CHAPTER B

RECYCLING: ITS IMPACT ON THE SAN FRANCISCO BAY AREA'S SOLID WASTE PROBLEM

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ABSTRACT

Recycling of solid wastes is currently far below estimated possible recovery rates, both nationwide and locally in the San Francisco Bay Area. The abundance of solid wastes constitutes a new resource mine. The amount of energy saved through recycling and reuse of secondary resources could be profitable both economically and environmentally. Neighborhood recycling programs in the Bay Area provide a relatively inexpensive avenue for recovery and reuse of these resources. Of twenty-five recycling centers studied, subsidized programs outdistanced private and volunteer organizations in terms of materials recovered. Financial assistance to recycling operations showed a correlation with success in percent participation and percent of solid waste recovered. Summaries of responding recycling centers and initial equipment costs are provided in the appendices.

Recycling

Recycling, in its most general use, is the reprocessing of waste to recover an original raw material. It is the productive use of what would otherwise be a waste material requiring disposal (USEPA, 1977). More specifically, the term recycling implies a labor-intensive process as opposed to the capital-intensive high technology and evergy consuming processes known as resource recovery, mixed waste separation or mechanical separation. Recycling is most closely related to the concept of source separation, defined as the setting aside of recyclable waste materials at their point of generation for segregated collection and transport to specialized waste processing sites (recycling centers) or final manufacturing markets (USEPA, 1977)(see Section III, Chapter A and Section V, Chapters A and B).

In the Bay Area's nine-county region, close to 1.9 million Metric Tons (MT) (2.1 million tons) of residential municipal solid waste was generated in 1975, enough to fill Kezar Stadium to the rim (Blum, ABAG, 1977). Of this 1.9 million, at most 5.9%, or 112.4 thousand MTs (123.9 thousand tons) was recycled (SCS Engineers, 1975). The U.S. Environmental Protection Agency estimates that as much as 25% of the gross total discards could be recycled. Recycling of solid waste materials generally causes less environmental damage than acquiring virgin raw materials and requires less energy in processing (USEPA, 1977; Lowe, 1974). Why then isn't a larger portion of the waste stream recycled to capture these resources?

The reasons are historical and, therefore, inherent today. Industry has always been accustomed to an abundance of easily accessible natural resources. Because of this abundance, private industry has developed the technology necessary to exploit them. Secondary (recovered) resources have been virtually ignored. However, because there is no need to mine, harvest, or extract secondary resources in an environmentally degrading manner, they should be more attractive than virgin resources for use in commercial production.

Generally, the economic cost of secondary materials before transportation is competitive with virgin materials, but the 'aesthetic' quality of secondary resources is usually less than that of virgin resources. For this reason and others, the demand is limited. Natural resources tend to be geographically concentrated and, after extraction and processing, homogeneous in physical properties and quality. Wastes, on the other hand, are dispersed over the nation in landfills and dumps, and concentration of the secondary resources in economically productive quantities requires costly transportation and handling, not to mention an increased health risk. In addition, the increasing amount of plastics in the waste stream causes contamination of the recovered resources (Darnay, 1972).

Traditionally, waste removal services have been funded by municipal or county coffers with some minimal collection fees. This total cost (not to mention external environmental costs) is so well hidden by general tax revenue that the services appear to be free. This has had the effect of negating possible economic incentives towards encouraging recycling (USEPA, 1977). In answering the question posed above, this particular feature, the practical economics is perhaps the most important. It has been estimated that over $1 billion in recoverable metals a year exists in the national waste stream (Ballard, 1974).

Industry's recycling priorities are: 1) The component be immediately reusable without alteration or repair; 2) The component is made up of material that originated from a natural resource in fixed, short, or dwindling supply; 3) Known technology can recover the original valuable material in a discarded item at a reasonable cost; and 4) The solid waste component has a chemical composition that makes it potentially useful as a fertilizer, soil conditioner, or fuel (Great Lakes Research Institute, 1972). Public recovery, however, may view this differently. Granted, there is no gold in garbage yet, but recycling would reduce the cost of disposal, since a recovered material has a market value and would eliminate a landfilling cost (Abert, 1974). Another way to view the problem of incentives is to study the energy required for production from virgin materials versus secondary materials. When the two systems are compared, the system using recycled materials most often consumes less energy when all stages of materials acquisition, processing and transportation are included (Lowe, 1974).

Recyclable Components in the Solid Waste Stream

The municipal solid waste stream is defined as "garbage, rubbish, bulk wastes, and street refuse generated by people in their homes and commercial establishments, but excludes that generated by industrial operations" (Great Lakes Research Institute, 1972). According to the EPA, 116.3 million Metric Tons* (MT) (128.2 million tons) of municipal solid waste was generated in 1975 (a drop from 122.3 million MT (134.8 million tons) in 1974 due to the recession), and as much as 130.7 million MT (144 million tons) may have been generated in 1977. In per capita terms, this would mean a national average of 1.5 kg/person/day (3.3 lb./per./day) in 1975, growing to 1.7 kg/per./day (3.8 lb./per./day) in 1977.

Closer to home, the San Francisco Bay Region produced 4.4 million MT (4.8 million tons) of municipal and industrial solid waste in 1975, and this quantity is expected to increase to 5.1 million MT (5.6 million tons) in 1980 and 6.4 million MT (7.1 million tons) by 1990 (ABAG, 1977). Average per capita generation was close to 2.5 kg/person/day (5.8 lb./person/day) in 1975. Of the national waste stream, only 6 to 7% was recycled (SCS Engineers, 1975). Of this regional quantity, the recycled portion was 5.9% (ABAG, 1977).

Paper and other cellulose products comprise the largest portion of recyclable waste, between 30 and 50% of the solid waste stream by weight (Smith, 1973). One source claims it may even be as high as 80% (ConservaTree, 1978). Specifically, newsprint is about 6%, corrugated paperboard 9%, office paper 4%, and the remaining 14% is other paper products (Smith, 1973). Newsprint on a national average, is about 19% of discarded paper, while in office buildings, 50% of paper waste is high grade recyclable paper (see Sec. III, Ch. C, Office Paper Recovery). In 1975, 15.4% of the 40 million MT (44.1 million tons) of discarded paper was recycled.

The market value of recycled paper depends upon its grading: In 1976, the prices varied from $5.50-22.00 per MT ($5-20 per ton) for mixed paper to $181-242.40 per MT ($165-220 per ton) for manila folders. White ledger paper commanded a price between $77 and $110 per MT ($70 and $100 per ton) (CAN, 1978). Recycled newsprint usually sells for about $5 to $7 below the virgin market price and is sold very rapidly. In addition, recycled newsprint generally is superior in printability and tear strength (Clark, 1971). Besides saving landfill space and forest trees, recycling paper saves energy--about 60% less energy is used in recycled paper than in processing virgin fiber. However, the more energy-intensive virgin pulping process usually uses bark and other wood wastes rather than fossil fuels to meet its energy requirements (Lowe, 1974). This by-product energy generation reduces the 60% margin but cannot diminish another 60% figure--recycled paper processes generate %60 fewer atmospheric emissions than do virgin paper-making processes (CAN, 1978). Furthermore, the water used in virgin pulping operations becomes more contaminated than that used in recycling processes (ConservaTree, 1978).

The next largest readily recyclable component of the solid waste stream is glass at 9.9% by weight (Smith, 1973). Food waste makes up about 16.6% and yard waste is 18.5%, but these are not recyclable per se (refer to the chapters in Section IV on composting and energy recovery for a detailed discussion of these subjects). Glass recovery in 1975 was estimated by the EPA to be 2.9% of gross glass discards (12.4 million Mt, 13.7 million tons), whereas maximum possible recovery for glass is estimated at 50-52%

*One Metric Ton = 1000 kg = 1.102 Tons. One kg = 2.205 lbs.

of gross glass discards (Lowe, 1974). The EPA estimated that if the maximum possible recovery of glass had been realized with 1974 technology, 8.4×10^{12} KJ (8 trillion BTUs)* of energy would have been saved. If 50% of the glass in 1975 solid waste had been recycled, 13.7 trillion KJ (13×10^{12} BTUs) would have been saved (Lowe, 1974). At 6.1 million KJ (5.8 million BTUs) per barrell of crude oil, this would have been equivalent to 1.4 million barrels (2.2×10^{8} l) in 1974, and 2.2 million barrels (3.5×10^{8} l) in 1975.

Consumers seem to enjoy the convenience of non-returnable bottles, yet are reported in surveys as preferring returnable over non-returnables by a 63.5% to 36.5% margin (Clark, 1971). Separated (by color) and crushed glass (cullet) may command a price of $33/MT. When cullet is introduced to the glass furnace, melting of the raw ingredients of glass (sand, limestone and ash) is hastened. Industry research has shown that cullet may be used for 30% of the raw material and possibly even as much as 50% (Hannon, 1972).

Crushed glass is used as an aggregate in asphalt (Baer, 1978). Streets and freeways have been paved with this Glasphalt in the past six years (Day, 1970). Furthermore, if all the glass containers in the U.S. were crushed and incorporated into Glasphalt, a maintenance layer of only 300 miles of four-lane highway would be required to consume the whole supply (Clarke, 1971). Crushed glass may also find uses in building materials, insulation, costume jewelry, etc.

The third largest recyclable component of the municipal waste stream is ferrous metals. Ferrous metals--iron, steel, stainless steel--are 8.2% of the national solid waste stream and weigh in at 10.3 million MT (11.3 million tons) (USEPA, 1977). Only 4.4% of this material was recovered in 1975, compared to a maximum possible recoverable figure of 63-67% (Lowe, 1974). The energy savings associated with the maximum possible recyclable portion is estimated at 87 trillion KJ.

The last recyclable component of solid waste is also the smallest--aluminum at 0.5 to 1%, or 907 thousand MT (1 million tons) in 1975. It may be the smallest fraction by weight, but it is the most valuable component. Its value as a recovered resource, in spite of its small weight contribution, is 15 to 20 times that of recovered steel, glass or paper (Talley, 1974). Statistics show that only 10% of the total post-consumer aluminum waste volume is currently recycled compared to the maximum possible figures of 46-56% (Lowe, 1974). The energy saved in recycling 56% of the aluminum in the municipal waste stream is 121.3 trillion KJ (115 trillion BTUs). The energy and monetary savings should stimulate more reclamation, but the unprofitably high cost of separation, purification, and processing by mechanical means is still an inhibiting factor (Talley, 1974). On the other hand, the voluntary return of aluminum cans to recycling centers is now over 25% in the nation, and 40% in the state of California. This is due in part to the minimal pay-back program initiated by the aluminum industry.

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*(1KJ/0.9484 BTU) x (BTU) = KJ. KiloJoules and British Thermal Units are the metric and English measures of energy. A BTU is the amount of heat required to raise 1 lb. of water one degree F.

The recycling of scrap metal is a special case: the metal industries have two categories of scrap--'new' or prompt industrial scrap, and obsolete scrap (see Table A).

TABLE A

"NEW" AND OBSOLETE SCRAP RECYCLE IN THE U.S., 1972*

Metal	"New" Scrap Recycle Tons	Obsolete Scrap Recycle Tons	Obs. Scrap as % of Total Consumption
Lead	119,000	498,000	33.5
Silver	1,091	1,066	20.3
Nickel	5,500	30,400	15.6
Copper	843,000	458,000	14.4
Iron & Steel	27,200,000(?)	15,000,000(?)	11.3(?)
Zinc	309,000	79,000	4.3
Aluminum	756,000	190,000	3.4
Magnesium	12,500	3,200	2.8
TOTAL	29,246,000	16,260,000	11.2

*Based on Minerals Yearbook, 1972.
After Kellog, 1978.

New scrap is the trimmings, punchings, borings, sweepings, etc., of metal fabricating industries. These are almost 100% recycled because of their concentration and pure composition. What must be encouraged then, to divert a larger portion of the solid waste stream, is recycling of obsolete scrap, the discarded appliances, autos, lawn chairs and wall clocks that have been consumed and have exceeded their usefulness.

From the figures cited and from Table B below, it is obvious that the distance between actual recycling of metals and the optimum amount of recycling leaves much to be desired. Of all the metals listed,

TABLE B

POTENTIAL AND ACTUAL RECYCLE OF OBSOLETE SCRAP*-U.S., 1969

Metal	Estimate of Available Obsolete Scrap, Tons	Actual Recycle of Obsolete Scrap, Tons	% Obsolete Scrap Recycled
Stainless Steel	210,000	159,000	76
Silver	2,620	1,100	42
Copper (incl. Cu in Brass)	1,620,000	657,000	41
Lead	1,320,000	497,000	38
Nickel (excl. Stainless Steel)	84,500	25,000	30
Aluminum	1,330,000	175,000	13
Zinc (incl. Zn in Brass)	1,200,000	50,000	4.2

*Based on ref. 7. After Kellog, 1978.

only stainless steel shows greater than 50% recycling of obsolete scrap. Lead is the greatest scrap contributor to the total metal supply, but 62% of the available scrap lead is still not recycled (Kellog, 1978).

The factors affecting proportions of scrap recycling vary from technical to social. The high dispersal of scrap appliances, cars, packaging and small items inhibits their collection into profitable quantities. In addition, these items are generally of mixed constituency that defy simple sorting for recycling (Dickson, 1972). Today's poorly designed goods and 'modern' appliances have weaned a disposable product attitude and complicated the ease of recycling. During World War II, saving and reclaiming salvageable materials was a way of life (Clark, 1971). Today's growing ranks of recyclers are re-examining that ethic. Toward this end, the California Resource Recyclers Association (CRRA) has formed, adopting the slogan "Reduce. Reuse. Recycle." (Papke, PASCo, 1978). Obviously a mine of resources is at hand (or in the can). The problem lies in finding the most efficient method of profitable extraction.

Survey of Neighborhood Recycling Centers

In an effort to determine the impact of recycling on the the solid waste stream in the Bay Area, surveys were sent by the author to 69 neighborhood recycling centers. Twenty-six surveys were completed and returned, representing about 40% of the sample (see Appendix A for a listing of the centers).

Fourteen (56%) of the responding recycling centers were volunteer operated (less than 60% paid employees), six (24%) were commercial, and five (20%) were government sponsored or otherwise subsidized. They ranged from simple drop-off centers, where the user delivered separated recyclables, to home pick-up programs. Some of the recycling organizations maintained satellite stations or bins which were regularly processed.

The respondents represented every county in the Bay region except Napa and Marin. The average population size of the serviced communities was 58.7 thousand (see Table VI), and ranged from a high of San Francisco's 150,000* to Stanford's 20,000.

Collection Characteristics

Table Ia indicates the materials collected by weight in each category (unless otherwise noted, collection figures are made on a per month basis). Table Ib indicates the percentage of the total collected in each category (for a full explanation of the tabular figures and their calculation see Appendix B).

Newspapers were the largest average component of recyclables at 41% (545.5 MT of the total 1342.4 MT collected). Twenty-one of the 25 centers accepted newspapers. Preparation of the newsprint varied from bundled or baled to loose neat stacks, depending on the market purchaser. Generally, the center requested bundles or stacks of not more than 12 to 15 inches high in order to facilitate handling. The centers collected an average of 25.6 MT of newspapers a month; volunteer and commercial

*figure submitted by Center

centers averaged 17.8 MT and 16 MT respectively, while public centers averaged 53 MT (32.2 MT without the Palo Alto center).

High quality paper and magazines were more difficult to recycle because of the increased time and labor required to ensure separation. The higher market price of paper was not enough to encourage many centers to handle it: only five did, collecting 30.63 MT, about 2% of the total recyclables collected. Magazines made up only 1% (18.2%) of the total wastes collected, with three centers recycling this material.

Glass was the second largest component of recyclables at 40% of total collected materials. The centers averaged a collection of 27.5 MT/mo., although the public centers did collect a much larger volume. Like newspaper, 21 centers processed this material. Some centers required color separation and crusning, while others accepted unsorted glass. Many of the larger centers contracted with Environmental Container Reuse (Encore), a bottle reuse corporation in Emeryville specializing in wine bottles. Encore washes, sterilizes and sorts bottles to be sold back to over 80 wineries in the Napa-Sonoma and Gilroy-Morgan Hill areas.

Aluminum, as mentioned earlier, is the smallest component of the waste stream, but its value is high. In spite of its light weight and its position as 1% of the waste stream, it represented 2% of the recycled materials. It was accepted by 21 of the centers. The centers not accepting it were small volunteer groups--three Scout troops and a high school ecology club.

Ferrous metals and Tin/Bimetals both ranked at 5% of the total volume collected. Seven centers accepted ferrous metals, while 16 accepted tin and other bimetals. Some centers were actually discouraging users from bringing ferrous and bi-metals, but would accept them and dispose of them through conventional channels (Belchamber, 1978).

The remaining 3% of total collected materials fell into the "other" category, consisting of mostly cardboard and motor oil. Eight centers responded in this area, collecting 45.1 MT.

Labor Characteristics

The 25 centers showed an average of 549 person-hours/month spend running the center. This time was broken down into five areas: 1) patron assistance helping users unload their recyclables; 2) material processing, actual sorting, crushing, baling and on-site/enroute handling; 3) transportation, movement of satellite station materials; 4) dealer transport, movement of goods to the market; and 5) administration, bookkeeping, advertising, marketing and public relations (Table II). Broken down into types of recycling centers, the volunteer-run organizations showed an average of 581.8 person-hrs/mo, but without Santa Rosa's contribution of 3000 person-hrs/mo, this figure is reduced to 98.2 person-hrs/mo (the total is reduced to 385.7 person-hrs/mo). The commercially operated organizations had an average of 470.8 person-hrs/mo, which was reduced to 98 person-hrs/mo when the Petaluma and People Who Care centers were removed. The public sponsored and subsidized centers exhibited the highest average, 733.5 person-hrs/mo. This figure decreased to 378 person-hrs/mo when the Palo Alto and Berkeley (CCC) programs were taken out.

TABLE Ia

COLLECTION CENTERS	MATERIALS COLLECTED (MT/mo)							
	NEWSPAPER	PAPER	MAGAZINES	GLASS	ALUMINUM	FERROUS	BI-MET/TIN	OTHER
Volunteer Centers:								
1.CAMPBELL COMM. RECYCL.	37.8	*	*	30.3	2.7	*	4.0	*
2.HAIGHT-ASHBURY NEIGH.	9.1	*	*	9.1	0.2	*	1.8	*
3.LINDA VISTA SCHOOL	---	*	*	0.7	0.2	*	*	*
4.LIVERMORE COMM. RECY.	---	*	*	165.8	5.7	24.2	2.7	*
5.LOWELL ECOLOGY CLUB	3.2	*	*	2.7	0.7	*	0.9	*
6.M^C^ATEER FREEWHEELERS	2.3	*	*	4.5	0.1	*	0.9	25 cases glass
7.THE OLD BARREL	*	*	*	*	0.1	*	*	*
8.PLEAS'NT HILL ECOLOGY	*	*	*	7.3	*	*	*	*
9.RICHMOND ENV'MNT. ACT.	31.8	0.5	*	31.8	0.8	6.0	*	6.4
10.SANTA ROSA RECYCLING	45.4	22.7	4.5	45.4	0.9	4.5	9.1	4.5
11.SCOUT TROOP 236	18.2	*	*	*	*	*	*	*
12.SCOUT TROOP 302	9.1	*	*	*	*	*	*	*
13.SCOUT TROOP 488	10.0	*	*	*	*	*	*	*
14.SOLANO CO. CAMPFIRES	11.0	*	*	10.4	0.4	*	4.5	*
AVERAGE VOLUNTEER	17.8	11.6	4.5	30.8	1.2	11.6	3.4	5.4
Commercial Centers:								
15.ECOL. ACT'N. PACIFICA	7.3	*	*	7.3	0.2	*	0.5	*
16.EDEN VALLEY-CASTRO VA.	14.1	*	*	11.3	0.3	0.2	2.3	*
17.EDEN VALLEY-HAYWARD	5.4	*	*	5.4	0.1	*	0.5	*
18.MANY HANDS, INC.	11.8	*	*	12.7	0.5	*	11.8	*

(continued)

TABLE Ia (cont.)

COLLECTION CENTERS	MATERIALS COLLECTED (MT/mo) NEWSPAPER	PAPER	MAGAZINES	GLASS	ALUMINUM	FERROUS	BI-MET/TIN	OTHER
Commercial Centers:								
19.PEOPLE WHO CARE	50.0	2.7	9.1	31.8	0.9	0.9	3.6	1132 1.
20.PETALUMA RECYC. CNTR.	7.3	*	*	8.2	0.6	*	*	10.0
AVERAGE COMMERCIAL	16.0	2.7	9.1	12.8	0.4	0.5	3.7	10.0
Public - Subsidized:								
21.ASSU RECYCLING	27.2	*	*	11.0	0.9	*	*	*
22.COMM. CONSERV. CENTERS	54.5	*	*	72.6	1.8	*	9.1	4.5-9.1
23.E.C. ology	40.8	4.5	4.5	27.2	6.4	7.3	0.9	0.9
24.MERRITT RECYCL. CNTR.	6.4	0.2	*	11.0	0.2	*	0.9	*
25.PALO ALTO SANITATION	136.1	*	*	63.5	2.7	27.2	13.6	16.3
AVERAGE PUBLIC	53.0	2.4	4.5	57.0	17.2	2.4	6.1	8.1
AVERAGE TOTAL	25.6	6.1	6.0	27.1	10.0	1.2	4.2	7.5
% PARTICIPATION	84%	20%	12%	84%	84%	28%	64%	32%

* not accepted

-- not available

TABLE Ib

MATERIALS COLLECTED: PER CENT OF TOTAL MATERIALS PER CENTER

COLLECTION CENTERS	(MT/mo.) TOTAL MATERIAL COLLECTED	PER CENT NEWS	PAPER	MAGS	GLASS	ALUM.	FERROUS	BI/TIN	OTHER
Volunteer Centers:									
1.CAMPBELL COMM. RECYCL.	77.8	48.6	*	*	38.9	3.4	0.9	3.7	--
2.HAIGHT-ASHBURY NEIGH.	20.2	44.9	*	*	44.9	1.1	*	9.0	*
3.LINDA VISTA SCHOOL	0.8	*	*	*	78.6	21.5	*	*	*
4.LIVERMORE COMM. RECY.	198.4	--	*	*	83.6	2.9	12.2	1.4	*
5.LOWELL ECOLOGY CLUB	7.5	42.4	*	*	36.4	9.1	*	12.1	*
6.M^C ATEER FREEWHEELERS	7.8	29	*	*	58.0	1.4	--	11.6	*
7.THE OLD BARREL	0.1	*	*	*	*	100.	*	*	*
8.PLEAS'NT HILL ECOLOGY	7.3	*	*	*	100.	*	*	*	*
9.RICHMOND ENV'MNT. ACT.	77.1	41.2	0.6	*	41.2	1.1	7.8	*	8.2
10.SANTA ROSA RECYCLING	137.0	33.1	16.6	3.3	33.1	0.7	3.3	6.6	3.3
11.SCOUT TROOP 236	18.2	100	*	*	*	*	*	*	*
12.SCOUT TROOP 302	9.1	100	*	*	*	*	*	*	*
13.SCOUT TROOP 488	10.0	100	*	*	*	*	*	*	*
14.SOLANO CO. CAMPFIRES	26.2	41.5	*	*	39.8	1.4	*	17.3	*
Commercial Centers:									
15.ECOL. ACT'N. PACIFICA	15.2	47.9	*	*	47.9	1.2	*	3.1	*
16.EDEN VALLEY-CASTRO VA.	28.2	50.2	*	*	40.0	0.9	0.8	8.1	*
17.EDEN VALLEY-HAYWARD	11.5	47.4	*	*	47.4	0.9	*	4.4	*
18.MANY HANDS, INC.	36.8	32.1	*	*	34.6	1.2	*	32.1	*

(continued)

TABLE Ib (cont.)

MATERIALS COLLECTED: PER CENT OF TOTAL MATERIALS PER CENTER

COLLECTION CENTERS	(MT/mo.) TOTAL MATERIAL COLLECTED	PER CENT							
		NEWS	PAPER	MAGS	GLASS	ALUM.	FERROUS	BI/TIN	OTHER
Commercial Centers:									
19.PEOPLE WHO CARE	98.9	50.5	2.8	9.2	32/1	0.9	0.9	3.7	--
20.PETALUMA RECYC. CNTR.	26.0	27.9	*	*	31.4	2.3	*	*	38.4
Public - Subsidized:									
21.ASSU RECYCLING	39.0	69.8	*	*	20.9	2.3	*	*	*
22.COMM. CONSERV. CENTERS	144.3	37.7	*	*	50.3	1.3	*	6.3	4.9
23.E.C. ology	92.7	44.0	4.9	4.9	29.4	6.8	7.8	1	1
24.MERRITT RECYCL. CNTR.	18.6	34.2	1.2	*	58.7	1.0	*	4.9	*
25.PALO ALTO SANITATION	259.6	52.4	*	*	24.5	1.0	10.5	5.2	6.3

TABLE II: LABOR ACTIVITIES

COLLECTION CENTERS	TOTAL MATERIAL COLLECTED (MT/mo)	(PERSON-HOURS/MONTH) PATRON ASSISTANCE	MATERIAL PROCESSING	TRANSPOR-TATION	DEALER TRANS.	ADMINIS-TRATION	TOTAL
Volunteer Centers:							
1.CAMPBELL COMM. RECYCL.	74.8	0	25	*	+	1	26
2.HAIGHT-ASHBURY NEIGH.	20.2	*	40+	2	+	4	46
3.LINDA VISTA SCHOOL	0.8	*	*	*	*	*	*
4.LIVERMORE COMM. RECY.	198.4	*	*	*	*	*	*
5.LOWELL ECOLOGY CLUB	7.5	*	4	*	1	1	6
6.M^c^ATEER FREEWHEELERS	7.8	16	15	*	4	--	35
7.THE OLD BARREL	0.1	*	*	*	*	*	*
8.PLEAS'NT HILL ECOLOGY	7.3	*	*	*	*	*	*
9.RICHMOND ENV'MNT. ACT.	77.1	*	174	*	+	10	184
10.SANTA ROSA RECYCLING	137.0	300	1800	200	100	600	3000
11.SCOUT TROOP 236	18.6	*	*	*	+	*	*
12.SCOUT TROOP 302	9.1	*	*	*	*	*	*
13.SCOUT TROOP 488	10.0	43.6	43.6	*	12	2	101.2
14.SOLANO CO. CAMPFIRES	26.2	75	75	*	40	10	200+
AVERAGE VOLUNTEER	68.5	108.7	310	101	39.2	104.5	581.8
Commercial Centers:							
15.ECOL. ACT'N. PACIFICA	15.2	25	16	2	+	*	43
16.EDEN VALLEY-CASTRO VA.	28.2	85	85	*	5	25	200
17.EDEN VALLEY-HAYWARD	11.5	4	36	*	1	10	51
18.MANY HANDS, INC.	36.8	*	*	*	*	*	*

TABLE II: LABOR ACTIVITIES (cont.)

COLLECTION CENTERS	TOTAL MATERIAL COLLECTED (MT/mo)	PATRON ASSISTANCE (Person-Hours/Month)	MATERIAL PROCESSING	TRANSPOR-TATION	DEALER TRANS.	ADMINIS-TRATION	TOTAL
Commercial Centers:							
19.PEOPLE WHO CARE	98.9	150	200	*	150	300	800
20.PETALUMA RECYC. CNTR.	26.0	*	*	*	*	*	1260
AVERAGE COMMERCIAL	36.1	66	68.2	2	39.3	84	470.8
Public - Subsidized:							
21.ASSU RECYCLING	39.0	*	120	120	+	80	320
22.COMM. CONSERV. CENTERS	144.3	150	42	*	16	*	1800+
23.E.C. ology	92.7	120+	200+	*	10	160	490+
24.MERRITT RECYCL. CNTR.	18.6	50	224	*	10	40	324
25.PALO ALTO SANITATION	259.5	40+	550+	*	100	280	970
AVERAGE PUBLIC	110.8	106.7	227	120	12	93.3	733.5
AVERAGE TOTAL	69.2	92.6	193.7	81	34.8	95.6	549.1

*not available

+Dealer provided pickup

Cost Characteristics

The figures from this portion of the survey are probably incomplete. In particular, the survey asked for monthly rental costs, operational and maintenance, costs, and labor costs. Depreciation, taxes and other costs may not have been included in these figures (Table III). However, the average cost per ton figures do show some consistency and an expected trend: the public-subsidized centers had the highest monthly cost per MT figure, $51.20, while the volunteer organizations had the lowest, $10.60.

This may be attributable to several factors. Public centers had more equipment, hence a higher overhead than the volunteer organizations, and they had more labor hours than the commercial centers. The commercial centers had an average of $50.20/MT, but dropping the Many Hands center with its high labor cost reduced the average to $38.90/MT. Although the volunteer and public centers had approximately the same number of labor hours, the volunteers largely donated their time. In addition, many of the volunteer programs had no more sophisticated equipment than sledgehammers and storage bins. Contrasting this, E.C.ology had a curbside pick-up program funded by the State Solid Waste Management Board (SSWMB), involving a modified fleet of trucks; CCC was underwritten by Berkeley's Department of Public Works ($65,000) because of its proven impact on the community; and the PASCo project was sponsored by the city of Palo Alto. E.C.ology received CETA funding. The Merritt and ASSU centers were supported in part by student registration fees and work-study funds. All of the sponsored centers and some of the volunteer centers enjoyed to some degree, relaxed licensing fees or donated space.

Marketing Characteristics

Market rates for each material did not vary widely--a good example of a competitive market (Table IV). The material reported to vary the most was newsprint. El Cerrito (E.C.ology) reported a contractual agreement that guaranteed a base price for newsprint (Papke, 1978). Some centers indicated two prices for glass: separated and mixed. The separated prices were about 20% higher than the mixed price. Solano Camp Fires reported frustration with geographical distance to markets. Commercial programs commanded the best overall market prices, but the difference between their averages and the average market prices of volunteer and public centers was very slight. Any differences in center performance then, were not primarily due to markets.

Revenues

Revenue figures for each center were calculated for each material using the volume and market price data (Table Va). The dollars per ton column represents a weighted average revenue for each center. Discrepancies were noted, especially in the case of E.C.ology. The calculated revenue figure is $63.24/MT per month, while the center believes a revenue of $30-35/MT is more accurate, due to the disproportionate volumes of newspaper, glass and aluminum and their respective market prices. It is noted that a ton of recycled waste, predominantly newsprint has a much lower revenue value than a ton of recycled waste that is predominantly aluminum. For this reason, Table Vb shows the percentage of the monthly revenue due to each material.

Diverted Wastes

Table V lists the percent participation calculated with the number of participants reported by the centers and population figures from the U.S. Census Bureau. This figure was highest for public centers (22.2%) and lowest for commercial centers (2.6%). The overall participation rate was 8.3%. These percentages must be the minimum participation because many of the participants may collect materials from their neighbors. The actual number of recycling participants may thus be actually higher than indicated.

The other important indicator on this table is the percent of waste stream diverted. This figure was calculated after estimating the flow of the community's generated solid waste stream. The centers collectively diverted an average 2.8% of the generated solid waste stream, volunteer and commercial centers diverting 1.8% each, and public centers 5.9%. It is pointed out, however, that of all the generated solid waste, only 40 to 50% may reach the landfill (ACSWMP, 1977). Calculations show Berkeley's generated flow to be about 6000 MT/mo. The Department of Public Works reports it collected about 3000 MT/mo. It is reasonable then, to assume the percentages shown in Table VI should be higher--almost doubled in some instances. For example, the CCC believes it is responsible for a 5 -4.5% diversion rather than the indicated 2.8%.

Diverted Savings

Data in Table VI shows first the difference between monthly revenue per ton and monthly costs per ton. A positive value indicates a profit; a negative value indicates a deficit. This calculation is a crude barometer of the profitability of each center. Some centers did not receive the full value of their recyclables because materials were donated to other groups. The Palo Alto and Lowell centers especially are not realistically portrayed--both donate their newsprint to other organizations. As a result, the Palo Alto group actually runs a deficit (covered by the city) and Lowell barely breaks even.

The landfill fee savings was calculated by multiplying the average fee, $9/MT by the volume of solid waste recycled. This figure was the amount saved by not landfilling the material. Although this amount is not received by any party, it should be considered in the effective cost and/or savings by deducting revenue and diverted disposal savings from the estimated operating costs (SCS Engineers, 1975). Most of the figures in the Effective Cost/Savings column are in parentheses, indicating they are savings over the month. Five centers, however, show cost figures. Of the five, three are subsidized; the other two are commercial operations. These two centers, Many Hands, Inc., and Petaluma Recycling employed disabled personnel and were probably assisted through government funding programs. One noticeable feature is the fact that in the Profit/deficit column, the only centers showing deficits are those subsidized ones, these two commercial organizations and Santa Rosa Recycling, a volunteer organization.

TABLE III:
COLLECTION CENTER COSTS

COLLECTION CENTERS	RENTAL COSTS ($/mo.)	OPERATIONAL COSTS ($/mo.)	LABOR (Pers.-hrs/mo)	PAID LABOR (Pers-hrs/mo)	% PAID LABOR	LABOR COST ($/mo.)	INITIAL CAPITAL ($)	TOTAL COST ($/mo.)	TOTAL COST PER MT ($/MT/mo.)
Volunteer Centers:									
1.CAMPBELL COMM. RECYCL.	--	--	100	--	--	--	1,000	--	--
2.HAIGHT-ASHBURY NEIGH.	160	21	46	0	0	0	*	181	9.00
3.LINDA VISTA SCHOOL	--	--	--	--	--	--	--	--	--
4.LIVERMORE COMM. RECY.	D	251	*	*	*	387	*	638	3.20
5.LOWELL ECOLOGY CLUB	60	20	6	1.25	20	12.50	*	92.50	12.36
6.McATEER FREEWHEELERS	--	20	35	D	--	D	--	20	2.6
7.THE OLD BARREL	--	--	--	--	--	--	--	--	--
8.PLEAS'NT HILL ECOLOGY	--	D	70	--	--	--	--	--	--
9.RICHMOND ENV'MNT. ACT.	*	350	120	64	53	220	250	570	7.40
10.SANTA ROSA RECYCLING	350	616.50	3000	1200	40	3000	30,000	3966.5	29.00
11.SCOUT TROOP 236	D	D	D	D	--	D	D	D	--
12.SCOUT TROOP 302	D	D	D	D	--	D	D	D	--
13.SCOUT TROOP 488	D	D	--	--	--	D	D	D	--
14.SOLANO CO. CAMPFIRES	?	D	D	D	--	D	*	--	--
Commercial Centers:									
15.ECOL. ACT'N: PACIFICA	12.00	370	43	41	95.3	265	*	647	42.70
16.EDEN VALLEY-CASTRO VA.	**	*	200	175	87.5	325	*	*	*
17.EDEN VALLEY-HAYWARD	*	*	50	40	80	*	*	*	*
18.MANY HANDS, INC.	900	*	*	1300	*	2200	*	3100	84.35

(continued)

TABLE III: (cont.)

COLLECTION CENTER COSTS

COLLECTION CENTERS	RENTAL COSTS ($/mo.)	OPERATIONAL COSTS ($/mo.)	LABOR (Pers.-hrs/mo)	PAID LABOR (Pers.-hrs/mo.)	% PAID LABOR	LABOR COST ($/mo.)	INITIAL CAPITAL ($)	TOTAL COST ($/mo.)	TOTAL COST PER MT ($/MT/mo.)
Commercial Centers:									
19.PEOPLE WHO CARE	*	1016.	800	750	93.75	1900	*	2116	29.50
20.PETALUMA RECYC. CNTR.	350	125	1260	1260	100	680	*	1155	44.40
Public - Subsidized:									
21.ASSU RECYCLING	D	450	620	620	100	950	15,000	9950	35.90
22.COMM. CONSERV. CENTERS	2416.70	3066.70	1800	1800	100	4,800	---	10,283	71.30
23.E.C. ology	292	917	1920	1920	100	10,000	35,000	11,209	(45) 120.90
24.MERRITT RECYCL. CNTR.	D	500	324	324	100	958	10,000	1453.	78.30
25.PALO ALTO SANITATION	D	3588	613	613	100	3012		6600	25.40

D donated

- not applicable

* not available

() figure submitted by center

TABLE IV

COLLECTION CENTERS	MARKET PRICES ($/MT) NEWSPAPER	PAPER	MAGAZINES	GLASS	ALUMINUM	FERROUS	BI-MET/TIN	OTHER
Volunteer Centers:								
1.CAMPBELL COMM. RECYCL.	26.50	--	--	33.10	374.70	--	16.50/33.	--
2.HAIGHT-ASHBURY NEIGH.	38.60	--	--	*	374.70	*	--	--
3.LINDA VISTA SCHOOL	--	--	--	--	187.30	--	--	22.04
4.LIVERMORE COMM. RECY.	22.-44.	--	--	33.10	396.70	33.10	16.50/33.	.10/gal.oil
5.LOWELL ECOLOGY CLUB	22.00	--	--	22.00	374.70	--	33.10	--
6.M^{c}ATEER FREEWHEELERS	22.00	--	--	11.00	374.70	--	44.10	--
7.THE OLD BARREL	--	--	--	--	484.90	--	--	--
8.PLEAS'NT HILL ECOLOGY	--	--	--	22.00	--	--	--	--
9.RICHMOND ENV'MNT. ACT.	30.30	88.20-110.	--	23.10	374.70	38.60	--	30.90 cardbd.
10.SANTA ROSA RECYCLING	30.90	8.80	8.80	13.20	374.70	11.-44.10	11.-16.50	--
11.SCOUT TROOP 236	11.00	--	--	--	--	--	--	--
12.SCOUT TROOP 302	16.50	--	--	--	--	--	--	--
13.SCOUT TROOP 488	35.70	--	--	--	--	--	--	--
14.SOLANO CO. CAMPFIRES	--	--	--	--	--	--	--	--
AVERAGE VOLUNTEER	27.80	54.00	8.82	22.50	368.60	31.20	16.50/35.8	10.60
Commercial Centers:								
15.ECOL. ACT'N. PACIFICA	27.60-41.3	--	--	33.10	440.80	--	27.60-33.	27.60 cardbd. 60. Encore
16.EDEN VALLEY-CASTRO VA.	22.-27.60	--	--	23.10	374.70	33.10	22.00	--
17.EDEN VALLEY-HAYWARD	27.60	--	--	23.10	374.70	D	22.00	--
18.MANY HANDS, INC.	44.10	--	--	55.10	--	--	55.10	33.10 cardbd.

(continued)

TABLE IV (cont.)

COLLECTION CENTERS	MARKET PRICES ($/MT)							
	NEWSPAPER	PAPER	MAGAZINES	GLASS	ALUMINUM	FERROUS	BI-MET/TIN	OTHER
Commercial Centers:								
19.PEOPLE WHO CARE	38.60	44.10	13.20	16.50	374.70	13.20	22.00	.08/gal.oil 38.60 cardbd.
20.PETALUMA RECYC. CNTR.	16.50	---	---	16.50	374.70	---	---	30.30
AVERAGE COMMERCIAL	29.50	44.10	13.20	27.90	387.90	23.10	30.30	30.40
Public - Subsidized:								
21.ASSU RECYCLING	26.5-30.90	---	---	17.60	374.70	---	---	80.00 Encore
22.COMM. CONSERV. CENTERS	27.6-38.60	---	---	33.10	484.90	---	33.10	13.22 cardbd.
23.E.C. ology	41.90	11.00	11.00	33.10	440.80	44.10	38.60	.12/gal.oil 70.00 Encore
24.MERRITT RECYCL. CNTR.	27.60	11.00	---	33.10	374.70	---	22.00	33.10 cardbd.
25.PALO ALTO SANITATION	33.10	35.94	---	20.60	217.80	36.20	18.40/26.5	---
AVERAGE PUBLIC	32.90	19.30	11.00	27.50	378.60	40.10	18.40/30.	23.10
AVERAGE TOTAL	29.40	35.00	11.00	25.70	376.30	31.50	17./32.10	28.60

Figures rounded to nearest 0/1

-- not applicable

* not available

TABLE Va: COLLECTION CENTER REVENUES

COLLECTION CENTERS	NEWS	PAPER	MAGS	($/MATERIAL) GLASS	ALUM.	FERROUS	BI/TIN	OTHER	($/mo.) TOT. REV.	$/MT
Volunteer Centers:										
1.CAMPBELL COMM. RECYCL.	1000	---	---	1000	999	--	67-133	---	3132	41.90
2.HAIGHT-ASHBURY NEIGH.	350	---	---	200[2]	84.70	--	60.00[2]	==	695	34.40
3.LINDA VISTA SCHOOL	--	--	--	--	30.81[3]	--	--	20.00[3]	60.81	72.39
4.LIVERMORE COMM. RECY.	?	--	--	5464[3]	2264[3]	1094[3]	55.60[3]	197.40[3]	9075	45.80
5.LOWELL ECOLOGY CLUB	70	--	--	60	255	--	30	--	415	55.44
6.McATEER FREEWHEELERS	50	--	--	50	42	--	40	--	182	23.30
7.THE OLD BARREL	--	--	--	--	44	--	--	--	44	484.90
8.PLEAS'NT HILL ECOLOGY	--	--	--	160	--	--	--	--	160	22.00
9.RICHMOND ENV'MNT. ACT.	963	40-50	--	735	306	231	--	196	2481	32.20
10.SANTA ROSA RECYCLING	1400	200	40	600	340	50-200	100-150	--	2930	21.40
11.SCOUT TROOP 236	200	--	--	--	--	--	--	--	200	11.02
12.SCOUT TROOP 302	150	--	--	--	--	--	--	--	150	16.50
13.SCOUT TROOP 488	356	--	--	--	--	--	--	--	356	35.71
14.SOLANO CO. CAMPFIRES	272+[2]	--	--	208[2]	123[2]	--	127[2]	--	730	27.80
Commercial Centers:										
15.ECOL. ACT'N. PACIFICA	200-300	--	--	240	80	---	13-15	60	740[3]	48.80
16.EDEN VALLEY-CASTRO VA.	311-389	--	--	261	97	8	50	--	805	28.60
17.EDEN VALLEY-HAYWARD	150	--	--	126	38	D	11	--	325	28.30
18.MANY HANDS, INC.	520	--	--	700	170.10[2]	--	650	--	2040	55.50

(continued)

TABLE Va: COLLECTION CENTER REVENUES (cont.)

COLLECTION CENTERS	NEWS	PAPER	MAGS.	GLASS ($/MATERIAL)	ALUM.	FERROUS	BI/TIN	OTHER	TOT.REV. ($/mo.)	$/MT
Commercial Centers:										
19.PEOPLE WHO CARE	1925	120	120	525	340	12	80	24	3164	31.80
20.PETALUMA RECYC. CNTR.	120	---	---	135	228	---	---	302	786	30.20
Public - Subsidized:										
21.ASSU RECYCLING	720-840	---	---	192	340	---	---	---	1372	35.20
22.COMM. CONSERV. CENTERS	1500-2100	---	---	2400	880	---	300	60-120	5800	40.20
23.E.C. ology	1710	50	50	900	2800	320	34.70	70	5864.80	63.20
24.MERRITT RECYCL. CNTR.	175	2.50	---	360	67.80	---	20	---	625.30	33.70
25.PALO ALTO SANITATION	4500	---	---	1306	593	985	250-360	---	7744	29.84
TOTAL REVENUE:	16039	1072	200	13860	9870.35	2215.70	2147.80	289.90	44,479	
AVERAGE REV./CENTER	641.60	42.90	8	554.40	394.80	88.60	85.90	51.60	1779	
AVERAGE PER CENT REV.	36%	2%	.45%	31%	22%	5%	5%	3%		

-- not applicable

[2] calculated w/current market price

[3] Figure submitted by center

TABLE Vb: PER CENT OF TOTAL REVENUE

COLLECTION CENTERS	($/mo) TOT. REV.	PER CENT NEWS	PAPER	MAGS	GLASS	ALUM.	FERROUS	BI/TIN	OTHER
Volunteer Centers:									
1.CAMPBELL COMM. RECYCL.	3132.	31.9	--	--	31.9	31.9	--	3.2	--
2.HAIGHT-ASHBURY NEIGH.	695.	50.4	--	--	28.8	12.2	--	8.6	--
3.LINDA VISTA SCHOOL	60.80	--	--	--	--	50.7	--	--	32.9
4.LIVERMORE COMM. RECY.	9074.70	?	--	--	60.2	25	12.1	0.6	2.2
5.LOWELL ECOLOGY CLUB	415.	16.9	--	--	14.5	61.4	--	7.2	--
6.M^c^ATEER FREEWHEELERS	182.	27.5	--	--	27.5	23.1	--	22.	--
7.THE OLD BARREL	44.	--	--	--	--	100.	--	--	--
8.PLEAS'NT HILL ECOLOGY	160.	100.	--	--	--	--	--	--	--
9.RICHMOND ENV'MNT. ACT.	2481.	38.8	1.8	--	29.6	12.3	9.3	--	7.9
10.SANTA ROSA RECYCLING	2930.	47.8	6.8	1.4	20.5	11.6	4.3	4.3	--
11.SCOUT TROOP 236	200.	100	--	--	--	--	--	--	--
12.SCOUT TROOP 302	150.	100	--	--	--	--	--	--	--
13.SCOUT TROOP 488	356.	100	--	--	--	--	--	--	--
14.SOLANO CO. CAMPFIRES	730.	37.3	--	--	28.5	16.8	--	17.4	--
Commercial Centers:									
15.ECOL. ACT'N. PACIFICA	740.	33.8	--	--	32.4	10.8	--	1.9	8.1
16.EDEN VALLEY-CASTRO VA.	805.	43.5	--	--	32.4	12.	1.	6.2	--
17.EDEN VALLEY-HAYWARD	325.	46.2	--	--	38.8	11.7	?	3.4	--
18.MANY HANDS, INC.	2040.	25.5	--	--	34.3	8.3	--	31.9	--

(continued)

TABLE Vb: PER CENT OF TOTAL REVENUE (cont.)

COLLECTION CENTERS	($/mo) TOT. REV.	PER CENT NEWS	PAPER	MAGS	GLASS	ALUM.	FERROUS	BI/TIN	OTHER
Commercial Centers:									
19.PEOPLE WHO CARE	3146.	61.2	3.8	3.8	16.7	10.8	0.4	2.5	0.8
20.PETALUMA RECYC. CNTR.	786.	15.3	--	--	17.3	29	--	--	38.4
Public - Subsidized:									
21.ASSU RECYCLING	1372.	56.9	--	--	14.	24.8	--	--	--
22.COMM. CONSERV. CENTERS	5800	33.6	--	--	41.4	15.2	--	5.2	1.6
23.E.C. ology	5864.80	29.2	0.9	0.9	15.3	47.7	5.5	0.6	1.2
24.MERRITT RECYCL. CNTR.	625.30	28	0.4	--	57.6	10.8	--	3.2	--
25.PALO ALTO SANITATION	7744.	58.1	--	--	16.9	7.7	12.7	3.9	--

-- not applicable

? not supplied

TABLE VI: DIVERTED SOLID WASTES

COLLECTION CENTERS	CITY	POP.[2] (1000)	% PARTICIP.	TOTAL MATERIAL COLL. (MT/mo)	VOL. TOTAL WASTE STREAM (MT/mo)	% OF STREAM DIVERTED
Volunteer Centers:						
1. CAMPBELL COMM. RECYCL.	Campbell	29.5	--	74.8	1486.8	5.0
2. HAIGHT-ASHBURY NEIGH.	San Francisco	40	--	20.2	2016	1.0
3. LINDA VISTA SCHOOL	San Jose	25[1]	--	0.8	1260	0.1
4. LIVERMORE COMM. RECY.	Livermore	50	--	198.4	2520	7.9
5. LOWELL ECOLOGY CLUB	San Francisco	40	--	8.0	2016	0.4
6. McATEER FREEWHEELERS	San Francisco	30	--	7.8	1512	0.5
7. THE OLD BARREL	Palo Alto	69[1]	--	0.9	3478	0.003
8. PLEAS'NT HILL ECOLOGY	Pleasant Hill	28	--	8	1411.2	0.5
9. RICHMOND ENV'MNT. ACT.	San Francisco	150	2.3	441.9[3]	7560	5.9
10. SANTA ROSA RECYCLING	Sonoma County	50,000 family	13	137.0	8568	1.6
11. SCOUT TROOP 236	Danville, Alamo, San Ramon	--	--	20	--	--
12. SCOUT TROOP 302	Walnut Creek	60[1]	--	10	3024	0.3
13. SCOUT TROOP 488	Vacaville	38	0.5	10.0	1915	0.5
14. SOLANO CO. CAMPFIRES	Solano County	170[4]	--	26.2	8568	0.3
AVERAGE VOLUNTEER		60.8	5.3	68.5	3257	1.8
Commercial Centers:						
15. ECOL. ACT'N. PACIFICA	Pacifica	38	0.7	15.2	1915	0.8
16. EDEN VALLEY-CASTRO VA.	Castro Valley	52	1.5	28.2	2620	1.1
17. EDEN VALLEY-HAYWARD	Hayward	80	0.5	11.5	4032	0.3
18. MANY HANDS, INC.	Pittsburg/Antioch	60	3.1	36.75	3024	1.2

TABLE VI: DIVERTED SOLID WASTES (cont.)

COLLECTION CENTERS	CITY	POP.[3] (1000)	% PARTICIP.	TOTAL MATERIAL COLL. (MT/mo)	VOL. TOTAL WASTE STREAM (MT/mo)	% OF STREAM DIVERTED
Commercial Centers:						
19. PEOPLE WHO CARE	Los Altos	35	8.6	98.9	1764	5.6
20. PETALUMA RECYC. CNTR.	Petaluma	24.5	1.2	26.0	1234	2.1
AVERAGE COMMERCIAL		48.3	2.6	36.1	2431.5	1.8
Public - Subsidized:						
21. ASSU RECYCLING	Stanford	20	---	39.0	1008	3.9
22. COMM. CONSERV. CENTERS	Berkeley	117[1]	15[3]	144.3	5897	2.5 (4.5)[3]
23. E.C. ology	El Cerrito	25[1]	45+	92.7	617[3]	7.4
24. MERRITT RECYCL. CNTR.	East Oakland	(90)[2]	---	18.6	4532.7	0.4
25. PALO ALTO SANITATION	Palo Alto	69	11.5	259.5	3478	7.5
AVERAGE PUBLIC		64.2	22.2	110.8	2431.5	5.9
AVERAGE TOTAL		58.7	8.29	69.2	3106.5	2.8

[1] Data from 1970 Census, US Bureau of the Census.

[2] Population of East Oakland calculated: (.25) x (360)=90

[3] Figure submitted by center

TABLE VII: DIVERTED SAVINGS

COLLECTION CENTERS	PER METRIC TON			DOLLARS PER MONTH			
	COSTS ($/MT/mo.)	REVENUE ($/MT/mo.)	(PROFITS) REVENUE - COST	MONTHLY COSTS	LANDFILL FEE SAVINGS	MONTHLY GROSS REVENUE	EFFECTIVE COSTS (SAVINGS)
Volunteer Centers:							
1.CAMPBELL COMM. RECYCL.	--	41.90	41.90*	----	747.90	3132.	(3880.)*
2.HAIGHT-ASHBURY NEIGH.	9.00	34.40	25.40	180.80	201.90	694.70	(716)
3.LINDA VISTA SCHOOL	--	72.40	72.40*	-----	8.40	60.80	(69)*
4.LIVERMORE COMM. RECY.	3.20	45.80	42.50	638.20	1983.60	9074.70	(10,420.20)
5.LOWELL ECOLOGY CLUB	12.36	55.4	43.10	92.50	74.90	415.00	(397)
6.McATEER FREEWHEELERS	2.60	23.30	20.70	20.00	78.30	182.00	(240)
7.THE OLD BARREL	--	484.90	484.90*	------	00.90	44.00	(44.90)*
8.PLEAS'NT HILL ECOLOGY	0	22.00	22.00	D	72.60	160.00	(232.60)
9.RICHMOND ENV'MNT. ACT.	7.40	32.20	24.80	570.00	771.30	2481.00	(2642)
10.SANTA ROSA RECYCLING	29.00	21.40	-7.60	3966.50	1370.20	2930.00	(334)
11.SCOUT TROOP 236	--	11.00	11.00*	D	181.50	200.00	(381.50)*
12.SCOUT TROOP 302	0	16.50	16.50	D	90.70	146.00	(237)
13.SCOUT TROOP 488	--	35.70	35.70*	D	93.00	356.00	(449)*
14.SOLANO CO. CAMPFIRES	--	27.80	27.80*	D	262.30	730.00	(992)*
Commercial Centers:							
15.ECOL. ACT'N. PACIFICA	42.67	48.80	6.10	647.00	151.60	740.00	(245)
16.EDEN VALLEY-CASTRO VA.	--	28.60	28.60*	------	281.50	805.00	(290)*
17.EDEN VALLEY-HAYWARD	--	28.31	28.31*	------	114.80	325.00	(440)*
18.MANY HANDS, INC.	84.35	55.50	-28.80	3100.00	367.50	2040.00	692.50

(continued)

TABLE VII: DIVERTED SAVINGS (cont.)

COLLECTION CENTERS	PER METRIC TON COSTS ($/MT/mo)	REVENUE ($/MT/mo)	(PROFITS) REVENUE - COST	DOLLARS PER MONTH MONTHLY COSTS	LANDFILL FEE SAVINGS	MONTHLY GROSS REVENUE	EFFECTIVE COSTS (SAVINGS)
Commercial Centers:							
19.PEOPLE WHO CARE	29.50	31.80	2.30	2916.70	989.10	3146.00	(1215)
20.PETALUMA RECYC. CNTR.	44.40	30.20	-14.20	1155.00	260.10	786.00	109
Public - Subsidized:							
21.ASSU RECYCLING	35.90	35.20	-0.70	9950.00	390.20	1372.00	8188
22.COMM. CONSERV. CENTERS	71.30	40.20	-31.00	10283.40	1313.00	5800.00	3170
23.E.C. ology	(45.00)# 120.90	63.24	18.20	(4173.40)# 11209.00	927.40	5864.81	(2618.80)
24.MERRITT RECYCL. CNTR.	78.30	33.70	-44.60	1453.60	185.60	625.30	(642.70)
25.PALO ALTO SANITATION	25.40	29.80	4.40	6600.00	2595.30	77.40	(27,099)

--not available

*donated costs= invalid indicator

#figure submitted by center

Conclusion/Analysis

It would appear that recycling centers in the Bay Area are barely making a dent in the regional solid waste stream. Yet it must be pointed out that many of the operations are small and volunteer oriented. These centers are generally found in small to medium-sized communities. Their users are those persons who are aware of the centers' existence, function and goals. The public centers have shown that if recycling is made as easy as possible, a much larger participation rate can be achieved. Curbside collection programs in California and throughout the nation have shown remarkable results (McEwen, 1977). However, success of these public programs depends on initial financial support. A study of recycling center characteristics throughout the United States indicates only 15 minutes a week are necessary to prepare the family garbage (SCS Engineers, 1975). This includes rinsing out cans and bottles as they are being used, and storing them in separate containers (Johanson, 1978).

Commercial centers show very small profits. A fluctuation in the monthly market prices could ruin the centers financially. The theoretical discounting of landfill costs increases the value of recycling, but it is not an economic value the center operators will receive. As a private industry, recycling will not be lucrative until markets improve and stabilize.

Some scavenger and disposal companies are beginning to implement minimal recycling along their routes, however. The Livermore user-dropoff program was changed to a free curbside pick-up by the Livermore-Dublin Disposal Co., a subsidiary of the Oakland Scavengers, Inc. in May, 1978. The operators plan to reach a break-even point with revenues from the recyclables (Hill, 1978).

An effective recycling program is one which minimizes inconvenience to the homeowner, is profitable (or at least not unprofitable), and recovers material in a form that will utilize the least amount of energy in reprocessing. The curbside pick-up program is most convenient and economical in the long run if the proper equipment is obtained at the outset (see Appendix C). In small to mid-sized communities, special collection trucks could follow different routes each day, allowing weekly or bi-weekly collection. In larger communities, a system of transfer depots or satellite stations could be interconnected with the central processing plant by large capacity trucks. This program could even be extended over a county or regional area. Cooperation of this sort would increase the volume of wastes collected, and would improve bargaining position with markets (Belchamber, 1978).

The quality of the materials recovered through source separation is very high, and complies easily with industry's rigid specifications. Glass is uncontaminated by ceramics, paper, aluminum and other metals. Recovered aluminum is also of high quality, unmatched by automated systems under present technology.

Mechanical separation of mixed wastes uses more energy than source separation. Recovery and recycling of glass mechanically from mixed wastes actually uses more energy than landfilling the glass and making new bottles (Hannon, 1972). Mechanical separation figures are generally one-sided. They are calculated on an output-input basis: as long as there is a positive balance, the system is considered efficient (Johanson, 1978). Energy recovery systems emphasize the production of energy from garbage, but more energy can be saved at a lower cost by source separation and waste reduction (Lipschutz, 1978). Measurements should be made on energy expended vs. value of recovered materials and their energy potential.

A study by the research staff at Santa Rosa Recycling Center indicates that programs such as large energy recovery plants create skilled labor positions at an average cost of $1.8 million capital investment each. Source separation collection and processing systems create one job for each $10,000 of capital investment. These are not garbage sorting jobs, but truck driving, forklift operating, and other blue collar labor positions. The energy recovery plants require a minimum daily input to ensure the energy output they will be contracted to produce/recover.

In the short term, continued subsidies are necessary to establish source separation programs (see Appendix C). Funds from California's SB 650, the Litter Control, Recycling and Resource Recovery Act, are particularly important for this puspose. The success of recycling programs has been dependent upon proper equipment, high publicity and public education. After a certain collection rate is achieved, the center can become self-supporting. Alternatives to direct subsidies include reasonably priced subscription rates, a buy back program much like that of the aluminum industry, or a surcharge to the existing garbage collection fee (if recycling is practiced, the fee decreases since fewer cans are being used) (Papke, 1978).

In the long term, source separation should find a place in the general Solid Waste Management Plan. This program minimizes energy use, recovers dwindling resources of high quality, reduces landfill costs, requires low initial capital investment compared to other recovery systesm, and provides jobs to the unskilled labor force, where unemployment is highest. It could be incorporated with a small energy recovery system coupled to a front end mechanical separator to recover what remains in the non-recyclable portion. The energy recovery system would be fed by several source separation/collection programs. With inter-city, county and regional cooperation, the most economical systems could be devised to improve marketing revenues, eliminate losses incurred in transport, and avoid duplication of effort.

APPENDIX A

RESPONDING RECYCLING CENTERS

County/City	Organizational Name Contact Person Phone Collection Address(es)	Materials Accepted*
Alameda		
1. Berkeley	Community Conservation Centers Pam Belchamber 548-3222 University Ave. & Sacramento Saturday and Sunday 10-5 Dwight Way & Grove T, W, Th 10-5	N, G, Al, T, cardbd.
2. Castro Valley	Eden Area YMCA-Castro Valley Terry Fowler 582-9614 3667 Castro Valley Blvd., C.V. Mon-Fri, 9-3; Sat, 10-4:30; Sun, 12-4 24718 Mission Blvd., Hayward (Same times)	N, G, Al, T
3. Hayward	Eden Area YMCA, Hayward Same as above These two centers are attempting to establish a pick-up with service group donated time and materials.	
4. Livermore	Livermore Community Recycling Center Lois Hill 447-5699 This center has been closed as of May 1978 and has been replaced by a curbside pick-up program operated by Livermore Disposal Co., 447-1300	n, G, Al, Fe, B
5. Oakland	Merritt Recycling Center Karen Pickett, 531-4911, ext. 230 Merritt College, 12500 Campus Drive Wed-Sun 10-4 pm.	N, P, G , Al, Fe, B, T, cardbd., bags
Contra Costa		
6. Danville	Scout Troop 236 Tom Seabury 837-4433 Community Presbyterian Church 24 hours	N
7. El Cerrito	E.C.ology Chuck Papke 234-7445 7501 Schmidt Lane Weekly curbside pickup This program has just initiated free curbside pickup under a State SWMB grant. Initial figures show a 800-1000% increase in overall participation. The operation is expected to be self-sufficient at the end of the year.	N, P, M, G, Al, Fe, B, T, cardbd., oil, rags

*N = newspaper
M = magazine
Al = aluminum
B = Bi-metals
P = paper
G = glass
Fe = ferrous metals
T = tin
cardbd. = cardboard

Contra Costa (continued)

8. Pittsburg/Antioch	Many Hands, Inc. Thelma Mosca 754-5915 Pittsburg-Antioch Highway 8:30-4:00 p.m.	N, P, M, G, Al, Fe, B, T, cardbd.
9. Pleasant Hill	Pleasant Hill H.S. Ecology Club Mr. Hipple 934-6746 School parking lot M-F after school, Sat & Sun	P, G, Al
10. Walnut Creek	Geary Rd. Co-op Chris Christmann 935-3410 1510 Geary Rd. This center is not operating at this time.	
11. Walnut Creek	Scout Troop 302 Richard Pierce 935-2100 2100 Tice Valley Blvd.	N, P, M
San Francisco		
12. San Francisco	Haight-Ashbury Neighborhood Council Michelle Welch 431-9892 Kezar Stadium parking lot 2nd and 4th Saturdays, 10-2	N, G, Al, Fe, T, cardbd.
13. San Francisco	Lowell H.S., 1101 Eucalyptus Kathy Chien Lowell H. S., 1101 Eucalyptus 3rd Saturday 8:30-12:00 p.m.	N, G, Al, T
14. San Francisco	McAteer Freewheelers Mt. Davidson Environmental Action McAteer H.S., O'Shaugnessy Blvd. Near Portola Drive	N, G, Al, T, wine bottles
15. San Francisco	Richmond Environment Action (REA) John Barry 387-3044 USF parking lot E, Turk Street Sat, 9-2	N, P, G, Al, Fe, cardbd.
San Mateo		
16. Pacifica	Ecology Action of Pacifica Helen Murawski 359-5353 Hwy 1 & San Pedro Terrace Road M-F two hours; Sat, four hours	N, P, G, Al, Ge, B, wine bottles
Santa Clara		
17. Campbell	Campbell Community Recycling Center Mr. Gillespie 379-4710 1 West Campbell Avenue Saturday 10-4	N, P, G, Al, B, T
18. Los Altos	People Who Care Recycling Center Kermit Cuff, Jr. 941-5380 Edith & San Antonio Roads	N, P, M, G, Al, Fe, B, T, oil
19. Palo Alto	The Old Barrel R. Tracy 493-2851 4075 El Camino Way 9 a.m. - 12:00 p.m. This Center is a retail liquor store.	Al

Santa Clara (continued)

20. Palo Alto	Palo Alto Recycling Center Palo Alto Sanitation Company (PASCO) 324-4894 2380 Embarcadero Rd. Wed-Sun, 9-5 p.m.	N, P, G, Al, Fe, T, B
21. San Jose	Linda Vista Community School Mrs. Joan Balcom 85 Gordon Avenue Sat 10-3 p.m. This operation was curtailed due to a lack of chaperones for the children involved	N, M, G, Al
22. Stanford	Associated Students of Stanford University Recycling (ASSU) Jim Knox 497-4331 Pampas Lane, Campus Tues, 2-6 p.m.; Sat, 11-3 p.m. This center operates a collection service Mon-Sat	N, P, G, Al, Fe, B, T,

Solano

23. Vacaville	Scout Troop 488 Mrs. Buff Fleming (707) 448-7448 City of Vacaville Water Plant & Corporation Yard, Emira Road First Sat 9-12 p.m. Operating as a satellite of #24, the Troop keeps revenues from newspapers and transports other materials by donated trucks to Vallejo.	N, G, Al, B, T
24. Vallejo	Solano County Camp Fires Eleanor Yuric, Director (707) 643-4573 Since 1971, this organization has incorporated city and county cooperation (donated labor, trucks and space) to handle the recycling in the northern county cities. The collection centers are operated by volunteer youths on one Saturday a month.	N, G, Al, T, B

Sonoma

25. Healdsburg	Sonoma Co. Recycling A.K. Pemberton 208 Hayden This center was closed by the Dept. of Health in May, 1977 for sanitary and safety violations. A lack of funds, volunteers, and equipment led to this deterioration.	
26. Petaluma	Petaluma Recycling Center Dennis Orner 763-4761 3504 Bodega Avenue Mon-Fri, 9:00-3:00; Sat & Sun 10-4	G, Al, B, T, cardbd.
27. Santa Rosa	Santa Rosa Recycling Center (Garbage Reincarnation, Inc.) Michael Anderson (707) 539-8385 101 Mission Blvd., Mon-Sun 10-5	N, P, G, Al, Fe, B, T, oil

APPENDIX B

This appendix reviews the calculations involved in the compilation of each table. All data were received from the various recycling centers in English measurements (e.g., lbs, tons, \$/ton). These were converted to metric units by the following equations:

1. 1 MT = 1000 kg = 2205 lbs = 1.102 Tons
2. (Tons) (Metric Ton/1.102 Ton) = MT
3. 1 kg = 1000 g = 2.205 lbs
4. (lbs) (kg/2.205 lbs) = kg
5. l = 1.06 qt. (liter)
6. (qt.) (l/1.06 qt.) = l
7. 1 KJ = 0.9484 lbs.
8. 1 Ton = 2000 lbs
9. (\$/Ton) (1.102 Ton/MT) = \$/MT

Table I, Materials Collected, was simply a tabulation of raw figures submitted by the centers. The English units were converted to Metric. Averages were calculated by summing each column and dividing by the number of centers.

Table Ia, Materials Collected: Percent of Total Materials per Center, indicates the portion of the total waste collected in each category for each center.

$$\frac{\text{MT from each category, Table I}}{\text{Total MT at each center}} \times 100 = \%$$

Table II, Labor Activities, again was a tabulation of raw figures. In some cases, the number of employees and the work week was returned. These two figures were multiplied, and the product multiplied by 4 to yield person-hours/week.

(Employees) x (work hours/week) x (4 weeks/month) = person-hours/month

Table III, Collection Center Costs, lists submitted rental and operational cost per month. "D" represents donated services and materials. Figures under the heading Labor Hours were from Table III; the notation and the number of paid labor hours were submitted by the centers. Percent Paid Labor was calculated by dividing paid labor by total labor, quotient multiplied by 100.

$$\frac{\text{Paid Labor}}{\text{Labor}} \times 1\text{-}0 = \%\ \text{paid labor}$$

Labor Cost and Initial Capital figures were raw data figures. Total Cost was simply a summation of rental cost, operational cost and labor cost. This sum divided by the center's total metric tonnage yielded the Rough Cost per MT figure.

Table IV, Market Prices, was submitted in ($/Ton). This was converted to ($/MT) and tabulated.

Table Va showed Collection Center Revenues, calculated with figures from Market Prices and Material Collection.

$$(\text{Market Price \$/MT}) (\text{Material Collected, MT}) = \$$$

Total Revenue was a horizontal summation of revenues. Division by Total Materials Collected indicated a weighted average $/MT for each center. Total Revenue at the bottom of the table shows a vertical summation of revenues in each category. Average Revenue indicates the portion of weight revenue the average center receives from each material.

Table Vb shows what percent each item actually represented out of the center's total revenue.

$$\frac{\text{Revenue per item}}{\text{total revenue, center}} \times 100 = \%$$

Table VI, Diverted Solid Wastes, listed the center's serviced community population (from U.S. Census Bureau) and the total generated stream was calculated by multiplying the population by 3.7 lbs of waste/day.

$$3.7 \text{ lbs/day} = 1.68 \text{ kg/day}$$

$$(1.68 \text{ kg/day}) (30 \text{ days/month}) = 50.4 \text{ kg/month}$$

$$(50.4 \text{ kg/month}) (\text{population}) = \text{Total kg/month}$$

$$(\text{Total kg/month}) (\text{MT/kg}) = \text{MT/month}$$

Percent of Stream Diverted showed Material Collected at each center divided by Volume of the Total Waste Stream, quotient mulciplied by 100.

Table VII shows Diverted Savings. The Revenue-Cost column indicates a profit if positive, a deficit if negative. Landfill fee savings was calculated using $9.00 average landfill fee.

$$(\text{Materials Collected, MT}) (\$9.00/\text{MT}) = \text{Landfill fees saved}$$

The effective cost/savings shows the cost or savings per month when the landfill fee savings are calculated.

APPENDIX

APPENDIX C

Source Separation curbside pickup and Recycling programs appear to be most effective when given assistance at the outset. Subsidies to neighborhood recycling programs provide the means of supporting operations until revenues from sales of materials are sufficient to allow profitable operation. Typically, the programs must be in operation for six months to a year and involve over 50% of the community before a break-even tonnage or profit is achieved, but this is not a hard and fast rule (Hansen, 1976; Papke, 1978).

Several levels of sophistication are possible; each higher level requiring more capital investment, but reducing the amount of direct handling of waste materials. The minimum amount of capital investment for a small to medium-sized community would appear to be $10,000 (Papke, 1978; Belchamber, 1978); Johanson, 1978). This would enable establishment of a center with very little equipment (barrels, bins or other containers) and a few workers. A program of this sort would rely heavily on volunteer labor and an environmentally conscious community to promote recycling. Service clubs such as Lions, Rotary, Kiwanis or a Merchants' organization could also donate time, labor or materials on a rotating basis to help keep costs low.

Funding for a more viable program in the same medium-sized community would be in the range of $30,000 to $75,000. This initial investment allows for development of an efficient site enabling quick and easy off-loading of materials from patrons' cars. It also enables purchase or leasing of storage barrels and bins designed for forklift maneuvering, roll off bins, mechanical glass crusher, paper baler, magnetic separator/crusher and platform scales. In addition, some funds may be utilized to modify a small fleet of pick-up trucks and trailers for route collection. A well planned, publicized and managed curbside collection program can drastically increase the percentage of patronage and materials collected (Papke, 1978).

A recycling program encompassing several communities may run up to $1 million. The Marin Environmental Co-op is one such organization (Belchamber, 1978). According to a recent newspaper listing, seven cities in Marin county are cooperating in a recycling effort.

An alternative to curbside collection is a network of mobile satellite depots. These would be extensions of the main recycling center; small bins could be placed in local parking lots on certain days, and removed by trucks when full. The mobility of the system in providing closer collection sites enables better coverage of the community without home pick-ups.

Some purchase costs submitted by responding centers follow:

ITEM	COST	CENTER
Roll-off truck	$30,000	PASCO
Roll-off bin	4,500	PASCO
Trash container	400	PASCO
Can crusher	1500-2000	PASCO
Baler	3,000	PASCO
Tools	500	PASCO
Signs	150	PASCO
Pick-up trucks	12,000	E.C.ology
Truck modification	1,000	E.C.ology
Fork lift	2,000	CCC
Flatbed truck	10,000	CCC
Site development/maintenance	500	

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