Chapter Five

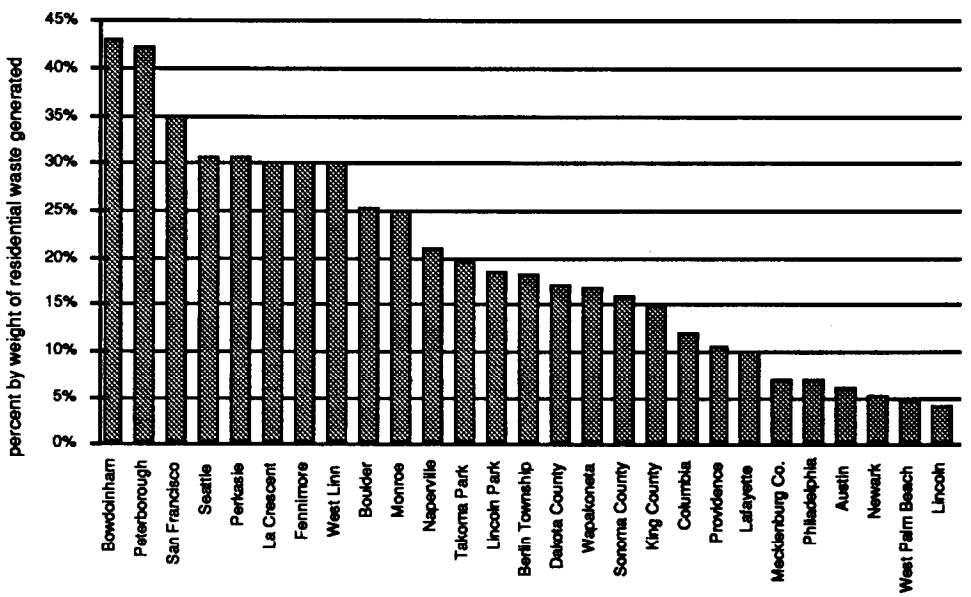
Improving Residential Recycling Levels

Overview

The nation has experienced tremendous growth in residential recycling opportunities in the last few years. In 1988 there were a little over 1,000 curbside recycling programs (full-scale and pilot) operating; by 1991 there were nearly 4,000--a growth of more than 250 percent in 3 years.[1] Drawing on the experience of the 30 communities studied, as well as model initiatives both in the United States and abroad, this chapter describes how municipalities are achieving high residential recycling levels. (composting programs, which are also critical to reaching high levels of materials recovery in the residential sector, are discussed in Chapter 4.) This chapter discusses the range of design options (including set-out method, frequency of collection, containers, and materials targeted), and outlines the features that increase participation and the amount of material collected for recycling.

Tables 5.1 and 5.2 list residential recycling, composting and recovery rates, and select program characteristics for the 30 communities studied. As indicated in these tables and Chart 5.1, communities are recycling up to 42 percent of their residential waste?

Chart 5.1
Residential Recycling Levels



Notes: These rates exclude residential materials composted. For Philadelphia and Newark, residential material is publicly collected waste. Bowdoinham's tonnage includes waste generated from a small number of businesses. For Wapakoneta and West Linn, recycling rates represent MSW recycling rates. In Naperville and Takoma Park the recycling rate represents that for the city-service area (which includes less than 60% of households), not the whole city.

Table 5.1
Residential Materials Generated and Recovered

Community	Year Data Collected	Residential Waste Generated (TPY)	Residential Materials Recycled (TPY)	Residential Materials Composted (TPY)	Residential Materials Recovered (TPY)	% Residential Materials Recycled (By Wt.)	% Residential Materials Composted (By Wt.)	% Residential Materials Recovered (By Wt.)	Residential Materials Recycled (lbs/HH/yr.) (a)	Residential Materials Composted (lbs/HH/yr.) (a)	Residential Materials Recovered (lbs/HH/yr.) (a)
Austin, TX	FY89	254,464	13,387	4,186	17,573	5	2	7	135	42	177
Berkeley, CA	FY91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Berlin Township, NJ	1990	6,035	1,053	2,339	3,392	17	39	56	1,170	2,599	3,769
Boulder, CO	1990	29,204	7,265	2,300	9,565	25	8	33	415	131	547
Bowdoinham, ME	FY90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Columbia, MO	FY90	30,857	3,242	NA	3,242	11	NA	11	252	NA	252
Dakota County, MN	1990	113,487	18,976	14,113	33,089	17	12	29	380	282	662
Fennimore, WI	1990	648	164	169	333	25	26	51	337	348	686
King County, WA	1990	646,109	77,328	48,058	125,386	12	7	19	408	254	662
La Crescent, MN	1990	1,109	309	144	453	28	13	41	394	184	578
Lafayette, LA	FY90	34,651	2,440	2,211	4,651	7	6	13	165	150	315
Lincoln, NE	1990	135,360	4,081	467	4,548	3	0	3	103	12	115
Lincoln Park, NJ	1990	7,750	1,409	2,387	3,796	18	31	49	662	1,121	1,782
Mecklenburg Co., NC	1990	292,897	20,171	0	20,171	7	NA	7	186	0	186
Monroe, WI	1989	3,802	804	417	1,221	21	11	32	376	195	572
Naperville, IL	1990	39,020	7,617	4,901	12,518	20	13	32	491	316	808
Newark, NJ (b)	1989	146,654	6,823	7,435	14,258	5	5	10	133	145	278
Perkasie, PA	1990	3,133	964	654	1,618	31	21	52	494	335	829
Peterborough, NH	1990	2,003	847	0	847	42	0	42	941	0	941
Philadelphia, PA (b)	FY90	928,054	56,284	1,571	57,855	6	0	6	167	5	172
Portland, OR	1990	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Providence, RI	1990	80,677	8,191	0	8,191	10	0	10	267	0	267
San Francisco, CA	1990	308,099	106,712	7,027	113,739	35	2	37	650	43	693
Seattle, WA	1990	256,219	78,911	36,780	115,691	31	14	45	634	295	929
Sonoma County, CA	1990	124,845	18,571	402	18,973	15	0	15	232	5	237
Takoma Park, MD	1990	6,889	1,269	1,206	2,475	18	18	36	361	343	703
Upper Township, NJ (b)	1990	6,879	2,527	884	3,411	37	13	50	1,309	458	1,767
Wapakoneta, OH	9/89-8/90	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
West Linn, OR	1990	NA	1,507	1,474	2,981	NA	NA	NA	489	478	967
West Palm Beach, FL	4/90-3/91	69,713	2,809	12,434	15,243	4	18	22	230	1,017	1,247

Key:
FY = Fiscal Year HH = Household NA = Not Available TPY = Tons Per Year Wt. = Weight

Notes:
Residential tonnages above may exclude some waste generated by the residential sector, such as waste generated by apartment buildings (e.g. in Takoma Park, Philadelphia, Providence and Newark), and self-haul waste (e.g. Seattle and Austin). For community-specific explanation of waste generation see Appendix C.

(a) Based on total households in the community.
(b) All tonnage figures and recycling, composting, and recovery rates represent materials handled by the public sector. Because public sector material in Upper Township includes recyclables collected from 222 businesses, which is over 5% of households served, figures for Upper Township are excluded from all graphs in this chapter. See Appendix A for definition of public sector waste.

Table 5.2
Select Residential Recycling Program Characteristics

Community	Year Data Collected	Residential Recycling Rate (% by wt.) (a)	MSW Recycling Rate (% by wt.) (a)	Mandatory Program (b)	Volume-based Refuse Collection Rates	Type of Recycling Program	Container Deposit Legislation	# of Public DO Sites	# of Private DO Sites/ Scrap Yards (c)
Austin, TX	FY89	5	NA	No	No	CS,DO,BB,Sa/R	No	0	33
Berkeley, CA	FY91	NA	20	No	Yes	CS,DO,BB,Sa/R	Yes	1	5
Berlin Township, NJ	1990	17	28	Yes	No	CS,DO	No	1	--
Boulder, CO	1990	25	18	No	No	CS,DO,BB	No	0	22 (d)
Bowdoinham, ME	FY90	NA	43	No	Yes	CS,DO,Sa/R	Yes	2 (e)	0
Columbia, MO	FY90	11	NA	No	No	CS,DO,BB	Yes	0	7
Dakota County, MN	1990	17	20	No	Yes	CS,DO,BB,Sa/R	No	1	Numerous
Fennimore, WI	1990	25	25	Yes	No	CS,DO	No	1	0
King County, WA	1990	12	22	No	Yes	CS,DO	No	7	49
La Crescent, MN	1990	28	21	No	Yes	CS,DO,Sa/R	No	2	0
Lafayette, LA	FY90	7	8	No	No	CS,DO,BB	No	0	5
Lincoln Park, NJ	1990	3	11	Yes	No	CS,DO	No	1	0
Lincoln, NE	1990	18	32	No	No	CS,DO,BB	No	16	--
Mecklenburg Co, NC	1990	7	16	No	No	CS,DO,BB,Sa/R	No	16	21
Monroe, WI	1989	21	25	Yes	No	CS,DO,BB	No	1	1
Naperville, IL	1990	20	NA	No	No	CS,DO	No	0	1
Newark, NJ	1989	5 (f)	NA	Yes	No	CS,DO,BB,Sa/R	No	1	50+
Perkasie, PA	1990	31	NA	Yes	Yes	CS,DO	No	1	0
Peterborough, NH	1990	42	19	Yes (g)	No	DO (h)	No	1	0
Philadelphia, PA	FY90	6 (f)	12	Yes	No	CS,DO,BB,Sa/R	No	2	30
Portland, OR	1990	NA	29	No	Yes	CS,DO,BB	Yes	0	147
Providence, RI	1990	10	NA	Yes	No	CS,DO (g)	No	1 (i)	--
San Francisco, CA	1990	35	25	No	Yes	CS,DO,BB	Yes	0	30+
Seattle, WA	1990	31	33	No	Yes	CS,DO,BB,Sa/R	No	2	100+
Sonoma County, CA	1990	15	11	No	Yes	CS,DO,BB,Sa/R	Yes	5	10
Takoma Park, MD	1990	18	NA	Yes	No	CS,DO	No	1	0
Upper Township, NJ	1990	37 (f)	NA	Yes	No	CS,DO	No	1	0
Wapakoneta, OH	9/89-8/90	NA	15	No	Yes	DO	No	1	0
West Linn, OR	1990	NA	30	No	Yes	CS,DO	Yes	1	0
West Palm Beach, FL	4/90-3/91	4	2	No	No	CS,DO,BB,Sa/R	No	4	4

Key:

BB = Buy-back center(s)
CS = Curbside collection
DO = Drop-off site(s)
FY = Fiscal Year
NA = Not available
Sa/R = Salvage/reuse operation(s)
wt. = weight
-- = Not applicable

Notes:

(a) Recycling rates exclude material composted. MSW recycling rates only are available in the cities of Berkeley, Bowdoinham, Portland, Wapakoneta, and West Linn.
(b) Residents must source-separate certain materials. Haulers in Dakota County, Portland, and West Linn are required to collect recyclables but set out by residents is voluntary. Residents in Peterborough utilizing the Town dump must segregate recyclables; however some residents choose not to self-haul refuse to the Town dump.
(c) The number of private drop-off centers may exclude numerous deposit container depots.
(d) An additional 225 sites are located on the University of Colorado campus.
(e) In 1991 Bowdoinham closed one of the drop-off sites.
(f) Represents recycling level of only publicly collected waste (see Data Definitions in Appendix A).
(g) Source separation of recyclables is mandatory for residents utilizing the town refuse/recycling center. Approximately 70% of residents utilize the center.
(h) Two private haulers offer curbside collection to 100 to 200 households.
(i) This site accepts only motor oil.

Table 5.3
Residential Curbside Recycling Program

Community	Curbside Initiation Year (a)	Total Households	Households Served (b)	% Total Households Served	Number of Households in Refuse Jurisdiction (c)	% in Jurisdiction Served (d)	Maximum Size of Multi-unit Bld. Served (# units) (e)	Mandatory (f)	Economic Incentives (g)	Participation Rate (%) (h)	Private Collection (i)	Public/ Private (Type)	Amount Recovered at Curbside (lbs/hh/wk)
Austin, TX	1982	198,464	110,000	55	110,000	100	2 (j)	No	A	40	Public	--	2.6
Berkeley, CA	1973	43,534	40,000	92	43,543	92	11 (k)	No	V	55	Contract	NP	5.8
Berlin Township, NJ	1980	1,800	1,700	94	1,700 (l)	100	1	Yes	F	97	Public	--	20.9
Boulder, CO	1976 (m)	35,000	25,500	73	NA	NA	7	No	None	60	Contract	FP	7.0
Bowdoinham, ME (n)	1989	880	290	33	290	100	1	No	V	95	Private	FP	NA
Columbia, MO	1985	25,742	7,060 (o)	27	18,500	38	1	No	None	62	Public	--	5.7
Dakota County, MN	1989	100,000	80,000	80	NA	NA	NA	No	A,V	75	Private (p)	FP	NA
Fennimore, WI	1989	970	970	100	970	100	All	Yes	F	100	Public	--	6.4
King County, WA	1989	379,090	NA	NA	NA	NA	4	No	V	80	Contr/Priv	FP	NA
La Crescent, MN	1989	1,568	1,568	100	1,568	100	All	Yes	V	74	Contract	FP	5.7
Lafayette, LA	1988	29,500	28,000	95	28,500	98	1	No	None	62	Contract	NP	3.4
Lincoln, NE	1989	79,079	622	1	NA	NA	1	No	None	51	Contract	FP	1.9
Lincoln Park, NJ	1987	4,260	4,260	100	2,772	100	All	Yes	F	95	Public	--	4.6
Mecklenburg Co, NC	1987	216,416	110,000	51	NA	NA	3	No	None	85	Public/Private	FP	6.1
Monroe, WI	1986	4,271	3,900	91	3,900	100	2	Yes	F	85	Public	--	5.3
Naperville, IL	1986	31,000	24,500	79	24,500	100	4	No	None (q)	75	Contract	NP	12.0
Newark, NJ	1988	102,473	90,000	88	NA	NA	NA	Yes	F	16	Contr/Public	NP,FP	2.2
Perkasie, PA	1988	3,900	3,500	90	3,500	100	1	Yes	V,F	100	Public	--	9.5 (r)
Philadelphia, PA	1987	673,880	159,245	24	572,798	28	6	Yes	None	80	Public	--	5.9
Portland, OR	1987	201,900	131,000	65	131,000	100	4	No	V	33	Private	FP,NP	4.4
Providence, RI	1989	61,454	56,423	92	56,423	100	6	Yes	F	74	Contract	FP	5.6
San Francisco, CA	1989	328,471	119,000	36	NA	NA	5 (s)	No	V	80	Private	FP	6.9
Seattle, WA (t)	1988	249,032	148,500	60	NA	NA	4	No	V	83	Contract	FP	14.5
Sonoma County, CA	1978	160,000	60,000	38	NA	NA	NA	No	V	54 (u)	Private	FP	NA
Takoma Park, MD	1989	7,036	4,100	58	4,100	100	12	Yes	F	88	Public	--	11.9
Upper Township, NJ	1984	3,860	3,860	100	3,860	100	All	Yes	F	95	Public	--	NA
West Linn, OR	1983	6,165	6,165	100	6,165	100	All	No	V	86	Private (v)	FP	7.7
West Palm Beach, FL	1990	24,442	18,306	75	24,442	75	3 (w)	No	None	79	Public	--	5.3

Key:

A = Awards
NA = Not Available
Bld. = Building
NP = Nonprofit company
F = Fines
V = Volume-based refuse rates
FP = For-profit company
wk = week
FY = Fiscal Year
-- = Not Applicable
hh = Households served

Notes:

This chart excludes the communities of Peterborough, NH and Wapakoneta, OH, which operate drop-off programs. Two private haulers offer curbside recycling collection to a limited number of Peterborough residents. Lincoln Park, NJ offers residents curbside collection of newspaper only.

(a) Berkeley began curbside collection of newspaper in 1973. Other materials were first collected at curbside in 1978. Ten of King County's 29 municipalities initiated curbside programs in 1989. Lincoln, NE has initiated only a pilot-scale recycling program. In Naperville, IL, one-quarter of the City received curbside service in 1986; citywide service began in 1989. In San Francisco, CA, 1 percent of the City's households received curbside service from 1981 to 1986. In Columbia, MO, a pilot program servicing 3,700 households was initiated in 1985. The program went citywide in 1986. In Newark, NJ, a pilot program for newspaper recycling began in December 1987.

(b) Households served by municipal or County curbside program.

(c) Number of households receiving municipal or public service refuse collection.

Notes (cont'd):

(d) Percent of households in refuse collection district that also receive municipal curbside recycling collection.
(e) Largest multi-unit building (number of units) served with municipal recycling collection.
(f) Mandatory for residents to source-separate recyclable materials. In Dakota County, MN, and in Portland and West Linn, OR, haulers are required to collect recyclables, but set-out of recyclables by residents is voluntary. In King County participation by residents is voluntary; however, cities must ensure the delivery of recycling services to residents.
(g) Economic incentives provided to residents to set out recyclables.
(h) See "In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results," ILSR, 1992, for information on the basis of participation rates.
(i) Public = City provides service; Contract = Municipality contracts with one or more providers; Private = One or more private haulers provide service independent of contract.
(j) In addition to servicing all one- and two-unit buildings, Austin services some three- and four-unit buildings.
(k) Berkeley's contractor services a few buildings with more than 12 units. In 1988, the City's Refuse Division began to service 15 multi-unit buildings with greater than 12 units.
(l) The number of households served with curbside collection of recyclables does not include two small apartment buildings.
(m) Curbside recycling was initiated by a nonprofit group in 1976, the municipal curbside program began in 1988.
(n) The majority of Bowdoinham's residents self-haul refuse to the landfill. One-third, or 290 households, pay for private refuse and recycling collection.
(o) The total number of households in Columbia and the total number served with recycling collection include 200 households served outside of the City limits.
(p) Recycling collection is public, or public under contract in three Dakota County cities.
(q) While no direct incentive is offered to residents for recycling, the City received a waste diversion credit from its refuse hauler of $35 for every ton of materials recycled in 1990.
(r) Includes some drop-off tonnage.
(s) By November 1990, 1,000 multi-unit buildings (with more than five units each) received municipal curbside service. San Francisco's two private haulers collect recyclables under contract with the City, but do not receive payment from the City for providing this service.
(t) Seattle has two different recycling programs, one in the north and one in the south section of the City. Each section is serviced by a different private hauler. In 1990, the participation rate in the north was 89.6 percent, and 15.82 lbs. per household per week were recovered. In the south, the participation rate was 77.3 percent and 13.15 lbs. per household per week were recovered. See Table 5.5 for more information.
(u) Participation rate for Sonoma County, CA is a 1989 figure based on data from the City of Santa Rosa. In June 1991, participation rate averaged 85 to 90 percent.
(v) West Linn Disposal is the sole hauler entitled to collect recyclables in West Linn.
(w) In March 1991, 888 four-plex apartments were added to the collection route in West Palm Beach.

While communities employ a variety of techniques to recover residential recyclable, those recycling large portions of their residential waste typically employ the following strategies

- providing convenient collection services to all types of households;
- targeting a wide range of materials for recovery, particularly those that comprise a significant percentage of the waste stream;
- securing high levels of participation in recycling programs (such as mandating residents recycle, implementing strong economic incentives, and conducting a comprehensive educational and promotional program); and
- identifying outlets for collected materials.

Providing Convenient Collection Service

Communities utilize a variety of methods to collect residential recyclable and prepare them for market. Collection strategies fall into two general categories: curbside and drop-off. Residents are most likely to participate in a recycling program if doing so is as convenient as disposing of their refuse. To make participation in recycling programs as convenient as possible, and thus maximize the amount of material collected, communities are

- providing weekly curbside collection of recyclable if weekly curbside collection of refuse is provided;
- offering service to all households;
- utilizing set-out and collection methods that encourage resident participation as well as yield high-quality, readily marketable materials;
- providing adequate containers for storage and set-out of residential recyclables; and
- establishing recycling depots or drop-off sites at disposal facilities if residents self-haul refuse.

Curbside Collection

Tables 5.3 and 5.4 describe curbside recycling programs, including program initiation year, number and type of households served, and service provider. Of the 30 communities documented, only

Table 5.4
Curbside Collection Methods for Recyclables

Community	Pick-up Frequency for Recyclables	Pick-up Frequency for Refuse	Same Day Collection (a)	Containers Provided (Gallons) (b)	Container Type	Comming. Set-out (c)	Segregations Required (d)	Sort En-Route (e)	Truck (Design/Capacity)	Crew Members per Vehicle
Austin, TX	Weekly	Semiweekly (g)	Yes	No (f)	Bucket	Yes	2	No	Eager Beaver 15-cy Recycler 6 Trailers	2
Berkeley, CA	Weekly	Weekly	Yes	Yes	Waxed Cardboard Bin	No	3	Yes	13-cy, 15-cy Lodal Trucks	1-2 (g)
Berlin Township, NJ	Weekly	Weekly	Yes	20	Bin	Yes	3	Yes	15- or 23-cy Eager Beaver Truck and a 10-ton Dump Truck	NA (h)
Boulder, CO	Weekly	Weekly	Varies	14	Bin	No	3	Yes	Retrofitted Compacter Truck	2
Bowdoinham, ME	Weekly	Weekly	Yes	No	--	Yes	5	No	1-ton 15-cy Dump Trucks	1
Columbia, MO	Monthly	Weekly	No	Few (i)	Bin	No	6	Yes	16-foot Trailer attached to Truck	2
Dakota County, MN	Weekly	NA	Varies	21	Bin	No	4	Yes	Varies	Varies
Fennimore, WI	Biweekly	Weekly	No	45	3 Stackable Bins, Bin	Yes	5	Yes	Used Beer/Pop Truck	2
King County, WA	Varies	Varies	Yes	33, 42, 90 (j)	3 Stackable Bins	Yes	Varies	No	Varies	1
La Crescent, MN	Weekly	Weekly	Yes	20	Bin	No	4	Yes	Retrofitted Vehicle	3
Lafayette, LA	Weekly	Semiweekly	Yes	34	3 Stackable Bins	No	3	Yes	15-cy Eager Beaver Trailers	3
Lincoln, NE	Weekly	Semiweekly	No	No	--	Yes (k)	2	No	Retrofitted Packer, Trailer	1
Lincoln Park, NJ	Monthly	Semiweekly	No	No	--	--	--	--	Dump Truck	3
Mecklenburg Co, NC	Weekly	NA	Yes	14	Bin	Yes	2	No	28-cy Lodal Trucks	1
Monroe, WI	Weekly	Weekly	Yes	12	Bin	Yes	3	No	Modified Dump Truck	1
Naperville, IL	Weekly	Weekly	Yes	No	--	No	8 (l)	Yes	Compartmentalized Trailer pulled by a 1-ton Truck	3
Newark, NJ	Biweekly (m)	Varies	Yes	8	Bucket	Yes	2	No	23-cy Eager Beaver Trucks and Eager Beaver Trailer	3
Perkasie, PA	Varies (n)	Weekly	No (n)	No	--	Varies	Varies	Yes	Trailer	4
Philadelphia, PA	Weekly	Weekly	No	6	Bucket	Yes	2	No	23-cy and 32-cy Lodal Trucks	3
Portland, OR	Wkly/Monthly	Varies	Varies	(o)	--	No	7	Yes	Varies	2
Providence, RI	Weekly	Weekly	Yes	14	Bin	Yes	2	No	31-cy Labrie Trucks	1
San Francisco, CA	Weekly	Weekly	Yes	12	Bin	Yes	2	No	31 cy Lodal Trucks	1
Seattle, WA (north)	Weekly	(p)	No	36	3 Stackable Bins	Yes	4	Yes	18- and 31-cy Trucks	1
Seattle, WA (south)	Monthly	(p)	No	60	Toters	Yes	1	No	Packers	1
Sonoma County, CA	Weekly	Semiweekly	Yes	Varies (q)	3 Stackable Bins (q)	Yes	3	Varies	44- and 50-cy Loaders with 3 Compartments	1
Takoma Park, MD	Weekly	Semiweekly (r)	Yes	5 (r)	Bucket	Yes	3	No	20-cy Kann Curb Sorter Truck	3
Upper Township, NJ	Weekly	Weekly	Yes	No	--	Yes	3	No	Two 20-cy Packer Trucks	3
West Linn, OR	Weekly	Weekly	Yes	14	Bin	No	5	Yes	3-cy and 16-cy Packer Trucks	3
W. Palm Beach, FL	Weekly	Semiweekly	Yes	18	Bin	Yes	2	No	30-cy Labrie Truck	1

Key:
Biweekly = every other week cy = cubic yard NA = Not available Semiweekly = twice per week -- = Not applicable

Notes:
(a) Recyclables are collected on the same day as refuse collection.
(b) Total capacity.
(c) "Commingled set-out" means that at a minimum, glass and metal food and beverage containers are set out in one recycling container.
(d) The number of segregations citizens must make when setting out recyclables at the curb, excluding the set-out of appliances, white goods, tires, car batteries, and motor oil. Often plastic containers are placed in the same container.
(e) Haulers place commingled or separated recyclables into more than two material-specific compartments on recycling vehicle.
(f) A limited number of households received recycling containers in 1990. In 1991, Austin began to distribute 14-gallon containers; 22 percent of eligible households received containers in that year. In 1992 Austin will collect refuse once per w
(g) Two-thirds of all routes are serviced by two crew members, one-third is serviced by one crew member.
(h) A total of eight workers collect refuse, recyclables, and yard waste.
(i) Residents are charged a fee for 14-gallon recycling bins; 200 residents, 3 percent of households receiving curbside service, had purchased bins by the end of 1990.
(j) In King County bin size varies from city to city. Generally one crew member operates each collection vehicle.
(k) Once ferrous cans and glass were added to the list of recyclables in 1991, residents were required to segregate (rather than commingle) recyclables.
(l) Naperville switched recycling contractors in 1991, and required commingled set-out of recyclables in 3 segregations.
(m) Commingled bottles and cans are collected one week, newspaper and magazines are collected the following week.
(n) Glass and aluminium are collected weekly. Newspaper, magazines, advertising mail, and corrugated cardboard are collected once per month. Recycling containers are available through the Borough.
(o) Some haulers offer 14-gallon containers for free.
(p) The majority of residents receive same day refuse collection.
(q) Recyclable materials are set out commingled in most cities. In Santa Rosa, Petaluma, Healdsburg, and Rohnert Park, residents set out recyclables in 3 stackable bins. In other cities, residents receive two 5-gallon buckets.
(r) Takoma Park began once per week collection of refuse in 1991 and began to distribute 14-gallon recycling bins.

Table 5.5
Seattle's Curbside Recycling Program By Section

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**
Frequency of Collection	Weekly	Monthly	—
Recycling Containers	Three 12-gallon stacking containers	One 60- or 90-gallon toter	—
Material Set-out	Commingled glass, aluminum, and ferrous cans, and PET containers in one bin; mixed waste paper in a second bin; newspaper in a third bin; corrugated cardboard on side.	All glass, PET containers, aluminum and tin cans, newspaper, and mixed waste paper in one container.	—
Collection Vehicle(s)	Compartmentalized Recycling Trucks	Rear-loading Packers	—
Avg. No. of HH Served (a)	60,256	61,290	121,546
Participation Rate (b)	89.6%	77.3%	83%
Avg. Pounds per HH per Year	822.7	683.6	752.6
Avg. Pounds per HH per Week	15.8	13.1	14.5

Notes:
Seattle believes that socioeconomic factors (in addition to collection frequency) may contribute to the difference in participation. The north end of Seattle is considered the University section, and, in general, is a higher income area than the south end.

(a) 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.

(b) Participation rate is defined as the sign-up rate--the ratio of the number of households registered for the program to the number of households eligible. As of June 1991, the participation rate increased to 92.3 percent in the north and 80.4 percent in the south section. In 1989, 89.3 percent of households in the north section and 67.3 of the households in the south section were registered.

Wapakoneta does not provide the option of receiving curbside recycling service.[3]

Collection Frequency

The majority of communities in this study with curbside recycling programs have weekly collection (see Table 5.4).[4]

In fact, most of the programs with high participation and recovery rates have weekly collection of recyclables. In communities with both weekly and monthly collection of recyclables, neighborhoods with weekly collection have higher participation rates. Participation in Portland's monthly collection programs averages 23 percent, while participation in its weekly programs averages 57 percent. In 1990 the north end of Seattle achieved a 90 percent participation rate in its weekly program, while the south side experienced only a 77 percent participation rate in its monthly program. (Table 5.5 compares participation rates, tonnage data, and program characteristics for Seattle's two curbside program).[5] Similarly, in communities that have switched from monthly to weekly collection, participation rates have increased. When Naperville switched from

biweekly to weekly collection in May 1990, overall monthly program participation increased from 54 percent in 1989, to 75 to 80 percent in 1990.

When participation increases, the amount of materials collected tends to increase. The tonnage of recyclables collected in Naperville after its switch from biweekly to weekly collection increased from an average of 436 tons per month (for the first 4 months of 1990) to an average of 750 tons per month (for the subsequent 5 months)--an increase of 72 percent. The same number of households were serviced and the same types of recyclables were collected. When Berkeley, California switched from monthly to weekly curbside collection during 1988 and 1989, curbside tonnages jumped significantly, from 2,044 total tons collected at curbside in FY 88 to 5,984 tons in FY 90. The same materials and households were targeted both years. Newark switched from biweekly to weekly collection of recyclables in October 1991; 20 percent more material was recovered in November 1991 than in November 1990.

More frequent collection can also increase the set-out rate and reduce the amount of material set out per household per collection day. This requires a collection vehicle to make more stops before filling up, thus decreasing collection efficiency. With the switch from biweekly to weekly service in Naperville, for example, the number of set-outs per collection day increased by 152 percent, while the weight of each set-out decreased by an average of 25 percent. (The total amount of material recovered from each household grew from 61 pounds per month to 71 pounds per month.) Additionally, the amount of certain materials recovered, including corrugated cardboard and HDPE plastic containers, increased disproportionately. The Naperville Area Recycling Center (NARC) explains that the bulkiness of these materials makes them inconvenient to store. When recycling collection became more frequent, storage was no longer a problem and setting out such materials for recycling collection became as convenient as setting them out for refuse collection.[6] Weekly collection of recyclables appears to be especially important in communities with weekly or twice weekly collection of refuse, since residents may be inclined to dispose of recyclable materials with refuse, particularly if storage is a problem.

Collection Day

Collecting recyclablse on the same day as refuse does not necessarily increase participation rates or residential recycling rates. Establishing a consistent recycling collection day, and conducting an effective promotional program that instructs residents to set out recyclables on the designated day, appears to be more important than collecting recyclables on the same day as refuse. The cities of Perkasie, Seattle, and Fennimore, which collect recyclables on a different day from refuse, all record high participation and recycling rates. The City of Portland has concluded that its low participation rates result from confusion regarding the collection day as much as from infrequent (monthly) collection of recyclables in some parts of the City. While the fact that recyclables are not collected on the refuse collection day in parts of the City contributes to this confusion, a more substantial cause is the lack of a routine collection day within neighborhoods. Households on the same block may have different haulers and therefore different recycling collection schedules. Thus, setting out recyclables on collection day is not reinforced by the observed behavior of one's neighbors.

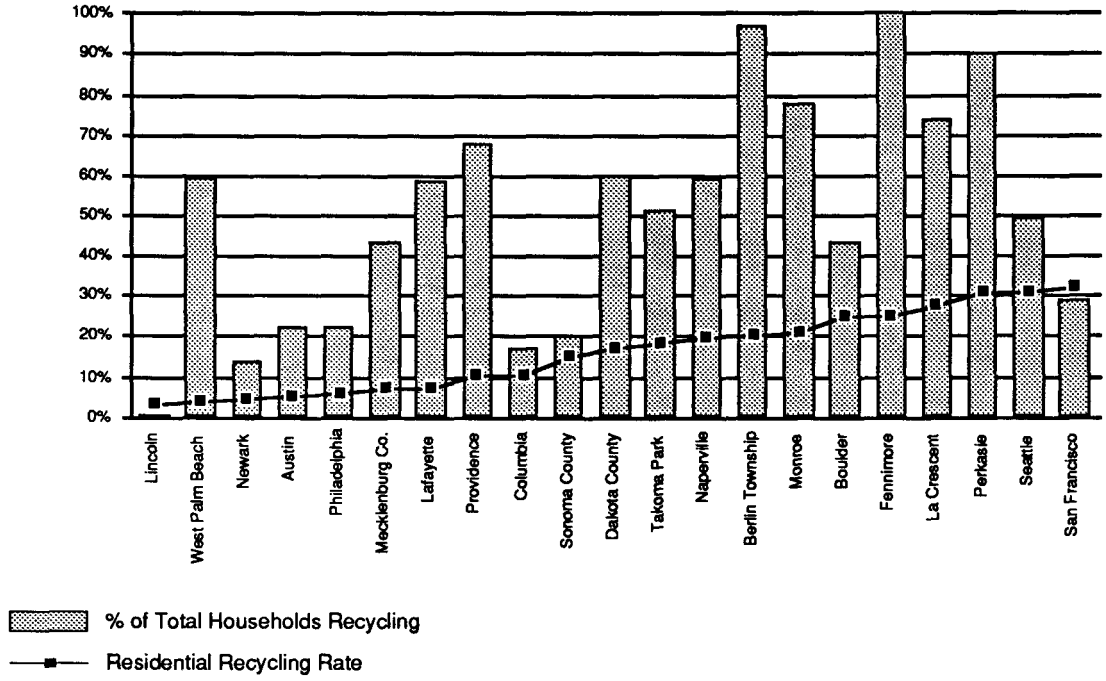
Offer Service to All Households

The more households that receive curbside collection of recyclables, the more residential materials a community will recover. Many of these communities with the highest residential recycling levels, such as Berlin Township, New Jersey; Fennimore and Monroe, Wisconsin; La Crescent, Minnesota; Perkasie, Pennsylvania; and West Linn Oregon, collect recyclables from at least 90 percent of their households. (See Table 5.3.) Many of the communities with lower residential recycling rates collect recyclables from a limited number of households. In 1990 Philadelphia serviced only 28 percent of households in its public service area, and recycled only 6 percent of its publicly collectd waste.

Communities wishing to raise recycling levels not only target all households with recycling collection, but also secure the participation of serviced households. Chart 5.2 compares net participation rates (the percent of total households serviced multiplied by the participation of serviced households) with residential recycling rates. Austin serviced only 55 percent of households with recycling collection in FY 1989; of these, only 40

Chart 5.2

Net Household Participation and Residential Recycling Rate



Notes: Net household participation represents the percent of total households receiving curbside recycling collection multiplied by the participation rate. For Providence, Philadelphia, Takoma Park, Naperville, and Perkasie recycling rate represents that in the City refuse collection jurisdiction only, in which 100% of households are serviced. For Philadelphia, the net participation rate represents that in City refuse collection area only. See Tables 5.2 and 5.3.

percent participated. This resulted in a 22 percent net participation rate, which explains Austin's residential recycling rate of 5 percent. The communities of Berlin Township, New Jersey and Fennimore, Wisconsin have high participation rates of 97 and 100 percent, respectively, and are recovering (recycling and composting) more than half of their residential waste stream. Participation in these communities' programs is required by law.

Providence is servicing 94 percent of its households (100 percent of the City's refuse collection district), but has achieved a moderate participation rate of 74 percent. (In addition, during the base year of study, Providence collected fewer types of materials for recovery than many of the communities with higher recovery rates.) In 1990 Providence recycled only 10 percent of its residential waste. Providence is working to increase program participation through education and publicity materials.

On the other hand, the cities of San Francisco, Seattle, and Boulder are recycling at least one-quarter of their residential waste streams despite the fact that their curbside programs serviced only 36, 60, and 73 percent of households, respectively. In these communities residential recyclables are also collected through many private drop-off and buy-back sites.[7] Seattle's 31 percent residential recycling rate is also attributed to the large amount of material collected at curbside per serviced household (14.5 pounds per household per week), primarily due to the collection of many grades of mixed waste paper.

Some cities already have plans to expand their curbside programs. Austin, for example, began collecting recyclables from an additional 1,500 households in 1991.

Recycling in Multi-Unit Buildings

In many communities, particularly urban areas, a large percentage of residents live in multi-unit buildings. Because refuse collection from these buildings is largely left to the private sector, many cities overlook large multi-unit buildings in setting up their residential recycling programs. (See Table 5.3.) However, cities with a large proportion of residents living in multi-unit buildings will have difficulty reaching high materials recovery levels without targeting multi-unit households for recyclables collection. The City of Austin, for example, recycled 5 percent of its residential waste in FY 89 by collecting recyclables from one- and two-family households; nearly 40 percent of residents did not receive collection, since they lived in buildings with three units or more.

Recovering recyclables and compostable materials from multi-unit buildings is typically more challenging than collecting recyclables from single-family units. Variables such as space and layout, waste hauling contracts, length of resident tenancy, and janitorial work agreements differ from building to building. Cities also often hesitate to intervene in apartment buildings' private waste-hauling arrangements. Yet programs currently

Model Rural, Suburban, and Urban Residential Recycling Programs

Bowdoinham, Maine, Perkasie, Pennsylvania, and **Seattle, Washington** represent rural, suburban, and urban communities, respectively, that have successfully matched recycling strategies to their individual needs and existing solid waste systems.

The rural Town of **Bowdoinham** (pop. 2,189) relies primarily on drop-off refuse collection. After experiencing little success with a vountary drop-off recycling program instituted in 1985, the Town established a landfill user fee in 1989, which charges residents $1 per 30-gallon bag of refuse disposed of at the landfill but no fee to drop off recyclable materials. The Town's two private refuse haulers, which service approximately one-third of the community, offer their refuse customers co-collection of source-separated recyclable materials at no charge. These economic incentives have proved extremely effective; in 1990 Bowdoinham recycled 43 percent and composted 11 percent of its municipal solid waste.

The Borough of **Perkasie** (pop. 7,878) began its curbside recycling program in January 1988. By the end of 1989, it was recycling 30 percent and composting 14 percent of its residential waste. Perkasie collects a wide range of recyclable materials from all single-family households, including newspaper, magazines, third class mail, corrugated cardboard, glass, and aluminum cans. Participation in this suburban community's recycling program is mandatory, and is further encouraged by the Borough's volume-based refuse collection system. In 1990 Perkasie recycled 31 percent and composted 21 percent of its residential waste. Furthermore, residential waste generation levels have been stabilized.

The City of **Seattle** (pop. 515,259) has established a goal of 60 percent municipal solid waste recovery by 1998. Using an econometric forecast model, the City determined that it could meet this goal through implementation of a comprehensive program that included curbside recycling and yard waste collection, apartment building recycling, transfer station drop-off sites, commercial sector paper diversion, and backyard composting. The City is well on its way to meeting this ambitious goal. In 1990 the City recovered 40 percent of its MSW, recycling 31 percent and composting 14 percent of its residential waste. Seattle believes that convenient collection service, strong economic incentives, and an extensive recycling education program are responsible for the success of its program. The City is currently working to expand recycling activities in multi-unit households and to recover food waste.

operating indicate that multi-unit buildings can achieve high levels of materials recovery. Local government can play an important role in facilitating these recycling efforts. Our case study communities' efforts to promote multi-unit recycling include the following:

- establishing provisions that multi-unit buildings comply with residential recycling requirements and recover designated materials;
- providing collection service or requiring private haulers to provide this service;
- offering haulers economic incentives to collect recyclables;
- providing buildings with recycling containers and other equipment;
- offering buildings technical assistance, including waste audits;
- encouraging building owners and managers to take an active role in planning and promoting the program; and
- encouraging buildings to establish recycling systems that closely parallel existing refuse collection systems.

Portland, Oregon is currently working to expand the delivery of recycling collection services to multi-unit households. Refuse haulers in the City are required to collect recyclables from only one- to four-unit buildings. As a result, approximately one-quarter of all households in the City receive no recycling collection. (In addition, 15 percent of one- to four-unit households do not receive collection.) The City has contracted with Portland State University (PSU) to setup recycling collection systems in selected multi-unit buildings. As of June 1991, 330 buildings had been supplied with recycling systems. The City provides technical assistance and supplies recycling containers (such as 90-gallon carts), which PSU delivers to the site. The hauler selected by the building collects and markets the materials. (Buildings are not charged an additional fee for the collection of recyclables.) Many buildings have set up central recycling depots in parking lots, while others instruct residents to bring individual bins to the curbside. The City budgeted $162,000, equivalent to $27 per multi-unit household, to set up recycling systems at 170 buildings containing a total of approximately 6,000 apartment units in 1992.

Portland State University conducted a 3-year research and demonstration project on multi-unit recycling. By closely studying 20 representative multi-unit recycling systems, PSU reached the following conclusions:

- Both depot and individual collection systems operate well, but the recycling systems are generally most effective when they parallel refuse collection systems. For example, in one building where newspaper recycling depots were conveniently located on each floor near garbage chutes, but other recyclables were collected in the basement parking garage, one-half of those who recycled reported that they recycled only newspapers.
- Participation and diversion levels vary with the program's user friendliness, the location of the recycling depot within a building/complex, and the degree to which the manager promotes the recycling program.

Over 80 percent of randomly surveyed tenants reported participating in their buildings' recycling program. Actual measurements of recycled materials at representative sites indicated that over 30 percent of waste by weight was diverted. (This excluded deposit containers and other material taken to drop-off or buy-back sites.)

(See side bar, "New York City's Intensive Recycling Project" in Chapter 4 for a description of a comprehensive multi-material apartment building recycling program.)

Curbside Set-out and Collection Methods

When implementing a recycling program, an important first step is to determine which materials to target for collection and how such materials will be collected and prepared for market. These steps are interrelated. Available markets and processing capabilities will determine which materials to collect. Targeted materials and market specifications will influence how recyclables should be collected and processed.

A variety of curbside collection systems are available for recyclable materials. Each collection and processing system has advantages and disadvantages. Sorting materials in the household or on the collection route minimizes the amount of sorting that must be performed at a processing

Table 5.6
Recyclables Set-out and Collection Method

Community	Set-out Method
Austin, TX	Two segregations: 1) OCC, ONP bundled/bagged; 2) A,F,G commingled in a separate container
Berkeley, CA	Three segregations: 1) ONP bundled or bagged; 2) A, F in waxed OCC box; 3) G in another OCC box (a)
Berlin Township, NJ	Four segregations: 1) A,F,G,P in a 20-gallon bin; 2) OCC, PB crushed and bundled together; 3) ONP bundled; 4)MP bundled
Boulder, CO	Three segregations: 1) A,F; 2) G; 3) ONP; all materials bagged separately in a bin
Bowdoinham, ME	Five segregations, all bagged: 1) ONP, 2) OCC, 3) glossy paper, 4) mixed paper, 5) A,F,G,P,SM,X bagged
Columbia, MO	Six segregations: 1) ONP bagged/bundled; 2) OCC bagged or bundled; 3-5) three sorts of glass; 6) A bagged
Dakota County, MN	Three segregations: 1) ONP bagged; 2) A,F,P bagged; 3) G bagged in bin
Fennimore, WI	Five segregations: 1) ONP in bin; 2) P in bin; 3) A,F,G in bin; 4) MP bagged; 5) OCC set beside bins
King County, WA	Either one bin for commingled recyclables or 3 segregations: 1) ONP; 2) MP; and 3) A,G,P
La Crescent, MN	Six segregations: 1) G bagged; 2) A,F bagged; 3) P bagged; 4) HP, ONP bundled/bagged; 5) MP bundled; 6) OCC bundled
Lafayette, LA	Three segregations: 1) G,P in bin; 2) A,F in bin; 3) ONP in bin
Lincoln, NE	Two segregations: 1) ONP bagged, 2) A bagged
Lincoln Park, NJ	ONP bundled
Mecklenburg Co, NC	Two segregations: 1) commingled A,F,G,P in bin; 2) ONP bagged
Monroe, WI	Four segregations: 1) MP,ONP bundled; 2) OCC bundled; 3) HP boxed/bagged; 4) A,F,G,P,SM commingled in bin
Naperville, IL	Nine segregations: 1) ONP bagged; 2) OCC bundled; 3-5) G color-sorted; 6) A; 7) F; 8) P; 9) HP bagged
Newark, NJ	Two segregations: 1) A,F,G bagged; 2) ONP bagged/bundled
Pottstown, PA	Seven segregations: 1) ONP bundled/bagged; 2) A; 3) MP; 4) OCC; 5-7) color-sorted G
Philadelphia, PA	Two segregations: 1) A,F,G,P in bucket; 2) ONP bundled/bagged
Portland, OR	Seven segregations: 1-3) color-sorted G; 4) F bagged; 5) A bagged; 6) P bagged; 7) ONP bundled
Providence, RI	Two segregations: 1) A,F,G,P commingled in bin; 2) ONP bundled
San Francisco, CA	Two segregations: 1) HP,OCC,ONP bagged; 2) A,G,P in a bin
Seattle, WA	Commingled or Segregated in 3 bins: 1) A,F,G,P; 2) MP; and 3) ONP
Sonoma County, CA	Three segregations: 1) ONP in bin, 2) G in bin, 3) A,F,P in bin
Takoma Park, MD	Three segregations: 1) A,F,G in one bucket; 2) ONP bundled/bagged; 3) OCC bundled
Upper Township, NJ	Three segregations: 1) A,F,G,P in container; 2) MP bundled/bagged; 3) OCC bundled/bagged
West Linn, OR	Six segregations: 1) ONP bagged; 2) OCC bundled; 3-5) color-sorted G bagged; 6) A,F bagged
West Palm Beach, FL	A,G,ONP,P in one bin

Key:

A = Aluminum CS = Curbside F = Ferrous cans G = Glass HP = High-grade Paper MP = Mixed Paper
OCC = Corrugated Cardboard ONP = Newspaper P = Plastics PB = Paperboard SM = Scrap Metal
X = Other materials including textiles

Note:

(a) MP and OCC are collected from approximately 2,000 City households. They are set out in bags or bundled, and placed in a separate compartment in the recycling vehicle.

Table 5.6
Recyclables Set-out and Collection Method (continued)

Community	Collection Method
Austin, TX	Two sorts: 1) OCC,ONP; 2) A,F,G in compartmentalized Eager Beaver Trailer.
Berkeley, CA	Three sorts: 1) ONP; 2) A, F; 3) G in a compartmentalized Lodal truck.
Berlin Township, NJ	A,F,G,P commingled in Eager Beaver truck; OCC, PB in dump truck, second dump truck for ONP, MP
Boulder, CO	Three sorts: 1) ONP in rear; 2) G on side; 3) A,F on other side, of a compartmentalized packer truck
Bowdoinham, ME	All segregated materials are placed in front or rear portion of a dump truck
Columbia, MO	Materials placed segregated in compartmentalized trailer, OCC in a packer truck
Dakota County, MN	Compartmentalized vehicles vary by hauler
Fennimore, WI	Eight sorts: 1) A,F; 2-4) color-sorted G; 5) MP; 6) ONP; 7) P; 8) OCC in a used beer/pop truck
King County, WA	Varies
La Crescent, MN	Eight sorts: 1-3) color-sorted G; 4) A,F; 5) P; 6) OCC; 7) MP; 8) MP,ONP
Lafayette, LA	Three sorts: 1) G,P; 2) A,F; 3) ONP in compartmentalized trailer
Lincoln, NE	Two sorts for A and ONP, placed in bins retrofitted on to refuse vehicles
Lincoln Park, NJ	ONP placed in a dump truck
Mecklenburg Co, NC	Three sorts: 1) A,F,G in one compartment, 2) ONP in a second, 3) P in cage on Lodal truck
Monroe, WI	Four sorts: recyclables are separated in different areas on a dump truck
Naperville, IL	Nine sorts: 6 for A,HP,OCC,ONP,P,PB, and 3 sorts of G on a compartmentalized trailer
Newark, NJ	One sort: A,F,G collected commingled one week, ONP the following in Eager Beaver trucks
Perkasie, PA	Four sorts in compartmentalized vehicle: 1) 3 color-sorted G; 4) A,MP,ONP in a packer; OCC in second packer
Philadelphia, PA	Two sorts: 1) A,F,G,P in one compartment; 2) ONP in another on a Lodal or Eager Beaver vehicle
Portland, OR	Varied compartmentalized vehicles
Providence, RI	Two sorts: 1) ONP placed on one side; 2) A,F,G,P on other side of a dual side-loading vehicle
San Francisco, CA	Two sorts: 1) HG,MP,ONP in one compartment; 2) A,G,P in second on compartmentalized Lodal truck
Seattle, WA	Compartmentalized vehicles for segregated recyclables, packers for commingled materials
Sonoma County, CA	Three sorts in varied compartmentalized vehicles (three compartments)
Takoma Park, MD	Two sorts: 1) OCC and ONP in rear compartment; 2) A,F,G in front compartment of Kann Curbsorter truck
Upper Township, NJ	Two sorts: 1) MP,ONP in packer truck; 2) A,F,G,P in second packer
West Linn, OR	Six sorts: 1) ONP; 2-5) Color-sorted G; 6) A,F separated in modified garbage truck or Kann Curbsorter
West Palm Beach, FL	Two sorts: 1) ONP; 2) A,G,P in Labrie recycling truck

Key:

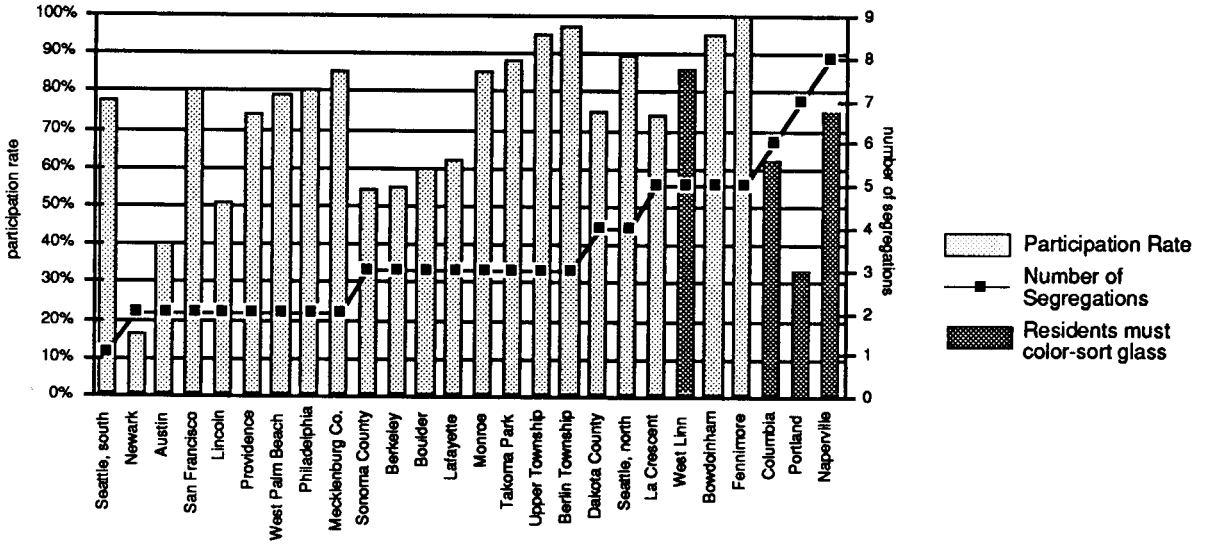
A = Aluminum CS = Curbside F = Ferrous cans G = Glass HP = High-grade Paper MP = Mixed Paper
OCC = Corrugated Cardboard ONP = Newspaper P = Plastics PB = Paperboard SM = Scrap Metal
X = Other materials including textiles

center, and frequently results in lower overall breakage and reject rates, increasing the net amount of material marketed. Sorting materials at a processing center may increase program participation and speed up collection, but often requires construction of a more capital-intensive facility, which may be difficult for a community to finance.

Table 5.6 details the set-out and collection methods utilized by the 30 communities studied. These represent a wide range of strategies, from an entirely commingled set-out and collection procedure used on the south side of Seattle, to an eight-sort set-out system utilized by Naperville, Illinois, in 1990. Eight of the communities studied require minimal separation on the household level; that is, segregation into only two fractions: paper in one container, and commingled food and beverage containers in a second container. (In this report, we have called collection programs "commingled" when residents are required to set out food and beverage containers in a single container.) Four communities require complete segregation of materials, including color separation of glass.

Set-out requirements may affect program participation. Chart 5.3 indicates that while both programs with simplified set-out arrangements and those with more complicated requirements achieve participation rates of 80 percent or higher, all three of the cities that require more than five segregations (including color-sorting of glass) have secured the participation of 75 percent or fewer households.[8] These lower participation rates may also be attributed to factors such as voluntary participation (all three programs are voluntary) and collection schedules. The fourth city requiring color-sorting of glass, West Linn, has an 86 percent participation rate. Its steep volume-based rates may be more of a recycling incentive than the color-sorting is a deterrent. In fact, this may be the case with programs requiring four and five sorts. Five out of six of these have volume-based refuse rates. Many of the cities with the lowest participation rates are actually those that require commingled set-out with only two segregations. This can be explained by the fact that many of these are large cities with diverse populations, where securing resident participation can be a challenging task.

Chart 5.3
Curbside Set-out Requirement and Participation Rate



Set-out and collection systems affect the overall recovery of materials. Within the 30 communities studied, processing facilities that accept segregated materials report low residue rates of 0 to 4 percent by weight, while those that accept commingled materials often rely on mechanized sorting and report higher residue rates of 0.5 to 16 percent by weight, largely due to glass breakage.[9] If, for example, the amount of recyclable material disposed of as residue from Rhode Island's processing facility (which has a residue rate of 14 percent) is subtracted from Providence's collected tonnage and added to their tonnage disposed, the City's recycling rate would drop from 10 percent to 9 percent. To increase the value of recyclables collected, Seattle is requiring its recycling hauler who services the south end of the City (which previously utilized a fully commingled system) to color-sort glass en route; paper contaminated with broken glass was becoming increasingly difficult to market. Sorting materials at the household level or on the truck can increase the net tonnage of material marketed. (See Chapter 8 and Table 8.17).

In the effort to increase materials recovery rates, a few communities in Europe, Canada, and the United States are pilot testing and/or implementing "wet/dry" collection systems. These programs typically target more materials for recovery in order to achieve higher overall recovery rates. However, due to the commingled collection system utilized, a larger proportion of collected recyclables and organics maybe contaminated than is the case with more traditional recycling systems. (See side bar, "Wet/Dry Collection Systems.")

Provision of Recycling Containers

Providing suitable containers to households for storage and set-out of recyclable materials may increase participation and recycling levels. The majority of the 30 communities studied distribute recycling containers to households. Table 5.4 lists container type and size. Storage containers serve several purposes: (1) they publicize a recycling program and remind individuals to source-separate material, thereby increasing program participation; (2) they assist drivers' identification of recyclable materials and loading of materials onto vehicles; and (3) they may increase the amount of material residents set out per collection day by providing a convenient and attractive place to store materials.[10]

All the communities with the highest participation rates (over 80 percent), except Upper Township and Bowdoinham, distribute recycling containers to residents. In Upper Township, residents are required by law to source-separate materials, and set-out is made convenient (only three segregations are required). In Bowdoinham, the per-bag refuse fee provides residents an economic incentive to participate in the recycling program. Many of the communities with low participation rates (including Newark, Austin, and Lincoln) did not distribute containers to residents. Newark, with the lowest participation (estimated at 16 percent in 1989), had distributed recycling containers to only 15,000 households.[11]

Within the 30 communities studied, processing facilities that accept segregated materials report low residue rates of 0 to 4 percent by weight, while those that accept commingled materials often rely on mechanized sorting and report higher residue rates of 0.5 to 16 percent by weight, largely due to glass breakage.

Container size may influence recycling rates. Small containers may limit the amount of material recovered. A container must not only be large enough to accommodate current levels of material, but must also accommodate substantial program growth. Communities have found 5-gallon bins suitable during the early stages of a recycling program, but inadequate once new materials are added to a collection program. Berlin Township's experience with different containers provides a striking example of the importance of container size. When the Township replaced its 5-gallon buckets with 20-gallon buckets to accommodate recycling of plastic containers, the amount of commingled recyclables collected, excluding plastics, increased 49 percent by weight with the distribution of the larger buckets.

Wet/Dry Collection Systems

In parts of Europe and Canada, communities have implemented a new type of materials recovery system known as "wet/dry" collection. These systems collect all refuse, recyclable, and compostable components in two or three fractions. In the two-stream method, residents place all wet wastes, including food scraps, yard waste, and soiled paper, in one container, and all dry waste, including recyclable components, in a second container. Wet and dry fractions are collected in one dual-compartmentalized vehicle. Recyclables are separated from the dry fraction at a processing center; inorganics are screened out of the wet fraction at a composting facility; and the remaining material is composted. Residual materials from the wet and dry fractions, which came to less than 40 percent of total materials in the pilot studies conducted in Guelph, Ontario and Kokomo, Indiana, are landfilled. In the three-stream system, residents separate organic yard and food waste into one bin, dry recyclables into a second, and residual materials into a third. Materials are collected in two separate vehicles; generally, organic waste and refuse are co-collected in one vehicle, and commingled recyclables are collected in a second vehicle. Wet waste is composted; recyclables are removed from the dry waste; and the refuse is landfilled. In some European countries, residents bring recyclables, such as glass, paper, and batteries, to igloos or other depot sites.

Wet/dry collection systems typically achieve high materials recovery rates of over 60 percent. A 10-week wet/dry pilot study conducted in Kokomo, Indiana, for example, recovered 82 percent of all waste generated. Residents in the 70 participating households were extremely surprised to discover the small quantity of material needing to be disposed in the refuse bag destined for the landfill.

Appendix E outlines the results of the wet/dry collection study conducted in Guelph, Ontario, a city of nearly 90,000.

Source: Michael Gibson (Waste Management Technician, City of Guelph, Ontario), personal communication, February 1991; (City of Guelph Wet/Dry Pilot Project, Summary of Preliminary Findings), April 1991; Anne Scheinberg et al., "European Food Waste Collection and Composting Programs," Biocycle, December 1990, 76-80; Tom Watson, "The Latest European Import: Wet/Dry Collection Systems," *Resource Recycling*, April 1991,19-23; Dan Hoornweg et al., "Wet/Dry Household Waste Collection," *BioCycle*, June 1991, 52-54; and Thomas High, *Kokomo's Recycling Demonstration Program.*, Kokomo Municipal Sanitation Utility, Kokomo, Indiana, n.d.

Small containers may increase the frequency with which residents set out recyclables, but decrease the amount of materials per set-out, thus decreasing overall collection efficiency. A study of 2,200 households in a southern California neighborhood found that households utilizing the largest of the four container systems tested--a set of three stackable recycling bins--had the lowest set-out rate (while still achieving high participation) and the greatest amount of material per set-out. Collection efficiency was highest with the stacking containers, averaging a collection time of 20 seconds per stop. Blue boxes, on the other hand, had an average loading time of 28 seconds per stop. While participation among households using blue boxes was quite high, residents reported that the rectangular boxes had inadequate capacity for their materials.[12]

Inadequately sized containers appear to be hampering the success of New York City's pilot project to collect a wide range of recyclable and compostable materials from 7,000 multi-unit households in Park Slope, Brooklyn. The City has supplied one- to three-unit buildings with a single 17-gallon container for waste paper; a 20-gallon container for commingled plastic, metal, and glass; and an 8-gallon bucket for food and yard waste. Although the amount of recyclables recovered increased after the distribution of recycling containers, one-quarter of the inquiry calls received

from residents have been complaints regarding small containers.[13]

In most instances, cities provide bins free of charge. To cover the cost of purchasing bins, cities sometimes charge residents for these items. However, requiring residents to pick up and purchase bins, particularly in voluntary programs, can decrease program participation. The City of Columbia, for instance, charges residents $5 for bins. At the end of 1990,5 years into its voluntary curbside program, the City had distributed recycling bins to only 200 households (representing 3 percent of enrolled households) and had secured the participation of only 62 percent of enrolled households.

Drop-off Collection

As indicated in Table 5.2, most of our study communities utilize some form of drop-off collection. While curbside collection is generally a more effective way to maximize the amount of recyclable materials collected, drop-off collection can augment curbside and serve as the primary method of recyclables collection in communities in which residents self-haul refuse. Convenient placement of sites, and economic incentives (such as payment for recyclables, or variable refuse rates) increase residents' participation in drop-off programs.

There is great variation in the type of drop-off opportunities offered. Some sites collect a wide range of materials, while others collect only bottle bill containers or scrap metal. Some sites operate unstaffed, while others are staffed. Some pay individuals for materials, while others accept materials at no charge. Table 5.7 lists the materials collected at public and private drop-off sites.

Drop-off sites area particularly viable and cost-effective alternative to curbside collection in rural or suburban communities in which residents self-haul refuse to disposal sites. Communities such as Peterborough, New Hampshire; Bowdoinham, Maine; Seattle, Washington; and Sonoma County, California operate successful drop-off sites at transfer stations and landfills. Peterborough, for instance, recovered 42 percent of its residential waste through drop-off collection alone.[14] All residents and private haulers utilizing the Town refuse and recycling center must source-separate a wide range of recyclable items, including many grades of paper, glass, metal, reusable items, and food waste, and deposit all material generated or collected, not just nonrecyclable (refuse) items or materials with a low market value. The rural community of Bowdoinham successfully recycled 43 percent of its municipal waste (which is largely material from the residential sector), primarily through two publicly run drop-off sites, one of which was located at the Town land fill.[15] Bowdoinham's volume-based refuse rates provide residents the incentive to self-haul recyclables to the Center.

Sonoma County and San Francisco, California and Seattle and King County, Washington utilize drop-off collection for those households not serviced by curbside collection, or for those self-hauling refuse to the landfill. Seattle, for example, recovers recyclable and compostable materials through hundreds of private drop-off sites (in addition to its curbside program) and two public drop-off centers, one each at the City's two transfer stations. The City's volume-based refuse fees provide residents ample incentive to source-separate and deliver recyclable materials to drop off sites. Philadelphia has implemented a "block corner" recycling program to service those households not provided with curbside collection. (See side bar, "Philadelphia's Block Corner Recycling Program.")

Seven of the 30 communities studied are located in jurisdictions with container deposit legislation. Beer and soft drink containers constitute on average 4.1 percent of the municipal solid waste stream. States with container deposit legislation realize return rates of 72 to 98 percent for such material,[18] enabling communities to recycle between 2.9 and 4.1 percent of their waste without spending any municipal funds. In 1977 Columbia enacted the nation's first and only local bottle bill. An estimated 85 percent of all glass, aluminum, and PET plastic deposit containers are returned through this legislation. While Columbia has a limited recycling program (only 27 percent of households received curbside collection service in 1990, and 33 percent received such service in 1991), the City recycled 13 percent of its total waste in FY 1990. Twelve percent of recycled material consisted of deposit containers.

Targeting a Wide Range of Materials for Recovery

Table 5.7 lists materials collected through drop off sites. Table 5.8 lists residential recyclable and compostable materials collected at curbside. Communities with the highest recycling levels are generally those that target a large number of materials for recovery, particularly those materials that constitute a significant percentage of the waste stream. The six communities recycling 28 to 42 percent of their residential waste target between 5 and 15 types of recyclable materials for citywide collection. The three communities recycling 35 percent or more of their residential waste—Bowdoinham, Peterborough, and San Francisco-are each collecting between 9 and 14 materials.[17] On the other hand, Newark, with a residential recycling rate of 5 percent, was collecting only four recyclable materials at curbside in the base year. Lincoln, Nebraska has the lowest residential recycling rate-3 percent—and targets only two materials, newspaper and aluminum cans, for curbside collection.

Philadelphia's Block Corner Recycling Program

Philadelphia utilizes a "block corner" collection program for areas of the City not yet serviced with curbside collection. The program, initiated by a neighborhood group in 1985, is a cross between curbside and drop-off service and costs about a third of curbside collection. Residents from 30 to 150 households in each block corner zone bring newspaper, glass, and aluminum cans to designated street corners for weekly or biweeky collection. Over a 3-hour period, City crews pick up material from 25 street corners. Materials are fully segregated at the curb, including glass separated by color, and require no further sorting. Neighborhood groups play a very active role in initiating and maintaining the program, but depend on the City for pick-up. Revenue from the sale of material is returned to the neighborhood to fund community projects. City costs for running this program were $58 per ton in 1990.

Charts 5.4 and 5.5 provide a breakdown of residential materials recycled, as a percentage of residential waste generated and in pounds per household. While the breakdowns in Chart 5.4 are affected by the relative weight of the other components of the residential waste steam, the per household breakdowns in Chart 5.5 are not.

Waste Paper

Paper, the largest single component of the waste stream, also accounts for the largest portion of residential recyclables. Paper comprises between 50 and 80 percent by weight of all residential materials recycled in the majority of these communities.

While newspaper comprises the bulk of this waste paper, other grades of paper, such as high-grade paper, mixed waste paper (including advertising mail, magazines, and paperboard packaging), and corrugated cardboard, can comprise a substantial percentage. The cities with the highest waste paper recycling levels, San Francisco and Seattle, are recovering 29 percent and 24 percent of their residential waste streams, respectively, through waste paper recycling alone. Both recover a wide range of paper grades, including newspaper, magazines, advertising mail, and corrugated cardboard.

As indicated on Chart 5.4, the recovery of mixed waste paper, which composes approximately 13 percent by weight of MSW nationally, plays an important role in reaching high recycling rates. All of the six communities recycling between 28 and 42 percent of their residential waste target mixed waste paper for collection. None of the eight communities with the lowest residential recycling rates are recovering mixed paper from the residential sector.

The City of Seattle has determined that mixed household waste paper comprises 19 percent of its residential waste. (Approximately half of which is not targeted for collection as it is coated or contaminated.) Of this mixed paper, it recovered nearly 30 percent in 1990. The City collects magazines, advertising mail, coupons, fliers, wrapping paper, used envelopes, cereal boxes, phone books, tube board, paper egg cartons, and brochures, in addition to corrugated cardboard and newspaper. The only paper that it does not collect

Table 5.7
Materials Recovered from Public and Private Drop-off Sites

	ONP	OCC	HP	MP	PHONE BKS	ALUM	FR CAN	SM	GLASS	PET	HDPE	OTHR PLAS	WG	OIL	FOOD	BATT	TIRES	OTHR	FOOD	GRS	LVS	WW	BRUSH	CT	LNDSCPRS' WASTE	MATS RECY (a)	MATS COMP (a)	TOT MATS (a)
Austin, TX	V		V	V		V	V	V	V	V	V		V			V				V	V			V	V	11	3	14
Berkeley, CA (b)	V	V	V	V		V	V	V	V				V					V		V	V	V	V		V	10	4	14
Berlin Township, NJ	M	M	V	M		M	M	M	M	M	M			M						M	M	M	M	M	V	11	5	16
Boulder, CO	V	V	V	V	V	V	V		V	V	V					V								V		11	1	12
Bowdoinham, ME (c)	V	V	V	V		V	V	V	V	V	V	V	V	V		V	V	V		V	V					16	2	18
Columbia, MO	V		V	V		V	V	V	V	V	V			V		V				V	V			V	V	11	3	14
Dakota Co., MN (d)	V	V	V	V		V	V	V	V	V	V	V	V	V		V	V	V		V	V		V	V	V	16	4	20
Fennimore, WI	M	M	M	M		M	M		M	M	M									M	M	M	M			9	4	13
King Co., WA	V	V	V	V		V	V	V	V	V	V					V				V	V	V	V	V	V	11	5	16
La Crescent, MN (e)	M	M	V	V		M	M	V	M	M	M	V	V	V		V	V	V		V	V				V	16	2	18
Lafayette, LA	V	V	V	V		V	V	V	V	V	V		V	V		V				V	V		V	V		13	4	17
Lincoln, NE	V	V	V			V	V	V	V	V	V		V	V				V		V	V		V	V	V	12	4	16
Lincoln Park, NJ (f)	M	M	M	M		M	M	M	M	M	M	M	M	M		M	M			M	M	M	M	M		15	5	20
Mecklenburg Co., NC (g)	V	V	V	V	V	V	V	V	V	V	V	V	V	V		V	V			V	V		V			16	3	19
Monroe, WI	M	M	M	M		M	M	M	M	M	M		V	M		M										13	0	13
Naperville, IL (h)	V	V	V	V		V	V	V	V	V	V	V	V			V										13	0	13
Newark, NJ	M	M	M	V		M	M	V	M					V		V	V									11	0	11
Perkasie, PA	M	M				M	V		M	V	V															7	0	7
Peterborough, NH (i)	M	M	M	M		M	M		M	M	M	M	M	M	M	M		M	M							16	0	16
Philadelphia, PA (j)	M	M	V	V		M	M	V	M					V		V	V	V		M	M		M			12	3	15
Portland, OR (k)	V	V	V	V		V	V	V	V		V	V		V						V	V	V	V		V	11	4	15
Providence, RI														V												1	0	1
San Francisco, CA (l)	V	V	V			V	V		V	V	V	V	V	V		V		V						V		13	1	14
Seattle, WA	V	V	V	V		V	V	V	V	V	V		V	V		V		V		M	M		M	M		14	4	18
Sonoma Co., CA (m)	V	V	V	V		V	V	V	V				V	V	V	V	V	V		V	V		V	V		14	4	18
Takoma Park, MD				V						V	V															3	0	3
Upper Township, NJ	M	M	M	M		M	M		M	M	M									V	M			V	V	9	3	12
Wapakoneta, OH (n)	V	V	V	V		V	V	V	V	V	V	V								M	M		M			11	3	14
West Linn, OR (o)	V	V	V	V		V	V		V		V	V		V						V	V	V	V	V		10	5	15
West Palm Beach, FL	V	V	V		V	V	V	V	V	V	V			V		V										12	0	12

Key:

ALUM = Aluminum
HP = High-grade Paper
MP = Mixed Paper
PET = Polyethylene Terephthalate
Batt = Batteries
L = Leaves
OCC = Corrugated Cardboard
SM = Scrap Metal
CT = Christmas Trees
LDPE = Low Density Polyethylene
TOT MATS = Total Materials
FR CANS = Ferrous Cans
LNDSCPRS' WASTE = Landscapers' Waste
ONP = Newspaper
WG = White Goods
GRS = Grass Clippings
MATS COMP = Materials Composted
OTHR PLAS = Other Plastics
WW = Wood Waste
HDPE = High-density Polyethylene
MATS RECY = Materials Recycled
OTHR = Other, including textiles, furniture, small household goods

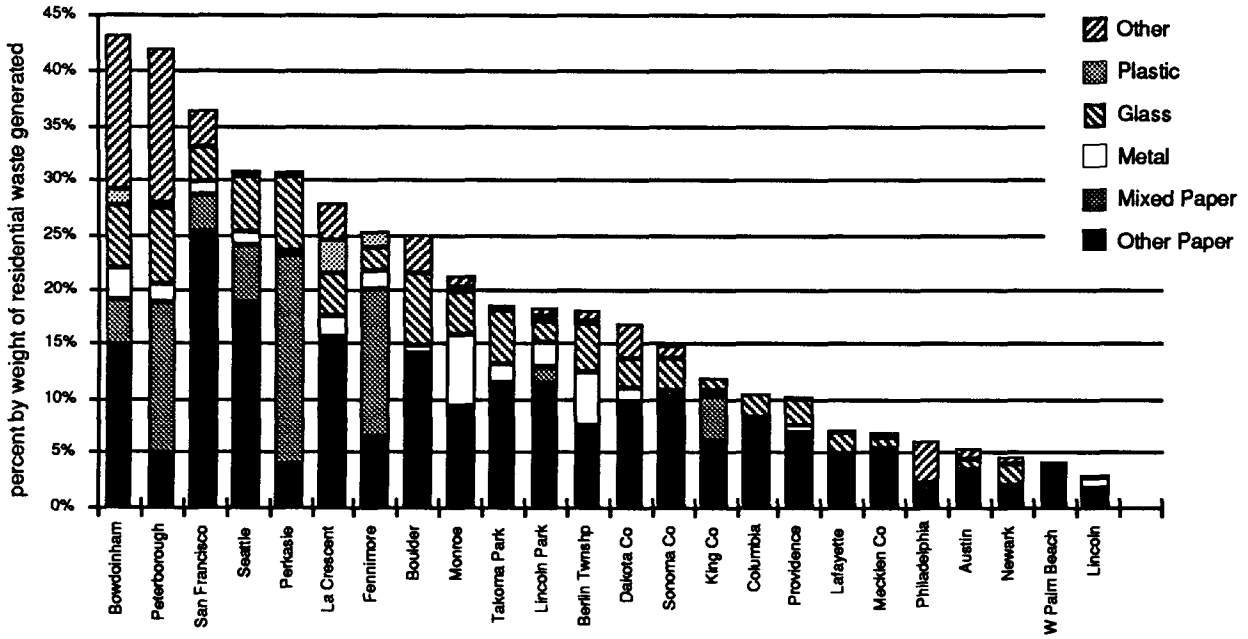
V = Source-separation of material by residents is voluntary.
M = Source-separation of material by residents is mandatory.

Notes:

Total materials recycled and recovered may be underestimated in some cases as mixed paper can incude several grades of paper. Landscapers' waste and phone books are not included in the number of materials composted or recovered.

(a) Materials recycled and materials composted represent the number of types of materials recycled and composted, respectively. Total materials recovered is the sum of the number of materials recycled and composted.
(b) Other includes household items such as furniture.
(c) Other materials collected are clothing, furniture, and rags.
(d) Other materials collected are household items including toys, clothing and books.
(e) Other materials includes furniture.
(f) Other is all plastic that held liquid.
(g) Other plastics include polypropylene, polyvinyl chloride, and scrap plastics.
(h) Recycles all types of plastic.
(i) Other materials include salvaged items and textiles.
(j) Collection of corrugated cardboard is mandatory for businesses and voluntary for residents.
(k) Other plastics are polystyrene packaging peanuts.
(l) Other materials collected are clothing, small appliances, and paint.
(m) The food waste collected is grease.
(n) Other plastics are polystyrene trays.
(o) Other plastic collected includes LDPE film and polystyrene.

Chart 5.4
Residential Materials Recycled, Percent by Weight



Notes: MSW tonnage data, which contains material recycled from 15 businesses, is utilized in lieu of Bowdoinham's residential tonnage data- which is unavailable. For Newark and Philadelphia, residential waste represents publicly collected material. "Other" includes white goods, tires, food waste, and reusable items. Deposit containers for Bowdoinham are included under "other." Deposit containers for Sonoma County and San Francisco are included under material type. Mixed paper collected in Berlin Township is included under "other paper."

from the residential sector is food-contaminated paper or paper coated with wax, plastic, or metal. On the other hand, Dakota County, which estimates that mixed waste paper comprises 10 percent of its residential waste, recovered none of its mixed paper in 1990. While Seattle recycled 31 percent of its residential waste in 1990,Dakota County recycled only 17 percent.

A number of communities have found that adding mixed paper to materials collected at curbside increases curbside tonnages. In 1990 Naperville, Illinois collected high-grade paper, box board (such as cereal boxes and tissue boxes), and magazines in addition to corrugated cardboard and newspaper. In 1991 its new hauler also began to collect advertising mail and all types of paperboard. The addition of these materials is partially responsible for the substantial increase in average monthly tonnages collected.[18] When Monroe, Wisconsin added telephone books, catalogues, paperboard packaging, and glossy inserts (in addition to PVC and PS plastics) to its curbside program in 1990, its currbside tonnages jumped from 537 tons in 1989 (the year of study) to 650 tons in 1990 and an estimated 748 tons in 1991.

Other Materials

As Chart 5.4 indicates, tires, white goods, glass, and metals can comprise a substantial percentage of residential recyclables. Targeting all these materials for collection helps raise recovery levels. For instance, 16 percent of the materials Peterborough recycled through its Town drop-off center in 1990 consisted of glass. To achieve its 31 percent residential recycling rate, Seattle recycled 59 percent of all residential glass waste generated in 1990, and 43 percent of all metal waste.

A number of communities target plastics for collection. See Tables 5.7 and 5.8. These include Berlin Township, Bowdoinham, Monroe,

Naperville, San Francisco, West Palm Beach, and Providence. While PET soda bottles and HDPE milk containers are the most common plastics recovered, some communities collect PVC, polystyrene, and LDPE film as well. Naperville, Illinois, with a residential recycling rate of 20 percent, collects all types of HDPE and PET containers, clean polystyrene containers, and LDPE six-pack rings. While plastics are light weight and thus add little to the weight of recovered materials, recovering such materials can reduce the volume of solid waste, as well as provide a feedstock for industry.

Food waste recovery has untapped potential. While food waste comprises a significant percentage of residential waste, few U.S. communities are recovering it. Food waste can be used as livestock feed, composted into a high-quality soil amendment, or manufactured into such products as perfumes and soaps. (See Chapter 4 for information on food waste composting in the U.S. and abroad.)

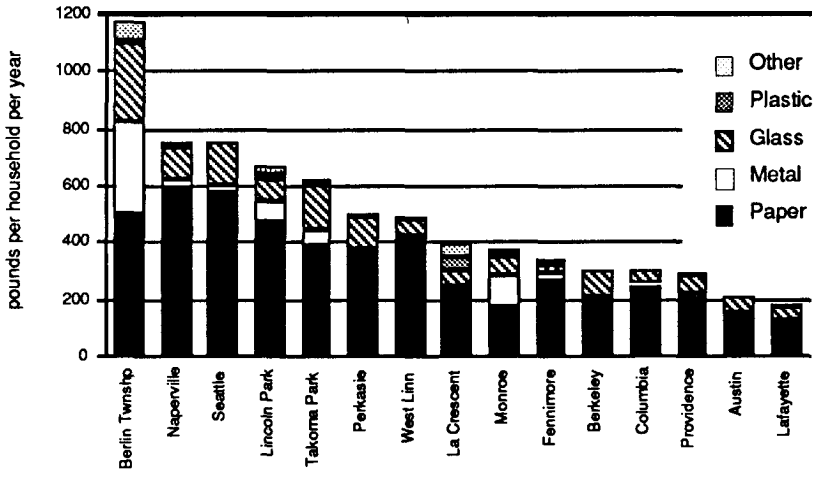
Hog farmers in New Jersey have provided Philadelphia residents the opportunity to recycle their food waste for over 80 years. In fiscal year 1990, hog farmers collected an estimated 30,000 tons of food waste from Philadelphia residents, equivalent to 3 percent of the residential waste generated and 53 percent of municipally sponsored materials recovered. (See side bar, "Urban and Rural Communities Collect Food Waste for Use as Animal Feed.")

Most communities have overlooked the recovery of reusable items. Reusable goods may compose up to 5 percent of the total waste stream.[19] Among the communities studied, Berkeley and Sonoma County, California have most effectively targeted this component of the waste stream for recovery. Berkeley, for example, recovered an estimated 68 percent of the white goods disposed of in the city through a private salvage/reuse operation. Please see Chapter 3 for further discussion of salvage and reuse.

Securing High Levels of Participation

Many of programs with high participation levels are mandatory. In fact, most of the communities recovering 40 percent or more of their waste have mandatory programs. Chart 5.6 examines participation rates for 38 mandatory and voluntary programs, including 10 communities from *Beyond 40 Percent: Record-Setting Recycling and composting Programs* (ILSR, 1990).[20] Chart 5.7 shows that of the nine communities in our study recovering over 40 percent of their residential waste, four mandate participation, three have volume-based refuse rates

Chart 5.5
Residential Materials Recycled, Pounds per Household



Notes: Communities for which the number of households generating recycled tonnage is unknown are excluded from this chart. For Austin, Berkeley, Columbia, Naperville, Providence, end Seattle, tonnages are those collected at curbside only. For West Linn, deposit containers are excluded from residential material. "Other" includes white goods, tires, end food waste.

Table 5.8
Materials Recovered at Curbside from the Residential Sector for Recycling and Composting

	YEAR COLLECTED	ONP	OCC	HP	MP	PHONE BOOKS	ALUM	FR CAN	SM	GLASS	PET	HDPE	OTHR PLAS	WG	OIL	FOOD	BATT	TIRE	OTHR	GRS	LVS	WW	BRUSH	CT	NO„ MATS RECYCLED	NO„ MATS COMPOSTED	ne„ MATS COLLECTED
Austin, TX	FY89	V	V				V	V		V											V				5	1	6
Berkeley, CA (a)	FY91	V					V	V		V										V	V		V	V	4	4	8
Berlin Township, NJ	1990	M	M		M		M	M	M	M	M	M		V	M		M	M		M	M	M	M	M	13	5	18
Boulder, CO (b)	1990	V					V	V		V													V		4	1	5
Bowdoinham, ME (c)	FY90	V	V	V	V		V	V	V	V	V	V	V						V	V	V				11	3	14
Columbia, MO	FY90	V	V		V		V			V				V	V									V	7	1	8
Dakota Co., MN	1990	V	V				V	V		V	V	V	V	V						V	V		V	V	9	4	13
Fennimore, WI	1990	M	M	M	M		M	M		M	M	M		V							M	M			10	2	12
King Co., WA (d)	1990	V	V	V	V		V	V		V	V	V								V	V		V	V	9	4	13
La Crescent, MN (e)	1990	M	M	V	V		M	M		M	M	M	V												10	0	10
Lafayette, LA	FY90	V					V	V		V	V	V								V	V		V	V	6	4	10
Lincoln, ME	1990	V					V													V	V		V		2	3	5
Lincoln Park, NJ	1990	M																		M	M		M	M	1	4	5
Mecklenburg Co., NC	1990	V					V	V		V	V			V											6	0	6
Monroe, WI	1989	M	M	M	M		M	M	M	M	M	M		M	M		M	M		M	M		M	V	14	4	18
Naperville, IL (f)	1990	V	V	V	V		V	V	V	V	V	V	V	V						M	M		M	M	12	4	16
Newark, NJ	1989	M					M	M		M										M	M		V	V	4	4	8
Perkasie, PA (g)	1990	M	M		V		M			M											V		V	V	5	3	8
Peterborough, NH (h)	1990	V	V	V	V		V	V		V	V	V	V	V	V	V	V								14	0	14
Philadelphia, PA	FY90	M					M	M		M	M	M		V		V		V			M			V	9	2	11
Portland, OR (i)	1990	V	V		V		V	V	V	V		V			V	V				V	V		V	V	9	5	14
Providence, RI	1990	M					M	M		M	M	M													6	0	6
San Francisco, CA (j)	1990	V	V	V	V	V	V	V	V	V	V													V	10	1	11
Seattle, WA	1990	V	V		V	V	V	V		V	V									M	M		M		8	3	11
Sonoma Co., CA (k)	1990	V					V	V		V	V	V												V	6	1	7
Takoma Park, MD	1990	M	V				M	V		M				V						V	V			V	6	3	9
Upper Township, NJ	1990	M	M	M	M		M	M	V	M	M	M		V	V		V	V		V	M	V	V	V	14	5	19
Wapakoneta, OH	9/89-8/90																								0	0	0
West Linn, OR	1990	V	V				V	V		V					V						V		V	V	6	3	9
West Palm Beach, FL	4/90-3/91	V				V	V			V	V	V		V						V	V	V	V	V	7	5	12

Key:

ALUM = Aluminum
HP = High-grade Paper
OTHR = Other, including textiles, furniture, small household goods
Batt = Batteries
L = Leaves
OTHR PLAS = Other Plastics
WW = Wood Waste
CT = Christmas Trees
LDPE = Low Density Polyethylene
PET = Polyethylene Terephthalate
FR CANS = Ferrous Cans
MP = Mixed Paper
SM = Scrap Metal
HDPE = High-density Polyethylene
OCC = Corrugated Cardboard

V = Set-out of material by residents is voluntary.
M = Set-out of material by residents is mandatory.

Notes:

Total materials collected may be underestimated in some cases as mixed paper can include several grades of paper.
(a) Only 2,600 of the 40,000 households, or 7%, receive yard waste collection.
(b) The Public Works Department collects brush over a 3-week period during spring cleanup.
(c) Bowdoinham collects high-grade and mixed paper for composting. Glossy paper (e.g. magazines) is recycled. Other plastic includes polystyrene and all other plastic resins.
(d) Six of thirteen cities have curbside collection of PET and HDPE plastic containers; nine received yard waste collection in 1990.
(e) Other plastic includes polyvinylchloride, polypropylene and all other plastic.
(f) Other plastic includes polystyrene, LDPE and six-pack rings
(g) It is not mandatory for residents to recycle junk mail.
(h) In 1990, 100 households received curbside recycling service. Other plastic collected is polystyrene.
(i) Some haulers collect HDPE milk jugs or mixed waste paper; food waste was collected for composting from an estimated 105 households in 1990.
(j) A small sector of the City receives curbside collection of Christmas trees.
(k) The County began a pilot curbside program in 1990 to collect leaves, grass, and yard waste from 1,200 homes; some areas have curbside Christmas tree collection.

Urban and Rural Communities Collect Food Waste for Use as Animal Feed

New Jersey hog farmers have collected food waste from Philadelphia residents for over 80 years. The City has reimbursed hog farmers for this service for 25 years. Currently farmers are paid a fee equivalent to the landfill tipping charge, which was $67 per ton in fiscal year 1990. Because the City avoids the cost of collection, this program is cost-effective.

Residents in over three-fourths of the City are eligible for food waste collection. Food scraps are set out at curbside in tightly covered 5- or 10-gallon containers, twice a week. Farmers unload the food waste into their sealed rear-loading vehicles. The City reports no fly or odor problems. The U.S. Department of Agriculture requires that food waste be heat-sterilized, or cooked for 30 minutes at a core temperature of 212 degrees Fahrenheit, before use as an animal feed. Some of the farmers' vehicles heat the food waste en route. Farmers also collect large quantities of food waste from businesses such as bakeries and groceries.

The rural community of Peterborough, New Hampshire has recovered food waste through the Town Recycling Center since 1987. In 1990 approximately 4 percent of materials collected at the drop-off site (32.84 tons) consisted of food waste. Residents store food scraps, including meat and fat, in plastic bags, which they deposit in 55-gallon drums at the Center. According to the Town Administrator, nearly all residents who use the Center—an estimated 64 percent of the Town's residents— drop off food waste. A local pig farmer collects the food scraps twice a week in the summer and once a week in the winter.

One local hauler in Peterborough, Kodiac Recycling, collects food waste from 100 households in a customized recycling vehicle. All residents who receive refuse/recycling collection from Kodiac must separate food waste from refuse. Food waste is placed in a lined compartment of the vehicle. The hauler recommends storing the materials in close-fitting containers or bags, which are collected and brought to the Town Recycling Center.

(which provide a strong economic incentive to recycle), and the other two do both.

Recycling mandates, however, may be weak without proper enforcement.[21] In Newark, New Jersey, enforcement of the 1987 mandatory source-separation ordinance has noticeably increased recovery rates. Beginning in January 1991, three municipal enforcement officers have performed spot checks for recyclables in residential refuse. As of July 1991, 863 warnings had been issued. After two warnings, residents are subject to a fine of $25 per violation. The Office of Recycling credits this new enforcement policy with the 20 percent increase in recyclable collected in the first quarter of 1991 (over 1990 rates).

Establishing Economic Incentives

Communities in our study are using economic incentives such as high tipping fees at disposal sites, low or no tipping fees at recycling or composting facilities, volume-based refuse collection rates, and contest awards to increase participation in recycling programs and reduce overall waste generation rates. (See Chart 5.7 and Table 5.3.)

Twelve of our 30 communities utilize volume-based refuse collection rates through which residents are charged higher fees for greater volumes of refuse set-out. In most instances, residents are not charged for set-out of recyclable or compostable materials, or are charged a reduced fee. Such rates, also known as variable rates, provide a direct economic incentive to generate as little waste as possible and recycle as much as possible.

There is some evidence that volume-based rates encourage recycling and waste reduction. Many of the communities with the highest recycling rates in the nation have volume-based refuse rates (see Chart 5.7). In 1985, 3 years before the start-up of Seattle's curbside recycling program, the City recycled 22 percent of its waste through small-scale, independent recycling centers. This recycling level is attributed to the City's variable can rate. Since the implementation of Seattle's variable can system the weighted average number of cans subscribed to by a single-family household decreased from 3.5 in 1981 to 1.4 in 1988. A significant increase in Seattle's refuse collection rates between 1985 and 1989, and the start-up of the City's curbside

recycling program in 1988, **has** led to an even more significant reduction in waste disposed than during the program's earliest years. Seattle recovered 40 percent of its municipal solid waste in 1990.

Since June 1990, Wapakoneta, Ohio has charged households $0.70 per bag of refuse in addition to a $6 per month flat trash collection fee. During the first year of the program's implementation, the City reported a decrease in the volume of waste disposed from 20 to 30 percent. Municipal pick-up of refuse has been reduced from 5 days to 4 days per week. Wapakoneta attributes this decline to increased recycling activities, backyard composting, and compaction of waste by residents. Attrition of approximately 20 commercial customers from municipal refuse collection may also contribute to this decrease. (See Chapter 3 for further discussion of variable refuse rates.)

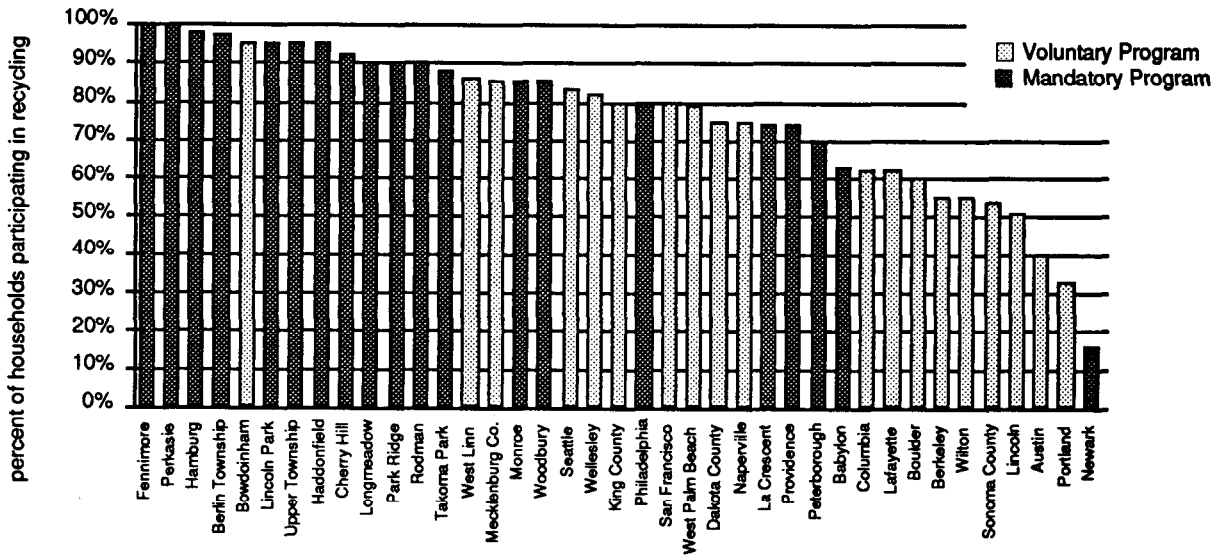
Comprehensive Educational and Promotional Programs

In order to motivate residents to participate in source-separation programs and instruct them how to comply with collection requirements, many communities undertake comprehensive educational and promotional programs. Educational outreach appears to be most critical for obtaining high participation rates in urban areas.

Virtually all 30 communities studied promote recycling. To target as wide an audience as possible, communities utilize techniques such as recycling information sheets, newsletters, posters, and utility bill inserts. Many communities take advantage of print and broadcast media, with their potential for reaching the broadest segment of the population. Monroe, Wisconsin reports the success

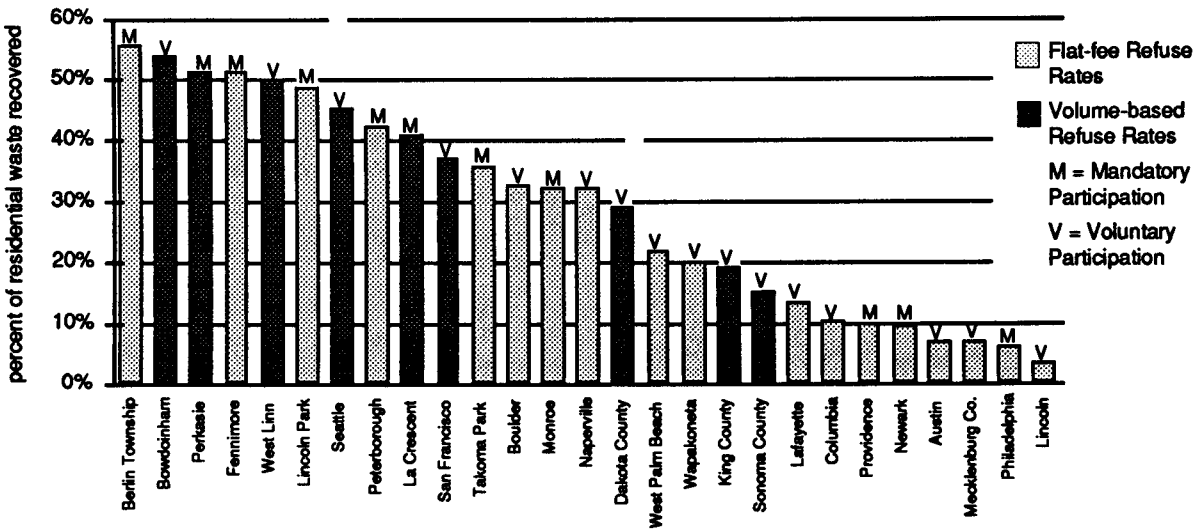
Chart 5.6

Household Participation Rates in Voluntary and Mandatory Programs



Note: Communities documented in ILSR's report *Beyond 40 Percent Record-Setting Recycling and Composting Programs* are included in this chart. Two communities are excluded, Wapakoneta--for which a participation rate is not available, and Peterborough-for which an exact participation rate is unavailable and participation cannot easily be classified as mandatory or voluntary (64% of residents self-hauling refuse to Town dump and an additional 6% of residents utilizing select private refuse haulers must source-separate recyclables. Other residents are not required to.)

Chart 5.7
Volume-based Refuse Rates and Residential Recovery Levels



Notes: Recovery rates include recycled and composted material. MSW recovery rates are utilized in Bowdoinharn, Wapakoneta, and West Linn, as residential breakdowns are not available and MSW is largely residential. Wapakoneta instituted volume-based refuse rates in June 1990 but because tonnage data were collected from Sept. 1989 to August 1990, it is listed as a flat-fee program.

of local recycling efforts in a local newspaper column. Local cable stations in Takoma Park, Maryland; Monroe, Wisconsin; Wapakoneta, Ohio; and Naperville, Illinois run programs highlighting solid waste management issues. Some communities promote recycling and composting through in-person education, which can be particularly effective. In-person includes door-to-door visits, staffed recycling booths at city or county fairs, or block leader programs.

Block leader or block captain programs actively promote recycling through neighbor-to-neighbor communication. Boulder, Colorado successfully initiated a block leader program in 1980. Designed by a psychology professor at the University of Colorado, Boulder's block leader program is currently run by Ecc-Cycle, a community-based recycling company. During the first year of the program a study revealed that participation rates in the neighborhoods with block leaders were over two times those without such programs. Boulder currently spends $30,000 per year on materials and labor to coordinate its block leader program. Communities as widespread and diverse as Minneapolis, Minnesota; Seattle Washington, and Austin, Texas have replicated the block leader program.

Similar in design are the Master Recycler/Composter programs, through which volunteers are trained to educate friends, neighbors, and co-workers about home composting source reduction, and recycling. King County, Washington conducts three 2-month training sessions each year; participants agree to contribute 40 hours each to community outreach initiatives. Capital expenditures for the program included $10,000 for training manuals and curricula, $6,000 for outreach tools, and $10,000 for the construction of two demonstration sites. The County spends $15,000 on training and equipment for each training session.

Education programs directed at school-age children play a vital role in the long-term success of a recycling program. Many communities utilize formal or informal recycling curricula to teach recycling concepts. The Ecology Center in Berkeley,

California developed "the Recyclones," lovable cartoon characters that reinforce recycling concepts. Newark, New Jersey created the Recycling Rangers to encourage students to spread the word about recycling to their parents. To generate enthusiasm for recycling, several communities conduct recycling poster contests, which use either a recycling theme or recycled materials.

Demographic factors play an important role in determining the amount of money a community must spend on recycling educational programs, and the types of programs implemented. Cities with transient populations and diverse ethnic groups face the greatest challenges in securing broad participation, and must typically spend more money on recycling education. Smaller communities, on the other hand, can rely on volunteer efforts, and word-of-mouth to ensure participation in recycling programs. Peterborough and Monroe, for example, report spending no money on education, yet both enjoy high residential recovery levels at 42 percent and 32 percent, respectively.

Educational outreach has played an important role in elevating recycling rates in large cities. Providence, Rhode Island, for example, increased participation in its curbside recycling program in the south side of the City (which has a large multilingual population) from 30 percent at the startup of the program to 60 percent one year later, using foreign-language brochures and other materials. Newark, New Jersey hired a local minority public relations firm to initiate a promotional campaign. Newark translates most mailings and bulletins into Spanish and Portuguese to reach its minority communities. Jersey City, New Jersey distributes recycling information pamphlets in Arabic, Hindi, Spanish, and Korean. San Francisco informs its Latino residents about its recycling program via Spanish-language radio and television stations. San Francisco also offers backyard composting workshops in Spanish and Cantonese.

By enlisting the help of community volunteers and school teachers, communities are implementing very successful educational programs without spending large sums of money.

Identifying Outlets for Collected Materials

Collecting materials for recycling is a challenging task, but perhaps one of the most difficult yet fundamentally important tasks is finding an outlet for the collected material. Identifying markets, securing agreements with materials brokers and end users, and meeting buyer specifications are all part of this task. Recycling collection programs can only be as successful as a recycling marketing program. Consequently market analysis will be both a planning and ongoing activity.

Identifying outlets for collected recyclables is an important component of all of the 30 recycling programs evaluated as part of this project. Many of these communities rely on private processors to find end users. Others undertake this legwork themselves. Municipal recycling coordinators and private processors are finding different end uses for the same material and using a variety of strategies to keep materials moving to those who can manufacture new products from them.

Wapakoneta, Ohio, sells its newspaper directly to a local manufacturer of insulation, whereas in Bowdoinham, Maine, a local farmer shreds the Town's old newspaper at no charge for animal bedding. In Sonoma County, California, some old newspaper is shipped to the Far East for deinking and reprocessing. The private processor of the County facility that Upper Township uses, sells some of its glass to manufacturers of new glass containers, and the rest is delivered to a manufacturer of glassphalt. Often communities sell their collected materials to brokers who resell the materials to manufacturers. Wapakoneta, for example, sells its baled PET to a broker in Minster, Ohio, who resells the containers to a firm in Cleveland for manufacturing into plastic lumber.

In Monroe, Wisconsin, the Monroe Area Recycling Committee (MARC) has secured a number of in-state brokers and end users for the City's recyclables. Much of the materials collected through the curbside program is sold locally to the Green County Salvage Yard, which resells it to various end users. MARC is considering selling more of the City's recyclables directly to end users, such as paper mills. MARC seeks additional markets when the supply of recyclables exceeds the

capacities of existing markets. For example, when traditional paper outlets are filled, Green County, in which Monroe is located, shreds and bales its paper for sale as animal bedding.

Peterborough, New Hampshire, is very active in the New Hampshire Resource Recovery Association (NHRRA). Begun in Peterborough in 1979, NHRRA helps to develop new markets for recyclable materials. Peterborough collectively markets some materials, such as glass, corrugated cardboard, newspaper, and plastic containers, through the NHRRA. Member communities are charged a fee of $0.03 per capita for this service plus a fee for brokering specific material; in return they receive revenue from the sale of certain materials. The NHRRA markets about 50 percent of all recyclables collected in the State of New Hampshire.

In addition to seeking markets for recyclables, a number of our case-study communities have implemented policies such as recycled-content product procurement to encourage further market development. See Appendix D for a list of these communities.

Notes

[1]Jim Glenn, "The State of Garbage in America." *BioCycle,* April 1992.

[2]For the communities of Philadelphia and Newark, residential material is publicly collected waste. Bowdoinham, West Linn, and Wapakoneta's MSW recycling rates are utilized in Chart 5.1 as their MSW is largely residential. The Cities of Berkeley and Portland have been excluded from Chart 5.1 as residential rates are not available. Upper Township has also been excluded as its publicly collected waste contain recyclables (although not refuse) from 222 businesses. Residential recycling rates are based on data provided by municipal officials and the private sector. Recycling rates are based on marketed tonnages in the few communities where such information was available; in most cases, however, recycling rates are based on collected tonnages. See Appendix A for methodology and data definitions, and Appendix C for waste calculations.

[3]Wapakoneta recycled 16 percent of its municipal solid waste in fiscal year 1990. while residents in the rural community of Wapakoneta receive curbside collection of refuse, they must drive to the privately run recycling drop-off site to participate in the City's voluntary recycling program. The Wapakoneta Recycling Center is operated by 19 Girl and Boy Scout troops and 1 volunteer recycling coordinator. In order to increase its recycling rate, Wapakoneta will institute weekly curbside collection of recyclable materials in spring 1992, based on a plan designed by the City's volunteer Waste Minimization Committee. In Lincoln Park, New Jersey, newspaper is the only material collected at curbside; all other recyclable are collected at the Borough's drop-off yard. Drop-off is the primary method of recyclable and refuse collection in the rural communities of Bowdoinham, Maine and Peterborough, New Hampshire. However, private haulers in both cities offer limited curbside recycling opportunities. In Bowdoinham one-third of the City receives curbside service.

[4]There are some exceptions. Columbia, Missouri; Lincoln Park, New Jersey; the south side of Seattle; parts of Portland, Oregon; and King County, Washington have monthly collection. Perkasie has weekly collection of glass and aluminum, and monthly collection of newspaper, junk mail, and corrugated cardboard. During the base year of study, Newark collected commingled recyclables and newspaper on alternate wees. Residents of Lincoln Park receive monthly collection of newspaper only; all other recyclables in Lincoln Park are collected through drop-off. Residents of Fennimore receive collection of recyclables every other week.

[5]Communities measure program participation differently. In most cases, the participation rate is the number of households setting out recyclable materials at least one time per month divided by the total number of households served. In Seattle, participation is the sign-up rate-the ratio of the number of households registered for the program to the number of households eligible. See *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results* (Washington, DC: ILSR, 1992) for information on how communities determine participation rates.

[6]NARC also discovered that biweekly collection saw a greater variation (plus or minus *40* percent) in the size of daily collection. With weekly collection, variation in tonnage decreased (to plus or minus 18 percent), which made scheduling easier and reduced the need for workers to put in overtime hours. Miriam Foshay and Anne Aitchison, "Factors Affecting Yield and Participation in Curbside Recycling Program," *Resource Recycling,* March 1991.

[7]1n the base year of study (1990), only 20 percent of San Francisco's residential recyclables were collected at curbside. With the curbside program fully phased in, the City estimates that it is recovering 55,000 tons per year at curbside, two and one-half times the amount recovered at curbside in 1990. In Boulder, the University, which comprises approximately 25 percent of the City's population, has 225 drop-off sites for recyclables on campus.

[8]Generally a household is considered a participant in a recycling program even if it sets out only one or two materials. Thus, participation rates do not indicate if all materials are set out.

[9]Glass breakage occurs on the collection vehicle as well as in the processing center. For example, the operators of the facility that processes Providence's commingled recyclables report that approximately 20 percent of glass entering the plant arrives broken.

[10]Before Monroe implemented its citywide curbside program in 1986, it conducted a study to gauge residents' participation rates and the suitability of recycling containers. The City observed that the type of collection container used had a direct effect on the amount of recyclables collected. During the pilot study, households that received a reusable plastic recycling bin set out an average of 4.94 pounds of recyclables each week. Households that received a plastic bag set out an average of 2.18 pounds per week.

[11]In order to increase participation rates, Newark distributed an additional 5,000 8-gallon bins in 1990, and budgeted for 12,000 bins to be distributed in 1991. The City is requiring its new recycling contractor, who servces one-third of the City, to supply residents with recycling bins.

[12]Jennifer S. Gitlitz, "Curbside Collection Containers: A Comparative Evaluation" *Resource Recycling,* January/February 1989.

[13]Tom Outerbridge (Recycling Programs and Planning Division, New York DEP), personal communication, February 1992. Alicia Culver (Center for the Biology of Natural Systems, Queens College), personal communication, March 1992.

[14]Two private haulers in Peterborough collect recyclables and refuse at curbside from 100 to 200 households requesting this service, and bring materials to the Town drop-off center.

[15]1n 1991 Bowdoinham closed the landfill drop-off site in order to avoid transporting materials the 6 miles from the landfill to the processing center. The City now collects most of the Town's recyclables at the processing center.

[16]General Accounting Office, "Solid Waste: Trade-offs Involved in Beverage Container Deposit Legislation," November 1990, 34.

[17]The number of materials targeted for collection may under represent the actual number of material types collected. Mixed paper, for example, contains several types of materials. Perkasie, for example, collected two types of mixed paper—magazines and advertising mail. Recycling rate excludes tonnages recovered through composting activities. Including composting, 11 communities are recovering 35 percent of their residential waste, and 9 of these are recovering more than 40 percent.

[18]Other factors responsible for the jump in curbside tonnages collected in Naperville, from an average of 750 tons per month from April to August 1990, to an average of 940 tons per month from April to August 1991, were the increased publicity for recycling as a result of the City's securing a new recycling hauler, and the change in set-out requirements, from eight sorts under the old system to three sorts under the new contract.

[19]Urban Ore, Inc. (salvage/reuse business), Berkeley, California, personal communication, June 1991.

[20]The Institute for Local Self-Reliance's 1990 publication, *Beyond 40 Percent: Record-Setting Recycling and Composting Programs,* documents 17 materials recovery programs recovering between 32 and 57 percent of their solid waste.

[21] Cities may choose to give residents a grace period before beginning enforcement measures, to allow residents time to adjust to recycling requirements.