ None of Austin's largest waste haulers recycled construction and demolition debris in 1989, nor were they aware of any C&D recycling in the City.

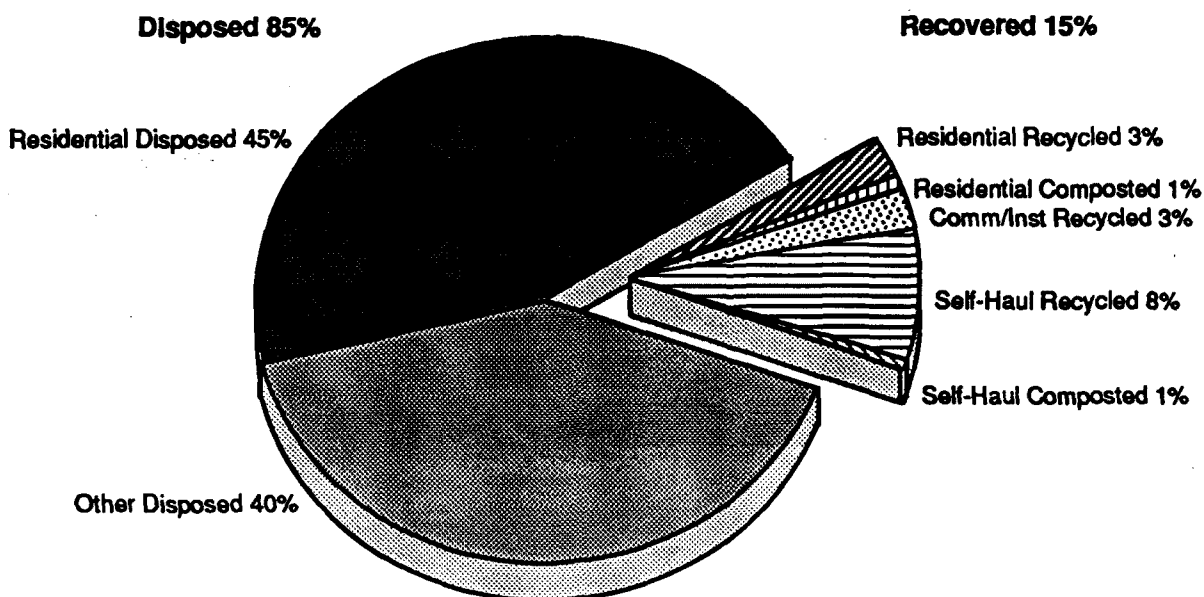
§ While the City tracks tonnage figures of waste disposed from single-family households, some duplexes, and a number of three- and four-unit buildings (160,000 tons in fiscal year 1989), it does not track the tonnage of waste disposed from condominiums, apartment buildings with greater than four units, from commercial and institutional establishments, or from construction and demolition sites.

An estimated 78,313 tons of waste were generated by apartment buildings with more than four units. Subtracting the 1,422 tons of recyclables collected at Ecology Action's drop-off sites (which service apartment buildings) from the estimated waste generated from this sector, yields 76,891 tons of waste disposed from multi-unit buildings. This amount is included in the 236,891 tons of residential waste disposed listed above. Waste generated from this sector is based on the following City statistics and estimates: 83,000 households in buildings with more than four units, 2.2 persons per household, and 2.35 pounds of residential waste generated per person per day in these units. Total waste disposed is based on an average state waste generation rate of 6.2 pounds of residential, commercial, and C&D waste per person per day (provided by the Texas Department of Health). This figure contains a small amount of industrial waste.

Landfill Tipping Fee:

City trucks do not pay a tipping fee at the Austin Municipal Landfill. Tipping fees averaged \$10 per ton in 1989, \$10.75 in 1990, and \$12.00 in 1991 at the Austin Community Landfill (WMI) and Sunset Hill Landfill (BFI).

Total Waste Recovered and Disposed (Percent by Weight, FY 1989)



Note: Due to rounding, percentages do not add to 100%

Refuse Collection and Disposal:

The City of Austin collects refuse twice weekly from single-family and duplex units as well as a number of households in three- to four-unit buildings. The City does not service condominiums but it does serve businesses whose refuse set-out does not exceed that for single-family households (i.e., home-based businesses). The City's cost for refuse collection and disposal in fiscal year 1989 was \$66 per ton. In 1989 residents serviced by the City paid a flat fee of \$8.25 per month for refuse collection. The fee increased to \$9 per month in 1990 and will again increase to \$10.60 in November 1991. This fee, which includes curbside collection of recyclables, will be replaced with volume-based refuse rates in 1992. Citywide implementation of volume-based refuse rates will be complete by 1993. (See Future Solid Waste Management Plans section.)

Ten private waste haulers collect refuse from the remaining multi-unit buildings, businesses, and institutions. They also haul construction and demolition debris. Private haulers include Central Texas Refuse, Longhorn Disposal (Waste Management, Inc.), Texas Disposal Systems, and BFI. Municipal haulers bring the majority of the City's refuse to the Austin Municipal Landfill 10 miles from the City. Private haulers bring refuse to the Sunset Farm Landfill and the Austin Community Landfill.

In winter 1991, Texas Disposal Systems was issued a permit to build a new landfill in the southeast corner of Austin; the facility opened in July 1991. Texas Disposal Systems chips and composts landclearing debris and yard waste at the new facility, and operates a recycling drop-off center there.

Materials Recovery Overview

Goals and Legislative Requirements: None

Ecology Action, a nonprofit volunteer organization, initiated recycling in Austin in 1971 with the opening of a recycling drop-off center. At first the center accepted only glass, steel, and aluminum cans, but by 1980 Ecology Action had added newspaper and aluminum and ferrous cans, and operated nine recycling drop-off centers. Ecology Action also collected newspaper at the University of Texas and initiated a municipal office paper recycling program. In 1981 the market price for old newspaper plummeted, and Ecology Action was forced to cut back operations. Austin citizens appealed to the City Council to support local recycling activities and implement a curbside recycling program. In response, the City in 1981 commissioned a consultant to develop a Solid Waste Management Strategy that would include a pilot curbside recycling program, technical assistance for the development of composting operations, construction of a waste incinerator and two new transfer stations, and permitting of a new municipal landfill. A 600 ton-per-day incinerator was approved by referendum in 1984. However, in 1988, due to citizen groups' opposition, Austin cancelled plans for the incinerator after \$16 million had been spent on the project.

The City implemented a pilot curbside recycling program in February 1982 in which municipal crews collected aluminum cans, newspaper, and glass from 3,000 single-family residences, 2 percent of all city households. In 1983, 12,000 households were served; by 1986, 58,000 households were served. In 1989 crews serviced 110,000 one- to two-unit buildings and a number of three- and four-unit buildings. In FY 1989, 7,347 tons of residential recyclables were collected through the municipal curbside program; in FY 1990, 11,090 tons of recyclables were collected, an increase of over 50 percent. Approximately one-half of the residential recyclables recovered in Austin are collected through the municipal curbside program. By 1991 municipal crews were collecting recyclables from 111,500 households in one- to four-unit buildings.

In the early stages of the City's program, Ecology Action processed and marketed recovered glass and metals, while Consolidated Fibers and ACCO Waste Paper processed and marketed the newspaper. In 1989 Austin awarded ACCO Waste Paper a 3-year contract to process all materials collected through the curbside program.

Austin implemented a seasonal curbside leaf collection program in 1988. Leaves are composted along with municipal sewage sludge. Other drop-off composting opportunities are offered year-round at Austin Community Gardens, a nonprofit community organization.

Residents can drop off household hazardous waste, including batteries, pesticides, flammables, and motor oil, on the annual Home Chemical Collection Day. Twelve-hundred gallons of paint were reclaimed for local housing rehabilitation projects in 1989.

In 1988, after the cancellation of the incinerator, the Austin City Council appointed a 9-member citizens' Solid Waste Advisory Commission to develop alternate solid waste management methods. The Commission completed the Solid Waste Master Plan in June of 1990, and the City Council adopted it unanimously the following September. City Staff developed a 5-year Business Plan based on this Master Plan that calls for volume-based refuse rates, elimination of the second refuse collection day, and year-round collection of yard waste. The Solid Waste Master Plan replaces the earlier plan prepared by private consultants.

Recycling Activities

Residential Curbside Recycling

Start-up Date:	February 1982
Service Provider:	The City of Austin Environmental and Conservation Services Department collects recyclables from all households in one- to two-family units including some three- and four-unit buildings. (In 1990 Longhorn Disposal and Central Texas Refuse collected recyclables from a small number of apartment buildings.)
Pick-up Frequency:	Weekly
Same Day as Refuse:	Yes
Households Served:	110,000 single- through duplex households (including some three- and four-unit buildings) were served in 1989 with municipal curbside collection. In 1991, 1,500 households were added to the municipal program.
Mandatory:	No
Participation Rate:	40 percent in 1989, 55 percent in 1990, 65 percent in 1991 (based on counting weekly set-outs on several collection routes over a 6-week study period).
Materials Collected:	Newspaper, corrugated cardboard, glass, aluminum and ferrous cans
Set-out Method:	Residents bundle newspaper and cardboard or place them in paper bags. Glass and metal containers are commingled in a separate container. Austin initially distributed used 5-gallon containers to some households. In 1991 the City distributed 25,000 14-gallon recycling bins to increase household participation. (The City hopes to purchase an additional 100,000 bins with funding from local businesses. The businesses will be allowed to place their logos on the containers in exchange for covering a portion of the bins' cost.)
Collection Method and Vehicles:	Two-person crews load materials into Eager Beaver Recycler 6 Trailers pulled by stake-bed trucks. Crews place paper and cardboard in one compartment, and cans and glass in another. On dead-end streets, collection crews use pick-up trucks instead of the Eager Beaver vehicles. Austin tested a Kann Curbsorter truck and Crane Carrier truck in order to determine the feasibility of one-person crews. (Initial results were less than promising.) In the fall of 1991, the City ordered nine new Lodal SA33 recycling trucks to replace the Eager Beaver vehicles over the next 3 years. Collection crews will be reduced from two to one, and crews will collect materials from the right side only in areas with high participation.
Economic Incentives:	Private businesses award \$100 per week to families that have set out recyclable materials at curbside.
Enforcement:	Not applicable. Although scavenging of aluminum cans has been a problem in the City, Austin has not taken any action against scavengers except for contacting them when possible and asking them to stop.
Annual Tonnage:	7,347 tons FY 1989, 11,090 in FY 1990, and 13,323 tons in FY 1991

Multi-unit Collection

Residents in multi-family buildings are encouraged to recycle materials at Ecology Action's drop-off sites. Ecology Action has also established a recycling drop-off station at one 409-unit apartment complex, with portable storage containers for glass and aluminum and ferrous cans, and dumpsters for newspapers. In 1990 Central Texas Refuse and Longhorn Disposal began to collect recyclables from approximately 30 apartment buildings. Both haulers provide 95-gallon containers for separate collection of newspaper, glass, and aluminum cans and empty bins on either a scheduled or an on-call basis. In 1991 Texas Disposal Systems initiated collection of aluminum and newspaper from 12 apartment complexes.

Austin has begun to address the problem of the lack of recycling services to multi-unit buildings, comprising more than one-third of the City's population. In January 1990, the Austin City Council passed a Comprehensive Recycling Resolution, which included a provision to include a recycling program for multi-family housing. In May 1990, the Austin Apartment Association initiated a series of discussions regarding the development of a comprehensive multi-unit recycling program. This led to the formation of a task force, as an auxiliary body to the Solid Waste Advisory Commission (SWAC), which included apartment owners, managers, residents, the Austin Tenants' Council, disposal companies, and the City Environmental and Conservation Services Department. The task force compiled a list of recommendations to the City, including both drop-off and on-site recycling opportunities, provisions for containers, educational materials, and publicity.

Commercial & Institutional Curbside/Alley Recycling

Legislative Requirements:	None
Service Provider:	Ecology Action, BFI, and Texas Disposal Systems
Number Served:	Ecology Action served approximately 150 businesses in 1989. BFI served approximately 200 businesses. Texas Disposal Systems serves approximately 20 businesses.
Type Served:	Offices, restaurants, bars, gas stations, banks, and grocery stores
Materials Collected:	Ecology Action collects most grades of paper including newspaper, computer paper, file stock, white ledger, laser printer, high-grade paper, and corrugated cardboard from office buildings; it collects glass and aluminum and steel cans from restaurants. As of October 1991, due to a depressed market, newspaper is no longer accepted. BFI collects cardboard. (In 1990 BFI and Longhorn Disposal began to collect high-grade and mixed office paper from a small number of businesses.) In 1991 Texas Disposal Systems began collecting corrugated cardboard.
Pick-up Frequency:	Varies. Some businesses are served weekly; others call vendors to arrange pick-up.
Set-out and Collection Method:	Businesses sort recyclables by material type in 20-, 30-, and 40-gallon fiberboard containers or in 55-gallon HDPE plastic barrels provided by Ecology Action. BFI collects truck-load quantities of compacted cardboard from supermarkets and other large businesses. In 1991 BFI set out a total of 60 dumpsters for collection of cardboard from its commercial customers.
Incentives:	None

Enforcement: None

Annual Tonnage: Ecology Action collected 712 tons of recyclables in 1989. BFI tonnages are not available.

Ecology Action began a municipal office paper recycling program in 1982, collecting materials free of charge. In 1991 Ecology Action began to charge a sliding fee ranging from \$35 to \$45 per pick-up because the market price for paper had declined and costs were exceeding revenues. The fee was based on the quantity of materials set out for recycling and the ease of collecting the materials. Many commercial accounts cancelled pick-up service, and office accounts dropped from 150 to 60. Ecology Action also began to charge bars and restaurants for pick-up of recyclables in 1991. The nonprofit charges \$35 per 10-12 barrel pick-up of glass and a \$45 charge if the pick-up includes corrugated cardboard. Ecology Action will not pick up cardboard alone. A private recycler has continued to service some businesses with free collection.

Since 1987 Central Texas Refuse has offered curbside collection of recyclables to residents at the Bergstrom Air Force Base. At first, crews collected commingled newspaper, glass, and aluminum cans in compactor trucks, but participation was low. In 1991 Central Texas Refuse cut back curbside collection to newspaper only and set up five drop-off sites throughout the base for newspaper, glass, and aluminum cans. Participation at these sites is also low.

By 1989 only a limited number of schools in Austin had instituted recycling. In 1990 Austin received a grant from the Governor's Energy Management Center to develop a model school recycling program. Ten city schools participated in a pilot project from February to May 1991. They collected newspaper, high-grade paper, mixed paper including file stock and notebook paper, aluminum and tin cans, and corrugated cardboard. Materials were emptied in centrally located 60-gallon barrels and paper collection boxes for each classroom. Staff brought recyclables directly to buy-back centers, and the small amount of revenues generated helped to cover costs and were used to fund school projects. As a result of the cardboard collection, the most bulky item in the schools' waste stream, dumpsters in the pilot school were reduced by several cubic yards each. The Governor's Office approved a 1-year extension of the project to determine how to improve delivering materials to collection centers. "Keep Austin Beautiful" developed an Adopt-A-Recycler program to finance the purchase of recycling containers and provide transportation to buy-back centers. With standardized containers purchased through this program, the schools will be better prepared to analyze their waste streams. A final model plan will be completed in September of 1992. In addition, several of the pilot schools and some other schools in the Austin School District composted yard waste for their organic gardening programs. They built small composting bins, which students managed and used in the school gardens. One school in a rural region of the City collected cafeteria food waste in 5-gallon plastic buckets. The waste was fed to pigs belonging to one of the school custodians. Texas will formulate a statewide school recycling program modeled after the results of the Austin pilot study.

Austin provides businesses with referrals of material buyers, collection services, and general information on establishing in-house recycling programs. In April 1991, the Solid Waste Advisory Commission created a Commercial Recycling Task Force representing haulers, businesses, and City government to develop Austin's commercial recycling opportunities.

Self Haul and Drop-off Center

Number and Type: 33, of which 16 are buy-back centers

Public or Private: All of Austin's drop-off centers are privately operated. Ten are operated by Ecology Action, a local nonprofit organization. Ecology Action's Landfill Diversion Center is privately run under contract with the City.

Sectors Served:	Drop-off centers primarily service the residential sector. Buy-back centers service the residential and commercial sectors.
Materials Accepted:	<p>Ecology Action^{Industrial} accepts newspaper, high-grade and mixed paper, aluminum cans, ferrous cans, scrap metals, glass, HDPE and PET plastics (PVC was added in 1991), and lead-acid batteries at its drop-off sites. White goods are accepted at its Landfill Diversion Center. Several Austin churches and schools accept aluminum cans, glass, and newspaper. The Humane Society of Austin accepts newspapers.</p> <p>ACCO Waste Paper runs a buy-back operation at its processing center, which accepts newspaper, high-grade and mixed paper, aluminum cans, ferrous cans, and glass. In 1990 the Center began to accept HDPE and PET plastics, as well. Six buy-back centers/scrap yards accept aluminum cans, batteries, and metals; four accept aluminum cans and metals; two accept aluminum cans only; two accept lead-acid batteries only; and American Fiber Mulch takes newspaper. The largest metal recycler, Commercial Metals, places roll-off containers at the landfills for deposit of white goods and appliances by residents.</p>
Annual Tonnage:	2,134 tons were recovered through Ecology Action's 10 drop-off centers in FY 1989.

Salvage/Reuse

As in many other communities throughout the country, organizations such as Goodwill and the Salvation Army collect household items, small appliances, clothes, and other salvageable goods. Austin tracked these materials through a survey and determined that 1,883 tons were collected in 1989.

Ecology Action operates a Landfill Diversion Center under contract with the City. In FY 1989 this contract was \$13,000. Residents are encouraged to bring bulky items, including white goods, to the center to avoid a \$10 landfill surcharge. The Center processes approximately 1.5 tons per day. In 1989 Ecology Action repaired and sold the white goods, or sold nonrepairable items as scrap metal. That year, landfill customers brought 363 tons of recyclables, primarily large appliances and bulky scrap metal, to the Diversion Center.

Processing and Marketing Recyclables

Municipal crews bring between 20 to 30 tons per day of glass and cans collected at curbside to the ACCO Waste Paper Processing Center located in Austin (which was purchased by BFI in October 1990). Built in 1989, ACCO also accepts recyclables from private haulers. The facility, which operates 280 days per year and is designed to process 400 tons per day, processes over 200 tons per day. The City pays no tipping fee; ACCO Waste Paper pays the City for its recyclables. In fiscal year 1989, ACCO Waste Paper paid \$29.69 per ton; in 1990 the City received \$20.02 per ton. Inside a 750-square-foot building, 20 developmentally disabled adults, employed through a local social service agency, hand-sort glass by color on conveyor belts. The glass is crushed and stored in Gaylord boxes. Aluminum and steel cans are separated and baled. City crews unload the paper outside onto a cement pad. There, five employees sort out contaminants and set the paper onto a conveyor that leads into another building, where it is baled. In 1990 ACCO Waste Paper began to process (bale) HDPE and PET plastic containers. An estimated less than 10 percent by weight of recyclables processed are rejected and disposed.

ACCO Waste Paper sells glass cullet to Owens-Brockway in Waco, Texas. The firm sells ferrous cans and metals to Commercial Metals in Austin, aluminum cans to Alcoa plants in Arkansas and Tennessee, and HDPE and PET plastics to Orion Pacific in Midland, Texas for the manufacture of new containers. ACCO Waste Paper's final market for newspapers is a deinking plant in Mexico City. Corrugated cardboard is marketed in Mexico where it is manufactured into linerboard. High-grade and mixed paper is sold to tissue mills in Fort Howard, Oklahoma or overseas through Houston or Mexico. During the mid-1980's, approximately one-third of the newspaper collected by the City curbside program was processed into a hydromulch product sprayed onto bare embankments to stabilize the soil. In 1989 the manufacturer of this product accepted only a small amount of newspaper. The Humane Society now collects newspaper for animal bedding.

Three full-time and two part-time employees at Ecology Action process approximately 11 tons per day of recyclables in a 15,000-square-foot processing center opened in 1986. Earlier, materials had been processed in one of the founder's backyard. The facility does not accept materials from private haulers. The facility operates 250 days per year. Employees sort and crush glass, and separate and bale HDPE and PET plastics, aluminum cans, and steel cans. In 1990 Ecology Action processed 2,301 tons; the facility is designed to process 21 tons per day. In 1991 Ecology Action began accepting PVC plastic containers at its drop-off sites. Ecology Action's warehouse was sold in October 1991, and it moved operations to a 14,200-square-foot facility. The group purchased a portable granulator and plans to begin chipping the plastics in late 1991. Ecology Action sells newspaper, high-grade and mixed paper, corrugated cardboard, glass, and HDPE and PET plastics to ACCO Waste Paper. It sells aluminum cans and ferrous cans to Commercial Metals in Austin; and PVC plastics are sold to Occidental Chemical in Pennsylvania (which uses the materials to produce new bottles). Lead-acid batteries are sold to local scrap yards.

Market Development Initiatives/Procurement

The City established a purchasing policy in October 1988 that created a 10 percent price preference for the purchase of recycled products by City agencies. In 1990 the City Council passed a comprehensive recycling resolution that redefined recycled paper as containing a minimum of 50 percent pre- or post-consumer recycled fiber content.

Composting Activities

Austin provides seasonal leaf collection, composts the leaves with wood chips (delivered by the City's tree service contractor) and dewatered sludge at its wastewater treatment facility. In 1991 Austin distributed brochures on backyard composting and sponsored a "Master Composter" program conducted by Austin Community Gardens. In January 1991, Austin initiated a "Don't Bag It" program whereby residents were urged to leave grass clippings on their lawns. In the spring 120 volunteers were selected as "Demonstration Lawns" for the program. Some of the volunteers received fertilizer, others received "Dillo Dirt" (finished compost), to apply on their lawns to hasten the composting process. In June the City and Travis County Agricultural Extension Service conducted a public tour of four demonstration lawns, including a demonstration of several brands of mulching lawnmowers.

In January 1991 the City Council solicited bids to purchase a brush shredder in order to divert wood waste from the municipal landfill. The wood chips will be added to the compost process, or used as a mulch, industrial fuel supplement, or cover for the landfill.

Curbside Collection

Start-up Date:	1988
Service Provider:	City of Austin
Households Served:	110,000 (in single and duplex buildings in 1989); 111,500 in 1991
Mandatory:	No
Materials Collected:	Leaves
Set-out Method:	Residents place leaves in either plastic or paper bags, which they supply.
Collection Vehicles and Method:	Three-person City garbage crews collect leaves in 40 compactor trucks.
Collection Frequency:	Weekly, from November to December and late February through early April on one of the refuse collection days
Economic Incentives:	None
Annual Tonnage:	1,372 tons from October 1988 through September 1989

Composting Site

Municipal crews bring leaves to the City's wastewater treatment facility at Hornsby Bend, 5 miles from the City, where prison inmates remove plastic bags and extraneous materials. No tipping fee is charged at the compost site. Small brush, dropped off at the site by City-contracted tree trimmers, is also added to the compost mix. Employees combine leaves with dewatered sewage sludge, wood chips, and water hyacinths with a front-end loader, and form the material into windrows. Before sludge is incorporated into the windrows, it must be tested according to state and federal standards (EPA's "Process to Significantly Reduce Pathogens [PSRP] and the Texas Department of Health's "Process to Further Reduce Pathogens" [PFRP]). Operators maintain windrow temperatures at 55 degrees Celsius for a minimum of 15 days in conformity with EPA guidelines. Compost has never failed EPA testing. Internal windrow temperatures are measured daily. Samples are analyzed monthly for heavy metal and three times per year for PCB content. The material is turned two times per week; it takes approximately 1 month to compost and 1 to 2 months to cure. After the curing process, it is screened through a 0.75-inch screen to yield a compost topsoil, or a 1-inch screen for a mulch product. Residue that does not pass through the screens is reused as bulking agents. The City has not received any odor complaints. Less than 2 percent by weight of compost collected is rejected and landfilled. The finished product, marketed under the trade name "Dillo Dirt," is used by City departments and sold to landscapers and local garden shops, which resell it to residents.

The City's annual Christmas tree mulching program uses private equipment and municipal labor. Residents bring Christmas trees to one of thirteen drop-off sites during the two weekends following Christmas. Local waste haulers provide roll-off containers to collect trees. Municipal crews shred trees with chippers loaned by local landscaping companies and apply the mulch to City parks. Residents who participate in this program receive a pine seedling.

Residents can also bring leaves and grass clippings year-round to a centrally located 6-acre compost site operated by Austin Community Gardens, a private nonprofit horticultural organization. Residents drop off materials free of charge, but landscapers are charged a \$35 yearly fee. In 1989, 50 landscapers deposited approximately one-half of the materials composted at the site; residents dropped off the rest. That year 5,628 tons of yard waste were composted. Employees place materials on three small

windrows on a 30-by 100-yard strip and turn windrows with a front-end loader once every 2 months. Compost is ready after 1 year and is applied to the 23 public gardens operated by Austin Community Gardens.

Amount and Breakdown of Materials Recovered

Material	Residential*	Commercial	Self-Haul†	Total
	(Tons, FY 1989)	Curbside (Tons, FY 1989)	(Tons, FY 1989)	(Tons, FY 1989)
Newspaper‡	7,235	65	500	7,800
Corrugated Cardboard	300	12,600	5,400	18,300
High-grade Paper	224	556	18,000	18,780
Other Paper	0	0	280	280
Glass	2,545	55	2,000	4,600
HDPE Plastic	0	0	200	200
Aluminum Cans	197	3	10,000	10,200
Ferrous Cans	376	24	NA	400
Scrap Metal	84	9	NA	93
Appliances/White Goods§	603	0	5,000	5,603
Batteries	180	0	NA	180
Other**	1,643	0	0	1,643
Subtotal MSW Recycled	13,387	13,312	41,380	68,079
Leaves and Grass Clippings††	4,186	0	0	4,186
Christmas Trees‡‡	NA	NA	NA	NA
City Tree Trimmings	-	-	1,418	1,418
Landscapers' Waste	-	-	2,814	2,814
Subtotal MSW Composted	4,186	0	4,232	8,418
Total MSW Recovered	17,573	13,312	45,612	76,497

Notes: Tonnage data is for fiscal year 1989 (October 1988 through September 1989), with the exception of yard waste composted at the Austin Community Gardens which is for 1989 (January through December).

50,000 tons of scrap metal were collected through private drop-offs. This tonnage is excluded from the above figures because it consists mostly of industrial and auto scrap.

Austin also collected 3,360 tons of motor oil during its Home Chemical Collection Day in 1989. Because the oil is burned as a fuel source, tonnages are not included.

*Residential tonnages were recovered through the municipal curbside programs (7,347 tons), Ecology Action drop-off centers (1,785 tons, including 84 tons of scrap metal and 363 tons through the Landfill Diversion Center), 180 tons of batteries, 1,643 tons of other privately collected items including household items, 240 tons of small appliances, 2,192 tons recovered through other non-profits, and composting operations (4,186 tons). These include municipal collection from one- to two-unit buildings and some three- and four-unit buildings, 17 private (nonprofit) recycling drop-off centers used by apartment buildings, and the Austin Community Gardens composting operation. Tonnages collected at nonprofit drop-off centers include a small amount of commercial materials.

†Self-haul tonnages include recyclables brought to private (for-profit) buy-back sites and scrap yards, and yard waste brought to the Austin Community Gardens, as well as brush collected through the City's tree trimming program. This includes material generated from both the residential and commercial sectors.

‡The tonnage of newspaper recycled from the residential sector includes cardboard, which residents commingle with newspaper for municipal curbside collection.

§Includes 240 tons of small appliances and 363 tons of bulky items collected at the Landfill Diversion Center.

**Other includes clothing (1,272 tons), household items (360 tons), and paint (11 tons).

††Includes yard waste collected through the municipal program (1,372 tons) and 50 percent of the material brought to Austin Community Gardens' site (2,814 tons).

‡‡Tonnage of Christmas trees recovered is not tracked and thus is not available.

Residential Materials Recovered through the Municipal Curbside Program

Material	Municipal Curbside Collection (Tons, 1988-89)	Municipal Curbside Collection (Tons, 1989-90)	Percent Change
Newspaper and Cardboard	5,589	7,682	37%
Glass	1,551	2,939	89%
Aluminum Cans	58	141	143%
Ferrous Cans	149	328	120%
Total Recycled	7,347	11,090	51%
Number of Households Served	110,000	110,000	0%
Participation Rate	40%	55%	38%

Publicity and Education

The City of Austin uses a variety of methods to advertise and promote municipal recycling programs. In 1983 it sent a recruitment brochure to all city residents to publicize the block leader program. Over 1,200 block leaders signed up to distribute fliers, brochures, and bumper stickers on local recycling and composting activities to their neighbors. Block leaders also received a yard sign. The block leaders are requested to commit 1 hour a month for the program and they may cover as large or small an area as they wish.

In September 1988, Austin launched an annual "Recycling Week" to publicize changes in the recycling program, including the addition of new materials. In 1989 the City asked private sponsors to fund a "Cash for Trash" program during the "Recycling Week." Private sponsors awarded \$100 each day to randomly selected residents participating in the curbside program during the recycling week and \$100 per week during the remainder of the year. Also that year, the City hired a full-time employee to operate a Recycling Hotline providing information on the City's programs. (The following year, Austin switched to a recorded message for this service.) The City also publicizes the recycling program through utility bill inserts, and announces program highlights on the radio and in the newspaper. In 1991 the City began to distribute recycling bins to all households served by curbside collection; 25,000 have been given out beginning with the neighborhoods with low participation rates. Private sponsors fund \$1.00 out of the \$3.00 cost of the bins. Recycling brochures, written in English and Spanish, are inserted in the bins. According to Laura Lancaster, the Recycling Public Relations Specialist, these bins are excellent publicity; recycling rates have increased by as much as 300 percent in some neighborhoods since their distribution.

Ecology Action publishes a quarterly newsletter. In 1991 the group published "The Austin Environmental Handbook." The handbook is a guide for the environmental community featuring information on organizations, City curbside and drop-off recycling programs, and activities for environmentalists.

Economics

Costs Cover: Capital costs cover the equipment used for the collection of 7,347 tons of recyclables and the collection and processing of 1,372 tons of leaves collected through the municipal curbside program. Processing takes place in the private sector; the City incurs no costs.

O&M costs cover (1) municipal collection and processing of 1,372 tons of organic material and the collection of 7,347 tons of recyclables, (2) the City's contract with Ecology Action to recover bulky items (363 tons) at the Landfill Diversion Center, and (3) the City's administrative and educational costs for municipal recycling and composting programs.

Capital Costs: Collection

Item	Cost	Use	Year Incurred
11 Stake-bed Trucks @ \$20,135	\$221,484	Recycling	1986
Pick-up Truck	9,930	Recycling	1986
11 Eager Beaver Trailers @ \$14,433	158,765	Recycling	1987
Crane Carrier Truck	61,000	Recycling	1989
6,000 Recycling Buckets @ \$1	6,000	Recycling	1989
Kann Truck	53,000	Recycling	1990
Eager Beaver Truck	38,000	Recycling	1990
20,000 Recycling Bins @ \$3.00	60,000	Recycling	1991
40 Compactor Trucks @ approximately \$55,000 each*	NA	Composting	NA

Note: All equipment has been paid in full at the time of purchase except for the Eager Beaver trucks and trailers which were paid off with a 5-year loan at an interest rate of 10.67 percent.

*The City uses 1 to 40 compactor trucks in a given week. Each truck may spend up to one-half of its route time in leaf collection while the program is in effect.

Capital Costs: Processing

Item	Cost	Use	Year Incurred
Brown Bear Windrow Turner	\$120,000	Composting	1986
Front-end Loader	80,000	Composting	1986
Conveyor and Screens	60,000	Composting	1988

Note: All equipment was paid in full at the time of purchase.

Annual and Per Ton Operating and Maintenance Costs (FY 1989)

	Cost	Tons Covered	Per Ton Cost
Recycling Subtotal*	\$830,700	7,710	\$108
Collection	\$735,000	7,710	\$95
Curbside	722,000	7,347	98
Drop-off at Landfill	13,000	363	36
Processing	0	7,710	0
Administration	65,300	7,710	8
Education/Publicity	30,400	7,710	4
Composting Subtotal	\$105,000	1,372	\$77
Collection	\$5,000	1,372	\$4
Processing	80,000	1,372	58
Administration	10,000	1,372	7
Education/Publicity	10,000	1,372	7
Recycling & Composting Total	\$935,700	9,082	\$103
Collection	\$740,000	9,082	\$81
Processing	80,000	9,082	9
Administration	75,300	9,082	8
Education/Publicity	40,400	9,082	4

Note: numbers may not add up to total due to rounding.

*In addition to these costs, the City paid \$9,600 in capital debt expense in FY 1989.

- Materials Revenues:** The Solid Waste Services Enterprise Fund received \$220,000 from ACCO Waste Paper for the sale of recyclables. The Wastewater Treatment Department received \$12,000 from sale of compost products.
- Source of Funding:** Recycling and composting programs are funded through City utility fees and capital bonds.
- Full-time Employees:** The City of Austin employs 34 people: 1 for recycling administration, 28 for recycling collection, 1 for composting administration, and 4 for processing yard waste. ACCO Waste Paper employs 22 people: 2 administrators and 20 developmentally disabled workers. Nine employees work at Ecology Action. Austin Community Gardens employs two people.
- Part-time Employees:** Up to 120 employees collect leaves two times per year.

Future Solid Waste Management Plans

As recommended in the City's 1990 Solid Waste Management Plan (SWMP), Austin will change its refuse, recyclables, and yard waste program in 1992. Each week City crews will collect refuse on one day, recyclables on another, and yard waste, year-round, on Monday in place of biweekly refuse collection. The City will also collect bulky items and brush on a quarterly basis. Additional recommendations from the SWMP include an expansion of the compost operation to accommodate year-round yard waste collection, a brush-shredding operation, and construction of two transfer stations with recycling capabilities. The City plans to implement volume-based refuse rates and semi-automated collection of refuse. Residents will have a choice of trash can or cart sizes: 30, 60, or 90 gallons. Monthly garbage disposal fees will vary according to size and number of containers chosen. In addition, for extra waste, residents will have to purchase tags in packages of five for \$10. This fee system provides an economic incentive for waste reduction, source separation, and participation in the recycling program. In a 1-year pilot program, which began in June 1991, residents pay from \$6 per month for 30 gallons of trash to \$12 a month for 90 gallons. The pilot program will help establish the rates necessary to provide adequate revenues for citywide implementation. The City expects the conversion to the semi-automated fleet to enhance worker safety and provide flexibility for pick-up of standardized containers, yard waste, and any excess refuse in labelled bags.

Recycling opportunities are limited outside the City. Private haulers serve some outlying communities with curbside pick-up of separated recyclables. Ecology Action plans to open up several drop-off centers in rural areas. The group plans to initiate one pilot freon recycling project at the Landfill Diversion Center to recover freon from refrigeration units, and to open other freon collection centers. Ecology Action is currently developing programs to begin motor oil container, aseptic packaging, and polystyrene recycling in the City. It is also working on developing an alternate use of newspaper to help overcome the severely depressed market.

In June 1991, Austin Community Gardens began a master composting project; the project has three phases. First, they are training 25 master composters and supplying them with composting bins. Second, Austin Community Gardens will provide residents with bins at cost, and will train landscapers to educate home gardeners on backyard composting. In the final phase, a large-scale compost site will be constructed and operated by Austin Community Gardens as a demonstration site for backyard composting.

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Berkeley, California

Demographics

Jurisdiction:	City of Berkeley
Population:	102,724 in 1990
Area:	18 square miles
Total Households:	43,534 (20,128 single-family homes, 17,945 households in buildings with 2 to 19 units, 4,881 households in buildings with 20 and more units, 14 trailer homes, and 566 other residences)
Total Businesses:	3,318 businesses
Brief Description:	Berkeley is a residential community in Alameda County across the Bay from the larger metropolitan area of San Francisco. One-third of Berkeley's business/institutional sector consists of government offices and institutions, such as the University of California, federal research laboratories, and the State Department of Health. There is little vacant land in the City, and Berkeley has experienced minimal growth and development in the last few years. Per capita income in 1990 was \$16,522; mean household income in 1990 was \$34,200.

Solid Waste Generation and Recovery

Annual Tonnages (July 1990 to June 1991)					
	Residential	Commercial/ Institutional	Total MSW*	Construction & Demolition†	Total Waste
Recovered	NA	NA	23,366	39,593	62,959
Recycled	NA	NA	20,366	39,593	59,959
Composted	NA	NA	3,000	0	3,000
Disposed	NA	NA	80,609	20,033	100,642
Incinerated	0	0	140	0	140
Landfilled	NA	NA	80,469	20,033	100,502
Generated‡	NA	NA	103,974	59,626	163,600
Percent by Weight Recovered					
Recovered	NA	NA	22%	66%	38%
Recycled	NA	NA	20%	66%	37%
Composted	NA	NA	3%	0%	2%

Note: Due to rounding, numbers may not appear to add to totals.

*Berkeley does not separately track residential and commercial waste recovered and disposed.

†29,000 tons of recovered construction debris were estimated from the first 6 months of 1991 data.

‡Municipal waste generated is based on 1988-89 annual data estimated from quarterly waste composition samplings. This is the best source of data available. Because no major demographic or economic changes occurred in Berkeley between 1989 and 1990, the City believes there has been no significant change in waste generation rates. Recovered tonnages are based on actual weighed amounts.

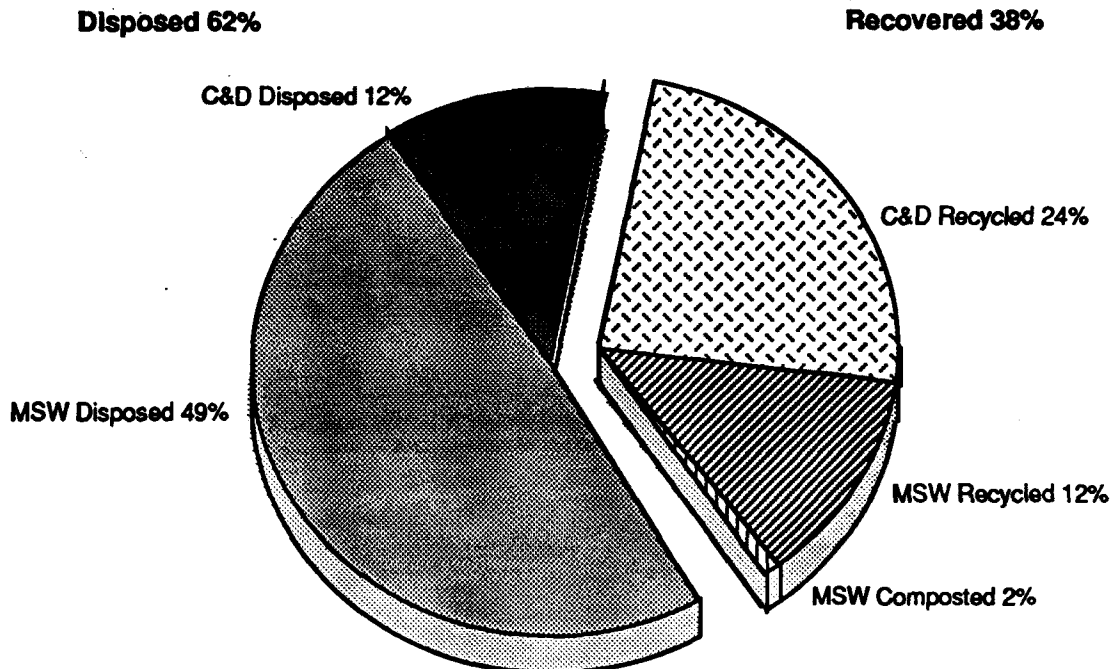
Transfer Station Tipping Fee:

\$48 per ton at Berkeley's transfer station in fiscal year 1991. In fiscal year 1992, the tipping fee at the transfer station rose to \$52 per ton.

Refuse Collection and Disposal:

The City of Berkeley has a monopoly on the collection of putrescible refuse from the residential and commercial/institutional sectors.¹ The City's Refuse Division collects all mixed refuse from the residential sector including the dormitories at the University of California. It also collects all putrescible refuse from the commercial sector, except from certain University buildings, as well as dry commercial waste from some businesses. Two private haulers, Richmond Sanitary Service and Oakland Scavenger, collect the remaining commercial and institutional refuse, including construction and demolition debris.

Total Waste Recovered and Disposed (Percent by Weight, FY 1991)



Note: Due to rounding, percentages do not add to 100%.

Refuse Collection and Disposal (cont'd):

There are two transfer stations in Alameda County, one in Berkeley and one in San Leandro. None of the County's three privately owned landfills is located in Berkeley. Berkeley's own landfill closed in 1983. Municipally collected refuse is taken to the City of Berkeley's Transfer Station, where it is hauled to the Vasco Road Landfill (owned and operated by Browning-Ferris Industries, Inc.) located 42 miles away. Some residents self-haul refuse such as yard debris directly to the transfer station. Waste collected by Oakland Scavenger and the University of California is taken to the Davis Street Transfer Station in Alameda County and then hauled to the Altamont Landfill (owned by Oakland Scavenger, a subsidiary of Waste Management, Inc.), in eastern Alameda County. Richmond Sanitary hauls the waste it collects to the West Contra Costa County Landfill.

In FY 1991 collection and disposal of refuse cost the City \$9.6 million for 83,000 tons of refuse. This is equivalent to \$116 per ton including tipping fees. Since 1984 Berkeley has charged households a variable rate for refuse collection. In fiscal year 1990 the rates were \$4.60 per month for a 13-gallon container, \$12 for a 32-gallon container, \$24 for a 64-gallon container, and \$36 for a 96-gallon container. In 1991, 200 residents are using a mini-can (13-gallon can).

Materials Recovery Overview

Goals and Legislative Requirements:

The California Integrated Waste Management Act of 1989 requires all California jurisdictions to divert at least 25 percent of the waste stream from disposal by 1995, and at least 50 percent by 2000, through source reduction, recycling, and composting. The Alameda County Source Reduction and Recycling Act of 1990 states that incineration cannot be counted toward this waste diversion goal. However in September 1991, this law was overruled by the Courts. Berkeley's own law (passed in 1982) does not allow incineration to be counted towards recycling goals. The State of California implemented deposit-container legislation in 1986.

The City of Berkeley has led the nation in municipal waste recycling and reduction, ever since the Ecology Center (EC), a community-based environmental organization, opened a recycling center in 1970. In 1973 the Ecology Center began monthly curbside collection of newspaper. Also that year, workers at the recycling center formed a separate organization called the Community Conservation Centers, Inc. (CCC), which subsequently opened two additional recycling drop-off centers in the City. The Ecology Center opened ENCORE!, a wine bottle reuse facility in 1975. In 1978 the Ecology Center began monthly curbside collection of source-separated metal cans and glass bottles, in addition to newspaper, from Berkeley households.

Berkeley's community organizations and residents have been a driving force behind the City's comprehensive recycling programs. In January 1982, the City Council adopted a recycling policy statement that established a goal of recycling 50 percent of the City's municipal solid waste, the nation's most ambitious recycling/waste reduction goal at the time. The same year Berkeley voters passed Measure U, which put in place a 5-year moratorium (which was subsequently renewed by the City Council) on garbage incinerators and directed the City to concentrate on recycling instead of incineration as its waste management strategy. By the time the Berkeley landfill closed in 1983, the City had completed construction of a Solid Waste Management Center on City-owned land. This complex included the new Berkeley transfer station, the Ecology Center's headquarters and materials processing center, a buy-back/drop-off site operated by CCC, and Urban Ore's salvage/reuse operation. In late 1982, at the request of the City, the three community-based organizations—the Ecology Center (a nonprofit organization), the CCC (a nonprofit organization), and Urban Ore (a for-profit business)—formed an alliance called the "Berkeley Recycling Group," to coordinate all the City's materials recovery operations on the new site. However, in 1983 two other businesses received the contract for these services; legal and political battles ensued, and one year later Berkeley residents passed the Recycling Policy Ordinance, which led to the return of the community groups. Also in 1984, a citizen initiative requiring the City of Berkeley to meet a 50 percent recycling goal was passed by Berkeley voters. In 1986, due to the City's inability to continue to provide a site for the operation, Urban Ore's composting operation was closed. Recycled Wood Products opened a composting operation in Berkeley in 1989.

During the 1970's and early 1980's, the City provided minimal financial or in-kind assistance, such as the use of City-owned property to EC's curbside collection program and CCC's drop-off programs. In 1985 the City began to formally contract EC's and CCC's drop-off recycling services. The contract fees paid to these organizations covered the difference between the programs' cost and revenues earned from the sale of recyclable materials. Under its contract with EC, the City pays a fee, or waste diversion credit, for every ton of material collected. The credit is based on a sliding scale tied to the door price of newspaper. The City purchased most of the capital equipment for EC's collection and processing program, including collection trucks and curbside recycling containers. The City has paid CCC approximately \$25,000 per year to operate the Buy Back. Since 1983 Urban Ore's license agreement

requires it to pay the City 10 percent of its monthly gross revenues, totalling up to \$2,900 per month (in June 1991). In fiscal year 1991 Urban Ore paid the City a total of \$30,000.

During 1988 and 1989, the Ecology Center expanded its curbside service from monthly to weekly collection of recyclables. From July 1990 to June 1991, 5,984 tons of recyclables were collected through the residential curbside program, nearly 200 percent more than 2 years earlier. In March 1988, the City's Refuse Division began a pilot commercial recycling program, collecting separated glass, aluminum, tin, and mixed paper from businesses and a few apartment buildings. By 1991, 290 businesses citywide (8 percent of businesses) and all municipal offices were receiving municipal collection of tin, aluminum, glass, corrugated cardboard, newspaper, and white office paper. In 1989 residents voted Berkeley's curbside recycling programs the "Best Loved City Service."

California has targeted an 80 percent recovery goal for beverage containers. The State's deposit container program is funded through fees paid by beverage distributors for each container sold in the State. Originally set at 1 cent, these deposit payments paid by consumers to retailers were increased, effective January 1990, to 2 cents per small container, and 4 cents for larger containers. Revenues from the Beverage Container Recycling Fund are used to pay the return value of 2.5 cents for each empty container, and 5 cents for each container greater than 24 ounces. Deposit containers are recovered both through the curbside and drop-off programs as well as supermarkets and liquor stores. Of the 3,629 tons of deposit glass containers estimated to have been generated in Berkeley in FY 1991, 2,874 tons, or 80 percent, were recovered and recycled. A total of 1,550 tons of deposit glass (54 percent) were recovered through the residential curbside program, 240 tons (8 percent) through drop-off, 712 tons (25 percent) through buy-back, 192 tons (7 percent) through the University and 99 tons (3 percent) were recovered outside of the City. Of the estimated 452 tons of aluminum cans generated, 318 tons, or 70 percent, were collected and recycled. The City believes that deposit legislation has increased the scavenging of materials from the curbside program.

Berkeley considers source reduction its primary waste management strategy (See Source Reduction Initiatives section). In its 1991 *Source Reduction and Recycling Element* (its new recycling plan), Berkeley set a source reduction goal of 8.4 percent of the waste stream by 1995 and 13.5 percent by 2000, to be accomplished through such activities as replacement of nonreusable materials in commercial enterprises, residential use of cloth diapers and other reusable products, junk mail reduction, home composting, and Urban Ore's salvage and reuse program. Berkeley has tried to discourage use of materials not easily recyclable, or are otherwise harmful to the environment. In 1988 the Berkeley City Council approved an ordinance prohibiting the use of fast food and take-out packaging made with chlorofluorocarbons (CFC's). In 1989 this ordinance was extended to ban all foamed polystyrene take-out food and beverage containers, whether or not they contain CFC's. This law further requires that food merchants ensure that at least 50 percent of their take-out food packaging be degradable or recyclable as defined by law. Berkeley has pioneered a citywide "precycling" campaign, encouraging residents to buy and use fewer disposable and nonrecyclable materials. The City has chosen to exclude plastics from the materials collected through its curbside collection program and drop-off sites, focusing instead on discouraging their use.

Recycling Activities

Residential Curbside Recycling

Start-up Date:	1973 for newspaper only; 1978 for other materials
Service Provider:	The Ecology Center, Inc., under contract with the City
Pick-up Frequency:	Weekly

Same Day as Refuse:	Yes
Households Served:	An estimated 40,000 households, primarily in buildings with fewer than 12 units. EC collects recyclables from a few buildings with 12 or more units if recyclables are properly set out at curbside.
Mandatory:	No
Participation Rate:	55 percent for 30,000 stops (ILSR calculation based on EC's observed weekly set-out rate of 25 percent multiplied by a participation/set-out ratio of 2.2). ²
Materials Collected:	Newspaper, aluminum cans, glass containers, tin cans, and refillable wine bottles. Mixed paper and magazines are collected in three neighborhoods (approximately 2,000 households) in the City.
Set-out Method:	Materials are segregated into three categories. Newspaper is tied or placed in bags, mixed metal cans are placed in waxed cardboard boxes provided by the City, and glass is placed in a second waxed cardboard box. In the mixed waste paper pilot recycling districts, mixed paper is placed in paper bags or bundled with twine.
Collection Method and Vehicles:	Recyclables are collected in one of five Lodal compartmentalized vehicles. One or two crew members (including the driver) place segregated recyclables into three different compartments. One for glass, a second for newspaper, and a third for metal. Mixed paper is placed in a fourth compartment (in the pilot mixed paper recycling districts), and the remaining compartment is used for overflow material. Two crew members ride on vehicles on hilly routes; 33 percent of routes are serviced by two crew members, 67 percent by one.
Economic Incentives:	The variable can-rate encourages residents to generate less waste, thus proving an economic incentive to recycle.
Enforcement:	The City has an anti-scavenging ordinance and violators can be fined \$100 or more (for repeat offenders). The City has issued a few citations for scavenging of recyclable materials, but has undertaken no coordinated anti-scavenging effort. The State Integrated Solid Waste Management Act makes scavenging of recyclables a misdemeanor punishable by a fine of \$500 or 6 months' imprisonment. In 1991 the State law was amended to provide for fines of \$1,000 and one year in prison. No one has yet been convicted under State law. By comparing actual recovery rates to expected rates, the Ecology Center estimates that it loses approximately \$10,000 per month in revenue due to scavenging of aluminum and glass. ³
Annual Tonnages:	5,984 tons in fiscal year 1991

Multi-unit Collection

In 1988 the City's Refuse Division began to service approximately 15 multi-unit buildings (with 12 or more households) through its commercial curbside program, collecting source-separated glass bottles, aluminum and tin cans, white office paper, and newspaper on a weekly basis in semi-automated recycling trucks. (See Commercial Recycling section for more information.) Participating buildings, which include co-ops and senior citizen apartment buildings, where tenants are especially interested in recycling, receive both refuse and recyclable pick-up from the City. Recycling service is provided free of charge to these buildings. The City intends to expand this program in 1992 and increase publicity.

Commercial & Institutional Curbside/Alley Recycling

Legislative Requirements:	All retail food vendors are required by the 1989 Ordinance Prohibiting Take-out and Fast Food Packaging Manufactured to provide recycling containers for glass and cans for customers' use.
Service Provider:	City of Berkeley's Refuse Division
Number Served:	250
Type Served:	Bars, restaurants, schools, and offices
Materials Collected:	Glass and metal beverage containers, high-grade paper, newspaper, and corrugated cardboard are collected from businesses. White office paper is collected from schools.
Pick-up Frequency:	Weekly
Set-out and Collection Method:	The City collects recyclables in a front-loading 44-cubic-yard, compartmentalized recycling vehicle custom built by T. J. Garge. The truck features a crane that automatically empties recycling containers into truck compartments.
Incentives:	Businesses serviced by municipal refuse collection can save money through recycling by reducing the size of their refuse containers.
Annual Tonnages	990 tons in fiscal year 1991 including a small amount of material from apartment buildings

The City Refuse Division began a pilot commercial recycling program in March 1988 in one business district. The businesses were not charged extra for curbside recycling service and the cost was covered by businesses' refuse collection payments. City refuse crews collected glass, aluminum, tin, and mixed paper using a pick-up truck and a compartmentalized trailer. The mixed paper was found to be contaminated with glossy paper and foil, and the City had difficulty finding markets for this material. In September 1988, the program, limited to the collection of glass, expanded citywide. In January 1989, with a grant from the County, the City purchased one 44-cubic-yard compartmentalized, custom-built recycling vehicle and began collecting tin, aluminum, glass, corrugated cardboard, newspaper, and white office paper. However, this front-loading vehicle caused significant glass breakage; an estimated 40 percent of glass collected was broken. By 1991, 250 businesses were served with municipal curbside collection, and all City schools were served with collection of white paper. The City hopes to expand this service, collecting at least 4,490 tons per year by 1995.

The Associated Students of the University of California Recycling Project collects source-separated recyclable materials from University of California at Berkeley facilities. These materials include glass bottles, aluminum cans, computer tab cards and paper, white and colored ledger paper, and mixed paper. Materials collected through this program were delivered by the students to the Berkeley Buy Back, run by the CCC, for processing. An estimated 318 tons of recyclables were collected through this program between September 1988 and August 1989. Between July 1990 and June 1991, 900 tons of recyclables were collected at UC Berkeley, an increase of nearly 200 percent.

Some additional private haulers, such as Richmond Sanitary, offer curbside collection of recyclables to their refuse customers. Some retail operations self-haul recyclable materials to the Berkeley Buy-Back; others set all recyclables at curbside, and independent individuals collect materials and bring them to the Berkeley Buy-Back or to buy-backs outside the City.

Drop-off Centers

Number and Type:	Six centers. The Community Conservation Centers, Inc. (a nonprofit company) operates two drop-off sites and the Berkeley Buy Back center. Urban Ore, Inc. (a for-profit company) runs a salvage/reuse drop-off operation, at two sites. American Rock & Asphalt, in Richmond, California, and Gallagher & Burke in Oakland, operate concrete recovery operations.
Public or Private:	All drop-off sites are privately operated. The City contracts with CCC to operate the Berkeley Buy Back.
Sectors Served:	Berkeley residents and businesses. American Rock & Asphalt, and Gallagher & Burke Construction, also accept construction and demolition debris from private contractors outside of the City.
Materials Accepted:	CCC accepts newspaper, mixed paper (such as magazines), glass containers, aluminum and tin cans, refillable wine bottles, and corrugated cardboard, from 9 am to 4 pm, 6 days a week. The Berkeley Buy Back purchases newspaper, cardboard, high-grade paper, mixed paper, aluminum and tin cans, ferrous metal scrap, and refillable wine bottles on a per pound basis. Urban Ore accepts construction and demolition materials such as doors, furniture, plumbing fixtures, windows, and other salvaged items. American Rock & Asphalt and Gallagher & Burke accept broken concrete and asphalt.
Annual Tonnage:	A total of 45,597 tons of Berkeley-generated recyclables from municipal waste and construction and demolition debris were recovered through Berkeley's drop-off centers in fiscal year 1991. This tonnage consisted of 5,390 tons of materials recovered at Urban One (a small amount of this was recovered at other salvage operations), 2,386 tons recovered at the Berkeley Buy Back, 1,821 tons at CCC's drop-off centers, 28,900 tons at American Rock & Asphalt, and 7,100 tons at Gallagher & Burke.

Since January 1990, the City Council has required the Public Works Department to install recycling containers for the collection of newspaper, glass, and metal cans in City parks and newspaper bins on major commercial streets. Much of this material is scavenged. In the future the City will attempt to track tonnages recovered through these drop bins.

Salvage/Reuse

Urban Ore is a model for-profit materials salvage business founded in Berkeley in 1980. The company receives and salvages materials, such as construction debris and used household items, which would otherwise end up in the landfill. Initially, Urban Ore retrieved the materials it sold, such as metal scrap, from the Berkeley dump. Today, only about 10 percent of the materials sold at Urban Ore are salvaged from the Berkeley transfer station. The bulk of materials are dropped off by residents and local businesses, and in many instances, Urban Ore pays for the material it receives. In 1991 Urban Ore began to offer Limited pick-up service.

Urban Ore operates two separate sites. The Building Materials Exchange sells salvaged construction items, such as doors, windows, bathtubs, and sinks. The Discard Management Center, located on 1 2/3 acres of City-owned land sells furniture, clothing, kitchen appliances, and other

household items. In October 1991, Urban Ore reconfigured its operations; it now operates one large retail sales area composed of two parts, the Building Materials Exchange and the General Store. The Discard Management Center has a receiving dock and processing rooms that occupy 12,000 square feet of a City building and lot next to the transfer station. The retail sales area, four blocks away, occupies 2.2 acres of commercial land consisting of a large open yard for the Building Materials Exchange and 17,300 square feet of warehouse space for the General Store, which handles cabinets, hardware, furniture, clothing, electronics, household goods, and commercial equipment. Urban Ore has offices in the General Store, including its new Information Services Division. The Company employs 16 people.

In 1990 Urban Ore recovered an estimated 1,123 tons of household goods and an estimated 4,267 tons of building materials for a total of 5,390 tons. Based on gross income, Urban Ore estimates that it has tripled the volume of material it handles since moving off the landfill site in mid-1983. The company grossed over \$600,000 in 1989 and \$729,996 in 1990; an additional \$5,629 was earned in consulting fees. Urban Ore's 1990 operating and maintenance costs totaled \$702,242 (\$135 per ton). Of this, \$95,000 was paid to residents and businesses for reusable goods (most of it went to local residents) and \$282,351 was spent on personnel. In 1990 Urban Ore earned \$27,754 in profits (equivalent to approximately \$5/ton). Its inventory is assessed at \$22,000. Dan Knapp, Urban Ore's founder, estimates that the company's 1991 revenue may reach \$900,000. In an average week in 1989, Urban Ore received most of its revenue from the sale of furniture, building materials, hardware, and commercial and office goods.

Urban Ore prefers to sell the materials it receives to residents or businesses for reuse. Materials that cannot be sold are recycled at any one of a number of local recycling and composting operations. For example, unpainted wood is taken to Recycled Wood Products.

Construction and Demolition Debris Recovery

Many private builders and contractors in Berkeley bring broken concrete and asphalt from construction and demolition projects to American Rock & Asphalt's two recovery facilities, located in Richmond and South San Francisco, or to Gallagher & Burke located in Oakland. Based on the first half of the year, American Rock & Asphalt estimates that it recovered 500,000 tons of material from Berkeley and other surrounding areas in FY 1991. (In 1989 it recovered about one-half this amount, or 250,000 tons of material.) Berkeley contractors brought an estimated 28,000 tons to the Richmond facility and 900 tons to the San Francisco facility in 1990-91. American Rock & Asphalt's primary recovery site is located on a quarry in Richmond, which exhausted its supply of virgin rock 3 to 4 years ago. The company retrofitted this facility to process recovered concrete and asphalt at a cost estimated at less than \$50,000. Individual contractors and businesses are charged a tipping fee of \$20 to \$50 per semi-load or 20 cubic yards (equivalent to 30 tons⁴) of broken concrete and asphalt. The tipping fee may be waived if a contractor agrees to buy American Rock & Asphalt's replacement materials.

Broken concrete, asphalt, and brick are sent down a conveyor, where laborers pull out wood and debris by hand. Steel is removed by magnets; materials are crushed and screened; water is added at different points in the process to dampen material. The end product, made from 100 percent recycled materials, is an aggregate road base, suitable as a preparatory material for roads under a final application of asphalt. It sells for approximately \$6.50 per ton. Contractors purchase it directly from the facility. American Rock & Asphalt claims that it routinely sends samples to a commercial laboratory for specification compliance testing.⁵

Urban Ore, a Berkeley-based company, salvages used building materials, such as windows, bathtubs, and furniture, at its Building Materials Exchange. Berkeley homeowners and builders purchase salvaged good for reuse. (See above.) In FY 1991, it salvaged 4,267 tons of Berkeley building materials, of which 3,593 tons are considered construction and demolition debris. Six-hundred and seventy-four tons of white goods, included in municipal solid waste tonnage recovered, were also salvaged at the Building Materials Exchange.

Processing and Marketing of Recyclables

Recyclable materials collected at curbside are taken to the Solid Waste Management Center (SWMC), which is owned by the City. The facility, constructed in 1982 on 7 acres of City-owned land, contains the transfer station, the Berkeley Buy Back, CCC's drop-off center, the curbside residential program operated by the Ecology Center, and one of Urban Ore's operations. The Buy Back and curbside operations have a combined design capacity of 1,500 tons per month. The throughput is currently 1,000 tons per month. Most of the equipment used to process materials is owned by the City.

The Ecology Center operates the portion of the Solid Waste Management Center that processes materials collected at curbside. A three-person crew including one forklift operator unloads material. Each compartment is removed from the recycling trucks with a rotating forklift, and materials are dumped on the ground. Minimal equipment is used to process recyclables. Cans are magnetically sorted on a small conveyor belt. Contaminants and aluminum foil are removed by hand. Tin cans are baled on site and sold to Proler for use in the precipitation of copper. Aluminum is sold to the Berkeley Buy Back center. Glass is hand-sorted on a second conveyor belt from which workers remove refillable glass bottles for sale to ENCORE!'s bottle facility. The remaining glass is crushed and sold as three-mix (three-colored mixed cullet) to California CRInc in Oakland. Newspaper is placed in 40-foot Sea-Land containers and sold to a local broker. Mixed paper is given to CCC for baling and marketing. The Ecology Center employs a total of 14 people, including site crew and drivers. Less than 1 percent of material collected through EC's curbside program is disposed as residue. Haulers will reject contaminants and nonrecyclables at curbside. The Ecology Center has consistently enjoyed a reputation among materials brokers as delivering very clean material.

CCC independently markets materials collected through its drop-off programs, selling to many of the same companies as EC. CCC uses a horizontal baler, several forklifts, and an aluminum separator to process materials. The City has installed expanded processing facilities in the Buy Back's section of the site, including a 40-foot conveyor belt system (at a cost of \$110,000) for cleaning and sorting recyclable materials. The City hopes to make this increased processing capacity accessible to other Berkeley recyclers.

Founded in 1975, ENCORE! washes up to 60,000 cases of wine bottles per month, of which 45,000 cases were post-consumer material. The group accepts most bottle types used by American producers. ENCORE! pays local collection groups, wineries, and glass manufacturers up to \$130 a ton for bottles, washes them, and sells the bottles back to the wineries for reuse. ENCORE! has steadily increased its profits each of its 15 years. Unfortunately, 1989 and 1990 were hard on the company, and its production, employment, and profits declined by 50 percent during that period. In 1991 ENCORE! processed only 30,000 cases of bottles per month, of which 5,000 cases were post-consumer material. Peter Heylin, co-founder of ENCORE!, attributes this sudden decrease to competition with the State deposit legislation. According to Heylin, in 1989 California unofficially began to accept previously excluded wine bottles with other beverage glass for redemption.

Market Development Initiatives/Procurement

The Alameda County Source Reduction and Recycling Act of 1990 requires counties to establish and fund programs to stimulate markets for recycled materials. The City of Berkeley has instituted a recycled product purchasing preference program.

Composting Activities

Urban Ore began composting Berkeley's yard debris and wood waste, under contract with the City, at the old landfill site in 1982. In 1985 Urban Ore composted 56,956 cubic yards of material.⁶ The composting operation was terminated in 1986. In September 1989, Recycled Wood Products opened a composting site, and the City instituted a pilot yard waste collection program. Berkeley's Refuse Division began serving 2,600 households (10 percent of the City) with curbside collection of yard waste. All municipally collected yard waste, as well as privately dropped-off landscapers' waste, is brought to Recycled Wood Products composting site in Berkeley.

Backyard Composting

An undetermined number of Berkeley residents currently compost yard waste and sometimes food waste at home. In September 1990, the Alameda County Waste Management Authority approved funding for a countywide home-composting education program. This program will include the development of demonstration gardens, a hotline, and workshops. In conjunction with this program, Berkeley is in the process of distributing 1,000 backyard composting bins to households. While the cost of these bins is subsidized in part by the City, residents must also pay \$33 for each Biostack composter (manufactured by Smith and Hawkin).

Curbside Collection

Start-up Date:	September 1989
Service Provider:	Berkeley's Solid Waste Management Division
Households Served:	2,600
Materials Collected:	Leaves, grass clippings, brush, and Christmas trees
Mandatory:	No
Set-out Method:	Yard materials are placed in 32-gallon bags or 64-gallon wheeled carts supplied by the City. (The City will not distribute bins free of charge once the program goes citywide).
Collection Vehicles and Method:	One rear-loading packer truck staffed with one crew member is used to collect yard waste.
Collection Frequency:	Every other week
Economic Incentives:	Berkeley's variable can rate serves as an incentive to set out yard waste for composting rather than as refuse.

The Solid Waste Management Refuse Division of the City of Berkeley collected an estimated 1,500 tons of yard waste in fiscal year 1991 for composting at Recycled Wood Products. Landscapers dropped off an additional 1,500 tons of waste (estimated). The University of California chips tree trimmings and mixes them with lawn clippings. Some of this material is hauled to Recycled Wood Products, the rest is used as mulch on campus grounds. Tonnages for waste collected from the University of California are not tracked, but are included in the 1,500 tons per year dropped off by landscapers.

Composting Site

All yard waste collected through the municipal composting program is brought to Recycled Wood Products' facility located near the Berkeley transfer station, on land leased from the University of California, Berkeley. This operation is one of five nationwide owned by Recycled Wood Products. Located on 4 1/2 acres of land, the facility employs seven individuals and utilizes \$700,000 worth of equipment to process about 50 tons per day of yard and wood waste—13,000 tons per year. Of the 3,000 tons of Berkeley-generated material processed at this site, 1,500 tons are dropped off by private landscapers and 1,500 tons are collected through the municipal program. According to Recycled Wood Products, the tonnage of material brought to the facility by Berkeley landscapers and the Solid Waste Management Division has increased considerably in the last few months, from about 10 to 15 tons per day in 1989, to 20 tons per day in 1990. About 80 percent of the 3,000 tons of Berkeley material composted in 1990-91 consisted of yard waste; 20 percent consisted of construction and demolition debris and wood pallets.

Recycled Wood Products charges the City of Berkeley \$24.75 per ton of yard waste delivered. Landscapers and private individuals are charged a tipping fee of \$25 per ton, or \$4 per cubic yard; \$2 per cubic yard is charged for clean wood and pallets. Material is tipped on the floor of the Recycled Wood Product's facility and contaminants, such as paper and plastic, are removed. The material is watered and fed into a Fuel Harvester Tub Grinder. After the material is ground, it moves along a conveyor belt, where it is watered again, to a Fuel Harvester Screen. Contaminants, including painted wood and nails (which are subsequently sold to scrap dealers), are removed, and the material is screened to three different dimensions; 90 percent of materials are screened to either a mulch product, or a finer product for composting. Ten percent of materials, generally from pallet manufacturers (not Berkeley yard waste), are formed into fuel pellets. Some screened material is sold to the Bay Area Waste District, prior to composting, as a bulking agent in its sludge composting program. Material designated for composting is watered again until a 50 percent moisture content has been achieved. The compost is mixed with the mulch product and formed into windrows 60 feet long, 20 feet wide, and 10 feet high. Windrows are turned weekly for a period of 2 months. Internal windrow temperatures, measured daily, are maintained at 180 to 190 degrees Fahrenheit. Finished compost is screened through one of two different trommel mill screens to produce one of two end products: either a fine soil amendment 1/4 inch wide, or a mulch product to 2 1/2 inches wide. Compost is frequently tested for lead and nutrient content. The demand for the finer-grained soil amendment exceeds the demand for the mulch. The soil amendment is sold wholesale for \$7 per cubic yard primarily to nurseries for use in potting soils. A small amount is sold to Berkeley businesses and residents at \$15 per cubic yard. An estimated 0.2 percent of all incoming materials, including dirt and rocks, is landfilled.

The composting operation at Recycled Wood Products' facility is currently operating at maximum capacity, constrained by its small size. High winds sometimes create odor problems for residents nearby. The University of California, which currently leases this site to Recycled Wood Products, is reportedly considering other uses for this land. As a consequence, this program may have to move to a different facility, or reduce the quantities composted. The City is actively looking for an alternative composting site, in or outside of the City.

Amount and Breakdown of Materials Recovered

Material	Total (Tons, July 1990-June 1991)
Newspaper	6,847
Corrugated Cardboard	4,976
High-grade Paper	890
Other Paper*	710
Glass†	3,643
PET Plastic‡	7
HDPE Plastic	4
Film Plastic	22
Aluminum Cans‡	318
Ferrous Cans	492
Appliances/White Goods	674
Other Metal	58
Wood Waste§	56
Textiles	219
Other Reusable††	1,141
Miscellaneous	309
Subtotal MSW Recycled	20,366
Landscapers' Waste	1,500
Other Yard Waste	1,500
Subtotal MSW Composted	3,000
Total MSW Recovered	23,366
Concrete/Asphalt**	36,000
Wood Waste	3,369
Other Building Materials	224
Total C&D Recycled	39,593
Total Materials Recycled	59,959
Total Materials Composted	3,000
Total Materials Recovered	62,959

Note: Materials are not tracked by sector. Tonnage listed represents marketed material, and includes all recyclables collected in the City including deposit containers.

*Includes mixed paper such as magazines.

†Includes 2,874 tons of redeemable glass and 59 tons of refillable wine bottles.

‡Redeemable containers.

§Includes 28 tons of reconditioned pallets. An additional 140 tons of wood waste was salvaged by the 415 Society, a nonprofit group, but because this material was burned as firewood, it is not listed in the above tonnages.

**Annual tonnages of concrete and asphalt recovered were estimated from 6 months worth of data.

††Includes doors and other wooden building materials.

Amount and Breakdown of Materials Recovered By Method and Recycler (FY 1991)

Material	Res-CS (Tons)	CCC-DO (Tons)	CCC-BB (Tons)	Com-CS (Tons)	UO* (Tons)	UC (Tons)	Other (Tons)	Total (Tons)
Newspaper	3,841	490	640	250	0	306	1,320	6,847
Corrugated/Kraft	0	200	590	100	0	306	3,780	4,976
Other Paper†	50	760	22	150	0	102	516	1,600
Plastic	0	0	7	0	0	0	26	33
Glass	1,963	304	895	240	0	97	144	3,643
Aluminum Cans	30	6	124	50	0	8	100	318
Ferrous Cans	100	61	90	200	0	41	0	492
White Goods	0	0	0	0	674	0	0	674
Scrap	0	0	18	0	0	40	0	58
Wood	0	0	0	0	0	0	56	56
Textiles	0	0	0	0	0	0	219	219
Reusables	0	0	0	0	1,123		18	1,141
Other	0	0	0	0	0	0	309	309
Subtotal Recycled	5,984	1,821	2,386	990	1,797	900	6,488	20,366
Yard Waste	1,500	0	0	0	0	0	1,500	3,000
Subtotal Compost	1,500	0	0	0	0	0	1,500	3,000
Total MSW Recovered	7,484	1,821	2,386	990	1,797	900	7,988	23,366
Wood	0	0	0	0	3,369	0	0	3,369
Building Materials	0	0	0	0	224	0	0	224
Concrete/Asphalt	0	0	0	0	0	0	36,000	36,000
Subtotal C&D	0	0	0	0	3,593	0	36,000	39,593
Total Waste Recovered	7,484	1,821	2,386	990	5,390	900	43,988	62,959

Key: Res = Residential Com = Commercial CS = Curbside Collection DO = Drop-off Collection BB = Buy Back

UO = Urban Ore salvage/reclaim operation

CCC = Community Conservation Center UC = The Associated Students of the University of California at Berkeley

Other = includes material recovered outside of the City (exports)

*Urban Ore materials listed above were collected through its Building Materials Exchange and Discard Management Center. A small amount of this material was collected at other salvage operations located in the City.

†Includes mixed paper and high grades.

Residential Curbside Recycling Program

(Annual Tonnages June 1988 to May 1989 and July 1990 to June 1991)

Material	Total (Tons, 1988-89)*	Total (Tons, 1990-91)	Percent Change
Newspaper	1,249	3,841	
Other Paper	0	50	
Glass	749	1,963	
Aluminum Cans	8	30	
Ferrous Cans	38	100	
Total MSW Recycled	2,044	5,984	+193%

Note: During 1988-89 the Ecology Center made a transition from monthly to weekly collection of recyclables. In 1990-91, recyclables were collected on a weekly basis throughout the City.

*Annual estimate extrapolated from the average of September and December 1988 and March and June 1989 monthly data. Source: CAL Recovery Systems, Inc. *Waste Characterization Study for Berkeley, California*, November 1989.

Source Reduction Initiatives

Berkeley values source reduction as the most desirable method of waste management and boasts a number of innovative source reduction programs. In its 1991 *Source Reduction and Recycling Elements*, Berkeley establishes a solid waste source reduction goal of 8.43 percent of the waste stream by 1995 and 13.45 percent of the waste stream by the year 2000. Using the California definition that source reduction is the diversion of waste *before* it enters a transfer, disposal, or recycling processing station, Berkeley estimates that it is currently diverting at least 3.3 percent of the waste stream through source reduction, including its reusable goods drop-off programs (86 percent of diverted materials), residential use of cloth diaper services, and used clothing stores. It also details how its source reduction goals will be achieved and establishes a goal of averting 2.8 percent of the waste stream by 1995 through reusable goods drop-off sites, 6 percent through home composting, approximately 1 percent through junk mail reduction, and 4 percent of the waste through other activities such as volume-based refuse rates and packaging and disposable product reduction.

Berkeley conducted the nation's first "precycling" campaign in 1989, urging consumers to prevent the generation of waste through environmentally-minded purchasing practices. The word "precycling," coined by Berkeley, has now entered common usage among recycling solid waste planners. Drawing on information provided by the Ecology Center and other community and environmental groups, the Department of Public Works has promoted the precycling concept through fliers and newspaper advertisements. To quote from the campaign's literature, "Sometimes the answers to our biggest problems are right within our reach. In this case, one solution to our waste problem may be in what we reach for on the supermarket shelf.... What we buy has a direct relationship to what we throw away and what we throw away contributes to the problem of diminishing landfill space and increasing costs for waste disposal.... Precycling is a revolutionary way of thinking about waste and, among other things, calls for a peaceful overthrow of wasteful plastic and other materials that are difficult to recycle." The City encourages local merchants to offer discounts to customers who bring their own containers and to use reusable napkins and silverware. Because Berkeley has not tracked its waste generation rates or waste composition since 1989, it cannot accurately determine how this program has changed the composition or volume of its waste stream.

Publicity and Education

Berkeley has long been in the forefront of the nation's recycling activities. The City has spent between \$25,000 and \$30,000 per year on public information and education programs administered either by the City or through contractors. The Ecology Center (EC) serves as a clearinghouse for environmental information and maintains a bookstore and library. The Ecology Center developed three education and publicity programs: "the Recyclones" cartoon characters, which reinforce recycling concepts; an information hotline; and a recycling lottery with money obtained from a State grant. Through the "Bottle Bop," the "Can Can-Can," and the "Bundle Boogie," the well-liked Recyclones explain how to prepare materials for Berkeley's source-separation recycling program. EC's hotline, staffed during business hours, provides information about the residential curbside program and other recycling and environmental activities. The Community Conservation Center and the Public Works Department also run recycling hotlines. Through the Ecology Center, the City ran a weekly recycling lottery in which a cash bonus of \$250 was offered to a randomly selected household found to be properly separating refuse and recyclables. If the selected household was found not to be properly separating recyclables, the pot increased by \$250 the next week. The lottery, funded through a grant from the California State Department of Conservation with container deposit funds, ended in 1989.

The City has a quarterly newsletter that frequently publicizes recycling and composting programs.

Economics

Costs Cover:

The City pays for the collection and processing of 5,984 tons of residential recyclables collected at curbside, and 2,386 tons collected at the Berkeley Buy Back through contract fees paid to Ecology Center and CCC. These costs are presented under operating and maintenance costs. The City also provides administrative support for the collection of 1,821 tons at CCC's drop-off sites. The City also purchased certain capital equipment for EC's and CCC's programs, which are presented below.

Also listed below are the City's capital and operating and maintenance costs for the collection of 990 tons of recyclables from businesses, institutions, and a few apartment buildings. The cost for collection and processing of 1,500 tons of yard waste collected through the City's pilot program is presented under operating and maintenance costs. Capital costs for this program are not available.

Urban Ore's capital expenditures for their salvage/reuse operations (5,390 tons) are listed below too. Note that the City's administration and education/publicity costs given below under O&M cover Urban Ore's program, in addition to the other City programs.

Capital Costs: Collection

Item	Cost	Use/User	Year Incurred
3 GMC/Chevrolet C-55*	NA	Recycling/EC	1975
International Truck†	NA	Recycling/EC	1975
3 Lodal 2050 @ \$75,000†	\$225,000	Recycling/EC	1989
2 Lodal 2300 @ \$100,000†	200,000	Recycling/EC	1990
70 Curbside Truck Binst‡	25,000	Recycling/EC	1973-89
50 3-cubic-yard Binst‡	15,000	Recycling/EC & CCC	1982
6 Scalest	25,000	Recycling/CCC	1982
Custom-designed Front-loading Commercial Recycling Vehicle†	100,000	Recycling/City	1989
Roll-off Truck‡	50,000	Recycling/CCC	1973
50,000 Waxed Tote Boxes @ \$1.50†	75,000	Recycling/EC	1988-89
Packer Truck @ 50%†	NA	Composting/City	1981

Key: EC = Ecology Center; CCC = Community Conservation Center.

Note: All the above equipment was paid for in full at the time of purchase. The purchase of the packer truck pre-dated the composting program.

*Equipment purchased and owned by the Ecology Center.

†Equipment purchased and owned by the City.

‡Equipment purchased and owned by the Community Conservation Centers.

Capital Costs: Processing

Item	Cost	Use/User	Year Incurred
Horizontal Baler	\$180,000	Recycling/CCC	1983
4 Forklifts*	80,000	Recycling/EC & CCC	1980, 1988
Aluminum Separator	25,000	Recycling/EC	1983
Glass Conveyor	25,000	Recycling/EC	1987
40-foot Conveyor System	110,000	Recycling/CCC	1991

Note: All the above equipment was purchased and is owned by the City. It was paid for in full at the time of purchase.

*Two forklifts were purchased and are owned by the City, one by the Ecology center, and one by the Community Conservation Centers.

Urban Ore's Capital Costs

Item	Cost	Year Incurred
5 Temporary Buildings	1 @ \$3,500	1980
	3 @ 20,000	NA
	1 @ 1,000	1988
12-foot Parcel Van	8,000	1986
EDF Ford 17-foot Flat Bed	11,000	1988
Ford Pick-up Truck	11,000	1991
2 Forklifts (Used)	75,000	1989
Apple Computer	NA	NA
60 Door Storage Racks	600	1983-91
70 Window Racks	14,000	1983-91

Note: Most of Urban Ore's equipment was purchased used or acquired through barter.

Annual and Per Ton Operating and Maintenance Costs (FY 1991)

	Cost	Tons Covered	Per Ton Cost
Recycling Subtotal	NA	11,181	NA
Collection and Processing	\$700,000	11,181	\$63
Curbside Residential (EC)*	400,000	5,984	67
Commercial/Institutional (City)†	275,000	990	278
Buy Back (CCC)*	25,000	2,386	10
Drop off (CCC)	0	1,821	0
Administration‡	NA	11,181	NA
Education/Publicity‡	NA	11,181	NA
Composting Subtotal	NA	1,500	NA
Collection and Processing	\$178,000	1,500	\$119
Administration‡	NA	1,500	NA
Education/Publicity‡	NA	1,500	NA
Recycling & Composting Total	\$1,178,000	12,681	\$93
Collection and Processing	\$878,000	12,681	\$69
Administration§	275,000	18,071	15
Education/Publicity§	25,000	18,071	1

Note: Costs presented above represent the City of Berkeley's operating and maintenance costs only.

*Represents fee paid to contractor. EC's 1990 contract fee was a flat fee (paid monthly) based on actual costs, of the number of households serviced.

†The high cost for the commercial curbside pick-up program is partially due to the fact that this was a pilot program with only 350 stops and the amount collected was small. The City is currently expanding the program to include 1,000 stops and estimates that costs will decrease to \$100 per ton.

‡Administration and education/publicity costs cannot be broken down between recycling and composting programs.

§Urban Ore's recovery programs (5,390 tons) are covered under these costs as the City assists in the promotion and support of Urban Ore (e.g., the City leases land and buildings to Urban Ore).

In 1985 the City first formally contracted EC's and CCC's drop-off recycling services. The contract fees paid to these organizations covered the difference between the programs' cost and revenues earned from the sale of recyclable materials. Under its contract with EC, the City pays a fee, or waste diversion credit, for every ton of material collected. The credit is based on a sliding scale tied to the door price of newspaper. In fiscal year 1991, the City paid Ecology Center \$400,00 for the collection and processing of recyclable materials, and paid CCC \$25,000 for the operation of two drop-off and one buy-back center. The City purchased most of the capital equipment for EC's collection and processing program, including collection trucks and curbside recycling containers. In fiscal year 1991, Urban Ore paid the City \$2,500 per month (or \$30,000 per year) for use of City property. Since 1983 Urban Ore's license agreement requires it to pay the City 10 percent of its monthly gross revenues, totalling up to \$2,900 per month (in June 1991).

Materials Revenues:	Materials revenue from the residential curbside program are kept by the Ecology Center. In FY 1989, EC earned \$170,035. In FY 1990, the CCC earned \$928,595 in gross sales.
Source of Funding:	City recycling activities are funded by refuse collection and transfer station fees.
Full-time Employees:	37. 6 City employees (3 with the commercial program, 3 with program administration), 14 with the Ecology Center, 11 with the Berkeley Buy Back center, and 6 with Urban Ore.
Part-time Employees:	10

Future Solid Waste Management Plans

The City of Berkeley plans to expand its recycling and composting programs within the next year. It intends, through its contract with the Ecology Center, to provide citywide curbside collection of mixed paper, magazines, and corrugated cardboard beginning July 1992. The City hopes to expand its collection of recyclable materials from multi-unit buildings. In 1991 the City Council drafted a law mandating recycling in the commercial sector. Public hearings on this law will be held in December 1991.

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Endnotes

¹The City of Berkley considers putrescible refuse to be mixed waste containing wet garbage.

²This set-out ratio is based on multipliers that Waste Management of North America, Inc. has found to be accurate for weekly programs; these range from 2 to 2.5. Source: *The National Recycling Coalition Measurement Standards and Reporting Guidelines*, National Recycling Coalition, October 1989.

³According to the Ecology Center (EC), newspaper should comprise approximately 60 percent of collected materials, but has typically accounted for 65 to 80 percent of its total. Therefore, EC estimates that it is losing 40,000 glass or metal containers each month. (Chris Clarke, Recycling Information Coordinator, Ecology Center, Inc., Personal communication, July 29, 1991.)

⁴American Rock & Asphalt uses a conversion factor of 1 cubic yard of broken concrete and asphalt to 1.5 tons (personal communication, July 29, 1991).

⁵John Williams, American Rock & Asphalt, Inc., Richmond, CA, personal communications, July 29, 1991 and August 2, 1991.

⁶An independent consulting firm used a conversion factor of 18 cubic yards per ton to convert this 1985 volume to 3,520 tons. Urban Ore claims the density of yard waste it received was 4 cubic yards per ton and thus estimates it composted 14,200 tons of yard waste in 1985.

⁷Based on a yard waste density of approximately 620 lbs per cubic yard.

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Lincoln, Nebraska

Demographics

Jurisdiction:	City of Lincoln
Population:	191,972 in 1990 (An additional 21,669 residents live in the surrounding Lancaster County)
Area:	64 square miles
Total Households:	79,079 (49,993 in single-family residences, 13,233 in two- to nine-unit buildings, 12,995 in buildings with ten units or more, and 2,858 mobile homes)
Total Businesses and Institutions:	7,500 businesses, 70 schools, and 4 universities, including the University of Nebraska
Brief Description:	Lincoln, Nebraska's state capital, experienced a population growth of 10 percent between 1980 and 1990. The service sector employs 39 percent of all employees in Lancaster County, followed by office and retail jobs. The State government and the University of Nebraska employ a total of 16,510 people. Lincoln's unemployment rate in 1990 was 1.7 percent, well below the national average of 5.5 percent. Per capita income was \$16,067 in 1990, and median household income was \$38,561.

Solid Waste Generation and Recovery

Annual Tonnages (1990)						
	Residential	Comm/ Instlt	Other*	Total MSW	C&D†	Total Waste
Recovered	4,548	21,027	1,835	27,410	193,167	220,577
Recycled	4,081	21,027	—	25,108	193,167	218,275
Composted	467	0	1,835	2,302	0	2,302
Disposed‡	130,812	61,962	—	192,774	12,979	205,753
Incinerated	0	1,000	—	1,000	0	1,000
Landfilled	130,812	60,962	—	191,774	12,979	204,753
Generated	135,360	82,989	1,835	220,184	206,146	426,330

Percent by Weight Recovered						
Recovered	3 %	25 %	—	12 %	94 %	52 %
Recycled	3%	25%	—	11%	94%	51%
Composted	§	0%	—	1%	0%	§

* Yard waste self-hauled to the transfer station. This tonnage cannot be broken down by residential and commercial sectors.

† 133,167 tons of construction and demolition debris that was less than 50 percent burnable were collected at the 48th Street facility and used as fill material to close the landfill. Private haulers recovered an estimated 60,000 tons of concrete and asphalt in 1990, which was used for road resurfacing, or to make new asphalt. A small amount of this material may come from parts of Lancaster County outside of the City of Lincoln.

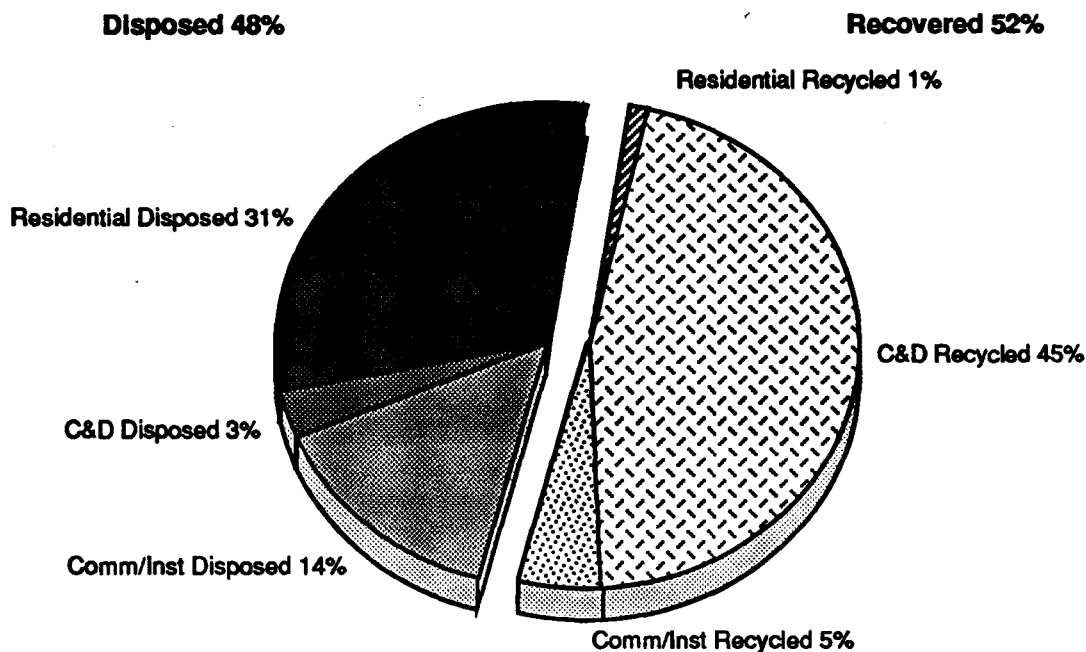
‡ Residential and commercial waste disposed includes tires.

§ Less than 1 percent.

Landfill Tipping Fee: \$8.00 per ton in 1988, 1989, and 1990; projected to increase to \$12.00 per ton in 1992

Refuse Collection and Disposal: The City's residential and commercial sectors are serviced with refuse collection and disposal by 37 private haulers. Haulers collect refuse twice a week. Typically, residents are charged between \$11 and \$13 per month for back door service with no limit on the quantity collected. Until 1988 refuse was disposed of at the 48th Street Landfill. In 1988 a new landfill was opened on Bluff Road, 3 miles from the City, and the 48th Street site was converted to a transfer station accepting primarily white goods, brush, and yard waste. Approximately 5 percent of the population self-hauls garbage to the transfer station. Beginning in mid-1988, waste has been disposed at the Bluff Road Landfill, which has an estimated lifespan of 28 years. Construction and demolition debris, provided it is less than 50 percent burnable, is used as a fill material to close the 48th Street Landfill. Otherwise, it is hauled to the Bluff Road Landfill for disposal. Tires can be landfilled for \$1 per tire. Large loads (roll-off boxes or dump trucks) are charged at a rate of \$15 per ton (approximately \$0.30 per tire) plus a \$25 landfilling fee.

Total Waste Recovered and Disposed (Percent by Weight, 1990)



Note: Due to rounding, numbers do not add to 100%.

Materials Recovery Overview

Goals and Legislative Requirements:

None in 1990. The 1992 State Integrated Solid Waste Management Act banned the landfilling of leaves and grass clippings as of September 1994, and lead-acid batteries, whole tires, and waste oil by September 1995. The Lincoln City Council has banned the landfilling of yard waste, effective October 1992.

Drop-off sites have characterized the collection system for recyclables in Lincoln. On Earth Day 1970, a group of students and activists from the University of Nebraska formed the Citizens for Environmental Improvement (CEI). The mission of this nonprofit organization was to preserve the environment through recycling and conservation. Initially, CEI established a single drop-off site for newspaper, open to residents and commercial establishments in Lincoln. By 1989 CEI was operating 15 drop-off sites. Four of these were multimaterial drop-off sites accepting newspaper, aluminum and ferrous cans, glass, and HDPE and PET plastics. The others handled only newspaper. In 1985 CEI began collecting high-grade paper from office buildings. The group was also active in education; representatives from CEI held workshops on recycling for schoolchildren. In 1990 workshops were conducted up to three times per week.

As the selling price of old newsprint dropped, CEI experienced financial difficulties. In October 1990, the City took over the collection of newspaper at all 15 sites, contracting with Dennis Paper Sales, a local processor, to supply the bins and collect and process the material, for which the the City

paid \$15 per ton. CEI continued to accept aluminum, glass, ferrous cans, and plastics at the four multi-material drop-off sites until February 1991, when the group could no longer cover its operating costs and ceased operation. Lincoln's Office of Recycling took over the four sites and contracted with Nebraska Recycling Center for collection and processing of recyclables. The Office is in the process of opening 10 new drop-off sites, and the City has allocated \$80,700 to the Office of Recycling for updating the voluntary drop-off program.

The first curbside program initiated in Lincoln was a yard waste collection program. In 1988 the City contracted with three private haulers for the collection of leaves and grass clippings from approximately 1,400 households in four neighborhoods of the City. By 1989 the program was expanded to service 2,000 households. In mid-1989, the program was further expanded to include the collection of newspapers and aluminum cans from those residents participating in the pilot yard waste program in two of the four neighborhoods. The purpose of the expansion was threefold: (1) to determine the demand for curbside recycling, (2) to estimate tonnages that could be recovered at curbside if the program went citywide, and (3) to estimate the cost for the implementation of such a program. Lincoln has been conservative in its move toward a large-scale curbside program. Both the collection of yard waste and the collection of recyclable materials are still in pilot stages.

In 1991 the Mayor established a separate Recycling Division within the Economic Development Department of the Mayor's Office. Perhaps as a result, the private sector has played and will continue to play a large role in materials recovery in Lincoln. In 1990 municipal recovery programs recovered only 3 percent of the residential waste stream, while 25 percent of the commercial waste stream was recovered through public and private recycling and composting activities. The City initiated a pilot bottle recycling project in conjunction with a local processor, the Nebraska Recycling Center, to facilitate the recovery of glass bottles from bars and restaurants throughout the City. Together with the University of Nebraska, the Recycling Office conducted waste audits of ten local businesses to establish models for similar businesses wanting to reduce their waste disposal. In 1992 the City decided to discontinue its Municipal recycling curbside program, due to poor market conditions in the region.

Rather than purchasing fill for closing the City's former landfill, Lincoln is using construction and demolition debris diverted from landfill disposal. The City is also using sewage sludge from the local wastewater treatment plant as a soil amendment at the old landfill. Special liquid wastes and household hazardous waste are also collected separately. The Health Department operates a drop-off site where residents can dispose of hazardous waste four times a year.

Although Nebraska has no solid waste reduction goals, the State has given some financial support to community recycling programs. In 1979 the Nebraska Litter Reduction and Recycling Act was passed for the purpose of funding programs to reduce, clean up, and recycle litter and to conserve natural resources. As of June 1987, the Environmental Control Council voted to allocate 40 percent of the fund for "new and improved community recycling and source separation programs." More recently, the State passed the Waste Reduction and Recycling Incentives Act (LB 163, July 1990), which requires that the State complete a comprehensive solid waste management plan by December 1991. The law also provides that a fee of \$1 be assessed on all new tires sold in the State as of October 1990, and that nominal annual fees of \$25 and \$50 be assessed on retailers of all tangible goods. The revenue generated from these fees will go towards funding municipal waste reduction and recycling programs.

Recycling Activities

Residential Curbside Recycling (Pilot Program)

Start-up Date:	Pilot program began in the summer of 1989. The City does not have plans to expand citywide at this time.
Service Providers:	Palmer & Sons Refuse and Niederhaus Brothers under contract with the City
Pick-up Frequency:	Weekly
Same Day as Refuse:	No
Households Served:	622 households volunteered to participate in the pilot project. (Palmer & Sons services 324 households, and Niederhaus Brothers services 294 households.)
Mandatory:	No
Participation Rate:	51 percent of households that volunteered for the pilot program set out recyclable materials or yard waste weekly.
Materials Collected:	Newspaper and aluminum cans in 1989. Ferrous cans and glass were added in 1991.
Set-out Method:	Residents are requested to source-separate materials. Newspapers, aluminum cans, and color-sorted glass may be set out in separate bags or boxes.
Collection Method and Vehicles:	<p>Palmer & Sons Refuse added a 1-cubic-yard container to the front bumper of a packer truck for the collection of newspaper, and uses side bins for collecting aluminum cans. Niederhaus Brothers placed two containers on a trailer pulled by a 1-ton cab, to facilitate separate collection of aluminum cans and newspapers. The City awarded each hauler \$500 for these upgrades.</p> <p>In 1991 a local vehicle manufacturer, Cushman Inc., designed a recycling vehicle and donated it to Lincoln for the City to evaluate in its pilot program. The vehicle has three hoppers, each of which is divided in two. A one-person crew color-sorts glass as needed and deposits green, amber, and flint glass, ferrous cans, aluminum cans, and newspaper each in separate bins.</p>
Economic Incentives:	None
Enforcement:	Not applicable
Annual Tonnage:	30 tons from July 1990 through June 1991

Recycle With Michael, Recycling Enterprises, and BCD Recycling offer curbside collection of recyclables to residents for a fee. Recycle With Michael, the largest provider, began offering bimonthly curbside recycling service to 12 households in June 1990 for a \$3 monthly fee. Unable to cover operating costs, Recycle With Michael increased the fee to \$5 per month. By the end of 1990, the company was serving 185 households in Lincoln; as of mid-1991, it was serving 400 households. Recycle With Michael guarantees to the customer that recyclables will be recycled and not disposed. The company asks that residents place commingled glass bottles and jars, aluminum, tin cans, and plastic

containers (HDPE milk jugs and colored detergent bottles, PET plastics, and polystyrene) into a recycled plastic bag, and that paper (newspaper, corrugated cardboard, white ledger, colored ledger, and computer paper) be separated by grade and placed in paper bags. In 1991 Recycle With Michael provided each customer with 24 bags made from 100 percent recycled plastic, which are in turn recycled by the supplier.

Recycling Enterprises began collecting recyclables at curbside in March 1991. As of mid-1991, the company collected glass, aluminum, tin, newspaper, PET, HDPE, polystyrene, and corrugated cardboard from 80 households for a \$3 monthly fee. Residents put all materials at the curbside commingled. A one-person crew collects the recyclables with a 1/2-ton pick-up, and sorts the materials en route. BCD Recycling has 350 residential accounts. BCD offers monthly collection of glass, tin, aluminum, and HDPE and PET plastics for \$5 per month.

Educ

Commercial & Institutional Curbside/Alley Recycling

Legislative Requirements:	None
Service Providers:	Dennis Paper Sales, Nebraska Recycling Center
Number Served:	Dennis Paper Sales serves approximately 300 businesses; Nebraska Recycling Center serves approximately 50 businesses.
Type Served:	Dennis Paper Sales serves office buildings and small businesses. As of 1991 it holds the contract for the collection of paper from State office buildings and the prison system. Nebraska Recycling Center services a few large accounts, including Goodyear Tire, and the Lincoln Office of Mental Health. Nebraska Recycling Center held the contract for State office buildings (including the State Capitol and the State Office Building) in 1990.
Pick-up Frequency:	Dennis Paper Sales picks up paper every other day from some accounts, weekly from others, and on an on-call basis from low-volume generators. Nebraska Recycling Center provides weekly collection of recyclable materials.
Materials Collected:	Dennis Paper Sales collects mixed file stock paper, white and colored ledger, and computer print-out from commercial accounts. Nebraska Recycling Center collects high-grade white ledger, computer paper, and aluminum cans.
Set-out and Collection Method:	<p>Dennis Paper Sales provides 40- and 44-gallon barrels to customers as needed. As of mid-1991, the company had provided 10,000 barrels. Large-volume customers are supplied with 90-gallon roll-carts or dumpsters. One-person crews with utility vans collect materials. Larger accounts are serviced by a two-person crew using a packer truck.</p> <p>Nebraska Recycling Center provides barrels that are placed on each floor of the building being serviced. When the barrels are full, custodial staff bring them to a basement storage area. Nebraska Recycling Center contracts with a hauler for night-time collection and delivery of the materials to the processing center.</p>

- Incentives:** Dennis Paper Sales and Nebraska Recycling Center offer recycling collection, but Dennis Paper Sales charges some customers for the shredding of confidential documents.
- Annual Tonnage:** Not available. Dennis Paper Sales estimates that it processes 4,000 tons of paper and 2,000 tons of glass and aluminum containers per month from the commercial sector, of which approximately 60 percent is generated in Lincoln, bringing its annual tonnage to 43,200 tons. Lincoln's recycling coordinator believes that this is an overestimate.

The City has initiated several pilot programs in the commercial sector. In September 1990, the City negotiated with Nebraska Recycling Center for the collection of glass from ten bars and restaurants. The businesses combined generated an average of 8 tons of glass per month. The program was supported by a grant from the State Litter Reduction and Recycling Fund, which provided money to purchase barrels and posters and to conduct a study on the effectiveness of the program. At the end of the 1-year pilot, government funds will no longer be available for equipment. Five of the ten businesses have agreed to pay a \$1.50 monthly fee for the recycling barrels, and the Lancaster County Office of the Mentally Retarded (LOMR) has agreed to collect and sort the glass. The LOMR is raising additional funding in the amount of \$5,000 to \$7,500 from local bottlers and liquor distributors, and anticipates an expansion of the program to include other areas of the City.

Ten area businesses participated in a waste assessment project conducted by the City Recycling Office and the University of Nebraska Civil Engineering Department. Program participants estimated that 30 to 65 percent of their waste stream had been diverted through recycling. While insufficient staffing has limited the program's success, Recycling Coordinator Gene Hanlon notes some of its achievements: the office building that recycled 29.8 percent of its waste (266 of the 8,935 tons generated), the manufacturer that recycled 65 percent (55 of the 85 tons of waste generated), and the pharmaceutical company that diverted 39.2 percent of its waste from landfill disposal.

Drop-off Centers

- Number and Type:** 22 (6 buy-back centers and 16 drop-off centers). Nebraska Recycling Center has one large multimaterial buy-back at the processing facility, and one other small buy-back for aluminum cans.
- Public or Private:** Private and public. In October 1990 the Recycling Office took over the collection of old newsprint from 15 drop-off sites previously operated by the nonprofit organization CEI.
- Sectors Served:** Residential and commercial/institutional sectors
- Materials Accepted:** Newspaper, glass, aluminum and ferrous cans, PET soda bottles, and HDPE milk jugs are collected at drop-off sites. Private recyclers buy back scrap aluminum, brass, copper, high-grade paper, and corrugated cardboard; they also accept white goods. Motor oil can be taken free of charge to numerous city service stations or to the Lincoln Police Department auto garage.
- Annual Tonnage:** An estimated 3,964 tons of recyclable materials are collected through drop-off sites annually. Of this, 390 tons were collected through City-operated drop-offs from October through December 1990. The remaining 3,574 tons were collected through private drop-off and buy-back sites.

In the summer of 1991, the City sought bids to establish 10 to 12 new drop-off sites for newspaper, glass, aluminum and ferrous cans, HDPE milk jugs, and PET soda bottles.

Construction & Demolition Debris Recovery

In 1990 Lincoln diverted 133,167 tons of construction and demolition debris. Generators of construction and demolition debris that is less than 50 percent combustible can bring the material to the former landfill on 48th Street, where it is used as fill material. Lincoln estimates that it will take 6 to 8 years to complete the closure of the landfill, at which time a separate landfill will be established for construction or demolition rubble. Lincoln requires in its bid specifications that contractors that work on City streets and lots be required to recycle the material. The Office of Recycling surveyed three contractors in Lincoln that reported recycling a total of 60,000 tons of concrete and asphalt generated in Lincoln in 1990. These companies use the material primarily as aggregate in road resurfacing, saving them approximately \$5 per ton. No figure is available for the tonnages of C&D debris recycled privately in 1990.

Salvage/Reuse

Household items, including appliances, furniture, and clothing, are collected in Lincoln at Goodwill Industries, the Junior League Thrift Shop, the Salvation Army, the People's City Mission, and two other thrift stores. In 1990 the City began to separate white goods at the transfer station. The program was expanded in 1991 to include all metals except refrigerators and freezers.

Processing and Marketing of Recyclables

There are two main processors of recyclable materials in the City of Lincoln: Dennis Paper Sales and the Nebraska Recycling Center. Newspaper from the City's residential curbside pilot program and from the 15 drop-off sites taken over by the City in October 1990 is processed at Dennis Paper Sales. Aluminum cans collected through the curbside program, as well as glass, plastic, and ferrous containers collected through the four multimaterial drop-off sites, are processed at the Nebraska Recycling Center. In addition, both companies process recyclable materials from their own buy-back sites, from other private drop-off sites, and from the commercial sector.

Dennis Paper Sales is a company that has been processing waste paper for more than 35 years. An estimated 72,000 tons of recyclable materials (48,000 tons of paper and 24,000 tons of glass and aluminum per year) are processed at the 55,000-square-foot facility each year; approximately 60 percent of this amount is generated in Lincoln. The intermediate processing center has the capacity to handle approximately 260 tons per day. More than \$2 million worth of capital equipment is used in the processing operation. High-grade paper is sorted and baled; corrugated cardboard and old newsprint are baled. Other paper is conveyed to a hammermill, where it is shredded and baled. To reduce operating costs, Dennis Paper Sales has asked commercial customers to separate paper into newspaper, white ledger, computer paper, and high-grade colored ledger, or to fill ten barrels before calling for pick-up. Due to a severe glut in the market, the company is considering scaling back to collecting only white office paper and computer print-out from commercial customers.

Nebraska Recycling Center began operating in 1977. A magnetic sorter separates ferrous metals from other materials. Aluminum is densified and baled in a bisquette baler. Color-sorted glass is crushed and stored in Gaylord boxes. Tin cans are densified and baled. In 1991 Nebraska Recycling Center began recycling PET and HDPE plastics collected from residents through drop-off and at

curbside. Plastics are baled and sold to the best available markets. In addition to processing recyclables brought in by residents and through the residential curbside program in Lincoln, Nebraska Recycling Center offers collection and processing of recyclable materials to many small towns within a 50 to 100 mile radius of the processing facility, to six nonprofit organizations, and to several for-profit groups. In 1990 Nebraska Recycling Center had a contract with the State for the collection of office paper and mixed paper from the State Capitol building and the State Office Building. The State supplied desktop boxes and storage bins for each floor; custodial staff collected the paper and brought it to a central storage area in the basement of each building, where Nebraska Recycling Center crews collected the paper. In 1991 NRC declined to bid on the State contract, which was awarded to Dennis Paper Sales.

In June 1991, Recycle With Michael, a small company that collects recyclable materials at curbside from the residential sector in Lincoln, began processing plastics in its 6,000-square-foot facility. Numbers 1, 2, and 6 plastics are collected, baled, and sold to a recycler in Chicago, Illinois. A baler and a forklift were provided under a grant from the Department of Environmental Control.

Markets for recyclable materials in Nebraska are severely depressed. The only users of scrap paper in the State are insulation companies such as Parco Insulation in Norfolk and Nebraska Insulation in Omaha. Nebraska Recycling Center sells much of its waste paper through brokers to markets in Oklahoma, Kansas, Korea and Mexico. Dennis Paper Sales sells paper primarily to domestic mills such as Durbin Paper Stock, Stone Container, Kimberly Clark, and others. Glass cullet from both processing centers is sold to Liberty Glass in Oklahoma, 450 miles from Lincoln. Aluminum from Dennis Paper Sales is sold to smelting plants such as Golden Aluminum in Fort Lipton, Colorado, and Alcoa in Indiana. Scrap metal from Nebraska Recycling Center is sold in Kansas.

Lincoln began collecting white goods in October 1990. From October to December of that year, 34 tons of white goods were collected and given to a Lincoln scrap metal dealer. Much of this metal went to a small steel mill in Norfolk, Nebraska.

Market Development Initiatives/Procurement

Lincoln is working with the Cooperative Extension Service and telephone companies to develop local and regional markets for waste paper products, such as the use of waste paper for animal bedding and for insulation. The City is planning to purchase benches made from plastic milk jugs collected in the City of Lincoln. *The Lincoln Journal*, the City's newspaper, is published on 60 percent post-consumer recycled newsprint, using an estimated 100 tons of old newsprint each month. Lincoln's Mayor signed an executive order in July 1990 requiring City departments to purchase recycled paper. The State of Nebraska requires its departments to procure recycled paper in accordance with EPA procurement standards.

Composting Activities

A composting demonstration project began in Lincoln in the summer of 1988, when the Recycling Office initiated a pilot project for the curbside collection of yard waste. As of October 1990, residents and landscapers could drop off brush and other yard waste at the transfer station for \$4 per pick-up load. Branches and yard waste are ground and composted. Christmas trees can be dropped off at eight sites throughout the City during the 4 weeks following Christmas. The trees are ground into mulch, which is available to residents free of charge at the old landfill. In 1990, 372 tons of yard waste were collected through the municipal curbside program; 1,835 tons of yard waste were collected at the transfer station; and 95 tons of Christmas trees were collected and mulched. A comprehensive solid-waste management plan now being prepared may ban yard waste from the landfill as of 1993.

Curbside Collection

Start-up Date:	Pilot began June 1988.
Service Provider:	Niederhaus Brothers, Palmers & Sons, Inc. and D&D Refuse under contract with the City
Households Served:	2,000
Materials Collected:	Leaves, grass clippings, and brush
Mandatory:	No
Set-out Method:	Materials are placed in 90-gallon totes supplied by the haulers. The City pays the haulers a \$2 per month fee for each household in the pilot program to cover rental of these bins.
Collection Vehicle and Method:	One-person crews collect yard waste using 20- to 25-cubic-yard packer trucks.
Collection Frequency:	Weekly from April through November in 1990
Economic Incentives:	The City does not charge participants in the pilot project for the collection of yard waste.
Annual Tonnage:	372 tons in 1990

Composting Site

The compost facility is located on the 8-acre site of the old landfill. The composting demonstration project occupies approximately 4 of the 8 acres. Leaves and grass clippings from the pilot curbside program and from commercial lawn businesses are ground, placed in windrows, and turned weekly with a front-end loader. The windrows are watered once in the fall. Finished compost is not sold, but is used as a soil amendment to help close the old landfill. Brush collected at the transfer station is ground with a tub grinder into mulch. The mulch is sold to landscapers for \$8 per cubic yard, or \$3 per cubic yard if 100 or more cubic yards are purchased.

Christmas trees are collected at eight drop-off sites throughout the City. Trees are chipped on site by four crews, one each from the Parks and Recreation Department, Public Works, the University of Nebraska, and the Lincoln Electric System. The Parks and Recreation Department is responsible for setting up the sites, and the Recycling Office publicizes the drop-off program. The estimated 1990 cost to the City was \$5,500, with another \$5,000 in in-kind services contributed by the private sector.

Amount and Breakdown of Materials Recovered

Material	Residential (Tons, 1990)	Commercial/ Institutional (Tons, 1990)	Other (Tons, 1990)	Total (Tons, 1990)
Newspaper	2,356	262	-	2,618
Corrugated Cardboard	-	6,562	-	6,562
High-grade Paper	-	4,252	-	4,252
Other Paper	-	8,925	-	8,925
Glass	400	-	-	400
PET Plastic	27	-	-	27
Aluminum Cans	836	278	-	1,114
Ferrous Cans	51	-	-	51
Appliances/White Goods*	34	-	-	34
Other Metal	377	240	-	617
Motor Oil	-	508	-	508
Subtotal MSW Recycled	4,081	21,027	-	25,108
Leaves, Grass Clippings & Brush	372	-	1,074	1,446
Tree Trimmings	-	-	761	761
Christmas Trees	95	-	-	95
Subtotal MSW Composted†	467	-	1,835	2,302
Total MSW Recovered	4,548	21,027	1,835	27,410
Asphalt and Concrete	-	-	193,167	193,167
Total C&D Recovered	-	-	193,167	193,167
Total Materials Recycled	4,081	21,027	193,167	218,275
Total Materials Composted	467	0	1,835	2,302
Total Materials Recovered	4,548	21,027	195,002	220,577

Note: Tonnages of recyclables are extrapolated from 1990 Lancaster County tonnage data and represent amounts of materials collected. The Lincoln Office of Recycling estimates that 85 percent of the recyclables recovered in Lancaster County are from the City of Lincoln. Actual tonnages may exceed listed amounts.

*The tonnage of white goods recovered in 1990 (34 tons) was estimated based on 102 tons collected at the transfer station between October 1990 and June 1991.

†Total MSW composted includes 1,835 tons of yard waste and landscapers' waste that were self-hauled to the transfer station. Of these, the City Parks and Recreation Department collected and chipped 1,074 tons of brush and tree trimmings. This tonnage cannot be broken down by residential and commercial sectors.

Source Reduction Initiatives

A brochure advising consumers to shop wisely by buying in bulk, purchasing recycled products, and purchasing products packaged with recyclable materials is part of the City's publicity and education campaign. Representatives of the City Health Department offer technical assistance to businesses in performing waste assessments and developing alternatives to waste disposal.

Publicity and Education

The City's "Give Trash A Second Chance" campaign, initiated in 1989, includes a 15-minute video, brochures, and posters to encourage residential and commercial waste reduction through reuse and recycling. The Recycling Office published a "Handbook for Commercial Waste Reduction" to help explain how offices, restaurants, and other businesses can separate their waste for recycling and reduce their waste stream. Posters are provided by the Recycling Office to businesses that initiate in-house recycling programs.

The Recycling Office publishes a newsletter, "Eco-Linc: A Guide to Conserving Resources in Lincoln and Lancaster County," which features articles on office paper recycling programs and recycled product procurement. The Center for Infrastructure Research and the Department of Civil Engineering at the University of Nebraska conducted in-depth waste audits for ten local businesses in conjunction with the Recycling Office. These businesses served as case studies for similar businesses. The finished report details how to set up an effective pollution prevention program and offers tips on conducting a waste assessment.

In 1991 the Recycling Office published a brochure for Lincoln residents on backyard composting and distributed leaflets on "The Magic of Mulch" to area garden centers for display. The front of the leaflet listed the benefits of mulch and wood chips as a soil amendment, and the back listed summer water conservation tips. The Recycling Office produced a small map detailing Christmas tree drop-off locations. Christmas tree vendors made these maps available to residents when they purchased a Christmas tree.

Economics

Costs Cover:

In 1990, 30 tons of recyclable materials and 372 tons of organic waste were collected through the pilot residential curbside program. An estimated 3,964 tons of recyclable materials were collected through drop-off sites. In addition, 1,835 tons of yard waste, brush, and tree trimmings and 95 tons of Christmas trees were collected at the transfer station and at Christmas tree drop-off points.

Most of the capital costs for the municipal curbside program are incurred by the private sector. However, the City did pay for cornstarch bags for the collection of recyclables and paper bags for the collection of yard waste. These costs are included below. Of the recyclable materials collected through drop-off centers, approximately 3,574 tons were collected through sites operated by CEI and for-profit businesses. Capital costs for the collection and processing of these tonnages are incurred by the private sector and are not available. The City took over the operation of CEI's newspaper drop-off

Costs Cover (cont'd): sites as of October 1990, and collected 390 tons of newspaper between October and December; costs for this operation are listed below.

The City has not incurred any capital costs for the collection of yard waste, since collection is provided by private haulers under contract. The City's capital costs to compost or chip 2,302 tons of organic waste in 1990 are given below.

Operating and maintenance costs incurred by the City in 1990 include contract fees for the collection and processing of 420 tons of recyclable materials (30 tons from the municipal curbside program and 390 tons through drop-off) and 372 tons of yard waste collected at curbside, City labor and vehicle maintenance costs for the collection and processing of 2,302 tons of organic waste, and administrative, education, and publicity costs.

Capital Costs: Collection

Item	Cost	Use	Year Incurred
18,000 Cornstarch Bags	\$2,500	Recycling	1990
8,840 Paper Bags	3,700	Composting	1990
10 EWI Fivestar Roll-off Bins	56,940	Recycling/DO	1991

Note: All equipment is paid out of cash reserves from landfill revenues.

Capital Costs: Processing

	Cost	Use	Year Incurred
Chipper	\$76,000	Composting	1987
Front-end Loader (10% of time)	63,600	Composting	1990

Note: All equipment is paid out of cash reserves from landfill revenues.

Annual and Per Ton Operating and Maintenance Costs (1990)

	Cost	Tons Covered	Per Ton Cost
Recycling Subtotal	\$57,070	454	\$126
Collection	\$10,787	454	\$24
Curbside Collection*	1,000	30	33
Drop-Off Collection †	9,787	424	23
Processing	450	30	15
Administration	39,000	454	86
Education/Publicity	6,833	454	15
Composting Subtotal	\$81,949	2,302	\$36
Collection	\$32,956	2,302	\$14
Curbside Yard Waste Collection	11,966	372	32
Transfer Station Collection	20,990	1,835	11
Christmas Tree Collection	0	95	0
Processing	32,260	2,302	14
Yard Waste Processing	26,760	2,207	12
Christmas Tree Processing	5,500	95	58
Administration	15,000	2,302	7
Education/Publicity	1,733	2,302	1
Recycling & Composting Total	\$139,019	2,722	\$50
Collection	\$43,743	2,722	\$16
Processing	32,710	2,722	14
Administration	54,000	2,722	20
Education/Publicity	8,566	2,722	3

* Curbside collection of recyclable materials cost the City \$1,000; this includes \$500 paid to Palmer & Sons Refuse and Niederhaus Brothers to retrofit existing vehicles.

† Includes the cost (\$3,944) for collecting and processing 34 tons of white goods self-hauled to the transfer station.

The City's curbside recycling collection costs include \$500 paid to haulers to upgrade their vehicles. Drop-off costs are \$5,843 in payments to Dennis Paper Sales for providing containers, servicing the sites, and processing and marketing the old newsprint. According to Lincoln's agreement with Dennis Paper Sales, the City pays Dennis \$14 per ton for processing the materials and \$1 per month for providing bins and servicing the sites.

The City paid \$5,936 to three private haulers to collect 372 tons of yard waste. Two of the three haulers contracted to collect yard waste chose to replace one of their two weekly refuse collection days with yard waste collection. The City paid these haulers \$8 per ton of yard waste collected, plus a small additional fee based on a non-participation formula; the low level of participation in the voluntary pilot program increased the haulers' actual per ton costs. The third hauler added an extra yard waste collection route to his two weekly refuse days. As a result, his overall costs were higher (than the other two haulers) and the City paid him \$28 per ton of yard waste collected. In addition, Lincoln paid haulers \$6,030 for monthly cart rental for 603 households over a 5-month period (\$2 per month, per household, rental fee). Transfer station collection consists of 761 tons of leaves, grass clippings, and branches dropped off by landscapers, and 1,074 tons of wood waste including stumps, logs, and branches dropped-off by the Parks Department and arborists. Yard waste processing includes tub grinder rental at \$175 per hour for 8 hours per day, 3 days per month, 6 months per year (\$25,200) and

labor costs for one laborer at the transfer station at \$7.50 per hour for 208 hours per year (\$1,560). Christmas trees are self-hauled to drop-off sites that are not staffed; thus, no cost for collection was incurred by the City. In addition to the \$5,500 Christmas tree chipping cost paid by the City, the private sector provided \$5,000. Administrative costs for the yard waste program include a \$60 per week record-keeping fee paid to each hauler for 5 months (from July through November 1990), totalling \$1,200, plus an estimated 30 percent of the administrator's time spent on this program, totalling \$4,500.

Materials Revenues: \$2,988 from the sale of wood chips. All other revenues are retained by the private sector.

Source of Funding: Landfill gate fees of \$35 per ton for fiscal year 1990

Full-time Employees: 1 City employee

Part-time Employees: 2 City employees (1 support staff, 1 student intern)

Future Solid Waste Management Plans

The City completed a comprehensive Solid Waste Management Plan in late 1991, which was approved by the City Council in March 1992. The Plan included banning yard waste, and the City will require haulers (as part of their license agreement) to collect source separated yard waste for composting. The City's ban on land filling yard waste commences in October 1992. The City is trying to encourage haulers to replace one of the two weekly refuse collection days with yard waste collection. It has updated a City law that formerly required all rental units to receive twice per week refuse collection. Now only buildings with more than four units must receive twice per week collection. At this time the City does not have plans to expand the curbside recycling program due to limited markets and the high capital and operating costs of a citywide program. In March 1992, the Teresa Street Wastewater Treatment Plant will begin to anaerobically digest sludge, and the finished waste will be used at the compost facility or in land application projects.

In the winter of 1991, the City received a \$4,100 grant from the Nebraska Litter Reduction and Recycling Fund to develop a recycled plastics demonstration project. Plastic gallon milk jugs will be collected and shipped to a regional recycling plant that will make picnic tables and park benches and resell them to Lincoln.

Contact

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Mecklenburg County, North Carolina

Demographics

Jurisdiction:	Mecklenburg County
Population:	511,433 in 1990
Area:	543 square miles
Total Households:	216,416 (135,677 in one- and two-family residences, 72,875 in buildings of three units or more, and 7,864 in mobile homes)
Total Businesses and Institutions:	17,303
Brief Description:	Mecklenburg County, located in southern North Carolina, is experiencing rapid growth; its population has increased 30 percent during the last decade. There are seven municipalities in the County. The principal city, Charlotte, has a population of 418,000, nearly 82 percent of the County's population. The County is the sixth largest wholesale distribution center in the nation and is also a major southeastern finance center. Other major employers include IBM, the utility company Duke Power, and Lance, a wholesale distributor of baked goods. The County's median per capita income in 1990 was \$14,470. Median household income was \$27,656.

Solid Waste Generation and Recovery

Annual Tonnages (1990)				
	Residential	Commercial/ Institutional	Other*	Total MSW
Recovered	20,171	92,521	1,176	113,868
Recycled†	20,171	92,521	0	112,692
Composted	NA	NA	1,176	1,176
Disposed	272,726	333,158	-	605,884
Incinerated‡	74,956	0	-	74,956
Landfilled§	197,770	333,158	-	530,928
Generated	292,897	425,679	1,176	719,752
Percent by Weight Recovered				
Recovered	7 %	22 %	-	16 %
Recycled	7%	22%	-	16%
Composted	NA	NA	-	**

Note: Municipal waste generated includes bulky items and tires. Tonnages for construction and demolition debris (C&D), which is disposed in more than 600 private landfills, are not available.

*Because of the 1989 Hurricane "Hugo," the County mulched an extremely large volume of yard waste in late 1989 and 1990. These tonnages, estimated at greater than 109,000 tons for Charlotte alone, do not reflect the County's yard waste tonnages mulched during a typical calendar year; thus, tonnages of yard waste dropped off by both landscapers and residents presented above were extrapolated from 7 months of 1988 and early 1989 data. Although a curbside yard waste program was initiated in January 1991, the program reflects activities that did not occur during 1990; thus, these tonnages are not included in the above table. The County recovered 15,881 tons of yard waste (31,762 tons for a calendar year) during the first 6 months of 1991 through its curbside and drop-off programs. If this residential yard waste tonnage replaced that reported above and residential MSW remained the same, then residential MSW recycled would equal 7%; residential MSW composted, 11%; and residential MSW recovered, 18%.

†A small fraction (less than 4 percent) of the 20,171 tons of recyclables attributed to residential recovery is actually commercial waste collected at County drop-off sites.

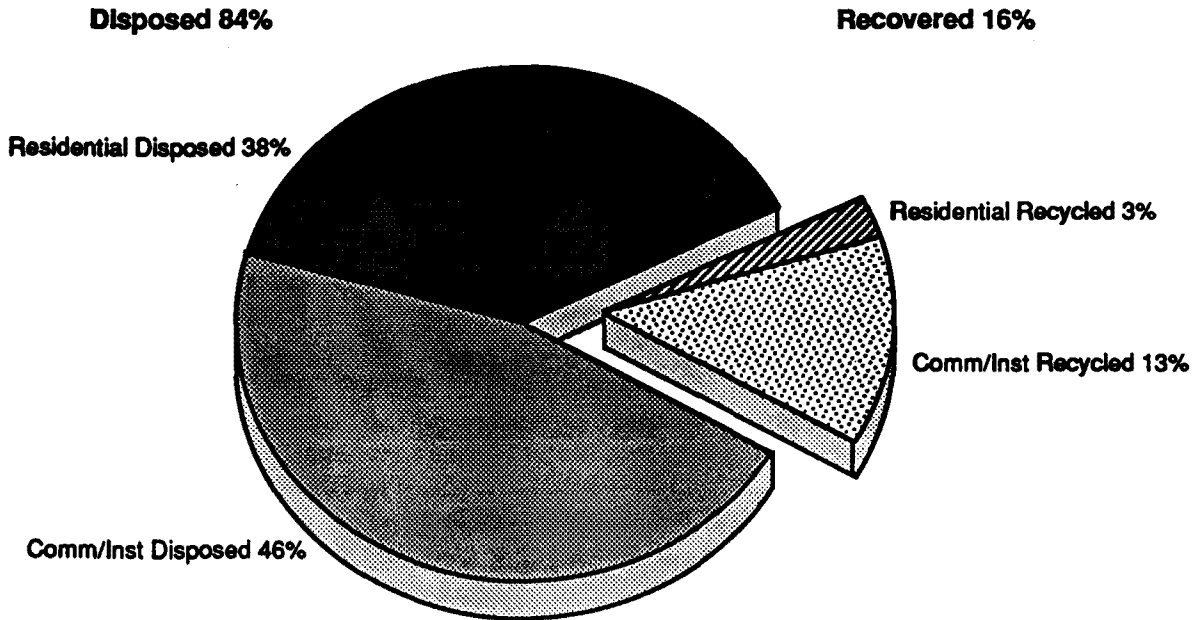
‡Waste incinerated includes 40 tons of oil burned as a fuel source.

§Waste landfilled includes 102 tons of tires.

**Less than 1 percent.

Landfill /Incinerator Tipping Fee:	\$23.00 in 1988, \$24.50 in 1989, \$26.00 in 1990, \$29.50 in 1991. (Incinerator and landfill tipping fees are identical.)
Refuse Collection and Disposal:	Municipalities are responsible for their waste collection services. The municipalities of Charlotte, Cornelius, Huntersville, and Pineville collect residential refuse. Davidson, Matthews, and Mint Hill contract with private haulers for residential waste collection. Refuse collection is not provided for residents in unincorporated areas, who must haul refuse to the Harrisburg Road Landfill. Many private haulers collect refuse from commercial establishments; the three primary haulers of commercial waste are BFI, Waste Management Inc., and Container Corporation of Carolina. Mecklenburg County oversees County waste disposal. Until mid-1985, the County operated three landfills. Two of

Total MSW Recovered and Disposed (Percent by Weight, 1990)



Note: Landscapers' Waste is less than 1%

Refuse Collection and Disposal (cont'd):

these were closed in 1986. In 1987 the only County landfill still operating, the Harrisburg Road Landfill, received a permit for an extension until the end of 1991. A County-owned and privately operated (M.K. Ferguson) incinerator was opened in June 1989. It was built at a cost of \$27.5 million and designed to incinerate 235 tons per day. In 1990, 12 percent of County municipal solid waste disposed was incinerated, approximately 50 percent was disposed at BFI's Speedway Landfill in neighboring Cabarras County, and 37 percent was disposed at the Harrisburg Road Landfill. When the County landfill closes, refuse will be disposed at the Speedway Landfill and the incinerator until the County receives a permit to build another landfill.

Construction and demolition (C&D) debris is disposed at over 20 private C&D landfills throughout the County and at over 600 small demolition landfills on construction sites. Some asphalt is privately recovered; however, tonnages are not tracked.

Residents in Charlotte receive refuse collection twice a week. In 1990 the City of Charlotte disposed of 148,867 tons of refuse at a cost of \$10,153,729 (\$68 per ton). This cost does not include the tipping fee because the County issues Charlotte a tonnage credit, which was not exceeded in 1990.

Materials Recovery Overview

Goals and Legislative Requirements:

North Carolina State Bill 111, passed in 1989, required counties to develop recycling plans by July 1991 and set a goal of recycling 25 percent of the State's waste stream by 1993. The State banned the disposal of white goods, lead-acid batteries, motor oil, whole tires, and waste in lined landfills.

In 1985 Mecklenburg County developed a Solid Waste Master Plan that set a goal of recycling 30 percent, incinerating 40 percent, and landfilling 30 percent of the County's waste stream by 2006. By 1994 the County plans to recycle 15 percent of its waste stream.

In 1975 the Mecklenburg Citizens Committee for Recycling urged the County Board of Supervisors to set up recycling drop-off centers at several Charlotte high schools. The County allocated \$17,000 to set up the drop-off centers, and established a recycling center at the Harrisburg Road Landfill in 1980. In 1987 the County set up a program at the landfill to recover loads of corrugated cardboard headed for disposal. Salvage of white goods and other metals was added later.

In February 1987, the County's first curbside program, serving 2,400 single-family homes, was implemented in the City of Charlotte. The City collected glass, aluminum and ferrous cans, newspaper, and PET plastic containers. These recycled materials were processed at an interim County-operated processing center. In June 1987, Charlotte began collecting recyclable materials at curbside from 12,000 households in the cities of Davidson, Huntersville, and Cornelius. By 1990, 106,000 single- through three-family residences were served countywide. As of the summer of 1991, all seven municipalities in the County have curbside recycling programs.

In December 1989, the County contracted with FCR Inc. (Fairfield County Recycling), a private Connecticut-based company, to process and market all materials collected through the curbside programs and County drop-off sites, in a new facility in Charlotte, called FCR/Charlotte. In 1990 the County paid FCR/Charlotte a \$7.50 per ton tipping fee (totalling \$140,000 for the year) for all materials collected at drop-off and curbside. The fee arrangement changed in 1991. FCR/Charlotte now keeps all revenues and no longer charges the County a tipping fee.

Residents not served with curbside collection can bring their recyclable materials to one of the 16 County-owned drop-off sites. The largest site is located at the Harrisburg Road Landfill, where residents are not required to pay a refuse disposal tipping fee if they bring three or more bags of recyclable materials in addition to their refuse. Private haulers also avoid the tipping fee if half their load contains materials to be recycled. Landfill and incinerator tipping fees support the County's incinerator, landfill, and recycling programs. The County continues to focus its efforts on collecting recyclable materials through County-sponsored drop-off sites. Municipalities are responsible for initiating curbside collection programs. The City of Charlotte initiated and operates curbside recycling programs in four of the seven municipalities. The City charges the communities a fee of \$0.28 per household per week for pick-up, and brings recyclables to the County processing center.

Recycling Activities

Residential Curbside Recycling

Start-up Date:	February 1987 in the City of Charlotte, June 1987 in Davidson, Huntersville, and Cornelius, and January 1990 in Mint Hill
Service Provider:	The City of Charlotte's Department of Public Works collects recyclable materials in Charlotte, Davidson, Huntersville, and Cornelius. Residential Collection Service (RCS), a private company in Mint Hill, provides curbside service in that city. In spring 1991, BFI began collecting recyclables in Matthews. A private hauler will begin servicing Pineville in the summer of 1991.
Pick-up Frequency:	Weekly. White goods are picked up in Charlotte free of charge on request.
Same Day as Refuse:	Yes
Households Served:	A total of 106,000 residences in the cities of Charlotte, Davidson, Huntersville, and Cornelius in 1990, primarily in one- through three-family homes, but also including one 200-unit garden apartment retirement complex in Davidson. When Charlotte's boundaries were extended in June 1991, 7,000 residences were added to the curbside program. A private hauler serves 4,000 households in Mint Hill.
Mandatory:	No
Participation Rate:	85 percent (based on participation surveys conducted in Charlotte in 1990)
Materials Collected:	Newspaper, glass, aluminum and ferrous cans, and PET plastic containers are collected through all curbside programs. White goods are collected by special request in Charlotte. HDPE plastic containers were added to all programs in January 1991.
Set-out Method:	Residents place commingled glass, aluminum and ferrous cans, and PET plastic containers in a 14-gallon bin and set newspaper in paper bags on top of the bins. Charlotte supplies bins to residents in the four communities it services. Residents at the retirement community bring their 14-gallon bins to a centralized location for collection. Residents in Mint Hill and Matthews are also supplied with bins.
Collection Method and Vehicles:	A one-person crew places glass and aluminum and ferrous cans in one bin, newspaper in another, and plastics in a cage on the side of a Lodal recycling truck.
Economic Incentives:	None
Enforcement:	Not applicable
Annual Tonnage:	17,356 tons in 1990 (15,932 tons through Charlotte's curbside programs, 536 tons through Mint Hill's program, and 888 tons of white goods)

Commercial & Institutional Curbside/Alley Recycling

Legislative Requirements: None

Service Provider: Public Collection
Mecklenburg County

Number Served: 7 buildings

Type Served: County office buildings

Materials Collected: High-grade paper

Pick-up Frequency: Weekly

Set-out and Collection Method: Employees place paper in desktop bins, which are emptied into centrally located rolling mail carts. County employees collect the paper and bring it directly to local brokers.

Incentives: None

Annual Tonnage: 92 tons in 1990

Private Collection

BFI collected materials in 1990. Container Corporation of Carolina began a corrugated cardboard collection program in January 1991.

Approximately 10 businesses in 1990. As of 1991, BFI collects cardboard from 160 businesses.

Convenience and retail stores, restaurants

Corrugated cardboard

Collection frequency varied in 1990. As of 1991, BFI collects cardboard weekly.

In 1990 BFI provided 30-cubic-yard compactors to businesses. As of 1991, BFI charges businesses various rates depending on the size of the container, the frequency of collection, and whether the corrugated cardboard is compacted.

None

Not available

Although private haulers can deliver recyclables to FCR/Charlotte, a number of businesses drop off recyclables at the 16 county-operated drop-off sites. These tonnages cannot be broken out and are included with residential recyclables recovered.

BFI processes the cardboard in its privately owned and operated IPC in neighboring Cabarras County. In fall 1991, BFI will begin a pilot glass, aluminum can, and plastic program for restaurants and bars. For a fee, BFI will distribute a 64-gallon roll-out container to each business and customers will be required to sort materials, including sorting glass by color.

In March 1991, representatives from all 117 County public schools participated in a school board meeting to initiate recycling programs in County schools. Approximately 11 schools began to recycle high-grade paper and aluminum cans as a fundraising activity. These schools are responsible for marketing their own materials. During the 1991-92 school year, 30 additional schools will initiate recycling programs. Although vendors do not collect materials at individual schools, they have proposed to pick up materials brought to centrally located schools.

Drop-off Centers

Number and Type:	37 (16 County-operated drop-off centers, 18 private buy-back centers, and 3 private drop-off centers.
Public or Private:	Public and private
Sectors Served:	Residential and commercial
Materials Accepted:	Newspaper, kraft paper bags, glass, aluminum cans, ferrous cans, and HDPE and PET plastic containers are accepted at County drop-off sites. Corrugated cardboard, lead-acid batteries, tires and motor oil are accepted at two sites, and scrap metal is accepted at the Harrisburg Landfill only. In addition to the materials listed above, private buy-back centers purchase or accept high-grade and mixed paper (including magazines and telephone books), polypropylene, PET, and PVC scrap plastics.
Annual Tonnage:	3,568 tons from County drop-off sites in 1990 (2,142 tons of glass, aluminum and ferrous cans, newspaper and plastic, 592 tons of white goods, 250 tons of cardboard, 502 tons of scrap metal, 40 tons of motor oil, 25 tons of lead-acid batteries, and 17 tons of tires). Private drop-off tonnages are not available.

The County places two types of containers for recyclables at drop-off centers. Residents set newspaper in 1-cubic-yard boxes and commingled materials in 8-cubic-yard slant top boxes. At several drop-off sites, roll-off containers or 20-cubic-yard containers are provided for white goods. Two of the sites are staffed. Eight are located at public schools, two at apartment buildings, and one at a restaurant. The County encourages businesses to use the drop-off sites. Businesses can thus avoid paying not only refuse tipping fees, but also the \$7.50 per ton recycling tipping fee at the FCR/Charlotte processing center.

Salvage/Reuse

The County salvages materials headed for disposal at the Harrisburg Road Landfill, including corrugated cardboard, white goods, scrap metal, radiators, clean aluminum scrap, brass, and copper. Landfill operators direct haulers with large loads of recoverable material to designated areas at the landfill. Haulers can avoid the \$29.50 landfill tipping fee if their loads contain more than half recyclable materials. In 1990 the County recovered 1,344 tons at the Harrisburg Road Landfill.

Processing and Marketing of Recyclables

All recycled materials collected at County drop-off sites and through the Charlotte, Davidson, Cornelius, Huntersville, and Mint Hill curbside programs are brought to the FCR/Charlotte intermediate processing center (IPC) opened in December 1989. Private haulers and businesses can also bring recyclables to the center. The IPC is owned and operated by FCR Inc., a private firm based in Stratford, Connecticut, and staffed by 26 full-time employees. The renovated building for the IPC, which FCR leases, contains 26,000 square feet for processing and 7,000 square feet for administrative activities. The facility, designed to process 200 tons per day, processes an average of 80 tons per day,

operating a single shift. FCR/Charlotte built an amphitheater within the facility for group tours and presentations, and allows visitors to view the recycling separation process through a large window. Capital costs for equipment, incurred in 1989, totalled \$700,000. In 1990 the County paid FCR/Charlotte a \$7.50 per ton tipping fee to process 18,610 tons collected at County drop-off sites and through Charlotte's and Mint Hill's curbside programs; the total came to \$140,000. Revenues from recycled materials in excess of \$410,000 were split between contractor and operator. The County retained 75 percent and FCR/Charlotte kept 25 percent. In 1991 Mecklenburg County altered the contract. It no longer pays a tipping fee at the processing center, and FCR/Charlotte keeps all revenues. This change helped FCR to stay in business after market prices dropped, and enabled the County to take all its recyclables to the facility for free.

Processing is labor-intensive; 22 employees hand-sort glass by color and separate aluminum cans, ferrous cans, and HDPE and PET plastic containers on three conveyor belts. Corrugated cardboard, newspaper, and kraft paper bags are sorted and baled. Seven percent by weight of the recyclable materials brought to the IPC are either rejected at the door or broken during processing. Most of the rejected materials are landfilled, except for broken glass, which is used as a landfill cover.

FCR/Charlotte sells aluminum cans, corrugated cardboard, kraft paper bags, and white and brown glass out of state. Green glass is marketed in state. Ferrous cans and HDPE and PET plastics are sold both in North Carolina and elsewhere. Mecklenburg County bales corrugated cardboard collected at its drop-off sites and sells it to Sonoco, a local container manufacturer. High-grade paper from County offices is sold to three local brokers.

White goods are taken to the Harrisburg Road Landfill, disassembled, bundled as scrap metal, and sold to a scrap dealer in South Carolina. Batteries are recycled at Classic Batteries in Charlotte. Tires collected through dealers and at the Harrisburg Road Landfill are sent to U.S. Tire Disposal, and either shredded and disposed of in a monofill or processed and sold as retreads, boots, or liners. Motor oil is re-refined as a lubricant or used as a fuel source.

In winter 1991, BFI opened an IPC in neighboring Cabarras County to process materials collected through its curbside and commercial programs.

Composting Activities

Since 1983 the County has processed and sold leaves, grass clippings, small brush, and other yard waste dropped off by residents and landscapers at the County landfill. The finished product, "Metro Mulch," is sold to the public, and is used by City and County departments as a soil amendment. In fiscal year 1989, the County mulched 1,176 tons of yard waste. The County mulched a disproportionately large amount of brush and yard waste in 1990 because of damage caused by the 1989 hurricane "Hugo." In Charlotte alone, more than 109,000 tons of such waste were estimated mulched.

Mulch sells for \$6 per cubic yard and compost sells for \$10 per cubic yard. If 5 or more cubic yards are purchased, the mulch costs only \$4 per cubic yard. In 1990 the County began to mulch Christmas trees.

In January 1991, the City of Charlotte implemented a weekly year-round yard waste collection program. It started by collecting Christmas trees (previously all trees had been landfilled), and followed with weekly collection of loose or clear plastic-bagged leaves, grass clippings, brush, and wood waste. Two-person crews picked up these materials in compactor trucks. During the first 6 months of 1991, the County composted 2,829 tons dropped off at the site by residents and 13,052 tons collected through Charlotte's curbside program. The County expects to compost 35,000 tons by the end of the year.

The northern portion of Mecklenburg County, including the Towns of Cornelius and Davidson, delivers yard waste materials to a County-owned and -operated 8-acre compost site. (Currently Charlotte delivers yard waste collected through its curbside program to this site.) A new site, "Compost Central," will open in November 1991 and will accept yard waste from Charlotte and the rest

of the County, approximately 80 percent of County residents. At that time the mulching operation at the Harrisburg Road Landfill will stop, and materials will be mulched at Compost Central. Less than 1 percent by weight of yard waste delivered to the site is rejected and disposed. Yard waste is windrowed, turned, and cured. County residents can continue to drop off yard waste at the site for free.

Amount and Breakdown of Materials Recovered

Material	Residential* (Tons, 1990)	Commercial/ Institutional† (Tons, 1990)	Other‡ (Tons, FY 1989)	Total (Tons, 1990)
Newspaper	15,469	NA	-	15,469
Corrugated Cardboard§	47	90,000	-	90,047
High-grade Paper	0	1,247	-	1,247
Mixed Paper**	0	2	-	2
Glass	2,270	NA	-	2,270
PET Plastic	443	NA	-	443
HDPE Plastic	47	NA	-	47
Other Plastic	NA	72	-	72
Aluminum Cans	227	644	-	871
Ferrous Cans	106	NA	-	106
Appliances/White Goods††	1,480	NA	-	1,480
Metal Scrap	0	556	-	556
Tires‡‡	17	NA	-	17
Motor Oil§§	40	NA	-	40
Batteries	25	NA	-	25
Subtotal MSW Recycled	20,171	92,521	-	112,692
Yard Waste	-	-	1,176	1,176
Subtotal MSW Composted	-	-	1,176	1,176
Total MSW Recovered	20,171	92,521	1,176	113,868
Total C&D Recovered	NA	NA	NA	NA

*Includes 15,932 tons collected through Charlotte's curbside programs, 536 tons collected through Mint Hill's program, and 2,142 tons of newspaper, glass, and cans accepted at Mecklenburg County drop-off sites. Drop-off center tonnages include some commercial materials.

†Includes 250 tons of cardboard and 502 tons of ferrous scrap collected at the Harrisburg Road Landfill and 92 tons of high grade paper collected from municipal offices. Other materials are privately recovered.

‡Because yard waste tonnages are not available for 1990, figures above listed under "other yard waste" represent leaves, grass clippings, and brush recovered one year prior to Hurricane Hugo. Yard waste was accepted at the Harrisburg Road Landfill from residents, landscapers, and private haulers. Yearly tonnage was extrapolated from compostables collected and weighed during a 7-month period. It is estimated that 1,176 tons were dropped off at the site in fiscal year 1989, based on an average of 98 tons per month.

§Residential corrugated cardboard includes kraft paper bags.

**Commercial mixed paper includes telephone books.

††Includes some white goods from the commercial sector.

‡‡This figure represents an estimated 14 percent of the 119.4 tons of tires collected in Mecklenburg County. These 17 tons were recycled into retreads, boots, and liners. The remaining 102.4 tons were landfilled in a monofill.

§§80 tons of motor oil were collected at County drop-off sites. Approximately 50 percent of this oil was re-refined and used as a lubricant, and 50 percent was burned as a fuel source.

Publicity and Education

Residential

In 1982 the County contracted out education and publicity programs to a private consulting firm. Although some recycling publicity is still handled by consultants, the County currently develops and coordinates most education and publicity programs. Program staff give tours of the County's recycling centers, processing operation, and landfill, and make presentations to school and community groups. The County publishes a map of its drop-off locations with instructions for preparation of materials. The local newspaper also prints a map identifying drop-off sites four times per year. The public television station produced two one-half hour documentaries on Mecklenburg County's waste management strategies. The County has sponsored three recycling conferences, and presents awards each year to outstanding businesses, students, and citizen recyclers. It also uses direct mail, doorknob notices, and an informational pamphlet on residential recycling.

Commercial

The County mailed all businesses a "Tee off on Trash" recycling fact sheet; 160 businesses contacted the recycling office to express interest in setting up a program. The County sent these businesses informational packages including a business recycling manual entitled, "The Possibilities and Practicalities of Business Waste Recycling." In addition, County staff will perform waste audits for local businesses and advise businesses on how to set up a recycling program.

Economics

Costs Cover:

Drop-off Collection: Mecklenburg County paid capital and O&M collection costs for 3,660 tons of materials recovered through its 16 drop-off sites and its County office building collection program in 1990: 2,142 tons of newspaper, glass, cans, and plastics, 592 tons of white goods (40 percent of the total tons of white goods recovered in the County), 80 tons of oil (of the 80 tons collected, approximately 50 percent were burned), 25 tons of batteries, 119 tons of tires (of which 17 tons were recycled), 752 tons of scrap metal and cardboard, and 92 tons of high-grade paper (from County office buildings).

Processing: The County paid a contract fee to FCR/Charlotte for processing 15,932 tons of recyclable materials collected at curbside from Charlotte, Davidson, Huntersville, and Cornelius, 536 tons from the town of Mint Hill, and 2,142 tons from the 16 County-operated drop-off sites. (Capital costs for processing recyclables are covered by FCR/Charlotte.)

The County also covered processing costs for 1,480 tons of white goods (592 tons collected through County drop-off sites and 888 tons through Charlotte's curbside program), 92 tons of high-grade paper, and 752 tons of scrap metal and cardboard. Capital costs for mulch processing equipment, covered by the County, are included below; however, operating and maintenance costs for the 1989 and 1990 mulching program are not available.

Other: Administrative, education, and publicity costs listed under operating and maintenance costs below are County costs only.

Capital Costs: Collection

Item	Cost	Use	Year Incurred
3 24-cubic-yard Front-end Loaders @ \$54,900, \$65,900, \$65,000 (90% of Time)	\$185,800	Recycling (DO)	1984, 1986, 1989
2 Cube Vans with Rear Lift @ \$7,530	15,060	Recycling	1985
2 Mack Roll-Offs @ \$85,000 (75% of Time)	170,000	Recycling (DO)	1986
Truck	20,000	Recycling	1988
Trailer	5,000	Recycling	1988
Maintenance Service Truck*	42,000	Recycl./Composting	1988
2 Forklifts @ \$24,000 & \$12,000	36,000	Recycling	1988 & 1989
28 1-cubic-yard Boxes @ \$450	12,600	Recycling (DO)	1989
100,261 14-gallon Recycling Bins @ \$3.46†	346,903	Recycling	1989
18 Lodal ECO 3,000 @ \$68,995†	1,241,910	Recycling	1989
24-cubic-yard Rear Packer	Leased	Recycling (DO)	—
5 20-cubic-yard Containers @ \$2,000	10,000	Recycling (DO)	NA
7 8-cubic-yard Slant Top Boxes @ \$630	4,410	Recycling (DO)	1990
13,500 14-Gallon Recycling Bins†	46,710	Recycling	1990

*The maintenance service truck is used to service both recycling and composting equipment and vehicles.

†Purchased and paid for by the City of Charlotte. All other equipment was purchased by the County and paid in full.

Capital Costs: Processing

Item	Cost	Use	Year Incurred
2 Vertical Balers @ \$15,000	\$30,000	Recycling	1980, 1985
Forklift	18,000	Recycling	1987
3 Conveyors*	NA	Recycling	NA
3 Skid Steer Loaders*	NA	Recycling	NA
2 Forklifts*	NA	Recycling	NA
Balers*	NA	Recycling	NA
Hoppers*	NA	Recycling	NA
Pick-up Truck	9,000	Composting	1979
Tub Grinder	99,000	Composting	1983
2 Dump Trucks @ \$27,000	54,000	Composting	1985 & 1990
Dump Truck	60,000	Composting	1987
Bobcat Skid Steer Loader	18,000	Composting	1987
Tractor Loader	17,000	Composting	1988

Capital Costs: Processing (cont'd)

Item	Cost	Use	Year Incurred
Scarab Windrow Turner	\$125,984	Composting	1989
W.H.O. Tub Grinder	156,710	Composting	1989
R.I.S. Tub Grinder	151,146	Composting	1989
Stomas Low Speed Shredder	457,865	Composting	1989
Dump Truck	26,000	Composting	1989
2 3-cubic-yard Wheel Loaders @ \$79,000 & \$89,000	168,000	Composting	1989 & 1990
2 Conveyors	41,000	Composting	1991
Tractor Loader	21,000	Composting	1991
Trommel Screen	108,000	Composting	1991

Note: All County equipment has been paid in full. The County purchased most of the composting equipment to process materials discarded as a result of Hurricane Hugo.

*Equipment purchased and owned by FCR/Charlotte. Costs incurred in 1989 for this processing equipment totalled approximately \$700,000.

Annual and Per Ton Operating and Maintenance Costs (1990)

	Cost	Tons Covered	Per Ton Cost
County Recycling Total	\$895,249	21,158	\$42
Subtotal Collection & Processing*	\$626,636	21,158	\$30
County Collection and Processing	\$486,636	NA	NA
Processing(FCR/Charlotte)†	140,000	18,610	7.50
Administration	181,613	21,158	9
Education/Publicity	87,000	21,158	4

Notes: Charlotte's curbside collection costs are not included in the above table. In 1990 the City curbside collection cost for 15,932 tons of newspaper, glass, cans, and plastic was \$1,533,311 (\$96 per ton). This figure is based on 6-month cost data. In addition, Charlotte covers education, publicity, and administrative costs for its programs. The cost of Mint Hill's collection program is not available.

1990 County labor costs totalled \$520,524. Charlotte pays collection personnel an average of \$9.74 per hour.

Operating and maintenance costs for yard waste collected during fiscal year 1989 and costs to clean up and mulch debris caused from Hurricane Hugo in 1989 and 1990 are not available.

*In 1990 the County covered the cost of collecting 2,142 tons of commingled recyclables through its 16 drop-off sites and the collection and processing at the Harrisburg Road Landfill of 592 tons of white goods, 250 tons of cardboard, 502 tons of scrap metal, 92 tons of high-grade paper, 80 tons of oil, 25 tons of batteries, and 119 tons of tires. In addition, the County paid for the processing of 888 tons of white goods and 15,932 tons of commingled recyclables collected at curbside from the City of Charlotte, and 536 tons of curbside recyclables collected from Mint Hill.

†Mecklenburg County covers the processing costs for newspaper, glass, cans, and plastic collected through Charlotte's program (15,932 tons), Mint Hill's program (536 tons), and through its 16 drop-off sites (2,142 tons) in the form of a tipping fee paid to the FCR Charlotte facility.

Materials Revenues:	\$769,740 total revenue in 1990. FCR/Charlotte generated \$693,000 in revenues from the sale of recycled materials. Of this, the County received \$215,000. The County also earned \$64,740 from the sale of recyclable materials it marketed elsewhere (including batteries, corrugated cardboard, foam rubber, white goods, and scrap metal). It received \$12,000 from its "Metro Mulch" program in 1990. Charlotte does not receive any revenue from its composting or recycling programs.
Source of Funding:	Landfill and incinerator tipping fees support County solid waste management and recycling programs. City taxes fund Charlotte's programs.
Full-time Employees:	84 (6 County employees administer recycling programs and education and publicity programs, 16 work at County recycling drop-offs and with the landfill diversion program, and 12 supervise or operate yard waste processing; FCR/Charlotte employs 26 people; and 24 employees of the City of Charlotte collect recyclables at curbside.)
Part-time Employees:	9 (collecting recyclables at curbside for Charlotte's programs)

Future Solid Waste Management Plans

Mecklenburg County currently uses recycled paper on a voluntary basis in all County offices. The County is testing recycled paper and reusable products to be included in a countywide procurement policy. The 1992 Mecklenburg County telephone directory will include a one-page listing of County recycling information numbers. Mecklenburg County plans to institute only one household hazardous waste program in 1992; although the County recommends a permanent drop-off site, household hazardous waste will be collected only once in Spring of 1992. Mecklenburg County and the City of Charlotte plan to increase the number of multi-unit buildings served with curbside collection; however, six additional apartment buildings will not be serviced until the next fiscal year or July 1992. In September 1991, Charlotte will add curbside collection of spiral paper cans "composite cans" (such as frozen juice cans) for recycling and will sell the cans to Sonoco, a local container manufacturer located in Hartsville, South Carolina.

Mecklenburg County plans to open a commercial recycling facility in 1993, and will send out requests for proposals (RFP's) in October 1991. The County has already sent out RFP's for construction of a second 600-ton-per-day incinerator, planned for 1996. It is also seeking a permit to construct a new landfill.

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Newark, New Jersey

Demographics

Jurisdiction:	City of Newark
Population:	275,221 in 1990
Area:	24 square miles
Total Households:	102,473 (13,475 single-family residences, 87,011 households in multi-unit buildings—43,398 in buildings with 2 to 4 units; 25,738 in buildings with 5 to 49 units; 17,875 in buildings with 50 or more units—and 1,987 households in other dwellings such as mobile homes and transient housing).
Total Businesses and Institutions:	4,642 (4,504 business establishments, 6 major hospitals, 5 colleges, and 127 schools)
Brief Description:	Newark, the largest city in New Jersey, is located in Essex County 8 miles from New York City on Newark Bay at the mouth of the Hudson River. It has an industrial economy composed of large manufacturing and transportation sectors. The Port of Newark and Newark Airport are among the largest employers in the City. Newark is a multicultural city: 58 percent black and 29 percent Caucasian. Twenty-six percent of the population is of Hispanic origin (black, white and other). Per capita income in 1987, based on population estimates extrapolated from the 1980 census, was estimated at \$7,622. Since Newark's population declined 14.6 percent between the 1980 and 1990 census, it is likely that this figure underestimates the true average income. (The per capita income in Essex County in 1987 was \$18,515.)

Solid Waste Generation and Recovery

	Annual Tonnages (1989)		
	Public Collection*	Private Collection†	Total Waste‡
Recovered	14,258	89,522	103,780
Recycled	6,823	87,350	94,173
Composted	7,435	2,172	9,607
Disposed	132,396	106,034	238,430
Incinerated§	467	2,546	3,013
Landfilled	131,929	103,488	235,417
Generated	146,654	195,556	342,210

Percent by Weight Recovered**			
Recovered	10 %	46 %	30 %
Recycled	5%	45%	28%
Composted	5%	1%	3%

Note: Municipally collected auto scrap (7,415 tons) was not included in waste recovered or disposed.

*Publicly collected waste recovered includes a small amount of material from the commercial sector collected at the municipal drop-off site, and excludes tonnages from multi-unit buildings in the residential sector that are serviced by private haulers. The latter tonnages are included under private collection.

† Privately collected waste includes some residential waste collected from multi-unit buildings, commercial/institutional waste, and C&D debris. The figures for waste recovered and generated do not include 147,176 tons of metal scrap reported as recovered by private haulers because this tonnage has not yet been confirmed as part of Newark's municipal solid waste stream. If it were included, Newark's recovery rate would jump to 51 percent. C&D waste disposed cannot be separated from municipal solid waste, but 3,599 tons of C&D debris (1,873 tons of asphalt and 1,726 tons of wood waste) were recovered from Newark's waste stream.

‡ Total waste is the sum of public and private collection.

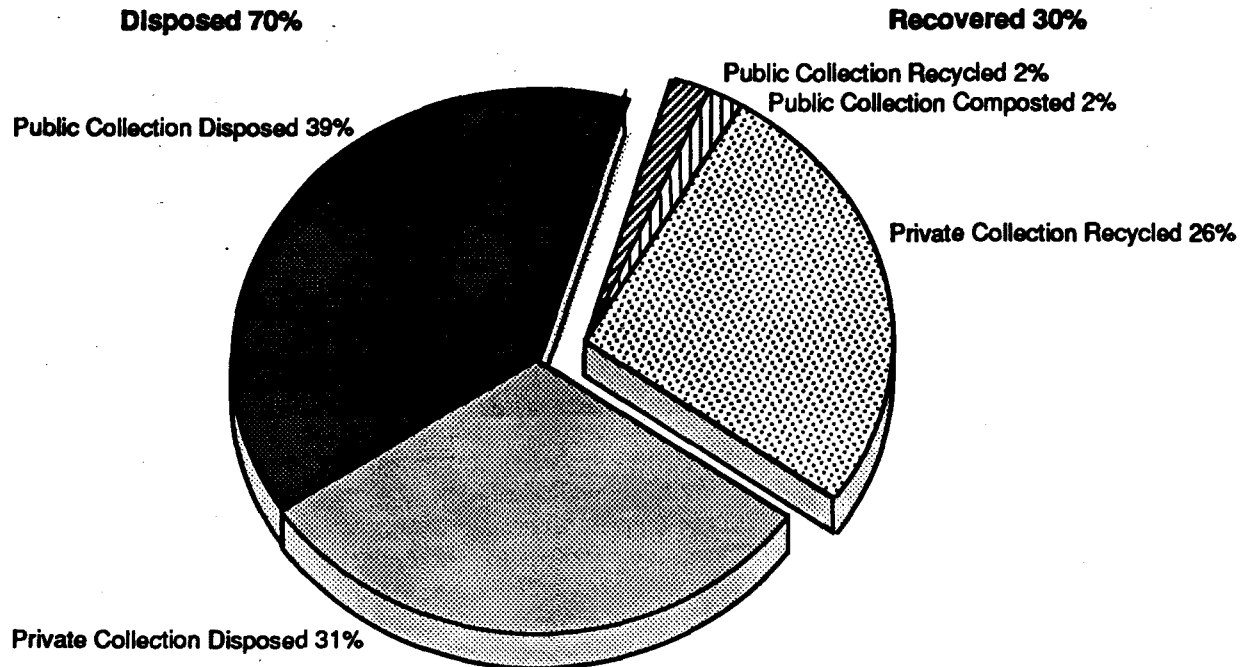
§ Tonnages incinerated represent 467 tons of tires collected through the municipal program and 2,546 tons of tires collected from the commercial sector by private haulers, which were shredded at Metropolitan Tire Converters for use as a fuel source.

** Due to rounding, percent recycled and percent composted may not add up to percent recovered.

**Transfer Station/
Incinerator Tipping Fees:** \$102.15 per ton for household waste, and \$109.85 per ton for bulky waste at transfer stations in 1988, 1989, and 1990; \$97.30 per ton at the Essex County Incinerator in 1990

**Refuse Collection and
Disposal:** The City of Newark collects refuse from two-thirds of the residential sector, with the remaining third serviced by Petrozello Disposal Co. under contract with the City. Some residential waste, such as that generated in large multi-unit buildings, is collected by private haulers not under contract with the City. Numerous private haulers collect commercial and institutional waste and construction and demolition debris. Additionally, the City and its contractors collect up to three 32-gallon containers from commercial sources twice weekly. The mixed waste is transported to two transfer stations (one of which collects primarily residential waste, while the other receives bulky waste) prior to being hauled to out-of-state landfills. In late 1990, with the

Total Waste Recovered and Disposed (Percent by Weight, 1989)



Refuse Collection and Disposal (cont'd):

opening of the Essex County Incinerator, one of the transfer stations closed. The incinerator began full-scale operation in January 1991.

Materials Recovery Overview

Goals and Legislative Requirements:

In June of 1987, the City of Newark passed an ordinance mandating source separation of recyclable materials in compliance with the Statewide Mandatory Source Separation and Recycling Act (P.L. 1987, c.102) enacted in April of that year. The State law mandates that each municipality recycle 15 percent of the municipal solid waste stream in the first year of its recycling program and 25 percent thereafter. Recycling of a minimum of three materials is required. In December 1989, Newark revised the ordinance so that its definitions were consistent with those in the Essex County Solid Waste Plan. In 1991 the State revised its goal to require a 60 percent recovery of materials by 1995.

As early as 1975, the City of Newark and Essex County, faced with diminishing landfill space and rising waste disposal costs, published the *Solid Waste Disposal--Plan of Action*, the culmination of a year of planning to alleviate some of the City's waste disposal problems. Recommended in the Plan was the construction of a refuse-derived fuel plant. A contract was awarded to Combustion Equipment Associates (CEA) in the late 1970s, but when a similar operation in Bridgeport, Connecticut failed, the company declared bankruptcy and Essex County advertised for the receipt of bids for a 2,100-ton-per-day municipal solid waste incinerator. Opposition of local community organizations to the incinerator delayed its construction. In July 1987, a consent agreement to cease landfilling in the nearby Meadowlands landfill was signed. The closing of the landfill and the persistent opposition to the incinerator necessitated the construction of two transfer stations to handle waste prior to long-distance hauling and disposal out of state.

In December 1987, in response to the New Jersey Statewide Mandatory Source Separation and Recycling Act, the City of Newark initiated a pilot program for curbside collection of bundled newspaper in four of its nine zones. The program was expanded on June 15, 1988 to include citywide collection of commingled glass, aluminum, and bimetal bottles and cans, in addition to newspapers. Severe fiscal constraints imposed by the economy of the late 1970s and early 1980s prompted the City of Newark to privatize many municipal services in the hopes of increasing efficiency through reduced costs, improved service delivery, and competition between municipal and contract employees. Recycling was no exception. During the first year of the curbside recycling program, the City contracted the services of The Occupational Center (OC), a community-based nonprofit organization that trains and educates handicapped individuals. OC was responsible for the collection of recyclables in two-thirds of Newark's residential zones. The City collected recyclables in the remaining third. In June 1989, the City contracted with Essex Recycled Fibers for the collection of recyclables from those areas that OC had serviced in the previous year, and OC took over collection from the third of the City formerly serviced by municipal crews. In 1989, the City began offering weekly collection of corrugated cardboard from businesses; it now offers this service to almost 250 businesses in the City, on a twice-a-week schedule.

Since the inception of the municipal curbside program, the Office of Recycling has undertaken an aggressive publicity and education campaign to encourage participation and to inform residents and businesses about the need and mandate to recycle. A study on participation rate conducted by the New School for Social Research in April 1989, found a correlation between participation rate and both median income and owner occupancy. Owner-occupied households or those with higher median income were more likely to participate in the recycling program. However, this study was conducted within the first year of the program; since then, total tonnages collected through the municipal program have increased. Because no further studies on participation rate have been conducted, it is unclear if participation has changed. The Office of Recycling has attempted to reach those neighborhoods believed to exhibit low participation through direct mailings, bilingual publications, and other media.

Newark continues to endorse strict environmental legislation. In early 1989, the City Council banned polystyrene and polyvinylchloride from use in retail food establishments. Later that year, the City Council passed a special ordinance restricting the release of chlorofluorocarbons (CFCs). All firms that service home or auto air conditioners, or refrigeration equipment, are now required to recycle and prevent the release of ozone-depleting chemicals. An ordinance requiring municipal agencies to purchase recycled products took effect in early 1990. In order to solicit input from businesses and community leaders, the City of Newark formed the Blue Ribbon Recycling Advisory Committee (BRRAC). A 19-member committee composed of representatives from community organizations, special interest groups, corporations, recycling businesses, and the City government, the Committee's purpose is to make recommendations on increasing the scope of recycling within the City. The committee has focused on evaluating plans proposed by the Office of Recycling, including plans to increase curbside recycling participation in general and the participation of multi-unit housing residents in particular.

Privately collected material, generated primarily by the commercial sector, accounts for less than half of the waste disposed and more than 85 percent of the waste recovered in the City. The daily influx of commuters to the City may be largely responsible for these high numbers. According to the

Manager of the Department of Engineering, the number of commuters triples Newark's population during the work week; many take advantage of office collection programs and bring their recyclables to work. The Office of Recycling and private haulers both report that area businesses are eager to participate in commercial recycling.

Newark's Office of Recycling, which works under the Department of Engineering, has achieved national and worldwide recognition for its highly successful efforts in recycling and waste minimization. Newark received two statewide awards for its recycling program in 1988, and an Award of Merit from *American City and County Magazine* in 1989. In 1990 Newark received awards from the U.S. Conference of Mayors, Public Technology, Inc., and the New Jersey Department of Environmental Protection, as well as honorable mention from the National League of Cities, for its recycling program and source reduction initiatives. In April 1991, the New Jersey Environmental Lobby presented Mayor Sharpe James with an achievement award for his work in Newark, and the U.S. Environmental Protection Agency (EPA) gave the New York Region Recycling Achievement Award to Newark. In May 1991, the City was the national winner of the Local Government Award in the EPA's first annual Administrator's Awards program, which honored innovative recycling programs.

Recycling Activities

Residential Curbside Recycling

Start-up Date:	June 15, 1988 (A pilot program for newspaper recycling began in December 1987, servicing households in four zones of the City.)
Service Provider:	Until June 1989, the City Division of Sanitation collected recyclables from one-third of the residential sector, and the Occupational Center (OC), a nonprofit training center for the handicapped, collected from the remaining two-thirds. As of June 1989, OC took over the City's collection zones and Essex Recycled Fibers, Inc. was contracted to collect recyclables from the remaining two-thirds of the residential sector.
Pick-up Frequency:	Weekly. Newspaper and commingled recyclables are collected on alternate weeks. Beginning October 21, 1991, all recyclables will be collected weekly.
Same Day as Refuse:	Yes
Households Served:	All households in single and multi-unit housing that the City services with refuse collection either through its crews or under contract with a private hauler. This is estimated to be 90,000 household units.
Mandatory:	Yes
Participation Rate:	The City does not track participation rate. A study conducted within the first year of the program found the participation rate to be 16 percent of the households surveyed (38 percent of the buildings), based on set-outs per month. ¹
Materials Collected:	Newspaper, glass, aluminum, and bimetal cans

Set-out Method:	Commingled glass bottles, aluminum, and bimetal cans are placed at curbside in paper bags or recycling containers. Newspapers are bundled and either tied with string or placed in brown paper bags. As of June 1991, the City had distributed 20,000 8-gallon recycling containers to residents at no charge. Of these, 10,000 were provided in 1988, 5,000 in 1989, and 5,000 in 1990. The City has budgeted for 12,000 20-gallon bins to be dispersed in 1991.
Collection Method and Vehicles:	Commingled bottles and cans are collected one week, and newspapers and magazines are collected the following week. Essex Recycling Fibers uses 23-cubic-yard Eager Beaver trucks with a crew of three persons (one driver and two laborers) for the collection of both. Occupational Center crews—also consisting of a driver and two laborers—collect recyclables in three Eager Beaver trailers with five compartments each hitched to a Nissan cab. Commingled materials are not sorted on route.
Economic Incentives:	None
Enforcement:	Enforcement began in January 1991 with three municipal enforcement officers performing spot checks for recyclables in residential refuse. As of July 1991, 863 warnings had been issued to residents. After two warnings, residents are subject to a fine of up to \$25 per violation. The Office of Recycling credits enforcement with the 20 percent (by weight) increase in recyclables collected at curbside between the first quarter of 1990 and the first quarter of 1991. In October 1991, the City began to issue fines. Between October and February, the City had issued 575 fines.
Annual Tonnage:	5,223 tons were collected at curbside in 1989

Multi-unit Collection

State law requires that landlords and managers of multi-unit residential buildings establish recycling plans for their buildings, and that tenants or owners of units source-separate recyclable materials as required by municipal ordinance. In May 1988, the Newark City Council passed an ordinance requiring that proposals for the construction of 50 or more single-family residential housing units or of 25 or more units of multi-unit housing, incorporate provisions for recycling.

The City is working with the Newark Housing Authority to expand its collection from public housing complexes in the City. The expansion is expected to be implemented by 1992. As of mid-1991, the Office of Recycling provides collection of recyclables from a Housing Authority senior citizen complex. The Office of Recycling supplies 20-gallon bins for bottles and cans, and bins for newspapers, which are placed in conveniently located storage areas on each floor of the complex. Maintenance crews bring the recyclables out to 6-cubic-yard dumpsters, where City crews collect them. The seniors keep the aluminum and sell it to raise funds for events at the complex.

Commercial & Institutional Curbside/Alley Recycling

Legislative Requirements:	The Essex County Solid Waste Plan mandates that municipalities provide, at a minimum, drop-off sites for corrugated cardboard and office paper. The City of Newark requires that, in addition to these materials, all commercial establishments must recycle newspapers, glass food and beverage containers, and aluminum and bimetal cans.
Service Provider:	The City of Newark's Office of Recycling collected corrugated cardboard from a small corridor of the City in 1989. Collection was expanded in 1990 to include all major business corridors. In addition, more than 88 companies reported collecting recyclable materials from Newark's commercial establishments and institutions in 1989.
Number Served:	In 1989 approximately 70 businesses were served by the City, with curbside corrugated cardboard collection. As of mid-1991, 247 businesses were serviced with curbside corrugated cardboard collection. The number of commercial businesses served by private haulers is not available.
Type Served:	Office buildings, retail stores, public buildings, butcher shops, and supermarkets
Materials Collected:	Varies with recycler. Materials may include high-grade paper, mixed paper, newspapers, corrugated cardboard, aluminum and bimetal cans, glass, used motor oil, tires, lead-acid, mercury and nickel-cadmium batteries, ferrous and nonferrous scrap metal, and food waste.
Pick-up Frequency:	Newark's Office of Recycling collects corrugated cardboard weekly. Businesses must arrange with private recyclers for curbside/alley pick-up of other recyclables.
Set-out and Collection Method:	On City routes, corrugated cardboard must be stacked and tied, or baled and placed at curbside. Three-person City crews collect corrugated cardboard using one packer truck. Many private haulers provide commercial establishments with bins for recyclable materials. Set-out method varies among private haulers.
Incentives:	The City does not charge for corrugated cardboard collection. Most private recyclers charge business/institutional establishments lower rates for the collection of recyclables than refuse haulers charge for refuse collection.
Enforcement:	Fines of up to \$1,000. No enforcement fines had been issued as of mid-1991.
Annual Tonnage:	Not available

In 1989 more than 85 percent of materials recovered in Newark were collected from the commercial sector. Of these materials, 82 percent was waste paper. Recycled Fibers of New Jersey reported collecting 47,995 tons of waste paper, or 63 percent of all the old newsprint, corrugated cardboard, high-grade and mixed paper reported as recovered in Newark. Recycled Fibers works on a driver account system; the driver establishes independent accounts primarily with offices for the collection of waste paper. Below is a sampling of firms that offer collection of recyclable materials from the commercial sector.

Regional Recycling: Regional Recycling, a company that has been collecting and baling waste paper for over 20 years, services businesses of all sizes. In addition to mixed paper and corrugated cardboard, Regional Recycling collects glass, aluminum, and ferrous metals. Recyclables can be set out commingled in bins provided by the company, and are collected with roll-offs, packers, rack trucks, or pick-ups, depending on the volume of recyclable materials generated by the customer.

P. Pepe & Sons: Another paper processor, P. Pepe & Sons, provides plastic hampers for its commercial customers. The hampers are stored in an area centrally located for office staff and collection crews. Office staff or janitorial staff deliver mixed office paper and computer paper to the central hampers. Waste paper is collected in 1- to 1.5-ton loads, using 24-foot-long trucks, and hauled to the processing facility. In 1989 the company collected corrugated cardboard and newsprint at no charge, and paid customers for mixed office paper. Now, most waste paper processors in New Jersey are charging their customers. Pepe & Sons also accepts computer paper and white paper at its drop-off site.

Standard Tallow: Rendering operations in Newark have their roots in the whaling days when soap, candles, and oil for lamps were produced from the remains of whales caught off the Atlantic Coast. Nowadays, the primary input for the production of tallow is meat waste from butchers and supermarkets. Standard Tallow provides barrels to customers, which it collects up to two times per week. The meat scraps and grease are used to produce tallow for soap, cosmetics, and candles, and for the production of animal feed. Of the 1,400 tons of food waste collected in Newark in 1989, 1,168 tons were collected by Standard Tallow.

Drop-Off Centers

Number and Type:	There are more than 50 drop-off centers and scrap yards in Newark, including the Newark Recycling Depot, which is operated by the City.
Public or Private:	One is public; all others are private.
Sectors Served:	Residential and commercial
Materials Accepted:	Newark's municipal drop-off site collects newspaper, corrugated cardboard, magazines, glass, aluminum and bimetal cans, white goods, used motor oil, tires, and lead-acid and nickel-cadmium batteries. Materials collected at private drop-off/buyback centers include high-grade paper, mixed paper, newspapers, corrugated cardboard, glass, aluminum and bimetal cans, used motor oil, tires, lead-acid, mercury, and nickel-cadmium batteries, and ferrous and nonferrous scrap metal.
Annual Tonnage:	1,523 tons through the Newark Recycling Depot in 1989. Tonnages from the other drop-off sites, which are privately run, are not available.

Salvage/Reuse

Goodwill Industries has a used clothing bin at Newark's Recycling Depot where residents can drop off old clothing for reuse.

Processing and Marketing of Recyclable Materials

Residential Sector Materials

Materials from Newark's municipal curbside program and drop-off are processed at an intermediate processing center, Distributors Recycling, and at a local paper mill, Newark Boxboard. In the first half of 1989, Newark also had arrangements with Zozzaro Brothers in Clifton, New Jersey and P. Pepe & Sons in Newark for the processing of newspaper, magazines, and marketed corrugated cardboard to a broker, Paper Recycling Corporation. As of the second quarter of 1990, all corrugated cardboard, as well as other paper collected through municipal programs, is processed at Newark Boxboard.

Distributors Recycling, Inc., of Newark opened in mid-1983 as a private bottle and can decasing operation, with the primary purpose of recycling New York bottle bill returns. Trucks from local beverage distributors and breweries bring cases of empty bottles and cans to the facility, where glass, aluminum, and corrugated cardboard are recycled. In 1986 Distributors Recycling began negotiating contracts with several New Jersey municipalities for the processing of their curbside recyclables. Having secured contracts with more than 60 municipalities, REI Distributors, the parent company of Distributors Recycling, built a 60,000-square-foot intermediate processing center (IPC) adjacent to the decasing operation in 1988, at an approximate cost of \$900,000. In 1989 the IPC employed 15 people (10 on a sorting line and 5 in administration). The capital costs of the operation were between \$1 million and \$1.5 million. Yearly operating and maintenance costs are estimated between \$490,000 and \$690,000, of which more than 55 percent is labor.

Municipalities deliver glass (flint, amber, green, and mixed), aluminum, ferrous scrap, tin and bimetal cans (and, as of August 1989, PET plastics) to the facility (5 to 10 miles from collection routes), which is operated in two 8-hour shifts, 5 days per week. HDPE was added to the list of materials processed by the facility in early 1990; detergent bottles were added later that year.

The City of Newark is paid \$12 per ton for commingled recyclables provided they contain at least 3 percent aluminum (by weight). Other municipalities and private haulers are paid from \$8 to \$12 per ton, depending on the terms of the contractual arrangement. Distributors Recycling processes more than 240 tons of commingled recyclables per day. In 1989 the IPC processed 63,500 tons of recyclable materials. The addition of plastics has decreased the tonnage processed each day to approximately 200. Commingled materials from Newark's curbside program are dropped onto a pad, inspected, and turned onto conveyors for sorting. Metals and plastics are mechanically removed from glass. Glass is hand-sorted by color, and plastics are hand-sorted by resin. Eddy current magnetic separators separate ferrous metals from aluminum cans. A \$450,000 glass cleaning system is used to clean glass. Processed materials are sold to various end users. Anchor Glass Container and Owens Brockway purchase most of the glass processed at the facility. Aluminum is baled and marketed domestically. Plastics are baled and marketed both domestically and overseas. Some ground glass residue is sold and recycled into asphalt. According to George Wolfson of Distributors Recycling, less than 5 percent of the incoming commingled materials is residue. As of 1991, REI has moved to a 100,000-square-foot facility in Newark, and is planning to install equipment for washing plastic.

Newspapers and magazines collected through the municipal curbside program and corrugated cardboard collected by the City and by some private haulers are processed primarily at Newark Boxboard. The plant produces 125 tons per day of chipboard from 140 tons of various grades of waste paper, including corrugated cardboard and newspapers.

Materials collected through the municipal drop-off center, including bulky items from the Department of Sanitation's bulk item collection, are marketed to various end users. In 1989, 246 tons of tires from Newark were sold to Tirec Systems, Inc., a local firm that produces crumb rubber for use in road resurfacing. (As of 1990, approximately 270 tons of crumb rubber were used in approximately 9,000 tons of modified mix for paving Newark streets.) Newark also delivered 467 tons of tires to Metropolitan Tire Converters at a tipping fee of \$70 per ton. Metropolitan Tire does not recycle tires but sells the shredded material to a firm in Greece, which uses it as fuel in cement production. Much of the

cement is imported back to the United States through the Port of Newark for use in construction. White goods collected at curbside and the Recycling Depot are sold to local scrap dealers. Labor costs of removing PCB-laden capacitors from white goods outweigh the return from the sale of scrap metal, but, according to the Office of Recycling, the avoided disposal costs make recycling white goods worthwhile for Newark.

In 1989, 9,000 abandoned vehicles were removed from City streets. In exchange for the ferrous scrap value, local towing companies are granted franchises for the removal of deserted vehicles from Newark's streets and lots. (The 7,415 tons of auto scrap recovered in 1989 are not included in the tonnage figures in this case study.)

Commercial Sector Materials

Many private recyclers that collect materials from commercial establishments have sorting and baling operations, and market the baled products independently or through a broker. Most small operations are currently experiencing financial difficulties. According to Ron Delucia, General Manager of Regional Recycling, the market for mixed paper (office paper, computer paper, colored ledger) is at a low point. Five years ago, he could sell waste paper for \$5 per ton; now it costs \$40 per ton to unload it. Likewise, the market for corrugated cardboard is poor. As of mid-1991, old corrugated cardboard was selling for \$15 per ton in New Jersey; 5 years ago, a ton sold for \$75-\$80. Delucia estimates less than 10 percent by weight of materials collected by Regional Recycling are rejected as nonrecyclable.

Market Development Initiatives/Procurement

An informal "buy recycled" policy has been in effect in Newark for several years. In the late 1980s, the City purchased crumb rubber from old tires for resurfacing City streets, recycled plastic park benches, and recycled paper for office copying and for printing publications. Newark has recently adopted EPA procurement guidelines as mandatory. In 1990 the Newark City Council passed an ordinance requiring municipal agencies to purchase recycled products. Directors of all City departments and agencies must recommend changes to incorporate the use of recycled materials, reusable products, and recyclables to the maximum extent practicable. Outside contractors that provide products or services for the City must also comply with the City's requirement to procure recycled products.

The Department of Engineering hosted three recycling forums for local businesses in late 1990. Representatives from more than 50 white collar, retail, manufacturing, and automotive-related businesses attended the forums. The businesses were encouraged to use the City's "Buy Recycled" data base, which contains information on more than 2,000 manufacturers and suppliers of finished goods made from recycled materials.

Composting Activities

Newark began composting leaves collected at curbside in 1986. In 1987 a State law banning the landfill disposal of leaves was passed. In the same year, the composting program was expanded to include collection of grass clippings, branches, and Christmas trees. From leaf collection alone, the City recovered more than 8,000 cubic yards in 1987, more than 15,000 cubic yards in 1988, and more than 22,000 cubic yards in 1989.

Newark offers other municipalities the use of excess capacity at its compost facility. The City received \$47,367 in 1989 from other New Jersey municipalities that dropped off leaves at Newark's compost facility.

Christmas trees are collected at curbside in Newark for 3 weeks following New Year's Day. Private tree removal services remove stumps and brush from City streets and lots under contract with the City's Department of Engineering. These materials are then privately chipped and used for landscaping. The City's WIN (Working Inmates Network) program employs laborers from the Northern State Prison to clean vacant lots in the City of refuse and brush. Small amounts of brush collected through this program are chipped at the compost facility.

Curbside Collection

Start-up Date:	October 1986
Service Provider:	The City of Newark contracts with three private haulers (Basso, Inc., Tobia Bros., and A&A Inc.) to collect yard waste and haul it to the compost site.
Households Served:	All households, as needed
Materials Collected:	Leaves, grass clippings, brush, and Christmas trees
Mandatory:	Yes, for leaves and grass clippings
Set-out Method:	Yard waste must be placed at curbside either loose or in degradable bags. Christmas trees must be free of adornments and set out at the curb.
Collection Vehicles and Method:	Several packers (30 and 40 cubic yards), dump trucks (16, 18, and 22 cubic yards), and roll-offs (20 and 30 cubic yards) supplied by private haulers are used for the collection of yard waste.
Collection Frequency	Leaves and grass clippings and brush are collected weekly from October through January.
Economic Incentives:	None
Annual Tonnage:	7,435 tons in 1989.

Composting Site

The compost facility, an 11-acre site, is located on East Rutherford Street in an industrial area of Newark. The facility is owned by the Passaic Valley Sewage Commission and leased to the City for \$1 a year. The City uses approximately 7.5 of the 11 acres for the composting process. Municipal crews and contractors transport leaves and grass clippings to the site. Newark employs three municipal workers and several state prison inmates at the site. The inmates empty bags of yard waste and remove any contaminating refuse. Of the three municipal employees, a supervisor oversees the operation and spot checks yard waste for contaminants, another employee operates the loader, and a third waters the windrows. Leaves and grass clippings are arranged in windrows 12 feet wide by 9 feet high. The windrows are watered once a month and turned every 2 weeks. At the height of the season (late November) there are over 60 windrows. The compost is tested twice a year by a State agricultural expert and more often by the City. Finished compost is ready in 12 to 18 months, when it is screened and made available to City residents and nonprofit horticultural organizations. It is estimated that between 75 and 85 percent of the material produced at the composting facility is distributed to Rutgers University for its Urban Gardening and to the greater Newark Conservancy Programs. According to the Essex County Cooperative Extension Service agent, the Urban Gardening Program has established 266 community gardens and 540 backyard gardens. Two thousand pounds of fruits and vegetables grown in urban gardens were given away to senior citizens and shelter houses in local neighborhoods. The compost is also used for beautification in City parks and recreation areas. A small amount is sold to private businesses for \$2 per cubic yard.

The Division of Sanitation loans a chipper to the Office of Recycling for 3 weeks in January for the chipping of Christmas trees. While the tonnage of Christmas trees collected in 1989 is not available, in 1990 approximately 196 tons were collected. Chipped trees were distributed to City residents and landscapers.

Amount and Breakdown of Materials Recovered

Material	Public Collection* (Tons, 1989)	Private Collection (Tons, 1989)	Other (Tons, 1989)	Total (Tons, 1989)
Newspaper	2,888	28,376	-	31,264
Corrugated Cardboard	77	6,404	-	6,481
High-grade Paper	35	2,362	-	2,397
Other Paper	-	36,341	-	36,341
Commingled	2,781	2	-	2,783
Glass	-	8,782	-	8,782
Plastic	-	-	-	†
Aluminum Cans	-	828	-	828
Ferrous Cans	-	12	-	12
Nonferrous	1	-	-	1
Appliances/White Goods	795	300	-	1,095
Food Waste	-	1,400	-	1,400
Tires	246	42	-	288
Motor Oil	-	525	-	525
Batteries	-	93	-	93
Textiles	-	10	-	10
Subtotal MSW Recycled	6,823	85,477	-	92,300
Leaves and Grass Clippings‡	2,850	-	-	2,850
Brush and Christmas Trees§	4,585	-	-	4,585
Stumps & Chips**	-	446	-	446
Subtotal MSW Composted	7,435	446	-	7,881
Total MSW Recovered	14,258	85,923	-	100,181
Asphalt	-	-	1,873	1,873
Wood Waste	-	-	1,726	1,726
Total C&D Recovered	-	-	3,599	3,599
Total Materials Recycled	6,823	85,477	1,873	94,173
Total Materials Composted	7,435	446	1,726	9,607
Total Materials Recovered	14,258	85,923	3,599	103,780

Note: While 131,049 tons of ferrous scrap and 16,127 tons of nonferrous metal were reported by Newark as material recovered from the commercial sector, ILSR has not verified that this is part of the City's municipal solid waste stream.

* Of the 6,823 tons of recyclables collected from the residential sector, 5,223 tons were collected through the City's curbside residential program, 77 tons of corrugated cardboard were collected through its commercial recycling program, and 1,523 tons were collected through its drop-off site.

† One-tenth of a ton

‡ In 1989, 22,801 cubic yards of leaves and other yard waste were collected. Newark uses a conversion factor of 8 cubic yards per ton, yielding 2,850 tons.

§ In 1989 the City collected 18,341 cubic yards of brush and Christmas trees. Newark uses a conversion factor of 4 cubic yards per ton. Seven hundred and eighty-six cubic yards of Christmas trees were collected in 1990, but a breakdown is not available for 1989.

** Four hundred and forty-six tons of stumps and chips were recovered by private tree trimming companies.

Source Reduction Initiatives

Newark has actively promoted solid waste source reduction. The City has initiated a precycling campaign modeled after the Berkeley, California program, to encourage environmentally conscious shopping. The campaign, conducted through newspaper advertisements, direct mailings, and presentations to community organizations, includes suggestions for product selection, and encourages consumers to purchase products that are not heavily packaged, or are packaged in recyclable materials; to buy in bulk; to avoid disposables; and to voice concerns and suggestions about store purchasing policies to local retailers. In 1990 a special feature on precycling was included in Newark's curbside collection calendar mailing to residents.

In February 1989, the Newark City Council passed an ordinance banning the use and sale of polystyrene and polyvinyl chloride, and the use of nondegradable plastic packaging in retail establishments. All fast-food restaurants, cafeterias, delis and other food establishments are now using degradable paper packaging. Several cafeterias have switched to reusable utensils, plates, cups, and carry-out containers. Among these are the cafeterias in the Federal Building, PSE&G, and New Jersey Bell.

In addition to these initiatives, the City rewards businesses and institutions for practicing source reduction. On Earth Day 1991, Mayor Sharpe James presented awards to Blue Cross and Blue Shield of New Jersey, Public Service Electric and Gas, and Seton Hall University School of Law for outstanding achievement in source reduction.

Publicity and Education

Prior to launching its curbside recycling program, Newark hired a local minority public relations firm, The Writing Company, to spearhead a campaign for educating the public about the new program. The initial campaign, "Sort it Out," was conducted primarily through colorful billboards and direct household mailings. The first mailing was a detailed brochure containing a map of the resident's area, a list of the streets in his/her collection zone, and a calendar of scheduled pick-up days for recyclables. A second mailing, a postcard/decal, was sent as a reminder to residents to source-separate. The decal, which displayed the message "Sort it Out, It's as easy as 1, 2, 3," could be placed on containers for recyclables. A third mailing in December 1988 and a fourth in mid-1989 contained the 1989 curbside collection schedule for recyclables. Enclosed with the 1990 collection calendar mailing was an entry certificate for a "Recycling Drawing." Winners, one from each of the nine zones, received \$50 gift certificates from an area supermarket (Foodtown) for the purchase of any food or drink packaged in recyclable materials. Two grand prize winners were awarded \$100 certificates, and each winner received "Newark Recycles" tee shirts and recycling buckets.

Through newspapers, television and radio advertising, direct mailings, billboards, and other media, The Writing Company continues to reach residents, school children, and business persons in the Newark area. Most mailings and bulletins are translated into Spanish and Portuguese in order to reach the communities in which these are the primary languages spoken. In 1990 The Writing Company produced two videos explaining and promoting Newark's recycling and composting programs for outside audiences and for residents within the City. The first is intended for viewing by schools and civic organizations; the second, a 14-minute documentary entitled "Newark: The Global City," details Newark's many successes in environmental policy and is intended to appeal to many audiences. These videos made Newark one of four national award winners of the Arts and Entertainment Competition sponsored by the National League of Cities Annual Conference.

For children, The Writing Company organizes an annual Recycling Poster Contest. Begun in 1988, the contest invites students from grades 4 through 12 to create posters with a recycling theme. Hundreds of students enter the contest, which is cosponsored by the Office of Recycling and the Newark Board of

Education. In 1989, 13 students won cash prizes ranging from \$25 to \$250. The "Recycling Rangers" program was initiated to encourage students to spread the word about recycling to their parents and friends. New Rangers are inducted at presentations and functions sponsored by the Office of Recycling. In August 1990, the Office of Recycling sponsored a Sculpture Art Contest at the Newark Public Library. Contestants had to use recyclable materials including cans, glass bottles and jars, newspapers, magazines, cardboard, and tires. The contest was open to pupils in grades four through eight. Among the prizes were 1- to 6-month scholarships at the Newark Community School for the Arts, and \$25 savings bonds.

In the spring of 1991, "The Woes of Waste," a puppet show sponsored by the Office of Recycling, was shown to school children. The City is employing a resident puppet theater, the Rainbow Puppet Workshop, to teach elementary school children the importance of recycling. A representative from the Office of Recycling gives a brief presentation on the City's laws and the curbside collection program at each showing. After the puppet show, the participating students are sworn in as Recycling Rangers.

Economics

Costs Cover:

In 1989, 5,223 tons of recyclable materials and an estimated 7,435 tons of organic waste (yard waste and Christmas trees) were collected at curbside through the City's residential curbside recycling program. Another 77 tons of corrugated cardboard were collected from the commercial sector by the City and 1,523 tons were collected at the City's Recycling Depot.

Capital Costs: Between January and June 1989, City crews collected 345 tons of recyclables from the residential sector at curbside and 77 tons of corrugated cardboard from the commercial sector. The costs of the trucks used to collect these materials are given below. The remaining 4,878 residential tons of recyclables were collected by private haulers and paid for by the City in the form of yearly contract fees listed under operating and maintenance costs. Intermediate processing of the recyclables is handled by the private sector; capital costs for processing are not available. The City's capital costs for the collection of 77 tons of corrugated cardboard is listed below.

The City's capital costs for the collection of recyclables include an Eager Beaver, recycling truck, which City crews used to collect 345 tons of material, and a packer truck, which was used to collect 77 tons of corrugated cardboard; both are listed below. The City's capital costs for composting or chipping 7,435 tons of organic waste in 1989 are also given below. The City does not incur any capital costs for yard waste collection, since these are included in contract fees paid to private haulers.

Operating and maintenance costs: incurred by the City in 1989 include contract fees and City labor costs for the curbside collection of 5,300 tons of recyclable materials (including the 77 tons of corrugated cardboard) and 7,435 tons of organic waste; City labor costs for 1,523 tons of materials accepted at the municipal drop-off center; and administrative, education, and publicity costs.

Capital Costs: Collection by City Crews

Item	Cost	Use	Year Incurred
31-cubic-yard Packer Truck*	\$84,000	Recycling	1984
14-cubic-yard Eager Beaver Recycler 6	34,600	Recycling	1988

Note: The City floats bonds for the purchase of equipment listed. Equipment is amortized over a 5-year period. Other capital costs were incurred by private haulers under contract with the City.

*The packer truck, used for the collection of corrugated cardboard, was purchased in 1984 by the City's Department of Sanitation. Its \$84,000 cost, was estimated by Newark's Recycling Coordinator.

Capital Costs: Yard Waste Processing

Item	Cost	Use	Year Incurred
Chipper (@ 6% of use)*	\$14,000	Composting	1984
Front-end Loader	84,000	Composting	NA
Royer Shredder-Mixer†	95,000	Composting	1986

Note: The City floats bonds for the purchase of equipment listed. Equipment is amortized over a 5-year period. Other capital costs were incurred by private haulers under contract with the City.

*The chipper is supplied by the Department of Sanitation for chipping Christmas trees. The Office of Recycling estimates that chipping Christmas trees consumes 6 percent of the chipper's available time.

† The capacity of the Royer purchased in 1986 was too small to handle the volume of leaves collected and brought to the composting facility. Thus, beginning in 1989, the City leased a Screen-All from Newark Disposal for \$60 per hour, 8 hours per day, 125 days per year, for a total cost of \$60,000 per year. This cost is included under operating and maintenance costs.

Annual and Per Ton Operating and Maintenance Costs (1989)

	Cost	Tons Covered	Per Ton Cost
Recycling Subtotal	\$1,004,314	6,823	\$147
Collection	\$744,023	6,823	\$109
Curbside Collection	728,852	5,223	140
City Crews (3 zones/6 months)	65,397	345	190
OC Contract (6 zones/5 months)	191,590	1,677	114
OC Contract (3 zones/6 months)	74,865	530	141
Essex Contract (6 zones/6 months)	397,000	2,671	149
Drop-Off Collection	10,695	1,523	7
Corrugated Cardboard Collection*	4,476	77	58
Processing†	0	6,823	0
Administration	188,291	6,823	28
Education/Publicity	72,000	6,823	11
Composting Subtotal	\$189,291	7,435	\$25
Collection	\$71,136	7,435	\$10
Processing	80,155	7,435	11
Administration	20,000	7,435	3
Education/Publicity	18,000	7,435	2
Recycling & Composting Totals	\$1,193,605	14,258	\$84
Collection	\$815,159	14,258	\$57
Processing	80,155	14,258	6
Administration	208,291	14,258	15
Education/Publicity	90,000	14,258	6

Note: Tons covered include residential recyclables and organic wastes collected through the City's residential curbside program, totalling 14,181 tons, plus 77 tons of corrugated cardboard collected from commercial establishments by the City. Due to rounding, breakdown of per ton costs do not add to total.

* Corrugated cardboard collection began in November at a cost of \$4,475.50 for the remaining two months of 1989. Costs are estimated based on the cost of two laborers at a wage of \$8.31 per hour and one truck driver at \$9.20 per hour, for 20 hours per week, which would total \$26,853 per year.

† Processing costs for recyclable materials are incurred by the private sector.

Yard waste collection costs include fees paid to three haulers by the Division of Sanitation for leaf collection for 36 days, 8 hours per day, at an average of \$35 per hour per truck and \$46 per hour per loader, totalling \$71,136. Yard waste processing costs include the cost of leasing a Screen-All in the amount of \$60,000 and the cost of three laborers (one at 75 percent time and two at 25 percent time) in the amount of \$20,155. Total processing costs for 1989 were \$80,155.

Administrative expenditures for the recycling program include \$100,018 in wages and salaries for administration and support staff, and \$107,206 for supplies, copying, printing services, advertising, and other in-office expenses. Education and publicity expenses include the contract fee paid to The Writing Company for the promotion of Newark's recycling program.

Materials Revenues:	The Office of Recycling received \$53,004 in fiscal year 1989 for the sale of commingled glass bottles and cans, newspaper, office paper, corrugated cardboard, and light iron and metallic scrap.
Source of Funding:	New Jersey Tonnage Grant and City of Newark General Fund. In 1989 the Office of Recycling was awarded \$199,178 through the State tonnage grant program.
Full-time Employees:	5 full-time employees. (From January to June 1989, the City of Newark employed 8 people full-time for the collection of recyclable materials, and 3 municipal employees and 4 state prison inmates for the processing of yard waste at the compost sites.)
Part-time Employees:	None

Future Solid Waste Management Plans

Newark's Office of Recycling is awaiting funding from the State for 12,000 20-gallon residential recycling bins, which are expected to increase participation in the municipal curbside program. Newark also plans to incorporate a recycling education puppet workshop into the City's kindergarten through sixth grade curriculum. Enforcement of mandatory source separation for residents and businesses began in early 1991 and looks promising. Issuance of warning notices began on January 1991, and fines were issued as of October 1991. The Office of Recycling plans to increase the use of enforcement to gain greater participation from Newark's residential and commercial sectors. The City has also observed that the switch to weekly collection of recyclable materials also has increased the amount of material collected. In November 1991, 20 percent more material was collected than in November the previous year.

In mid-1992, the City began to request bids for awarding a new contract for the collection of residential recyclables in the one-third of the City currently serviced by The Occupational Center (OC). The City prefers that the future contractor pick-up both refuse and recyclables from this sector, so that vehicles can be shared. The City is also requesting that the hauler awarded the collection contract supply residents 20-gallon recycling containers with recycled content. The City will assign OC workers another recycling or public works function.

Literature is being produced to encourage recycling in high-rise apartment buildings and to inform owners about their responsibilities. The Office of Recycling is drafting more stringent legislation, targeting large multi-unit buildings in order to promote participation and increase collection of recyclable materials. Finally, the Department of Engineering, which oversees the Office of Recycling, is lobbying for bottle bill legislation in the State to increase the recovery of glass and metal beverage containers.

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Endnotes

- ¹ In April 1989, graduate students at the New School for Social Research conducted a study on participation in Newark's curbside recycling program. They found that recyclables were set out at least once a month in front of 37.7 percent of the buildings surveyed. The buildings included both single-family houses and small multi-unit buildings. Based on the number of households within the buildings in the study group, it was estimated that 16 percent set out recyclables at least once a month.

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Philadelphia, Pennsylvania

Demographics

Jurisdiction:	City of Philadelphia
Population:	1,633,826 in 1990
Area:	136 square miles
Total Households:	673,880 (572,798 single family to 6-family residences and 101,082 households in buildings of seven units or more—ILSR estimate based on distribution of households in previous years)
Total Businesses and Institutions:	26,579 (23,253 commercial businesses and offices, 3,326 institutions and unclassified businesses)
Brief Description:	Philadelphia is the fourth largest city in the nation, and the second largest city on the eastern seaboard. It is a major center for industry, commerce, oil refineries, and manufacturing. In 1989 the median per capita income was \$10,266, and 862,000 people were employed in the City.

Solid Waste Generation and Recovery

Annual Tonnages (July 1989 to June 1990)

	Public Sector	Private Sector	Total MSW	Construction & Demolition	Total Waste
Recovered	57,854	181,959	239,813	23,588	263,401
Recycled	56,283	181,959	238,242	19,088	257,330
Composted	1,571	0	1,571	4,500	6,071
Disposed	870,199	950,120	1,820,319	408,096	2,228,415
Incinerated	0	NA	NA	NA	NA
Landfilled	870,199	NA	NA	NA	NA
Generated	928,053	1,132,079	2,060,132	431,684	2,491,816

Percent by Weight Recovered

Recovered	6%	16%	12%	5%	11%
Recycled	6%	16%	12%	4%	10%
Composted	*	0%	*	*	*

Notes: Municipal solid waste cannot be broken down into residential and commercial. Public sector materials recovered include recyclables collected by City crews from 159,245 single- through six-unit households (approximately one-third of such households), from community block corner and drop-off programs, and from municipal office buildings as well as leaves collected by the City. Public sector waste disposed includes residential waste disposed from 572,798 single- through six-unit households, waste from commercial establishments employing fewer than six employees, and municipal street sweepings.

Private sector materials recovered include recyclables, compostables, and refuse collected by private haulers from multi-unit residences with seven or more units, commercial businesses, and institutions. Private sector waste disposed also includes 23,224 tons of residential and commercial waste self-hauled to landfills. Commercial waste cannot be broken out from private or public sector waste, but it is estimated to comprise 60 percent of municipal solid waste generated.

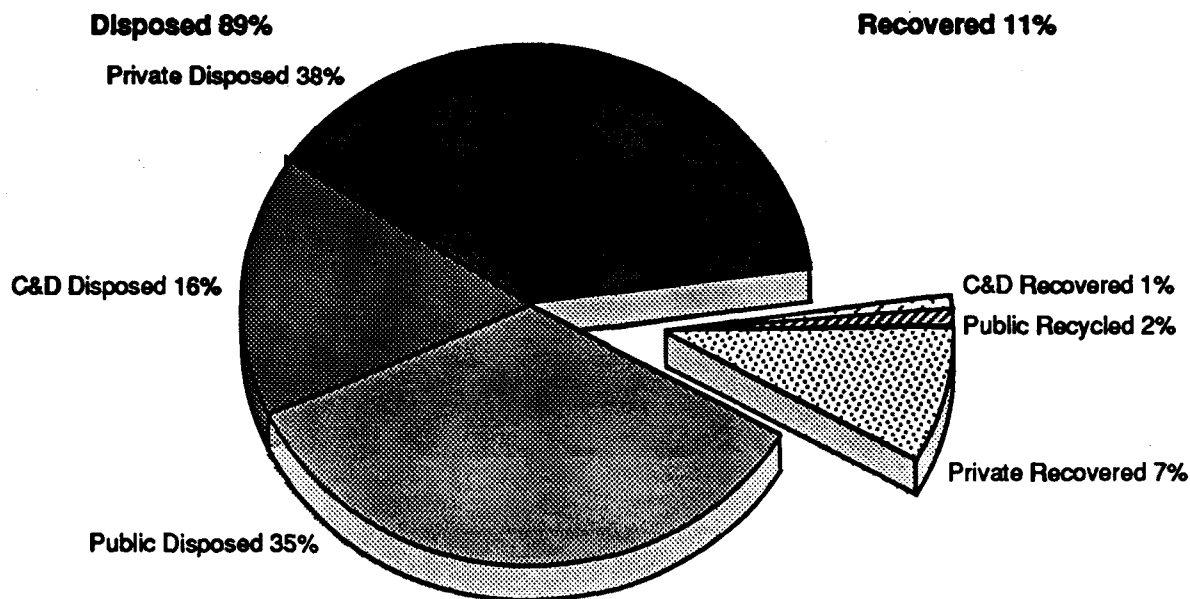
The tonnage of recyclable materials self-hauled to drop-off centers or private scrap yards is not included in this table.

*Less than 1 percent.

Landfill Tipping Fee: \$66.25 per ton in 1989, \$69.56 per ton in 1990

Collection and Disposal of Refuse: The Philadelphia Streets Department partitions the City into 6 waste collection districts, which are subdivided into 13 waste collection regions. City crews collect refuse once each week from single-family through 6-unit residences, and from businesses that employ fewer than six people. There are 5 City-owned transfer stations and 17 private transfer stations. In 1988 the Streets Department negotiated a 6-year contract with Waste Management Inc. (WMI) to dispose of its municipal refuse at the Tulleytown or GROWS landfills in Bucks County, Pennsylvania. In fiscal year 1990 the City paid \$148,260,228 (\$170 per ton) for disposal of 870,199 tons including collection, disposal, and maintenance costs. Thirty-nine private haulers collect waste from apartment buildings with seven or more units, commercial businesses, institutions, industrial plants, and construction and demolition sites. Thirty-four percent of privately collected waste is disposed out of state. A small percentage of this waste is incinerated.

Total Waste Recovered and Disposed (Percent by Weight, FY 1990)



Note: Due to rounding, numbers do not add up to 100%.

Materials Recovery Overview

Goals and Legislative Requirements:

In August 1987 the City of Philadelphia enacted ordinance 1251A, which established a goal of 50 percent reduction in the waste stream through recycling and composting by the end of 1991. The law required the mandatory separation for recovery of newspaper, plastic, glass, aluminum and ferrous cans, and yard waste, to be phased in citywide over a 2-year period. In March 1991, Philadelphia lowered its recovery goal to 40 percent of the waste stream by the year 2000.

The Pennsylvania Municipal Waste Planning, Recycling, and Waste Reduction Act (State Law 101), enacted September 1988, mandates statewide recycling. All municipalities with populations greater than 10,000 are required to recycle leaves and a minimum of three materials from a list of recyclables including glass, aluminum and ferrous cans, newspaper, cardboard, high-grade paper, and plastic. Effective September 1990, State Law 101 established a goal of recycling 25 percent of its waste stream by 1997, and required that all counties develop comprehensive 10-year waste management plans. Philadelphia is a county as well as a city. Act 101 also prohibits anyone from landfilling consolidated loads of leaves and lead-acid batteries.

Like many other northeastern cities, Philadelphia faced rapidly rising trash disposal costs in the 1980's. Its disposal costs rose from \$8.5 million to \$40 million between 1983 and 1988. The City administration, determined to find alternatives to landfilling, pushed for construction of a waste incineration plant in the Philadelphia Navy Yard. The proposal was vehemently opposed by a coalition of community, environmental, and religious groups. The City Council rejected the plan, and in June 1987, Philadelphia passed a law that made recycling and composting the primary waste management strategy. This ordinance, Act 1251A, mandated a goal of recovering 50 percent of the residential, commercial, and institutional waste streams through recycling and composting. The ordinance included provisions for setting up educational programs, establishing more than six intermediate processing centers, developing formulas for determining the avoided disposal costs through recycling, and implementing appropriate mechanisms for savings such as shared savings or bonuses. However, this legislation did not provide the funding necessary to achieve these goals. As a result, in 1991 the City's goal was lowered to recovering 40 percent of the waste stream through recycling and composting by the year 2000.

The Philadelphia Recycling Office (PRO), a unit of the City's Managing Director's Office, was established to plan the recycling agenda. The Streets Department is responsible for the collection, processing, and marketing of municipal recyclables, and for enforcing the recycling law. The City created two committees, as required by Ordinance 1251A, to guide PRO. The Recycling Advisory Committee (RAC) includes representatives of private sector recyclers and recycling advocates. The Inter-Agency Task Force (IATF) is the policy-making body directing the PRO and other City agencies affected by changes in the recycling programs, including the Streets Department, the Procurement Department, and the Law Department.

Philadelphia implemented a voluntary pilot curbside program in September 1987. Municipal crews collected newspaper, glass, and aluminum and ferrous cans every other week from 23,000 households. National Temple Recycling, a private nonprofit community-based organization, won the bid to process and market recyclables collected in the first phase of the City's curbside program. In 1988 the program expanded into weekly collection. In 1989 the program became mandatory when the pilot was expanded to the entire Sanitation District, which is divided into nine anticipated recycling zones. Two additional neighborhoods were serviced and plastic beverage containers were added to the list of materials collected. The Philadelphia Transfer and Recycling Center (PTRC), a subsidiary of Waste Management Inc., received the recycling contract as the low bidder. In fiscal year 1990, the City recovered 18,368 tons of recyclables; tonnages recovered increased to 27,441 during fiscal year 1991.

As of 1991 municipal crews service one-third of the city's eligible households, or 28 percent of all households. Philadelphia's fiscal crisis has stalled further expansion of the curbside program. Residents not served by the municipal curbside program are encouraged to recycle at City drop-off sites, private buy-back centers, and drop-off sites run by private community groups.

Municipal curbside leaf collection, implemented in 1978, is conducted in areas of the City with the highest tree density. Materials are composted at the Fairmount Park Compost Site and used in City parks or given to Philadelphia residents.

In 1988, to fulfill the requirements of State Act 101, the Mayor appointed 20 members to the Philadelphia Solid Waste Advisory Committee (SWAC) to prepare a Municipal Waste Management Plan. Completed in 1990 and approved by the City Council in March 1991, this plan recommended a three-tiered strategy: (1) waste reduction, (2) recycling and composting, and (3) disposal methods, including landfilling and waste incineration.

Philadelphia is suffering from severe financial problems that have curtailed the growth of the City's recycling and composting programs. The recycling program is funded directly from the City's general fund. Recycling revenues go to the general fund rather than to PRO's budget or the Streets Department budget. Under State Act 101, counties and municipalities may apply for a variety of State grants funded through a \$2 per ton surcharge on landfill tipping fees. However, State grants do not provide for an equitable distribution of funds. Although Philadelphia represents 16 percent of the State's population, Act 101 stipulates that no single municipality may receive more than 10 percent of total funds targeted for implementation of recycling programs. Moreover, the Pennsylvania

Department of Environmental Resources (DER) requires that grant funds be used for education, planning, program development, and market development expenses. In Philadelphia labor and operating and maintenance costs comprise most of the recycling and composting budget.

Recycling Activities

Public Sector Curbside Recycling

Start-up Date:	September 1987 for voluntary biweekly pilot program; January 1989 for weekly mandatory collection
Service Provider:	The Philadelphia Streets Department-Sanitation Division. Approximately 22 private pig farmers collect food waste under contract with the Streets Department.
Pick-up Frequency:	Recyclables are collected weekly, food waste is collected biweekly, and tires and white goods are collected on request.
Same Day as Refuse:	No. Municipal workers collect recyclables on the workday preceding refuse collection.
Sectors Served:	115,000 households in buildings with six units or fewer in 1989, and 159,245 such households in 1990. Small businesses are also served.
Mandatory:	Yes, for newspaper, glass, aluminum and ferrous cans, and HDPE and PET plastic beverage containers
Participation Rate:	80 percent of households served. In 1987 PRO determined an average set-out weight per household for recyclables. Dividing the total tonnage by the average set-out weight yields an approximate number of participating households. The total number of households served is then divided by the number of participating households to determine an estimated participation rate.
Materials Collected:	Newspaper, glass, aluminum and ferrous cans, and HDPE and PET plastic beverage containers. The Streets Department collects white goods and tires free of charge on request, and farmers collect food waste.
Set-out Method:	Residents bundle newspapers or place them in paper bags. They commingle all other materials in 6-gallon plastic buckets provided free of charge to each household. Residents may also use any additional containers. Food waste must be set out in separate 5 or 10-gallon covered containers provided by residents.
Collection Method and Vehicles:	A three-person collection crew collects recyclables in 32-cubic-yard Lodal trucks, or 23-cubic-yard Eager Beaver, trucks. Commingled materials are placed in one bin, newspaper in another. When recycling vehicles fail to operate, City crews collect recyclables in compactor trucks. The Streets Department uses a 20-cubic-yard open truck to collect tires and white goods.
Economic Incentives:	None

Enforcement:

Although recycling is mandatory, the City does not enforce the law. While municipal crews can refuse to pick up recyclables set out improperly at curbside, they rarely do so. Although scavenging occurs in Philadelphia, the City has not taken any measures to prevent it.

Annual Tonnage:

54,304 tons in fiscal year 1990 (18,368 tons of recyclables, 2,402 tons of white goods, 3,534 tons of tires, and 30,000 tons of food waste). In fiscal year 1991, 27,441 tons of recyclables and 30,000 tons of food waste were recovered, excluding white goods and tires).

Residential Block Corner Collection

The Queen Village Recycling Committee (QVRC), located in a central Philadelphia neighborhood and comprising 90 city blocks, initiated a block corner collection program in 1985 to improve the convenience of recycling for residents over drop-off locations. The Committee contacted the City's recycling office and arranged for a City truck and crew to collect the recyclables. The program combines the efficiency of a drop-off center with the convenience of curbside collection. Bob Pierson, volunteer spokesman for the Queen Village Recycling Committee, estimates that the costs of the block corner program are one-third those of curbside collection.

Residents bring their newspaper, glass, and aluminum cans to designated street corners each Saturday morning. (In 1990 recyclables were collected every other Saturday.) Over a 3-hour period, City crews pick up materials from 25 street corners. (The short time materials are left at curbside reduces the opportunities for scavengers to remove saleable materials.) The two-person crew puts newspaper into a compactor truck and other materials into a compartmentalized vehicle, such as a Lodal 3030 or Eager Beaver, Recycler Six. Block corner materials are fully separated at the corner, including glass separation by color, and require no further separation. Because each corner stop services 30 to 150 homes, the block corner program is highly efficient. In addition, the driver can help load the recyclables at each stop. About one-third of Queen Village residents live in a public housing project, and do not yet participate in the program. There are 3,200 households in the Village. Three other neighborhoods (all smaller than Queen Village) are included in the block corner collection route serving Queen Village. Together, these neighborhoods collect about 400 tons of recyclables a year. This tonnage is tracked by receipts provided by the buyers of the materials.

The block corner idea has spread to other Philadelphia neighborhoods. Both high- and low-income neighborhoods are served. In 1990 recyclables were collected from ten block corner neighborhoods at an estimated cost of \$58 per ton. In 1991 there are 15 block corner programs operating. According to Bob Pierson, the block corners have received well-supervised and highly competent collection services from the City's Sanitation Division of the Streets Department. Local organizing and publicity efforts were all either homegrown or through networking with already established block corner programs.

Neighborhoods interested in initiating a block corner program establish a network of block coordinators, arrange collection with the Streets Department, and publicize their programs. Block coordinators are key to the success of the program. These volunteers are responsible for selecting and monitoring a corner, and distributing startup and reminder leaflets to the residents on their blocks. The neighborhood groups work with the City to select buyers for their recyclables. Revenues from material sales are returned to the community and used to fund neighborhood projects such as early childhood programs, tree plantings, park planning, and clean-up of vacant lots.

Food Waste Collection

New Jersey hog farmers have collected food waste from Philadelphia's residential and commercial sectors for more than 80 years. The City has also reimbursed haulers for collection of food waste from residential households for at least 25 years; in 1989 the City reimbursed haulers \$67 per ton. The City bases farmers' reimbursements on the average weight of a truckload of food waste for a given collection route. Food waste is weighed approximately once per month. The Streets Department coordinates collection routes, and households located in an area extending over three-fourths of the City can receive food waste collection service. Residents place food waste in 5- or 10-gallon cans with tight-fitting lids. The City reports no fly or odor problems with its food waste collection program. All types of food waste are accepted. Before food scraps can be fed to hogs, they must be cooked for 30 minutes at a core temperature of 212 degrees Fahrenheit. Some of the farmers' vehicles are equipped to cook the food waste en route. Hogs are usually fed the food scraps the following day. Most farmers currently cook food waste at their farms.

Commercial establishments such as bakeries, hospitals, and prisons also recycle food waste. Unused or pre-consumer commercial food waste, such as out-of-date bakery items and produce, does not need to be cooked. Although some hog farmers feed their hogs entirely on food scraps, the program is not expected to expand. According to Robert Shisler, president of the New Jersey Livestock Association, the number of hog farmers has declined due to suburban encroachment and high start-up costs. He estimates that the number of private food waste haulers has decreased from approximately 100 haulers 15 years ago to 22 haulers in 1991. The tonnage recovered from the residential sector in fiscal year 1991 decreased somewhat. The Sanitation Division is currently trying to increase residential participation by advertising food waste routes and collection days.

Office/Institutional Collection

In 1989 seven municipal office buildings implemented a mixed paper recycling program. Staff disposed of all mixed paper in designated wastepaper baskets. Municipal crews collected the paper and paid Newman and Company, a paperboard manufacturer, approximately \$13 per ton to process the paper. In February 1991, Waste Management Inc. was awarded a contract to process separated high-grade paper (and remaining mixed waste) from the seven municipal office buildings.

The Philadelphia Procurement Department's Disposal Unit salvages and reuses numerous items from other City departments, including typewriters, 55-gallon drums, and copiers. Approximately 60 percent of the Disposal Unit's workload involves re-issue of used equipment. The Department also recycles items such as light poles involved in auto accidents, street signs, and fire department ladders.

In fall 1990, 25 public schools participated in a 1-year pilot recycling project. The Streets Department talked with school principals and maintenance personnel about collection procedure. Waste was separated into two fractions: classroom waste (primarily paper) and lunchroom waste. Lunchroom waste, which was not solely food waste, was disposed; however, the contents of the classroom bins were highly contaminated and most materials collected were unusable. This program was ended and the City is planning another school program slated to begin in November 1991. (See "Future Solid Waste Management Plans.")

Private Sector Curbside/Alley Recycling

Legislative Requirements:	State Act 101 requires that all commercial and institutional establishments and all apartments not served by the City implement recycling programs by September 1990. Such entities are required to recycle a minimum of high-grade office paper, corrugated cardboard, aluminum cans, and leaves.
Service Provider:	Approximately 76 private haulers based in Philadelphia and numerous haulers from outside the City
Number Served:	Not available
Sectors Served:	Commercial, institutional, and industrial establishments including office buildings, retail stores, restaurants, bars, universities, and hospitals; apartment buildings with more than six units
Materials Collected:	Private haulers and recyclers collect materials mandated by State Act 101—high-grade office paper, corrugated cardboard, aluminum cans, and leaves—as well as other materials, including mixed paper, ferrous cans, HDPE and PET food and beverage containers, food waste, yard waste other than leaves, wood waste, construction and demolition debris, and tires.
Pick-up Frequency:	Varies
Set-out and Collection Method:	Depending on the hauler selected, commercial customers either segregate recyclables by material or set out commingled recyclables. Private haulers collect recyclables in a variety of containers, including buckets, cans, hampers, dumpsters, and roll-offs. They load materials in a variety of vehicles, including compactor trucks and specialized recycling vehicles.
Incentives/Enforcement:	Although recycling is mandatory in Philadelphia, it is not enforced.
Annual Tonnage:	Not available

Many commercial and institutional establishments have implemented in-house recycling programs. Below one program at a hospital is detailed.

Hospital Recycling Collection Programs

Several Philadelphia hospitals have established recycling programs to reduce the large volume of waste typically generated at these institutions. The Hospital of the University of Pennsylvania established its recycling program in 1988. Michael Smith, Manager of Environmental Services, estimates that corrugated cardboard recycling alone has decreased the volume of the hospital's disposed waste by 20 percent. Thirty-five departments, including the pharmacy, nursery, and laboratories, participate in the program under the supervision of an area coordinator. The hospital recycles corrugated cardboard, office and computer paper, clear glass, and aluminum cans. Janitors wheel full bins (mail carts) of materials to central storage rooms in the hospital's basement. Corrugated cardboard is brought directly to a compactor at the loading dock area, where haulers pick it up three times per week. The hospital contracts with three haulers to take the recyclables to vendors, who pay the hospital only for its high-grade office paper. Because haulers are typically apprehensive about receiving contaminated loads, the hospital must be extremely careful to keep all

other-hospital wastes out of the recyclables. In August 1991, the hospital will add ferrous cans, polystyrene, polypropylene, PET, and HDPE plastic containers to its recycling program. Jefferson Hospital, which also has an extensive recycling program, has purchased specialized recycling containers.

Drop-off Centers

Number and Type:	32. The City operates two municipal drop-off sites. Philadelphia community groups operate four drop-off sites, of which three are buy-back centers. Twenty-six private recyclers accept or buy recyclables. In 1990 PRO purchased 60 igloos, and an additional 40 were donated, to collect materials at sites throughout the city. Four igloos are placed at each site for collection of clear, green, and brown glass, and aluminum cans. The igloos were initially set up at six sites throughout the Philadelphia Park System; however, two of the sites have been closed due to Fairmount Park opposition. In 1991 the City set up 11 igloo sites at fire stations and 3 sites at City transfer stations.
Public or Private:	Public and private
Sectors Served:	Community group and municipal drop-off sites service residents who do not receive municipal curbside collection. Private recyclers service both the residential and the commercial/institutional sectors.
Materials Accepted:	<p>Newspaper, glass, and aluminum cans are accepted at the two municipal sites. At 11 drop-off sites, community recycling groups collect primarily newspaper, glass, and aluminum cans. Some community recycling groups also accept corrugated cardboard, high-grade paper, computer paper, magazines, and thrift store items. Three groups collect only aluminum cans.</p> <p>In addition to these materials, private recyclers collect nonferrous and ferrous metals, lead-acid batteries, tires, yard waste, and construction and demolition debris such as concrete, wood pallets, asphalt, and brick. Pep Boys and other service stations accept motor oil.</p>
Annual Tonnage:	1,118 tons were collected through the two City drop-off sites and seven of the City-assisted community drop-off programs in fiscal year 1990. This tonnage includes recyclables collected from the block corner programs.

Processing and Marketing of Recyclables

The Streets Department delivers approximately 40 tons per day of newspaper and commingled recyclables from municipal collection to two privately owned and operated regional facilities that also serve curbside programs outside of Philadelphia: the Philadelphia Transfer and Recycling Center (PTRC) and The Forge. Collection crews delivered 9,859 tons to the PTRC and 9,632 tons to The Forge in fiscal year 1990. Both are subsidiaries of Waste Management Inc. In 1989 Philadelphia received \$5.08 per ton from The Forge for recyclables (\$2 per ton in 1991), and paid \$30 per ton for materials brought to the PTRC (\$20 per ton in 1991).

The Forge and the PTRC each have a capacity to process 100 tons per day, and currently process approximately 75 tons per day. Thirty-five employees work at each facility. Up until 1991 The Forge,

which collects recyclables from the northeast section of Philadelphia, delivered its recyclables to the PTRC. Currently The Forge processes recyclables collected through the City's program and by private haulers. Both processing centers utilize a similar processing system. At the PTRC, which began operations in July 1989, all glass is passed through a vibrating screen; broken glass drops out and is sold as mixed glass cullet. Pickers remove green and amber glass; clear glass remains on the main conveyor belt. Magnets pull ferrous metals out from the aluminum cans. Newspaper is baled. HDPE and PET plastics are baled together. Approximately 13 percent by weight of curbside materials brought to the PTRC are landfilled as residue. The Forge, which operated as a transfer station in 1985, began to process corrugated cardboard and newspaper in 1986. In 1991 The Forge began processing commingled glass, plastic, and cans collected through residential curbside programs.

Some of the recyclable materials is shipped overseas, while some is sold to local markets. The PTRC exports some of its baled newspaper to Europe and the Far East and sells some directly to local paper mills. In 1989 the mixed paper collected from municipal offices was processed into paperboard by a local manufacturer, Newman and Company. Plastics are sold to Dupont and further processed at the Plastics Recycling Alliance, a joint Dupont and WMI venture located in Philadelphia.

Recyclables collected through the municipal drop-off sites and the City-assisted community and block corner programs are processed and marketed by National Temple Recycling, Container Corporation of America, Philadelphia Recycling Inc., and NAPA Recycling. The Highway Department recycles asphalt from City sidewalks and streets for new road construction. Whole tires collected through the municipal program are recycled by Domino Salvage into crumb rubber to be used for road aggregate and as a bulking agent for compost processing. The City pays Domino \$60 per ton to take the crumb rubber. Manzi Metals pays the Streets Department for white goods collected through the municipal program. Appliances are disassembled, bundled, and sent overseas or to local markets.

Most private construction and demolition debris is processed at two facilities inside the City and by ten similar businesses outside the City. One large Philadelphia recycler, Winzinger Recycling, began to recycle construction and demolition debris in 1985. The company processes and sells yard waste, wood waste, concrete, asphalt, and brick as recycled construction and landscaping materials.

Market Development Initiatives/Procurement

Philadelphia's mandatory recycling law has helped to attract new businesses to the area and to expand existing businesses. Companies taking advantage of the supply of secondary materials include recycling brokers such as Paper Recycling, Inc., a plastics processing company, Plastics Recycling Alliance, and a manufacturer of plastic lumber, Rivinite Corp.

The Philadelphia Recycling Office is working with the Philadelphia Industrial Development Corporation (PIDC), community activists, and recycling entrepreneurs to stimulate economic development through recycling. At least 35 recycling companies have started up or expanded operations in the Greater Philadelphia area since 1986. PRO estimates that approximately 350 people in Philadelphia were employed by private recycling companies in 1991.

One PRO staff member works on local market development and researches new export markets for local brokers. PRO is currently assembling a data base of information for use by Philadelphia industries. The office plans to create an industrial waste exchange program and an educational program on secondary materials substitution.

Philadelphia's recycling ordinance requires municipal procurement of products containing recycled materials. The City allows a 10 percent price preference for recycled products. This change has enabled manufacturers and distributors of recycled content office paper to compete in the bid process.

Composting Activities

During 2 months of the year, the Philadelphia Streets Department assigns Sanitation Division crew members to pick up leaves from the four residential areas with the heaviest leaf concentrations. Nine of the 13 districts serviced by the City receive some yard waste collection. Collection crews spend approximately 2 weeks in each district. To ensure that residents rake their leaves to the curb, the City advertises leaf collection schedules in the local papers and informs citizen groups of leaf collection days.

Backyard Composting

In 1991 PRO received a \$90,000 grant from the Pennsylvania Department of Environmental Resources to fund a master composting program. The program, conducted by the Pennsylvania State Cooperative Extension Service, will train a total of 75 master composters to teach backyard composting techniques to residents. The first class of 15 master composters graduated in April 1991. The City also plans to establish several permanent demonstration sites in the City, but does not have plans to give out bins.

Curbside Collection

Start-up Date:	1978 for leaves (1985 for Christmas trees)
Service Provider:	Philadelphia Streets Department-Sanitation Division
Households Served:	Philadelphia collects leaves in the four residential neighborhoods (45,000 households) considered to have the highest tree density in the City.
Materials Collected:	Leaves and Christmas trees
Mandatory:	Recovery of leaves is mandatory, as stated in Pennsylvania Act 101; recovery of Christmas trees is voluntary.
Set-out Method:	Residents rake loose leaves to the curb.
Collection Vehicles and Method:	City crews ranging from three to five persons collect leaves by one of two methods. In the first method, crews sweep leaves together with mechanical brooms, vacuum them into hoppers, and dump them into a pile at curbside. Leaves are loaded into a 20-cubic-yard compactor truck with a front-end loader. The second method employs leaf loaders to vacuum up leaves and blow them into a 65-cubic-yard trailer pulled by a tractor. Christmas trees are collected in open trucks.
Collection Frequency:	Leaves are collected at least once from each of the four neighborhoods during the November through December collection period.
Economic Incentives:	None
Annual Tonnage:	1,571 in FY 1990 (1,006 tons of leaves and 565 tons of Christmas trees)

Composting Site

Municipal crews bring leaves collected from residential neighborhoods to the Fairmount Park Compost Site. The leaves are combined with manure from the Philadelphia Zoo and the City's police horses. (Landscapers' waste was accepted at the site until July 1989. At that time, construction to expand the site began, and the new site did not have space for landscapers' materials.) Manure and yard waste are first stored separately because the 200-by-200-yard concrete composting pad cannot accommodate all the materials at one time. As space on the pad becomes available, operators add leaves and manure to form new windrows. Compost is turned once a week, and the process is complete in approximately 4 months. Finished compost is tested approximately once a year for heavy metals. City residents and private landscapers may take finished compost free of charge. Park crews also deliver compost to public and community gardens, Philadelphia prisons, and private contractors. None of the yard waste delivered is rejected as noncompostable.

The Streets Department is funding an expansion of the Fairmount Park Compost Site to accommodate residential leaves collected through the curbside program. The Department completed the first phase of these site improvements in October 1990. The pad was doubled in size, regraded, and blacktopped. Eight large irrigation guns were purchased to shoot streams of water into the compost windrows. In 1991 PRO allocated \$370,125 to purchase composting equipment, including a new front-end loader and windrow turner.

From 1986 through 1989, City crews brought Christmas trees to the Fairmount Park Compost Site for chipping. By 1990 the City could no longer afford to operate and maintain equipment and to pay its staff overtime, so it contracted Waste Management Inc. to chip the trees at the Tulleytown or GROWS landfill.

Amount and Breakdown of Materials Recovered

Material	MSW Public Sector (Tons, 89-90)	MSW Private Sector (Tons, 89-90)	Other (Tons, 89-90)	Total (Tons, 89-90)
Newspaper	11,400	130	-	11,530
Corrugated Cardboard	0	155,000	-	155,000
High-grade Paper	861	19,800	-	20,661
Glass*	5,126	NA	-	5,126
HDPE & PET Plastic*	561	NA	-	561
Aluminum Cans*	240	NA	-	240
Ferrous Cans*	1,041	NA	-	1,041
Commingled Materials†	1,118	130	-	1,248
Appliances/White Goods	2,402	NA	-	2,402
Other Metal	NA	4,650	-	4,650
Food Waste	30,000	NA	-	30,000
Tires	3,534	2,249	-	5,783
Motor Oil‡	NA	NA	-	NA
Subtotal MSW Recycled	56,283	181,959	-	238,242
Leaves	1,006	NA	-	1,006
Christmas Trees	565	NA	-	565
Subtotal MSW Composted§	1,571	NA	-	1,571
Total MSW Recovered	57,854	181,959	-	239,813
Asphalt	-	-	1,188	1,188
Other**	-	-	17,900	17,900
Total C&D Recycled	-	-	19,088	19,088
Wood Waste	-	-	4,500	4,500
Total C&D Composted	-	-	4,500	4,500
Total C&D Recovered	-	-	23,588	23,588
Total Materials Recycled	56,283	181,959	19,088	257,330
Total Materials Composted	1,571	0	4,500	6,071
Total Materials Recovered	57,854	181,959	23,588	263,401

Notes: Tonnage figures provided above are marketed tonnages for fiscal year 1990 (July 1989 to June 1990).

Some recyclables are self-hauled to private drop-off sites or scrap yards. This tonnage is not available from the City and is not included above.

*Publicly collected glass, plastic, aluminum cans, and ferrous cans are collected and weighed commingled. Listed tonnage breakdowns were estimated by the PTRC in April 1990. Tonnages for public sector programs do not add up to total due to rounding.

†Public sector commingled materials include newspaper, glass, aluminum cans, and high-grade paper generated through the public drop-off centers, the block corner programs, and the City-assisted community drop-off programs. Private sector commingled materials include glass, ferrous and aluminum cans, and PET and HDPE plastics. A breakdown of these materials is not available.

‡Motor oil is collected throughout the City; however, tonnages are not available.

§Leaves are not weighed. Tonnage figures are estimated by the City, based on the total number of trucks delivering leaves to the composting site.

**Other C&D includes asphalt, concrete, brick, and cinder blocks.

Publicity and Education

Residential

Philadelphia's population is extremely diverse both culturally and economically. Forty percent of residents are functionally illiterate or do not read English. The Philadelphia Recycling Office utilizes a variety of techniques to inform City residents of recycling requirements and programs. PRO's newsletter (*PRO file*) announces program events, highlighting changes in the recycling and composting programs. PRO prints educational materials, including a listing of recycling opportunities for single-family and multi-unit residences not serviced with municipal curbside collection. Through newspaper ads, billboards, public service announcements, presentations, and utility bill inserts, PRO spreads its recycling message. PRO circulars placed in residents' recycling buckets use graphics and pictures to explain recycling requirements. Recycling vehicles are painted red to stand out from the standard yellow trash trucks.

Commercial/Institutional

The Philadelphia Recycling Office is currently offering publications and technical assistance to help businesses develop recycling programs. (The commercial sector generates an estimated 60 percent of the City's municipal waste stream.) PRO compiled a Commercial Recycling Quick Reference that lists recycling buy-back centers, drop-off centers, and haulers. In addition, it has published three guides for commercial and institutional establishments on how to set up recycling programs. Two of the guides are geared toward commercial businesses; the other is written for managers of apartments and condominium buildings.

PRO has organized a number of business-specific informational exchanges to promote recycling. The Greater Philadelphia Chamber of Commerce set up a meeting of PRO staff with Center City business representatives to encourage recycling efforts in retail establishments. PRO also sponsored a hospital recycling roundtable at which nearly all of Philadelphia's hospitals were represented.

Working with the Philadelphia Industrial Development Corporation, community activists, and local recycling entrepreneurs, PRO is helping to establish local recycling processing and buy-back centers in economically depressed parts of the City. Together with the Waste Recyclers Organization, an umbrella organization of private recyclers in Philadelphia, PRO has organized workshops for recycling companies on financing opportunities and preparation of bid proposals for City recycling contracts.

Economics

Costs Cover:

The Recycling Office does not have its own budget and is funded through the general fund. Listed costs include capital and operating and maintenance (O&M) costs for recycling collection from 159,245 households in residential buildings with six units or fewer (18,368 tons). Listed costs to process recyclables delivered to the PTRC and The Forge, and contract fees paid to hog farmers for the collection of 30,000 tons of food waste are also included. Some composting costs are included under O&M costs but the public collection of residential white goods (2,402 tons), tires (3,534 tons), the municipal paper program (861 tons), collection of 1,006 tons of leaves and 565 tons of Christmas trees are not available.

Capital costs for processing recyclables are unavailable, since these activities occur in the private sector. Capital costs for public leaf collection are also unavailable. The Streets Department has a large fleet of equipment used for various Streets Department activities, and vehicles are not designated specifically for yard waste collection. The equipment listed below for leaf collection represents the type and number of vehicles needed for this collection. Compost processing equipment was procured through the Procurement Department, and some purchase prices are not available.

Capital Costs: Collection

Item	Cost	Use	Year Incurred
21 32-cubic-yard Lodal Trucks @ \$30,500	\$640,500	Recycling	1989
80,366 6-gallon Buckets @ \$3.57	286,907	Recycling	1989
13 23-cubic-yard Eager Beaver Trucks @ \$16,610	215,930	Recycling	1990
7 15-cubic-yard Trucks @ \$15,714	110,000	Recycling	1990
40-cubic-yard Tractor Trailer	80,000	Recycling	1990
60 Igloos @ \$800	48,000	Recycling	1990
98,621 6-gallon buckets @ \$3.78	372,787	Recycling	1990
2 Vacuum Leaf Loaders	12,000	Composting	1982
6 Tractors and Trailers*	NA	Composting	NA
2 Large Loaders*	NA	Composting	NA
10 Mechanical Brooms*	NA	Composting	NA
20-cubic-yard Compactor*	NA	Composting	NA

Note: City equipment was purchased through the leasing authority (a City government department). The City sold bonds at 8 to 9 percent interest to pay for the equipment.

*The Streets Department has a large fleet of equipment used for various Streets Department activities; it assigns the equipment listed above on a daily basis for leaf collection. Vehicles are not designated specifically for yard waste collection.

Capital Costs: Processing

Item	Cost	Use	Year Incurred
Fiat Front-end Loaders*	NA	Composting	1976
Cobey Windrow Composter*	NA	Composting	1978

*Compost processing equipment was procured through the Procurement Department. Purchase prices are not available.

Annual and Per Ton Operating and Maintenance Costs (FY 1990)

	Cost	Tons Covered	Per Ton Cost
Recycling Subtotal*	\$6,114,510	*	\$158
Collection	\$5,181,439	48,368	\$107
Municipal Curbside Collection†	3,177,800	18,368	173
Food Waste Collection and Processing‡	2,003,639	30,000	67
Processing§	154,121	18,368	8
Administration**	670,950	18,368	37
Education/Publicity	108,000	18,368	6
Composting Subtotal	NA	1,006	NA
Collection	NA	1,006	NA
Processing††	\$90,000	1,006	\$89
Administration	10,000	1,006	10
Education/Publicity	0	1,006	0

Notes: Total costs for recycling and composting are not available. O&M costs listed above represent only a portion of the City's program expenses.

* Some administrative costs incurred by the Streets Department are excluded. The per ton recycling cost of \$158 is calculated by adding per ton collection costs to per ton costs of processing, administration, and education/publicity.

†FY 1990 labor costs for curbside recycling collection totalled \$2,977,158 including benefits. Collection crew members earn \$9.50 per hour. By July 1991 the curbside recycling cost decreased to \$168 per ton.

‡Philadelphia reimburses hog farmers \$66.78 per ton to collect food waste from City residents. The City estimates that it recovered approximately 30,000 tons in 1990.

§Contract fee paid to WMI for processing recyclables at the PTRC (based on \$30 per ton fee) and at The Forge (the City received \$5.08 per ton).

**Recycling Office administrative costs given above cover the curbside recycling program alone. Of these costs, \$472,500 was spent in wages; an additional 42 percent of this (\$198,450) was paid in fringe benefits. The Streets Department administrative expenses are not included.

††Approximate salary of three employees at Fairmount Park Composting Site. (This figure excludes fuel and other maintenance costs for composting.)

In December 1990, PRO compiled a list of recommendations to the Streets Department on reducing recycling operating and maintenance costs and increasing productivity. The Philadelphia Recycling Office suggested that the Streets Department (1) have City collection crews leave the sanitation yard one-half hour earlier each morning, (2) establish collection standards for recycling vehicle based on the volume capacity of the vehicle, (3) replace compactor trucks with recycling vehicles,

and (4) increase participation in the northwest area of the City, which has been identified as having a low participation rate. In November 1991, PRO released a second report evaluating the City's options for expanding residential recycling services. These include expanding the efficiency of the current system, and adopting a co-collection program.

Materials Revenues:	\$36,051 in fiscal 1990 from materials processed at The Forge. Compost materials are not sold.
Source of Funding:	Funds are appropriated from City taxes (via the Managing Director's office budget) and State grants.
Full-time Employees:	115 (Approximately 100 City employees collect recyclables at curbside; 3 people work at the Fairmount Park Composting Site; and 12 people work at the Philadelphia Recycling Office.)
Part-time Employees:	27 (assigned full-time to leaf collection from November through December)

Future Solid Waste Management Plans

Due to its budget crisis, the City has curtailed plans to expand Philadelphia's recycling and composting programs to cover the remaining two-thirds of its single to six family residences that currently do not receive curbside service. Based on the fact that the cost of recycling has come within the range of trash collection, the City plans to expand curbside service to one additional neighborhood in Spring 1992. In an effort to keep costs down, the Sanitation Department will switch three refuse crews servicing this neighborhood to recycling collection. Although the first phase of the Fairmount Park Compost Site improvement project has been completed, the second phase has been put on hold. The total cost, estimated at \$2,100,000, was to be funded through State grants and appropriations from the City budget. The project included plans to establish an on-site recycling center, improve the access road, and construct a building for the truck scale.

In November 1991, the City implemented a district-wide school recycling program in 276 administration and school buildings. Funding for the program is provided through Energy Conservation, a School District program. Aluminum cans, newspaper, high-grade and mixed paper (including magazines and note pads), and corrugated cardboard are collected in containers provided by each school. Students and staff place aluminum cans in bins located in lounges and cafeterias; cardboard is collected in shipping and receiving areas; and paper is collected in labelled wastebaskets in each classroom and office. Training sessions were provided to maintenance staff and handouts were sent to all students and administrative staff. BFI, under contract, collects recyclables and provides each building with a dumpster ranging in size from 2 to 8 cubic yards. Workers deliver the recyclables to BFI's processing center in King of Prussia, PA. BFI charges each school between \$25 and \$35 for collection and processing. If the market for a recyclable material increases above a designated figure, schools will receive a rebate from BFI, credited towards their next bill. In addition, Energy Conservation will distribute its surplus funds to the schools, based on tonnages recovered through each school.

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Portland, Oregon

Demographics

Jurisdiction:	City of Portland
Population:	440,000 in 1990
Area:	138 square miles
Total Households:	201,900 in 1989 (154,117 in one- to four-family homes, and 47,783 in buildings with five or more units)
Total Businesses and Institutions:	569 institutions in the City, 50,325 businesses in the five-county area
Brief Description:	<p>The Portland metropolitan area is comprised of five separate counties, one of which is located in Washington State. Manufacturing is one of the largest sectors of the economy, with more than 3,300 manufacturing companies in the Portland area. Portland is a growing high technology center, and its port handles the largest volume of exports of any on the West Coast. Large employers include the retailer Fred Meyer, Inc., Legacy Health Systems (a nonprofit health care provider), Oregon Health Services University, and Tektronix, Inc. Lumber and wood product manufacturing is also a major industry. There are numerous parks in Portland and many nearby opportunities for outdoor recreation; the City has been recognized by national magazines as having an especially high quality of life. The City's 1989 median disposable household income was \$23,238, and per capita income in the Portland metropolitan area was \$16,446 in 1989.</p>

Solid Waste Generation and Recovery

Annual Tonnages (1990)*			
	Residential	Commercial/ Institutional	Total MSW
Recovered	NA	NA	199,749
Recycled†	NA	NA	180,695
Composted	NA	NA	19,054
Disposed	NA	NA	412,945
Incinerated	NA	NA	0
Landfilled	NA	NA	412,945
Generated	NA	NA	612,694

Percent by Weight Recovered			
	Residential	Commercial/ Institutional	Total MSW
Recovered	NA	NA	33%
Recycled	NA	NA	29%
Composted	NA	NA	3%

Note: Due to rounding, numbers may not appear to add to total.

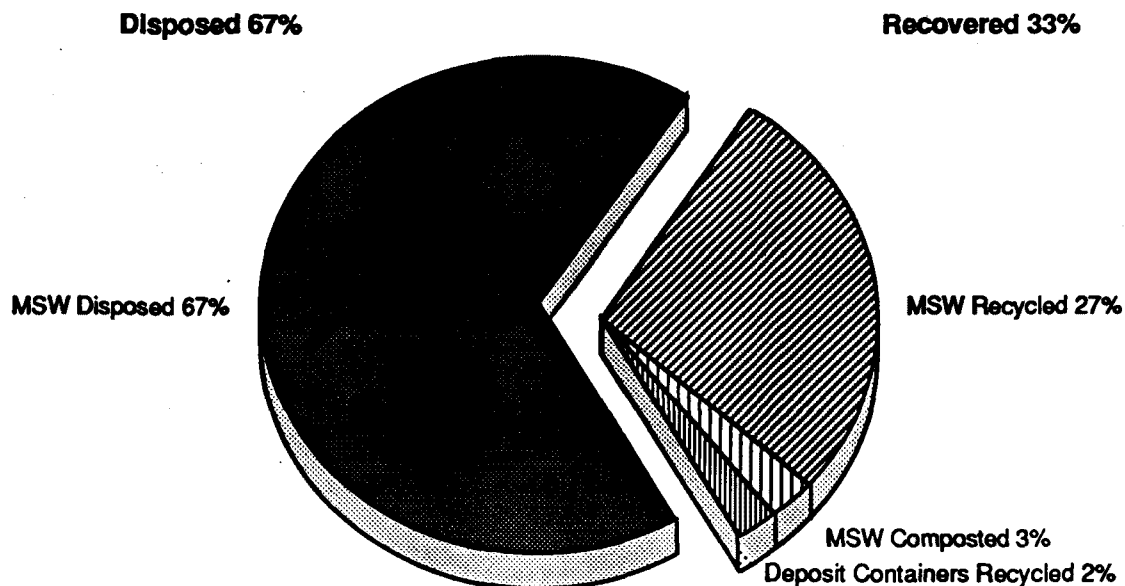
*Tonnages for the City of Portland listed above were calculated by the City Recycling Office based on per capita averages for the Metro region. Metro does not track MSW separately as residential and commercial/institutional material, nor does it track C&D waste generated or recovered. MSW includes bulky items such as white goods and wooden pallets but excludes tires and construction debris. Of all the construction and demolition debris generated in the City of Portland in 1990, 19,468 tons were disposed. A small amount of construction debris generated in 1990 was recovered, but this tonnage was not tracked.

†Includes 13,908 tons of deposit containers.

Transfer Station Tipping Fee: \$16.70 per ton in 1987, \$47.99 per ton in 1988, \$48.35 per ton in 1989, \$56.35 per ton in 1990, and \$68.00 per ton in 1991. Self-haul customers are charged a minimum of \$15 per load; beginning in 1991, the per ton charge was \$55 for self-haul customers.

Refuse Collection and Disposal: In 1990 Portland's residential refuse was collected by 89 different private haulers. These haulers operate with minimal regulatory oversight (although they must be permitted), and no government-established rate structure. Collectively, these haulers serve 131,000 residential households—equivalent to approximately 85 percent of residences in one-to four-unit buildings, or approximately two-thirds of total households. Private haulers charge households an average of \$12 per month for weekly collection of one 32-gallon can, and approximately \$22 for set-out of two cans. This fee includes the collection cost for both refuse and recyclables. Residents in the remaining buildings with one to four units self-haul their refuse to the transfer stations or landfill. Residential curbside collection services only households in buildings up to four units. Waste from residential buildings with more than four units is considered commercial waste by the City.

Municipal Solid Waste Recovered and Disposed (Percent by Weight, 1990)



Note: Due to rounding, numbers do not add to 100%.

Refuse Collection and Disposal (cont'd):

The majority of the residential waste collected in 1990 was either brought to a local transfer station or disposed of directly at the St. John's Landfill, a general-purpose landfill inside city limits. In 1991 the landfill closed and Portland began shipping its waste to the Columbia Ridge Landfill, a large regional facility 168 miles east of Portland. A second transfer station was opened in 1991. A small amount of waste was sent to the Riverbend Landfill in McMinnville, Oregon. Construction debris is taken to the Hillsboro Landfill for disposal.

In April 1991, Portland opened the largest operating municipal solid waste (MSW) composting facility in the nation. The facility will process 600 tons per day (185,000 tons per year) of mixed waste. The tipping fee at the new facility is \$68 per ton. Portland will be delivering 148,000 tons per year—80 percent of its total feedstock—to the new facility.

Materials Recovery Overview

Goals and Legislative Requirements:

In 1983 the Oregon legislature adopted the Recycling Opportunity Act, which requires that curbside collection of recyclable materials be provided in municipalities with populations of at least 4,000. It also requires recycling depots at all disposal sites, and sets minimum recycling education and promotion requirements. The State is divided into "wastesheds," or waste generation areas. Materials required to be recycled are defined by the State for each wasteshed according to the availability of markets.

Refuse collectors in the City of Portland have been required by State and City regulations to offer their customers collection of eight different recyclable materials since 1987. Citizen participation in this recycling program is voluntary. The regional government, the Metropolitan Service District (Metro), is responsible for solid waste planning in a three-county area that includes Portland. In 1989 Metro set a waste reduction goal of 56 percent to be met by 2010. In September 1988, the State Environmental Quality Commission identified yard waste as a principal recyclable material in the Metro region and required local governments to submit a yard waste recovery plan to the State. Metro completed a regional yard waste recovery plan in January 1991. Portland haulers will be required to collect yard debris, including grass clippings, garden trimmings, and leaves as of April 1992.

In 1991 the Oregon legislature added to the existing recycling legislation with the passage of Senate Bill 66. The new law sets a 50 percent recycling goal for the State by the year 2000 and a 45 percent goal for the Portland metropolitan area by 1995. Only 5 percent of the recycling goal can be met through MSW composting in the Metro region. The bill also set minimum standards for recycling programs.

Recycling has long enjoyed public support in the City of Portland and the State of Oregon. In 1971 Oregon became the first state to adopt a container deposit system, requiring a 5-cent deposit on most carbonated beverage containers. The public returns over 90 percent of the aluminum, glass, and plastic deposit containers. Based on a State annual per capita recovery rate for deposit containers of 0.032 tons, Portland calculates that it recovered 13,908 tons of deposit containers in 1990. Oregon also became the first state to legislate recycling when it passed the 1983 Recycling Opportunity Act. Refuse collectors in the City of Portland have been required by State and City laws to offer their customers collection of eight different recyclable materials since 1987. Haulers must offer a minimum service of weekly newspaper collection and monthly curbside collection of glass containers, tin cans, corrugated cardboard, aluminum, ferrous and nonferrous metals, and used motor oil. Office paper is collected from commercial accounts. All materials are segregated by type for collection. Drop-off centers also play an important role in the recovery of materials in Portland. It is estimated that nearly 90 percent of residential materials recovered are brought to drop-off sites. Presently there are 147 recycling drop-off centers in the greater Portland metropolitan area. Most of these are single material drop-off sites; only a few sites accept a full range of materials.

Promotion is a key element of the City's recycling program, since participation in source-separation programs is currently voluntary. The City coordinates a variety of activities, including media advertising, promotional events, promotional literature, classroom programs, and presentations to citizen groups.

Portland recovered 24 percent of its 442,000 tons of waste through recycling and its container deposit system in 1987. In 1990 it generated 612,694 tons of waste, of which 33 percent was recovered through recycling, composting, and bottle bill redemptions.

Sunflower Recycling Cooperative is a model, small recycling and refuse business operating in Portland. In 1990, it collected refuse, recyclables, yard waste, and food waste from residential customers, refuse and recyclables from commercial customers, and also ran a drop-off site. Founded in the early 1970's, Sunflower serviced 1,100 households with refuse and recycling collection in 1989, and approximately 1,600 residential households by the end of 1990. Of these customers, approximately 7 percent received weekly pick up of food waste. According to Sunflower, 7 percent of its residential refuse customers receive refuse pick up only once per month, and an estimated 25 percent of residential customers who receive all services have reduced their refuse disposal to approximately 30 percent of their total waste generated.

Beginning in February 1992, Portland will restructure and standardize its residential curbside recycling program in order to increase its recycling rates. Haulers offering residential refuse service will be franchised to provide waste collection services. Previously haulers operated under a free market system and multiple haulers serviced the same neighborhoods. The City believes that the lack of uniform collection days, weekly collection, and recycling containers has hindered residents' participation in curbside recycling programs. Under the new plan, haulers will be assigned a franchised area and will be required to offer weekly curbside collection of recyclables on the same day as garbage pick-up. The City will provide two 14-gallon containers to each garbage service customer for set out of recyclable materials. Garbage collection rates under the new system will be regulated. The City will fund administration, education, and promotion of its recycling program by charging haulers a 5 percent franchise fee on gross revenue earned from residential refuse fees. The new residential recycling program will cost the City an estimated \$1.1 million with an additional \$450,000 to purchase recycling containers. In addition to the eight recyclable materials they must pick up currently, haulers will also be required to collect HDPE milk jugs and magazines. Haulers will be required to offer a special rate for a "mini-can" and other variable refuse can rates. Under the new system, however, haulers with fewer than 3,000 customers will be required to offer curbside collection of recyclable materials by entering into a cooperative venture with other small haulers. As a result, some smaller recycling/refuse haulers will provide collection of garbage only, while recycling service is provided by the cooperative. Prior to 1989, 113 different private haulers collected refuse and recyclables from Portland's households. Due a large number of mergers and sales, 89 haulers serviced Portland in 1990, and by February 1992, this number will decline to 69.

In January 1989 the City passed Ordinance 161573, which bans certain polystyrene foam containers and establishes a public/private task force to reduce disposable plastic products in landfills and incinerators.

The Metropolitan Services District has recently completed construction of a large-scale municipal solid waste composting facility located in Portland, which is designed to handle 600 tons per day, or 185,000 tons per year. The facility began accepting material in April 1991. A "put or pay" provision obligates Metro to deliver (or pay for) a minimum of 185,000 tons per year (maximum 800 tons per day) of municipal solid waste to the facility. Metro estimates that this is approximately 50 percent of the residential waste generated in the area.

The program described in the following case study, by and large, represents recycling activities in the base year 1990. References to program changes in 1991 are interspersed in certain sections of the report. The final section, Future Solid Waste Management Plans, further details future changes to Portland's recycling and composting program.

Recycling Activities

Residential Curbside Recycling

Start-up Date:	June 1987 for citywide programs. (Some individual hauler-operated programs began before this time.)
Service Provider:	89 private waste haulers in 1990
Pick-up Frequency:	Weekly for newspaper and at least once a month for other recyclables
Same Day as Refuse:	Varies
Households Served:	131,000 (in one- to four-unit buildings)
Mandatory:	Haulers must provide service, but participation by residents is voluntary.
Participation Rate:	33 percent in 1990 (based on a weighted average from weekly and monthly programs and excluding those who set out only newspaper). Participation in weekly collection programs averaged 57 percent, while participation in the monthly collection program was 23 percent.
Materials Collected:	Newspaper, glass containers, tin cans, corrugated cardboard, aluminium, ferrous metal, other scrap metal, and used motor oil are required to be collected. Some haulers, voluntarily collect other materials, such as HDPE milk jugs or mixed waste paper.
Set-out Method:	All haulers request that materials be separated by material type in paper bags or other re-usable containers. Glass must be color-sorted. Tin cans are placed in one container, aluminum in another. Newspaper is bundled. Plastic milk jugs are placed in one container. Some haulers offer their customers 14-gallon recycling containers.
Collection Method and Vehicles:	Haulers use a variety of compartmentalized recycling vehicles. These include state-of-the-art compartmentalized vehicles, compartmentalized trailers pulled behind pick-up trucks, and retrofitted vehicles, as well as side boxes and bumper boxes on garbage trucks. Sunflower Recycling Cooperative, for example, paid \$10,000 to retrofit a step van with 11 compartments or bins that are easily emptied with a forklift. Some haulers have on-board plastic compactors. An average of two crew members operate vehicles.
Economic Incentives:	No discounts are offered to residents who recycle. Residents can reduce the cost of refuse disposal through recycling by down-sizing their refuse containers or reducing pick-up frequency.
Enforcement:	Penalties are issued to haulers for various infractions, including failure to provide collection services to residential customers, failure to submit the required monthly report to the City, failure to respond to consumers' inquiries regarding recycling, or mixing separated recyclables with refuse. At least six fines ranging from \$300 to \$900 have been issued for noncompliance.
Annual Tonnage:	An estimated 15,083 tons in 1990, excluding cardboard and scrap metal (and 39,000 gallons of motor oil, which were burned)

Multi-unit Collection

The City of Portland runs a multi-unit recycling program through Portland State University (PSU). The City provides technical assistance and supplies containers, such as 90-gallon roll carts, which PSU delivers to multi-unit buildings (including several high-rises). PSU is paid by the City for its services. As of June 1991, 330 buildings had been supplied with recycling systems. While buildings do not have to pay for containers, they pay for the pick-up of recyclables by private haulers through their refuse/recycling bills. Buildings have established different systems compatible with haulers' collection programs. Materials are collected and marketed by the hauler of the building's choice. Many buildings have set up recycling depots in parking lots. Materials are segregated by type; glass is sorted by color. In some buildings, residents are supplied with individual recycling bins and instructed to bring materials to the curbside. The City has budgeted \$162,000 for fiscal year 1992 to set up recycling systems at 170 sites (buildings), which is equivalent to 6,000 apartment units.

Commercial & Institutional Curbside/Alley Recycling

Legislative Requirements:	The Oregon Recycling Opportunity Act requires that waste haulers offer collection of scrap metal, tin cans, glass, newspaper, corrugated cardboard, and high-grade office paper to commercial establishments in Portland. The participation of businesses and institutions in this program is voluntary.
Service Provider:	All City-permitted waste haulers. Independent recyclers such as Weyerhaeuser, Far West Fibers, and K.B. Recycling will also pick up recyclable materials such as corrugated cardboard from large quantity commercial generators.
Number Served:	Not available
Type Served:	All businesses and institutions, including offices, retail establishments, grocery stores, restaurants, printing shops, municipal offices, and schools
Materials Collected:	Materials for which haulers are required to offer pick-up are high-grade paper, newspaper, corrugated cardboard, glass containers, tin cans, and scrap metal. Some haulers also collect mixed paper and PET and HDPE plastic.
Pick-up Frequency:	Varies
Set-out and Collection Method:	Recyclables are segregated by material type and set out in separate containers. A variety of vehicles is utilized for the collection of materials.
Incentives:	Some haulers pay their customers for material. The cost of recycling and refuse service may not exceed refuse service alone, according to State law. Some large businesses such as Fred Meyer and Tektronix have saved money through recycling by reducing their refuse collection fees, which are generally based on per container and per pick-up fees.
Enforcement:	While haulers are required by law to offer recyclable collection service to their customers, many do not inform their customers of this option, and there is currently little enforcement of the law.
Annual Tonnage:	Not available

CiIn 1990 the Metropolitan Service District (Metro) stepped up its efforts to develop commercial recycling programs. It conducted a promotional campaign for office paper recycling, "Paper Train Your Staff," and distributed starter kits to Portland area businesses. The kits include handbooks and labeled desk-top recycling boxes. Metro also refers companies to haulers that pick up office paper, and provides a commercial waste audit program. Metro reports that recycling of printing, writing, and other paper, including magazines, has increased from 23 percent in 1989 to 49 percent in 1990. Metro believes that some of this increase may be due to the "Paper Train Your Staff" Program.

Most major businesses collect corrugated cardboard for recycling. Fred Meyer, Inc., a major retailer in the City, has implemented a recycling program that recovers all office paper as well as a shelf labeling program that identifies products made from recycled materials. Some large businesses send select loads of commercial waste to Waste Tech, located in the Metro region, where cardboard, plastic, and office paper are separated out and processed.

Drop-off Centers

Number and Type:	147 (including 30 scrap dealers) in a three-county area
Public or Private:	Private, except for the recycling/yard waste depots at the two transfer stations, which are owned by Metro. The operation of these facilities is contracted out to the private sector.
Sectors Served:	Residential and commercial/institutional
Materials Accepted:	Newspaper, high-grade paper, corrugated cardboard, magazines, other waste paper, glass, aluminum, tin cans, scrap metal, motor oil, HDPE, PP, and PS plastics, wine bottles and canning jars (for reuse)
Annual Tonnage:	Not available. (90 percent of all recyclable and compostable materials collected from the residential sector in Portland are recovered through drop-off sites.) In 1989, 2,420 tons of material were collected through four drop-off sites operated by the Portland Recycling Team.

Drop-off sites established in the early 1970's provided Portland residents their first recycling opportunities. Three different organizations—Portland Recycling Team, Sunflower Recycling Cooperative, and Cloudburst—set up the first drop-off sites in 1970-71, with Portland Recycling Team implementing the first of these. Currently, both City transfer stations serve as drop-off sites for recyclables. At one transfer, residents drive up to refuse pits, unload their refuse, and place recyclable materials into shopping carts or bins. Metro-contracted employees wheel recyclables to a storage area. In the second transfer station, residents tip refuse onto the ground and employees remove quantities of recyclable materials. For example, large volumes of paper are removed from commercial refuse and sorted on a paper line located on the premises. Household hazardous materials are also removed.

Processing and Marketing of Recyclables

Recyclable materials collected at curbside are either marketed by haulers with minimal processing or taken to one of two privately owned processing facilities in the Portland area. According to a Solid Waste Planner at Metro, approximately 50 percent of all materials collected from the residential curbside program and 25 percent of those collected from businesses are brought to the K.B. Recycling or Waste Tech facilities (also known as the Oregon Processing Recovery Center). The majority of these materials are brought to K.B. (In 1991 all materials collected at curbside by Portland Recycling Refuse

Operators [PRROS, a large consortium of recyclers in Portland], were brought to K.B.) Most materials taken to these processing facilities are already segregated by material type; the facilities will accept limited loads of partially commingled material, such as newspaper mixed with corrugated cardboard, or tin mixed with aluminum.

K.B. Recycling runs two different facilities, one in Canby and one in Milwaukee. Portland's haulers bring materials to the facility in Milwaukee, 4 miles from the city limits of Portland. K.B. pays for all materials it accepts, excluding mixed paper. While most recyclable material is delivered to the facility by private haulers, residents and businesses also drop off materials, and K.B. will pick up material from large volume generators, such as businesses and schools. The 18,000-square-foot facility, which opened in 1987, employs 20 people and operates 6 days a week, processing 167 tons per day of newspaper, corrugated cardboard, high-grade paper, mixed paper (including telephone books), glass, tin and aluminum cans, HDPE and PET plastic jugs, and aluminum, copper, and brass scrap metal. The total capital cost of the facility was approximately \$1.5 million, including start-up costs and additional site improvements and machinery purchases made through 1991. (By 1990 more than \$1 million had been spent.) K.B. Recycling uses Krause machinery manufactured in Bellingham, WA. Six conveyors, one conveyor/baler, four forklifts, and two scales are used to process materials. Eight to ten employees sort paper products, including newspaper, junk mail, corrugated cardboard, and high-grade paper, on three conveyor belts. Tin cans are separated from aluminum cans on another conveyor equipped with a magnetic head outside of the building. Plastic jugs are separated from ferrous cans on a fifth conveyor belt. Workers empty sorted glass from the recycling trucks with a rotating forklift into separate 20- or 30-cubic-yard boxes. Using a HRB-10 Harris Baler/conveyor (which cost \$450,000 in 1988), operators separately bale newspaper, corrugated cardboard, high-grade paper, tin and aluminum cans, and HDPE and PET plastics. An estimated 2 percent by weight of recyclables brought to the processing center are rejected and landfilled.

Some haulers market their own materials with minimal processing; one such example is Sunflower Recycling Cooperative. Sunflower collected an estimated 3,133 tons of recyclable (including the eight mandatory materials, mixed paper, HDPE plastic jugs, and PP and PS plastic tubs) through its residential curbside program, commercial high-grade paper collection, and drop-off center in 1990. The company processes the materials it collects at its own facility before delivering them to market. Glass cullet is hauled to Owens-Brockway, plastic is marketed at Partak in Vancouver, Washington and Envirothene in Los Angeles, California, and paper products are marketed at Smurfit Recycling, Weyerhaeuser, and EZ Recycling. Sunflower sold a small amount of refillable wine bottles, which it collected through its curbside and drop-off programs, to a bottle washer in the Metro region. This, however, was discontinued in 1991.

There are numerous brokers of recyclable materials in the metropolitan area, as well as many end use markets. End use markets include two Smurfit deinking plants near Portland, which accept newspaper and magazines; a Weyerhaeuser mill in Longview, Washington, which accepts deinked newspaper for the manufacture of new newspaper; an Owens-Illinois glass plant, which accepts container glass; three Oregon mills (Willamette Industries, Weyerhaeuser, and Georgia Pacific), which process Portland's corrugated cardboard; and a detinning facility in Seattle, which accepts tin cans. In addition, local brokers purchase plastic and nonferrous metal, and export large quantities of waste paper to Asian mills through the Port of Portland.

Market Development Initiatives/Procurement

Portland's procurement policy directs the City to purchase recycled motor oil, compost, bark dust, and retreaded tires wherever appropriate and available. The City also has a 5 percent price preference for the purchase of recycled paper products.

The State of Oregon allows a 50 percent tax credit for investment in equipment or machinery used to collect, transport, or process reclaimed plastic, or to manufacture a reclaimed plastic product. It also

allows a 50 percent investment tax credit for facilities constructed to prevent, control, or reduce pollution—including recycling facilities. Companies that process materials collected from Portland, such as Georgia-Pacific, Owens-Illinois, Smurfit Newsprint, and Willamette Industries, have benefitted from this tax credit.

Composting Activities

Portland relies primarily on drop-off programs for the collection of yard waste and other organic materials. Curbside collection service is currently limited to three private haulers that collectively picked up 3,700 cubic yards, or an estimated 411 tons, of yard waste in 1990,¹—about 3 percent of such materials recovered in the City. Of the estimated 673,100 cubic yards (approximately 74,789 tons) of loose yard waste generated per year in the City, an estimated 16 percent was recovered in 1990 through all programs.

The City Office of Transportation Maintenance Division collects residential leaves at curbside in the fall in neighborhoods with mature trees to prevent the clogging of storm drains. An estimated 2,777 tons of leaves, equivalent to 23 percent of recovered yard waste, are recovered through this collection program. Approximately 20 percent of this amount is delivered directly to homeowners who have requested leaves for use as a soil amendment. The remaining leaves are taken to a pilot composting site in Portland.

Residents can bring leaves, brush, grass clippings, and wood waste to the transfer stations, where they will be stored and eventually transported to one of two composting plants in the Portland metropolitan region: Grimms Fuel or MacFarlane's Bark. Material can also be brought directly to these two facilities. There are approximately five other composting or shredding facilities in the Metro region and many more mobile chippers.

Backyard Composting

The Metropolitan Service District (Metro) promotes home composting through its Recycling Information Center. It has established backyard composting demonstration sites in the region and offers literature on how to compost at home. At these sites Metro offers backyard composting seminars run by volunteers who have completed a master gardener course. Metro hopes to expand this program in the future, and to provide 50 households in each county with backyard composting bins. It is not known how many households in the City currently compost yard debris in their backyards.

Curbside Collection

Service Provider:	Three private haulers—Sunflower Recycling, Inc., Cloudburst Recycling, and Diane's Disposal—offered service to their refuse (and sometimes other) customers.
Start-up Date:	Sunflower began collecting food waste in 1973 and yard debris in 1987. Diane's Disposal began picking up yard waste in 1989. Cloudburst began collecting yard waste in the late 1980's.

Households Served:	Sunflower serviced approximately 200 households with curbside collection of yard waste (though not all of these households receive monthly pick-up) and an estimated 105 households with collection of food waste in 1990. Diane's Disposal reports that 20 percent of its refuse customers set out yard waste each week. Its yard waste pick-up service was discontinued in mid-1991.
Mandatory:	No
Materials Collected:	Leaves, grass clippings, brush, and Christmas trees. Sunflower also collected food waste at curbside (including bones, fat, and other food scraps), but this service was discontinued in June 1991.
Set-out Method:	In 1990 Sunflower collected loose yard debris; food waste was set out in 5-gallon buckets (old paint or soap buckets) provided to residents free of charge, which were emptied into a side bin ("slop bucket") on the truck. These bins could hold material from approximately 25 to 30 buckets. Diane's Disposal collected bagged yard debris. Residents could set out up to two bags of yard debris each week.
Collection Vehicles and Method:	In 1990 Sunflower Recycling, Inc. picked up food waste in side bins on compactor trucks which were simultaneously used to collect garbage. A compactor truck was used for the collection of yard debris.
Collection Frequency:	In 1990 Sunflower collected waste weekly, year-round, and yard waste once a month between April and November, and on call during the summer. Diane's Disposal picked up yard waste on a weekly basis year-round, on the same day as refuse collection. Cloudburst collects material on a monthly basis.
Economic Incentives:	Diane's Disposal provided free collection of limited quantities of bagged yard debris. Sunflower and Cloudburst charged for the service.
Annual Tonnages:	An estimated 411 tons of yard waste were collected at curbside in 1990. Sunflower collected approximately 126 tons (1,137 cubic yards) of this amount.

In 1990 Sunflower Recycling, Inc., serviced 1,600 households with refuse collection, up from 1,100 in 1989. Of these, 105 households, or 7 percent, signed up for food waste collection, and approximately 200 households received yard waste pick-up. Sunflower estimates that it collected 5 tons of food waste per month, which adds up to approximately 60 tons per year.

Due to changes in Portland's refuse and recycling collection system, Sunflower terminated its food and yard waste collection program in June 1991. According to Sunflower, food waste collection and composting would have been more cost-effective had the company collected a greater volume of material. Customers were charged an additional \$2 for this service, and only a small percentage of customers signed up. The company will continue to operate its drop-off site, but will no longer accept food waste.

Composting Sites

Sunflower Recycling mixes food scraps with sawdust (a ratio of 2:1) in two 7-cubic-yard cement mixers. The food waste compost could be finished in 2 to 3 weeks; however, workers tend not to turn the

material frequently, so the composting process takes 2 months on average. The company sells approximately 3 cubic yards (estimated at 2 1/4 tons)² per month, at \$10 per cubic yard.

Sunflower delivers the yard waste it collects to Grimm's and McFarlane's composting sites. The company recovered 1,137 cubic yards of yard waste in 1990 through its curbside service and drop-off programs—twice the amount it recovered in 1989.

Grimm's accepts pallets, residential yard trimmings, and stumps and woody discards from land development and construction projects. It began accepting construction debris in 1991. Tipping fees range from \$4 per cubic yard for residential yard trimmings to \$6.50 per cubic yard for loose material (\$17 to \$20 per compacted ton).

All incoming material is ground (or sheared to 3 inch by 3 inch pieces and then ground in the case of cleared trees) prior to composting. Pallets and stumps are ground separately and hauled to the Smurfit Newsprint plant in Newburg, Oregon, for use as hog fuel. Excluding pallets, Grimm's Fuel, the larger of the metropolitan area facilities, processed an estimated 17,313 tons (155,815 cubic yards) collected from the Metro area in 1990. The remaining material is composted in large piles on 2 to 3 acres of land and turned three to four times with payloaders during the 6-month composting period. Equipment includes grinders, conveyors, a trommel screen, a Clark 275 (15-cubic-yard) bucket loader, and several payloaders. Much of this equipment is used sawmill equipment adapted by Grimm in-house. Grimm's estimates that 0.5 percent of all material received is considered residue and noncompostable.

The compost end product, used by homeowners, landscapers, and nurseries, includes garden mulch mixed with steam-sterilized horse manure.

McFarlane Bark, located in Milwaukie, just southeast of Portland, accepts organic yard trimmings and residential wood waste (such as old 2 by 4's) self-hauled by residents, or brought in by landscapers or by curbside haulers from outside of Portland. A nearby juice company hauls citrus peels to the site for composting. McFarlane processed an estimated 11,089 tons (99,797 cubic yards) of Metro material. Approximately 50 percent of the 500 to 600 cubic yards (estimated at 56 to 67 tons) delivered per day to McFarlane is brought from the residential sector; the remainder is commercial and landscapers' material.

McFarlane charges a tipping fee of \$35 per ton, with a \$2 minimum. Contaminants, which are estimated to be 1 percent by weight of incoming material, are picked out and landfilled at a cost of \$68 per ton. The remaining material is ground and added to "Mt. McFarlane," a compost pile more than 100 feet high, where it remains for at least 10 months with minimal turning. Recently, odor complaints to the State Department of Environmental Quality have prompted more frequent turning. Composted material is screened prior to sale in bulk as fine, medium, or coarse compost. McFarlane will begin selling bagged compost in spring 1992.

Mixed Municipal Solid Waste (MSW) Composting

Citizen rejection of incinerators and the difficulty of siting a new landfill in the Portland area have prompted Metro to consider MSW composting as a viable solid waste management alternative. In April 1991, Metro opened a 600-ton-per-day MSW composting facility on an 18-acre site in a light industrial area well served by major transportation arteries. Riedel Environmental Technologies operates the facility, using DANO MSW composting technology. The \$24 million capital cost of the plant was publicly financed by tax-exempt revenue bonds. The plant was designed to recover recyclables and to produce a saleable compost using residential waste.

Metro's MSW composting plant was sized to accept about 50 percent of the Metro area's residential waste. A "put or pay" provision obligates Metro to deliver (or pay for) a minimum of 185,000 tons per year of MSW to the facility. The City of Portland will be delivering 80 percent, or 148,000 tons per year, of this amount. A \$68 per ton tipping fee, which is the same as the transfer station tipping fee, is

charged at the facility. Of this money, Riedel receives \$48, and Metro receives \$20, which it uses to fund public education programs, hazardous waste collection, and recycling grants.

Riedel is required to recycle at least 5 percent of the feedstock. Source-separation recycling programs and Oregon's container deposit legislation will potentially minimize the quantity of recyclables entering the waste stream. Composting takes 6 weeks to complete. Plans are to market the finished compost to landscaping firms and as a soil amendment for sod and Christmas tree farms, but only if tested compost consistently meets Metro and State Department of Environmental Quality standards. Metro specifications require that no more than 60,000 tons of material (approximately one-third of incoming tonnages) be landfilled as residue.

The start-up period has not been without problems, primarily related to odor control, household hazardous materials handling, and meeting the 5 percent recovery and marketing requirement for recyclables. Nearby residents and businesses in the industrial park filed a complaint about the odor with Oregon's DEQ. Riedel has applied bark chips to the building's floor, has planted 300 trees, and continues to work with DANO to fully address the odor problem. Few recyclables have actually been recovered and many of those that have been recovered have been unmarketable. Riedel retrained "pickers," in order to improve the removal of recyclables at the beginning of the process, and is considering adding cleaning/processing equipment to improve the marketability of its recyclables. These problems may be further mitigated by Metro's construction of a permanent household hazardous waste drop-off facility and by switching from a monthly to a weekly schedule for Portland's curbside recycling collection (anticipated February 1992).

Commercial composters of yard trimmings and of sewage sludge have expressed concerns that production from the MSW composting plant will hurt the market shares of their compost products. Some fear that Metro will "give away" its compost; others, that the marketing of substandard compost will discourage users from switching "permanently" to compost, hence retarding the overall market growth of compost as an alternative to other soil amendments. In response, Metro negotiated limitations on the sales of Riedel's compost product, including annual reviews of Riedel's marketing efforts and plans. Concerns remain, however, because several operational problems are still being worked out and the finished compost has yet to be mass marketed.

Due to persistent odor problems, in January 1992 the MSW composting facility stopped accepting garbage. The plant's operators are under State order to remedy the problem. Additionally, the plant has failed to produce a certified compost. Tests of lead content in the end product have exceeded the acceptable standard of 250 parts per million.

Amount and Breakdown of Materials Recovered

Material	Total (Tons, 1990)
Newspaper	34,148
Corrugated Cardboard	45,668
High-grade Paper	21,173
Other Paper*	19,008
Glass	1,510
PET Plastic	†
HDPE Plastic	518
Other Plastic‡	1,237
Aluminum	†
Ferrous Cans	1,142
Other Metal	39,206
Deposit Containers§	13,908
Reusables**	3,177
Subtotal MSW Recycled	180,695
Food Waste	60
Wood Waste††	6,729
Yard Waste‡‡	12,265
Subtotal MSW Composted	19,054
Total MSW Recovered	199,749
Total C&D Recovered§§	NA

Notes: Data on the tonnage of materials (except food waste) recovered were estimates derived by the City on a per capita basis from the total amount of materials recovered in the Portland metropolitan area. Tonnages recovered represent marketed material, and cannot be broken down by sector.

In 1990, 148 tons of oil and an unknown number of tires were recovered. Because these were burned as fuel, they are not included in recycled tonnages. Whole tires are banned from landfilling in the State of Oregon.

* Includes magazines and mixed paper.

† Recovered PET plastic and aluminum are listed under Deposit Containers.

‡ Consists of PS, LDPE, and other plastic.

§ Includes 11,000 tons of glass, 626 tons of PET plastic, and 2,282 tons of aluminum cans.

**Includes thrift store items.

††Consists primarily of wooden pallets.

‡‡ Includes leaves, brush, and Christmas trees.

§§ While tonnages of C&D recovered are not tracked and thus not available, the City recycling office believes that only a small amount was recovered in 1990.

Publicity and Education

Residential

The City of Portland coordinates a variety of publicity and education activities, including media advertising, distribution of written materials, promotional events, and presentations at citizen meetings. Refuse collectors are required to distribute City-printed recycling information at least twice yearly to their customers. Many haulers provide their customers with additional educational materials. Metro has also set up a Recycling Information Center through which citizens can receive recycling information on the telephone. This service utilizes comprehensive computer data bases on recycling services and markets. Funding for the center now comes from landfill tipping fees. In 1990 the City developed a public display to publicize "environmental shopping" concepts and emphasize the benefits of recycling.

Commercial/Institutional

In February 1990, the Metropolitan Service District launched a "Paper Train Your Staff" campaign, giving starter kits for office paper recycling to more than 2,000 area firms, and referring companies to private haulers that pick up office paper for recycling. The program received endorsements from top management of 12 Portland area businesses, and was advertised on billboards and in displays at trade shows. Metro also encourages landscapers to drop off yard waste at area processing sites for composting.

Economics

Costs Cover:

The City did not incur capital costs for the collection or processing of 180,695 tons of recyclable material and 19,054 tons of compostable materials in 1990; such activities are conducted by the private sector and paid for by customers in refuse bills. The City incurs some costs for the administration of recycling and composting programs and for education and publicity programs. Additional administrative costs are incurred by Metro, and are not included in this report. While most capital costs are unavailable, equipment, capital expenditures, and operating costs incurred by one model recycling hauler (which are not necessarily representative of other haulers) are described below.

City's Annual and Per Ton Operating and Maintenance Costs (1990)*

	Cost	Tons Covered	Per Ton Cost
Recycling & Composting Total	\$675,298	-	-
Collection	\$0	-	-
Processing	0	-	-
Administration	612,250	-	-
Education/Publicity	63,048	-	-

Notes: The above costs reflect only the cost incurred by the City of Portland for administration, education, and promotion of recycling and composting programs. Metro incurs additional administrative and education/publicity costs for Portland's programs. Metro also covers the cost of operating two recycling drop-off centers at the transfer stations. All other recycling costs are incurred by private haulers and residents through refuse bills.

In FY 1991 the City's total budget for recycling and composting programs will increase to \$2.4 million. Of this, \$450,000 will be spent for the purchase of residential recycling containers. Metro will pay an additional \$450,000 for the purchase of containers.

*The costs listed above are for FY 1990 (July 1990 to June 1991).

Sunflower Recycling Cooperative's Capital Costs

Item	Cost	Use	Year Incurred
International Step Van (1971) Retrofitted	\$12,000	Recycling Collection	1982
Dodge Truck (1972)	5,000	Office paper Collection	1987
2 Compactor @ 5% of use	14,000	Yard Waste Collection	1990
2 Caterpillar Forklifts (1976,78)	16,500	Processing	1987, 1989
Economy Baler (for paper)	10,000	Processing	1988
Cement Mixer (used)	300	Food Waste	NA
Retrofitting	1,000	Processing	
Granulator (for plastics)	17,000	Processing	1990
40 1-cubic-yard to 43-cubic- yard containers	10,000	All uses	NA

Note: Of the equipment listed above, the Dodge truck, forklifts, and baler have not yet been paid off.

In 1990 Sunflower Recycling Cooperative's total gross income from its refuse, recycling, and composting business was \$550,000, \$240,000 excluding refuse collection. Its total costs in 1990 for 3,319 tons of recyclable and compostable material collected were approximately \$230,000, equivalent to \$69 per ton. Sunflower employed 25 people in 1990 for recycling and yard waste collection and processing activities.

Materials Revenues:	The City does not receive revenue from the sale of recyclables or compost.
Source of Funding:	Funding for the City's administration of recycling programs currently comes from a \$2.85 per ton surcharge (\$0.50 of which is spent on remediation of a hazardous waste site) in FY 1990, billed to refuse collectors for solid waste collection within the City service area.
Full-time Employees:	3 City employees in 1990
Part-time Employees:	A few City employees assist in promotion efforts and financial planning.

Future Solid Waste Management Plans

The City is restructuring its recycling collection program in order to increase participation and recovery rates. Collection of refuse and recyclables will be more tightly controlled by the City. The new system will standardize garbage and recycling collection procedures, and will not allow individual operators to collect recyclables unless they service a minimum of 3,000 customers. The City will require use of a compartmentalized recycling truck with hydraulic dumping bins. Haulers wishing to use other trucks must prove their vehicles can work as efficiently and can make a minimum of 240 stops per vehicle per day (a standard determined by the City). Beginning in the spring of 1992, all haulers will be required by the City to collect yard waste. The City has proposed monthly collection beginning in April 1992 and bi-weekly collection beginning in July of that year. Yard debris will be set out in 30-gallon paper bags, 32-gallon cans, or 60-or-90-gallon roll-off carts (formerly used for refuse disposal); plastic bags will not be allowed. The cost of collecting 1 unit of yard waste (i.e., one 30-gallon container) per collection period will be covered by residents refuse/recycling fees. Residents setting out additional yard debris will be charged an additional fee, which will be less than the per can refuse fee. The total cost of the new recycling and composting program, including residential and commercial activities, will be \$2.4 million in FY 1991.

A private company in Portland, Wood Exchange, has recently begun to chip wood waste, including pallets, for the manufacture of particle board. In the future, it will recover larger pieces of wooden construction debris for the manufacture of particle board and will repair pallets for reuse. Other recycling entrepreneurs that offer recovery of what they term "difficult wastes," such as construction debris, have recently emerged.

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Regional Yard Debris Recycling Plan. Portland Metropolitan Area/Metro Region, January 1991.

1990 Recycling Levels: Survey of Recycling Markets. Portland: Solid Waste Department, Metropolitan Service District, July 1991.

Endnotes

¹Based on Portland's conversion factor of 9 cubic yards per ton of mixed yard waste.

²Density of completed compost is 1,500 lbs/cubic yard. (Source: Sunflower Recycling Cooperative, 1991)

Providence, Rhode Island

Demographics

Jurisdiction:	City of Providence
Population:	160,728 in 1990
Area:	19 square miles
Total Households:	61,454 (13,456 single-family residences and 47,998 households in multi-family buildings)
Total Businesses and Institutions:	1,065 (1,023 businesses and institutions, 42 schools)
Brief Description:	Providence, the capital of Rhode Island and the third largest city in New England, is located on the eastern seaboard. Its primary industries are health care and jewelry manufacturing. Providence is also home to Brown University and the Rhode Island School of Design. The City estimates its unemployment rate at 8 percent in 1990, 3.5 percent above the national average of 5.5 percent.

Solid Waste Generation and Recovery

Annual Tonnages (1990)			
	Residential*	Commercial/ Institutional†	Total MSW
Recovered	8,191	8,700‡	16,900
Recycled	8,191	NA	NA
Composted	0	NA	NA
Disposed	72,486	58,300	130,800
Incinerated	0	0	0
Landfilled	72,486	58,300	130,800
Generated	80,677	67,000§	147,700
Percent by Weight Recovered			
Recovered	10%	13%	11%
Recycled	10%	NA	NA
Composted	0%	NA	NA

Note: Tonnages of construction and disposal waste disposed and recovered in Providence are not tracked on a city level and thus not listed in this chart.

*Residential waste recycled and disposed includes only materials collected from one- to six-unit buildings and public housing. It does not include refuse or recyclables collected from households in buildings with more than six units. In 1990 an estimated one-half of such households was recycling, but materials were collected by private haulers and tonnages were not tracked. If tonnages broken during processing (14% of collected recyclables) are included in waste disposed rather than waste recovered, Providence's residential recovery rate would drop to 9%.

†Providence does not track the tonnage of commercial and institutional waste generated in the City. Tonnages of commercial and institutional waste disposed and recovered, given above, are estimates by ILSR staff based on data submitted to the RI Department of Environmental Management by 34 of Providence's 56 businesses with more than 250 employees. Businesses of this size were required to submit reports in 1990 detailing waste recovered and disposed.

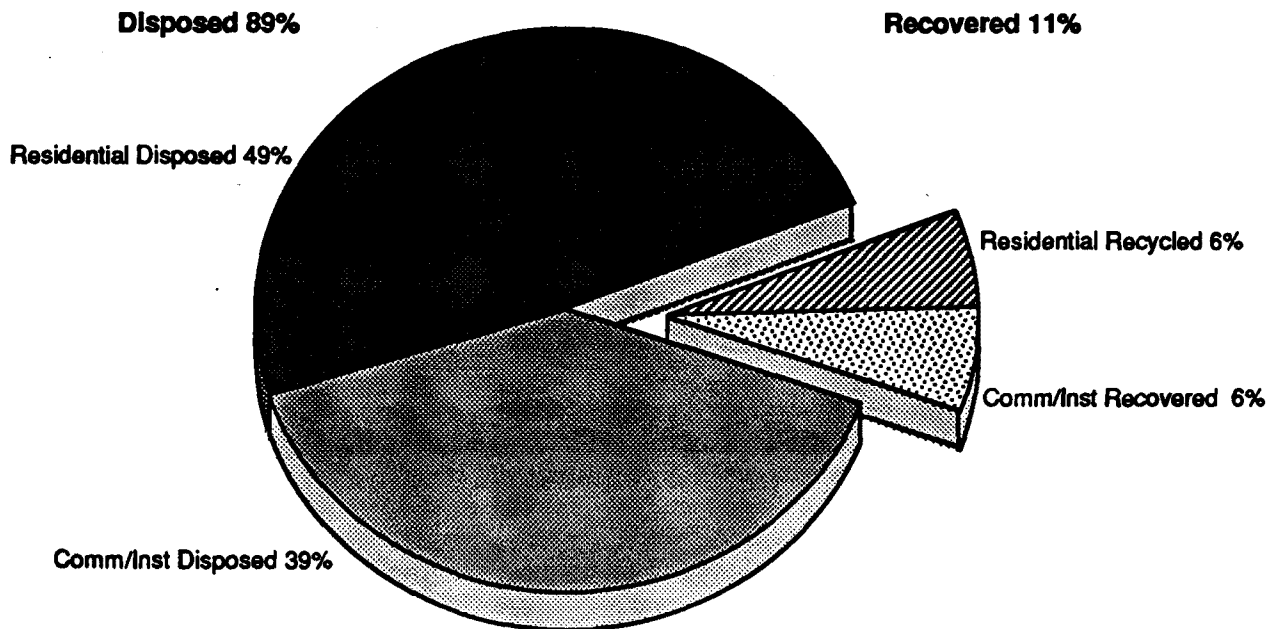
‡For an explanation of how we calculated commercial and institutional waste recovered, please see Amount and Breakdown of Materials Recovered.

§We estimated the commercial and institutional waste generated in Providence by multiplying by three the post-consumer tonnage generated from the 34 establishments (22,245 tons) that submitted recycling reports (by March 1991). These businesses have 32,000 employees, about one-third of all the employees in Providence. Further, researchers at Brown University who have been evaluating the data submitted from businesses across the State, have generally found that the waste generated from those businesses completing recycling reporting requirements on a state level by March 1991, represented one-third of all commercial waste generated in Rhode Island. (Personal communication, John McCabe, Brown University, April and July 1991.)

Landfill Tipping Fee: \$13.00 per ton in 1989, \$13.98 in 1990. Tipping fee for private haulers disposing commercial material was \$49 per ton in 1990.

Refuse Collection and Disposal: The City of Providence contracts with Chambers Waste Systems to collect refuse from the residential sector, including buildings with up to six units, as well as public housing buildings. Municipally collected refuse is disposed of at the State-owned Central Landfill in Johnston, RI, approximately 15 miles from the city, where 90 percent of the State's refuse is disposed. In 1990 the City paid its refuse hauler \$2,773,432 for the collection and disposal of 72,486 tons of refuse disposed, including tipping fees but excluding administrative overhead. This is equivalent to \$38 per ton.

Municipal Solid Waste Recovered and Disposed (Percent by Weight, 1990)



Note: Due to rounding, numbers do not add to percent disposed and percent recovered.

Refuse Collection and Disposal (cont'd):

Refuse from households in multi-unit buildings and commercial and institutional establishments is collected by at least ten private haulers, and much of it is hauled to the state Central landfill for disposal. In 1990 an estimated 40 percent of privately hauled waste from Providence was disposed of out of state, in Massachusetts. However, in June 1991, the State launched an effort to enforce its 1986 flow control legislation, which mandates that *all* solid waste generated in the state be disposed in State facilities. (The State Solid Waste Management Corporation is supported by tipping fees and loses money if material is disposed out of state.) Private haulers collect construction and demolition (C&D) debris; they bring most of the wood waste, concrete, and asphalt collected to New England Ecological Development (NEED), located near the Johnston landfill, for processing. Wood is chipped and eventually burned as a fuel; concrete and asphalt are processed and sold as fill. However, tonnages of C&D waste disposed and recycled are not tracked.

Between October 1989 and December 1991, the Rhode Island Solid Waste Management Corporation, which is responsible for building and operating State solid waste facilities, purchased 82 houses and 100 parcels of land adjacent to the State landfill because the landfill was perceived as an odor problem.

According to the 1986 Solid Waste Management Law, the State is required to build three 750-ton-per-day mass burn waste incinerators and three recycling facilities.

Refuse Collection and Disposal (cont'd):

While the three incinerators have already been sited (the Central Fall site is only proposed), and two of the three are in the permitting stages, construction of the incinerators has not yet begun. The proposed incinerators have met with local opposition, and the incinerator sited for North Kingston has not been able to prove it can meet emissions standards. In June 1991, a bill, which failed by a narrow margin, was introduced in the State Senate to eliminate construction of two of the three incinerators.

Materials Recovery Overview

Goals and Legislative Requirements:

Rhode Island was the first state in the nation to mandate recycling. Its 1986 Solid Waste Management Law requires municipal solid waste to be source-separated into recyclable and nonrecyclable components prior to disposal in State facilities. The law established a State goal of recycling 15 percent of the total waste generated from the residential and commercial sectors and from municipal government offices. The Law also required the construction of three State recycling facilities and three State incinerators. The State is required to fund all reasonable costs for municipal recycling activities during the first 3 years of a program's operation. Beginning in 1990, State disposal facilities could no longer accept commercial waste containing more than 20 percent by weight of listed recyclables. In April 1989 Providence passed a local recycling ordinance mandating citizen participation in its source-separation program.

With a population of only 1 million, the state of Rhode Island manages its solid waste and materials recovery in a centralized fashion. State agencies, the Department of Environmental Management (DEM) and the Solid Waste Management Corporation (SWMC), oversee planning, program development, construction and operation of facilities for disposal and materials processing, publicity, and education. They also provide financial and technical assistance to municipalities for implementation of recycling programs. Municipalities are responsible for collection of refuse and recyclables, and for enforcement of the source-separation requirement.

Statewide recycling was mandated in Rhode Island in 1986, and in 1987 pilot curbside recycling programs began in the communities of East Greenwich and West Warwick. In 1988 municipal recycling programs in the State were expanded to include a total of 130,000 households. A State-owned, privately operated materials processing center, designed to process 120 tons per day of recyclables, was opened in April 1989. In 1990 the processing center (known in the State as a materials recovery facility, or MRF) was operating above capacity, processing an average of 190 tons per day of recyclables. The second State processing center, while already sited, has been forestalled by financial difficulties and by the linking of its construction with the construction of an incinerator. Despite Rhode Island's initial intention to include all municipalities in the recycling program, only 20 of the State's 39 cities and towns had instituted mandatory recycling programs by June 1991.

The City of Providence began curbside collection of recyclables in October 1989. The cost of recycling is shared between the City and the State. The City pays the annual contract for collection of recyclable materials, and the State supplied the recycling bins and provides publicity and educational materials. Providence is reimbursed by the State for all reasonable costs associated with the recycling program for the first 3 years of the program's operation, including the collection contract. In the initial phase of the program, households served with municipal refuse collection (households in buildings with less

than seven units or in public housing), municipal offices, and businesses were required to recycle. In the second phase of the program, all households were required to recycle. Households in multi-unit buildings and commercial businesses rely on private, independent haulers for this service. By 1991 all of the City's public schools were recycling.

Recycling Activities

Residential Curbside Recycling

Start-up Date:	October 30, 1989
Service Provider:	Chambers Waste Systems, under contract with the City. McCaughey, another private hauler under contract with the City, collects materials from public housing.
Pick-up Frequency:	Weekly
Same Day as Refuse:	Yes
Households Served:	56,423 households in 1990, including residences in buildings up to and including six units, and five public housing buildings.
Mandatory:	Yes
Participation Rate:	74 percent (based on the number of bins set out per month divided by the total number of households served). In the beginning of the program, participation in source-separation programs in South Providence and the West End, which are primarily multi-lingual minority, neighborhoods, was quite low with an average participation rate of 30 percent. To raise participation, the City targeted special education programs to these neighborhoods, including distribution of foreign language brochures published by the State. According to Providence's Recycling Coordinator, by late 1990, participation in these neighborhoods averaged 60 percent.
Materials Collected:	Newspaper, glass, aluminum and ferrous food and beverage containers, milk (HDPE) jugs and soda (PET) bottles
Set-out Method:	Plastic, glass, and metal containers are commingled in a 14-gallon blue recycling bin supplied by the State. Newspaper is bundled or placed in kraft paper bags on top of other recyclables.
Collection Method and Vehicles:	The City is divided into nine different collection routes for recycling pick-up. Labrie side-loading, dual-compartmented collection trucks are utilized for curbside collection. Trucks are operated by a single crew member, who places newspaper into one bin and commingled recyclables into the other. The bins are then hydraulically lifted and emptied into the appropriate compartment.
Enforcement:	Upon random inspection, the City will issue residents who put refuse in their recycling bin a warning and subsequently a fine for \$25. By October 1991, a few tickets had been issued. Ticket fees are returned to the City's general fund. Additionally, scavengers can be fined \$250 for taking materials from recycling bins.
Economic Incentives:	None
Annual Tonnage:	8,171 tons in 1990

Multi-unit Collection

According to State law (passed July 1988), all multi-unit buildings (not serviced with municipal collection) must begin recycling the same materials as those in the curbside recycling program within 6 months of the onset of the municipal recycling program. Multi-unit buildings must contract with private haulers for this service. According to the City's recycling coordinators, an estimated one-half of Providence's 13,000 households in buildings with seven or more units was in compliance with recycling regulations 1990.

Apartment buildings are serviced by at least 10 different private haulers, who are responsible for securing their own recycling markets. Residents of buildings in compliance with DEM planning requirements are supplied with 5-gallon recycling buckets. Many private haulers supply 96-gallon wheeled toters and require residents to bring materials downstairs to centrally located storage containers, which are often kept outside, adjacent to dumpsters. Newspaper is placed in one toter and commingled materials in the other. Private haulers charge separately for the collection of recyclable materials, on a per pick-up, per volume basis. The cost of picking up recyclables varies from hauler to hauler and can exceed the cost of picking up refuse in a few cases. However in some cases, if an apartment building can reduce its size or number of refuse containers or frequency of refuse pick-up, overall refuse budgets can decrease.

Managers of multi-unit buildings (not serviced with municipal curbside collection) are also required to submit plans to the DEM for reducing and recycling their building's solid waste. Recycling plans must provide information on how materials will be collected and marketed, resident education/publicity programs, and how the program will be evaluated. Recycling plans from multi-unit buildings were required to be filed at the State DEM by October 1990. Multi-unit recycling has been put on hold because the MRF has been operating over its capacity.

Five public housing high-rise buildings are serviced with recyclable materials collection through the City's program. The buildings contain 200 to 300 units each for a total of 997 units. McCaughey, a private hauler that services these building with refuse pick-up, provides weekly collection of glass, cans, plastic containers, and newspaper. Materials are brought to the State MRF for processing. Apartment tenants are supplied with 5-gallon recycling buckets; they bring their newspapers and commingled bottles and cans to two 96-gallon toters located indoors in a central storage area. Building staff estimate high participation rates, between 80 and 90 percent, and little contamination of recyclable materials. In a 3-month period, from April to June 1991, 200 tons of refuse and 41 tons of commingled recyclables were collected from these five buildings, yielding a recycling rate of 17 percent.

Commercial & Institutional Curbside/Alley Recycling

Legislative Requirements:

Since January 1, 1989, commercial businesses in Providence have been required, according to State regulations, to recycle a specific list of materials (see below). All municipal offices have been required to recycle since the fall of 1989. Additionally, businesses with more than 50 employees must submit recycling and waste reduction plans and annual recycling reports to the State DEM according to a specific timetable. Businesses with more than 500 employees were required to submit plans by June 30, 1989; businesses with between 250 and 499 employees were required to submit plans by December 31, 1989; businesses with 101 to 249 employees were required to submit their plans by June 30, 1990; and businesses with 51 to 100 employees are required to submit plans by December 31, 1991. Within 60 days after the plan is approved by the DEM, the recycling program must be fully implemented. Compliance inspection by the DEM may take place any time after this 60-day period.

Legislative Requirements (cont'd):	Once their plans have been approved by the DEM, businesses must file an annual report on their recycling and waste reduction programs.
Service Provider:	An estimated 10 private haulers collect recyclable materials from the commercial/institutional sector in Providence. These include BFI and local companies such as McCaughey and Macera Brothers. The public schools contract with Chambers Waste to collect recyclable materials. Municipal offices contract with McCaughey to collect their recyclables.
Number Served:	<p>It is not known exactly how many businesses were recycling in 1990; however, 33 of the 34 commercial businesses submitting reports or plans to the DEM were recycling at least a few materials. A majority of the remaining 22 businesses with over 250 employees are also recycling, as are many of the businesses with more than 50 employees. In addition, 15 public and 15 private schools were recycling in 1990.</p> <p>As of 1991, all businesses with over 100 employees have approved plans filed at the DEM and were recycling mandatory materials. In 1991 all 33 public schools were recycling. All municipal offices have been recycling since 1989.</p>
Type Served:	All businesses were required to recycle in 1990. Institutional recycling is also considered mandatory, although this is not stated in the law.
Materials Collected:	<p>In 1990 businesses were required to recycle corrugated cardboard, white office paper, colored office paper, glass food and beverage containers, tin and steel containers, aluminum cans, newspaper, HDPE milk containers, and PET soft drink containers. Some businesses voluntarily recycled other plastics, textiles, white goods, metals, waste oil, and batteries. At least two businesses and one university were recovering food waste.</p> <p>In 1991 businesses were also required to recycle white goods, wood waste, used oil, lead-acid batteries, and automobiles.</p>
Pick-up Frequency:	Varies
Set-out and Collection Method:	Businesses set out materials in a variety of containers including compactors, 8- or 6-cubic-yard containers, or 96-gallon totes. Sometimes materials are stored outside and sometimes they are stored inside. Some private haulers utilize dual compartmentalized collection vehicles.
Incentives/Enforcement:	Potential savings to businesses that reduce the number or size of refuse containers. According to the DEM, by 1991 all businesses with over 500 employees have been inspected and fines have been issued for failure to comply with planning requirements.
Annual Tonnage:	Exact tonnages are not available.

Generators of commercial waste must prepare a waste reduction and recycling plan for their business (see above). The plan must list the amount and types of materials currently recycled, the amount of refuse disposed, a waste stream composition breakdown, and a proposed plan for reducing and/or recycling the required components of the waste stream—including how materials will be separated, collected, and transported to market. The plan must also describe how the program will be publicized to employees, and must give a detailed description of materials comprising at least 5 percent of the waste stream that are not targeted to be reduced by at least 70 percent. While DEM enforced the planning requirement in 1990, it did not, however, enforce the implementation. In 1991 it hired a full-time staff person to visit businesses and enforce the implementation of the recycling programs.

Brown University recovered 19 percent of its waste stream (or 413 tons of material) through recycling and composting over a 12-month period, from July 1989 to June 1990. Sixty-one percent of the recovered material consisted of food scraps, which are collected daily by a Massachusetts hog farmer. Brown has recovered food waste for 15 years. In 1989-90, it recovered 252 tons of food scraps through its largest dining hall, which generates an estimated three-fourths of the food waste generated on campus. Leftover food and food preparation waste, including meat scraps, are scrapped into barrels by kitchen staff. The hog farmer picks up the food waste (estimated at 1,500 lbs per day) every morning, 7 days per week. The University also collects office paper, corrugated cardboard, newspaper, scrap metal, and yard waste for recovery. Yard waste is composted at a local farm.¹

At least two other businesses in Providence—a potato wholesaler and a bakery—recover food waste. The owner of a local hog farm, Vinagro Farms (located near the Johnston landfill), picks up food scraps daily from these two enterprises. (The potato wholesaler is serviced 5 days per week; Calise Bakery receives pick-up 6 days per week.) A total of 1,450 tons of food scraps were collected from these two businesses in 1990.²

Beginning mid-1990, local public and private schools have recycled a variety of materials. By 1991 32 public schools and 10 private schools were recycling. The City negotiated with Chambers Waste Systems, the school's refuse hauler, to pick up recyclables free of charge. Commingled recyclables, tin and aluminum cans, and PET and HDPE plastic containers are brought to the MRF for processing. Corrugated cardboard and high-grade paper are brought to a local broker. In 1990, 100 tons of material were collected from public schools alone.

According to a research project conducted at Brown University, two-thirds of Rhode Island's larger businesses that have completed mandatory recycling reports have either saved money or maintained their previous costs as a result of recycling; businesses reported net savings up to \$108,000 per year. (Actual savings are believed to be even higher as one-time implementation and capital costs were incurred during the first year of the program's operation.)

Drop-off Centers

The Providence Department of Public Works collects waste oil at one drop-off site. The site is operated by the Department of Public Works, and is open 6 days per week, and staffed from 7 to 5, and unstaffed from 5 to 11. Private haulers drop off C&D debris (concrete, asphalt, and wood waste) at New England Ecological Development, a private facility located at the Johnston landfill. Wood waste is chipped and eventually burned as fuel; asphalt and concrete are processed and reused as fill. Tonnages of asphalt and yard waste recovered are not tracked on a City basis.

Processing and Marketing of Recyclables

All materials collected through Providence's municipal curbside program and from City schools are brought to the Materials Recovery Facility (MRF) near the Johnston landfill, approximately 15 miles from the City, and are tipped for free. The processing center is owned by the State Solid Waste Management Corporation (SWMC) and is operated by New England CRInc, a private company. (The Solid Waste Management Corporation solicited three different contracts, for facility design, construction, and the provision of equipment and operation of the plant.)

The facility, which opened its doors in April 1989, is a 40,000-square-foot plant utilizing the highly mechanized West German Bezner system. The facility's capital cost is estimated at \$6 million, with \$2 million spent on equipment. The plant was built to process 120 tons of material per day in one shift, or an estimated one-half of the State's recyclables. In 1990 the MRF was processing between 190

and 240 tons of materials per day (58 percent paper and 42 percent commingled recyclables), in two daily 8-hour shifts, 5 days per week.

Six different types of materials, collected through mandatory municipal collection, enter the MRF in two streams: (1) newspaper; and (2) commingled bottles, cans, and plastic containers. The paper is dumped on the floor and any kraft paper bags are removed by two workers. (According to the MRF's operators, the removal of bags has reduced overall processing efficiency from 11 tons per hour to 6 tons per hour.) The paper is moved via inclined conveyor to a hopper, baled, and automatically tied.

Commingled recyclables ascend via conveyor to an elevation of 20 feet above the tipping floor. (The flow of recyclables is monitored by sensors and regulated so that materials are sent at an even stream.) The recyclables are conveyed under a magnet that removes ferrous cans. The glass, metal, and aluminum descend via the force of gravity. Materials are sorted by weight as they tumble through a row of moving metal weights on chains. Glass, the only material heavy enough to fall through the "chain curtain," is sent downward to a special sorting tray. An eddy current magnet runs over the plastic and aluminum, charging the aluminum and causing it to fall in one direction. Plastic containers continue their descent in another direction. A worker pulls off any nonplastic items, and separates out the HDPE bottles. The PET bottles fall onto a conveyor belt. The glass, pulled by gravity falls over a shaker-table with 2-inch-wide holes. Broken pieces of glass, fall through the holes and onto the residue conveyor. Whole glass bottles continue along the conveyor to a sorting table where six workers sort glass by color. Twenty-seven workers are employed at the MRF, approximately 10 on the processing line.

Over 40 percent of all glass entering the facility breaks. Broken glass is landfilled, as is all other MRF residue, which is estimated at 14 percent by weight of all material entering the MRF. The Glass Packaging Institute has awarded the MRF a grant to research ways to reduce glass breakage. The operators of the MRF maintain that about half of this breakage occurs en route, and that much glass arrives at the plant already broken.

Bimetal and ferrous cans are shredded with an AMG Cutler shredder into steel "crumbs." Aluminum is flattened. Glass is crushed to market specifications. PET bottles are perforated, flattened, and baled whole. HDPE bottles are flaked with a granulator. Paper is sold overseas to Japan, Taiwan, Holland, or Italy. Glass is sold to Anchor Glass in Dayville, Connecticut, Maine Beverage, or Central NY Bottle Company. Tin and steel are sold to AMG Resources in Pittsburgh; aluminum is sold to Reynolds Aluminum in Richmond, Virginia; and PET and HDPE plastics are sold to Wellman in Johnsonville, South Carolina.

Annual operational costs of the MRF are estimated at \$1.5 million, or \$31.83 per ton, in 1990, including residue disposal but excluding debt payment and facility depreciation. That year, the MRF received approximately \$1,349,113 in revenues from the sale of 41,300 tons of material (an average of \$32.67 per marketed ton). Fifty percent of this was for the sale of aluminum; yielding a net loss of approximately \$160,000. The State paid CRInc. approximately \$1.1 million for operating the MRF, and an additional \$100,000 in revenue sharing (CRInc receives 10 percent of all revenue earned), and \$100,000 for shipping expenses.

Recyclables collected from commercial enterprises, institutions, and apartment buildings are generally not brought to the MRF for processing. Private recyclers must market their materials elsewhere, a task which can at times, be difficult. Paper and corrugated cardboard are brought to paper brokers such as United Paper Stock in Pawtucket, Rhode Island. Glass is sometimes sold to Anchor Glass in Dayville, Connecticut. Securing viable recycling markets can sometimes pose problems for local haulers. The State MRF serves as a "market of last resort" when no other markets are available. Haulers bringing materials to the MRF are charged a fee equal to one-fourth of the State tipping fee (at the Central landfill) for private haulers, which was \$49 per ton in 1990.

Market Development Initiatives/Procurement

In October 1990, the Rhode Island DEM promulgated regulations establishing an official State recycling emblem. Under the law, which goes into effect in November 1991, products must meet certain designated criteria and definitions in order to use the recycling emblem or to print the terms "reusable," "recyclable," or "recycled" on product labeling. A product cannot be promoted as reusable unless it can be reused a minimum of five times through a program established by a manufacturer, retailer, or distributor. A product can be advertised as recyclable only if it can be used in its entirety (excluding labels, adhesives, and closures) for a feedstock and is either listed as a mandatory recycling material (for residential or commercial programs) or returned to a specified agent to be recycled, achieving an in-state recycling rate of 50 percent. A product can be labeled as recycled only if the label lists the percentage by weight of pre- and post-consumer material. Rhode Island hopes that the use of the State recycling emblem will increase demand for secondary materials, eliminate false market claims, and stimulate the growth of secondary material markets.

Composting Activities

Providence does not have a composting program. Some private haulers drop off wood waste for chipping at New England Ecological Development. These tonnages are not tracked, and wood chips are eventually burned as a fuel source. In 1991 it became mandatory to recycle wood waste. Source separation of leaves and yard debris will be mandatory in the City beginning January 1, 1993.

In November 1991, the City began a pilot leaf collection program. BFI picks up bagged leaves in packer trucks from 15,000 households on an every other week basis through December. Leaves are brought for composting to a site managed by the Solid Waste Management Corporation (SWMC) adjacent to the landfill. The material is formed into windrows and turned regularly. The City covers the cost of the \$15 per ton tipping fee and receives a \$5 rebate per ton from the SWMC. BFI is not currently charging the City for this pick-up service, perhaps because it hopes to receive the contract when such collection is implemented citywide.

Also in the fall of 1991, the SWMC, the City of Providence, and the Southside Land Trust began a joint venture to encourage backyard composting in the City of Providence. They will conduct workshops to demonstrate backyard composting techniques on Southside Land Trust land, located in the City.

Amount and Breakdown of Materials Recovered

Material	Residential (Tons, 1990)	Commercial/ Institutional (Tons, 1990)*	Total (Tons, 1990)
Newspaper	5,489	NA	NA
Corrugated Cardboard	0	NA	NA
High-grade Paper	0	NA	NA
Other Paper	0	NA	NA
Glass	1,963	NA	NA
PET Plastic	134	NA	NA
HDPE Plastic	92	NA	NA
Aluminum Cans	100	NA	NA
Ferrous Cans	393	NA	NA
Food Waste	0	NA	NA
Motor Oil	20	NA	NA
Scrap Metal	NA	NA	NA
Batteries	NA	NA	NA
Subtotal MSW Recycled	8,191	NA	NA
Subtotal MSW Composted	0	NA	NA
Total MSW Recovered	8,191	8,700	16,900
Total C&D Recovered	NA	NA	NA

Notes: Above tonnage represents collected material, included material broken during processing. In 1990 an additional 184 tons of residue (not included in above figures) were collected through the municipal curbside program. This represents 2 percent of all materials collected through the municipal program.

*The tonnage of waste recovered from the commercial and institutional sectors in Providence was estimated using data obtained from 34 of Providence's largest businesses. These 34 businesses recovered 3,862 tons of post-consumer waste in 1990, or 17.3 percent of their waste stream. Assuming that one-third of the commercial/institutional waste stream is being recovered at a 17.3 percent rate, another one-third at three-quarters this rate (about 13 percent), and the remaining one-third at half this rate (about 9 percent), we estimate that Providence recovered about 13 percent of its commercial/institutional waste in 1990.

Source Reduction Initiatives

Initiatives promoted in Providence to encourage solid waste source reduction are developed at the state level. The State Department of Environmental Management (DEM) promotes source reduction of commercial waste in its *Handbook for Reduction and Recycling of Commercial Solid Waste*. DEM requires businesses to prepare a waste reduction and recycling plan that proposes how each portion of the waste stream will be reduced and/or recycled. The Handbook suggests that offices use supplies and equipment more efficiently, replace disposable materials with reusable, recyclable, and more durable products, and increase use of recycled materials. However, the DEM is short-staffed and lacks the capacity to enforce reporting and recycling requirements.

As described earlier, Rhode Island has just adopted use of a recycling emblem to identify and promote products that are recyclable, recycled, and reusable.

Publicity and Education

Prior to the implementation of its mandatory curbside program, the City of Providence held public meetings to inform citizens about program details. Ads were placed in local newspapers to announce the distribution of recycling containers and the onset of the pick-up program. Brochures printed in multiple languages were mailed and distributed in blue bins, and the program received coverage on local TV and radio.

The State DEM and SWMC have developed a variety of educational materials, some of which are voluntarily used in Providence schools. These include a two-volume recycling curriculum put out by the Ocean State Clean-up and Recycling (OSCAR) program of the DEM. The DEM distributes written manuals to managers of multi-unit buildings and commercial enterprises with tips on reducing and recycling solid waste.

Economics

Costs Cover:

Providence does not incur any capital costs for the collection and processing of recyclables. Costs listed below cover the City's expenses for the curbside collection of 8,171 tons of residential recyclables from households in one- to six-unit buildings in 1990, including the annual contract fee paid to Chambers Waste Systems, and the City's administrative and education and publicity costs. All costs for the processing of Providence's recyclable materials are paid for by the State.

State capital expenditures for the purchase of recycling bins in Providence are also provided below. State education and publicity costs for the development of recycling in Providence are not available. Private processing equipment is listed below, but a cost breakdown is not available.

Capital Costs: Collection

Item	Cost	Use	Year Incurred
9 Labrie Trucks*	\$630,000	Recycling	1989
62,000 Recycling Binst†	307,648	Recycling	1989

Note: All equipment is paid off

*The recycling vehicles were paid for by the City's private recycling hauler, Chambers Waste Systems, using a portion of its annual contract fee received from the city. After 3 years, the trucks become the domain of the City if Chambers Waste no longer serves as the contracted recycling hauler.

†Bins were paid for by the State.

Capital Costs: Processing

Item	Cost	Use	Year Incurred
Bezner Sorting Equipment	NA	Recycling	1987
Bollegraf Baler	NA	Recycling	1987
AMG Cutter Shredder	NA	Recycling	1987

Note: All processing equipment is estimated to have cost \$2 million, and the total cost of the MRF was \$6 million. The SWMC financed the capital costs of the MRF with \$3.8 million in bonds amortized over a 4 year period at a 9.25% interest rate.

Annual and Per Ton Operating and Maintenance Costs (FY 1990)

	Cost	Tons Covered	Per Ton Cost
Recycling Total	\$945,146	8,171	\$116
Collection*	\$857,343	8,171	\$105
Processing†	0	8,171	0
Administration	85,853	8,171	11
Education/Publicity‡	1,950	8,171	0.23

Note: The costs presented are for fiscal year 1990, which runs from October 1989 to September 1990. The tonnage data presented are for calendar year 1990.

*The State reimbursed the City \$738,345 from the above collection contract the City paid to Chambers Waste Systems (it deducts the savings to the City in averted tipping fees).

†The State paid approximately \$32 per ton to process Providence's recyclables excluding debt payment.

‡Most education/publicity material is published by the State.

Materials Revenues: None. Revenue is split between the private processors (New England CRInc. and the SWMC).

Source of Funding: State Solid Waste Management Corporation

Full-time Employees: 2 City staff and 9 haulers under private contract

Part-time Employees: None

Future Solid Waste Management Plans

The Rhode Island Solid Waste Management Corporation, funded by tipping fees collected at State disposal facilities, is experiencing financial difficulty. While Rhode Island is the first State to mandate statewide recycling, it has not yet achieved its intended goal of including all municipalities in the program.

A Bag and Tag bill that would have mandated statewide, volume-based refuse collection rates was introduced in the 1991 State legislative session. Although the DEM and the SWMC supported the bill, it did not pass. The State hopes to reintroduce this bill.

In April 1991, amendments to State legislation were proposed that would double the list of materials required to be recycled from commercial business. Among the materials that are now required to be recycled are , lead-acid batteries, used lubricating oil, automobile hulks, white goods, leaves, grass clippings, and other wastes (effective January 1993). In 1990 Rhode Island was the first of two states to mandate telephone directory recycling. Effective January 1992, telephone directories can only be disposed through the DEM collection system. Providence is hoping to increase recycling opportunities in the commercial sector and to begin a pilot composting program near the landfill in the fall of 1991.

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San Francisco, California

Demographics

Jurisdiction:	City of San Francisco
Population:	723,959 in 1990
Area:	49 square miles
Total Households:	328,471 (105,150 in single-family homes and 223,321 in multi-unit buildings)
Total Businesses:	61,235 businesses and 900 nonprofit agencies
Brief Description:	San Francisco, located on San Francisco Bay on the Pacific coast, is the seventh largest city in the nation by population. Its population is multicultural: 54 percent Caucasian; 29 percent Asian, 11 percent African-American; 6 percent are of other races, and 14 percent of the total population is of Hispanic origin. Per capita income in San Francisco was \$15,137 in 1990; mean annual household income was \$41,200, and median annual household income was \$28,530.

Solid Waste Generation and Recovery

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Annual Tonnages (1990)						
	Residential	Commercial/ Institutional	Other Self-Haul	Total MSW	Construction & Demolition	Total Waste
Recovered*	113,739	70,829	2,160	186,728	12,428	199,156
Recycled	106,712	68,971	2,160	177,843	12,428	190,271
Composted†	7,027	1,858	0	8,885	0	8,885
Disposed	194,360	321,935	15,845	532,140	15,076	547,216
Incinerated‡	4,249	8,262	2,840	15,351	0	15,351
Landfilled	190,111	313,673	13,005	516,789	15,076	531,865
Generated	308,099	392,764	18,005	718,868	27,504	746,372
Percent by Weight Recovered§						
Recovered	37%	18%	12%	26%	45%	27%
Recycled	35%	18%	12%	25%	45%	25%
Composted	2%	**	0%	1%	0%	1%

*Residential materials recovered in 1990 include recyclable materials collected at curbside, through drop-off and buy-back centers and some bulky items self-hauled to the transfer station. Commercial tons include materials collected from office buildings, retailers, restaurants, and bars. Other self-haul tonnages consist of materials brought to the public disposal and recycling area at the transfer station and are derived from both residential and commercial waste streams. Much of the data comes from a waste composition of San Francisco's waste stream by the consulting firm, Brown, Vence and Associates.¹

†Residential waste composted includes 4,414 tons of food waste and 2,164 tons of yard waste reported to have been composted in residents' backyards, 400 tons self hauled to compost facilities and 49 tons of Christmas trees which were chipped and used as mulch. Commercial waste composted includes 850 tons of waste that was composted privately and 1,008 tons collected by the City Departments.

‡Wood waste, including 8,262 tons of commercially-generated wood, is burned for fuel.

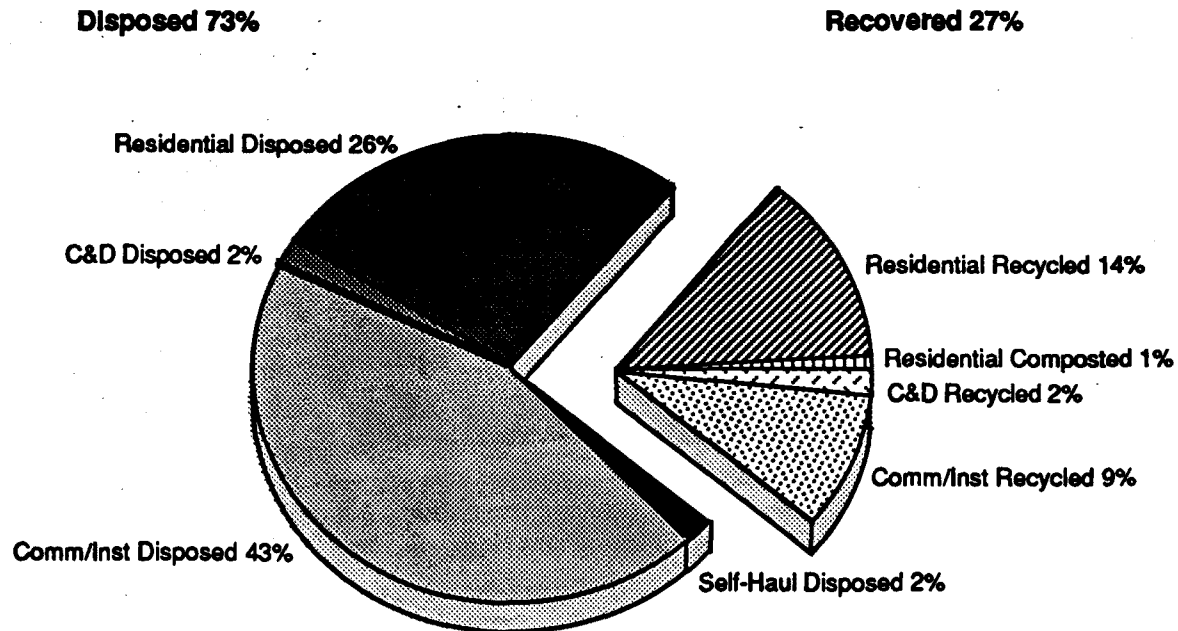
§Numbers may not add due to rounding.

**Less than 1 percent.

Transfer Station Tipping Fee: \$45.20 per ton in 1990; \$52.62 as of October 1991. This fee covers transfer station costs, transportation to landfill, landfill disposal costs, host community fees, and solid waste planning costs. The fees are set by the City's Refuse Collection and Disposal Rate Board.

Refuse Collection and Disposal: Golden Gate Disposal and Sunset Scavenger have collected refuse from the residential and commercial sectors in the City since the early 1900s. Golden Gate serves the downtown/financial district and Sunset Scavenger serves the balance of the City. The two companies, which merged under Norcal Waste Systems, Inc., in 1987, are protected by a 1932 ordinance

Total Waste Recovered and Disposed (Percent by Weight, 1990)



Note: Due to rounding, numbers do not add to 100%.

Refuse Collection and Disposal (cont'd):

that authorizes them to collect refuse on specific routes in the City. Other companies may pick up refuse but must first obtain a permit from the City's Department of Public Health. To date none has applied. Under the ordinance, other companies do not need a permit to collect construction and demolition debris and other waste that has a commercial value (such as used beverage containers, paper, and scrap metal); more than 30 companies collect such waste. Refuse is delivered to a transfer station operated by Sanitary Fill, also a subsidiary of Norcal, prior to being long-hauled to the Altamont Landfill in Alameda County, approximately 60 miles from San Francisco.

Residents pay the collection companies on a per-can basis for refuse collection and disposal: \$8.49 per month for one 32-gallon can, and \$3.86 per month for each additional can. Recyclables are collected at no charge. New rates went into effect as of October 1991: \$9.35 per month for a 32-gallon can plus \$4.24 for each additional can, \$8.03 per month for a 20-gallon mini-can (\$7.19 per month for residents 65 years old or older).

Materials Recovery Overview

Goals and Legislative Requirements:

San Francisco's 1988 Solid Waste Management Plan targeted solid waste diversion goals through source reduction, recycling, and composting of 32 percent of the City's waste stream by 1992 and 43 percent by 2002. In September 1989, the California legislature passed the Integrated Waste Management Act (AB939), effective January 1990. The Act requires counties and incorporated cities within those counties to prepare Integrated Waste Management Plans, and sets State goals at 25 percent solid waste reduction by 1995 and 50 percent reduction by 2000. After the passage of AB939, San Francisco updated its goals to make them consistent with the State law. In 1986, the California legislature enacted a bottle bill (AB2020).

The City of San Francisco has taken a multifaceted approach to its solid waste problem. In addition to residential and commercial sector curbside recycling, its programs encompass phone book recycling, recycling glass from bars and restaurants, promoting backyard composting, and educating residents to pay attention to the environmental impacts of products when they shop.

San Francisco has a long history of recycling, dating to the turn of the century. Golden Gate Disposal and Sunset Scavenger evolved from the old Scavengers Protective Association, a league of immigrants that paid the City for the rights to collect refuse on a given route. The scavengers had a long tradition of hand-separating wastes in open trucks into paper products, wet products, and a mixture of glass, rags, and metals. The advent of packer trucks for refuse collection in the late 1950s rendered the practice of recovering recyclables on the truck impractical and uneconomical. In 1967 the two companies terminated all but their paper and metals recycling programs.

The first community recycling center in San Francisco opened in 1970, accepting newspaper, glass, and cans. Other community drop-off centers opened over the next several years. By 1980 the nine community recycling centers then existing formed a nonprofit corporation called the San Francisco Community Recyclers (SFCR). Today the San Francisco Community Recyclers operates five buy-back centers. In addition to the SFCR, the Haight-Ashbury Neighborhood Council (HANC), Richmond Environmental Action (REA), and Goodwill Industries in conjunction with Norcal each operate viable multimaterial drop-off and buy-back centers in the City, and promote recycling at special events.

In 1980, under the direction of the Chief Administrative Officer, the City established the San Francisco Recycling Program (SFRP) as a division of its Solid Waste Management Program. Designed to facilitate and encourage recycling in the City, the SFRP has developed programs around the existing private sector recycling activities. The San Francisco Board of Supervisors adopted a resolution in September 1979, directing the City to establish a long-term solid waste management program including municipal solid waste combustion, landfilling, and recycling. As part of the long-term strategy to reduce solid waste in the City, the Board in 1983 selected Combustion Engineering (C-E) to site, permit, and finance the construction of an incinerator for municipal solid waste from the Bay area. But in May 1987, the Board voted to suspend negotiation of a contract with C-E due to public concern about air emissions, ash disposal, project economics, and the negative impact the project would have on recycling.

The City, working with the refuse haulers and recycling centers, applied for a State grant to fund numerous recycling programs. In July 1981, the State awarded the City two grants: \$120,000 for the start-up of several buy-back centers with local community recycling groups, and \$20,000 to start an apartment building recycling program at a high-rise apartment complex. During the fall of 1980, the City hired a full-time recycling manager and the SFRP initiated the first of its pilot programs—a white office paper recovery program in City Hall. By the end of the year, City Hall had reduced its garbage by one-third.

At the suggestion of the recycling community, the City in 1982 established an ongoing fund, the Recycling Development Fund, to initiate and expand recycling ventures. The intent of the fund was to offer grants to promising private and nonprofit recycling projects. Funding for this program was \$100,000 per year for fiscal years 1982 through 1986, but was discontinued in 1986. San Francisco continues to fund various recycling and waste reduction activities through its solid waste budget. The City granted monies to the San Francisco League of Urban Gardeners to start a backyard composting program. In 1991 the City awarded \$30,000 in funding for a feasibility study on the creation of a center in the City for manufacturing and selling goods created from discarded materials.

In November 1981, the City, the two collection companies (Golden Gate Disposal and Sunset Scavenger), and Sanitary Fill began a residential curbside pilot program collecting newspaper, glass, and aluminum cans from 3,500 single-family homes in the Sunset District. The program was discontinued because of illegal scavenging and lack of commitment by the management of the collection companies. An advisory committee to the Chief Administrative Officer, consisting of representatives from the City, the refuse collection companies, nonprofit recyclers, environmental organizations such as Sierra Club and EDF, and end users of recyclable material, such as Owens-Brockway and Reynolds, was established to help develop a new curbside program. In April 1989, the City initiated the current curbside recycling program, with Sunset Scavenger as the primary service provider under contract with the City. The program was implemented in four phases. Phase I of the program began with collection of newspaper, corrugated cardboard, mixed and high-grade paper, and commingled bottles and cans from 29,000 households in the southern section of the City. As of November 1990, 154,000 households were being served, and approximately 15,000 households in 1,000 apartment buildings. By the fall of 1991, the program is projected to reach 172,000 households and at least 5,000 apartment buildings.

The San Francisco Recycling Program has received repeated acclaim for its public education and sponsorship of private recycling activities. In 1990 the National Recycling Coalition named San Francisco's program the Best Urban Recycling Program. In the same year, the California Department of Conservation granted an award to the City for its outstanding recycling education program.

Recycling Activities

Residential Curbside Recycling

Start-up Date:	Pilot program began in November 1981 and ended in November 1986. The present San Francisco curbside program began in April 1989.
Service Provider:	Sunset Scavenger in conjunction with Golden Gate Disposal provide service under contract with the City. Both Sunset Scavenger and Golden Gate Disposal are subsidiaries of Norcal Waste Systems, Inc.
Pick-up Frequency:	Weekly
Same Day as Refuse:	Yes. The majority receive same-day service.
Households Served:	29,000 households from April 1989 to April 1990; expanded by phases to 154,000 households in one- through five-unit buildings, and 1,000 multi-unit buildings (of six or more units) as of November 1990.
Mandatory:	No
Participation Rate:	50 percent weekly set-out rate in 1990. From this data, the Recycling Manager estimates an 80 percent monthly participation rate.

Materials Collected:	Newspapers, corrugated cardboard, high-grade paper, magazines, junk mail, phone books, glass containers, aluminum cans, tin cans, bimetal cans, aluminum foil, and PET plastics
Set-out Method:	Residents are asked to place paper goods (old newsprint, corrugated cardboard, high-grade ledger, magazines, junk mail, and phone books) in paper bags, and commingled glass, plastic bottles, and aluminum cans in 12-gallon plastic bins. The bins, made of at least 10 percent postconsumer plastic, are supplied by the hauler. Larger apartment buildings are provided with 60- and 90-gallon containers as needed; these are placed in central locations in each building.
Collection Method and Vehicles:	Lodal 31-cubic-yard two-compartment Bi-Loader collection vehicles are used to collect recyclable materials. The model was in part designed by Sunset Scavenger to accommodate collection on the hills of San Francisco. It has a shorter wheel base for better maneuverability and handling on hills, and loads from both sides to improve collection efficiency on narrow streets. Generally, one person collects the materials, placing paper in one compartment and commingled bottles and cans in the other.
Economic Incentives:	The variable refuse rate provides an economic incentive for residents to recycle. As a result of the success of the curbside program, San Francisco introduced a 20-gallon "mini-can" for refuse in October 1991.
Enforcement:	An anti-scavenging ordinance has been in effect since April 1990. As of September 1991, four citations have been issued and two arrests have been made.
Annual Tonnage:	21,463 tons in 1990. With the curbside program fully phased in, the City estimates that it is recovering 55,000 tons per year. In September 1991, 4,500 tons were collected through the residential curbside program.

Commercial & Institutional Curbside/Alley Recycling

Legislative Requirements:	None
Service Providers:	Golden Gate Disposal and Sunset Scavenger, the primary refuse haulers collect recyclables from their commercial refuse customers. West Coast Salvage and Recycling, also a subsidiary of Norcal, and an additional 30 for-profit and nonprofit companies collect recyclables from the commercial sector.
Number Served:	Golden Gate Disposal serves approximately 500 accounts. Of these, approximately 200 are retailers served with corrugated cardboard collection and 300 are bars, restaurants, and hotels receiving glass bottle and aluminum can collection. The recycling manager estimates that each account has an average of at least five tenants. Sunset Scavenger serves approximately 1,000 businesses, of which 220 are the Bar and Restaurant Glass Recycling Program customers. West Coast Salvage serves over 100 buildings, with an average of 20 to 30 commercial tenants in each. Information was not available from other haulers.

Type Served:	Golden Gate Disposal and Sunset Scavenger serve small and large businesses, all major hospitals, schools, hotels, bars, and restaurants. Golden Gate serves more large accounts because its collection route is in the downtown/financial district of the City. West Coast Salvage and Recycling services primarily high-rise office buildings. The Association for Retarded Citizens consolidates recyclable materials from City Hall. Other community groups collect from some small and large commercial establishments. Over 30 independent collectors pick up recyclable materials from small and large commercial establishments.
Materials Collected:	Golden Gate and Sunset Scavenger collect corrugated cardboard, newspaper, glass, and aluminum cans, and sponsor a 1-day phone book collection. In 1991 both companies began accepting mixed waste paper. West Coast collects primarily high-grade office paper. Over 30 independent haulers collect glass, and different grades of paper, including telephone books.
Pick-up Frequency:	Varies from once every two weeks to six times a week. Golden Gate and Sunset Scavenger collect glass from their Bar and Restaurant Glass Program customers up to four times per week, and collect corrugated cardboard up to six times per week.
Set-out and Collection Method:	<p>Golden Gate Disposal provides 60- and 90-gallon toters, and 1-, 1.5- and 2-cubic-yard bins as needed to customers. Corrugated cardboard and newspapers are commingled in a toter or bin, separate from refuse. Some retailers bale cardboard and haul it to their distribution center for pick-up. Bars and restaurants commingle three colors of glass with aluminum cans in plastic wheel bins or metal containers. Golden Gate collects newspaper in packer trucks and glass in a 30-cubic-yard top-loading vehicle. West Coast Salvage and Recycling paper customers are asked to separate white ledger and computer paper from colored ledger and mixed paper.</p> <p>Sunset Scavenger also provides 60- and 90-gallon toters to customers. Recyclables are collected in four rear-loading packer trucks and a converted top-loading truck. Three of the rear-loading trucks are used to collect corrugated cardboard (200 tons per month), and one is used to collect mixed paper. The 22-cubic-yard top-loading truck is a converted tallow truck with a front-loader fork for collection of commingled glass from bars and restaurants.</p>
Incentives:	Bar and restaurant glass accounts received a volume-based rebate on the glass that is recycled. In mid-1990 this rebate was \$36.50 per ton. Golden Gate and Sunset Scavenger discontinued the rebate in September 1991. Both companies offer a reduced refuse collection rate to bars and restaurants that recycle containers with other recycling companies, based on the reduction in volume collected.
Annual Tonnage:	Golden Gate and Sunset Scavenger collected an estimated 3,500 tons of glass and cans in 1990, paying over \$100,000 in rebates to participating bars and restaurants. Additional tonnages are recovered from the commercial sector but cannot be divided between curbside and self-haul recycling activities.

Because the bulk of the growth in solid waste generated is anticipated to come from the commercial sector, SFRP heavily promotes both government and private sector commercial recycling. All

government offices recycle office paper. A full-time staff person at SFRP coordinates City government office recycling efforts and provides businesses with free consulting services on how to set up office waste reduction and recycling programs. The SFRP also provides desktop recycling boxes and staffs a recycling hotline.

In 1985 Golden Gate Disposal and Sunset Scavenger, together with the Haight Ashbury Neighborhood Council (a nonprofit group) with a matching grant from the City, initiated the Bar and Restaurant Glass Recycling Program. Until September 1991, high volume "producers" received rebates from hauling fees from Sunset Scavenger and Golden Gate Disposal for separating commingled glass from regular refuse. These haulers would like to continue to provide container collection to these companies, but are facing increasing obstacles. Golden Gate Disposal's recycling manager estimates that 30 percent (by weight) of the commingled material was lost to theft in the beginning of 1990. Moreover, according to her figures, the company incurred several thousand dollars in damages to totes and bins during this period. The recycling manager directly correlates this rise in scavenging with the increase in California container redemption value from 1.5 to 2.5 cents in January 1990. Customers have since been asked to put bins indoors or in a secured area. Golden Gate had to terminate service to an estimated 15 percent of its Bar and Restaurant Glass accounts due to a high scavenging rate and inability to secure containers to prevent further scavenging. In addition, end users of glass are becoming more reluctant to accept the glass generated by bars and restaurants, since it is not sorted by color.

Golden Gate Disposal and Sunset Scavenger also recover high-grade paper from refuse generated by businesses in the downtown/financial district of San Francisco. These businesses either are not recycling or are not recovering a significant amount of their waste stream. The mixed waste is brought to a processing center, where the high-grade paper is separated from refuse.

Self-haul and Drop-off Centers

Number and Type:	More than 30 privately operated buy-back and drop-off centers
Public or Private:	Private. Norcal Waste Systems owns and operates Sanitary Fill Transfer Station. West Coast Salvage and Recycling, a subsidiary of Norcal, owns and operates two multimaterial buy-back centers, and three buy-backs for California Redemption Value containers. It also owns five buy-backs that are operated by Goodwill Industries. The nonprofit San Francisco Community Recyclers (SFCR) operates three buy-back centers. Haight-Ashbury Neighborhood Council and Richmond Environmental Action each operate a site.
Sectors Served:	Residential and commercial/institutional
Materials Accepted:	California Redemption Value beverage containers, glass bottles and jars, whole wine bottles, tin and bimetal cans, PET and HDPE plastic, computer and high-grade paper, newspaper, corrugated cardboard, clothing, small electrical appliances, kitchenwares, paint, polystyrene packing peanuts, used motor oil, auto batteries, and household-generated hazardous waste
Annual Tonnage:	An estimated 74,515 tons of residential recyclables were collected through various drop-off sites in 1990. An additional 2,160 tons of recyclables were collected from the residential and commercial sectors at the public disposal and recycling area.

Drop-off is a primary method of recyclables collection in San Francisco, particularly in 1990 when the curbside program was not yet fully implemented.

More than 30 State-certified drop-off or buy-back centers are now operated by a variety of community and private groups. Independent community drop-off recycling centers in San Francisco date back to 1970, when the first was opened to accept newspapers, glass, and aluminum cans. The Haight-Ashbury Neighborhood Council and the Richmond Environmental Action each operate a buy-back center. Together with Golden Gate and Sunset Scavenger, the San Francisco Solid Waste Management Program sponsors the Household Hazardous Waste Collection Facility, one of the first of its kind in the U.S. It adjoins the City's solid waste transfer station and accepts materials from residents 3 days a week, year round. While this facility addresses the responsible disposal of such wastes by residents, the City's educational materials address non-toxic alternatives as well.

Construction & Demolition Debris

Construction and demolition debris is reclaimed at the Sanitary Fill Transfer Station. According to Kelly Runyon of Sanitary Fill, approximately 100 tons of C&D per day are processed at the transfer station. Of the total C&D debris coming into the transfer station, 75 percent is recovered for use in road resurfacing and new construction. Of this, approximately 40 percent is rock and dirt, 20 percent is wood, and 15 percent is scrap metal. In 1989, 11,800 tons of asphalt and concrete were recovered at the transfer station; 12,428 tons of these materials were reclaimed in 1990. Five other companies in San Francisco offer debris box service for the reclamation of construction and demolition debris.

According to the City's Recycling Coordinator, all construction and demolition debris from the collapse of the Embarcadero Freeway in the October 1989 earthquake was recycled. When the City called for bids on reconstruction of the freeway, most estimates were around \$8 million. The company that was awarded the contract bid \$3.2 million on the reconstruction and claimed it was able to do so because it was using recycled asphalt and concrete.

Salvage/Reuse

Goodwill Industries operates five buy-back and donation centers in San Francisco and accepts used clothing and housewares. Other thrift shops accept used clothing, appliances, and furniture. ENCORE! in Richmond, California accepts wine bottles at its facility. The bottles are rewashed and sold for reuse to wineries throughout the U.S., although the biggest customers are in Napa Valley, California. The City is providing start-up funds to SCRAP (Scroungers Center for Reusable Arts Parts), a non-profit group that will collect discarded materials and provide them to artists and schools for art projects.

Processing and Marketing of Recyclables

West Coast Salvage and Recycling is the largest materials processing operation in the Bay Area. The Company, like the two primary haulers of refuse and recyclables, Sunset Scavenger and Golden Gate Disposal, is a subsidiary of Norcal Waste Systems, Inc. West Coast has three intermediate processing centers: the Total Urban Recycling Facility (TURF), the Bayshore facility, and the 350 Rhode Island facility.

Materials collected at curbside from the residential sector are brought to the Total Urban Recycling Facility and the adjacent Bayshore facility. These companies are located on the southeastern border of San Francisco, an average distance of 3 to 5 miles from residential curbside collection routes. Commingled glass, aluminum and plastic bottles brought in by Sunset Scavenger are tipped onto a main floor at the TURF and scooped with a front-end loader onto a shaker screen, where crushed glass and small contaminants fall through. The material is then conveyed onto a sorting belt where laborers hand-pick California Redemption Value PET and other plastics, and remove larger contaminants.

Material passes over a magnet where tin is pulled off, and over an air classifier, which blows the aluminum cans off of the conveyor. Three laborers color-sort the glass and pull out contaminants.

Mixed waste paper, corrugated cardboard, and high-grade paper from the residential curbside program, and from Golden Gate Disposal's and Sunset Scavenger's commercial accounts, are processed at the Bayshore facility. Corrugated cardboard and kraft paper bags are pulled out by hand, then baled. High-grade paper is separated out from mixed paper; the two grades are then baled separately.

Mixed glass collected by Golden Gate and Sunset Scavenger through the bar and restaurant collection program is brought to TURF. (In 1991 the material was shipped directly to a broker, Circo Glass.) Color-sorted glass from West Coast's buy-back centers is brought to the 350 Rhode Island facility in debris boxes and shipped in trucks, which carry between 20 and 25 tons of glass to regional markets such as No-Cal Beneficiation, Owens-Brockway, and CalCRINC. Other recyclable materials collected from commercial accounts, such as aluminum cans and PET plastics, are processed at the 350 Rhode Island facility, located in downtown San Francisco. PET plastics and aluminum cans accepted at buy-back sites located throughout the City are also processed at the Rhode Island processing center.

Aluminum cans are baled or densified (40-pound blocks) and sold to Reynolds, Alcoa, or other vendors. Tin cans are sold to Prolar in Lathrup, California, about 150 miles from San Francisco. PET is sold to brokers. The majority of cardboard, newspaper, and mixed waste paper is sold to overseas markets.

According to Maureen Hart, general manager of West Coast Salvage and Recycling, the three facilities combined were processing approximately 450 tons per day in September 1991. Of these, approximately 200 tons per day were from the residential curbside program (at that time fully phased in). TURF operated two 8-hour shifts; Bayshore operates for 10 hours, 6 days per week; and 350 Rhode Island operates 24 hours a day. In all there are 102 people employed at the three facilities, approximately 11 were hired from the San Francisco Conservation Corps, a jobs training program; and 15 work in administration.

Most of the community drop-off/buy-back centers process and market their own materials. The SFCR ships glass in 30-cubic-yard roll-off containers to No-Cal and CalCRINC. Aluminum cans are flattened and sold to Alcoa or Reynolds Aluminum. Corrugated cardboard is sold to a local paper broker. Newspaper and mixed paper are sold to West Coast Salvage and Recycling.

Wood debris is hauled to a site adjacent to the transfer station, where Sanitary Fill separates wood and dirt, grinds the wood, and sells the wood chips as a fuel for electricity generation to two companies in the Bay Area. Sanitary Fill also provides dirt free of charge as an interim landfill cover. In the 1980's Sanitary Fill assisted in the start-up of West Bay Metals, a business that removes ferrous metals from the waste stream at the transfer station. Motor oil is re-refined at local refineries. Tallow renderers collect grease and bones from restaurants and other businesses. Most of their finished product is sold overseas.

Market Development Initiatives/Procurement

Although the SFRP has commissioned market studies for the recyclables collected at curbside, marketing and market development are generally left to the collection companies. However, the curbside collection contract between the City and Norcal (Golden Gate/Sunset Scavenger) allows the City to redirect recyclables to new markets for market development. SFRP also acts as a facilitator between the markets and the private companies and nonprofit community recyclers.

The Program has used City government offices to spearhead efforts for increased purchases of reusable, recycled, and recyclable products. SFRP is developing City procurement policies for paper, oil, building products and tires. To date, however, there is no legislation related to procurement. SFRP is planning to complete a purchasing guide that includes a list of recommended products and recycling definitions. The guide will be made available to local businesses so that they may implement a "buy-recycled" program.

Composting Activities

Although the City does not offer curbside collection of yard waste, it is addressing recovery of organic wastes on several fronts. In addition to funding and working closely with the San Francisco League of Urban Gardeners (SLUG) to promote backyard composting, the City is reevaluating its current approach to hauling and landfilling food wastes, which amount to 30.9 percent by weight of the residential waste disposed and 19 percent by weight of commercial waste disposed.

Backyard Composting

In 1988 SFRP began working with SLUG to develop a home composting program for the City. While SFRP designs and promotes the program, SLUG is responsible for its implementation. SFRP granted SLUG \$25,000 for its first year of work on the project, which included conducting workshops for the general public, developing and disseminating related educational materials, staffing a compost education center at SLUG's Garden for the Environment, and maintaining the "rotline," a composting hotline. Carl Grimm, education director of SLUG, reports that during the first year of the program, more than 300 people learned home composting at SLUG workshops, more than 3,000 persons took the self-guided tour at the compost education center, and more than 10,000 brochures were distributed.

In the summer of 1990, SLUG held composting workshops, and produced 30,000 "How To Compost" brochures. During this period, SLUG began vermicomposting workshops, where residents pay \$35 for instruction, a worm bin, and worms. The response has been very positive, with waiting list only space available.

In the third year of its home composting program, the SFRP has budgeted \$80,000 to include a master composter program and bin distribution program. In addition the SFRP is taking advantage of the City's decision to offer a mini-can for refuse collection by encouraging residents who are switching to the mini-can to use their old garbage cans for backyard composting. The SFRP will begin offering workshops in Spanish and Cantonese and the SFRP is putting money toward expanding SLUG's composting education center. SFRP advertises the home composting program on bus shelter signs and posters in buses and is tailoring promotions to encourage more participation from residents in other parts of the City.

ZooDoo Composting

Since 1989, following the lead of New York's Bronx Zoo, the nonprofit Urban Resource Systems Inc. began composting zoo animals' manure and bedding material to produce a marketable compost product called "ZooDoo." Funded initially by a \$58,000 grant from the SFRP and three foundations, the project saved money in landfill tipping fees and recycled a valuable resource. The City provided a total of approximately \$100,000 in funding over the three years of the program. Since 1989 the City's Recreation and Parks Department, under whose jurisdiction the Zoo falls, has been hauling the manure to its composting site in Golden Gate Park.

TreeCycling Program

The SFRP initiated a Christmas "TreeCycling" program in January 1988. One thousand of the 30,000 trees sold that season were chipped by the City and recycled as mulch or used as fuel. In the 1990-91 season, more than 26,000 trees—nearly 50 percent of the 53,000 trees sold—were recycled. Various promotional efforts, including the distribution of handouts to tree-selling sites and curbside collection of trees in a small area of the City, have contributed to the program's success. Trees were returned to

two public drop-off sites for on-the-spot chipping (with residents receiving the mulch) or to bins at five recycling sites operated by private groups, which chipped the trees for sale as a fuel. A total of 26,500 trees (172 tons) were collected during the 1989-90 Christmas season. Of these, 49 tons of trees were chipped and the remaining 123 tons were burned.

Amount and Breakdown of Materials Recovered

Material	Residential (Tons, 1990)	Comm/ Institutional (Tons, 1989)	Other* (Tons, 1989)	Total (Tons, 1989)
Newspaper	52,085	866	-	52,951
Corrugated Cardboard	15,754	9,928	250	25,932
High-grade Paper	9,963	9,227	-	19,190
Other Paper	10,578	24,019	-	34,597
CA Redemption Glass†	5,704	19,797	40	25,541
Other Glass	3,470	332	20	3,822
HDPE Plastic	8	-	-	8
PET Plastic†	152	-	-	152
Other Plastics	12	-	-	12
Aluminum Cans†	1,665	13	-	1,678
Ferrous Metal	1,768	200	1,850	3,818
Nonferrous Metal	62	585	-	647
White Goods/Appliances	3,521	4	-	3,525
Textiles	1,814	-	-	1,814
Tires	-	52	-	52
Fat, Grease, and Bones	-	3,948	-	3,948
Household Hazardous Materials	156	-	-	156
Subtotal MSW Recycled	106,712	68,971	2,160	177,843
Food Waste	4,414	-	-	4,414
Yard Waste	2,564	1,858	-	4,520
Christmas Trees	49	-	-	49
Subtotal MSW Composted	7,027	1,858	0	8,885
Total MSW Recovered	113,739	70,829	2,160	186,728
Asphalt/Concrete	-	-	12,428	12,428
Total C&D Recovered	-	-	12,428	12,428
Total Materials Recycled	106,712	68,971	14,588	190,271
Total Materials Composted	7,027	1,858	0	8,885
Total Materials Recovered	113,739	70,829	14,588	199,156

Note: Residential materials include tons collected through the municipally sponsored curbside program, self-hauled to drop-off centers, and to the transfer station in 1990. Tonnages of wood burned as fuel are excluded, as is recovered manure.

* Other municipal solid waste includes corrugated cardboard, glass, ferrous scrap, and wood collected at the transfer station from debris boxes and from a public self-haul area on the site.

† Most of these containers are recovered as a result of the bottle bill.

Source Reduction Initiatives

Source reduction efforts include volume-based refuse rates and "environmental shopping" publicity and education. Homeowners pay \$8.49 per month for one 32-gallon refuse can and \$3.86 for each additional can. Rates were increased and 20-gallon mini-can was added effective October 1991, both are expected to encourage increased participation in the recycling programs. The "It's Easier Than You Think" campaign, initiated in 1986, emphasized the use of brown paper bags to store and carry recyclables and encouraged people to ask for paper bags at the supermarket. In 1990 Safeway Stores promoted an "environmental shopping" campaign in its stores and paid for billboards and bus signs designed by the SFRP. More than 70,000 "environmental shopping" guides were distributed from May 1990 through the summer of 1991. The City sponsored a "Grocery Docent Program" in conjunction with Safeway Stores to educate shoppers on ways that they could reduce waste at the source. Two persons staffed booths located at five stores throughout the City. The City also provides educational materials that suggest non-toxic alternatives to household hazardous wastes, and offers waste reduction guides to offices.

Publicity and Education

While the SFRP promotes recycling through coordination of existing programs and the planning and facilitation of new ones, its main thrust is public education. Since recycling opportunities are widely available throughout the City, the Program's challenge is to maximize the number of people taking advantage of such opportunities. To this end, SFRP has targeted a variety of demographic and community groups, and has tapped the expertise of various businesses.

In 1986 SFRP awarded \$20,000 each to four public relations firms to promote recycling in four separate communities in the City. The first program promoted a "cash-for-trash" theme in the low- and middle-income Bayview-Hunter's Point area. The second targeted Hispanic residents via Spanish-speaking radio and TV stations. The third program, "Recycle for Life," targeted the gay and lesbian communities, encouraging recyclers to donate their recycling proceeds to the AIDS Foundation. The fourth campaign, "It's Easier Than You Think," targeted the ethnically mixed, middle-class Richmond/Sunset District, explaining how and where to recycle. This campaign was extended citywide in 1986-87. In 1988 a Newspaper Recycling Starter Kit was distributed to 119,000 households with the daily newspaper to encourage recycling.

In 1987 the SFRP hired a Recycling Education Coordinator to introduce a K-5 curriculum, developed in accordance with the State's Science Frameworks Guidelines, that would use recycling activities to teach science. The Coordinator also helps schools set up their own recycling programs, gives presentations to classes and faculty, and leads field trips to the transfer station and recycling centers. The School Education Program maintains a library of recycling curricula from other states and various teaching materials, including books and videos. A curriculum for grades 6 through 12 will be available in late 1991. More than 1,000 teachers in the City's seventy-three elementary schools use the K-5 curriculum, and most schools have started recycling programs.

In the 1990-91 school year, SFRP sponsored 60 performances of the play, "Garbage is My Bag." The main character in the play, Dr. T, has a Ph.D in Garbology, and through audience participation highlights the benefits of recycling and encourages students to find innovative ways to use garbage. An additional 60 performances are slated for the 1991-92 school years.

SFRP has worked with Safeway Stores to promote "environmental shopping" and with Pacific Bell to encourage phone book recycling. In 1990 the City, coordinating with Pacific Bell, printed a recycling message on the bags used to distribute phone books. The phone company coordinated a mailing urging businesses receiving more than 300 sets of phone books to recycle, and included a four-page insert on recycling in the yellow pages.

Many of SFRP's educational and motivational materials are available in English, Spanish, and Chinese, including public service advertising on radio and TV, buses, transit stations, and billboards. Recycling information appears monthly in various southeast Asian language newspapers, and a media relations consultant channels news and feature stories to the media.

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Economics

Costs Cover:

Costs cover administration associated with program development, the promotion of recycling projects, public outreach, and grants. Other costs, including capital costs and operating and maintenance costs, are incurred by the private sector or directly by residents, not the City.

West Coast Salvage and Recycling, the largest materials processor in the Bay area (also a Norcal Waste Systems company), would not provide information on capital equipment or O&M costs.

SFRP was set up in 1980 as part of the City's Solid Waste Management Program to facilitate and encourage recycling in the City. From an initial budget in 1980-81 of \$100,000, the SFRP grew to account for almost half, or \$900,300, of the SWMP's budget in 1990; of the balance, \$610,000 was allocated to the Household Hazardous Waste Program, and \$490,000 to solid waste administration and planning.

Estimated costs of the residential curbside program total \$8.8 million. The program will recoup \$1.8 million in revenues from the sale of materials. All revenues from the sale of materials are rolled back into the program to offset costs. If the revenues exceed the amount estimated for rate-making purposes, residents will receive a reimbursement on their garbage bill for this amount, which is calculated on a quarterly basis. If the revenues fall below the estimated minimum, the garbage companies absorb that cost until such time as they think it is necessary to apply for a rate adjustment.

Capital Costs: Sunset Scavenger/Golden Gate Recycling Collection

Item	Cost	Use	Year Incurred
5 Rear-loading Packer Trucks*	\$500,000	Commercial Recycling	NA
54 Lodal Bi-loader Recycling Trucks @ \$85,000	\$4,590,000	Curbside Recycling	1989
2 Top-loading Packer Trucks @ \$70,000	\$140,000	Commercial Recycling	1990-1991
30-cubic-yard Roll-off Container†	NA	Special Events Recycling	NA

Note: Sunset Scavenger and Golden Gate Disposal lease the above equipment with an option to buy at the end of a 5-year depreciation period.

* The cost of purchasing new rear-loading packers is estimated at \$100,000 each. These trucks were purchased and have been depreciated over more than 10 years.

† Roll-off container is used for the collection of recyclable materials at special events.

San Francisco's Annual Operating and Maintenance Costs (1990)

	Recycling	Composting	Total
Collection*	\$0	\$6,000	\$6,000
Processing*	0	83,000	83,000
Administration	434,500	86,500	521,000
Education/Publicity	251,620	38,680	290,300
Total	\$686,120	\$214,180	\$900,300

Note: These costs are based on the City's 1990-91 budget.

* The City does not incur any costs for the collection or processing of recyclable materials. In 1990, \$6,000 was allocated for the collection of Christmas trees, and \$83,000 was budgeted for funding the backyard composting program.

Materials Revenues:	No revenues are retained by the City. Haulers roll their revenues from the sale of recyclables collected at curbside back into the program to offset its cost.
Source of Funding:	Funding is generated from a \$1.12 per household fee charged as part of the monthly garbage rate; it is paid into a separate Solid Waste Impound Account (rather than being commingled with general City funds).
Full-time Employees:	5 City employees (1 Recycling Manager; 1 Assistant Coordinator each for office recycling, education, and special projects; and a Public Information Coordinator)
Part-time Employees:	3 City employees (2 on the school education program; 1 on special projects)

Future Solid Waste Management Plans

San Francisco's Office of Recycling is planning to finalize the 6th through 12th grade recycling curriculum and introduce it into schools. The office plans to develop an interactive recycling exhibit with the San Francisco Academy of Sciences or the San Francisco Exploratorium, and is planning courses on natural resource conservation, including recycling, at various community colleges.

SFRP is addressing several aspects of composting. With food waste as a target, the City plans to expand the vermicomposting workshops, introduce the composting of food and yard trimmings into large apartment complexes, site a public drop-off for compostables, and investigate the feasibility of a commercial food waste collection program. Additionally, SFRP is considering citywide expansion of the curbside Christmas tree collection program.

The City is contracting Micro Services Plus to investigate the feasibility of a nonhazardous waste exchange program. SFRP is providing \$30,000 in funding for a feasibility study of a project that would create a recycled products job training and retail center in the City. Also SFRP is considering a wet/dry collection system in conjunction with the existing curbside program.

The Program is also compiling a list of organizations that accept home furniture, appliances, and other reusable items that Goodwill and the Salvation Army do not accept; the list will include businesses that repair such items. Together with the Bureau of Building Inspection, SFRP plans to advocate an amendment to the existing City Building Code that would require storage space for recycling in all new buildings. SFRP is also working with State agencies to develop legislation for the

collection and recycling of batteries. Finally, San Francisco has budgeted \$294,000 for anti-scavenging enforcement in 1991.

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Endnotes

¹William Schoen, Brown, Vence and Associates, San Francisco, California, personal communication, October to November 1991.

Seattle, Washington

Demographics

Jurisdiction:	City of Seattle
Population:	516,259 in 1990
Area:	92 square miles
Total Households:	249,032 total households (132,330 single-family households; 113,146 households in multi-unit buildings: 22,641 in buildings of 2 through 4 units, 71,285 in 5- through 49-unit buildings, and 19,220 households in buildings of 50 units or more; and 3,556 households in mobile homes, trailers, and other dwellings)
Total Businesses:	30,000 businesses (estimated by the Citizens Service Bureau)
Brief Description:	Seattle, the largest city in Washington and a noted cultural center of the Northwest, sits on Puget Sound surrounded by the Cascade and Olympic Mountains. The annual average unemployment rate of the Seattle metropolitan statistical area was 3.5 percent in 1990. The latest available figures suggest that unemployment is rising. Per capita income in the Seattle primary metropolitan statistical area was \$21,137 in 1987.

Solid Waste Generation and Recovery

Annual Tonnages (1990)						
	Residential*	Comm/ Instlt†	Self-Haul‡	Total MSW	C&D	Total Waste
Recovered	115,691	157,643	21,002	294,336	1,129	295,465
Recycled	78,911	154,199	8,038	241,148	133	241,281
Composted	36,780	3,444	12,964	53,188	996	54,184
Disposed	140,528	239,672	64,374	444,574	NA	NA
Incinerated	0	0	0	0	0	0
Landfilled	140,528	239,672	64,374	444,574	NA	NA
Generated	256,219	397,315	85,376	738,910	NA	NA
Percent by Weight Recovered§						
Recovered	45%	40%	25%	40%	NA	NA
Recycled	31%	39%	9%	33%	NA	NA
Composted	14%	**	15%	7%	NA	NA

Note: In 1990, 81,192 tons of solid waste were self-hauled to City transfer stations. For a period in 1990, sites designated for the disposal of construction and demolition debris were closed to the public and 16,818 tons of C&D were self-hauled to the transfer stations. This tonnage has been subtracted from the self-haul waste disposed, yielding 64,374 tons.

* If material rejected during processing (690 tons) were subtracted from material recovered, and instead included as waste disposed, Seattle's residential recycling rate would be 30.5% instead of 30.8%.

† Commercial/Institutional tonnages recycled are based on the City's extrapolations (using conservative growth estimates) from 1988 actual tonnages collected.

‡ Self-haul materials include recyclable materials and municipal solid waste brought to the Seattle Waste Utility's two transfer stations by residents and businesses. A study conducted in 1990 by Matrix, a Seattle-based consulting firm, showed that 57 percent of self-haul waste is residential and 43 percent is commercial.

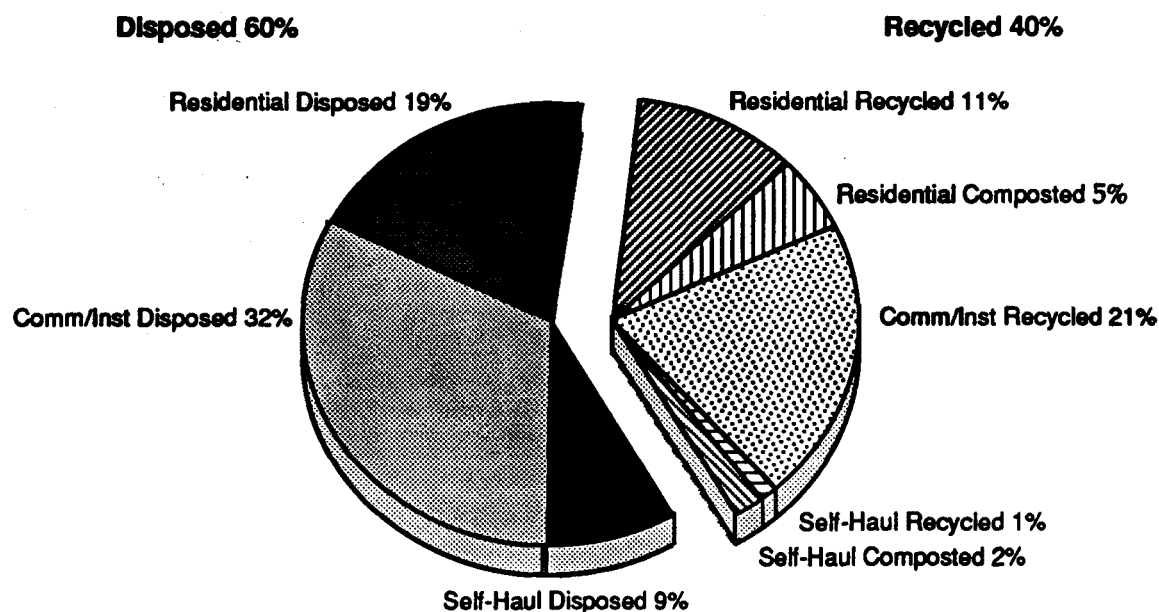
§ Numbers may not add to total due to rounding

** Less than 1 percent

Landfill and Transfer Station Tipping Fees: \$11.00 per ton in 1986 and \$31.50 per ton in 1987 through 1990 at the landfill; \$62.00 per ton at City transfer stations in 1990; \$58 per ton at private transfer stations. Beginning April 1991, MSW was tipped at the Argo Railyard for \$41.50 per ton.

Refuse Collection and Disposal: Residential waste in Seattle is collected by private contractors, brought to one of two City-owned transfer stations, and then long-hauled by truck to King County's Cedar Hills Landfill, approximately 30 miles from Seattle. As of April 1991, MSW was directed to the Argo Railyard for longhaul to a landfill in Arlington, Oregon. The railyard fee of \$41.50 per ton covers transportation and disposal. Commercial waste is collected by two private haulers who have franchises enabling them to collect refuse in Seattle. In 1990 the haulers transported commercial waste to two privately owned transfer stations in the City. Seattle Disposal, Bayside Disposal (owned by Waste Management), and two other companies, Halfman Trucking and Montleon Trucking, haul construction and demolition debris. The City paid a total of \$17,404,000 for refuse collection and disposal in 1990. Of this, Seattle paid \$9,387,000 for the

Municipal Solid Waste Recovered and Disposed (Percent by Weight, 1990)



Refuse Collection and Disposal (cont'd):

collection of 140,528 tons of residential refuse and \$8,017,000 for the disposal of 221,720 tons of refuse (140,528 from the residential sector and 81,192 tons self-hauled to City transfer stations). Seattle has had a variable can rate, as opposed to a flat monthly garbage rate, since 1981. The City offers residents four different-sized containers: a 19-gallon "mini-can" at \$10.70 per month; a 32-gallon can at \$13.75 a month; a 60-gallon can at \$22.75 per month; and the largest container, a 90-gallon can, at \$31.75 per month.

Materials Recovery Overview

Goals and Legislative Requirements:

Seattle has set a goal of recovering 60 percent of its municipal solid waste stream by 1998: 24 percent through residential curbside and drop-off collection programs; and 36 percent from the commercial sector. Some construction and demolition debris is recovered at the transfer stations, but is not targeted in Seattle's 60 percent recycling goal. The City has interim goals of 40 percent by 1991 and 50 percent by 1993.

The City began developing recycling plans in 1985, after plans to build a mass burn incinerator were derailed by citizen protest. In September of 1986, after the closure of two City-operated landfills, Seattle had to renegotiate its disposal options. The City decided to transport its waste to a County-operated landfill, where disposal fees were almost three times that at the City-operated landfills. In 1987 the City renewed the incinerator option. Continued citizen objections to the new incinerator plan

prompted additional recycling and waste reduction research by the City Solid Waste Utility. This research yielded an analysis of existing recovery activities in the City and additional recovery strategies that could be implemented. One of the scenarios predicted that the City could recover 64 percent of its waste stream by the year 2000. A modification of this alternative was adopted as the official plan to recover 60 percent of the City's solid waste by 1998 and was used to convince the City Council to abandon plans for incineration and adopt a recycling/landfilling waste management strategy.

In February of 1988, Seattle began a citywide residential curbside recycling program. The Solid Waste Utility contracts with two private haulers for the collection and processing of materials collected at the curb. The collection services are offered to approximately 148,500 single- through 4-unit residences, with the two collection contractors using different approaches. Recycle America, a subsidiary of Waste Management, Inc., provides collection services in the north section of the City. Households there receive three stackable containers for recyclable materials, which are collected weekly. Recycle Seattle, a subsidiary of Rabanco, Inc. (a locally owned waste management company), collects materials in the south section of the City. Participants in the south section are provided with 90-gallon containers, and the recyclables are collected monthly. In 1989 the amount of recyclables collected per participating household was 18 percent greater on average in the north section than in the south section; in 1990 it was 15 percent greater.

The City of Seattle is very interested in how the two different service methods perform, but believes that it is too early to draw any conclusions. The south end is different demographically from the north end. In general, the north section of the City is a higher-income area than the south section. The City commissioned Elway Research, Inc. to compare attitudes and recycling behavior of participants and nonparticipants in areas of low participation in the City, and to assess which factors contribute to nonparticipation. Three hundred and one households from areas of low participation in the City were randomly selected and the residents surveyed by telephone. Solid waste, yard waste, and recyclable materials were collected from a subsample of 149 households. The results of the study, published in May 1991, suggest that nonparticipants are more likely to live in a 1- or 2-person household (as opposed to a group house in which more waste is generated), not to have attended college, and to earn less than \$30,000 per year. The study also found that participating households actually produce more household waste than do similar nonparticipating households.

A pilot collection program for mixed plastic servicing 4,500 households began in November 1988. As a result of this pilot program, the City in 1989 implemented curbside collection of PET plastic containers only, although PET, LDPE, and HDPE plastic containers were accepted at eight City drop-off centers. In an effort to reduce the amount of plastics generated in Seattle, the City in 1988 banned the use of polystyrene and plastic beverage containers at all City facilities.

The tonnage of recyclable material collected at curbside from the residential sector increased 12 percent from 1989 to 1990 and 91 percent from 1988 to 1990. The 45,737 tons collected through the residential curbside program represents over half of the 78,911 tons of recyclables collected in the residential sector.

Before the establishment of the recycling goals, the City relied on a network of independently owned for-profit and nonprofit recycling centers that purchased, accepted, or collected household and commercial recyclable materials.¹ In 1985 this network alone recovered a remarkable 22 percent of the City's waste. This level of recycling is attributed to the City's variable can rate, which has been in effect since 1981. The Seattle Solid Waste Utility has set up a mitigation committee to analyze the effect of the curbside program on the independently owned for-profit and nonprofit recycling centers. Thus far, they have found that the recyclers operating drop-off centers and buy-back centers in the City may have seen their recovery rates go down, but those operating outside the City limits have experienced an increase in material. A study quantifying these results has not been completed, but one possible explanation for the increase in materials collected outside of town is the increased education and advertising for recycling and waste reduction.

In 1989 Seattle implemented a citywide curbside yard waste collection program, and required residents to set out yard waste separate from recyclable material and refuse. From 1988 to 1990, the City witnessed a decrease in yard waste disposed from more than 17 percent to less than 3 percent.

Through its Environmental Allowance Program, the Solid Waste Utility has funded many projects to test innovative recycling techniques, including mixed waste paper collection from small businesses and apartment buildings (\$99,000, Paper Fibres); a program to test methods for the recycling, reuse, and safe disposal of latex paint (\$21,000, Morley and Associates); Cash for Trash, a monthly garbage lottery that paid participants for having recyclable-free garbage (\$30,000, Metrocenter YMCA); and the purchase of a shredder-chipper for loan to neighborhood residents for backyard composting (\$2,000, Duwamish Peninsula Community Commission).

The City of Seattle won the *Best Overall Program in a Large City* award in the Institute for Local Self-Reliance's *Record Setting Recycling Contest 1989*. The City has received similar awards from the National Recycling Coalition and the Washington State Department of Ecology. In May 1991, Seattle Tilth's Community Composting Education Program won the EPA's first annual Administrator's Award for Community, Civic, and Nonprofit Recycling Activities.

Recycling Activities

Residential Curbside Recycling

Start-up Date:	February 1988 for the north section, April 1988 for the south
Service Provider:	Private haulers under municipal contract: Recycle America in the north section and Recycle Seattle in the south section.
Pick-up Frequency:	Recyclables are picked up weekly in the north section of the City and monthly in the south section.
Same Day as Refuse:	No
Households Served:	148,500 households (single-family through four-unit households, based on Seattle Solid Waste Utility estimates) are eligible for curbside collection service as of 1990 (69,000 in the north section, and 79,500 in the south section).
Mandatory:	No
Participation Rate:	83 percent citywide in December 1990 (89.6 percent in the north section, and 77.3 percent in the south section). Participation rate is defined as sign-up rate—the ratio of the number of households registered for the program to the number of households eligible. As of June 1991, 92.3 percent of eligible households in the north section and 80.4 percent in the south end had signed up for curbside collection of recyclables.
Materials Collected:	Newspaper, mixed waste paper (magazines, junk mail, coupons, fliers, wrapping paper, used envelopes, cereal boxes, cancelled checks, old bills, old papers, phone books, paper tubes, paper egg cartons, and brochures), glass, aluminum, tin, PET plastic containers, and corrugated cardboard

Set-out Method:	In the north section of the City, residents are furnished with three 12-gallon stacking containers made by Rehrig Pacific. One holds commingled glass, aluminum, PET plastic containers, and tin cans. Another holds mixed scrap paper. The third holds newspaper. Corrugated cardboard is set out next to the containers. In the south section, 60-gallon or 90-gallon totes, made by Toter Inc. and Dye Plastics, hold commingled materials (glass and plastic containers, aluminum and tin cans, newspapers, and mixed paper).
Collection Method and Vehicles:	Compartmentalized recycling trucks are used for collection of recyclables in the north section of the City. Five rear-loading trucks are used in the south section. In both sections of the City, a 1-person crew operates the recycling vehicle.
Economic Incentives:	The variable can rate is an incentive for residents to generate as little waste as possible and to recycle as much as possible.
Enforcement:	Not applicable
Annual Tonnage:	45,737 tons in 1990, of which 24,787 were collected from the north end and 20,950 were collected from the south end. (23,984 tons were collected at curbside in 1988 and 40,732 tons were collected in 1989.)

Under Seattle's contract terms the haulers must pick up and market waste paper. Both companies instruct customers to recycle all paper products that are not wax- or plastic-coated. Recycle America has modified its collection method; its recycling vehicles must periodically off-load the waste paper into packer trucks due to the volume of waste paper collected through the residential curbside program.

Multi-unit Collection

In 1988 the City hired a full-time coordinator to develop and implement an apartment recycling program. The coordinator has been responsible for informing apartment owners, managers, and dwellers how to recycle; making the program available throughout the City; and coordinating with the City, recyclers, and apartment building owners, managers, and tenants. The City started the program in the fall of 1989, offering recycling services to households in multi-unit buildings.

Initially, the Seattle Solid Waste Utility planned to give haulers an economic incentive for providing recycling to multi-unit buildings of five or more units. The haulers were to receive a diversion credit of \$30 to \$40 per ton for recyclable materials collected. However, only one small hauler, Nuts & Bolts Recycling, signed up for this program. The City then approached the current curbside recycling contractors about adding apartments to their routes; it also opened negotiations with two other private contractors. A satisfactory price could not be negotiated, so the City prepared an RFP asking only for proposals that did not exceed \$75 per ton, the approximate avoided disposal cost. Nuts & Bolts, which originally signed up for the diversion credit program was allowed to utilize it. In 1989 this hauler reported 305 tons recycled; it has increased this amount to approximately 75 tons per month in 1990.

As of 1991, the City pays a \$60 per ton diversion credit to two private recyclers. Nuts & Bolts Recycling, the larger of the two, collects recyclables from approximately 400 buildings of four units or more in the north end of the City. West Seattle Recycling collects from 25 to 30 apartment buildings of four or more units in the south end of the City. Nuts & Bolts collects old newsprint, aluminum and tin cans, color-separated glass bottles, and mixed waste paper (all but wax- and poly-coated), and West Seattle Recycling collects newspapers and aluminum cans. Residents are asked to separate their recyclables, sort glass by color, and place materials in 55-gallon containers (provided by the hauler), which are typically located in the building's basement or garage.

In addition to paying the diversion credit, the City shares the risk of marketing the recyclables. The City and the contractors negotiated for a base selling price of \$40 per ton for newspaper and glass bottles, \$55 per ton for tin cans, \$633 per ton for aluminum cans, and \$15 per ton for mixed paper. The contractor takes the loss or the gain if the price deviates up to 20 percent from the base price; for price deviations greater than 20 percent, the City shares the loss or the profit equally with the contractors. The City is negotiating with both Recycle America and Recycle Seattle for the provision of citywide collection of recyclables from apartment complexes.

Sun West Disposal collects recyclable materials from high-density apartment buildings (approximately 20 to 50 units) independent of the City. Sun West has arrangements for the collection of recyclables with the owners or managers of approximately 400 apartment buildings, independent of municipal contracts. It supplies 90-gallon toters as needed and collects materials commingled. Collection crews bring materials to the Rabanco Recycling Center.

Commercial & Institutional Curbside/Alley Recycling

Legislative Requirements:	None
Service Provider:	Seattle Disposal (a Rabanco company) and Bayside Disposal (a Waste Management company), the primary refuse haulers, offer recycling services to their customers. In addition there are numerous other paper companies such as Weyerhaeuser International, Pacific Paper Stock, Independent Paper Stock, and Ideal Paper Stock provide, and recycling companies, such as Nuts & Bolts Recycling, Sun West/American Recycling, West Seattle Recycling, and Seadrumar Recycling, also collect recyclable materials from offices and businesses in Seattle.
Number Served:	Not available
Type Served:	Any business that requests service
Materials Collected:	Corrugated cardboard, office paper, computer paper, magazines, aluminum and ferrous cans, plastic containers, and glass
Pick-up Frequency:	On-call basis
Collection Vehicles and Set-out Method:	Haulers collect materials that are set out in 90-gallon toters or in 1-, 2-, or 3-cubic-yard dumpsters
Incentives:	Rates for the collection of source-separated materials are between 25 and 45 percent less than for refuse collection. The City currently excludes collection of commercial recyclables from the City Business and Occupation Tax that haulers must pay on garbage collection revenues.
Annual Tonnage:	Not available

Private Sector Activities

Four collection companies service the commercial and industrial sector of Seattle with refuse collection. Each of these haulers holds a certificate from the Washington Utility Transportation Commission (WUTC), which regulates refuse rates. As of 1991 the WUTC approves commercial recycling tariffs, special recycling rates submitted by the haulers which determine what rate the haulers may charge commercial customers. Seattle Disposal and Bayside Disposal, the major

commercial waste haulers, collect recyclable materials from many of their commercial customers. These two companies compete for customers through service, but have identical territories and rates. They both provide regular route service and drop-box service for on-call customers. Both offer reduced rates for the collection of source-separated materials—typically a 25 percent price reduction. Paper companies in the region collect high-grade paper from offices, some also collect other materials such as corrugated cardboard, used beverage containers, and a number of other private recyclers collect recyclable materials from businesses and pick up material from school- and charity-sponsored paper drives. Seadrunar Recycling collects used beverage containers, corrugated cardboard, mixed paper, and magazines from businesses. The revenues from the materials go to fund its drug and narcotic rehabilitation program. The City does not regulate or fund private sector collection services.

Public Sector Activities

Seattle has had a recycling program in City offices for 10 years. The City has contracted with Seadrunar Recycling, a nonprofit organization committed to drug rehabilitation of juveniles and adults, for weekly pick-up of paper and cardboard at municipal offices. Employees typically keep a recycling box at their work stations. Periodically, they empty the boxes into centralized collection stations, usually blue 55-gallon drums. On pick-up day, the recycling operator empties the barrels and takes the paper for baling and marketing.

In 1989 the City signed new contracts for a multimaterial recycling collection program of office paper, newspaper, aluminum, glass, and cardboard. Collection services were expanded to include smaller City facilities not previously served. The program includes employee education, promotion, and additional sign-ups.

The Solid Waste Utility contracted with two local consulting firms in 1990 to conduct waste audits of 50 commercial establishments in Seattle. From the results of these audits, the City published the *Commercial Waste Audit Manual*, to aid businesses in evaluating their current operations, waste streams, and disposal practices, and to help them develop and implement waste reduction and recycling programs.

Self-haul and Drop-off Centers

Number and Type:	There are hundreds of private drop-off sites and buy-back centers throughout the City.
Public or Private:	There are two public drop-off centers, one at each of the City Solid Waste Utility transfer stations. The rest are private. Numerous drop-boxes are sponsored by schools, churches, scout troops, clubs, and other charities.
Sectors Served:	Residential and commercial/institutional sectors
Materials Accepted:	The Solid Waste Utility accepts newspapers, mixed paper, corrugated cardboard, glass, aluminum and tin containers, plastic bottles, large appliances, scrap metal, mattresses, batteries, and motor oil. Other sites collect newspaper, high-grade paper, glass containers, and aluminum cans. Most schools, churches, scout troops, and other charities typically collect only newspaper and/or aluminum cans.

Annual Tonnage:

8,038 tons of recyclables and 12,964 tons of yard waste in 1990 were collected at the City's Solid Waste Utility's two transfer stations. This represents an increase of 82 percent in recyclables and 15 percent in yard waste over 1988 figures. In addition, an estimated 24 percent of Seattle's waste stream is recovered by independently owned, for-profit and nonprofit recycling centers, but exact tonnages are not available.

Salvage/Reuse

The Solid Waste Utility has completed a directory for rental, repair, salvage services, as well as businesses that sell used goods to promote reuse in the City. Eight thousand directories will be distributed through retail outlets to businesses and households throughout the City. Salvation Army, Seattle Goodwill Industries, and other charities take reusable items at drop boxes in the City.

Processing and Marketing of Recyclables

Recyclable materials collected through the City's residential curbside collection program and private commercial garbage collection services are processed at private facilities: the Rabanco Recycling Center, the Recycle America Processing Center, and the Eastmont Development Transfer Station.

The Rabanco Recycling Center was built on the site of a former steel warehouse and began operating in June 1988. The 80,000-square-foot processing facility is located on 5 acres. The plant is designed to process 500 to 700 tons per day of recyclables from a variety of waste streams including clean paper, cardboard, newspaper, and plastic loads; paper-rich loads of commercial waste collected from selected commercial garbage routes; and commingled recyclables from Recycle Seattle's residential curbside collection program in the south end of the City and from certain commercial accounts. It is estimated that start-up costs for the plant were between \$6 and \$8 million dollars. Sixteen full-time employees work at the processing center. The facility uses a combination of conveyors, trommel, disc screens, magnetic separation, air classification, hand picking, and baling to recover and process recyclable materials. Approximately 65 to 70 percent of the recovered material is paper, and 30 to 35 percent commingled bottles and cans. Glass and metal are marketed locally. Color-sorted glass is sold to Fibres International, a Seattle glass beneficiation plant. MRI, a local company, removes the tin from bimetal cans and sells the remaining steel to plants in the Puget Sound area. Aluminum is sold to regional plants. PET is sold domestically. An average 2.7 percent by weight of the materials collected at curbside from the south end of the City was reported rejected as nonrecyclable in 1990. Rabanco also has a high-grade processing facility where high-grade paper from office building collection is processed. Much of this high-grade paper is sold through Rabanco's subsidiary, Ideal Paper Stock, to markets in the Pacific Rim.

The Recycle America Processing Center was opened by Waste Management in the fall of 1988 to process recyclables collected by Recycle America from the north end of Seattle. Initial equipment costs for the 43,000-square-foot facility (of which the processing area comprises 37,000 square feet) were an estimated \$500,000, and annual operating and maintenance costs were approximately \$858,000 in 1989. The center, designed to handle approximately 350 tons per day, is currently processing approximately 110 tons per day, and employs 24 people full-time and 1 person half-time (5 on the paper sort floor and 7 on the bottle and can sort line). Over 65 percent of the material processed at the facility is paper, including newspaper, cardboard, and mixed paper. Glass, ferrous, aluminum, and PET containers from the curbside program are also processed there. Since recyclables are partially separated by the generators and are collected in compartmentalized trucks, the facility is primarily used for baling and sorting commingled bottles and cans. Glass, tin, and aluminum are sorted on a pick line through a

combination of magnets and hand sorting. Most of the glass is sold locally to Fibres International and most of the ferrous containers to MRI. Waste paper is baled and brokered to markets in South Korea and Taiwan that use the paper as filler stock for other paper grades. PET is sold domestically. The facility is also designed to process commercial loads of source-separated cardboard and mixed waste paper. About 0.5 percent by weight of the materials collected at curbside was reported rejected as contaminants in 1990. Two new lines were added to the facility in September 1991. One replaced the former bottle and can line, and the other is a corrugated cardboard and mixed waste paper sort line.

The Eastmont Development Transfer Station is owned and operated by Waste Management. Commercial waste collected by Bayside Disposal is dumped at this transfer station. The facility uses a conveyor belt to spread out dry commercial loads. Workers hand-pick cardboard and aluminum.

Market Development Initiatives/Procurement

On August 11, 1987, the Mayor of Seattle directed all departments of the City to print letterhead on 100 percent recycled paper. Seattle municipal offices procure envelopes and copier paper made from recycled paper fiber. The City requires haulers to identify markets for the recyclable materials they collect. The Solid Waste Utility has entered into market risk-sharing agreements with the contracted haulers for the materials collected through the apartment building recycling program.

Through the Business and Industry Recycling Venture, Seattle and King County are urging businesses to procure materials with recycled content. This program, which began in September 1990, is a cooperative effort between the Greater Seattle Chamber of Commerce, the Solid Waste Utility, and King County's Commission for Marketing Recyclable Materials. Two recycling information specialists, one from the City and one from the County, provide information to businesses on recycling services and vendors of recycled products.

The Washington Committee for Recycling Markets, a consortium of representatives from the private and public sector, established by the State legislature, hired Matrix, a Seattle-based consulting firm, to assess market conditions from mixed waste paper. The firm's study indicated that the four mills in the state currently using a total of 16,000 to 23,000 tons per year of mixed waste paper (to make fruit tray pads, gypsum wallboard backing, roofing felt, construction paper, and corrugated cardboard) are not planning to increase their consumption. Matrix recommended that the State (i) provide a number of incentives, including subsidies and diversion credits, to offset the cost of processing mixed waste paper; (ii) provide access to capital and/or a consumption tax credit for processing and manufacturing facilities that use mixed waste paper; and (iii) evaluate the feasibility of establishing a mixed waste paper pulp factory. In 1990 the State passed legislation to create a permanent market development center known as the Clean Washington Center with an annual budget of \$2 million.

The City of Seattle added PET plastics to curbside recycling in the fall of 1989, with the National Association of Plastic Container Recovery (NAPCOR) guaranteeing markets. Recycled Plastics Markets (RPM) in Bellevue, Washington is manufacturing Seattle's compost bins from plastic milk jugs collected at drop-off sites throughout the City. Approximately 66 to 79 jugs are used to make each bin.

Composting Activities

Since 1980 the City of Seattle has undertaken numerous demonstration projects and experiments with composting. These provided data and experience that helped the City in planning its comprehensive composting program, which began in 1989. Initial composting projects included composting demonstration at 12 Pea Patch gardens, a community composting education program, a Zoo Doo program, Christmas tree chipping, and a 3-month pilot "Clean Green" program in 1987 at the City's two transfer stations. In October 1988, Seattle passed an ordinance requiring residents to separate

yard waste from other recyclables and refuse. To handle this yard waste, the City has a three-pronged strategy: expanding the transfer station "Clean Green" collection program, encouraging backyard composting, and collecting yard waste at curbside.

In 1986 the City began collecting pen waste and pen straw from the Woodland Park Zoo, in cooperation with the Parks Department. This material is composted and sold to the public under the name of "Zoo Doo." The Parks Department budgets and manages the program, which generates enough revenue to cover its own costs, as well as avoiding disposal costs for pen wastes.

Clean Green Program

The two transfer stations accept clean yard waste (grass clippings, leaves and brush, trees and branches up to 12 inches in diameter) at a discounted fee to customers, through the "Clean Green" program. The City began this program on a 3-month pilot basis in 1987. In 1988 it expanded service to all City residents and businesses during designated daily hours. Residents and businesses may self-haul yard waste to either of the two transfer stations. Cars are charged \$4.00 per trip as compared to \$5.00 for mixed refuse; trucks are charged \$48.00 per ton, instead of \$66.00 per ton for refuse. The yard waste is dumped into two direct-dump trailers placed in slots below floor level. Transfer station employees direct yard waste customers to the "Clean Green" area, assist in unloading, and watch to ensure that no contaminants are dumped with the yard waste. In 1989, 11,248 tons were collected at the drop-off sites and transferred to Cedar Grove, a private composting facility, for processing; in 1990, 12,964 tons were collected and processed through the program. The City incurs a cost of \$12 per ton for transporting materials to Cedar Grove (roughly 40 miles round trip), and \$16 per ton for processing the material.

Backyard Composting

Since 1986 the City has sponsored four composting demonstration sites throughout Seattle. Three of the sites are in urban gardens, and one is next to an urban market. The City also funds a backyard composting education program run by Seattle Tilth, a local organization of urban gardeners. The program trains volunteers to be proficient at composting. These volunteers, or master composters, perform 40 hours of outreach for neighborhood and business groups, and at schools and street fairs. In addition, they give presentations and tours at the City's demonstration sites. In 1988 with a program budget of \$27,500, master composters responded to over 2,000 calls on the compost hotline and made over 20,000 contacts with citizens.

The Solid Waste Utility allotted \$483,000 in 1989 for the backyard composting program, with 75 percent of the cost covered by a \$362,500 Department of Ecology grant. The City has hired a consultant to coordinate the distribution of free composting bins, half of which are targeted for specific neighborhoods, and has trained seven master composters to assist residents in setting up and maintaining the bins. Each participant will receive in-home instruction on composting techniques. Bin distribution began in December 1989. By the end of 1990, 10,840 bins had been distributed to single-family households.

Curbside Collection

Start-up Date: January 1, 1989

Service Provider: General Disposal, a local independent company, collects yard waste in the north section, and U.S. Disposal, a subsidiary of Rabanco, collects in the south section, both under contract with the City.

Households Served:	94,805 are participating in the curbside yard waste collection program; other households may self-haul their yard waste to the transfer stations.
Mandatory:	Yes. As of 1989, residents are required to separate yard waste from refuse.
Materials Collected:	Leaves, grass clippings, brush, and trees and branches up to 4 inches in diameter
Set-out Method:	Yard waste may be placed in cans, bagged, or bundled with string.
Collection Vehicles & Method:	A 1-person crew collects yard waste using rear-loading packer trucks.
Same Day as Refuse:	Yes
Collection Frequency:	Weekly, year-round in the north section of the City; biweekly from March through October, and monthly for the rest of the year in the south section of the City
Economic Incentives:	For a fee of \$2 per month, haulers contracting with the City will collect as many as 20 bags, cans, or bundles of yard waste.
Enforcement:	Private haulers will not pick up refuse that contains yard waste. (In such cases, they leave a note explaining why the refuse was not collected.) The program seems to be successful; a recent waste stream composition study indicated that only 1 percent of residential waste disposed in Seattle consists of yard waste, as compared with 17.1 percent in 1988.
Annual Tonnage:	36,781 tons in 1990 (25,936 collected from the north end and 10,845 tons collected from the south end)

Composting Site

The Cedar Groves Compost Facility, located 30 miles southeast of Seattle, is owned and operated by Rabanco. The 26-acre compost site is designed to process up to 60,000 tons annually. In 1990, 49,745 tons of yard waste were composted at the facility. Of these, 36,781 tons came in through the residential curbside program and 12,964 tons from self-haul. U.S. Disposal, a subsidiary of Rabanco, hauls yard waste collected at the curb in the south section of the City directly to the Cedar Groves facility. General Disposal hauls yard waste from the north section of the City to one of the Utility's transfer stations, and the City then hauls this yard waste, along with yard waste collected through the self-haul program, to the compost facility. A laborer empties bags of yard waste and pulls out contaminants. These contaminants account for less than 1 percent by weight of the total incoming material. The material is shredded in a tub grinder and then composted in piles. The Rabanco Company, in conjunction with the Seattle Solid Waste Utility, is producing several different mixes of compost. Compost is sold for \$6 per cubic yard to topsoil wholesalers. Retailers and wholesale outlets sell the compost in 1-cubic-foot bags for approximately \$3.00 per bag.

Seattle pays General Disposal \$56.36 per ton for collecting yard waste from the north end and delivering it to the City's south transfer station. The Cedar Grove facility charges the City a tipping fee of \$5.47 per ton for the first 24,000 tons and \$18 per ton for any tonnage above that. This fee covers the cost of processing the yard waste. The City pays U.S. Disposal \$84.29 per ton for collection, hauling, and processing of materials that it collects in the south end of the City.

Amount and Breakdown of Materials Recovered

Material	Residential (Tons, 1989)	Commercial/ Institutional (Tons, 1988)	Self-Haul (Tons, 1989)	Total (Tons, 1989)
Newspaper	41,597	4,900	73	46,570
Corrugated Cardboard	—	51,345	227	51,572
Other Paper*	20,477	48,400	166	69,043
Glass	13,450	2,595	66	16,111
PET Plastic†	93	7	122	222
HDPE Plastic	20	97	—	117
LDPE Plastic	—	97	—	97
Other Plastic	—	92	—	92
Aluminum	1,675	101	3,581	5,357
Ferrous Metals‡	1,689	—	—	1,689
Motor Oil	—	9,600	136	9,736
Appliances	184	90	—	274
Mattresses	—	—	34	34
Subtotal Recycled	79,185	117,324	4,405	200,914
Yard Waste	31,656	0	11,248	42,904
Subtotal Composted	31,656	0	11,248	42,904
Total Recovered	110,841	117,324	15,653	243,818

* Residential tonnages include corrugated cardboard, high-grade paper, and mixed paper.

† Self-haul tonnages include PET, HDPE, and other plastics.

‡ Self-haul tonnages include ferrous metals.

Residential recyclables collected at curbside increased from 40,732 tons in 1989 to 45,737 in 1990. Residential yard waste collected at curbside increased from 31,656 tons in 1989 to 40,666 tons in 1990. Material self-hauled to public and private drop-off centers increased dramatically from 1988 to 1990 (figures are not available for 1989). City-owned drop-off centers accepted 4,405 tons of recyclables in 1988 as compared to 8,038 tons in 1990; they took in 11,248 tons of yard waste in 1989 and 12,964 tons in 1990. Materials collected through private commercial recycling activities came to 117,324 tons in 1988 and 154,355 tons in 1990. These breakdowns are detailed in the preceding and following tables.

Material	Residential (Tons, 1990)	Commercial/ Institutional (Tons, 1990)*	Self-haul (Tons, 1990)	Total (Tons, 1990)
Newspaper	40,102	11,123	182	51,407
Corrugated Cardboard	7,874	62,571	511	70,956
High-grade Paper	4	57,496	4	57,504
Mixed Scrap Paper	13,218	4,866	650	18,734
Other Paper	346	498	7	851
Glass	12,905	4,093	169	17,167
PET Plastic	748	7	243	998
HDPE Plastic	161	96	†	257
Other Plastic	—	187	—	187
Aluminum Cans	1,589	303	2	1,894
Ferrous Cans	1,565	296	1	1,862
Other Post-consumer Aluminum	20	221	1	242
Other Post-consumer Ferrous	149	341	5,855	6,345
Nonferrous	3	27	43	73
Other (misc.)‡	227	12,074	370	12,671
Subtotal MSW Recycled	78,911	154,199	8,038	241,148
Yard Wastes§	36,780	3,444	12,964	53,188
Subtotal MSW Composted	36,780	3,444	12,964	53,188
Total MSW Recovered	115,691	157,643	21,002	294,336
Concrete	8	45	80	133
Wood Waste	16	36	944	996
Total C&D Recycled	8	45	80	133
Total C&D Composted	16	36	944	996
Total C&D Recovered	24	81	1,024	1,129
Total Materials Recycled	78,919	154,244	8,118	241,281
Total Materials Composted	36,796	3,480	13,908	54,184
Total Materials Recovered	115,715	157,724	22,026	295,465

Note: Tonnages provided above represent materials collected, including any materials that may have been rejected as contaminants. If rejects are subtracted from residential tonnages, the City recycled 78,221 tons of residential material, rather than the 78,911 tons listed above. This was calculated in the following manner: 24,787 tons collected in the north X 0.5% reject rate + 20,949.5 tons collected in the south X 2.7 reject rate = 690 tons rejected.

*Commercial/institutional tonnages recycled are based on City extrapolations (using conservative growth estimates) from actual 1988 tonnages collected.

† Less than 1 ton

‡ Other (miscellaneous) includes food waste, textiles, vehicle batteries, and used oil.

§ Yard waste includes grass clippings, leaves, and brush.

Curbside Recycling Program By Section

Material	North Section (Tons, 1989)	South Section (Tons, 1989)	Total (Tons, 1989)
Newspaper	7,524.8	7,590.8	15,115.6
Mixed Paper	9,118.7	6,030.9	15,149.6
Glass	5,296.5	3,374.9	8,671.4
Aluminum	320.1	113.1	433.2
Tin	678.0	601.9	1,279.9
PET	13.3	75.6	88.9
Total	22,951.4	17,787.2	40,738.6
% Recyclables Recovered	56%	44%	100%
Avg. No. Households Served*	55,339	50,223	105,562
Avg. Pounds per HH per Year	829.5	708.3	771.8
Avg. Pounds per HH per Day	2.27	1.94	2.11

* Seattle records the number of households signed up for the curbside program on a monthly basis. The average number of households served is the average of these numbers over 12 months of the year.

Material	North Section (Tons, 1990)	South Section (Tons, 1990)	Total (Tons, 1990)
Newspaper	9,057.2	8,315.8	17,373.0
Mixed Paper	9,687.8	7,514.0	17,201.8
Glass	4,874.2	4,222.7	9,096.9
Aluminum	358.5	236.6	595.1
Tin	745.3	561.4	1,306.7
PET	64.0	99.0	163.0
Total	24,787.0	20,949.5	45,736.5
% Recyclables Recovered	54%	46%	100%
Avg No. Households Served*	60,256	61,290	121,546
Avg Pounds per HH per Year	822.7	683.6	752.6
Avg Pounds per HH per Day	2.25	1.87	2.06

* Seattle records the number of households signed up for the curbside program on a monthly basis. The average number of households served is the average of these numbers over 12 months of the year.

Between 1989 and 1990, tonnages of recyclables collected through the residential program increased by 12 percent overall (8 percent in the north section of the City and 18 percent in the south section of the City). Paralleling this increase was an even greater increase in the sign-up rate (15 percent overall). From January through December 1989, an average of 105,562 households (71 percent of eligible households) had signed up for residential recyclables collection. Over 1990, an average of 121,546 households—82 percent of those eligible—signed up for the curbside program. The south end of the City experienced a 22 percent increase in sign-ups; the north end experienced a 9 percent increase.

Source Reduction Initiatives

Among Seattle's efforts to reduce waste at the source are volume-based refuse rates and an extensive program. In addition, the Utility's public education campaign includes brochures entitled *Cutting Down on Garbage, Precycling, and Other Ideas for Reducing Waste*.

The City has had a variable can rate, as opposed to a flat monthly garbage rate, since 1980. It offers four different-sized containers: a 19-gallon "mini-can" at \$10.70 per month; a 32-gallon can at \$13.75 a month; a 60-gallon can at \$22.75 per month; and the largest container, a 90-gallon can, at \$31.75 per month. An analysis, *Volume-Based Rates in Solid Waste: Seattle's Experience*, showed that more garbage would have been generated and disposed if the City had not imposed a variable rate structure. In 1986 and 1987, the City increased rates. This led to significantly more customers subscribing to fewer or smaller cans. The new curbside recycling, which became available early in 1988, further influenced the downward shift in subscriptions. In fact, the weighted average number of cans subscribed by single-family customers decreased from 3.5 to 1.4 per customer between 1981 and 1988.

Publicity and Education

The implementation of Seattle's comprehensive materials recovery program has required an aggressive promotional campaign. Two mailings were sent out citywide when the new residential recycling program first began. Customers were asked to sign up to receive recycling services, and were then provided with recycling containers. The City, which manages the promotion of the program, has made a constant effort to advertise. Booths are staffed at street fairs and festivals, and signs are placed on city buses. The City Utility regularly produces media events.

The Utility continually places articles in the newspapers, has an automated phone service with over 100 recorded messages regarding recycling, and circulates an information packet on recycling. The packet stresses selective shopping to avoid plastics and disposable materials, composting of yard waste and food waste, and donation and resale of household items. The City occasionally inserts selective shopping tips in garbage bills. The two contractors that collect recyclables at curbside, Recycle America and Recycle Seattle, work with the Utility to promote the curbside recycling program. The City Utility conducted a massive media campaign when it first implemented the variable can rate.

In the 1989-90 school year, the City conducted a \$105,000 pilot education and recycling program for ten elementary schools. The Utility offers technical assistance and financial support, including cash awards, to selected schools for recycling and composting of materials generated at the school. It also retains a consultant who will provide schools with posters, classroom educational materials, and assistance.

Economics

Costs Cover:

In 1990 the City of Seattle recovered 295,465 tons of materials (294,336 tons of municipal solid waste and 1,129 tons of construction and demolition debris). Of the 294,336 tons of municipal solid waste recovered, 103,520 tons were collected through municipally sponsored programs: 53,775 tons of residential recyclable materials and 49,743 tons of residential organic waste. These 103,520 tons were collected by private companies under contract with the City (45,737 tons of recyclable material and 36,781 tons of organic waste at curbside), and at the two City-owned transfer stations (8,038 tons of recyclables and 12,964 tons of compostable materials).

The City does not incur any capital costs for the collection or processing of recyclable materials recovered through the curbside program, since these activities are contracted out to the private sector, but pays per ton contract fees to the two haulers, Recycle America and Recycle Seattle; these are listed under operating and maintenance costs. In addition, the City paid to transport 8,038 tons of material from the transfer station to end markets.

Capital costs for yard waste collection and processing are incurred by the private sector, and are not available. The City contracted with General Disposal for the collection of 25,936 tons of yard waste at curbside in the north end of the City, and with U.S. Disposal for the collection and processing of 10,845 tons of yard waste at curbside in the south end of the City. In addition, the City paid Rabanco a processing fee for the 25,936 tons of yard waste collected at curbside by General Disposal, and for the 12,964 tons of yard waste self-hauled to the transfer station.

Operating and maintenance costs incurred by the City include contract fees for the collection and processing of recyclable materials and yard waste collected at curbside; City labor costs for the collection and transportation of material self-hauled to the transfer stations; and administrative and education and publicity costs.

The City pays Recycle America, which handles collection services in the north section of the City, \$51.54 per ton with a minimum payment of \$2.8 million over a 5-year contract. Recycle America absorbs total market risk. Recycle Seattle is paid \$57.44 per ton; its contract includes an agreement with the City to share market risks. In 1989 the City paid Recycle America \$48.15 per ton and Recycle Seattle \$47.75 per ton. Each year of the contract period, the price paid per ton is adjusted at 80 percent of the change in the Consumer Price Index.

Annual and Per Ton Operating and Maintenance Costs (1990)

	Cost	Tons Covered	Per Ton Cost
Recycling Subtotal	\$3,037,652	53,775	\$56
Collection and Processing	\$2,537,652	53,775	\$47
Curbside	2,481,386	45,737	54
Contract Fees for Recycle America	1,278,018	24,787	52
Contract Fees for Recycle Seattle	1,203,368	20,950	57
Transfer Station	56,266	8,038	7
Administration	300,000	53,775	6
Education/Publicity	200,000	53,775	4
Composting Subtotal	\$3,636,022	49,745	\$73
Collection and Processing	\$3,036,022	49,745	\$61
Curbside Collection	2,375,878	36,781	65
Contract with U.S. Disposal*	914,125	10,845	84
Contract with General Disposal	1,461,753	25,936	56
Transfer Station Collection and Transport	155,568	12,964	12
Transfer Station Processing	202,560	12,964	16
Processing at Cedar Grove†	302,016	25,936	12
Administration	300,000	49,745	6
Education/Publicity	300,000	49,745	6
Recycling & Composting Total	\$6,673,674	103,520	\$64
Collection and Processing	\$5,573,674	103,520	\$54
Administration	600,000	103,520	6
Education/Publicity‡	500,000	103,520	5

Note: Contracts with Recycle America (Waste Management) and Recycle Seattle (Rabanco) for the collection of recyclable materials expire in December 1992. In 1993 Recycle America will receive \$78 per ton and Rabanco will receive \$84 per ton.

*The contract fee paid to General Disposal does not include processing costs.

†Cedar Grove processing cost for the processing of material collected by General Disposal and is calculated based on a tipping fee of \$5.47 for 13,155 tons (the first 24,000 tons cost the City \$5.47 per ton, of which 10,845 tons are included in U.S. Disposal's contract) and \$18.00 per ton for the remaining 12,781 tons collected by General Disposal.

‡ The total cost for education and publicity includes both in-house and contracted services. This was estimated by the Public Education Coordinator as approximately \$3 per household eligible for curbside collection. An estimated 40 percent is dedicated to recycling and 60 percent to composting.

Materials Revenues:	Approximately \$50,000 in 1989, and \$45,000 in 1990, from the sale of transfer station recyclables. Other revenues are retained by the private haulers.
Source of Funding:	Residential garbage rates, which account for 75 percent of the Utility's revenues are the sole source of revenue for the recycling program.
Full-time Employees:	19 employed in recycling and composting at the Seattle Solid Waste Utility

Future Solid Waste Management Plans

The Seattle City Council decided in October 1988 to terminate its disposal contract with the King County Cedar Hills Landfill as of 1992, and to contract for disposal at a landfill east of the Cascade Mountains by 1993. The Council took this step because it believes that landfills in that arid, sparsely populated region present fewer environmental hazards than landfills in the Puget Sound region.

The City is planning to study collection of commercial food waste for composting at an in-vessel compost facility in 1991. In 1991-92, Seattle and King County are jointly pursuing an \$800,000 project to explore the technical and economic feasibility of residential and commercial/institutional food waste composting. If an economically feasible collection system can be devised, the City will collect residential food waste.

In addition, Seattle plans to lobby for Federal and State legislation aimed at reducing the amount and toxicity of waste being generated. The City will consider adopting waste reduction legislation itself if neither Federal nor State waste reduction legislation is passed by July 1993. The City will also work with local retailers to promote the use of products that are durable, reusable, recyclable, or made of recycled materials.

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Endnotes

¹One of the two private recyclers that formerly operated small curbside collection routes was bought out by the two main contractors that now operate the residential curbside program.

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