V. MARKETS FOR RECOVERED MATERIALS

CHAPTER A - EXISTING MARKETS FOR MATERIALS RECOVERED FROM BAY AREA SOLID WASTE

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Introduction

This chapter deals with the existing markets for materials recovered from the San Francisco Bay Area solid waste stream--paper, glass, ferrous and nonferrous metals, and compost. The first section of this chapter examines specific recycling centers and firms; when information is available, it will be described along the following lines: the types of commodities dealt with by recycling centers and firms, the buyers and sellers of each commodity, the volume and price of sales, and finally the stability of the markets. The second section describes the problems that these markets have in common, along with some suggested solutions for these problems. The final section re-examines general marketing issues in light of the information gained in the specific product areas.

Method

Data gathered in this chapter were confined to interviews, telephone calls, and a seminar. In addition, available materials in reports and studies supplemented the empirically collected data. The general problem of recycling was explored first at the E.C.ology Recycling Center. Then an attempt was made to interview one person in-depth in one firm from each segment of the recycling industry in the Bay Area. The similarities and differences in the firsthand collection of data are summarized in Table 1.

A GENERAL RECYCLING CENTER

Present Operations

Operation of the E.C.ology Recycling Center in El Cerrito was examined to define the characteristics of present recycling operations. This center handles recyclable materials. Its sources of input are public drop-off and recycling center pickups. Chuck Papke, director of the Center, provided the information during an interview. He stated that the Center's present volume of operation ranged between 68.0 and 72.0 metric tons (75-80 tons) per month, with about 20 percent of that amount being collected. The items picked-up include glass, cans, newspaper, and corrugated boxes. A rough description of the Center's operation is summarized in Table 2 and the hand-out provided by the E.C.ology Recycling Center (see Fig. 1).

E.C.ology's current operational goal is to increase its present volume from 9.0 to 18.0 metric tons (10-20 tons) per month, thus meeting the statewide goal of 25% solid waste recovery by 1980. At that rate, the Center will be handling about 150 metric tons (170 tons) per month. In May 1978 E.C.ology intends to start a purchasing program which involves buying newspaper, glass, and cans from the public at $0.005

per kg ($0.01 per pound). In the near future the Center also plans to design a new pick-up system in order to increase the present volume of input.

Problems Related to Recycling Centers in General

Studies done on market problems for recycling centers have shown that most centers are small, localized, and costly operations that are competing among themselves. Industrial buyers have a somewhat monopolistic control of the market because most of the localized recycling centers are selling their recyclable materials to a few industrial buyers (see Tables 2 and 3). Secondary materials suppliers are also at a competitive disadvantage due to their smaller size and not well established relationships with industrial buyers. According to Papke, a need exists at present to develop a cooperative market. Such a group market would enlarge operations, thereby obtaining an economy of increased operational scale. A cooperative market would also help to ensure steady supplies of secondary material from the public. Further assessment of needs for most Bay Area recycling centers points to the importance of negotiating fair contracts with the buyers, in order to guarantee a stable market for the commodities they sell.

THE RECYCLING INDUSTRIES

Commercial Operations

Most secondary materials companies in general, and the paper recycling industry in particular, can do little to influence the demand for the commodities they sell. Instead, they attempt to control supplies by holding down inventories. This action is taken by most buyers to prevent their inventory losses and to compensate for the frequent and large price fluctuations. The net result of this action is to encourage or discourage the collection of wastes for recycling according to the demand for recycled materials in the economy.

These kinds of marketing problems will be explored in more detail below. In this chapter individual industries are examined according to the types of commodities they handle.

Paper

Paper, the largest component of municipal waste, comprises 40%-50% of the residential/commercial solid waste stream (Table 4). About 1.86×10^6 metric tons (2.05×10^6 tons) are generated per year in the Bay Area (see Table 5). Present technology makes it feasible to recover at least 85% of the fiber fraction of paper from the waste stream. All these recovered waste papers could be absorbed by direct users; that is, paper manufacturers and paper brokers. These parties take title to the material and take responsibility for quality, quantity, and grading. Studies done by Diaz and others (1976) have shown that most of the Bay Area paper recycling companies can absorb 90 to 180 metric tons (100 to 200 tons) of waste paper per day. (See Figure 3 for a breakdown of the total recoverable potential of waste paper).

Usually waste paper is gathered by recycling centers or industries via such means as municipal collection programs, consumer sources, and individual companies. The dealers (brokers) handle waste paper in a variety of grades based on the fiber content. Some common grades include: mixed paper, newsprint, corrugated boxes, and high grade pulp substitutes. Each grade has a different market value. For example, Consolidated Fibers Corporation is paying $22/metric ton ($25/ton) for newspaper, $18/metric ton ($20/ton) for cardboard, $36/metric ton ($40/ton) for mixed paper, $72/metric ton ($80/ton) for computer printout, and $99/metric ton ($110/ton) for IBM cards (Hendrizk, 1978, oral communication). In general, the price paid for the paper and paperboard products will fluctuate as the demand changes for such materials as combination paperboard, by-products of wood construction, paper stock, and pulpwood.

This fluctuation is due primarily to the voluntary nature of the waste paper supply. For instance, Consolidated Fibers Corporation has a daily input fluctuation of 4.0 to 9.0 metric tons (5-10 tons) (Hendrizk, 1978, oral communication). Therefore, the supply of waste paper is uncontrolled and fluctuates from time to time.

Paper dealers consider it economically impractical to retain any substantial paper stock inventory (i.e., paper which has been collected, sorted, and graded to meet specification). This reluctance is due to the high production but low and irregular consumption rate for recycled paper and paper products (Hendrizk, 1978, oral communication). The price of waste paper is related to supply, but the shortage of supply is due primarily to the time lag resulting from the need to coordinate activity, rather than from actual lack of waste paper.

For recent years in general, the demand for recycled paper has been lower than the supply (Block, 1978, oral communication). The paper recycling industries have only limited control over the demand for their products because this demand is in turn affected by the demand for recycled paper and paperboard products. However, new markets, such as foreign demand for all secondary paper materials and domestic demand for used newspaper by the cellulose insulation industry have become increasingly important. For instance, a large insulation plant like Mono-Therm can consume 1,814 metric tons (2,000 tons) of old newspaper per month (Burke, 1978, oral communication). These new markets have in turn increased the demand for recycled paper products from secondary paper industries in the United States.

Consolidated Fibers, one of several paper brokers in the Bay Area, can be considered typical of paper recycling firms. Norman Hendrizk, division account executive in the firm's Richmond office, indicated that it is the society's demand for recycled paper ("consumer power") which keeps Consolidated's recycling business going. Over the past 3 years, the firm has been selling about one and one-half million metric tons of recycled paper annually. This includes exports to 40 foreign countries. These sales have taken place in spite of an unstable market. He also mentioned that paper recycling industries compete more now for buyers than they did before. At the same time, however, companies who purchase recycled paper and paperboard products are becoming more selective than they have been in recent years. Paper products they purchase must be separated from other solid waste and be free of contaminants (such as bindings, carbon papers, and plastics). (See Figure 5 for types of contaminants).

Additional data provided by Peter Block in the advertising division of the same company indicates that in spite of the continued increase in paper consumption in this nation, the rate of paper recycling (weight of paper recycled divided by the total weight of paper produced) has declined since 1946. In fact, it dropped from 31% in 1951 to 24% in 1976. In 1951 the United States produced 26 million metric tons of paper products and recycled 8 million metric tons; in 1976 the country produced 49 million metric tons of paper products but recycled only 12 million metric tons. In other words, paper recycling has increased only 50% from 1951 to 1976, while total paper production has increased about 88% during the same period.

These data show that in order for paper recycling to resume its prior place in relation to paper production, greater effort is needed than is being made at present. The interviews made suggest that the paper stock processors are now seeking to increase their activities in exporting recycled paper surplus in order to expand their market.

Marketing Problems in Secondary Paper Industries

The market for recycled paper has traditionally been adversely affected by three misconceptions. First among these is the widely held view that recycled paper and paper products are inferior in quality to new paper. Second is that the secondary materials are in short supply, and third is that prices are usually higher when compared to the virgin fiber products (Paper Stock Institute of America). Other marketing problems exist in the secondary paper collecting business stemming from the factually correct small and localized activity of most recycling centers. Consequently, the operations of these centers are always subject to the severe fluctuations of market demands and prices.

On the one hand, information collected from Consolidated Fibers also suggests that the problems of fluctuations and small demand for recycled paper can best be solved by (1) creating special priorities for the use of recycled paper over the use of virgin materials, (2) encouraging the use of recycled papers from the mass media, (3) changing the ratio of recycled paper stock to virgin pulp, (4) educating the public, and finally (5) encouraging "consumer power" to increase its demand for recycled paper products. On the other hand, the market supply and price could be stabilized if long-term contracts could be negotiated between buyers and sellers and better inventory policies were implemented.

Glass

Glass constitutes about 10% of the municipal solid waste for the Bay Area. About 3.14×10^5 metric tons (3.46×10^5 tons) per year are recyclable (See Tables 4 and 5). This amount would supply less than one-third of what the container manufacturers could use (Diaz et al., 1976, p. 143). This potentially recyclable glass includes container glass, as well as flat, press, and blown glass. According to Harry Lucky, reclamation coordinator at Owens-Illinois in Oakland, the "cullet" (broken or refuse glass usually added to the virgin material to facilitate melting in making glass) is a contaminant-free and color-sorted product. The amount of cullet added to a pound of new glass can vary from 10% to 30%, according to the batch formulas of individual corporations. (Each company has its own formulas to make glass). Lucky at Owens-Illinois hopes that cullet can be made sufficiently predictable in price to compete with the basic raw materials of glass (sand, limestone, and soda-ash).

In 1977 the plant of Owens-Illinois in Oakland recycled 4,263 metric tons (4,700 tons) of glass with an increase of about 34% (from 3,170 metric tons, that is, 3,500 tons in 1976, in one year). Lucky has described this market situation as a relatively stable one. He noted, however, that the glass companies are competing for recyclable glass and that buyers are becoming more selective than in the past with regard to the quality of the reusable glass which they are willing to buy (See Figure 2).

Information collected from Lucky also suggests that the glass industries experience strong, competing forces between the use of cullet and virgin materials. The cullet cost $30 per ton, excluding transportation cost from the collection point to the reclamation plant. On the other hand, virgin materials average $32 to $36 per ton, including transportation, and are more readily available than cullet.

Faced with the competing forces, Lucky indicated that the consumption of cullet may be motivated by economical and technical incentives: the batch preparations of cullet and virgin materials are mixed proportionally and then delivered to the furnace. This practice does several things. It reduces fuel requirements (for every 5% increase in cullet used, 1% of the total energy input is saved) and air pollution, extends the life of furnace linings, and produces a "melt" faster than if only virgin materials were utilized. Theoretically, it takes 453,600 K Cal (1.8 million BTU) to convert one ton of glass made wholly from virgin materials. When cullet is added to the batch, it takes only 378,000 K Cal (1.5 million BTU).

Two additional incentives for using cullet are: (1) that soda ash has become more difficult to obtain since its increased use in biodegradable detergents, and (2) the price for virgin materials is increasing, having already increased from $1.00 to $2.00 per ton in 1975 alone. So according to Lucky the glass industries, especially those making glass containers, have increased their interest in consuming more cullet as supplies permit.

The purchase of cullet raises additional problems for the purchasers. Purchasers have no control over the quality of cullet they buy. The cullet used for batch preparations must meet standards specified by the Glass Production Industry (GPI) (See Figure 2). Specifically, this means that the cullet must be chemically acceptable, color-sorted, clean, and free of metallic contaminants. Another problem related to the supply of cullet is that due to the rising costs and declining supplies of good quality cullet, less than 20 cullet dealers were left in the United States as of 1972 (Darney & Franklin, 1972, p. 68). This decrease has come about principally from the increased use of plastics in the packaging industries. In conclusion here, the market for cullet is always greater than the supply. On the other hand, the supply of cullet is associated with high costs, unknown quality, and fluctuating volume.

Ferrous Metals

The scrap metal recycled from municipal waste is a marketable operation. Steel scrap comprises about 7%-8% of urban solid waste, with about 2.54×10^5 metric tons (2.80×10^5 tons) per year which can be recovered (See Tables 4 and 5). The recovery of steel scrap from solid waste has been practiced for several years with markets for steel scrap well established. The recovery of steel cans, especially, constitutes about 50% of the recyclable steel scrap (See Figure 4).

John Mitchell, market manager at MRI Corporation (formerly M & T Chemicals, Inc., and still a subsidiary of American Can Company) stated that his company has recycled tin plate scrap and cans for over 69 years. To MRI, its recycling operations have become increasingly more profitable, due to the rising cost of ferrous metals in the past few years.

Its plant in South San Francisco, for instance, with a productive capability of over 90,720 metric tons (100,000 tons) of ferrous materials per year, can anticipate working at full capacity. In contrast, however, its can recycling program in Oakland has been unsuccessful, due to the low supply in metal and bimetal cans from the public (Sellmen, 1978, oral communication). The current base price being paid for all cans delivered to the facilities at South San Francisco is $25 per gross ton; the price paid for bimetal or a mixture of steel and bimetal cans is $15 per gross ton. Mitchell hopes to use long-term contracts between buyers and sellers so as to stabilize sources of supply and demand. He also stated optimistically that "the entire concept of resource recovery from municipal refuse is still in its infancy, and all of us are in a learning process."

Mitchell further indicated that MRI is one of the largest de-tinners in the world. MRI processes about 317,520 metric tons (350,000 tons) of tin plate annually, converting it into (1) reusable, high-grade steel melting scrap for the steel industry, (2) shredded scrap to the copper mines, and (3) metallic tin and tin chemical for a variety of users. The process of chemical de-tinning is essentially the dissolving of surface tin from steel cans. The tin, electrolytically recovered from solution, yields a metal of extremely high purity which can then be converted into a variety of tin chemicals. The de-tinned steel is either hydraulically compressed into tight bundles for re-melting by the steel mills or shipped in loose, shredded form to the copper mines.

For the scrap industry as a whole, the demand for scrap metals depends on the total production of iron and steel from ores. In other words, the price of scrap is influenced by the domestic and foreign demand for iron and steel. The market price for the different grades or varieties in turn depends on the supply and demand in different regional markets. Studies indicate that the critical factors for marketing obsolete scrap are the following: (1) the unremovable metallic impurities (such as lead, copper, and enamel coating), (2) the high transportation cost, and (3) the value of ores versus that of the scrap (Darney & Franklin, 1972, p. 58).

Nonferrous Metals - Aluminum

Scrap aluminum contributes the largest portion to nonferrous metals waste. Municipal solid waste in the Bay Area has been found to contain approximately 0.7%-1.0% aluminum, of which 27.5×10^3 metric tons (30.0×10^3 tons) per year is recyclable. This comes principally from beverage containers and package materials (See Tables 4 and 5).

Information obtained from Papke at E.C.ology and from Bruce Richmond at Kaiser indicate that a stable market exists for aluminum scrap. As with glass and paper, people bring in the aluminum in such forms as flattened cans, trays, and flat foil. For recycling centers like E.C.ology, aluminum collection involves volunteer workers at the same time that it, by itself, is a profitable operation. Both the studies done by Darney and Franklin (1972, p. 61) and the information provided by Kaiser indicate that aluminum cans can be recycled profitably and that there is no technical limitation. To be profitable, however, the aluminum scrap has to meet two further requirements: (1) it has to be delivered to various central processing plants within certain transportation and quantitative constraints (in 1976, a minimum of 27,216 kgs, 60,000 lbs of aluminum per load was needed to ensure the lowest freight rates), and (2) those materials have to be delivered in high enough quality to use the processing equipment at the reclamation plant economically (Diaz et al., 1976, p. 125).

Information gathered also from Kaiser points out that the major aluminum companies (Alcoa, Reynolds and Kaiser) began their program of aluminum recycling for sound economic reasons. Recycled aluminum saves 90%-95% of the energy needed to produce new aluminum from ore. Further, it takes four pounds of bauxite (the aluminum-containing ore) to make one pound of aluminum--and bauxite continues to increase in cost. Based on this trend, the above companies have expressed interest in negotiating long-term contracts for the purchase of a refuse-derived aluminum scrap (Richmond, 1978, oral communication).

Among all the recycled materials, the market situation for aluminum recycling is one of the most stable. For Kaiser, the rate of aluminum recycling has increased five-fold over the last two years. It handled 2,718 kgs. (6,000 lbs.) per week in 1976. At the present time, Kaiser handles 13,608 kgs. (30,000 lbs.) per week. Currently, in California, the recycled aluminum cans comprise 35% to 40% of the total beverage can production. Even though their outlook for aluminum scrap consumption rate is expected to stay high, the remaining problems in aluminum recycling--contamination control, cost of separation, and cost of collection--are still unsolved (Richmond, 1978, oral communication).

Nonferrous Metals - besides Aluminum

Information gathered from MRI indicates that it can set up a system similar to that used for detinning in order to recover zinc, copper, and nickel for reuse by industry. Mitchell stated that obsolete steel cans are readily accepted in the copper mining industry where copper is precipitated out of the acid leach solutions. This process consumes between 1.2 to 2.5 tons of iron for each ton of copper produced. A growing market exists for shredded tin plated steel because copper extraction by leaching has grown rapidly during the last several years. According to MRI, copper mines prefer de-tinning material

material to other types of iron because of its uniform high quality, its low rate of contaminants, and high reactivity.

The recycling of other nonferrous metals such as zinc and lead is not economically sound at present. Darney and Franklin (1972, pp. 62-63) indicate that recycling zinc is difficult because this metal is used as an alloying agent and coating, and to make small objects and fixtures. The recycling of lead is also uneconomical because recovery requires specialists and special processing equipment. Recycling exotic and precious metals such as gold and silver is even more difficult because the metals appear in small quantities, often in combination with other metals which require considerable processing.

Compost

The city of Berkeley has a recycling center dealing exclusively with plants and plant debris from garden wastes dumped at the site by the public. In this center a machine grinds up the plants and debris into a mulch. Then it is put into cylinders, watered and aged for about two months; after that it is ready to be sold. Under this program the compost can be purchased for $0.75 per cubic foot and $13 per cubic meter ($10 per cubic yard).

Information provided by Mike Baumann, coordinator of the Berkeley recycling program, indicates that this program exists exclusively for the public. Costwise, composting is comparable to incineration. This comparability is modified in part by the wide range of costs in composting due to size, location, and type of plant. Less waste reduction by volume is accomplished by composting than by incineration; incineration, however, is also associated with air pollution while composting is not.

The city of Berkeley is losing money on this composting operation. The compost is used by the city in parks and recreational areas or is sold to the public. Actually, only a limited market exists for compost. Among all the materials dealt with in this chapter, the recycling of compost succeeds least. Not only is the operation losing money, but also no salespersons or sales promotion exist for this product. One could say that the market for composting has never been developed.

GENERAL MARKET ISSUES

Having examined the recycling centers and industries, a brief summary of the market issues is in order. Consistent with Caughron's research, we have found that the "secondary markets" are supported by junkmen, small salvage dealers, secondary material processors, brokers and specialists of one kind or another. Also involved are private and public collectors, disposal operators, and commercial establishments. All these compete with the virgin material in order to provide material for industrial buyers (Caughron, 1973, p. 9).

The buyer and seller interactions in the secondary markets are frequently characterized by somewhat monopolistic practices on the part of the industrial buyers. These practices have lowered the prices and quantities of material that are purchased, when compared to the free market situation where many buyers and sellers are interacting. Based on the interviews conducted for this study, little cooperative development is likely to develop, given the competition and fragmented activity of the dealers and centers.

Within the secondary market, we noted that the selling price of the recovered materials is beyond the control of the suppliers. The prices are determined by the demands of other industries for the secondary materials. These demands in turn depend on general economic conditions and the relative availability and cost of virgin resources. The recycling firms buy and sell materials on a weekly or monthly contractual basis, or without any contracts at all. These practices have weakened the bargaining situation of secondary materials suppliers and led to wide price fluctuations.

In summary then, the recycling industries are highly fragmented and localized; buyers tend to monopolistically control the market, and the secondary materials have competitive disadvantages in price and quality over the virgin materials. Such disadvantages come from the high costs of transportation, collection, and separation incurred by the sellers as well as the contamination of materials and high specified quality required by the buyers. The principal disadvantage for most of the recycled materials stems from a lack of demand.

Some solutions have been suggested to these problems by those interviewed: (1) to establish a cooperative market among the sellers, (2) to negotiate fair contracts among buyers and sellers, (3) to increase publicity to inform the general public about existing recycling programs, (4) to improve programs to educate the public about conservation, and finally (5) to initiate legislative changes to make secondary materials comparable to or competitive in price with virgin materials.

By way of conclusion, economic feasibility is a key element in the structure of recycling operations. This mechanism facilitates the way industries reuse the recycled goods. Although definite social, environmental, and economic benefits exist in recycling, the market for such goods is unstable with drastic changes in price, quantity, and quality. Large buyers such as Consolidated Fibers, MRI, Owens-Illinois, and Kaiser are making contracts with various city and county disposal facilities and private facilities in order to ensure large stable inputs of high quality materials. These activities indicate that some American industries (as well as some American people) are becoming concerned with the idea of recycling and conserving natural resources.

On the other hand, the present study, supported by Darney and Franklin (1972, p. 95), suggests that the supply of secondary materials is not limited by technological inaccessibility, but the relative constraints in cost and information available to the public. Further, the technology exists to recover secondary materials via federal and private efforts, but the capabilities of the social, political, and economic institutions are lagging behind in the recovery of secondary materials.

The present study has shown that sufficient demand does not exist for large quantities of materials which could be made readily available on a cost-competitive basis from municipal waste. More demand and marked changes in the practices of exploiting virgin materials are needed to improve the existing markets for recovered materials.

Table 1

Interview Schedule for Firms Consulted

Produce	Name of Firm	Contact Information
General	E.C.ology Recycling Center, El Cerrito	3 interviews: 1 hr., ½ hr., ½ hr. 2 phone calls: 5 min.each mid-Jan/early April, 1978
Paper	Consolidated Fiber Inc. Richmond	1 interview: 1 hr. 3 phone calls: 10 min. each mid-January/March 5, 1978
Glass	Owens-Illinois Oakland	1 interview: 2 hrs. 2 phone calls:10 min. each
Aluminum	Kaiser, Oakland	no interview 2 phone calls: 15 min. each May 1978
Ferrous Metals	Seminar: State of Calif. Solid Waste Management Board on Material Resource Recovery, San Francisco	participant in meeting: 3 hrs. February 1978
Nonferrous Metals	Seminar on Solid Waste Management, San Francisco	participant in meeting : 3 hrs.
Compost	City of Berkeley Recycling Center	2 phone calls: 10 min. each

Table 2

Operations of the E.C.ology Recycling Center, 1978

Commodity	Buyers	Price/Vol./ Freq. of Sale	Market Stability
Paper[1]	Consolidated Fibers	$36.3-$45.4/metric ton ($40-$50/ton) 2.275-6.825 kg/week (5,000-15,000 lb/week)	Both price and volume fluctuate
Glass[2]	Brockway Glass Owens-Illinois	$27.2/metric ton ($30/ton) 13.6-18.1 t/month (15-20 ton/month)	Has been stable for the past 3 years
Aluminum	Kaiser (contracted)	$0.078/kg ($0.17/lb) 910 kg/month (2,000 lb/month)	Stable and price increasing
Scrap metal (tin & steel)	M & T Chemicals	$27.2/ metric ton ($30/ton) 2.27/ metric ton (2.5 tons) every 2 weeks	Stable

[1] Sale is under contract with a guaranteed price from buyer of minimum $26.3 t ($29/ton).

[2] Recently negotiating a contract to sell mixed colored glass to Modesto.

Source: Interviews with Chuck Papke, mid-January-early April, 1978.

Table 3

The Buyers of the Berkeley Recycles (Community Conservation Center), 1978

Commodity	Buyers
Paper	Consolidated Fibers Sonoco
Glass (separated by color)	Owens-Illinois
Aluminum	Reynolds Kaiser Coors
Tin	Judson Steel M & T Chemicals

source: Interview with Pamela Belchamber, Berkeley Recycles, February 1978.

	Alameda	Contra Costa	Marin	Napa	San Francisco	San Mateo	Santa Clara	Solano	Sonoma	MSW Richmond Cal., (a)	Avg. MSW NCRR (b)
Newsprint	9.0	9.0			8.0		8.0				
Corrugated	22.0	6.0			2.0		6.0				
Other paper	12.0	35.0			38.0		31.0				
Total - fiber	43.0	50.0	35.0	50.0	48.0	31.0	45.0	55.0	41.0	43.2	43.0
Ferrous	8.0	7.0			8.0		6.0			7.3	8.0
Aluminum	0.7	1.0			1.0		0.5			0.7	0.7
Other Non Ferrous	0.3	---									0.3
Total-Metals	9.0	8.0	8.0	8.0	9.0	10.0	6.5	7.0	9.0	8.0	9.0
Glass, ceramics, rocks	10.0	10.0	11.0	6.0	13.0	10.0	6.0	6.0	14.0	10.8	10.0
Plastic, rubber, rags, etc.	5.0	6.0		10.0	5.0	11.0	6.0	12.0	6.0	4.5	5.0
Garbage, yard wastes	33.0	20.0	37.0	24.0	5.0	36.0	26.0	20.0	22.0	23.5	26.0
Other, Misc., Non-class, fines	–	6.0	9.0	2.0	20.0	2.0	10.5	–	8.0	10.0	7.0

a) Unpublished studies - University of California, Berkeley 1975.

b) Fan, Dah-Nien, "On the Air Classified Light Fraction of Shredded Municipal Solid Waste - Composition and Physical Characteristics", Resource Recovery and Conservation, Vol. 1, No. 2, 1975. pp 141-150.

Table 4 - AVERAGE COMPOSITION FOR RESIDENTIAL, COMMERCIAL, AND INDUSTRIAL SOLID WASTE
(Percent by weight)

source: Louis F. Diaz, et al. "Market Potential of Materials and Energy Received from Bay Area Solid Wastes," College of Engineering, Univ. of Calif., Berkeley, 1976, p.16.

Table 5

QUANTITIES OF SOLID WASTE GENERATED IN THE SAN FRANCISCO BAY AREA

1975 - 1980 Average

(Thousands of Tons per year)

	Alameda	Contra Costa	Marin	Napa	San Fran.	San Mateo	Santa Clara	Solano	Sonoma	Total
Residential - Municipal	570	480	280	57	280	280	660	210	220	4215
Commercial - Industrial					200	430	530	18		
Construction, Demolition		110	18	-	650	140	340	-	-	1258
Sewage Sludge (Dry Solids)(a)	32	25	6-12	7	14	25	33	6	2	150-156
Food Process Residue	78	-	-	-	-	5	160	107	-	350
Other	570	310	-	-	90	-	50	197	-	1217
Agricultural Crop Residue	66	110	10	1	-	18	90	670	60	1025
Manures	59	110	263	1	3	26	90	125	-	677
TOTAL	1375	1145	577-583	66	1237	924	1953	1333	282	8892-8898

Residential, Commercial, Industrial Components - Recyclables

	Alameda	Contra Costa	Marin	Napa	San Fran.	San Mateo	Santa Clara	Solano	Sonoma	Total
Newspaper	51	34			35		92			
Corrugated	125	100			55		69			
Other paper	68	150			210		360			
Total - paper	244	284	100	28	300	360	521	124	89	2050
Ferrous and Bi-metal	47	29	21	5	33	44	69	15	18	281
Aluminum	4	3.8	2.2	0.5	5.0	5.7	5.5	1.8	1.8	30.3
Glass, Ceramics	57	43	31	4	52	53	69	13	24	346
Plastic, Leather, Rubber, etc.	-	41	-	6	26	52	69	25	13	232
Garbage, Yard Wastes	190	60	100	13	14	100	300	45	48	870
Other, Misc., Non-class.	28	29	25	1	100	86	120	3	24	416
		-	-	-	-	-	-	-	-	570
TOTAL - All Categories	570	489.8	279.2	57.5	530	700.7	1153.5	226.8	217.8	4795.3

(a) Source: County Plans, 1980 figures, except Santa Clara County, 1975.

Note: Blanks indicate either data is not available or that the particular waste has been included with other types.

source: Louis F. Diaz et al. "Market Potential of Materials and Energy Received from Bay Area Solid Wastes," College of Engineering, Univ. of Calif., Berkeley, 1976, p. 15.

Fig. 1. Types of Commodities Handled by E.C.ology Recycling Center, El Cerrito, California

Fig. 2. GLASS PRODUCTION INDUSTRY

(GPI) TENTATIVE SPECIFICATIONS
FOR
GLASS FROM RESOURCE RECOVERY SYSTEMS

11/9/76

GLASS OF THIS QUALITY WOULD BE USABLE AS CULLET FOR GLASS CONTAINER MANUFACTURING. EACH GLASS MANUFACTURING COMPANY, HOWEVER, MAY RESERVE THE RIGHT TO ACCEPT OR REJECT THIS SPECIFICATION.

1. Glass from Resource Recovery Systems shall be soda lime glass and a representative sample must meet the following specifications to qualify the glass lot to be used for direct use in soda lime glass container manufacturing. Sample should be prepared and examined per GPI TSTM etc.

2. Specifications: The sample must not contain more than the percentage fraction of each of the following contaminants based upon dry weight:

2.1. Liquid---------------No drainage from sample, non-caking and free-flowing (see note in supplement).

2.2. Screen Size----------0% retained on 2" mesh screen.

15% maximum to pass through a U. S. series 140 mesh screen.

2.3. Organic Substances---Total organics as measured per GPI Tentative Test Methods shall not exceed 0.2% of dry sample weight.

2.4. Magnetic Materials---0.05% of dry sample weight; no particle size shall exceed 1/4".

2.5. Allowable Color Mix for Color-Sorted Glass

2.5.1. Flint Glass* -	90-100%	Flint
	0-5%	Amber
	0-1%	Green**
	0-0.5%	Other Color
2.5.2. Amber Glass -	90-100%	Amber
	0-10%	Flint
	0-10%	Green
	0-5%	Other Color
2.5.3. Green Glass -	50-100%	Green
	0-35%	Amber
	0-15%	Flint
	0-5%	Other Color

*Flint glass containing over 0.1% Fe_2O_3 and/or 0.002% Cr_2O_3, as determined by chemical analysis, shall be considered mixed color glass.

**Flint glass can contain up to 1% emerald green or 10% Georgia green, or a combination within these limits. Note: (1% of Georgia green equals 0.1% emerald green.)

GPI TENTATIVE SPECIFICATIONS
FOR
GLASS FROM RESOURCE RECOVERY SYSTEMS

11/9/76

GLASS OF THIS QUALITY WOULD BE USABLE AS CULLET FOR GLASS CONTAINER MANUFACTURING. EACH GLASS MANUFACTURING COMPANY, HOWEVER, MAY RESERVE THE RIGHT TO ACCEPT OR REJECT THIS SPECIFICATION.

1. Glass from Resource Recovery Systems shall be soda lime glass and a representative sample must meet the following specifications to qualify the glass lot to be used for direct use in soda lime glass container manufacturing. Sample should be prepared and examined per GPI TSTM etc.

2. Specifications: The sample must not container more than the percentage fraction of each of the following contaminants based upon dry weight:

2.1. Liquid---------------No drainage from sample, non-caking and free-flowing (see note in supplement).

2.2. Screen Size----------0% retained on 2" mesh screen.

15% maximum to pass through a U. S. series 140 mesh screen.

2.3. Organic Substances---Total organics as measured per GPI Tentative Test Methods shall not exceed 0.2% of dry sample weight.

2.4. Magnetic Materials---0.05% of dry sample weight; no particle size shall exceed 1/4".

2.5. Allowable Color Mix for Color-Sorted Glass

2.5.1. Flint Glass* - 90-100% Flint
0-5% Amber
0-1% Green**
0-0.5% Other Color

2.5.2. Amber Glass - 90-100% Amber
0-10% Flint
0-10% Green
0-5% Other Color

2.5.3. Green Glass - 50-100% Green
0-35% Amber
0-15% Flint
0-5% Other Color

*Flint glass containing over 0.1% Fe_2O_3 and/or 0.002% Cr_2O_3, as determined by chemical analysis, shall be considered mixed color glass.

**Flint glass can contain up to 1% emerald green or 10% Georgia green, or a combination within these limits.
Note: (1% of Georgia green equals 0.1% emerald green.)

Figure 2. (cont.)

2.6 Inorganic Material (non-magnetic metal, refractories, and other solid inorganics) - Total inorganics 0.1% of dry sample. No particle shall exceed 1/4".

2.6.1. Refractories - Based upon U.S. Series screen size and sample weight, the following refractory particle count will apply.

+20 mesh	1 particle per 40# sample. No particle shall exceed 1/4".
-20+40 mesh	2 particles per 1# sample.
-40+60 mesh	20 particles per 1# sample.

2.6.2. Non-magnetic metals

-20 mesh	1 particle per 40# sample. No particle shall exceed 1/4".

3.0 Soda-Lime Glass - This glass will have a limited composition range as follows:

SiO_2	66.0 to 75.0%
R_2O_3	1.0 to 7.0%
CaO + MgO	9.0 to 13.0%
Na_2O	12.0 to 16.0%

Supplement to 2.1. Liquid

"Non-caking and free-flowing." A moisture content of less than 0.5% by weight would probably be necessary to meet the free-flowing characteristic of a cullet which is predominately of small particle size (-16 U.S. series mesh).

Source: John Mitchell, "Opportunities for Source Separated Materials," Solid Waste Management Board, California, 1978.

*Information taken from Southern California Urban Resource Recovery Project Appendix 2B, Product Identification Market Research and Analysis.

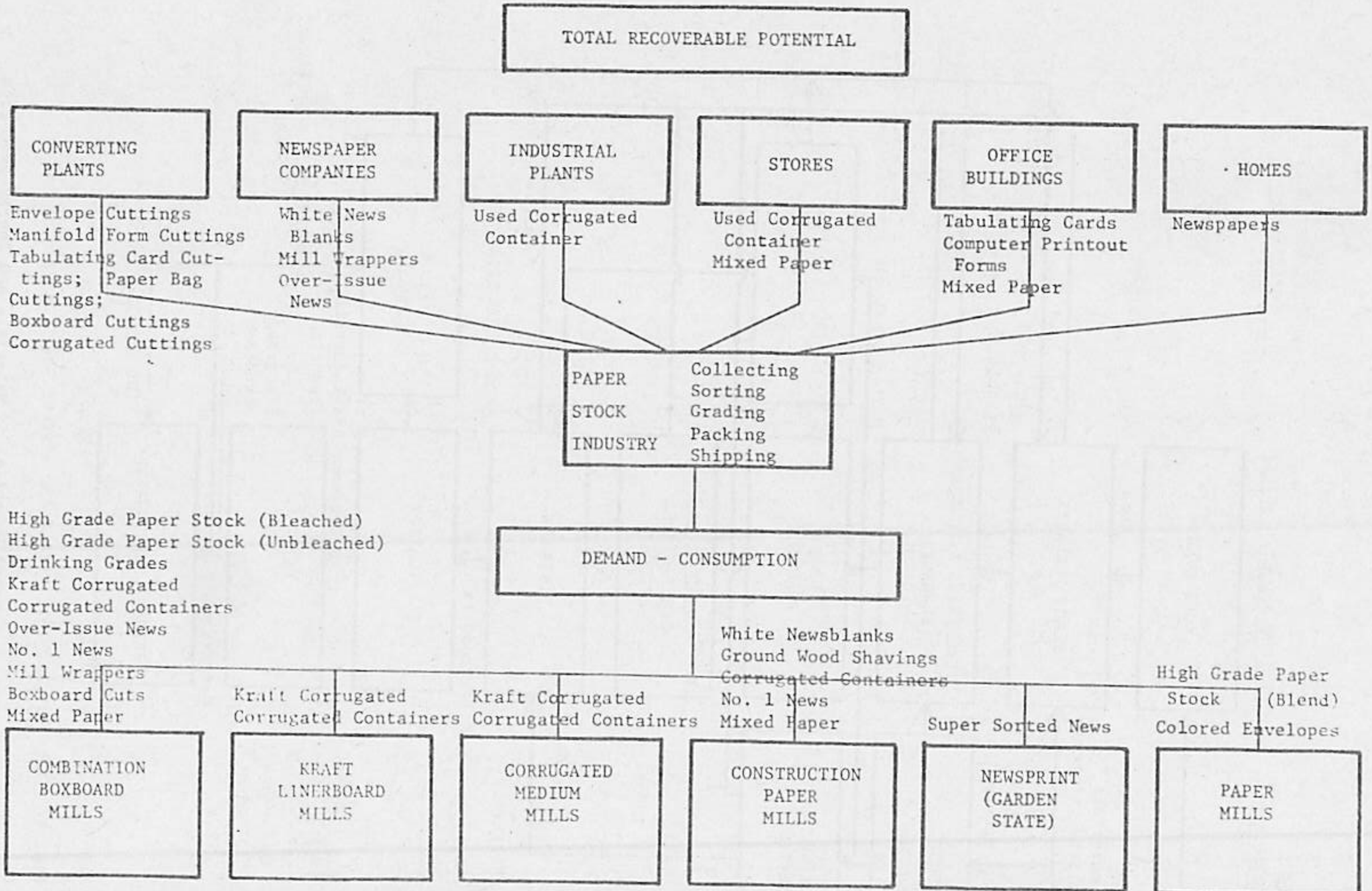

Fig. 3. The Paper Recycling Situation as It Exists in the Bay Area of California

source: Luis F. Diaz, et al. "Market Potential of Materials and Energy Recovered from Bay Area Solid Wastes," College of Engineering, Univ. of Calif., Berkeley, 1976, p. 50.

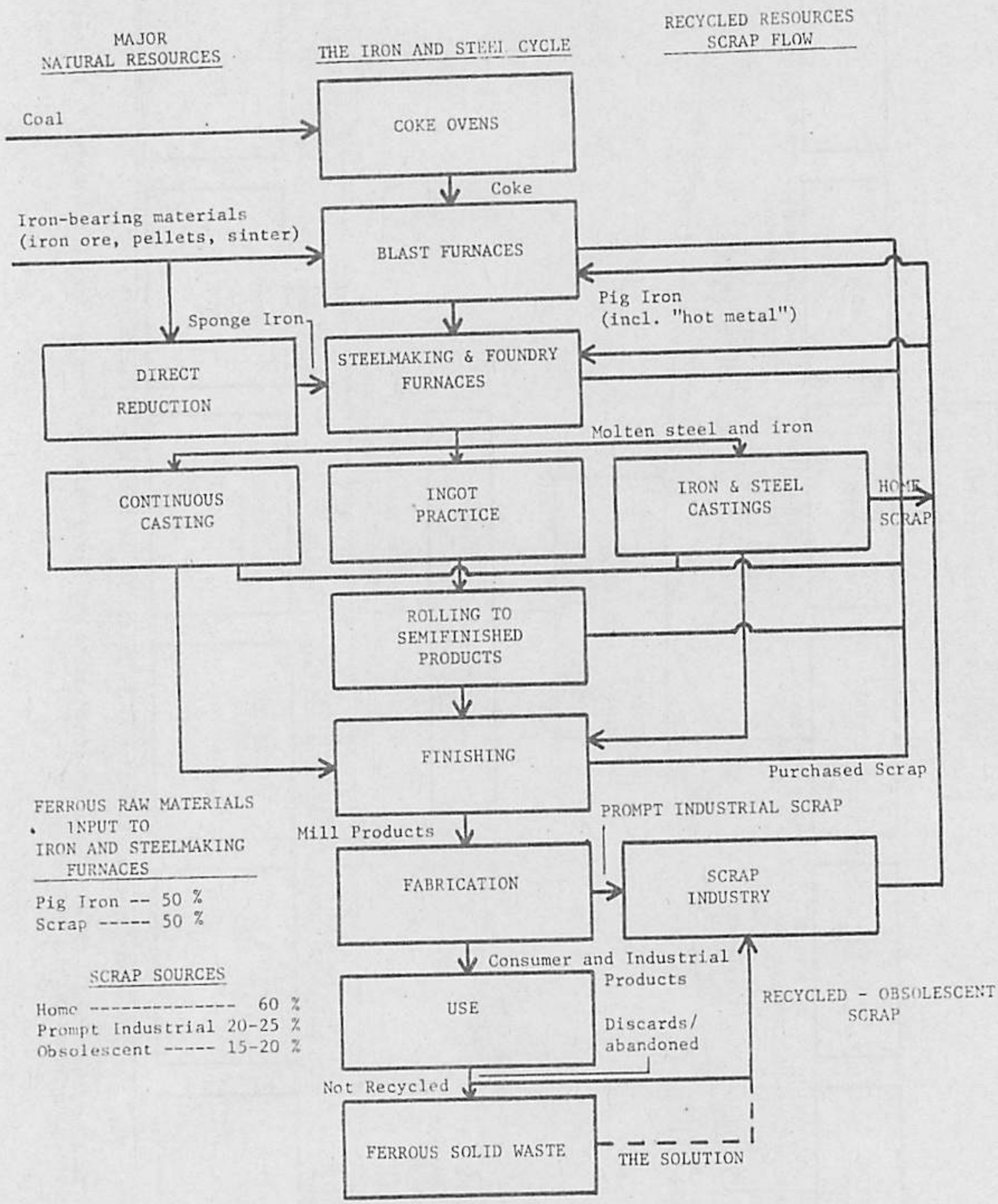

Fig. 4. THE IRON AND STEEL CYCLE AND FERROUS SOLID WASTE

source: Louis F. Diaz, et al., "Market Potential of Materials and Energy Recovered from Bay Area Solid Wastes," College of Engineering, Univ. of Calif., Berkeley, 1976, p.90.

Figure 5. Poster Issued by the Paper Stock Conservation Committee to Aid Handlers in Reducing Contamination in 1975.

Source: "Waste Paper Recycling," Paper Stock Conservation Committee (New York: American Paper Institute, Inc., 1975).

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