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6 ❖ RECYCLING

Recycling, the process by which materials otherwise destined for disposal are collected, processed, and remanufactured or reused, is increasingly being adopted by communities as a method of managing municipal waste. Whether publicly or privately operated, a well-run recycling program can divert a significant percentage of municipal, institutional, and business waste from disposal and can help to control waste management costs by generating revenue through the sale of recyclable materials. Public support for establishing recycling programs continues to grow and some states now require communities to recycle.

Successful recycling is not guaranteed, however. Program managers must give special attention to making the program economically efficient and maximizing public participation. Establishing an effective recycling program presents a major administrative and political challenge to a community. In successful programs, procedures are continually reviewed and adjusted according to changing conditions.

Program managers should continually strive to provide a consistent stream of high-quality (free of contaminants) recovered materials that meet the standards of the marketplace.

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6 HIGHLIGHTS

Program design and revision are ongoing efforts.
(p. 6-1)

Establishing an effective recycling program presents major administrative and political challenges to a community. In successful programs, procedures are continually reviewed and adjusted according to evolving conditions and changing community needs.

Design programs as coherent systems that involve the public in every step.
(p. 6-6)

An efficient recycling program requires a systems approach—all program components are interrelated; decisions about one must be made with other components in mind. Successful recycling also requires enthusiastic public participation, and programs must be designed with public convenience and support in mind.

This 12-component plan provides an outline for successful program design.
(p. 6-7)

Following a sequential approach can ensure adequate planning and successful program implementation.

1. Identify goals.
2. Characterize recyclable volume and accessibility.
3. Assess and generate political support.
4. Assess markets and market development strategies for recyclables.
5. Assess and choose technologies for collection and processing.
6. Develop budget and organization plan.
7. Address legal and siting issues.
8. Develop start-up approach.
9. Implement education and publicity program.
10. Commence program operation.
11. Supervise ongoing program and continue publicity/education.
12. Review and adjust program.

Successful marketing of recyclables requires

- **accurate market knowledge**
- **shared decision making.**

(p. 6-13 — 6-16)

Securing stable, reliable markets requires (1) basing marketing decisions on a clear understanding of the recyclables market system, and (2) sharing decision making among recycling program planners, government officials, the public, and the private sector. Assessing markets involves the following:

- *Identifying buyers:* Names, phone numbers and addresses are available from state recycling offices (many produce recycling markets directories).
- *Contacting buyers:* Ask about the price they will pay, specifications for how the materials must be prepared, and amount of contamination that is acceptable.
- *Selecting buyers:* The buyer's abilities must closely match the recycling program's needs. Some program planners interview prospective buyers.
- *Contracting with buyers:* A written contract specifying what is expected of all parties should be made. During market downturns some buyers will only service customers who have contracts.

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Understanding current U.S. and foreign market trends is crucial.
(p. 6-16 — 6-17)

Successful marketing requires an understanding of current trends and changes in domestic and foreign markets. Current trends include the following:

- More communities are developing MRFs (materials recovery facilities).
- Expanding and adding new recyclers as intermediate processing services is becoming more common.
- The improving quality of recyclables makes processing larger quantities more cost-effective and serving markets at greater distances possible.
- Export markets for recyclables are expanding, and direct marketing strategies for exporting recyclables are helping spur the expansion.

Several options for market development can be pursued.
(p. 6-17 — 6-24)

Market development requires balancing supply of recyclables with demand for products made from them. This chapter discusses the following strategies and tools:

- legislative options
- economic incentives
- technology developments and improvements
- transportation networks
- business development
- education strategies
- cooperative marketing.

Program design will be based on answers to these questions.
(p. 6-24)

- What form will the waste be in when it is provided to the collector?
- How will the waste be collected?
- What type of processing/storage facility is best?

Several options exist for preparing recyclables for collection.
(p. 6-24 — 6-28)

Many options exist for preparing recyclables for collection—individual community needs and circumstances determine which is appropriate. These options include the following:

- residential drop-off centers
- residential buy-back programs
- curbside collection
- source separation
- mixed waste collection
- wet/dry collection.

6 ❖ HIGHLIGHTS (continued)

Options for collecting recyclables include both public and private collectors.
(p. 6-30 — 6-32)

Options for collecting recyclables may include the following:

- using existing public sanitation workers for waste and recyclables
- using private haulers for recyclables only
- using private haulers for waste and recyclables.

Inner cities and multiple-family dwellings have special collection needs.
(p. 6-33)

Inner-city neighborhoods and multiple-family dwellings pose special problems; education programs and buy-back centers may improve participation.

Processing and storage centers can benefit both small and large communities.
(p. 6-33 — 6-34)

Small communities or groups of communities may develop small drop-off centers that feed a larger processing facility (see Figure 6-7); each small community, then, benefits from a convenient, low-cost collection point and the economies of scale that a large facility provides.

To manage large urban recycling programs, many communities use MRFs (material recovery facilities), which process large volumes of material in the most efficient and cost-effective manner.

MRF designs must consider
- **space needs**
- **safety**
- **accessibility.**

(p. 6-33 — 6-34)

There are three crucial considerations in designing a MRF:

- The site must accommodate buildings, traffic and storage.
- Layout and equipment must facilitate efficient and safe materials processing, movement, and storage in compliance with local building codes.
- Design must allow efficient and safe external access and internal traffic flow.

Program organization and budgets.
(p. 6-44 —6-46)

Organization: To be successful, every recycling program must be run like a business, rely on trained personnel, and have an institutionalized structure within the community. Programs can be purely public (run by public works departments and city councils), public and private (run by sanitary district or recycling commission), or purely private (nonprofit or for profit).

For any program, a paid manager and staff with broad business and organizational skills is necessary.

Budget: The budget should estimate personnel, equipment, building, and other expenses; indicate capital and operating costs for a MRF or collection center; and predict revenues and other sources of income (see Table 6-14).

Financing: Revenue from the sale of recyclables may be inadequate to cover all program costs. Most communities budget additional tax monies or develop alternative strategies for program financing.

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Program planners must address legal and siting issues. (p. 6-45 — 6-48)	Resolving legal and siting issues during the planning and implementation process is crucial. Overlooking a legal requirement can halt the entire project if a legal challenge arises. Five categories of legal/siting issues are discussed: • zoning and land use considerations in siting • permits • contracts • general business regulation • ordinances.
"Start-up plans" help communities adjust to new programs. (p. 6-48 — 6-49)	All new recycling programs involve major changes in the way citizens handle waste; a start-up plan is, therefore, a must. Communities can start with a voluntary or pilot program, and use information and experience gained from it to plan for a larger-scale recycling program.
Program options can be evaluated during pilot programs. (p. 6-49)	In these programs, materials are collected using prescribed methods for a set period of time; the program's efficiency is then evaluated. Such programs allow communities to test the appropriateness of different strategies to meet their needs.
Starting with a voluntary program helps education. (p. 6-49 — 6-50)	Voluntary programs allow an educational period in which the benefits and strategies of a recycling program are taught. A subsequent change to a mandatory program will be more easily accepted and complied with.
Education and publicity programs should be ongoing efforts. (p. 6-51 — 6-52)	The long-term success of any recycling program depends on public participation. Citizens and local officials must be constantly reminded of the environmental, economic, and social reasons for reducing landfill waste. Program publicity, promotion, and education must be ongoing.

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6 ❖ RECYCLING

DEVELOPING A RECYCLING PROGRAM: A SYSTEMS APPROACH

In cost-effective and efficient programs, decisions are made with all other program components in mind.

Designing an efficient recycling program requires a systems approach. Decisions about collecting, marketing, and processing recyclables are interrelated. Making a decision about one component of a recycling program without taking into account the impact of that decision on other components may lead to an inefficient and overly expensive program, prone to public criticism and meager participation. Since the public (citizens, families, and businesses) must be relied on to participate by separating a high percentage of uncontaminated recyclable materials, the program must be designed with public convenience and support as a primary objective.

To ensure success, a community recycling program must be developed in a coordinated fashion. First, communities should decide which materials will be recycled. This decision should be based on an analysis of the volume of the community's recyclable material that can be diverted to the recycling operation and the marketability and economics of handling such materials. Once it is known which materials will be collected and in what volume, decisions can be made concerning how to collect the material, what processing will be needed, and how much processing and storage space will be required. The needs of potential buyers will help determine what types of equipment for processing and storage will provide better marketability.

A well-designed recycling operation should have minimal environmental impacts. However, as with any material processing operation, land use and siting issues must be considered and any conflicts resolved. Significant effort must also be made to operate the facility as a good neighbor and keep nuisance conditions, such as noise, from developing.

Finally, a recycling program must be designed to meet the requirements of state recycling legislation. This chapter discusses the key issues involved in developing and operating a recycling program. Steps and procedures are explained within the context of a system with interrelated components.

USING EXISTING RESOURCES

Drawing on local resources can save time and money.

Carefully evaluate what local public and private sectors can offer.

In many communities, private businesses or public agencies may be able to provide the services necessary for planning and implementing a recycling program. For example, a local hauler may own or have access to an existing recycling processing facility, which would eliminate the need for the community to provide its own processing capability. Similarly, recycling consultants can provide expert planning advice, which is especially important for small communities lacking environmental or public works staff.

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The extent of outside involvement will depend on community resources and goals and the availability of qualified service providers. The inefficiency and cost of duplicating services should also be considered. The community must make an effort to develop an effective program, but may not need to perform every task internally. Recycling often provides an excellent opportunity for developing partnerships between the public and private sectors.

Cooperative Recycling

Cooperation among communities can benefit a recycling program, and opportunities for such cooperation should always be pursued. Processing recyclable materials from more than one community creates economies of scale for equipment purchase and program administration. Joint marketing of recyclable material can enhance marketability by increasing the volume of material available to buyers.

DESIGNING AND IMPLEMENTING A RECYCLING PROGRAM

Decision making should be well organized and coordinated.

Designing an effective recycling program requires a careful analysis of the variety of technical options available in light of the resources and goals specific to a community. Each community is unique; others can provide ideas, but each community or regional cooperative should develop its own program.

Community decision making should follow a coordinated process. Following a sequential approach reduces the likelihood of overlooking an essential issue or giving it insufficient attention. The long-term success of a program can be jeopardized by inadequate planning or poor implementation.

Regardless of whether or not state recycling legislation is in place, developing and implementing a recycling program should involve a 12-component process, which is outlined in Table 6-1. Components 1, 2, and 3 (identify goals; characterize recyclable quantity, composition and accessibility; assess and generate political support) focus on gathering information and developing the political base needed to determine the scope of the program; they are addressed in detail in Chapters 1, 2, and 3.

Components 4 through 8 (discussed in this chapter) focus on markets and the technical details of the program. Components 9 through 12 (also discussed in this chapter) address implementing the program in the community. By following this systematic approach, program managers will improve the likelihood of program success.

Table 6-1
A 12-Component Recycling Program Plan

1. Identify goals.
2. Characterize recyclable quantity, composition, and accessibility.
3. Assess and generate political support.
4. Assess markets and market development strategies for recyclables.
5. Assess and choose technologies for collection and processing.
6. Develop budget and organization.
7. Address legal and siting issues.
8. Develop start-up approach.
9. Implement education and publicity program.
10. Begin program operation.
11. Supervise ongoing program and continue publicity and education.
12. Review and adjust program.

Source: P. Walsh. 1993. University of Wisconsin–Extension, Solid and Hazardous Waste Education Center

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Assess Markets and Market Development Strategies for Recyclables

It is frequently said that the ultimate success of recycling depends on stable, reliable markets for recyclables. Unless a community has markets for the materials it collects, it may end up temporarily storing some materials and later landfilling some or all of them. If citizens are asked to separate materials for recycling and some are subsequently landfilled because markets are depressed or nonexistent, a negative political backlash may result; community support for recycling could fall and the program may be jeopardized. Unless state law requires that certain materials be collected, it may be wise to start by collecting only readily marketable materials for the community collection program.

Securing stable, reliable markets for recyclables is a twofold process. First, it requires marketing decisions based on a clear understanding of the infrastructure of recycling. Second, it demands that recycling program planners, government officials, and the public share responsibility with the private sector in adopting and implementing market development strategies.

STRUCTURE OF THE RECYCLABLES MARKET

The following sections discuss recycling markets and market development strategies from domestic (U.S.) and global perspectives. They also discuss recycling markets and market development trends currently being used and studied, as well as potential barriers to those techniques. After reviewing these sections, the reader should understand how local marketing and purchasing decisions affect, and are affected by, the global marketplace.

Competing in the global recyclables market requires knowledge of handling strategies and their changes.

The tonnage of municipal solid waste recovered for use by U.S. and export markets has increased dramatically over the past several decades. According to the USEPA, almost 6 million tons of materials were recycled in 1960. That figure grew to nearly 30 million tons by 1992. The amount of recyclables available to markets is expected to increase even faster in coming years as recycling programs around the country continue to grow. These significant growth rates will require accelerated attitudinal changes that recognize recyclable materials not as waste, but as raw materials or feedstock for industries with a great potential to affect local, national and international commerce.

Recycling collection and marketing are not new phenomena. Recyclables have been collected from non-municipal sources, especially industry, for a very long time, exceeding one or two hundred years in some cases. Thus, the tonnages of materials separated for recycling are higher from these sources. Table 6-2 reports the 1992 tonnages of recyclables collected from all sources (for which data are available) and marketed to domestic and export users. As shown, nearly 1 billion tons of materials were collected.

Table 6-2
1992 Tonnages of Selected Recyclables

Category	Export Market	Domestic Market
Scrap Paper and Paper Products	6,448,000	27,299,000
Metals: Ferrus/Nonferrous	10,563,000	52,378,000
Plastics	202,000	401,000[1]
Glass[2]	n/a	n/a
Total	17,213,000	80,078,000

[1] *Includes tonnage of bottles only.*
[2] *Tonnages of recovered glass are not tracked.*

Sources: *Resource Recycling*, April 1993; *Scrap Processing and Recycling*, May/June 1993

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As the quantity of recyclables increases, it will affect the established material-handling network for recyclables in the United States. An understanding of existing material-handling strategies and probable changes to these strategies is important to recycling program planners who want to remain competitive in this emerging global marketplace.

Market Structure

Markets link buyers and sellers for a particular good.

A market is an institution that serves as a link between buyers and sellers of a particular good. In recycling, the market infrastructure includes two tiers: intermediate markets and end-use markets. Intermediate markets are commonly categorized as collectors, processors, brokers, and converters. End-use markets use recovered material as feedstock to manufacture a new product. Companies can serve one or more of these functions simultaneously.

Collectors/Haulers

Collectors are companies that collect recyclables or are waste haulers who have expanded their business to include collecting recyclables from residents and businesses. Most collectors accept unprocessed recyclables, either source-separated or commingled. These materials are commonly marketed to another intermediate materials handler or domestic market; collectors usually do not export materials.

Processors

Processors accept and modify recyclables from residential or business sources by sorting, baling, crushing, or granulating. Processors include local, private buyback centers, and privately or publicly operated material recovery facilities (also referred to MRFs, pronounced "murf"). These buyers sell to other intermediate buyers or domestic end-use markets and do not generally use export markets. Processors may be material-specific (e.g., processing mixed paper into various goods).

Brokers

Brokers can switch materials from one market to another, depending on demand and other factors.

Brokers buy and sell recyclable materials, often arranging to have them shipped from one location to another by collectors or processors. The broker receives a fee for this service. Depending on the situation, some brokers provide processing services, while others only move preprocessed recyclables. Brokers generally sell to converters or to end-use markets and commonly export materials to foreign countries. The advantage of brokering is that brokers have a variety of markets available to them and can switch materials from one market to another depending on demand and other factors. Sometimes brokers are able to quickly market a slightly contaminated load for a lower price through other market contacts. Brokers may require all materials collected to be marketed through them so that they receive the more lucrative materials as well as materials with higher levels of marketing risk.

Converters

Converters are companies that take recyclable materials in a raw form and alter them so they are readily usable by a manufacturer. An example of a converter is a company that produces pulp from paper; the pulp is then used by a paper mill.

End-Use Markets

End-use markets are public- or private-sector entities that purchase recovered materials from a number of sources and use those materials as feedstock to manufacture new products. Although historically the majority of private-sec-

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With direct marketing to end users, communities can avoid market price swings and benefit local manufacturers.

tor markets for U.S. recyclables were in this country, export markets are becoming stronger. Communities may want to market some materials directly to end-use markets. Although direct marketing eliminates the need to pay a broker, the community assumes the risk if the buyer rejects a slightly contaminated load and there is no alternative market readily available. If, however, a community has a well-run program producing high-quality recyclable material, direct marketing can work well. Many communities around the country have established lucrative and stable markets by direct marketing baled newsprint for newsprint. Direct marketing to end users can relieve the community of broad swings in market prices and provide benefits to local manufacturers. As with any product, local marketing must be carefully developed and the materials' value well publicized.

Transportation Companies

Transportation companies nationwide are developing strong business relationships with a variety of industries that market products made from recyclable materials. These transport businesses may be able to guarantee to the community that materials collected by the hauler will be marketed by the hauler. The community and the hauler should negotiate issues such as who will own the recyclables and who will receive revenue for the materials sold. Often communities and haulers share risks and benefits by agreeing to split revenues.

Material-Specific Market Structure

The list of potentially recyclable materials is long, and it continues to grow as technological developments enable more materials to be recycled into more products. To simplify a discussion of these commodities, the list of materials can be grouped into five major categories of postconsumer recyclables: paper, glass, plastics, scrap metals, and waste tires.

Paper

Recovered paper and paper products are bought and sold through well-established local processors and brokers who sell to domestic and export paper mills.

Recovered paper and paper products are bought and sold through a well-established network of local processors and brokers who typically bale these materials for sale to domestic and export paper mills. Increasingly, mills are also buying directly from collectors as well. Table 6-3 presents tonnages of wastepaper recycled by domestic and export markets in 1992. Paper and paperboard represented a significant contribution to export trade in the 1970s, when fiber-poor nations like Japan and South Korea began to add new papermaking capacity and the output of Scandinavian countries (once leading ex-

Table 6-3
Waste Paper in Thousand Tons, 1992

Grade	Domestic Use[1]	Export	Total
Newspaper	5,856	1,285	7,141
Corrugated grades	12,614	2,765	15,379
Mixed grades	3,145	875	4,020
High grades	5,684	1,490	7,174

1. Consumption by U.S. paper and paperboard mills, including producers of molded pulp and other products.

Source: American Forest and Paper Association, 1993

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porters) began to decline. Recovered paper is classified as newsprint, corrugated cardboard, mixed paper (including magazines, junk mail, and boxboard), high-grade de-inking (white office paper), and pulp substitute (usually mill scrap).

The paper industry has set a recovery goal of 40 percent by 1994. The current recovery rate is 38 percent.

Paper mills, the most common end users of recovered paper, use the material as a feedstock to manufacture recycled paper and paper products, such as newsprint, chipboard, kraft linerboard, corrugating medium, and tissue products. Other uses of recovered paper include roofing felt and chipboard. Shredded paper can be used to make animal bedding, hydromulch, molded pulp products, and cellulose insulation. The paper industry is making a significant investment in manufacturing capacity for making paper and paper products with recycled content, and has set a recovery goal of 40 percent by 1994. The current recovery rate is 38 percent.

Foreign mills continue to add recycling capacity as well. In fact, the rate of growth in the export of recovered paper has exceeded domestic growth, due in part to the tremendous economic growth and prosperity in the Pacific Rim nations. From 1970 to 1986, the American Paper Institute (now called the American Forest and Paper Association) estimated that U.S. exports of wastepaper rose from 408,000 tons to 3.75 million tons, an increase of 818 percent in just 16 years. Furthermore, it should be noted that fiber-poor countries like Japan and South Korea have some of the most advanced paper-making mills in the world; hence exports of wastepaper should continue to surpass the growth rate of domestically remanufactured paper.

Glass

Glass manufacturers purchase glass containers recovered in the United States for reprocessing into new clear, green, and brown glass jars and bottles. The majority of recovered glass is remanufactured in this country. According to the Glass Packaging Institute and representatives from Owens-Brockway, a small percentage is exported from west-coast and northeast states to Canada and Mexico. Glass is typically broken for size reduction or crushed into cullet and ultimately sold to glass manufacturers as furnace-ready cullet after metal caps and rings, labels, and other contaminants are removed. The glass industry has pledged to increase the percentage of cullet in its manufacturing operations from the present rate of 31 percent up to 70 or 75 percent, given consistent supplies. Alternative markets for glass include glassphalt, art glass, sandblasting, and from postindustrial window pane glass, fiberglass insulation. The state of California recently passed legislation mandating the use of postconsumer container glass in fiberglass insulation.

Recovered glass markets allow very little contamination. Recycling program planners must address this concern for high-quality recovered glass and other commodities.

Markets for recovered glass have been strong and stable for brown and clear containers. Green glass, however, is seldom used to package goods domestically, so fewer companies produce this color and demand is more sporadic. Although the glass industry has made a commitment to increase the demand for recovered glass overall, there is an important and pervasive market concern about the quality of material being produced by collection programs and at processing facilities. Recovered glass markets usually require very little contamination. Recycling program planners must address this concern for high-quality recovered glass as well as for other commodities.

Plastic

Postconsumer plastic-resin recycling technology has developed more rapidly than technologies for any other recovered material in the last half century. (Note that *postindustrial* plastics have been successfully recycled for years.) Whereas only five to ten years ago postconsumer high-density polyethylene (HDPE) and polyethylene terephthalate (PET) plastics were vaguely considered recyclable, these two resins, especially HDPE milk jugs and clear PET

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plastics, now hold a stronger place in the market. However, according to many in the plastics industry, the outlook for colored PET and HDPE is uncertain because demand is presently not keeping pace with supply. The recyclability of other resins, such as polystyrene, polyvinyl chloride, low-density polyethylene, polypropylene and mixed plastic resins is making strides but much remains to be done. Table 6-4 provides data on plastics recycling from 1990 to 1992.

The market structure for plastics is the least developed among recyclables because of the recency of recycling capabilities.

The market structure for plastics is the least developed among recyclables because of the recency of recycling capabilities. However, most plastics are densified locally by flattening, baling, or granulating, and sold either to converters, where the resins are turned into pellets, or directly to domestic or export end users for remanufacture into such products as soda bottles, lumber, carpet and carpet backing, flower pots, and insulation.

Metals

Ferrous and nonferrous metals have been bought and sold through a well-established network of processors and brokers and shipped to domestic and export markets throughout the last century. With few exceptions, this long-standing track record makes ferrous and nonferrous metal markets among the most stable of the recyclable materials. Ferrous scrap includes autos, household appliances, equipment, bridges, cans, and other iron and steel products. Nonferrous scrap metals include aluminum, copper, lead, tin, and precious metals.

Ferrous and nonferrous metals can be prepared for sale through some combination of processing by flattening, baling, and shredding.

Both ferrous and nonferrous metals can be prepared for sale to markets through some combination of processing by flattening, baling, and shredding of the material. In some cases, processors melt the metal into ingots before selling it to end-use markets. Concern over polychlorinated biphenyls (PCBs) in capacitors and chlorofluorocarbons (CFCs) in appliance cooling systems has caused changes in appliance handling systems since the late 1980s and may continue to do so for some time.

The development in 1988 of the Steel Can Recycling Institute, now called the Steel Recycling Institute, has helped strengthen demand for postconsumer steel cans. Since that time, several foundries and steel mills have begun or expanded recycling efforts; steel mini-mills also appear to be increasing their use of recovered steel in regions which typically lack large mills. However, the strength of the postconsumer steel can market will vary regionally into the future.

Tires

Tires represent a special challenge to solid waste and recycling program managers.

Tires represent a special challenge to solid waste and recycling program managers. In the past most tires were retreaded, but with the advent of steel-belted radials and cheaper new tires, fewer tires are being retreaded.

Table 6-4
Plastics Packaging Recycling: 1990-1992 (in millions of pounds)

Item	1990	1991	1992
PET	226.7	292.8	402.1
HPDE	160.2	277.2	416.7
LDPE/LLDPE	42.5	41.8	63.5
PS	12.9	23.9	31.6
PVC	1.5	1.6	10.2
PP	0.4	5.2	15.2

Source: R.W. Beck and Associates, 1993; *Plastics News*, July 5, 1993

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Scrap tire recycling and disposal has tripled from 1990 to 1992 and may exceed the annual supply of scrap tires generated by 1997.

In the United States, recycling and disposal of scrap tires has tripled from 1990 to 1992 and is expected to exceed the annual supply of scrap tires generated by 1997.

The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 requires states to meet minimum utilization requirements for asphalt containing recycled rubber in federally funded transportation projects; states not meeting the minimum requirements will lose a portion of the federal highway funding. By 1994, 5 percent minimum recycled rubber content is required, rising to 20 percent by the year 1997.

As Figure 6-1 shows, using chipped or shredded tires as a fuel source is also growing. Electricity-generating facilities, pulp and paper mills, and cement kilns are the most common processes using these scrap tires.

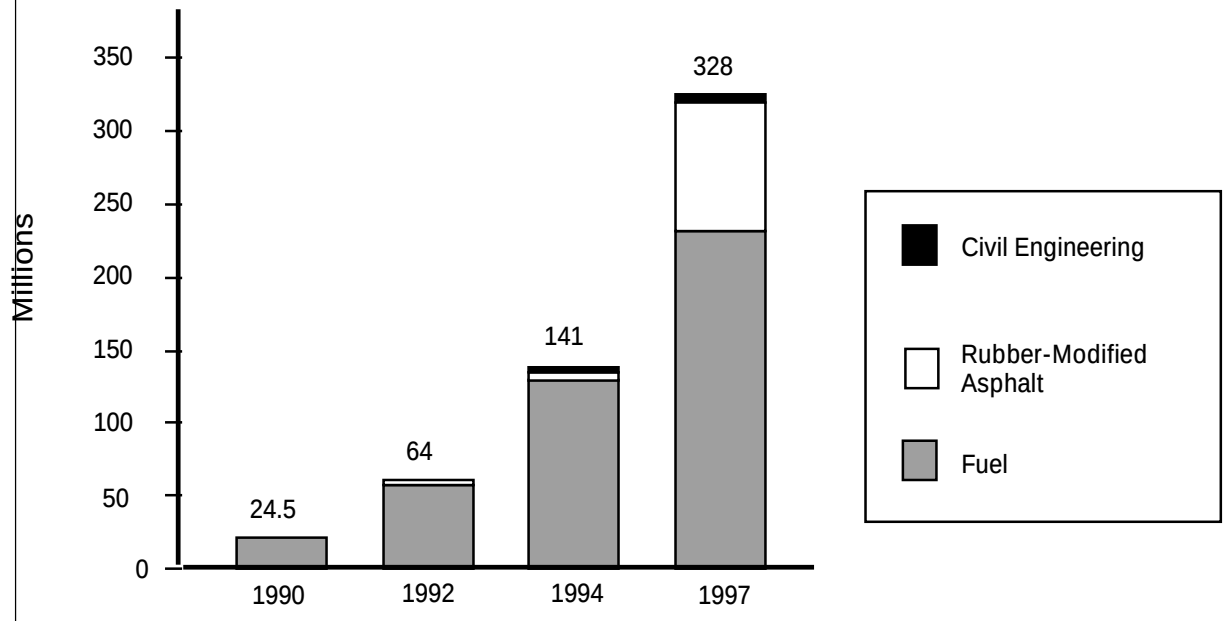
ASSESSING MARKETS

Over time, the ability to consistently sell materials to a buyer may be more important than the price they offer.

When assessing markets for recovered materials remember that, over time, the ability to move materials to a buyer on a regular basis may be more important to the success of the program than the price paid. Developing a relationship with a buyer who will attempt to provide a stable market for customers during poor market conditions is essential to the success of the program. Some communities sell to "spot" markets, jumping from buyer to buyer depending on which company is giving the best price at the time. While this method may increase revenues in the short run, a community with no loyalty to its buyers can expect no loyalty in return from its buyers during downturns in the market. For the marketing of most materials, communities are better served by establishing long-term relationships with reputable buyers.

There is no simple way to determine the best market situation for a given material. This task requires a four-step process which includes identifying, contacting, selecting, and contracting with buyers.

Figure 6-1
Uses of Scrap Tires



Source: Scrap Tire Management Council 1992

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Identifying Buyers

For each commodity, a range of available buyers must be identified and contacted.

For each commodity under consideration, a range of available buyers must be identified and contacted. This is tedious but extremely important work. There are numerous methods for finding out which buyers might be willing to purchase or accept your recyclables. Three common methods which have proven successful include company phone calls, visits, and requesting written information or proposals from potential buyers.

The names, phone numbers, and addresses of recycling buyers willing to provide service to communities can be found in a number of places. Many state recycling offices produce a recycling markets directory which can be obtained at little or no cost. Other sources of market information include talking to other recycling program operators, or contacting national industry organizations, such as the American Forest and Paper Association, the American Plastics Council, or the Steel Recycling Institute, as well as privately produced recycling market listings. Names and addresses for these contacts are included in Table 6-5.

Sufficient time and resources should be devoted to identifying markets.

Sufficient time and resources should be devoted to identifying markets for recovered materials. In communities without recycling coordinators or solid waste managers, the task of collecting market information may best be assigned to a committee, with each committee member agreeing to obtain information for a given material. By dividing up the work, the information can be collected efficiently, without burdening any individual.

Contacting Buyers

Know the specifications for presenting the material to the buyer and the acceptable degree of contamination—cleaner materials are more valuable.

When each potential marketing representative is contacted, in addition to asking what price the marketer is willing to pay for the material, other essential information should be solicited. Most important are specifications for how the material must be presented to the buyer and what degree of contamination

Table 6-5

Selected Organizations Providing Market Listings (free of charge)

Glass

Glass Packaging Institute
1801 K Street, NW, Suite 1105L
Washington, DC 20006
202/887-4850

Plastics

American Plastics Council
1275 K Street, NW, Suite 400
Washington, DC 20005
800/2HELP-91

Paper

American Forest and Paper Association's
"PaperMatcher"
260 Madison Avenue
New York, NY 10016
800/878-8878

Metals

Aluminum Association
900 19th Street, NW, Suite 300
Washington, DC 20006
202/862-5100

Steel Recycling Institute
Foster Plaza 10, 680 Anderson Drive
Pittsburgh, PA 15220
800/876-SCRI

General Information

Institute of Scrap Recycling Industries
1325 G Street, NW, Suite 1000
Washington, DC 20005
202/466-4050

Most state recycling agencies maintain a markets directory. Also, statewide nonprofit recycling organizations often perform a similar service.

NOTE: This listing is not intended to be comprehensive. Inclusion on this list does not indicate an endorsement by the USEPA or the document's authors.

Source: M. Kohrell. 1993. University of Wisconsin–Extension, Solid and Hazardous Waste Education Center

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(i.e., foreign material) is acceptable. In the case of newsprint, many marketers will pay a different price depending on whether the material is baled or loose. Also, material that is wet from rain or snow or discolored by the sun may be unacceptable to the buyer. In general, the cleaner the material, the more valuable it is, both in terms of price and marketability. Information concerning price and specifications will determine other program components such as storage space needed and whether processing equipment needs to be purchased. These are important decisions with potentially significant financial impact and they should only be made with complete information. As market competition increases, those recycling programs able to effectively and regularly meet buyers' specifications will be assured a more secure and stable market for the collected materials.

As competition increases, programs meeting buyers' specifications will have more secure and stable markets.

Transportation costs are extremely important in the economics of recycling, so company representatives should be asked whether buyers will provide transport for collected materials or whether the materials must be delivered. If the buyer will provide a vehicle to collect recyclables, it is important to clarify who pays for the hauling, what tonnage is required, and who loads the collection truck. Some marketers will provide containers, such as semitrailers or Gaylord boxes (heavy corrugated boxes open at the top, measuring 4 feet by 4 feet by 4 feet) for storage, and will pick up the materials when a full semitrailer load is collected. Some buyers will also have equipment to process the materials and will recover these costs by paying a lower price for the materials. If the buyer does not provide transportation services, recycling program planners must make arrangements with an alternative hauling service.

Transportation costs are extremely important, so ask company representatives if buyers will provide transport if materials must be delivered.

It is important to determine whether marketing representatives will pay higher prices for higher volumes of materials. Often, if a buyer can be guaranteed a high volume of quality recyclable material on a regular basis, the buyer will pay a premium price. Likewise, communities should determine whether there are minimum quantities that the market will accept.

Market representatives should also be asked to provide references for other programs they have serviced. Also, discuss buyers' reputations with other recycling programs in the area. Ask about buyers' track records for providing prompt pick-up and payment, how well they adhere to contracts they have signed, how long they have been in business, and their financial viability.

Check references and past records of buyers and market representatives.

The revenue offered or charge assessed by a potential buyer should only be considered in relation to the criteria discussed above; revenue cannot be considered as the only or most important criteria. Quoted prices can be compared with general price and trend information provided by industry publications. See Table 6-6 for a listing of price-tracking publications.

Selecting Buyers

The process of selecting buyers begins with evaluating information collected during the waste characterization effort. The objective should be to select buyers whose abilities most closely resemble the needs of the recycling program. Information gathered from potential buyers can be informally evaluated by a recycling employee or planning committee, or a formal evaluation process can be designed. Some recycling program planners schedule interviews with potential buyers to ask specific questions of each. The results are analyzed and the best buyers are selected. Another option is to establish a scoring system that assigns to each buyer a certain number of points based on a set of criteria. The buyers with the highest score are then selected.

Contracting with Buyers

Once buyers have been selected for one or more recyclables, an agreement is commonly negotiated so that each party (the seller and the buyer) knows what is expected of them. While many sellers and buyers have traditionally done

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business with a "hand-shake" agreement, a written buyer/seller agreement is necessary to protect the relationship with the buyer as competition for markets continues to escalate. Contracts can be particularly useful documents when markets take a downturn because buyers may only service customers with written contracts. Types of written agreements offered by buyers include letters of intent to purchase material and formal contracts.

Provisions included in a written agreement may include tonnage and volume requirements, material quality specifications, provisions for delivery or pick-up, termination provisions, length of commitment, and the pricing basis.

ANTICIPATED CHANGES IN U.S. AND EXPORT MARKETS

Many private recyclers have been in business for generations and understand all too well the intricacies of the recycling market. Conversely, involvement in operating a recycling program is, for the most part, a relatively new enterprise for the public sector.

Using MRFs and intermediate processing facilities is increasing nationwide.

A recent trend in the United States is the development of hundreds of processing facilities, called material recovery facilities (MRFs) or intermediate processing centers (IPCs), which accept commingled (mixed) recyclables and process them to market specifications. In early 1990, close to one hundred such facilities had been established; by the mid-1990s, more than a thousand could exist. These facilities are financed with public or private funds, and operation is provided by some combination of the public and private sectors. MRFs and IPCs provide large governments and groups of smaller governments with cost-effective mechanisms to control their own processing strategies, as well as an opportunity to sell materials directly to end-use markets.

A second trend is the expansion of existing capacity and the addition of new private recyclers to provide intermediate processing services. It is a re-

Table 6-6
Commonly Used Price-Setting and Tracking Publications

PAPER

Fibre Market News
GIE Inc. Publishers
4012 Bridge Avenue
Cleveland, OH 44113
216/961-4130
800/456-0707

Official Board Markets
"The Yellow Sheet"
1 E. 1st Street
Duluth, MN 55802
218/723-9355
800/346-0085

The Paper Stock Report
McEntee Media Corp.
13727 Holland Road
Cleveland, OH 44142
216/362-7979

PLASTIC

Modern Plastics
McGraw-Hill Publishers Co.
P.O. Box 602
Heightstown, NJ 08520
609/426-7070
800/257-9402

Plastics News
Crain Communications, Inc.
965 E. Jefferson Avenue
Detroit, MI 48207
313/446-6000
800/678-9595

METAL

American Metal Market
825 7th Avenue
New York, NY 10019
212/887-8560

Iron Age
Hitchcock Publishing Co.
191 S. Gary Avenue
Carol Stream, IL 60188
708/665-1000

MULTI-MATERIALS

Materials Recycling Markets
P.O. Box 577
Ogdensburg, NY 13669
800/267-0707

Waste Age's Recycling Times
5615 W. Cermak Road
Cicero, IL 60650
202/861-0708
800/424-2869

Most state recycling agencies maintain a markets directory. Also, statewide nonprofit recycling organizations often perform a similar service.

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Source: M. Kohrell. 1993. University of Wisconsin–Extension, Solid and Hazardous Waste Education Center

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sponse to two factors: (1) the growing number of municipal programs and retail businesses without the capability or desire to become involved in material processing, and (2) the need to consistently meet material quality specifications required by markets. Additional processing capacity will be particularly popular for commodities such as glass and plastics, for which tightening quality requirements make beneficiation necessary before the material can be used by the end-use market.

Selling materials to distant U.S. and foreign markets will become more commonplace.

Growth in the quantity of available recyclables will offer both the public and private sectors the ability to accumulate and cost-effectively process greater tonnages of these materials. This trend will allow materials to be transported to markets at greater distances than in the past. Thus, selling materials to distant markets in the United States and other countries will become more commonplace than is already the case in many locations. An analysis of export data for recyclables indicates that markets in Canada and Mexico are relying more heavily on U.S. recyclables as raw feedstocks than in years past. In addition to these two border countries, the Pacific Rim will continue to dominate the marketplace for west-coast exports. However, as European countries continue to increase their recovery rates, the United States will be forced to compete for Pacific Rim markets.

While private-sector brokers have historically marketed wastepaper and scrap metal to export markets, exports will include more materials, such as glass and plastic. In addition, big-city public-sector recycling staff near east- and west-coast ports of export, such as those in San Francisco, the Washington D.C. area, New York City, and Los Angeles, have made efforts to establish a rapport with export markets to explore the possibilities of direct marketing.

ASSESSING MARKET DEVELOPMENT INITIATIVES

Market development involves the attempt to create an even balance between the supply of recyclables and demand for products manufactured from those materials. Just as each recyclable material has unique marketing characteristics, so market development initiatives vary by material. Depending on the material, strategies can be demand-directed, supply-directed, require more stringent material specifications, or be a combination of two or more types of strategies.

Market development for recyclables involves balancing

- *the supply of recyclable materials*
- *the demand for products made from them.*

While material-specific actions are an important factor in market development, such actions need to be carried out in the framework of broader categories of market development tools. An understanding of strategies being undertaken at federal and state levels is important, along with knowledge of local activities that can favorably impact market development. This section provides information on seven categories of actions currently being undertaken by the public and private sectors at the national, regional, state, and local levels. It also suggests effective strategies to implement at the local level. After reviewing the information in this section, the reader should understand that a philosophy of "think globally, act locally," is essential to market development for recyclables and recycled products.

Legislative Options

Legislative activities being considered or undertaken by federal, state, and local governments to promote market development are a combination of supply-driven and demand-driven initiatives.

A study conducted for the U.S. Environmental Protection Agency by Franklin Associates Ltd. found that very few local and state recycling program managers know with any certainty the tonnage of recyclables being collected in those programs. Until a structured tracking system is in place, there will be a twofold problem: (1) recycling markets may hold back expansions until

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knowledge of guaranteed tonnages is available, and (2) the impact of additional quantities of recyclables on the marketplace cannot be projected.

Supply-side legislation, particularly mandatory recycling laws and disposal bans, was in effect in 39 states and the District of Columbia in 1992.

Supply-side legislation, particularly mandatory recycling laws and disposal bans, was in effect in 39 states and the District of Columbia in 1992. Twenty states require preparation of recycling plans, seven states and the District of Columbia mandate source separation of one or more materials, and 12 states take an intermediate approach. These laws included numeric recycling rates mandating that between 25 and 70 percent of state wastes be recycled, with deadlines ranging from 1991 to 2010. In many cases, local government goals surpass state-mandated levels.

The ability to guarantee private-sector processors and manufacturers reliable supplies of quality recyclables will promote market development. As local recycling program planners and government officials implement recycling programs, careful attention should be given to keeping detailed records for tracking the supply of each commodity sold to buyers. Tonnage information can be added to state and federal tracking systems, when they exist, to inform private-sector businesses of the supply they can expect. Local governments can also pass legislation mandating certain percentage goals or banning disposal of certain items.

Careful attention should be given to keeping detailed records for tracking the supply of each commodity sold to buyers.

Regulatory initiatives designed to encourage increased demand for recyclable materials include recycled content mandates, environmental standards, recycled product labeling laws, and requirements to procure recycled products.

Legislation mandating recycled content in consumer products has been popular in recent years. As a result of certain economies of scale attainable at the state level, the focus of such legislation has rested with state governments or coalitions of state governments. Table 6-7 shows that laws mandating recycled content in newsprint had been passed in at least 11 states by 1992. Recycled content mandates have also been passed for trash bags, glass containers, plastic containers, and telephone books, among other items. National organizations, such as the National Recycling Coalition and the American Society for Testing and Materials, have focused efforts on devising nationwide voluntary standards for recycled content in various products. Adoption of such standards aids manufacturers in making products that meet broadly accepted recycled content levels.

An environmental regulation related to demand for recycled products is the federal Food and Drug Administration's (FDA) prohibition against using recycled plastic resins in new food containers. Continued investigation into

Table 6-7
Examples of Recycled Content Mandates

	Newsprint	Glass Containers	Plastic Containers	Trash Bags	Telephone Books
Arizona	50.0% by 2000				
California	50.0% by 2000	65.0% by 2005			10.0% by 1993[1]
Connecticut	50.0% by 2000			30.0% by 1991	40.0% by 2001
Dist. of Columbia	40.0% by 1998				
Illinois	28.0% by 1993				
Maryland	40.0% by 1998				
Missouri	50.0% by 2000				
N. Carolina	40.0% by 1998				
Oregon	7.5% by 1995				
Rhode Island	40.0% by 2001				
Wisconsin	45.0% by 2001		10.0% by 1995		

1. The 10% goal applies to bags 1.0 mil thick; the 30% goal applies to bags .75 mil thick.

Source: National Solid Wastes Management Association, 1992; *Resource Recycling*, 1993

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safety issues by the FDA has opened this market avenue. Several companies have received certifications of "no objection" from the FDA to use recycled plastic content in food containers. For example, several companies are now manufacturing new PET soda bottles from recycled PET. While not a direct approval, this type of environmental regulation is a step toward improved markets for some materials.

Recycled-product labeling regulations can help create demand, but inconsistent state standards create interstate marketing problems.

Recycled-product labeling regulations can help to create demand for recycled products. However, different standards for such labeling in different states creates an inherently complex problem because most products are sold across state boundaries. The Coalition of Northeast Governors (CONEG) and the Northeast Recycling Council (NERC) organized ten states in an attempt to coordinate labeling efforts on a regional basis. Other notable, moderately compatible, actions have been taken by Rhode Island, New York, and California to define standards for labeling recycled products.

Government procurement of recycled products can affect the demand for such products.

It also serves as a positive example to consumers.

According to a study by the National Institute of Governmental Purchasing, state and local government purchasing makes up 12 to 13 percent of the nation's GNP. With this much purchasing power, government procurement of recycled products can indeed affect the demand for such products. In addition, procurement of recycled products by federal, state, and local governments can serve as a positive example to consumers. Several state purchasing programs provide cooperative purchasing programs that local governments and other public entities can access.

Virtually every state has legislation requiring recycled product purchase. Many states require certain percentages of recycled content; some allow for price preferences. Numerous local governments have laws with goals surpassing their states' laws. Printing and writing papers are often the focus of much of this legislation, since so much of it is used in the office setting. Cooperative purchasing agreements, mainly focusing on paper products, have been implemented by numerous multi-state entities.

USEPA has published procurement guidelines for purchasing several types of recycled products.

On May 1, 1995, the Environmental Protection Agency issued the "Comprehensive Guideline for Procurement of Products Containing Recoverable Materials" (CPG) (60 Federal Register 21370) and its companion piece, the "Recovered Materials Advisory Notice" (RMAN) (60 Federal Register 21386). The CPG designates 24 recycled-content products in seven product categories. The RMAN provides recommendations for purchasing the products designated in the CPG. Through use of these guidelines, the federal government hopes to expand its use of products with recovered materials, and to help develop markets for them in other sectors of the economy. By May 1, 1996, all government agencies and government contractors that use appropriated federal dollars to purchase the designated items will be required to purchase them with recycled content. For information, call the RCRA Hotline, 1(800) 424-9346.

There are several legislative mechanisms that local governments can use to positively influence the demand for recyclables. First, local governments can pass legislation showing voluntary or mandatory preference for products with recycled content. Governments can also effectively promote the use of recycled product labeling standards that are consistent with those at the state level. Finally, local governments can lead with their actions by adopting purchasing specifications that favor the purchase of recycled products, and following through on those specifications. A list of suggested methods for locating recycled product suppliers is included in Table 6-8.

Economic Incentives

There are economic benefits for using virgin materials in the U.S. that distort the value / cost of these materials. In some cases an advantage is given to virgin materials, for example, through depletion allowances in the tax code and tax credits for virgin materials. Altering these existing economic incentives might involve more readily providing recyclers with tax incentives, rebates, and grants and loans.

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Nearly half of all states offer some form of tax credits that can assist recycling.

Nearly half of all states offer some form of tax credits that can assist recycling. Property tax exemptions are provided for buying new recycling equipment in Indiana, Kentucky, North Carolina, Pennsylvania, and Wisconsin. Sales tax exemptions are given in Iowa, Illinois, New Jersey, and Wisconsin to help processors or manufacturers purchase new recycling equipment. Individuals and corporations in Oregon receive income tax credits for capital investments in recycling equipment and facilities; Arkansas, California, Maine, New Mexico, and Delaware also provide income tax credits. Tax-exempt bond financing for building processing and manufacturing facilities has been used by many local governments. Transportation tax credits or exemptions for carriers of recyclables are being used in Washington and Maine to help make hauling materials to market cost effective. Local governments can offer property tax exemptions to recycling-related businesses wanting to locate or expand locally. Another incentive is to sell or lease land or equipment to recyclers at no or low cost.

Approximately two-thirds of all states offer grants and loans to help improve recycling market economics.

Approximately two-thirds of all states offer grants and loans to help improve recycling market economics. Rebate programs to reimburse companies for the recyclables they use or the money invested in recycling equipment can be very effective market stimulators. In Wisconsin, manufacturers who use secondary materials can qualify for rebates of several hundred thousand dollars. Utah pays tire recyclers $21 per ton for tires made into new products or energy.

Grants, loans, and loan guarantees provide new or existing businesses with necessary capital at no or low cost. These incentives are quite popular with private industry. For example, grant programs in Minnesota, Michigan, New York, and Wisconsin will fund demonstration projects or established technologies. Indiana gives priority to the recycling industry for state economic development grants. Loans and loan guarantees—used in Minnesota, New Jersey, New York, Pennsylvania, and Vermont—can provide low-interest capital for businesses. Such loans may be especially helpful for small and minority business enterprises.

Technology Developments and Improvements

Technology developments, more than any other market development initiative category, tend to be material specific. This section provides an overview of some recent developments that have assisted or may assist recycling markets.

Table 6-8

Creating Demand for Recyclables: Purchasing Recycled Products

To ensure a market outlet for your recyclables, purchase products made from those materials. This table outlines three possible methods.

1) Talk to potential markets. Is there a recycled product they make that you could purchase? If so, such reciprocal arrangements are a great way to stimulate your market. Examples: government purchase of recycled plastics curbside recycling bins from the company it will sell plastic to; convincing the local newspaper publisher to buy recycled newsprint from a paper mill who will, in turn, buy your recyclable newsprint.

2) Check listings of recycled products to learn what products are available. Many office supply catalogues now contain a recycled product section. Other listings:

- Buy Recycled Paper Products Guide
  National Office Paper Recycling Project
  U.S. Conference of Mayors
  1620 I St., NW, 4th Floor
  Washington, DC 20006
  202/293-7330
- Guide to Buying Recycled Printing and Office Paper
  Californians Against Waste Foundation
  926 J Street, Suite 606
  Sacramento, CA 95814
  916/443-8317
- The Official Recycled Products Guide
  P.O. Box 577
  Ogdensburg, NY 13669
  800/267-0707

3) Talk to the "Buy Recycled" Program Director with the National Recycling Coalition at 202/625-6406. Or talk to the Procurement Coordinator for Recycled Products at your local state agency. Many state coordinators maintain lists of recycled product suppliers under state contract.

Source: M. Kohrell. 1992. University of Wisconsin–Extension, Solid and Hazardous Waste Education Center

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Several technological breakthroughs are encouraging additional demand for fibers.

Markets for fibers have had several technological breakthroughs that will encourage additional demand. While most markets prohibited magazine recovery until as recently as mid-1991, industry analysts predict that demand will outstrip supply for the foreseeable future, thanks to a flotation de-inking technology, developed in Europe about 10 years ago and recently adopted in the United States, that requires a mix of 10 to 30 percent magazines with old newsprint. Several new and converted paper mills in the United States and other countries, notably Canada, should create a stable market for magazines. In another fiber technology development, manufacture of recyclable self-adhesive sticky labels will create a more stable market for office wastepaper. The new technology would eliminate machine-gumming and paper-tearing contamination problems encountered when attempting to recycle self-adhesive labels now in use. Finally, new rules for designs of corrugated containers will allow production of lighter weight containers with an increased content of recycled fibers.

Recent developments among manufacturers have created competition between detinners, foundries, and mills, and have strengthened markets.

The work of the Steel Can Recycling Institute (SCRI) in 1988, now called the Steel Recycling Institute (SRI), has assisted in boosting market capacity for tin-plated steel and bimetal cans at detinning facilities, foundries, and steel mills. While the development of detinning facilities capable of handling post-consumer cans was an initial focus of SRI, recent developments among manufacturers have created unanticipated competition between detinners, foundries, and mills, and have strengthened markets. In response to an SRI promotion, the steel industry, which historically considered the tin plating on steel cans a contaminant, conducted highly successful pilot efforts to use steel and bimetal cans in the remanufacture of steel. Such technological developments will continue to expand across the country.

In the late 1980s and early 1990s, plastic recycling technology developments led other material market developments. Mixed-plastic resin recycling applications have seen some growth recently with the development of the plastic lumber. With the new technology, resins are extruded into various lumber and lumber-like products. The success of these products now depends on the development of standards for plastic lumber, the ability of producers to market the lumber, and on consumers' willingness to purchase the lumber or products made of this material. Problems with contamination of PET bottles by similar-looking polyvinyl chloride (PVC) bottles have jeopardized some plastic recycling programs. The recent development of an improved flotation system designed to remove PVC from the PET recycling stream, along with high-tech developments using x-ray fluorescence and computer scanning, should help advance plastic recycling. Finally, collection and processing equipment developments aiding the recycling of resins such as polystyrene and high- and low-density polyethylene bags will encourage plastic markets.

Public/private partnerships providing funding and guaranteeing supplies of recyclables spur technology developments.

Part of an ongoing continuum, technology developments such as those described above depend on effective public/private partnerships that provide funding opportunities and guarantee supplies of recyclables. Consumer demand, government research and regulations, and private-sector initiatives will necessitate continuing these efforts.

Local governments can encourage businesses to adopt new technologies.

Local governments can work with businesses to encourage them to adopt new technologies that will advance local recycling markets; providing financial assistance when possible will be an additional incentive. Guaranteed supplies of recyclables, along with guarantees from local governments or businesses to purchase products manufactured with local recyclables, can also be an incentive. Use of a local linkage principle as a market strategy will continue to grow in importance.

Transportation Networks

Development of better truck, rail, and overseas transportation networks to move recyclables to domestic and export markets may strengthen markets for many recyclables.

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As tonnages available and distances traveled grow, a better truck transport infrastructure is needed.

Loads of recyclables have long been hauled in open-top dump trailers, box trailers, and other long-distance, over-the-road vehicles. However, as tonnages available and distances traveled grow, a better truck transport infrastructure is needed. In addition, haulers must be given access to containers and scales outside of traditional business hours. Recycling program planners and transportation coordinators are making concerted efforts to arrange for backhauls to move recyclables; these efforts should continue. (A backhaul is the return leg of a distance-carrier's journey, so named because it is a load hauled on the way back to the point of origin.) Backhauling provides more cost-effective transportation because recyclers only pay for a return trip; the other commodity being hauled pays the freight in the opposite direction.

Shipment of recovered materials via rail has long been used for moving certain recyclable materials to domestic markets. To make rail hauling more competitive, however, several rail lines are creating tariffs expressly for shipping secondary materials. Along that same line, trade organizations like the Institute for Scrap Recycling Industries (ISRI) have asked Congress to consider deregulating the railroads with respect to the movement of recyclables.

Temporary shortages of overseas export containers creates a barrier to transporting recyclables overseas. Although exported scrap metals do not require the use of overseas containers, they are usually required for paper and other recyclables. A container shortage in 1990 and 1991 caused problems for export brokers. Ongoing monitoring is necessary to alleviate such shortages.

Local recycling program planners should try to understand and accommodate haulers' needs.

In terms of transportation networks, local recycling program planners can be most supportive by attempting to understand and accommodate haulers' needs. This means having recyclables ready to load on schedule (never keep a driver waiting), allowing pick-ups during non-business hours if necessary, and shipping only full loads of recyclables. Finally, considering the use of rail transport and backhauls will help strengthen the national transportation network.

Business Development

Most businesses want to know that sufficient demand for their products exists to make their operation financially viable.

Three primary approaches to developing new markets for recyclables are generally associated with business development: (1) attracting an established recycling industry to locate a manufacturing facility, (2) encouraging existing local manufacturers to use or increase their use of recyclables, and (3) assisting local entrepreneurs with the start-up of small-scale manufacturing businesses. However, it is important to note that most legitimate businesses will not be attracted or encouraged by a supply of recyclables alone; they need to know that sufficient demand for their products exists to make their operation financially viable.

Encouraging large companies to locate in a region by providing incentives is a traditional approach to recycling market development.

The most traditional approach to recycling market and economic development has been to encourage large companies to locate a plant in a given region by providing incentives. This method has been used successfully to develop recycling markets in many areas of the United States. For instance, for years, paper and steel mills have solicited competitive requests from potential suppliers of recyclables when deciding to locate new facilities; large suppliers along the east and west coasts, such as the cities of Boston, New York, or San Diego, are often competitors for such facilities. However, as the number of communities in need of markets continues to grow, the number of large recycling industries capable of locating and building new facilities does not. This is evidenced by the fact that more recently announced industry expansions are adding capacity to existing facilities rather than locating new facilities.

More recent business development concepts for encouraging market growth focus on establishing local "linkages." Linkage studies identify the flow of goods and services in a specified region. Conducting a linkage study is one of the first steps toward eventually encouraging existing industries to use recovered materials generated locally and to encourage new business start-ups to do the same. This market development concept also lends itself well to local economic development.

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Local officials, economic development staff, and recycling program planners should cooperate to determine optimum local opportunities.

Opportunities for working with existing industries or entrepreneurs are unique to each location. In using this type of market-development strategy, it is important that local elected officials, economic development staff, and recycling program planners work together to determine the optimum local opportunities. In investigating the potential for local interindustry linkages, it is important that an accurate determination be made of the amounts and suppliers of raw feedstock consistently available to manufacturers. In addition, opportunities to include existing intermediate processors should be investigated. A study prepared by Gainer & Associates on behalf of the Arcata (California) Community Recycling Center provides a good model for determining linkages and assessing the feasibility of working with existing businesses or entrepreneurs.

Education Strategies

Education is one of the most vital components to help foster market development among the public and private sectors. Educational programs must involve every sector of the population, including government officials; industry representatives; collectors, haulers and processors of recyclables; and the general public.

Government officials responsible for setting solid waste policy at the local, state, and federal levels must be educated to understand the impact of policy decisions. Whether procurement of recycled products is mandatory or voluntary, government employees should be educated to pursue procurement practices favorable to recycled products whenever possible.

Education is vital to fostering market development between the public and private sectors.

Industry officials need to be made aware of the importance of recycling at their facilities and of using recycled products. Perhaps even more important, industry managers should be provided with information regarding local legislation, available supplies of recyclables, developing recycling technologies, and funding sources. Creating a working group including industry and government officials is an important mechanism to facilitate such information sharing. Some industry groups themselves have created education campaigns geared toward other population sectors. The Institute for Scrap Recycling Industries' "Design for Recycling" program, which promotes mandatory and voluntary efforts to assist recyclability of materials, especially metals, is one such noteworthy effort.

The collecting and processing sector is a vital link to market development, since it is through this sector that a reliable supply of quality recyclables is generated. Education programs geared toward helping collectors understand the importance of quality control at the curb or drop-off site are vital. Likewise, educating public- and private-sector processing facility employees is important to ensure that manufacturers' specifications will be met.

The public is another vital link to market development.

The general public may be one of the most vital links to market development, and educational programs for this sector are, therefore, of utmost importance. The public must be educated to understand the importance of participating in recycling programs and following local requirements regarding contaminants and acceptable materials. In addition, efforts must be made to increase public awareness of recycled products sold at retail outlets. Finally, information about standardized definitions for "recycled" products needs to be disseminated to the public so individuals can understand and assess the environmental and recycled claims made by manufacturers. "Buy Recycled" campaigns coordinated by state governments in Michigan and Minnesota have successfully promoted procurement of recycled products by the public.

To implement an effective local education program, it is useful to appoint an education committee to work with recycling staff or volunteers. Committee members should include representatives from local government, manufacturing industries, the commercial sector, recyclers (collectors / processors), and the public. The committee should devise a comprehensive local education strategy. The members will also educate the other members of their respective interest groups, for example, the Chamber of Commerce or the City Council.

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Cooperative Marketing

Regional marketing cooperatives help maintain reliable markets and improve bargaining power.

To maintain more reliable markets and to improve bargaining power, communities around the country have formed regional marketing cooperatives. By identifying and negotiating with buyers, the cooperative acts as the agent for member communities. For example, in New Hampshire more than 100 small communities participate in the New Hampshire Resource Recovery Association cooperative marketing program, a nonprofit organization that provides marketing, technical, and education services. Such programs are also being initiated in upstate New York, Wisconsin, Minnesota, and Arizona, among other states.

The benefits of cooperative marketing include the ability to amass greater recyclable volumes for sale and economies of scale for processing and program administration. The challenges facing communities following a cooperative approach include maintaining quality control of recyclables collected by members, adopting an appropriate legal structure, and developing equitable means for sharing program costs and revenues. A marketing cooperative can be designed to have both public- and private-sector membership. Local recycling program planners wishing to investigate the feasibility of cooperative marketing can contact communities in their county, solid waste district, or region. Since planning commissions, nonprofit organizations and state recycling offices often track interest in such programs, contacting one of those agencies may also be useful. The National Cooperative Marketing Network has recently compiled data on cooperative marketing programs in the U.S. and Canada to help those interested in these programs.

ASSESSING AND CHOOSING COLLECTION AND PROCESSING TECHNOLOGIES

Choosing appropriate technologies requires making three preliminary decisions:

- *which methods to use for collecting recyclables*
- *how the collection system will operate*
- *what type of facility is needed for processing materials.*

After deciding what materials will be recycled and estimating the quantities of each, the community is ready to develop a basic program design. For most communities, developing a design will involve making three important decisions. First, the community must decide what collection method(s) to use. Second, the community must decide how the mechanics of the collection system will work. Third, the community must decide what type of processing and storage facility is needed to prepare materials for marketing. To develop a unified, efficient program, each decision must be made in relation to the others.

When analyzing available collection and processing arrangements, the interaction between the public and private sectors should be carefully considered. Even where public pickup of refuse is conducted, some communities are opting for private collection of recyclables. Private businesses are also providing waste processing services. A thorough analysis of potential collection and processing options should include an analysis of the benefits and costs associated with all public- and private-sector alternatives, including a combined approach. Of course, recycling collection and processing systems must be designed to incorporate state recycling legislation.

Ways to Collect Recyclables

Residential Waste Drop-Off and Buy-Back Collection

Deciding how recyclables will be collected is important.

At the outset, collection program developers must decide the best way for citizens, institutions, and businesses to prepare recyclables for collection and the best way to collect the materials. Local conditions should be taken into account when designing a collection program. For a small rural community that does not provide curbside pickup, educating and encouraging citizens to de-

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Drop-off programs require thorough education and promotion to achieve participation rates similar to those of curbside collection.

liver materials to a drop-off site may be all that is needed. A recycling center can be established at the same location where residents deliver waste. Mobile recycling drop-off trailers can also be used. Drop-off recycling, however, is less convenient than curbside pickup. In order to promote high public participation, communities saving on the cost of collection by instituting a drop-off program must make special efforts at promoting the cost benefits of the reduced service to local residents. If a thorough educational and promotional effort is not made, drop-off programs tend to have lower participation rates than curbside collection.

Establishing a buy-back center (a place where recyclables are purchased) may help induce citizens to recycle. Some buy-back centers purchase some materials and accept others, depending on current market conditions. Private or public mobile buy-back operations can serve some areas of the country, purchasing recyclables in small communities or in neighborhoods of large metropolitan areas on a regular schedule.

Curbside Collection Options

To maximize recyclable collection, many communities, large and small, are establishing curbside collection programs. There are a variety of approaches being tried; most are seeking the optimal balance among citizen and business participation and transport needs versus material processing requirements. Many communities provide both drop-off and curbside pick-up centers. Drop-off centers work well for items such as waste oil that are hard to pick up at the curb.

In source separated programs, recyclables picked up at curbside are kept separate from the waste.

Source Separation

Many communities now provide curbside pickup of recyclables kept separate from other waste. There are a variety of options used, depending on community resources and goals. Some communities are providing rigid and stable containers for collection of recyclables. Bins and buckets are most popular. Programs using bins and buckets have been very successful; the social pressure that results when neighbors can see who is and isn't complying with the program helps to spur high participation rates. Although using bins and buckets means higher initial cost for each community, many communities feel that the visibility of the program and the high participation rates make the investment worth it (see Table 6-9). Communities have experienced some problems with theft of bins and the materials they contain. Another approach uses plastic bags, with all recyclable materials placed in one bag and all nonrecyclables in another bag. Pick-up crews are instructed to leave at the curb any waste that is put in improper bags. They affix stickers (see Figure 6-2) to the bags indicating why they were not picked up. Because neighbors can see if a resident's waste has not been collected, compliance with such a program is generally high because of social pressure. Using plastic bags also allows existing collection equipment to be used, although care must be taken to ensure that the mixed recyclables do not contaminate one another (for example, broken glass contaminating plastic and paper).

For both bin and bag collection, issues of privacy have been raised. Some citizens have stated that it is an invasion of privacy to be forced to allow refuse collectors, or anyone walking by, to know the types of garbage that a resident generates. This type of opposition could cause problems for some communities.

Figure 6-2
Examples of Stickers Indicating Why Waste Was Not Picked Up

Source: Prairie du Sac, Wisconsin

Mixed-Waste Collection

This approach requires the least change in generators' habits. Communities collect waste unsorted as usual in one truck, and waste processing to remove recyclables is done later. This approach is obviously most convenient for resi-

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Mixed-waste collection is convenient and requires few changes in habits and minimal education efforts.

But mixing refuse can contaminate otherwise recyclable materials.

dents and eliminates the need for most education. For some commodities, such as cardboard from food stores, so-called "dump and pick" operations have been successful. Because the cardboard makes up a large fraction of the total collected refuse and wastes that might otherwise contaminate it are absent, the cardboard remains relatively clean and easy to separate.

But mixing municipal refuse can result in contamination of waste that would otherwise be recyclable. Paper can become covered with wet food debris and glass can be broken. For some of the first mixed-waste processing facilities, upwards of 25 percent (by weight) of incoming recyclable material was contaminated and thus unmarketable.

However, because of the convenience for both citizens and collectors, many communities, especially large urban centers, are developing mixed-waste processing projects. Known also as full-stream processing, mixed-waste processing to remove recyclables is usually performed in conjunction with compost or refuse-derived fuel (RDF) production (see Table 6-10). Manual and mechanical separation to remove recyclables is performed at the front end of the process. Although the total volume of recyclables marketed from these facilities may be lower than the volume recovered when source separation is required at curbside, communities and businesses operating these plants point out that the total percentage of waste diverted from landfilling through production of RDF and compost is significant (see Table 6-11). Some of the

Table 6-9

Costs and Participation Rates by Container Type

	Blue Boxes	Stacking	Sacks	Buckets
Participation rates				
Average weekly set out rate (percent)(1)	56	42	36	40
Overall participation rate (percent)(2)	88	62	55	78
Average pounds per set out	14.40	18.46	13.94	16.47
Average pounds per week per household	8.11	7.90	5.09	6.69
Average number of set outs per household	6.42	6.16	6.24	5.18
Frequency of set outs per household (1 set out/# weeks)	1.40	1.46	1.44	1.74
Container handling time (seconds/set out)(3)				
Driver	23.52	24.17	26.78	25.00
Collector	32.39	15.78	31.65	22.04
Driver and collector average	27.95	19.97	29.21	23.52
Container costs(4)				
Capital cost per household	$5.50	$17.00	$0.86	$3.80
Capital cost for 38,000 homes	$209,000	$646,000	$32,680	$144,000
Approximate container lifetime(5)	10 years	5 years	1 year	3 years
Percent containers replaced annually(6)	5	5	100	5
Annual replacement cost	$10,450	$32,300	$32,680	$7,220
Annual amortization costs(7)	$34,014	$170,000	$ ——	$58,065
Total annual cost	$44,464	$202,713	$32,680	$65,285

(1) The average percentage of homes placing a set out on the curb in any given week.

(2) The percentage of homes participating at least twice during the nine-week study.

(3) Measured as the time from first touching the container(s), sorting the material into the truck bins, and replacing the container(s) on the ground. The highest and lowest of 25 measurements for driver and collector were dropped.

(4) These prices are offered for comparative purposes only and may vary due to the percentage of recycled plastic used, quantities ordered, and customization of the container. For current prices, contact the manufacturers directly.

(5) The lifetimes are based on manufacturers' claims and may vary with extremes of heat and cold, exposure to sunlight, and abuse of the containers.

(6) The 5 percent figure is based on the experience of many communities and accounts for loss and container theft, and people moving and taking their containers. The 100 percent figure in the Sack neighborhood includes the factors stated above and sacks wearing out.

(7) Amortization figures are based on a 10 percent annual interest rate.

Source: Gitlitz, J. 1989. "Curbside Collection containers: A Comparative Evaluation," *Resource Recycling* January/February

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When considering mixed-waste processing, the experience and reputation of the technology vendor is important.

mixed-waste facilities process source-separated materials (see Table 6-10). New technologies are increasing recovery efficiency. When investigating the potential for mixed-waste processing, the experience and reputation of the technology vendor is a key consideration.

Wet/Dry Collection

In this variation of mixed-waste collection, wet materials—yard trimmings, food scraps, disposable diapers, soiled paper, and animal waste—are separated from other materials for collection. The wet stream is composted. Other materials, including recyclables, form the dry portion. Some communities collect all of their dry waste mixed and separate recyclables during processing. Others require further separation of dry materials into recyclable and nonrecyclable fractions. In Some programs require generators to bundle newsprint or take glass bottles to a drop-off site to reduce contamination and breakage. In this approach, a separate collection vehicle is usually used for each container type.

Combined Collection Options

Many communities provide a combination of drop-off, buy-back, and curbside collection. Often some collection is publicly provided, with other collection provided by local businesses. Especially in large communities, a combination of options may lead to higher participation and result in a more effective overall program.

Table 6-10
Selected Mixed Waste Processing Operations

	Delaware Reclamation	Fillmore County	Future Fuel	Rabanco	Recomp	Refuse Resource Recovery Systems	Reuter County	Sumter	Wastech	XL Disposal
Type of waste (1)	R-90%, C-10%, sludge	R, C	R, C	SC	R, C	R-80% C-20%	R	R-80%, C-20%	SC	R
Throughput (2) (tons/day)	1,000 (R,C), 260 (sludge)	8, also 3 SS	45	150-200, 100 SS	100	300-400 start-up, 600+ design	400	60	48, also 60 SS	376 start, 400 design
Recycled materials (3)	F, NF, G/M	ONP, F, P, NF, G/S	OCC, F, NF, P	OCC, MP, G/S, F, NF	OCC, F	ONP, OCC, MP, F, NF, P	OCC, F, NF, P	F, NF, P	OCC, MP, F, NF	ONP, OCC, F, NF, P
Products	Compost, pellets	Compost	Compost Pellets	None	Compost	Compost	Pellets	Compost	None	Grit/glass, Pellets in start-up
Source separation	None	Curbside, drop-offs, household hazardous waste	None	Curbside, drop-off, buy-back	Curbside, buy-back, drop-off, commercial	Bagged recyclables collected with garbage	Curbside	Pilot curbside	Curbside, drop-off, commercial	None

(1) R = mixed residential solid waste, C = mixed commercial solid waste with a paper-rich fraction, SC=selected commercial waste with a paper-rich fraction.

(2) SS = source-separated curbside materials are also processed by this facility but with a different processing line of equipment. Design capacities are shown for facilities operating less than a year.

(3) ONP = old newspapers, OCC = old corrugated containers, MP = mixed waste paper, F = ferrous, NF = non-ferrous, G/M = mixed color glass containers, G/S = color-sorted glass containers, P = container plastics (e.g. HDPE, PET).

Source: *Resource Recycling*, 1990; *1990-91 Materials Recovery and Recycling Yearbook*

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Collection Schedule

Stating clearly how each citizen and business is to take part in the program is necessary.

Collection scheduling is another important consideration. Generally, programs that collect recyclables weekly on the same day as regular trash is picked up experience the highest participation rates. However, the same-day pickup may involve additional equipment and personnel; this may make same-day pickup beyond the economic resources of some communities. Decreasing the collection frequency may result in lower participation. Collection options are discussed in the next section.

Citizens must know what is expected of them. A clear statement by the community of how each citizen and business is to take part in the program is a necessity. This can be accomplished through the use of an ordinance. For communities that may experience theft of recyclables, a strong antiscavenging ordinance should also be considered. The structure for model ordinances is discussed in this chapter in the Ordinances section.

Business and Bulky Waste

Many businesses generate large volumes of recyclables — always consider this source when developing a program.

Many businesses generate large volumes of clean, homogeneous wastes. Highly effective recycling programs can be developed to collect these wastes from a variety of similar businesses on a routine basis. In many communities around the country, there are successful programs recovering these high-quality waste streams. Business and institutional recycling should be considered during program development. Different programs are described below.

Waste from Retail Businesses

Many consumer-oriented businesses, especially retail stores, produce large quantities of corrugated cardboard. If this material is kept separate from other waste streams, it is easily and economically recycled. However, cardboard must be sorted carefully because it can easily be contaminated with food

Table 6-11

Recovery Levels for Selected Mixed Waste Processing Operations

	Location	% Recyclable materials	% Other products (1)	% Landfilled
Delaware Reclamation	New Castle, DE	4	80	16
Fillmore County	Preston, MN	8	N.A.	N.A.
Future Fuel	Thief River Falls, MN	16	73	11
Rabanco	Seattle, WA	N.A.	N.A.	N.A.
Recomp	St. Cloud, MN	5	55	40
Refuse Resource Recovery Systems	Omaha, NE	(2)	(2)	(2)
Reuter (3)	Eden Prairie, MN	7	38	55
Sumter County	Sumterville, FL	7	76	17
Wastech	Portland, OR	50	0	50
XL Disposal	Crestwood, IL	14	20	66

N.A. = Not available.

(1) Such as refuse-derived fuel and compost.

(2) Refuse Resource Recovery Systems must recover, as recyclable materials or compost, 20 percent of the wastes delivered by the city, which represents 65 percent of the stated throughput. This diversion goal increases two percentage points per year until 30 percent is reached. A separate yard waste collection program will start in April 1991. Omaha estimated diversion in 1991 to be 44 percent.

(3) Two-thirds of the RDF is stored because Reuter has been unable to sell it.

Source: *Resource Recycling*, 1990; *1990-91 Materials Recovery and Recycling Yearbook*

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wastes. Weather (precipitation, wind, etc.) can also damage the quality of corrugated cardboard. Retail businesses also frequently produce large volumes of office paper, wood, glass, and plastic.

Waste from Restaurants and Bars

Bars and restaurants produce large quantities of glass and aluminum.

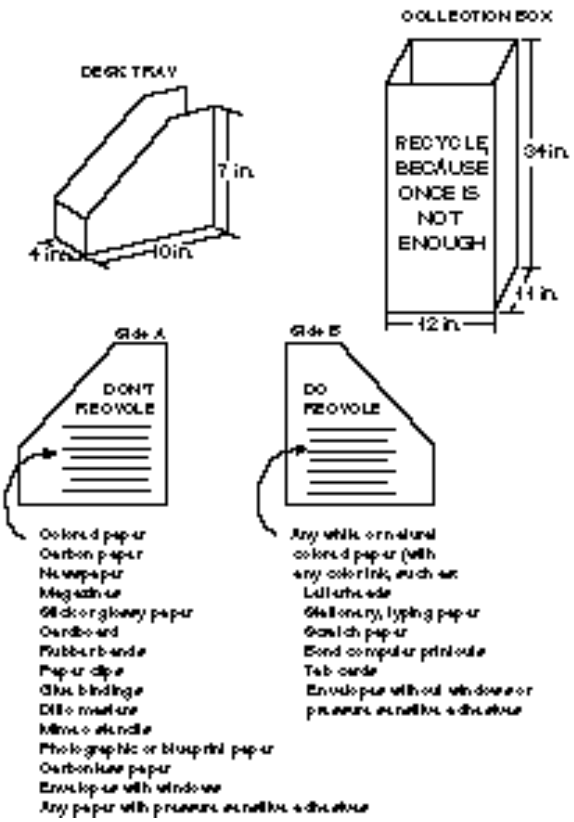
Bars and restaurants produce large quantities of glass and aluminum. Glass can become a storage and safety problem and its marketability can be affected by contamination. Metal tabs, for example, if mixed with glass, can significantly reduce the value of the glass. Glass should also be separated by color unless a processing center performs this task.

High staff turnovers in the bar and restaurant business can also create problems with ensuring that workers properly separate the materials. A continuing effort at working with cooperating businesses is necessary for glass recycling.

Many restaurants and grocery stores with butcher shops create a regular supply of used cooking oil, grease, and animal fat. These materials can be rendered into a variety of useful products, including animal feed, soap, lard, and cosmetics. Storing such materials must be carefully planned to avoid generating objectionable odors or attracting vermin.

Institutional Waste

Figure 6-3
Office Paper Recycling Containers



Source: The Resource Recovery Section, Waste Management Division, Michigan Department of Natural Resources

Government offices and businesses such as banks and insurance companies generate quantities of used paper, much of which is high quality, including tab cards, computer printout paper, and ledger paper. To successfully create a program to collect and recycle such paper, a system must be developed for bringing wastepaper normally generated by individuals a few pages at a time to a central location where the paper can be collected. Some systems make use of individual desk collecting bins, while others have central boxes or collection points.

Employee education is a key: workers must be told which types of office paper can or cannot be mixed together. Figure 6-3 shows an example of office paper recycling containers used by the Michigan Department of Natural Resources. Also, some effort must be made at predicting office paper volumes. Overflowing waste bins or boxes will create a potential for fire or accident, as well as opposition from those being asked to cooperate.

In addition to recycling office paper, many businesses want to shred corporate documents before disposal and will pay a premium to have documents rendered unreadable. Shredding requires an investment in processing equipment, but could prove economically attractive for recyclers working with proprietary businesses. The shredded material, properly segregated, can be recycled.

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Contamination by dirt, metals, or masonry decreases the recyclability of wood.

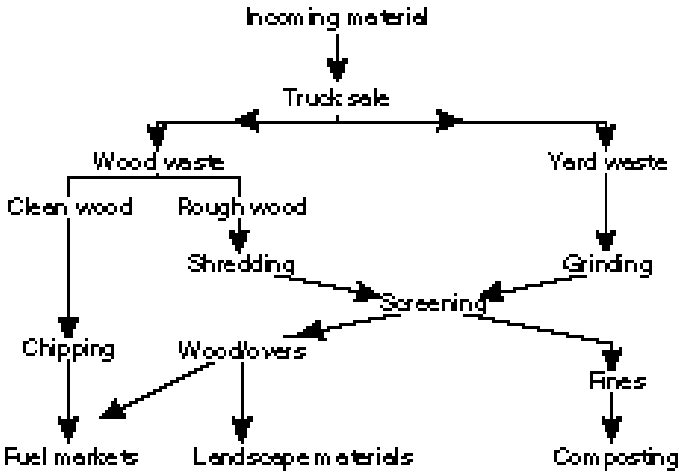
Also avoid contamination from asbestos, PCBs, and other hazardous materials.

Wood and Construction/Demolition Material

Wood recycling is on the rise. Many businesses generate pallets, which can either be repaired and reused, chipped into fuel or plant bedding material, or reconstructed into other secondary products. Demolition projects can also be a source of high quality wood wastes for recycling (see Figure 6-4).

Contamination by dirt, metals, or masonry can significantly decrease the recyclability of wood. Care must be taken to ensure that hazardous materials, such as asbestos and PCBs, do not become mixed with recovered items.

Figure 6-4
Material Flow Chart for Wood Waste Management



Source: Schroeder, R. 1990. "Operating a wood waste recycling facility," *BioCycle*, December

Appliances

Communities have recycled appliances (refrigerators, stoves, washers, dryers) for many years. Most provide for or require a separate pickup, and some charge generators for the special service. Appliances are delivered to metal scrap recyclers.

Some states require removal of PCBs, and federal law requires recovery of chlorofluorocarbons (CFCs) before appliances are recycled.

In recent years, scrap recyclers have become wary of shredding appliances that may have capacitors containing PCBs, a hazardous material. Although PCBs are no longer manufactured in the United States and only a small percentage of all appliances contain PCB capacitors, some scrap recyclers refuse to accept any appliances containing capacitors, and others are charging a per-appliance fee to pay for capacitor removal. The local market situation should be monitored so that the economics of appliance recycling can be accurately determined. Some states require removal of PCBs before recycling. Federal law requires recovery of chlorofluorocarbons (CFCs) before any appliance is recycled.

OPERATIONAL ISSUES

Collecting Recyclables

The next question that must be addressed is how to most efficiently move recyclable material from each generator to the processing facility. Depending on community resources and desires, this question, too, has a variety of answers

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(see Table 6-12). As previously stated, the choice of collection method(s) will influence how the entire collection system will operate.

Either public or private collectors can be used.

An initial decision is who should collect recyclables for the community. One approach is to use existing public sanitation workers. Another is to use public workers for collection of waste and contract with private haulers for collection of recyclables. Many private haulers now offer full-service collection. The level of recyclable collection service which will be provided to the commercial and institutional sector should be determined and clearly communicated, so that these entities can make alternative arrangements if necessary.

Recycling collection is sometimes subject to public bidding, with the winning bidder receiving a contract for the entire community.

For first-time collection programs in large cities served by private haulers, the number of haulers is a key consideration. In some communities, recyclable collection is subject to public bidding, with the winning bidder receiving a contract for the entire community. This procedure can be administratively efficient for the community, but can displace smaller haulers already serving the community who may be unable to bid on a large contract.

Other communities have opted to allow existing trash haulers the opportunity to also provide recycling collection services to the neighborhoods and businesses they serve. This procedure protects existing small haulers, but it must be closely monitored to ensure that all haulers follow program guidelines and are actually recycling the materials collected. Some communities require haulers to obtain permits and to file reports showing participation rates and volumes collected.

Table 6-12
Collection Characteristics

Community	Frequency	Same Day as Trash	Provide Container	Household Separation	How
Barrington, IL	Weekly	No	Yes	Three	P-M-G
Blaine, MN	Weekly	Yes	Yes	Three	P-M-G
Boulder, CO	Weekly	65%	Yes[1]	Three	P-M-G
Champaign, IL	Weekly	No	Yes	N/S	N/A
East Greenwich, RI	Weekly	Yes	Yes	Two	P-C
East Providence, RI	Weekly	Yes	Yes	Two	P-C
Franklin, PA	Monthly	Yes	Yes	Three	P-M-G
Irvine, CA	Weekly	Yes	Yes	Three	P-M/Pl-G
Ithaca, NY	Weekly	Yes	No	Separate	I.M.
Jersey City, NJ	Weekly	No	No	Two	P-C
Lafayette, LA	Weekly	Yes	Yes	Three	P-M-G/Pl
New London, CT	Weekly	Yes	Yes	Two	P-C
Olympia, WA	Weekly	Yes	Yes	Three	P-MP-C
Ontario, CA	Weekly	Yes	Yes	Four	P-M-G-Pl
Orlando, FL	Weekly	Yes	Yes	Two	P-C
Oyster Bay, NY	Weekly	No	Yes	Two	P-C
Saint Louis Park, MN	Weekly	Yes	Yes	Three	P-M-G
Seattle (North), WA	Weekly	Partial	Yes	Three	P-MP-C
Seattle (South), WA	Monthly	No	Yes	One	All
Shakopee, MN	Weekly	Yes	Yes	Three	P-M-G
Trenton, NJ	Bi-Monthly	No	Yes	Two	P-C
Whitehall Twp, PA	Weekly[2]	60%	Yes	Three	P-M-G

P — Paper; M — Metal; G — Glass; Pl — Plastics; C — Mixed Containers;
MP — Mixed Paper (Separate); I.M. — Individual Materials

1. Container for newspaper only.
2. Newspaper collected one week, containers collected the next.

Source: Glenn, J., "Curbside Recycling Reaches 40 Million," *BioCycle*, July 1990

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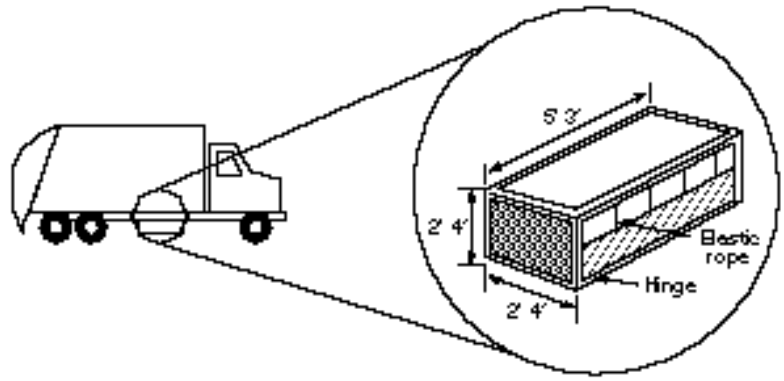
Structure private collection programs to avoid anti-competition claims from competing firms.

Regardless of whether one private hauler or a variety of private haulers are used, the program should be carefully structured to avoid claims that the program violates anti-competition laws. A hauling business that loses customers or one that is unable to gain new customers may blame the community for illegally restricting business opportunities. The attorney serving the community should be consulted to develop proper bidding and permit procedures.

Collecting Residential and Commercial Waste

In the initial planning stages, communities usually have two choices: they can use existing equipment to collect recyclables, or they can invest in new equipment. Private haulers have the same options and often ask a community to help finance new equipment purchases. Many communities begin with existing equipment and expand the program to include more specialized vehicles when the program has had some operating experience.

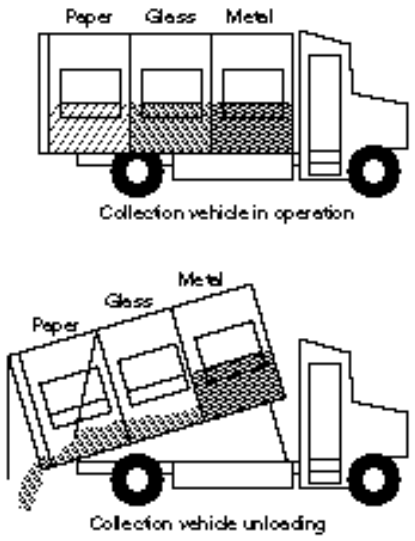
Figure 6-5
Newspaper Rack for Rear-Loading Collection Vehicle



Source: Adapted from City of Madison

For programs starting up, existing community or private equipment, such as refuse collection trucks, pickup trucks, and dump trucks, is often used to collect recyclables. Refuse trucks can be converted to allow paper collection (see Figure 6-5). Using existing equipment saves money at the outset, but can be inefficient if recyclables cannot be kept separated. In addition, existing equipment may present a hazard to workers, who may be forced to lift recyclable containers high in the air to drop materials into a dump truck or pickup truck without a lift gate. Attaching a trailer to an existing dump truck to collect both recyclables and waste together may work. However, this technique has caused problems in communities with alleys and cul-de-sacs, which make turning difficult for long collector vehicles. Some haulers are collecting separated, bagged recyclables along with other bagged waste in the same truck.

Figure 6-6
Source Separation Collection Truck



Source: P. O'Leary & P. Walsh. University of Wisc.–Extension, Solid and Hazardous Waste Education Center, reprinted from *Waste Age* Correspondence Course articles 1988

Increasingly, compartmentalized vehicles to transport and keep recyclables separate are being developed (see Figure 6-6). These trucks are low to the ground and allow workers to keep a variety of recyclables separated in the truck. Where communities use bin systems, vehicles with two or more compartments are usually used for collection. Collection personnel may take longer to collect material at each residence because they must throw separated material into each compartment. However, the contamination rates for these collection schemes are lower and processing time at the processing facility may be shorter.

Selecting trucks with compartments must be done carefully; it is very important to consider the ratio of the volume of different commodities to be collected. Ignoring or miscalculating the ratios can result in costly expenditures of time and fuel. Prematurely filling one compartment will force a truck off its route to off load materials. Off loading a truck filled to

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only 1/4 or 1/2 of its capacity dramatically increases labor costs and overall fuel consumption. Recyclable collection trucks are now available with movable partitions, allowing adjustments based on space needs.

Special Collection Problems

Many large urban communities choose to collect waste commingled from multi-family dwellings and inner city areas.

Obtaining high participation rates and quality control for recycling programs has been a problem in both multi-family dwellings and in inner-city urban neighborhoods. Some speculate that high resident turnover in these housing areas results in less understanding of the requirements of the source separation program. Others feel that neither multi-family nor inner-city dwellers share the sense of responsibility for community well being that spurs residential families to recycle. Whatever the reason, a number of large urban centers have given up on requiring multi-family dwelling and urban source separation and have chosen to collect such waste commingled, even if other areas of the city practice source separation. This approach requires different processing (sometimes different processing facilities) for each type of collection.

Other communities feel that special efforts at improving education, monitoring, convenience, and motivation are needed. Information, including newsletters, flyers, or posters, is provided on a regular basis, perhaps monthly. The program is personally explained to new tenants or neighborhood residents. At multi-family dwellings, managers or caretakers provide active oversight to ensure compliance and quality control. In urban areas, a block captain or neighborhood recycling committee may fulfill the role of educator and motivator.

Residential and commercial waste recycling programs are designed with convenience in mind. Recycling containers are placed in areas convenient for both residents and haulers (for example, basements may be avoided because they can be dirty and may attract vermin). Each container is well marked and can be reached by children. Pickup is regular, to help alleviate storage problems that can make recycling difficult for apartment dwellers. Fire codes may also affect storage options.

Motivating people in multi-family dwellings and the inner-city is also necessary. Some success has been achieved by establishing buy-back centers in inner-city areas to spur economic interest in recycling, especially among children. Some suggest that siting processing centers in urban areas and hiring local residents are crucial to linking recycling with local economic benefits. Providing some portion of recyclable sales revenue to a neighborhood group or a tenants' association may also provide a valuable economic incentive to improve participation and quality control, although these economic incentives must be balanced against the increase in program costs, which may have to be borne by other parts of the community.

Siting processing centers in urban areas and hiring local residents can help link recycling with local economic benefits.

PROCESSING/STORAGE CENTER DESIGN

How waste is collected helps determine the processing/storage facility design.

Collected recyclables are normally delivered to a processing facility, where the recyclables are either stored until large enough volumes are collected to be marketable or are processed to meet the specifications of recycling markets. Obviously, the manner in which waste is collected will help to determine the processing/storage facility design.

Small communities or groups of communities may develop small drop-off centers that feed a larger processing facility (see Figure 6-7). The drop-off center/large processing facility approach provides each small community with the benefits of a convenient, low-cost collection point, as well as the economies of scale and higher volumes that a large processing facility can provide. Each drop-off center can be serviced by a transporter on a regular basis, or transporters can be called when the center has reached capacity. Who pays

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for recycling transportation and how the material should be transported must be decided.

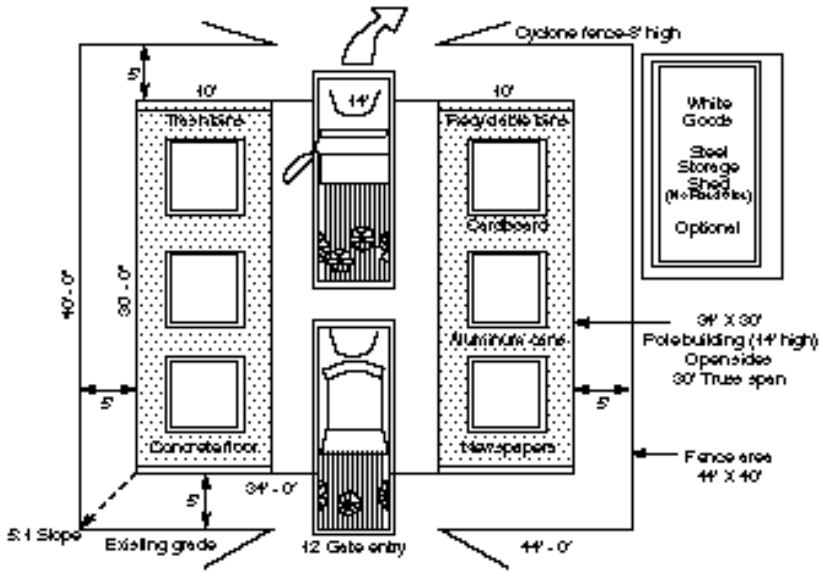
To manage large urban recycling programs, many communities consider implementing MRFs, which are designed to process large volumes of recyclable material in the most efficient and cost-effective manner; some can handle thousands of tons of material and many types of recyclables.

MRFs should be designed to receive, sort, process, and store recyclable material efficiently and safely.

The design goal for a MRF is to receive, sort, process, and store recyclable material efficiently and safely. Although most recyclable material will be trucked to the facility, some facilities provide for citizen drop off or buy back. Depending on whether materials are delivered to the facility as mixed waste, mixed recyclables, or separated recyclables, there are a variety of options and tradeoffs involving equipment and personnel.

There are three major issues that must be addressed when building and designing a MRF. First, a site must be found that can accommodate the building and its associated features for traffic and storage, and be consistent with local land use. Second, the building layout and equipment must be designed to accommodate efficient and safe materials processing, movement, and storage, in compliance with local building codes. Third, the building must be designed to allow efficient and safe external access and to accommodate internal flow. Each of these design issues is discussed below and special considerations are highlighted.

Figure 6-7
Rural Container Station



Source: Northwest Wisconsin Regional Planning Commission

Site Location

The ideal MRF location is a large piece of clear, uncontaminated land in an industrial area close to the source of material production.

The ideal location for a MRF is a large piece of clear, uncontaminated land close to the source of material production and located in an industrial area. Industrial areas normally have access to utility services and to different modes of transportation, including rail, barge, and highway. Moreover, neighbors are accustomed to the volume of truck traffic that would be received by a recycling center. Also, noise associated with operation of processing and storage equipment at the recycling center should not create the type of problems that a

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center located in a more residential area may create. A site in an industrial area would also be properly zoned, which would obviate the need to seek rezoning or a variance as part of the site approval process. Finding and obtaining such an ideal site could be extremely expensive or even impossible for many communities.

Communities can consider various options, such as locally owned government property or used industrial property (warehouses, manufacturing facilities, etc.). However, if a site has been used for manufacturing, be sure that no hazardous waste or hazardous material problems exist at the site. Leaking underground storage tanks, crumbling asbestos insulation, or contaminated soil could turn a low-cost piece of property into a fiscal nightmare. Performing an environmental audit before acquiring the property is recommended. If a large enough property with a building is available, an investigation should determine if the building can be retrofitted to house the recycling facility or if it should be razed. More details on siting a facility can be found in Chapter 2.

Manufacturing sites must be evaluated for possible hazardous materials/waste problems.

Area

The site must be large enough to accommodate the recycling building, safe and efficient traffic flow for several vehicles, and have buffer space for fencing, landscaping, signs, and other incidentals (see Figure 6-8). If possible, entrances and exits for trucks should separate from those used by automobiles. There should be enough room for tractor/trailers of 55 feet and over to park and turn safely and easily. Also consider outdoor storage needs for revetments, pallets, baled materials, or appliances (see Figure 6-9). If possible, include an area for expansion.

Review local land use regulations to determine if setback regulations exist.

Local land use regulations should be consulted to determine if setback regulations exist. Likewise, some space should be set aside for fencing, signs, and landscaping. Adding trees or shrubs to the site design can provide a buffer zone, cut down on noise, and provide an aesthetically pleasing appearance to neighbors and to citizens using the site's drop-off center.

Scale

The site should have a scale that can be used to weigh both incoming and outgoing materials. Typical scale lengths are from 60 to 70 feet. The site should also accommodate a queuing area for trucks from the entrance to the scale and from the scale to the recycling facility. To determine the queuing area, some predictions must be made of the peak vehicle traffic times, as well as the time necessary to weigh and unload an incoming vehicle. Try to minimize the number of intersections and amount of cross traffic in the site design (see Figure 6-10).

Building Design: Outside-Inside Interface

The facility's outside walls should be designed to allow safe and easy access for incoming and outgoing vehicles. It is important to design doors wide and high enough to accommodate vehicles unloading inside the building. Door damage has been a problem at many MRFs because of collisions caused by empty, but still open, trucks backing out. There should be enough doors to accommodate the expected number of trucks at normal peak times. The same is true for areas where materials will be loaded onto trailers for transport to markets.

Tipping or Unloading Area

The tipping or unloading area should be designed to accommodate at least two days' expected volume of material, although even more space would be preferable because insufficient area to handle incoming waste is a common

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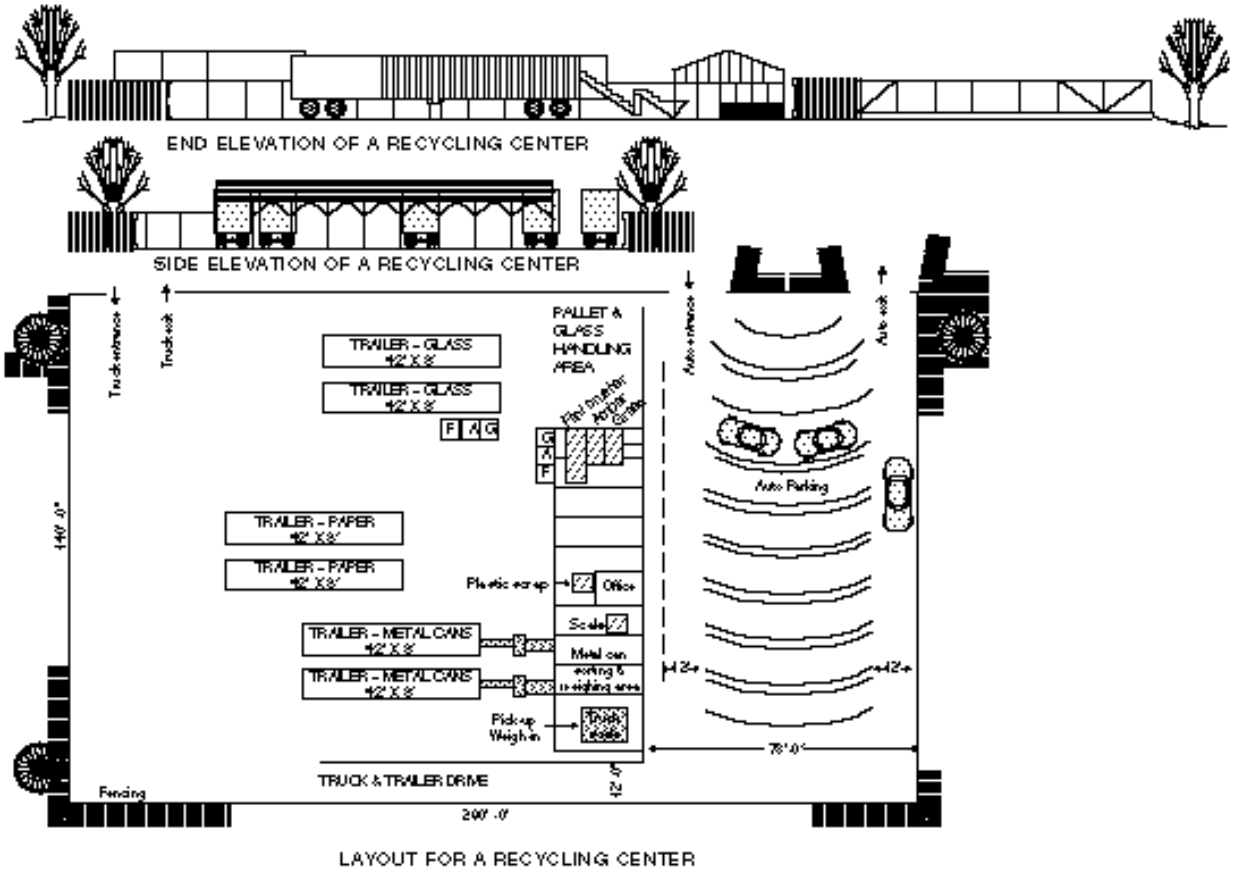
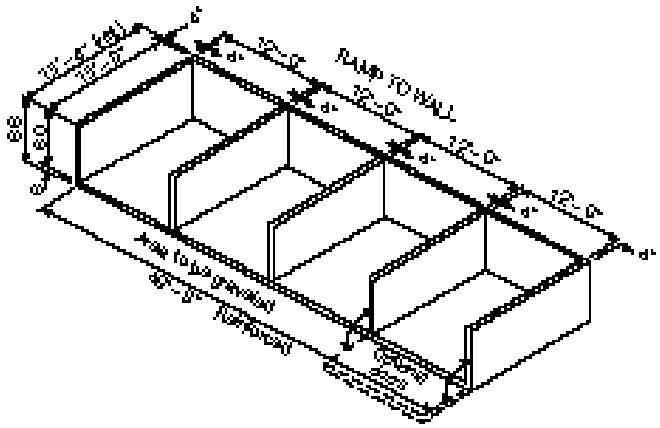
Figure 6-8
Recycling Center, Toledo, Ohio



Source: *The Complete Guide to Planning, Building and Operating a Multi-Material Theme Center*, Glass Packaging Institute, 1984

Figure 6-9
Recycling Revetments



Source: Manitowoc County, Wisconsin Ad Hoc Committee on Recycling

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problem for MRFs. The tipping floor can be unheated, but the design should ensure that cold air does not infiltrate the processing area.

Larger MRFs often accept both source-separated and commingled materials.

Larger MRFs are usually expected to accept both source-separated and commingled materials. Although all recyclable material could be accommodated on one large tipping floor, designing the facility with separate areas for separated and commingled recyclables may be best. This facilitates more efficient processing in the building, since processing equipment may be different for each. Signs should clearly indicate to each driver the proper location for material delivery.

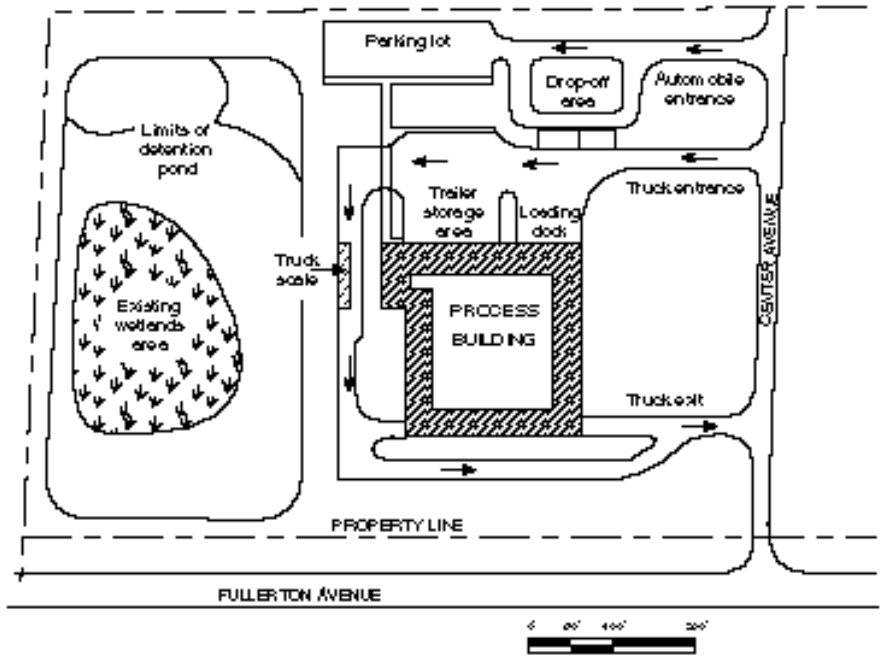
A MRF can be designed to run more than one shift. With this option, sufficient storage space on the tipping floor is essential to allow for processing during the second shift. One approach is to process all separated material during the first shift and all commingled material during the second shift. Using multiple shifts may allow for an overall smaller facility design, although the tipping floor may need to be larger.

The tipping or unloading floor should be designed to handle heavy weights, withstand the wear caused by pushing and moving recyclables, and to provide efficient drainage for liquids brought in by trucks. Wet floors pose safety hazards for employees and create difficult working conditions. The design must also minimize glass breakage, which poses safety hazards and creates a large percentage of nonrecyclable volume at many MRFs. If possible, use a sloped tipping pit or ramp to minimize jarring. Corrugated cardboard can also be placed on the tipping floor as a cushion. Reducing the number of times each load must be handled also reduces breakage.

The area needed for the tipping or unloading floor can be estimated by using the material characterization data collected and converting the anticipated recyclable weights to loose volumes (see Table 6-13). Remember to account for slopes at the ends of stored material piles. By adding up the expected daily volumes of the commodities to be processed, the daily throughput for the facility can be estimated.

Figure 6-10

Material Recycling Facility Site Plan and Traffic Flow, DuPage County, Illinois
North Intermediate Processing Facility



Source: Camp Dresser and McKee, Inc. 1991

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Table 6-13

Sample Weight to Volume Conversion Factors for Recyclables

Material	Volume	Weight in pounds
Newsprint, loose	one cubic yard	360-800
Newsprint, compacted	one cubic yard	720-1,000
Newsprint	12" stack	35
Glass, whole bottles	one cubic yard	600-1,000
Glass, semi crushed	one cubic yard	1,000-1,800
Glass, crushed (mechanically)	one cubic yard	800-2,700
Glass, whole bottles	one full grocery bag	16
Glass, uncrushed to manually broken	55 gallon drum	125-500
PET, soda bottles, whole, loose	one cubic yard	30-40
PET, soda bottles, whole, loose	gaylord	40-53
PET, soda bottles, baled	30" x 62"	500
PET, soda bottles, granulated	gaylord	700-750
PET, soda bottles, granulated	semi-load	30,000
Film, baled	30" x 42" x 48"	1,100
Film, baled	semi-load	44,000
HPDE (dairy only), whole, loose	one cubic yard	24
HPDE (dairy only), baled	32" x 60"	400-500
HPDE (mixed), baled	32" x 60"	900
HPDE (mixed), granulated	gaylord	800-1,000
HPDE (mixed), granulated	semi-load	42,000
Mixed PET and dairy, whole, loose	one cubic yard	average 32
Mixed PET, dairy and other rigid, whole, loose	one cubic yard	average 38
Mixed rigid, no film or dairy, whole, loose	one cubic yard	average 49
Mixed rigid, no film, granulated	gaylord	500-1,000
Mixed rigid and film, densified by mixed plastic mold technology	one cubic foot	average 60
Aluminum cans, whole	one cubic yard	50-74
Aluminum cans, flattened	one cubic yard	250
Aluminum cans	one full grocery bag	1.5
Aluminum cans	one large plastic grocery bag	300-500
Ferrous cans, whole	one cubic yard	150
Ferrous cans, flattened	one cubic yard	850
Corrugated cardboard, loose	one cubic yard	300
Corrugated cardboard, baled	one cubic yard	1,000-1,200
Leaves, uncompacted	one cubic yard	250-500
Leaves, compacted	one cubic yard	320-450
Leaves, vacuumed	one cubic yard	350
Wood chips	one cubic yard	500
Grass clippings	one cubic yard	400-1,500
Used motor oil	one gallon	7
Tire — passenger car	one	12
Tire — truck	one	60
Food waste, solid and liquid fats	55 gallon drum	412

Source: *DRAFT National Recycling Coalition Measurement Standards and Reporting Guidelines,* presented to the NRC Membership, (October 31, 1989)

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Storage Area

Table 6-13 can be used to estimate storage needs.

Table 6-13 can be used to estimate storage needs. After determining the types of equipment that will be used to process and compact the recyclables, a general estimate can be made of space requirements to store this material. It is important not to underestimate storage space needs. Enough storage space should be available to store materials for sufficient periods to gain high-volume prices or to account for the inability to sell some materials during market downturns. Some materials can be stored outside or in trailers, depending on market specifications.

Building Structure

The building should have as few interior columns as possible. This will allow the maximum flexibility for placing equipment and accommodating future needs to rearrange the layout. The floor should be strong enough in all places to accommodate both vehicles and heavy, stationary processing equipment. The floor should also be designed to allow for anchoring equipment. Although there may be a need to design in some recyclable pits to hold various materials, keeping a flat floor space will allow for easier moving or changing of equipment.

The ceiling should also be high enough to accommodate equipment specifications. Especially for larger MRFs, conveying lines, air classifiers, shredders, and other processing equipment can be as tall as forty feet. For flexibility, it is just as important to have enough space vertically as horizontally (see Figure 6-11).

Employee and Education Facilities

Locker rooms, bathrooms, showers, a first aid station, an administrative office, a weighing station and public education facilities should be considered.

In addition to estimating space for material drop off, processing, and storage, the design must include space for employee facilities. Locker rooms, bathrooms, showers, a first aid station, an administrative office, and a weighing station should all be considered. For facilities that operate a buy-back center along with the MRF, space for a cashier and an area for accepting recyclables from the public should be provided. Large facilities often have rooms where the operation can be explained to public tour groups or for use as a lunch room. The rooms have windows overlooking the processing floor, and educational programs can be conducted safely and quietly.

Depending on the site's geographic location, radiant heating units or space for furnace or air conditioning equipment should be part of the design. Local building codes should be consulted to determine work place minimum environmental standards. If employees are to be drawn from a specialized work force, such as developmentally disabled individuals or the handicapped, special regulations may apply. A shop for housing tools and maintaining equipment could also be part of the design.

Hazardous Materials Area

MRFs accepting household hazardous waste or waste oil should include a special area designed according to local, state, and federal requirements.

A MRF may or may not be designed to accept household hazardous waste or waste oil. If the MRF is intended to accept household hazardous waste or waste oil, a special area should be designed according to local, state, and federal requirements. Even if household or other forms of hazardous waste will not be accepted as part of the recycling program, some area should be set aside for storing the hazardous materials that will no doubt be received at some time during the MRF operation. Hazardous waste, medical waste, low-level radioactive waste, and other hazardous chemicals may be found in incoming loads. A protocol for handling this material should be established.

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Employees should be carefully trained to reduce risk of injury or exposure. Accepting hazardous waste can complicate siting and permitting requirements.

Building Layout and Equipment Choices: Manpower Versus Machines

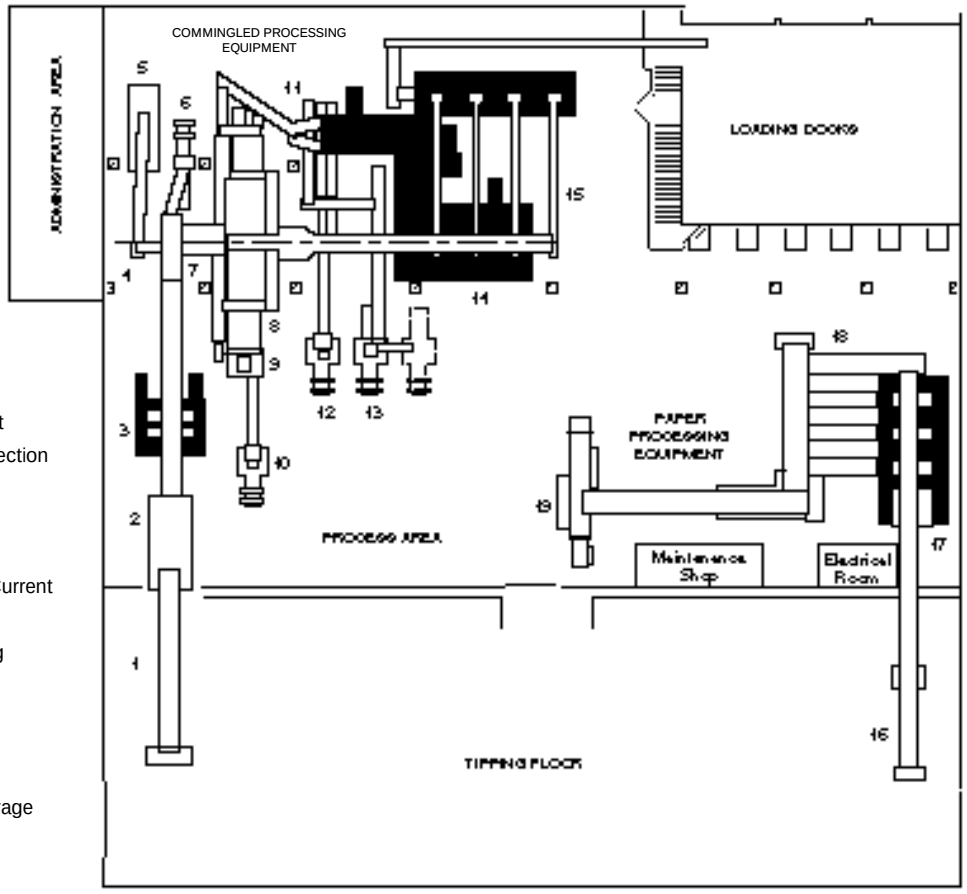
Manual sorting yields high-quality, low-contamination loads of recyclables and minimizes downtime.

Mechanized sorting equipment providing improved handling efficiency at an acceptable quality is available.

Manual sorting is the best way to get high-quality, low-contamination loads of recyclables and experience less downtime. For some commodities, such as mixed colored glass, manual sorting is the only proven feasible alternative. However, manual sorting can also be dirty, dusty, dangerous, and expensive, especially when large volumes of material must be handled.

Increasingly, mechanized sorting equipment is becoming available, which may provide improved handling efficiency at an acceptable quality. This equipment is designed to receive commingled recyclables and separate the total volume into its component parts, such as aluminum cans, plastics, glass, and ferrous metals. Classifiers, using air or mechanical methods, separate light materials from heavier. Eddy currents separate aluminum cans. Magnetic belts or drums can pick off ferrous metals. Proprietary technology,

Figure 6-11
Facility Layout, DuPage County, Illinois, North Intermediate Processing Facility



1. Commingled Infeed Pit
2. Flow Control Sensors
3. Pre-Sort Station
4. Overhead Electromagnet
5. Reject and Residue Collection
6. Ferrous Baler
7. Vibrating Screen
8. Inclined Sorting Table
9. Vibrating Screen/Eddy Current
10. Aluminum Baler
11. Head-on Plastics Sorting Stations
12. PET Plastics Baler
13. HDPE Plastics Baler
14. Glass Sorting Station
15. Glass Crushers and Storage Bunkers
16. Paper Infeed Pit
17. Paper Sorting Station
18. Paper Storage Bunkers
19. Paper Baler

Source: Camp Dresser and McKee, Inc. 1991

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such as the BRINI system, is available. New techniques include the Bezner system, which uses moving chain curtains to trap light materials like plastic and aluminum cans, while allowing denser materials, such as glass, to move through the hanging chains. Optical scanners are also being developed to sort glass by color. More technology for sorting recyclables is expected to come on the market in the near future.

Several factors affect the decision to use manual or mechanical sorting methods.

In designing a MRF, decisions about whether to rely on manual sorting or mechanical sorting must be based on the volume and types of materials to be handled; the economics of purchasing, operating, and maintaining the equipment versus the cost of hiring additional employees; and market requirements concerning the degree of acceptable contamination. High-volume facilities should probably be designed to use mechanical sorting if efficient equipment is available, supplemented with manual sorting for quality control (see Figure 6-12). A primary design goal should be minimizing the number of times that material must be handled as it moves through the facility.

Conveyor Line

Handling efficiency for a MRF is greatly enhanced by using conveyor lines to move waste from the tipping area through processing. Conveyor lines can be used merely for transporting materials to mechanical equipment or can act as moving lines that allow workers to separate various commodities. Conveyor lines are an integral part of any well-designed MRF.

A conveyor line should be designed to allow an employee to be standing upright or seated while separating materials. If an employee must bend over or stand in an uncomfortable position, injuries will result. Likewise, the line should be designed to keep employees from snagging clothes or receiving injuries while sorting. Emergency shut-off cords and palm-size panic buttons should be included with conveyor systems.

To achieve very low contamination levels, a positive sorting system should be used.

If very low contamination levels will be accepted by markets, a positive sorting system should be used. In positive sorting, recyclables are picked from the conveyor and placed in storage containers; with negative sorting, contaminants are picked off the conveyor, but everything else ends up in the same storage bin. Negative sorting allows a greater percentage of contaminants to slip through the process.

Processing and Densifying Equipment

For small operations, collected recyclables can be stored loose in Gaylord boxes and marketed directly. The feasibility of this option depends on local markets and transportation costs. Most recycling centers use some processing and densification equipment in order to increase the price paid by a market or to lower unit transportation costs by maximizing the volume in each load. Decisions about buying processing equipment depend on the volume of material that will be handled and especially on the requirements of the markets. Some markets want to receive material baled, some shredded, others loose. Some markets will accept waste in a variety of forms, but will pay different prices for each. Processing equipment should be selected carefully for each facility to meet its particular processing requirements. The capital and operating costs, along with space requirements, must be balanced against the improved marketability and revenue that processing will bring.

Decisions about buying processing equipment depend on the volume of material and market requirements.

Balers are usually the most versatile piece of processing equipment that recycling centers use. Balers can be used to densify many types of materials including paper, cardboard, plastic, and cans. Using a baler facilitates stacking bales, which improves space utilization and reduces material transportation costs. Balers come in a variety of sizes and prices. For industrial markets, large bales (600-1200 pounds, 30-40 inches wide) are the norm. For animal bedding from newsprint, small bales, on the order of 70 pounds each, are preferred by farmers.

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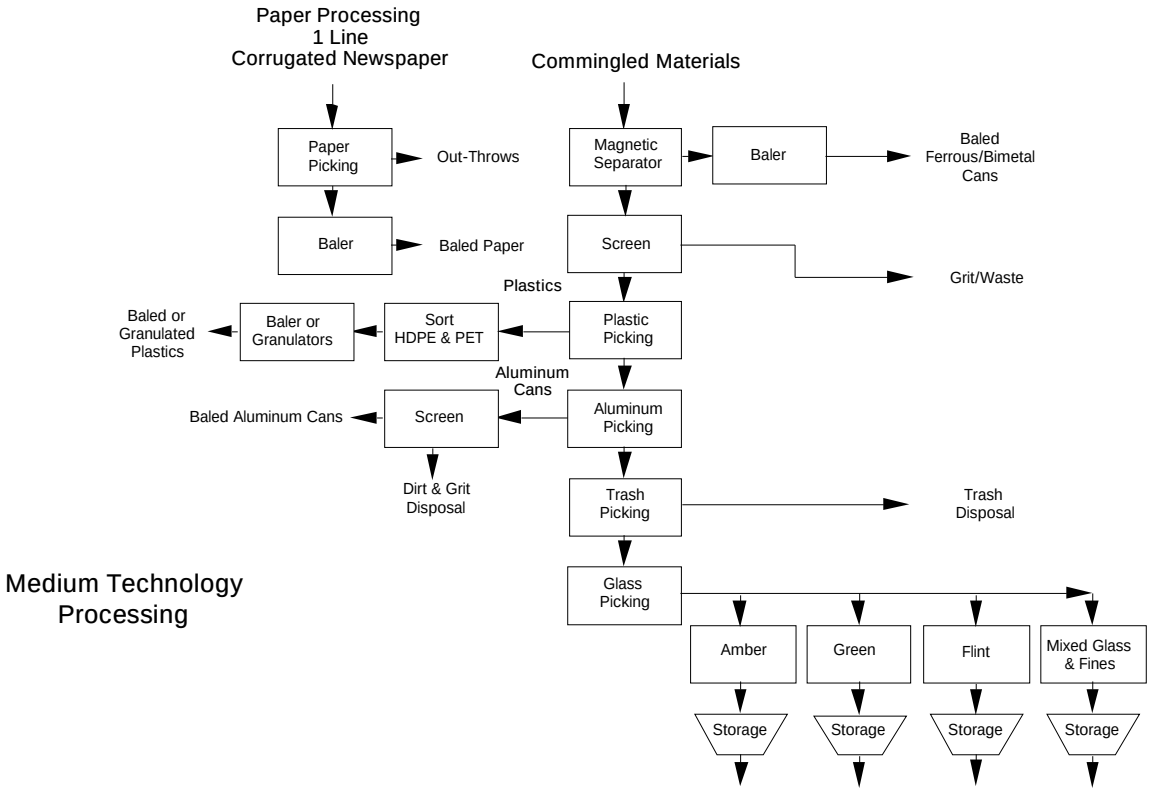
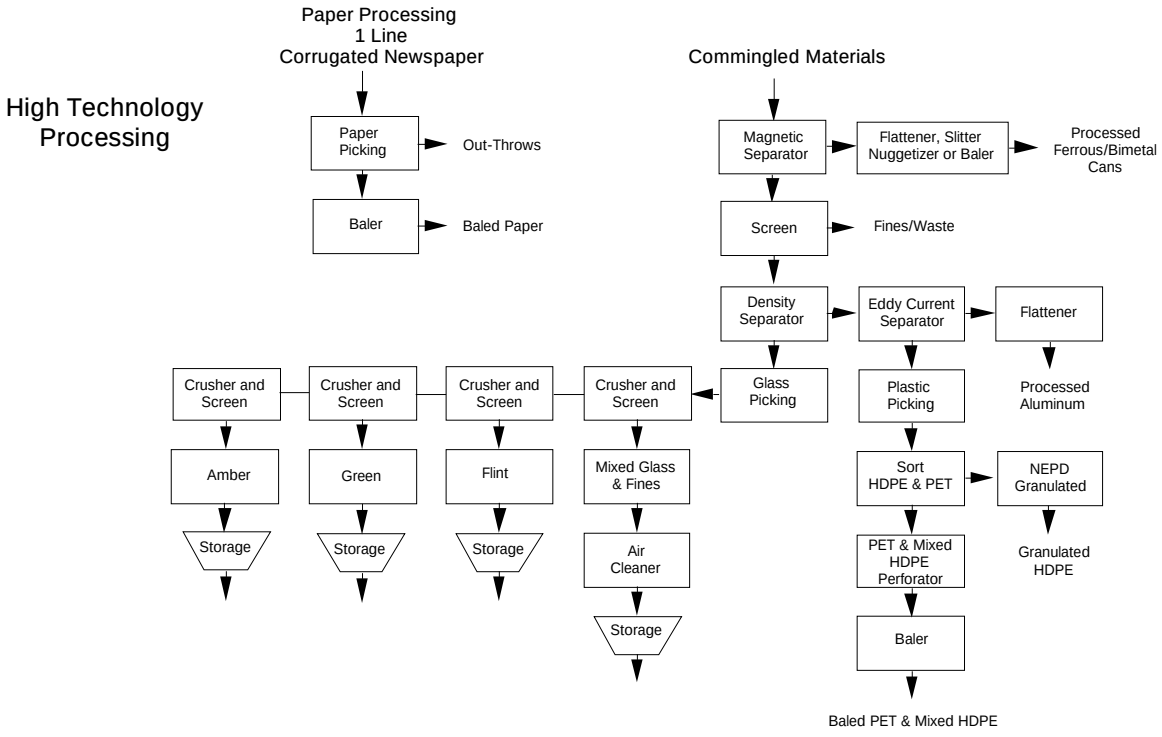
Figure 6-12
Medium and High Technology Processing





Source: Pferdehirt, W. "Planning Bigger, Faster, More Flexible MRFs," *Solid Waste and Power,* October 1990

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Higher-volume facilities typically require balers with continuous-feed (rather than batch) capability, and with an automatic tying mechanism. Larger processing facilities typically have one heavy-duty baler for all paper materials and one or more medium-duty baler for cans and plastics. A baler to be used for PET bottles can be fitted with a perforator, thereby eliminating the need to manually remove caps from the bottles before baling. Balers for paper materials should be equipped with a swing-out ruffler that can be engaged when baling newspapers to increase bale density.

Glass crushing improves densification and makes for more cost-efficient loads.

Glass crushing improves densification and makes for more cost-efficient loads. Glass-crushing equipment can be as simple as a sledge hammer used to crush glass through a hole in the top of a 55 gallon drum of glass. A hammer mill can also be used, if large volumes must be crushed. Some recycling operations simply drop glass from the top of a long conveyer onto other glass piled in a revetment, using gravity as the breaking force. Equipment to crush, screen, and store glass must be designed to accommodate the highly abrasive nature of crushed glass; well-designed glass processing equipment often includes wear plates that can be routinely replaced. Marketing requirements, volume needs, and resources will help determine which type of glass-crushing equipment is feasible.

The market will determine whether a shredder is needed or, in the case of plastics, acceptable.

Shredders and chippers can be used for newsprint (for animal bedding), mixed paper, plastic bottles, and confidential documents. The market will determine whether a shredder is needed or, in the case of plastics, acceptable. Shredders and chippers should be equipped with safety protections, including dust control.

Other specialty equipment like can flatteners can also provide improved densification. Frequently in the past, processing equipment that was developed for other uses was converted and used for recycling. Recently, industry has begun developing processing and densification equipment especially for recycling operations. Improvements in equipment design and operation are expected in the future.

Handling Equipment

Even small recycling operations will need some methods of moving materials from the tipping area to storage and from storage to transport vehicles. When 55 gallon drums are used, hand trucks or dollies may be sufficient. However, for 55 gallon drums of glass, handling with a hand truck can be dangerous and difficult.

The MRF layout should allow sufficient aisle space for efficient and safe movement of materials.

For larger operations, fork-lift trucks to move baled material are a must. Front-end loaders are also used to move loose materials such as paper, glass, and cans. For air quality purposes, propane or electric fork-lift models should be used inside. Diesel or gas models are fine for outside work.

In developing the layout for the MRF, it is important to allow sufficient aisle space for efficient and safe movement of materials. Handling equipment must have sufficient room to move from processing to storage areas, preferably without the need to make tight turns or to cross flow paths used for moving other materials. The traffic pattern should also allow for rapid loading and unloading of vehicles.

When choosing processing, handling, and densification equipment, it is important to consider equipment life cycle costs.

When making decisions about processing, handling, and densification equipment, it is important to consider the life cycle cost for this equipment. In addition, factors such as the capacity of the machine, whether it is continuous feed or batch feed, its reliability record or servicing needs, and energy requirements are all important. Likewise, the space needed for equipment and the required loading and unloading areas should be noted. Also, reinforced concrete slabs should be designed to withstand the weight of loaded collection trucks and tractor trailers and to properly support equipment and stored materials.

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Redundancy

Including redundancy in equipment processing capability is important.

When laying out the overall design of the MRF and making equipment choices, it is important to include redundancy in equipment processing capability where possible. Equipment failure in one area of the MRF should not cause the entire operation to shut down. Although cost and space requirements may prevent having two of everything, developing multiple sorting lines and alternative handling methods will make the system less prone to shut down. Likewise, equipment should be placed so that both routine and special maintenance can be performed easily and without disruption to other MRF functions. Having an operator from an existing MRF on the new facility's design team can help avoid future operational problems.

DEVELOPING AN ORGANIZATIONAL PLAN AND BUDGET

To be successful, recycling operations must be run like businesses.

Whether the recycling operation is public or private, to be successful it must be run like a business. In the past, many community programs were run with mostly volunteer labor. Although some volunteers may still be used, successful recycling programs rely on trained personnel and have an institutionalized structure within the community. The program must be designed to run smoothly despite changing conditions and personnel turnover.

Organization

Recycling programs can be designed to be purely public, public and private, or purely private.

Recycling programs can be designed to be purely public, public and private, or purely private. The legal organization of the recycling program will depend on local circumstances and the desire for allocating risk and control. Special attention should be given to legal requirements in deciding on the program organization.

For a purely public program, the operation could be run by the public works department and overseen by the city council or county board. For multijurisdictional programs, a sanitary district or recycling commission could be formed, depending on local laws. For these operations, intergovernmental agreements stating clearly the duties and responsibilities of each municipal member should be signed. A system for sharing expenses and revenues, an enforcement policy, and other programmatic details should be clearly stated.

For private programs, a decision needs to be made whether the operation should be for profit or nonprofit. Nonprofit corporations are tax exempt, but have greater government scrutiny of financial operations. Deciding whether to become a for-profit or nonprofit corporation is a major decision that should be discussed thoroughly with a qualified attorney.

Regardless of the legal structure, the organization should have clear delineation of responsibility.

Regardless of the legal structure, the organization should have clear delineation of responsibility. For any recycling program to succeed over the long term, someone must be directly responsible for ensuring that the program is properly managed. Without this clear responsibility, inefficiencies will develop, maintenance will be ignored, education and promotion efforts will slip, and downturns in the market could threaten the program's viability.

A recycling program will not run itself. For any large program, a paid manager or staff is necessary. The staff should have broad business and organizational skills. Personnel must have the ability to operate and supervise use of a variety of expensive and often dangerous machines. The manager should also be an effective promoter of the recycling program; he or she must be able to conduct public education and awareness programs and work with the local press. Other support personnel—office workers, cashiers, bookkeepers, accountants, and maintenance and cleaning personnel—should be planned as part of the organization. Paying a fair wage is crucial to attracting and keeping qualified employees.

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Budget

The budget should estimate as accurately as possible personnel, equipment, building, and other expenses.

Using the information developed in the previous steps, a detailed budgetary breakdown should be prepared. The budget should estimate as accurately as possible personnel, equipment, building, and other expenses. It should indicate anticipated capital and operating costs for a MRF or a collection center and predict revenues and other income sources. Because recycling markets are volatile, revenues from recyclable sales should be conservatively estimated. Budgets should include any program-related expenses, such as the cost of publicity and promotion, insurance, utilities, office equipment, and maintenance (see Table 6-14). The availability of state and local grants or loans should also be considered.

When several scenarios are considered, a budget should be prepared for each. For example, a large community might compare building one very large MRF versus two or three smaller ones. Establishing transfer points to move smaller quantities of material to a central MRF can also be considered. Likewise, purchasing a costly piece of processing equipment can be compared to costs for additional manual processing without the equipment. While cost is not the driving force behind most recycling programs, comparing costs and discussing goals can help a community choose from a variety of options.

Financing

Revenue from selling recyclables is usually inadequate to cover all program costs.

Most communities budget additional tax moneys or develop alternative financing strategies.

Revenue from the sale of recyclables is usually inadequate to cover all program costs. Most communities need to budget additional tax moneys or develop alternative strategies for program financing. Some also use program financing methods as incentives to recycle, for example, charging for waste collection on a volume-based standard. Such "user-fee" or "generator-pay" systems internalize the cost of waste production for each generator, thereby encouraging them to decrease the amount of waste they discard by changing buying habits, reusing materials, and increasing recycling. To encourage recycling, recyclable collection is often provided free or at low rates and its costs rolled into the nonrecyclable rate base. These programs have improved recycling rates and decreased overall waste volumes.

In some rural communities, an increase in littering or home disposal has occurred when a volume-based system was instituted. In urban areas, residential waste may be dumped in commercial dumpsters. Additional education and publicity may be necessary to explain program benefits when such problems develop.

Many private haulers will work with communities to share the benefits and risks of recycling. Some haulers provide a rebate to communities based on the volume of recyclables collected and the volume of waste diverted from the landfill. Careful negotiations during contracting can provide a strong incentive for both the hauler and the community to work hard to make recycling a success. A contract that shares benefits and risks should also provide a procedure for sharing costs during slow market periods.

Communities owning a landfill, MRF, waste-to-energy plant, compost operation, or transfer station may be able to help underwrite recycling program costs by including within its tipping fee a portion for recycling. Private haulers and other communities would then be supporting community recycling efforts. The tipping fee increase can also be seen as an incentive to recycle.

ADDRESSING LEGAL SITING ISSUES

Addressing legal issues during the planning and implementation stage is crucial.

A variety of legal issues must be addressed in developing an effective recycling program. Resolving these issues as part of the planning and implementation process is crucial. Forgetting or ignoring a legal requirement could stop the entire program in its tracks because of a legal challenge. To keep program

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A detailed budgetary breakdown including all program-related expenses should be prepared.

Table 6-14: Model Budget

Budget Categories:

- Personnel
- Equipment
- Supplies
- Contractual
- Leasehold and site improvement
- Other operating expenses
- Space rental

Budget Categories	Total	Donated
Personnel		
Salary and fringes	$00,000	
Overtime	0,000	
Subtotal	$00,000	
Equipment		
Floor scale	$0,000	$0,000
Portable scales (2)	0,000	0,000
Truck, hydraulic lift tailgate	0,000	0,000
PET grinder	00,000	
Forklift Truck		0,000
Can crushers	00,000	0,000
Aluminum and steel sorter	0,000	
3 chain-flail glass crushers	0,000	
Belt conveyor	0,000	0,000
Wooden steps (paper trailer)	000	
Self-dumping hoppers	0,000	0,000
Bulk cullet containers		0,000
Push carts (10)	0,000	0,000
Pallets (50)		000
Miscellaneous signs	0,000	
Glass storage bins	0,000	
Subtotal	$000,000	$00,000
Office Equipment		
Cash register	$0,000	
Furniture	0,000	$0,000
Typewriter	000	
Calculator		000
Phone answering machine	000	
Subtotal	$0,000	$0,000
Supplies	$000	$000
Contractual		
Professional fees	$0,000	
Physical plant layout and design		$0,000
Subtotal	$0,000	$0,000
Leasehold and site improvements		
Grading and paving	$00,000	$00,000
Building construction		00, 000
Outside lighting		0, 000
120/140 volt power		0,000
460 volt power		0,000
Subtotal	$00,000	$00,000
Other Operating Expenses		
Utilities	$0,000	
Advertising	0,000	
Repairs and maintenance	0,000	
Trash and snow removal	000	
Insurance	000	
Phone	000	
Gas and oil	00	
Other	000	
Subtotal	$0,000	
Space Rental	$0,000	
Grand Total	$000,000	$00,000

Source: *The Complete Guide to Planning, Building and Operating a Multi-Material Recycling Theme Center*, Glass Packaging Institute, 1984

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development on schedule then, attention to legal issues is crucial. Some legal issues may result from legislative mandates at the state level.

Zoning and Land Use Considerations in Siting

When possible, it is best to look for a site already zoned for recycling processing.

A proposal to site a MRF may be opposed by neighbors. When possible, it is best to look for a site already zoned to allow recycling processing. If the best site available needs a zoning change or a variance, procedures to obtain the approvals should be initiated immediately. Some opponents may try to convince local officials that a recycling operation is a glorified junk or scrap yard. It will be important to show clearly that this is not the case.

As discussed in Chapters 1 and 2, plans for public involvement during program development should be implemented. By providing for public education and input, issues that could create opposition can be recognized and resolved. Public support for the community planning effort will be fostered. A well-conceived public involvement program will assist decision makers in generating a broad consensus in favor of the proposed community approach to recycling.

Building Codes

Follow local building codes carefully.

Local building codes should be carefully followed when designing a MRF. Basics such as the number of bathrooms, minimal working space per employee, and other requirements may be specified. Working condition rules such as minimum and maximum temperatures, air changes, and required ventilation may also influence design. Note that the standards may be higher if developmentally disabled workers will be employed.

Permits

All permits should be obtained before beginning the recycling program operation.

All necessary permits should be obtained before beginning the recycling program operation. Contact regulatory authorities to determine if permits are needed for air and water quality or solid and hazardous waste storage. Permits may also be needed for both intrastate and interstate transportation of recyclables, especially for overweight loads. Local governments may also have a variety of operating permits and other restrictions. Federal and state rules regarding employee and community right to know and employee safety should be studied. Protocols for meeting these criteria and protecting employees from injury should be established.

Contracts

Depending on the type of program, a variety of contracts may be needed. All aspects of recyclable operation, including collection, processing, and marketing, may be covered by contract. Construction of a MRF may also be covered by local bidding laws, and it may be necessary to negotiate a variety of contracts. Specifications for equipment purchases must also be developed.

General Business Regulation

Procedures for insurance, worker's compensation, tax withholding, and social security should be developed.

Procedures for business operation, such as adequate insurance, worker's compensation, tax withholding, and social security should be developed. If the operation of a public recycling program involves unionized employees, union contracts should be investigated to determine if problems could arise. This is an important consideration. Some cities have signed expensive contracts with private haulers only to find that the contracts violated union agreements. Special attention should be given to insurance, labor, and other issues in programs that will use volunteer help.

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Ordinances

As part of a recycling program, a variety of ordinances may be needed. If mandatory recycling is chosen by state or local government, some programs may require local government enforcement to induce broad compliance. To ensure that people understand what is required of them, many communities use recycling ordinances that have the force of law.

While there is no all-encompassing model for a source recycling ordinance, in general each ordinance should have the following components:

In general, ordinances should have these components.

1. **Statement of purpose:** reasons recycling is being imposed, such as saving landfill space or protecting the environment.
2. **Applicability of the ordinance:** who must separate the waste? Does the ordinance apply to both citizens and private businesses? How will apartment houses be handled? Is anyone exempt?
3. **Items that must be separated:** not all communities want to recycle the same items. A definition section in the ordinance may be advisable to clarify which items must be recycled. Also, state which items—such as grass clippings or leaves—will not be accepted.
4. **Material processing:** processing requirements, such as crushing, cleaning, cap removal, bundling, or stacking in bins, should be clearly stated.
5. **Collection procedure:** some communities have separate pick-up days for recyclables and nonrecyclables. Others require drop off at recycling centers. The local situation will dictate how this is handled. For a recycling center, the hours of operation should normally be included in the ordinance.
6. **Penalties: s**ome communities impose fines for noncompliance. Others will not pick up unseparated waste.

It may be a good idea to enact an antiscavenging ordinance, too, in communities that will impose curbside pickup. The ordinance would make it unlawful for unauthorized persons to pick up recyclables from curbside. Fines for scavenging should be large enough to act as a deterrent. If a community's sole aim is to reduce the waste stream, scavenging may not be considered a problem. However, if program revenue is important, efforts at discouraging scavenging should probably be undertaken.

DEVELOPING A START-UP APPROACH

A recycling program involves a major change in handling waste for most citizens. A curbside collection program may require of a community large expenditures for new equipment and personnel. For recycling programs to be successful, citizens must know what is expected of them and must help make the program a success. If a program gets off to a poor start because collection is inconvenient or inefficient for local citizens, the long-term program may never achieve the success desired.

Expect unusually large amounts of recyclables for the first week or two weeks of collection. Citizens and businesses tend to save recyclables in anticipation of the beginning of the program. If not anticipated, this initial response can inundate collection vehicles and the MRF. Collections could slow and residents may be unhappy. Asking residents to set out recyclables over a number of collection days will help avoid problems. This request should be made during preprogram educational and publicity efforts.

Most programs benefit from devising and following a careful start-up plan.

Therefore, even with a well-designed program, a careful start-up plan should be devised. Although some communities successfully go from no recycling to mandatory curbside recycling, a better approach may be to devise a smaller scale or less compulsory start-up approach. The approach can be used to

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develop information that will help the community make decisions about how best to collect material and about which type of collection strategy works the best. Once the program is running at full scale, it may be difficult to make changes. Using a pilot start-up approach allows the community to try a number of ideas prior to making full-scale, expensive, and perhaps irreversible decisions. Phasing in the system, starting with the residences, then adding apartments and then businesses, has also been successful for some communities.

Pilot Programs

In a pilot program, recyclables are collected using prescribed methods for a certain period of time. The efficiency of the approach is then evaluated. Often, pilots are run using different methods in different neighborhoods so that results can be compared.

In pilot programs, recyclables are collected through a specific period using prescribed methods. The efficiency of the approach is then evaluated.

A pilot program serves a variety of needs. First, it allows the community to try an approach, such as clear bag collection or bin collection, without the expense of going community wide. Second, if coupled with a strong education and publicity program, the pilot program can begin public discussion and understanding of the recycling program and generate community support for source separation. Third, the pilot can provide a good estimate of the quantity of recyclables that can be expected. This information can be used to refine adjustments made earlier as part of waste characterization. Some communities have conducted pilot studies in place of waste characterization, feeling that an actual recycling program will yield better estimates of expected volumes than statistical studies.

The structure of the pilot can be fitted to the needs of the community. In a large city, a recycling program could be instituted in a few neighborhoods at first; eventually, the program could be extended to the whole city. Recycling could also be conducted only at a specific type of residence, such as single family homes, with the expectation that harder to reach citizenry, such as multi-family dwellers, would be added later.

Voluntary Recycling

Beginning the program with voluntary recycling may be a good idea, even for communities in which mandatory recycling is anticipated. A voluntary program can be used to educate people concerning the requirements and benefits of recycling without the coercive enforcement of a mandatory recycling ordinance. Once citizens are used to the voluntary program and many are already participating, a shift from voluntary to mandatory will not seem such a large step. Changes in procedures can also be made more easily when the program is voluntary than when enforcement is associated with noncompliance. If a curbside program is being developed, voluntary drop-off centers can provide an option for those who are separating recyclables. The drop-off centers can also provide publicity for recycling in the community.

Beginning programs with voluntary recycling may be beneficial, even for communities planning for mandatory recycling.

For many communities, the high participation rates achieved with a well-run and well-publicized voluntary program have eliminated the need for a mandatory program. Since it is always better for community well-being to seek cooperation rather than require it, an effort at voluntary source separation should probably be made at the outset. If a voluntary program does not achieve high participation rates, the local government then has a good political reason to move toward a mandatory program.

Another approach is to provide a strong economic incentive to recycle by "internalizing the cost of waste generation"—making recycling pay at the lowest level, for the user. For example, some communities charge variable rates for collecting recyclables and nonrecyclable waste, with the rate for recyclable collection being lower or free. This system provides a strong incentive to reduce overall waste costs by reducing waste generation and encouraging recycling.

Communities can provide strong economic incentives to recycle by internalizing the cost of waste generation.

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In addition, many communities now charge for pickups of special items, such as white goods, tires, or furniture, which in the past were picked up as part of refuse collection. Along with encouraging recycling, these efforts at internalizing the costs of waste generation have also encouraged waste reduction at the source.

Mandatory Recycling

Curbside pickup is the most common type of mandatory source separation program.

Among the various mandatory recycling programs now underway in the United States, each involves a different degree of community and citizen involvement. Curbside pickup is the most common type of mandatory source separation program. There is an important difference between a voluntary curbside pickup program and one that is mandatory. In many mandatory programs a resident who has not set recyclables out separately will not have his or her trash picked up. Many programs use stickers to indicate why waste was left at the curb (see Figure 6-2). Some mandatory programs impose fines for noncompliance, but to achieve compliance, most programs rely on the social pressure of having neighbors see that one's garbage was not picked up.

In rural areas and for some types of waste in urban areas, ordinances require residents to take materials to drop-off centers. Some rural communities have recycling centers at their landfills, with bins for recyclables.

Mandatory drop-off programs appear to work best when an attendant ensures that people dropping off waste have first separated recyclables. In urban areas where mandatory drop-off is used, it usually applies only to yard trimmings which are composted at a central site.

Ten states and a number of communities in the United States have deposit legislation for beverage containers. Generally, states with deposit legislation recover more of the targeted material than states using other collection schemes. New beverage container deposit legislation is now highly controversial. Some recyclers are concerned that a beverage deposit system may disrupt the many curbside collection programs as valuable materials, such as aluminum, are diverted from the curbside program. However, many communities with beverage container deposit laws also have successful curbside collection. Some states have enacted deposit legislation for pesticide containers and auto and other batteries to keep these products from going into landfills.

Some state recycling laws and communities that operate landfills serving other municipalities require source separation as a prerequisite for using the landfill.

Some state recycling laws and communities that operate landfills serving other municipalities have recently imposed source separation as a prerequisite for using the landfill. Fellow municipalities are required to enact recycling programs or look elsewhere for a disposal site. Waste that arrives at the landfill unseparated is rejected.

Note that this approach places a heavier burden on the waste hauler. Problems with compliance are especially difficult for haulers who serve sources like apartment complexes, where separation is hard to enforce. For these programs, haulers and client municipalities need to work closely together to develop an effective program.

IMPLEMENTING THE EDUCATION AND PUBLICITY PROGRAM

Long-term success will be achieved by a recycling program only if the reasons for participating are understood and accepted by the public. The public and local officials must be regularly reminded of the environmental, economic, and social reasons for reducing the amount of wastes taken to a landfill. They should receive regular feedback concerning amounts recovered and participation. To accomplish this, a plan must be developed—and implemented—providing publicity and promotion on a routine basis.

How can recycling be promoted? Some communities have Boy Scouts and Girl Scouts deliver flyers to local residences. Others have included pro-

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Programs achieve long-term success if the public understands and accepts the reasons for participating.

Accomplishing this requires a plan for providing publicity and promotion on a routine basis.

motional literature with water bills, tax bills, or weekly shoppers. Many have prepared public service announcements for radio and TV, and some have used special promotions. However, special promotions should be carefully considered, because some programs have experienced significantly decreased participation when the promotions ended.

Many citizens and businesses will have questions about new programs. A phone-in customer information service will smooth program implementation. Surveying community attitudes or conducting focus group sessions can also help determine which educational approach will work best.

Developing a recycling logo, which is placed on all community recyclable collection vehicles, is an effective method of publicizing the program. Recycling vehicles will be routinely seen by community residents during collection. The vehicles can also be used for publicity at public events such as fairs or sports competitions.

Education is the key to a recycling program's long-term success.

Although publicity and promotion are important ongoing needs, education is the key to long-term success. Children, who will one day be adults, will help determine whether recycling will become established, stable, and widely practiced in this country in the future. A number of curricula for teaching children about the need to recycle are now available. Children learn, through exercises specially designed for their grade level, how waste is produced, how much each person generates, where the waste goes, the environmental problems that can develop, and the benefits of limiting disposal needs through prevention recycling.

Besides educating the children, these programs often educate their parents. Many otherwise reluctant parents will participate if their children enlist their interest. While changing school curricula to include recycling education may take some time, a recycling program's chance of long-term success will be greatly enhanced if local educators become involved.

Plans should include a long-term schedule for promotion and education. Many recycling programs start with high participation rates during the first few months, only to see operations fail in the end because community outreach and education programs were neglected. The promotion plan should include periodic reports to local government officials concerning how the program is progressing. Local officials who are kept informed will be more amenable to providing both financial and legislative support for the program, should that become necessary.

BEGINNING PROGRAM OPERATION

If the program has been carefully planned and developed, program implementation should run smoothly. However, with new personnel, new equipment, and new rules for citizens, some problems will certainly develop. With patience and perseverance, the program can be fine tuned during its initial shakedown phase to make it run smoothly and efficiently. If the program is managed by an experienced recycling coordinator, the learning curve should be relatively short. A pilot program can help work the bugs out of a new system before the program is instituted throughout the community.

CONTINUING SUPERVISION, LONG-TERM PUBLICITY AND EDUCATION

Programs should be carefully supervised to maintain citizen and local government support.

Especially for a large community, a recycling program will be a significant investment of community resources. Recycling programs often start with great fanfare but are quickly forgotten as other community problems are faced. Unless the program is carefully supervised, citizen support could wane and problems could develop. Likewise, continuing local government support, such as for maintenance for the MRF, could decrease.

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The key to long-term success for the program will be planning and education. An operational plan should provide for timely maintenance and replacement of equipment and for continuing publicity. Program expansion, new technology, and variable markets must all be expected and planned for. Both management and operating personnel must be willing to change and improve skills to keep ahead of new developments in the field.

Likewise, changes in the processing technology that will affect the collection program must be communicated to the public. For example, if a commodity that was not collected before is now collected, the public should be adequately informed. Periodically, "how to" literature should be redistributed to educate new residents and to reinforce program parameters to the community. If a former requirement, such as removing the label from a steel can, is no longer required, the public should be informed. A well-developed program will generate community pride as well as keep the program from encountering unnecessary contamination.

A program to inform local officials about program benefits and costs should be implemented.

A program should also be implemented to keep local officials informed about program benefits and costs. If future expenditures by the community are needed, the program will have the support base necessary to explain the requirements and generate political support for budget requests. It will be hard to convince an uninformed governing body that additional equipment or operating moneys will be needed for a recycling program.

REVIEWING AND REVISING PROGRAMS TO MEET CHANGING NEEDS

All programs should be constantly reviewed and adjustments made when necessary.

Even managers of successful programs must constantly review their programs' progress and make necessary adjustments. Recycling is a fast-moving field with new technology, fluctuating market conditions, changing consumer waste generation patterns, and changing regulations as federal and state environmental legislation is enacted. An effective program must be flexible enough to adapt as conditions change.

REFERENCES

Gitlitz, J. 1989. "Curbside Collection Containers: A Comparative Evaluation," *Resource Recycling* January / February.

Glass Packaging Institute. 1984. *The Complete Guide to Planning, Building and Operating a Multi-Material Theme Center.*

Glenn, J. 1990. "Curbside Recycling Reaches 40 Million," *BioCycle*. July.

Gorino, R. J. 1992. "Commodity Wrap Up," *Scrap Processing.*

National Recycling Coalition. 1989. *National Recycling Coalition Measurement Standards and Reporting Guidelines: Draft.*

Pferdehirt, W. 1990. "Planning Bigger, Faster, More Flexible MRFs," *Solid Waste and Power,* October.

Powell, J. 1993. "How Are We Doing? The 1992 Report," *Resource Recycling,* April.

Schroeder, R. 1990. "Operating a Wood Waste Recycling Facility," *BioCycle*. December.

Steuteville, R., N. Goldstein and K. Grotz. 1993. "The State of Garbage in the America," *BioCycle*. June.

USEPA. 1992. *Characterization of Municipal Solid Waste in the United States, 1992 Update*. EPA / 30-R-92-019. July.

USEPA. 1990. *Procurement Guidelines for Government Agencies*. EPA / 530-SW-91-011. December.

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