ENVIRONMENTAL POLLUTION, MATERIAL SCARCITY AND
THE DEVELOPMENT OF ALUMINUM RECYCLING
REVERSE CHANNELS OF DISTRIBUTION

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In the past, unrestricted growth, unlimited and cheap energy, and an abundance of raw materials were the central values of business enterprise. The future, however, seems to offer a new organizational paradigm based on controlled growth, energy conservation, and materials reuse.

Central to this paradigm is the reverse channel of distribution, in which producers of recyclable and reusable solid waste material are conventional consumers and the users of these materials are traditional producers. Paradigms based on recycling reverse channels of distribution provide impetus for new channel institutions and a change in sorting emphasis for existing intermediaries.

The purpose of this study was to analyze the developing organizational and management paradigms in the aluminum packaging and container industry, where reverse channels of distribution offer an excellent vehicle for studying organizations which are "closing the distribution circle."

The most important reverse channels available to recycle aluminum are the manufacturers' direct channel and the specialist dealer channel. The direct channel is owned and operated by primary aluminum manufacturers as a source of raw materials. The specialist dealer reverse channel is comprised primarily of the forward distribution channels of major
beverage producers. Organization and management of the manufacturers' direct reverse channel and the specialist dealer reverse channel are analyzed by classifying and profiling organizational designs and management philosophies.

The stages of development and degree of sophistication of reverse channels show marked patterns of organization and management philosophy. Patterned recycling organization and management philosophy are largely the result of several influences operating upon the aluminum and beverage industries. Most important are (1) environmental legislation, (2) scarcity of raw materials, (3) energy shortages, and (4) economical solid waste management technology.

Based on the analysis, several conclusions are offered.

1. The extent to which primary manufacturers have entered aluminum packaging and container recycling and subsequently developed effective reverse channels of distribution is contingent upon needs for resources.

2. The most successful recycling programs are those which have decentralized organizations.

3. Central to beverage producers' decisions to develop extensive reverse channels of distribution is the belief that recycling is (1) a deterrent to container legislation, (2) a source of favorable publicity, (3) a source of company profits, and (4) can improve supply relationships with primary aluminum suppliers.

4. Regional beverage companies in the environmentally conscious Far West have the most successful and comprehensive recycling operations.

5. Loose organizational federations such as those of the soft
drink franchise do not seem amenable to the development of reverse channels of distribution.

6. Where it serves the needs of the enterprise, firms are developing sophisticated and efficient reverse channels of distribution. The institution of reverse channel intermediary functions reflects a new management and organizational paradigm based on environmental considerations.

7. A major stumbling block to further reverse channel development is the uncertainty caused by proposed container legislation.
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CHAPTER I

INTRODUCTION

The magnitude of solid waste pollution in the United States has reached staggering proportions and continues to increase at an alarming rate. Already solid waste pollution is adversely affecting the quality of the human environment and threatens to destroy the beauty and usefulness of many urban as well as rural areas. Early impetus for control of unsightly solid waste pollution was initiated primarily as a result of genuine concern for the natural environment and, along with air and water pollution, served as a key area of emphasis and effort of the ecology movement.

However, today a new and perhaps harsher reality has spawned the growing interest in solid waste pollution, a reality which goes far beyond concerns for the beauty of the natural environment. These new exigencies stem largely from the seemingly sudden realization by government officials and business executives that the United States is rapidly depleting its available natural resources and becoming more dependent on foreign sources of raw materials. This new and prevailing attitude toward solid waste pollution is exemplified by a statement made by West Virginia Senator Jennings Randolph on July 9, 1974 before the Panel on Materials Policy of the
Subcommittee on Environmental Pollution of the Committee on Public Works. Senator Randolph noted,

Solid waste problems involve more than just mere disposal of what we call discards. The energy crisis and the continuing attention which we must give to this subject and the growing shortages of raw material make it essential that we devise and implement resource recovery. . . . Reality is now forcing us to adopt conservation attitudes and to develop the potential for reusing many materials that we formerly considered as waste (19).

The Extent of Solid Waste in the United States

In examining the current dimensions of the solid waste problem, the United States Department of Health, Education and Welfare (DHEW) has found that individual households in 1930 generated about 2.2 pounds of solid waste per day and by 1970 this figure had risen to 5.3 pounds. Moreover, solid waste per household is projected to be in excess of 8 pounds per day by 1980—a fourfold increase in 50 years (15, p. 34). There is considerable concern among DHEW officials and environmentalists as to the long-range effects of these dramatic increases.

Additional solid waste studies initiated by the President's Council on Environmental Quality support the alarming proportions of the solid waste pollution problem and indicate that solid waste materials of the nation are "piling up" at the frightening rate of 4.3 billion tons a year, a figure which will double by 1980 (24, p. 14). Solid waste discarded in the United States consists of approximately 1.7 billion tons animal wastes, 1.7 billion tons mineral wastes, 640
million tons agriculture wastes, 230 million tons urban wastes, and 140 million tons industrial wastes. If significant changes are not soon initiated, by the year 2000 the United States will have to cope with some 12 billion tons of solid waste generated each year (12).

Currently, however, the rising tide of solid waste pollution shows no sign of abating. While the population of the United States grows at a little over one percent per year, consumption of goods has risen four to six percent a year (15, p. 34). With this increase in consumption there is an accompanying four to six percent increase in urban solid waste which in the United States amounts to a yearly average of approximately one ton for every man, woman and child, the highest per capita rate in the world (12, p. 202).

The specific environmental problems and effects of unchecked solid waste pollution are many but are perhaps best suggested by the declaration of purpose of the Solid Waste Disposal Act as amended. The Act states that

The continuing technological progress and improvement in methods of manufacture, packaging, and marketing of consumer products has resulted in an ever-mounting increase, and in a change in the characteristics of the mass material discarded by the purchaser of such products. . . . Inefficient and improper methods of disposal of solid wastes result in scenic blights, create serious hazards to public health, . . . have an adverse effect on land values, create public nuisances, [and] otherwise interfere with community life and development (22).

These conditions are becoming increasingly prevalent and are largely the result of America's affluence and throw-away
attitude. For example, America's discard after one-time use amounts to over 250 million tons of residential, commercial, and institutional waste each year including more than 60 billion metal cans, 46 billion glass containers, 65 billion metal bottle caps, 7 million automobiles, and 7.6 million television sets (12, p. 203). This is an extremely wasteful situation and as Joseph A. MacDonald so poignantly suggested,

Not only are these discarded materials lost as commodities of economic value, they also create ... management costs of overwhelming proportions. The collection, dumping, burning or burying of municipal wastes represents an extravagant destruction of billions of dollars worth of precious by-products of this planet's finite natural resources. The prospect for the problem eventually to level off appears dim (12, p. 203).

Senator Frank Moss of the Commerce Committee's Subcommittee on Environment properly conceptualized and summarized not only the magnitude and thrust of current solid waste pollution but also suggested what is perhaps the most realistic means for solving this pressing environmental issue.

In the past we have operated under a "frontier economy." In the frontier resources were there for the taking, and we took, and we dumped our wastes. Business that relied on the depletion of scarce resources, whether biological or mineral, did not see that they were borrowing from nature. Society will have to pay the interest and the principal on that borrowing at a later date. We are beginning to be aware of the need to change our attitudes regarding this, but the rhetoric of the ecology movement has yet to reach the reality of the marketplace (20).

Implicit in Senator Moss's statement is the notion that it will take more than just legislation or public awareness of pollution to solve the solid waste problem. It will take a positive effort in the marketplace, and the most effective
method of stimulating business to control solid waste is through the traditional concepts of profit. Thus, as raw or virgin materials become more scarce and expensive, producers will find the reuse of waste materials to be a viable, even preferable, alternative.

Resource Shortage Perspectives

It is becoming more readily accepted by government officials, business executives and scientists that we live in a world of finite resources. Indeed, numerous national as well as international organizations and societies have been formed to study growth and its effects in a world with limited raw materials. Perhaps the best known of such organizations is The Club of Rome, an informal organization formed to specifically investigate and foster understanding in five major trends of global concern—accelerating industrialization, rapid population growth, widespread malnutrition, depletion of nonrenewable resources, and a deteriorating environment (13, p. 21).

Much of the research design and analysis presented by The Club of Rome is based specifically on Jay W. Forrester's original work at the Massachusetts Institute of Technology in which he developed a computer simulated global model. The Forrester model is designed to study the limits of the planet as a whole and attempts a clearer identification of the effects and interrelationships of continued growth on economic
activity, population, food supplies, natural resources and environmental pollution (7).

The somewhat more elaborate Club of Rome global model built under the direction of Dennis Meadows produces much the same conclusions as those of the Forrester model and are delineated as follows.

1. If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity.

2. It is possible to alter these growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium could be designed so that the basic materials of each person on earth are satisfied and each person has an equal opportunity to realize his individual human potential.

3. If the world’s people decide to strive for this second outcome rather than the first, the sooner they begin working to attain it, the greater will be their chances of success (13, p. 24).

As with any forecast of the future a great deal of controversy and disagreement surrounds The Club of Rome and Forrester's models and conclusions (4). However, there is also considerable agreement as to these conclusions particularly with regard to trends in raw material consumption and limits of such resources and to the effects of unchecked pollution (16).

There is much current evidence available, particularly regarding the United States, to support the gloomy assumptions
underlying The Club of Rome analysis of resource shortages. For example, in 1970 the Interior Department reported that the United States was dependent on imports for more than half its supply of six important minerals including aluminum, manganese, nickel, tin, zinc and chromium (14, p. 145). By 1995 the United States will be dependent on overseas sources for more than half of all its metal needs and already substitutes are being sought for chromium, gold, platinum, palladium and tin. Moreover, within two decades substitutes for helium, mercury, tungsten, vanadium, silver and zinc must be found for known world reserves will be in serious short supply (14, p. 145).

Much additional evidence supporting increased shortages and scarcity of natural resources has been accumulated by the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee of Congress. This evidence was gathered by the subcommittee while studying resource scarcity, economic growth and the environment. The opening statement by Senator William Proxmire in December 1973 captures the mood and emphasis of much of the subsequent testimony. Senator Proxmire indicated that

... Shortages of certain foods, of industrial raw materials, of manufacturing capacity, and now, most seriously, of fuels have wreaked havoc with the U.S. economy and the price system. The question recurs, of course, have we entered a period of scarcity? Must we expect continuously to confront one shortage after another? Must we choose between maintaining our material standard of living and preserving our environment?
Traditional economics teaches us that the price system will allocate scarce resources. The price of the scarce commodity will rise relative to other prices. This will encourage conservation and promote the adoption of substitutes. But recently we seem to have run out of substitutes. When beef prices rose . . . , consumers were advised to turn to other sources of protein. However, it did not take long to discover that chicken, eggs, cheese, milk, and even soybeans were also in short supply. Few substitutes were left.

Similarly, in the past we have turned to plastics and synthetics as substitutes of metals and for natural fibers. But now, as one outgrowth of the petroleum shortage, we face a growing shortage of plastics and synthetics. Now what do we substitute? (11).

It is quite apparent that the United States, as well as the entire world, is facing a critical scarcity problem. There continues to be an increasing demand for natural resources in the face of a limited and dwindling supply. Ultimately it is unimportant whether one concurs with the conclusions of the several "doomsday" models which indicate acute material shortages in the very near future or even the more empirical evidence gathered by various government agencies. It is simply impossible to deny the fundamental logic that we live in a finite world consisting of a given amount of resources. Whether advancing technology can vitiate these problems, it is difficult to surmise. However, it seems clear that some sort of conservation policies are in order to prevent unnecessary waste and preserve the remaining material resources and the natural beauty of the land.

The Role of Materials Recycling

What is needed in the United States is a comprehensive analysis of material supply and demand over the foreseeable
future and the formulation of a national materials policy developed as a joint effort by government, business and the community. This national policy should be designed to provide adequate resources and resource substitutes for the future while balancing material needs and environmental considerations. As M. J. Mighdoll and Peter D. Weisse have pointed out,

Unless American industry now takes careful measure of its long-term materials needs and motivates the federal government to implement rational policies to ensure plentiful resources in the future, the nation will be plagued with limited and costly supplies of energy-related raw materials of every kind. The results will ultimately have a disastrous impact on every sector of the economy (14, p. 143).

This attitude seems to be becoming more common. Indeed many organization and management theorists are discarding "modern" organization theory and are establishing new organizational paradigms based on assumptions of scarcity and management philosophies which reflect shortage values. William G. Scott's recent article, "Organization Theory: A Reassessment" in the June 1974 Academy of Management Journal, suggests that traditional assumptions of organization are hopelessly antiquated in light of the current and future material resource scarcity. Scott indicates,

The one fact which stands out clearly, after some years of experience and with hindsight, is that in 1960 major changes in American values, politics, and resources were unanticipated by management scholars and practitioners. . . .

Growth, abundance, and consensus are the paradigmatic values that control the classical and systems models. . . .
It is obvious that the preservation and nonabuse of our environment is of great concern and of urgent importance. The environment is a resource, and how this resource is used depends upon present-day values. Historically, we have leaned toward exploitation of the environment, but now attitudes are moving toward conservation. If this is more than a passing trend (and who can say now?), then attitudes governing the use of those resources which are essential to the technology of society will change toward a vision of scarcity that is consistent with the conservationist mentality (18, pp. 243, 245 and 248).

A major element of a national materials policy and important variable in contemporary and dynamic management models is waste management or, more simply, solid waste recycling. Recycling in its simplest form is the use of waste material in the manufacture of the same or a similar product, for example, using waste paper to produce paper or using ground glass to produce glass. Recycling alone can have a tremendous effect on extending the availability of raw materials as well as conserving energy resources. As H. V. Hodson has pointed out,

Much economy in the drawing-down of scarce natural resources can . . . be effected by re-use and re-cycling. Most industrial scrap is re-used or re-cycled, but there is still much that is not, and when we come to the final product we can see immense scope for economy of this nature. Metal objects, large like motor cars or small like tin cans, are just junked. Waste paper is burnt or treated as garbage. The non-returnable glass bottle is a growing pest to everyone but the manufacturers and retailers, who of course are the people with the direct and effective economic motive. Municipal cleansing departments burn, bury or take out to sea millions of tons of re-usable material daily. Sorting and re-using, or re-cycling, may not pay now, but they will come to do so, and if the rundown of world resources were allowed for in the price of materials used they ought to pay a great deal better forthwith (10, p. 199).
As suggested by Senator Moss, for solid waste recycling to be successfully implemented it must be carried out by business enterprise. There is no doubt that solid waste pollution is having an impact on society, both in terms of raw material waste and ecologically. Individual business enterprises are certainly responsible for those impacts and it is their responsibility to help solve the problem. Peter F. Drucker has indicated that there is no doubt regarding management's responsibility for social impacts and the optimal solution is to make the elimination of such impacts into a business opportunity (6, pp. 327-334).

Therefore, the key to recycling and reuse (the use of a product more than once) is to make it profitable for manufacturers. To make recycling profitable, additional costs of processing solid waste by the manufacturer plus the cost of accumulating, sorting and transporting recyclable material from the points of consumption to the points of production must be less than the cost of using raw materials. With the increasing volume of solid waste pollution, mounting public concern, scarcity and rising costs of virgin raw materials, availability of solid waste management technology and additional legislation protecting the environment, there are new economic opportunities and incentives that are contributing to the development of formal, highly sophisticated "reverse channels of distribution."
The Reverse Channels of Distribution Concept

The concept of the reverse channels of distribution is a logical extension of the marketing function—to bridge the physical and nonphysical gaps which exist between producers and consumers. However, in reverse channels traditional concepts of producers and consumers must be abandoned. The producers of recyclable and reusable solid waste materials are conventional consumers and the final users of their "product" are conventional producers. As illustrated by William G. Zikmund and William J. Stanton, the reverse channel of distribution "is identical to the traditional channel of distribution. The consumer has a product to sell and, in essence, he assumes the same position as a manufacturer selling a new product. The consumer's (seller's) role is to distribute his waste materials to the market that demands his product" (27, p. 35). In the reverse channel the consumer becomes the first link in the distribution chain and the manufacturer becomes the last. Also immanent in this concept is a reversal in the traditional physical flow of products.

An apparent problem in this reverse channel chain which must be solved before it can be considered effective is that there are numerous, extremely small producers of solid wastes producing highly differentiated products. Moreover, these producers seem to be without substantial motivation to participate in the channel. At present there is little incentive for individual consumers to consciously recycle solid waste
material; however, there are clear signs that this may be changing. This changing attitude is evidenced in various extant successful recycling programs. One of the most successful is the recycling of aluminum cans, particularly at the Adolf Coors Company.

**Reverse Channel Functions**

In order to create channel efficiency it is necessary for intermediaries to intervene between the many small producers of solid wastes and the consuming companies providing traditional middleman functions. As suggested by Alderson, in traditional channels the number and character of intervening intermediaries are determined primarily by the requirements of sorting and by the opportunity to effect economies by suitable sorting arrangements (1, pp. 38-39).

In reverse channels of distribution as in traditional channels the elements of sorting are of primary importance and can be considered the main justification for reverse channel intermediary existence. It should be noted, however, that there seems to be change in sorting emphasis in the reverse channel. In traditional channels all four sorting functions recognized by Alderson, sorting out, accumulation, allocation and assorting, are considered essential functions. However, because of the nature of reverse channels, assorting and allocation are not undertaken to any great extent. It appears that the important intermediary sorting functions in reverse
channels are sorting out—the breaking of heterogeneous supplies into homogeneous lots, and accumulation—the concentration of similar products into large homogeneous supplies.

Reverse channel middlemen therefore must have the capability of amassing large quantities of recyclable and reusable materials, a prerequisite to efficient and profitable recycling. This process includes the grading, sorting and segmenting of like materials into homogeneous lots for ultimate delivery to the appropriate manufacturing enterprises. Solid waste wholesalers are thus involved in accumulating large homogeneous supplies of recyclable and reusable solid waste materials via the sorting out process.

**Reverse Channel Attributes**

The reverse channel of distribution should be considered as a highly specialized channel performing a limited number of essential channel functions. The sequence of agencies involved in the reverse channel seems necessarily limited and it is doubtful that intermediaries would develop at the retail level. The existence of the solid waste merchant wholesaler, however, is considered essential and the ingredient which makes recycling possible.

As with traditional channels, reverse channels must be supported by a sequence of facilitating agencies which performs various auxiliary functions. Again, however, there appears to be a difference in emphasis with which these
facilitating agencies are employed. For example, the use of intermediary storage facilities along the channel seems unreasonable and unlikely. Facilitating agencies which may be most visible when the channel has reached a relatively significant degree of development may be transportation agencies moving large quantities of recyclable goods from merchant wholesalers to consuming companies.

It must also be emphasized that the process of getting recyclable and reusable solid waste materials from consumers back to producers creates the identical "flows" which exist in the forward physical movement of goods. Thus there are physical flows of goods through geography and time, and the associated flows of payment, ordering and capital, and an array of intangible flows consisting of ownership, negotiation, information and risk.

Because of the unique aspects of the reverse channel, the large-volume solid waste wholesaler may ultimately be in a position to dominate the channel, a role traditionally reserved for the manufacturer. This dominance may occur because solid waste middlemen exercise control over both elements of supply and demand. Middlemen may exercise control over demand of solid waste because small volume recyclable solid waste producers (traditional consumers) are forced to deal with a centralized intermediary which is willing and capable of accumulating large volumes of a variety of solid waste items. It seems unreasonable to assume that manufacturers without
developing their own solid waste reverse channel could economically deal with numerous small quantity producers.

Solid waste middlemen may also control the raw materials market. As virgin material costs rise, manufacturers must increasingly turn to solid waste intermediaries who have the facilities to sort and accumulate large quantities of recyclable materials. Therefore, the wholesaler could be in a position to exercise considerable channel leadership and in many cases may be regarded as the "channel captain." Such channel control may force manufacturers to integrate a reverse channel of distribution into their operation.

Reverse Channels of Distribution Research

While the literature contains a vast amount of research, statistics and analysis on solid waste pollution and its implications at a macro level, little has been accomplished concerning the development of specific organizational mechanisms to effectuate solid waste recycling. The organizational mechanism, which essentially creates a business opportunity out of an impact on society, is the reverse channel of distribution. The reverse channel of distribution, whether an extension of the manufacturing enterprise or an independent middleman organization, has been adequately conceptualized by Zikmund and Stanton (27), Ginter and Starling (8), and Guiltinan and Nwokoye (9). However, there has been no apparent detailed study designed specifically to analyze reverse channel development in a particular industry at a micro level.
Purpose of the Study

The broad intent of the study is to show that for many industries, especially manufacturing industries, a new organizational and management paradigm may indeed be in order. Environmental contingencies are playing a much larger role in determining how organizations function and resource scarcity perspectives are dictating new management emphasis and direction. Therefore, it is the purpose of this study to analyze the extent to which managerial effort and organizational design is being directed toward the consumer, not within the framework of the "marketing concept" but rather as a valuable and necessary source of "raw" materials. This study, within the limits outlined below, assesses the theoretical concept of enterprises "closing the circle" through the development of reverse channels of distribution.

Delimitations of the Study

The intent of the study will be accomplished by an analysis of the major reverse channels of distribution in the aluminum industry. Segments of the aluminum industry have perhaps the best developed reverse channels and currently offer the greatest incentive for further development. In addition, a study of this nature is valuable in identifying organizational contingencies and patterned relationships which may be extended to other commodity recycling efforts.
The aluminum industry is a complex and multifaceted industry and it is therefore necessary and appropriate to place some further delimiters on the study. Such delimitations are appropriate largely: (1) because certain types of materials are more amenable to recycling, (2) because there are many and varied uses of aluminum, and (3) because of the composition of the municipal solid waste stream.

Materials Amenable to Recycling

For the most part, the extent to which materials can be recycled depends largely upon the particular use for which the product was originally designed and manufactured (17, p. 281). The word "use" in this sense refers to whether the product is designed for "permanent use" or "temporary use." Therefore, product life is an extremely important determinant as to whether materials or products will be recycled.

Obviously the greatest potential and need for recycling lie with those products which are originally designed for temporary use. Temporary use products are generally more available in the solid waste stream and represent the most conspicuous waste of raw materials. In many instances temporary use represents extremely short periods of time—weeks, days and in some cases even hours or minutes. Such short product use periods occur most frequently with packaging materials. As suggested by Pavoni, Heer and Hagerty in their book *Handbook of Solid Waste Disposal: Materials and Energy*
Recovery "... examples for products in temporary use would include ... magazines, newspapers, and packaging materials. The metal, plastic, and glass containers used in the packaging industry are in use for very short periods of time and therefore constitute a prime target of recycling efforts" (17, p. 281).

The Aluminum Industry and Prospects for Aluminum Recycling

The United States Aluminum Industry can be subdivided by the various product markets it serves. The aluminum industry has identified its major markets as (1) building and construction, (2) transportation, (3) consumer durables, (4) electrical, machinery and equipment, (5) containers and packaging, and (6) export and other uses (2, p. 15).

The market category which constitutes the most "temporary use" products is the container and packaging market and is comprised of cans, semirigid food containers, household and institutional foil, caps and closures, collapsable tubes and many flexible packaging uses (2, p. 15). Containers and packaging is the aluminum industry's second largest market (see Table I) with recorded shipments of 2,265 million pounds in 1974, up 10.2 percent over 1973, and 2,001 million pounds in 1975. Shipments for metal cans accounted for more than 70 percent of the 1975 container and packaging market volume (3, p. 16). Moreover, larger amounts of primary aluminum are being diverted to the container and packaging markets. For
TABLE I

PRIMARY ALUMINUM SHIPMENTS BY MARKET*

<table>
<thead>
<tr>
<th>Market</th>
<th>1973 Percentage</th>
<th>1974 Percentage</th>
<th>1975 Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building &amp; Construction</td>
<td>24.7</td>
<td>22.9</td>
<td>22.6</td>
</tr>
<tr>
<td>Transportation</td>
<td>19.2</td>
<td>17.8</td>
<td>17.2</td>
</tr>
<tr>
<td>Consumer Durables</td>
<td>9.1</td>
<td>8.5</td>
<td>7.6</td>
</tr>
<tr>
<td>Electrical</td>
<td>12.6</td>
<td>13.4</td>
<td>12.2</td>
</tr>
<tr>
<td>Machinery &amp; Equipment</td>
<td>6.5</td>
<td>7.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Containers &amp; Packaging</td>
<td>14.0</td>
<td>16.5</td>
<td>20.2</td>
</tr>
<tr>
<td>Exports</td>
<td>6.4</td>
<td>6.9</td>
<td>8.2</td>
</tr>
<tr>
<td>Other</td>
<td>7.5</td>
<td>5.4</td>
<td>5.3</td>
</tr>
</tbody>
</table>


instance in 1964 only 8 percent of total aluminum production went into the production of containers and packages as compared to 1975's 20.2 percent (3, p. 16). (See Table II.)

The United States' supply of aluminum consists of domestic primary production, primary imports, metal recovered from domestic scrap, metal recovered from imported scrap and imports of mill products. The primary aluminum made from recovered domestic scrap is an important source of United States primary aluminum production and accounts for approximately 24 percent of total production (3, p. 27). Domestic scrap combined with imported scrap accounts for 22 percent of total production (3, p. 38).

Total recovery from scrap in 1975 on a recovered metal basis was 1,182,000 tons. Further, in 1975 new scrap (scrap
TABLE II
PERCENT TOTAL OF CONTAINER AND PACKAGING ALUMINUM MARKET*

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Aluminum**</th>
<th>Container and Packaging Market**</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1964</td>
<td>7,171</td>
<td>574</td>
<td>8.00</td>
</tr>
<tr>
<td>1965</td>
<td>8,150</td>
<td>656</td>
<td>8.05</td>
</tr>
<tr>
<td>1966</td>
<td>9,032</td>
<td>740</td>
<td>8.19</td>
</tr>
<tr>
<td>1967</td>
<td>8,946</td>
<td>868</td>
<td>9.70</td>
</tr>
<tr>
<td>1968</td>
<td>9,977</td>
<td>1,026</td>
<td>10.28</td>
</tr>
<tr>
<td>1969</td>
<td>10,825</td>
<td>1,194</td>
<td>11.03</td>
</tr>
<tr>
<td>1970</td>
<td>10,112</td>
<td>1,467</td>
<td>14.51</td>
</tr>
<tr>
<td>1971</td>
<td>10,428</td>
<td>1,512</td>
<td>14.50</td>
</tr>
<tr>
<td>1972</td>
<td>12,049</td>
<td>1,811</td>
<td>15.03</td>
</tr>
<tr>
<td>1973</td>
<td>14,686</td>
<td>2,056</td>
<td>14.00</td>
</tr>
<tr>
<td>1974</td>
<td>13,732</td>
<td>2,285</td>
<td>16.49</td>
</tr>
<tr>
<td>1975</td>
<td>9,926</td>
<td>2,901</td>
<td>20.16</td>
</tr>
</tbody>
</table>


**Millions of pounds.

generated by plants making end products) accounted for approximately 73 percent of total aluminum recovery and old scrap (scrap recovered from metal that has been used by consumers) for approximately 26 percent. There were 319,000 tons of aluminum metal recovered from old scrap which was a new high in recovery from old scrap in 1974. Moreover, reclamation from aluminum cans in 1975 was over 87,000 tons, up almost 70 percent from the 51,500 tons of aluminum cans recovered in 1974 (3, p. 38).
The Municipal Solid Waste Stream

Packaging and containers also account for a significant portion of the overall municipal solid waste stream. Packaging and containers comprise the largest single category of waste in the municipal solid waste stream and make up 35 percent of municipal solid waste discard (25, p. 6) (see Table III), a figure that has been growing annually (21, p. 23). Moreover, packaging materials are becoming an increasingly acute solid waste problem and their use continues to expend larger amounts of raw materials and energy resources. Marshall Sittig points out that

Packaging is the largest and one of the fastest growing product classes in municipal solid waste. Because of its predominance in the waste stream, it has become the focus of a great deal of public attention in recent years . . . . The growth of packaging consumption has led to increased consumption of raw materials and energy (with attendant adverse environmental effects) and an increased rate of generation of solid waste (21, p. 23).

The tremendous growth in the use of materials for packaging purposes is demonstrated in Table IV. Table IV indicates that consumption of raw materials used for packaging and containers increased by almost 71 percent between 1958 and 1971 with greatest growth occurring in aluminum and plastics (27, p. 7). When the per capita consumption of packaging materials is further analyzed, the increase in packaging and container materials used is still quite large—almost 44 percent (25, p. 7). Per capita consumption figures show an increase in "real" growth of usage while accounting for an
TABLE III

MAKEUP OF THE SOLID WASTE STREAM

<table>
<thead>
<tr>
<th>Municipal Solid Waste**</th>
<th>Percent of Total***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packaging and Containers</td>
<td>35</td>
</tr>
<tr>
<td>Nondurable Goods</td>
<td>18</td>
</tr>
<tr>
<td>Food Wastes</td>
<td>17</td>
</tr>
<tr>
<td>Yard Wastes</td>
<td>19</td>
</tr>
<tr>
<td>Durable Goods</td>
<td>11</td>
</tr>
<tr>
<td>Miscellaneous Inorganics</td>
<td>1</td>
</tr>
</tbody>
</table>


**Of total municipal waste (commercial and residential waste—not waste from industry, mining or agriculture).

***Total greater than 100 percent due to rounding.

increase in population. Packaging and container materials is one of the fastest growing categories of solid waste discard and aluminum packaging is one of the fastest growing of the available packaging materials.

This study is therefore limited to an analysis of the reverse channels of distribution for aluminum packaging and container materials. Packaging and containers is currently the largest and fastest growing single category of solid waste in the municipal solid waste stream. In addition, aluminum packaging is playing a larger role in the packaging and container pollution problem and offers perhaps the greatest incentive for solution. The aluminum packaging and container market is continuing to expand, capturing continually greater amounts of the total aluminum production. This growth further
TABLE IV
CONSUMPTION OF PACKAGING MATERIAL, 1958-1971*

<table>
<thead>
<tr>
<th>Packaging Material</th>
<th>Thousands of Tons</th>
<th>Percent Change</th>
<th>Per Capita (in pounds)</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper**</td>
<td>16,552</td>
<td>27,700</td>
<td>+ 67.3</td>
<td>193.0</td>
</tr>
<tr>
<td>Glass</td>
<td>5,933</td>
<td>11,100</td>
<td>+ 87.1</td>
<td>69.2</td>
</tr>
<tr>
<td>Steel</td>
<td>6,198</td>
<td>7,255</td>
<td>+ 17.1</td>
<td>72.3</td>
</tr>
<tr>
<td>Aluminum</td>
<td>97</td>
<td>757</td>
<td>+680.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Plastic</td>
<td>368</td>
<td>2,900</td>
<td>+688.0</td>
<td>4.3</td>
</tr>
<tr>
<td>Wood and Miscellaneous</td>
<td>6,212</td>
<td>10,613</td>
<td>+ 84.2</td>
<td>72.4</td>
</tr>
<tr>
<td>Total</td>
<td>35,360</td>
<td>60,325</td>
<td>+ 70.6</td>
<td>412.4</td>
</tr>
</tbody>
</table>


**Paper figures represent tonnage of paper packaging produced rather than tonnage of paper packaging consumed. Other material categories reflect consumption of packaging material.
suggests that aluminum container and packaging pollution is apt to increase in the future and yet at the same time there are greater demands for domestic aluminum scrap.

Methodology of the Study

The purpose of this study is accomplished by drawing upon a thorough review and synthesis of the available and applicable literature including journal articles, federal and state statutes and hearings, federal and state government publications, related books, newspapers, graduate theses and dissertations, and some unpublished papers. In addition, the present status and requirements of aluminum container and packaging reverse channels of distribution are also studied through some basic research questions directed to (1) aluminum manufacturers and (2) key aluminum reverse channel middlemen.

Study at the Manufacturing Level

There were only twelve domestic primary aluminum producing companies in the United States as of December 31, 1975. They are Aluminum Company of America (Alcoa), ALUMAX Incorporated (50 percent interest in Intalco and Eastalco), Anaconda Aluminum Company, Consolidated Aluminum Corporation (including 66 percent interest in Ormet), Howmet Aluminum Corporation (50 percent interest in Eastalco and 50 percent interest in Intalco), Kaiser Aluminum & Chemical Corporation, Martin Marietta Aluminum Incorporated, National Aluminum
Company (50 percent interest in National-Southwire), Noranda Aluminum Incorporated, Revere Copper and Brass Incorporated (including 34 percent interest in Ormet), Reynolds Metals Company and Southwire Company (50 percent interest in National-Southwire) (3, p. 32). (See Table V for aluminum production capacity and percent of total industry.)

**TABLE V**

PRIMARY ALUMINUM CAPACITY: DECEMBER 31, 1975*

(Short Tons)

<table>
<thead>
<tr>
<th>Company</th>
<th>Primary Aluminum Capacity</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcoa</td>
<td>1,575,000</td>
<td>31.37</td>
</tr>
<tr>
<td>Reynolds</td>
<td>975,000</td>
<td>19.42</td>
</tr>
<tr>
<td>Kaiser</td>
<td>724,000</td>
<td>14.42</td>
</tr>
<tr>
<td>Consolidated</td>
<td>352,000</td>
<td>7.01</td>
</tr>
<tr>
<td>Anaconda</td>
<td>300,000</td>
<td>5.97</td>
</tr>
<tr>
<td>ALUMAX</td>
<td>219,000</td>
<td>4.36</td>
</tr>
<tr>
<td>Howmet</td>
<td>217,000</td>
<td>4.33</td>
</tr>
<tr>
<td>Martin Marietta</td>
<td>210,000</td>
<td>4.18</td>
</tr>
<tr>
<td>Revere</td>
<td>199,000</td>
<td>3.96</td>
</tr>
<tr>
<td>National Aluminum</td>
<td>90,000</td>
<td>1.79</td>
</tr>
<tr>
<td>Southwire</td>
<td>90,000</td>
<td>1.79</td>
</tr>
<tr>
<td>Noranda</td>
<td>70,000</td>
<td>1.39</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,021,500</strong></td>
<td><strong>99.99</strong>**</td>
</tr>
</tbody>
</table>


**Error due to rounding.

These twelve firms were surveyed through mail questionnaire in order to answer several basic research questions concerning the development and organization of the aluminum packaging reverse channels of distribution. The transmittal
letters and research questionnaire are included in Appendix A and B respectively.

**Study at the Middleman Level**

Non-manufacturing aluminum reverse channel middlemen are considerably more difficult to identify than the primary aluminum manufacturers. Both the Aluminum Association and the Environmental Protection Agency (EPA) officials indicate that no comprehensive listing of major aluminum recyclers is currently available (5; 26). The Aluminum Association and the EPA, however, do suggest that beyond the twelve primary aluminum manufacturers, the beverage industry (beer and soft drinks) performs the bulk of the reverse channel middlemen efforts particularly for packaging and container materials (5; 26). Much of the available solid waste and recycling literature justifies these conclusions.

Therefore, this study undertakes an analysis of the reverse channel middlemen through a survey of the major beverage producing companies in order to validate the general conclusions of the Aluminum Association and EPA. Such a process admittedly omits the independent "junkmen" and the individual entrepreneur from specific consideration. The elimination of independent recycling middlemen from the study is justified, however, because it is the general intent of the study to suggest that new organizational paradigms are in order for complex organizations and to analyze the extent that manufacturers
and producers are extending their operations toward the consumer as sources of raw materials.

The beverage industry consists of four distinct segments—wine, soft drinks, distilled spirits and beer (23, p. 361). Because of the nature of the products produced in the beverage industry, only the soft drinks and beer segments of the industry utilize aluminum packaging and containers. Therefore, producers in these two segments of the industry are studied as to their role in the aluminum reverse channel of distribution.

There are about 50 breweries today and in 1975 the top 5 brewers accounted for 67 percent of the industry's shipments and the top 10 for 84 percent (23, p. B63). The top 10 brewers are Anheuser-Busch Incorporated, the Joseph Schlitz Brewing Company, the Pabst Brewing Company, the Miller Brewing Company, the Adolph Coors Company, the F. & M. Schaefer Brewing Company, the Olympia Brewing Company, the Stroh Brewing Company, the Falstaff Brewing Corporation and the George Heileman Brewing Company (see Table VI). The 5 leading soft drink franchise companies include Coca-Cola, PepsiCo, Seven-Up, Dr. Pepper and Royal Crown Cola, which in the aggregate accounted for 74.9 percent of the industry volume in 1975 (23, p. B69). (See Table VII).

In studying the aluminum packaging and container reverse channel middlemen this study surveyed by mail questionnaire the ten major United States brewers and the five leading United States soft drink franchisers. The transmittal letters
### TABLE VI

**LEADING UNITED STATES BREWERS IN 1975***

<table>
<thead>
<tr>
<th>Brewer</th>
<th>Barrel Sales (Millions)</th>
<th>Percent of Change from 1974</th>
<th>Percent of Market Share**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anheuser-Busch</td>
<td>34.2</td>
<td>+ 3.2</td>
<td>23.7</td>
</tr>
<tr>
<td>Joseph Schlitz</td>
<td>23.3</td>
<td>+ 2.7</td>
<td>15.7</td>
</tr>
<tr>
<td>Pabst</td>
<td>15.7</td>
<td>+ 9.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Miller</td>
<td>12.9</td>
<td>+41.9</td>
<td>8.7</td>
</tr>
<tr>
<td>Coors</td>
<td>11.9</td>
<td>- 4.2</td>
<td>8.0</td>
</tr>
<tr>
<td>Schaefer</td>
<td>5.9</td>
<td>+ 5.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Olympia</td>
<td>5.6</td>
<td>+29.6</td>
<td>3.8</td>
</tr>
<tr>
<td>Stroh</td>
<td>5.1</td>
<td>+17.6</td>
<td>3.5</td>
</tr>
<tr>
<td>Falstaff</td>
<td>4.6</td>
<td>-20.4</td>
<td>3.1</td>
</tr>
<tr>
<td>Heileman</td>
<td>4.5</td>
<td>+ 5.5</td>
<td>3.1</td>
</tr>
</tbody>
</table>


**Based on United States Brewers Association industry estimate of 148.63 million barrels.

and research questionnaire are included in Appendix A and B respectively.

### TABLE VII

**CONSUMPTION OF SOFT DRINKS BY COMPANY***

<table>
<thead>
<tr>
<th>Company</th>
<th>Million Cases</th>
<th>Percent of Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coca-Cola</td>
<td>1572.8</td>
<td>35.3</td>
</tr>
<tr>
<td>PepsiCo</td>
<td>939.5</td>
<td>21.1</td>
</tr>
<tr>
<td>Seven-Up</td>
<td>340.5</td>
<td>7.6</td>
</tr>
<tr>
<td>Dr. Pepper</td>
<td>245.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Royal Crown</td>
<td>240.0</td>
<td>5.4</td>
</tr>
<tr>
<td>Total</td>
<td>3337.8</td>
<td>74.9</td>
</tr>
</tbody>
</table>

A thorough review of the literature together with aluminum industry and channel middlemen perspectives as to the present status and future outlook of aluminum recycling provides a detailed composite of the aluminum reverse channels of distribution and suggests its place in an organizational paradigm based on recycling and resource scarcity. This study did not attempt any type of attitude assessments. However, opinions as to the current and future status of the reverse channels by authoritative sources are included and coupled with other supporting data in order to provide additional insight and perspective as to reverse channels development and requirements.

Plan of Study

Chapter I has presented an introduction to the problems of solid waste pollution and growing raw materials scarcity. This chapter has also introduced the role of materials recycling, the concept of the reverse channel of distribution, a brief review of the emphasis and direction of past solid waste research, a statement of the purpose of the study, the methodology to be utilized, and finally a glossary of terms germane to solid waste pollution. Chapter II describes the current and proposed major federal and state legislation which is influencing the development of formal reverse channels of distribution. The current solid waste recycling situation, raw materials scarcity, energy conservation and solid waste
processing technology are studied in Chapter III. Chapter IV analyzes the reverse channels of distribution for aluminum packaging and containers. This analysis is directed toward the consumer, significant channel middlemen and the primary aluminum manufacturers. Chapter IV also suggests some contingencies extant in primary aluminum and beverage producers recycling organization and management. Chapter V contains the summary, conclusions and recommendations. The summary is presented through a restatement of the problem and a compendium of the analysis. Conclusions are based upon the results of the analysis and contingencies presented in Chapter IV. Also included in this chapter are recommendations for individual consumer's recycling policy, federal and state government solid waste legislation policy, business organization and management policy and areas for further research.

In addition to the five chapters described above, this study includes supplementary information in the form of appendices and bibliography. The bibliography will also be valuable as a comprehensive listing of sources for further study of solid waste pollution, reverse channels of distribution and material scarcity.

Glossary of Solid Waste Pollution Terminology

Agricultural Wastes—solid waste materials produced from the raising of plants and animals for food. Includes such things as animal manure, plant stalks, hulls and leaves.

Air Pollution by Way of Sublimation—air pollution generated by the direct conversion of a solid material into a gaseous pollutant.
Aluminum Magnet—equipment which uses magnetic fields to repel aluminum thus separating it from other refuse.

Balance of Payments—summary of the international transactions of a country over a period of time, including commodity and service transactions, capital transactions, and gold movements.

BDOE—barrels of oil per day equivalent.

Biodegradable—material (usually organic) which can be reduced (digested, oxidized) by micro-organisms to form stable compounds such as carbon dioxide and water.

BTU—British thermal unit. A unit of heat required to raise the temperature of one pound of water one degree Fahrenheit. 1 barrel/oil = 5.8 million BTUs. 1 kilowatt-hour electricity = 3,413 BTUs.

Composting—the conversion of solid waste, particularly cellulose into humus.

Cost Depletion Allowance—reduction of tax liability by depreciating the actual capital costs of the property (lease acquisition cost plus specific property exploration costs minus prior natural depletion) each year over the productive life of the property in an amount equivalent to the ratio the oil, gas, or other minerals extracted bears to the estimated recoverable reserve on the property.

Cullet—crushed glass which becomes a major component of new bottles.

Depletion Allowance—special tax treatment to allow extractive industries to recoup their capital investment and exempt from tax the discovery value of a mineral. Depletion tax together with special treatment for exploration and development costs permits complete offset of taxes.

Dissolved Materials—a substance separated into molecules and dispersed through a liquid medium.

Durable Goods—products that are designed for long-term use, including appliances, furniture and tires.

Effluent—the liquid discharged by a collection network or various treatment units of a treatment plant. Or, more generally, the liquid, solid, or gaseous product discharged or emerging from a process.
Energy Recovery—any system by which waste is utilized for its fuel value. Wastes, usually the organic portion, can be burned directly or converted to fuel oil or gas.

Extractive Industries—industries which take virgin materials from the earth.

Ferrous—of or relating to, or containing iron, e.g. iron, steel and related alloys.

Industrial Waste—solid waste materials that result from industrial processes and manufacturing.

Inorganic Wastes—wastes derived from nonliving organisms, primarily minerals. Consist of metals and glass.

Leachate—liquid that filters through solid waste or other medium and has extracted materials from it. Often ends up in underground waters; may be toxic.

Litter—refuse or rubbish lying scattered about generated primarily by construction sites, loading docks, household garbage, commercial garbage, uncovered trucks, motorists and pedestrians.

Materials Conversion—the utilization for an economically valued purpose other than that for which the material was originally used, e.g. recovered glass or cullet as a building or road construction aggregate.

Materials Recovery—the recovery of specific reprocessed secondary materials from discarded materials, which includes both direct recycling and materials conversion.

Methane Production—methane and carbon dioxide are produced when discarded materials decompose in an anaerobic (oxygen-free) environment.

Mining Wastes—the solid wastes that result from mining operations.

Municipal Wastes or Post-Consumer Wastes—the solid waste generated by residential and commercial activities; not necessarily handled by a municipality.

Nondurable Goods—products, excluding containers and packaging, that are designed for single or short-use. Include newspapers, magazines, paper plates, paper towels, etc.

Open Dump—area where refuse or other discarded materials are disposed of, in an open-air fashion, uncovered and unenclosed.
Organic Wastes—those wastes that are derived from plants or animals and contain carbon compounds. Consist of paper, fabric, plastics, food wastes.

Penny-A-Pound—proposal for a tax, levied at the point of production, to cover collection and disposal costs of a product based on an average rate of $20 per ton (or 1¢ per pound).

Percentage Depletion Allowance—reduction of a tax liability by deduction each year of a percentage of the income from the mining project (oil, natural gas, other minerals) either by deducting the assigned percent of the gross income (value) of oil or gas at wellhead or other minerals at minemouth or by deducting 50 percent of the net income from the mineral or oil property, whichever is the lesser. Since the deductions are allowed without time limit and without regard to amount invested, they—plus special treatment for exploration and development costs—allow deduction of more than the asset cost; the result can be tax-free income for companies and individuals who have taxable income from other sources against which to offset the overage from the percentage depletion allowance.

Pollution Intensiveness—the extent to which a product or material causes pollution, because of its extraction, processing, manufacture or disposal.

Primary Energy Use—energy derived from basic fuels (oil, gas, coal).

Product Redesign—changing the configuration of an item so that it uses less materials or energy in its manufacture or is made longer lasting, more easily repairable or less susceptible to style changes.

Product Reuse—reusing a product that has been discarded without reprocessing it.

Pyrolysis—thermal decomposition of materials in the absence or near-absence of oxygen. This process results in: (1) a gas consisting primarily of hydrogen, methane, and carbon monoxide; (2) a liquid fuel that includes organic chemicals; and (3) a char consisting of almost pure carbon, plus any metal, glass or rock that may have been processed.

Reclamation—the restoring of wastes to a more useful or improved state, e.g. extracting aluminum from solid waste or improving land by sanitary landfilling.
Recycling—process in which valuable materials are extracted from the solid waste stream and then utilized either in original or changed form. Most frequently recycling is returning a material into the process by which it was first formed (i.e. waste paper into paper making, crushed glass [cullet] into glass making).

Resource Intensiveness—the extent of a product's or material's use of materials or energy in its extraction, processing or manufacture.

Resource Recovery—the extraction and use of materials and values from the solid waste stream.

Reuse—the use of a product more than once, without structural change, e.g. returnable bottles.

Sanitary Landfill—engineered method of land disposal for wastes in which trash is compacted and covered with fill dirt. Site can be used for other purposes after landfill is completed. Generally considered the best means of land disposal, although leachate may contaminate groundwater.

Scrap Industry—also called the secondary materials industry. Includes purchasers, processors and users of recoverable waste materials.

Secondary Materials—materials that are used in place of primary, raw or virgin materials in the manufacturing process, e.g. scrap iron, newsprint.

Shipment Value—the sales value of a product being shipped from the manufacturer to the distributor or seller.

Sludge—a muddy or slushy mass, deposit or sediment as precipitated solid matter produced by water and sewage treatment processes.

Solid Wastes—useless, unwanted or discarded solid materials.

Source Reduction—cutting down on materials or energy used in product manufacturing, or reducing the total amount of waste generated.

Source Separation—segregation of discarded materials at the point of discard for concentrated collection.

Standard Metropolitan Statistical Area (SMSA)—a reporting unit defined by the Bureau of Census, used to aggregate and report domestic socio-economic data.
Subsidies—financial assistance, at the expense of others in the economy, to particular private groups to alter their behavior in the marketplace: to encourage or discourage output, supply, or use of items and related economic behavior. Includes: cash payments, low interest rates, guaranteed loans, reduction of a tax liability, provision of goods and services at prices below market value, government purchase of goods at prices above market value (price support), regulatory actions that alter particular market prices.

Tax Credit—direct reduction of a company's tax by a specified percent of sum spent for capital goods or by an allowable deduction in computing taxable income in the year of purchase; amount of subsidy depends on the corporate income tax bracket in which the company falls. Sum deducted from tax decreases government income by that amount and increases company profits.

Virgin Materials—all basic materials for the industrial process which have not previously been used, e.g. wood pulp, trees, iron ore.

Yard Wastes—plant cuttings and trimmings, including leaves, branches, etc.
CHAPTER BIBLIOGRAPHY


CHAPTER II

MAJOR FEDERAL AND STATE SOLID WASTE POLLUTION CONTROL LAWS

A primary factor in the development and maturing of reverse channels of distribution is federal and state environmental legislation. Environmental legislation is impacting on the development of reverse channels of distribution because it has fostered a growing demand for materials recovery. The major impacts of federal environmental legislation on resource recovery have resulted primarily from the creation of pollution control enforcement powers, establishment of environmental standards, the setting of implementation guidelines and the award of research and development grants (6, p. 2). The emphasis of state legislative efforts influencing channel development has been directed toward mandatory solid waste recovery, banning of nonreturnable packages and containers and environmental clean-up and restoration programs.

Current hearings and proposed federal and state solid waste pollution control legislation indicate a further development of highly sophisticated reverse channels of distribution. Legislative measures that have been contemplated for the future at state, local and federal levels include powers for mandatory establishment of resource recovery, financial backing of recovery operations, additional and more stringent environmental
regulations, expanded enforcement powers and regulations that would reduce the generation of nonrecoverable waste (6, pp. 2-3). Therefore, this chapter will (1) review the major existing federal statutes which have influenced the development of reverse channels of distribution, (2) review examples of extant state legislation that have supported and in many cases surpassed federal requirements in aiding in the development of reverse channel functions, and (3) assess the present federal solid waste legislative atmosphere and general trend of state enacted law.

Major Existing Federal Legislation

The development of solid waste reverse channels of distribution has been influenced by a wide variety of statutes directed toward all phases of the environment. For instance, federal legislation impacting on resource recovery includes laws categorized under air pollution control, water pollution control, solid waste management, environmental impact, materials management and energy (6, p. 3). Reverse channel development influences stemming from such differing environmental categories tend to point out the interdependency of seemingly separate environmental issues and stress the need for a comprehensive national environment and materials policy.

The two most important pieces of federal legislation influencing reverse channels development are the Solid Waste Disposal Act of 1965 (PL 89-272), and the Resource Recovery
Act of 1970 (PL 91-512), which amended the Solid Waste Disposal Act. Other important federal legislative measures include the Rivers and Harbors Act of 1899; the Clean Air Act of 1963 (PL 88-206); the Water Quality Act of 1965 (PL 89-234); Air Quality Act of 1967 (PL 90-148); the National Environmental Policy Act of 1969 (PL 91-190); the Clean Air Amendments of 1970 (PL 91-604); the National Materials Policy Act of 1970 (PL 91-512); the Federal Water Pollution Control Act of 1972 (PL 92-500); the Energy Reorganization Act of 1974 (PL 93-438); the Non-Nuclear Energy Research and Development Act of 1974 (PL 93-577); and the Resource Conservation and Recovery Act of 1976 (PL 94-580). Important segments of these statutes which have helped to establish the increasing demand for resource recovery will be briefly described in subsections of this chapter. These statutes will be reviewed as originally passed (unamended) and in chronological sequence so that each act's contribution to channel development may be delineated and evaluated.

**Refuse Act of 1899**

Solid waste pollution control finds very rudimentary beginnings with the enactment of the Rivers and Harbors Act of 1899. Section 407 of this act is commonly referred to as the Refuse Act of 1899, and its main emphasis is directed toward keeping interstate waterways clear from obstructions. More specifically, the Refuse Act is concerned with the control of
solid waste discharged into navigable waters of the United States. An important part of the Refuse Act of 1899 states that it is unlawful to,

... Throw, discharge, or deposit or cause, suffer, or procure to be thrown, discharged, or deposited either from or out of any ship, barge, or floating craft of any kind or from the shore, wharf, manufacturing establishment, or mill of any kind refuse matter of any kind or description whatever ... , into any navigable water of the United States, or into any tributary of any navigable water which the same shall float or be worked into navigable water. ... (18).

While the intent of the Refuse Act of 1899 was essentially to keep the waterways of the U.S. clear for interstate traffic, it was the first legislative attempt to control solid waste pollution. In addition, the Refuse Act of 1899 was one of the earliest illustrations of the interrelationship of many environmental problems plaguing the U.S. There are few if any environmental issues which are not directly related to solid waste pollution. It is now evident that solid waste problems greatly affect the quality of the air, the quality and supply of fresh water, material scarcities, and pollution of the natural environment.

Clean Air Act of 1963

The Clean Air Act of 1963 (PL 88-206) primarily affects resource recovery by implicitly limiting the manner in which refuse can be disposed of through burning or other methods which emit air pollutants. The purposes of the Act are cited in Section 1, paragraph b and are as follows:
1. To protect the Nation’s air resources so as to promote the public health and welfare and the productive capacity of its population;

2. To initiate and accelerate a national research and development program to achieve the prevention and control of air pollution;

3. To provide technical and financial assistance to state and local governments in connection with the development and execution of their air pollution prevention and control programs; and

4. To encourage and assist the development and operation of regional air pollution control programs (2, p. 393).

The Clean Air Act specifically affected resource recovery through (1) the development of guidelines for evaluating hazardous air pollution agents, and (2) the power to force the person or persons discharging matter causing or contributing to air pollution to make pollution abatement modifications or cease operations. Provisions for the development of guidelines for standards of acceptable air pollution are cited in Section 3, paragraphs (C)(2) and (C)(3). These paragraphs state,

Whenever he [the Secretary] determines that there is a particular air pollution agent (or combination of agents), present in the air in certain quantities, producing effects harmful to the health or welfare of persons, the Secretary shall compile and publish criteria reflecting accurately the latest scientific knowledge useful in indicating the kind and extent of such effects which may be expected from the presence of such air pollution agent (or combination of agents) in the air in varying quantities. . . .

The Secretary may recommend to such air pollution control agencies and to other appropriate organizations such criteria of air quality as in his judgment may be necessary to protect the public health and welfare (2, p. 395).
Enforcement of the air pollution standards developed by the Department of Health, Education and Welfare is also provided for in this Act. Section 5, paragraph (d) indicates that where the standards are violated action may be taken. This paragraph states,

If the Secretary believes . . . that effective progress toward abatement of such pollution is not being made and that the health or welfare of any persons is being endangered, he shall recommend to the appropriate state, interstate, or municipal air pollution control agency (or to all such agencies) that the necessary remedial action be taken. . . (2, p. 397).

This Act therefore restricted the open burning of waste materials and forced municipalities and waste management firms to seek alternative forms of disposal.

Water Quality Act of 1965

In 1965 Congress amended the Federal Water Pollution Control Act with the passage of the Water Quality Act of 1965 (PL 89-234). The Water Quality Act of 1965 made two primary changes in the Federal Water Pollution Control Act. First, the Act mandated the formation of enforceable water quality criteria, and, second, the Act transferred primary administrative responsibilities from the Department of Health, Education and Welfare to the Department of the Interior (19, p. 34).

This Act was important for solid waste disposal because it initiated enforcement of specific effluent guidelines and discharge limits. Provision for the development of such standards is delineated in Section 5, paragraph (c)(3) which reads as follows:
Standards of quality established pursuant to this subsection shall be such as to protect the public health or welfare, enhance the quality of water and serve the purpose of this Act. In establishing such standards the Secretary, the Hearing Board, or the appropriate State Authority shall take into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and agriculture, industrial and other legitimate uses (22, p. 908).

**Solid Waste Disposal Act of 1965**

The most significant single piece of legislation concerning solid waste until amended by the Resource Recovery Act was the Solid Waste Disposal Act of 1965 (PL 89-272). The Solid Waste Disposal Act was the first statute directed specifically toward control of solid waste materials and was the first legislative action which acknowledged the mounting problems of solid waste pollution. This acknowledgment is evidenced in the findings of Congress, Section 202(a)(1), (4) and (5) of the Act.

The Congress finds--

that the continuing technological progress and improvement in methods of manufacture, packaging, and marketing of consumer products has resulted in an ever-mounting increase, and in a change in the characteristics, of the mass of materials discarded by the purchaser of such products;

that inefficient and improper methods of disposal of solid wastes result in scenic blights, create serious hazards to the public health, including pollution of air and water resources, accident hazards, and increase in rodent, and insect vectors of disease, have an adverse effect on land values, create public nuisances, otherwise interfere with community life and development;

that the failure or inability to salvage and reuse such materials economically results in the unnecessary waste and depletion of our natural resources (21, p. 997).
While acknowledging the serious effects of increasing solid waste discard in the U.S., the Solid Waste Disposal Act provided no specific direct action toward abating such pollution. The Solid Waste Disposal Act instead provided for indirect action through research and study programs and technical and financial assistance. Such indirect action is clearly delineated in Section 202.(b) of the Act.

The purposes of this Act therefore are—

1. to initiate and accelerate a national research and development program for new and improved studies directed toward the conservation of natural resources by reducing the amount of waste and unsalvageable materials and by recovery and utilization of potential resources in solid wastes; and

2. to provide technical and financial assistance to State and local governments and interstate agencies in the planning, development, and conduct of solid-waste disposal programs (21, p. 997).

Thus it was not until the passage of the Resource Recovery Act of 1970 (Title I) and the National Materials Policy Act of 1970 (Title II) (PL 91-512) that specific solid waste disposal guidelines were established and more specific direct action for solid waste abatement and resource recovery was initiated.

Air Quality Act of 1967

The Air Quality Act of 1967 (PL 90-148) amended the Clean Air Act of 1963 and essentially served to broaden the scope of air pollution control and expended the State and Federal enforcement powers. In amending the Clean Air Act the Air
Quality Act authorized additional planning grants to air pollution control agencies, expanded research provisions relating to fuels and vehicles, provided for interstate air pollution control agencies or commissions and authorized the further establishment of additional air quality standards (1, p. 485). This Act placed further restrictions on open burning of solid waste materials.

National Environmental Policy Act of 1969

The National Environmental Policy Act of 1969 (PL 91-190) is extremely broad in scope and was enacted to establish a single national policy for the environment and create a governing body to administer national environmental issues—the Council on Environmental Quality (CEQ) (8). The broad purpose of this Act is delineated in Section 2 of the Act.

The purposes of this Act are:
To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and national resources important to the nation; and to establish a Council on Environmental Quality (12, p. 852).

An important part of the National Environmental Policy Act requires that comprehensive environmental impact statements be filed to, and in consultation with, the Council on Environmental Quality for major actions which affect the quality of the environment. Provisions for this significant requirement are outlined in Section 102.(C) of the Act.
Include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on--

1. the environmental impact of the proposed action,

2. any adverse environmental effects which cannot be avoided should the proposal be implemented,

3. alternatives to the proposed action,

4. the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

5. any irreversible and irrevocable commitments of resources which would be involved in the proposed action should it be implemented (12, p. 853).

The National Environmental Policy Act of 1969 has the effect of requiring environmental impact assessments on major solid waste disposal and materials recovery projects. Through the requirements of the Act a great deal of solid waste disposal and resource recycling impact planning was initiated. This broad Act also acknowledged the interrelationships of air, water and solid waste pollution and provides the framework for assessing pollution problems on a national scale.

Clean Air Amendments of 1970

The Federal Clean Air Act, originally passed in 1963, was broadened in 1965, 1967, and particularly in 1970 to shore up state and federal control over air pollution (20, p. 2). The Clean Air Amendments of 1970 (PL 91-604) placed primary responsibility upon the various states for control of air pollution within guidelines provided by the federal government.
Such responsibility is outlined in Section 107.(2) of the Act.

Each State shall have the primary responsibility for assuring air quality within the entire geographic area comprising such State by submitting an implementation plan for such State which will specify the manner in which national primary and secondary ambient air quality standards will be achieved and maintained within each air quality control region in such state (3, p. 1678).

In addition to providing for a broadening of state and federal enforcement powers to control of air pollution and the manner in which solid wastes could be disposed, the Clean Air Amendments of 1970 also broadened and strengthened the air quality criteria and control techniques. The Act provides specifically for strict standards for stationary sources of air pollution, especially applicable for consideration of solid waste disposal, while broadening types of pollutants controlled. Section 108.(a)(1) and (b)(1) of PL 91-604 specifies the additional air quality criteria and control techniques.

For the purpose of establishing National primary and secondary ambient air quality standards, the Administrator shall . . . publish, and shall from time to time thereafter revise, a list which includes each air pollutant--

(A) which in his judgement has an adverse effect on public health or welfare;

(B) the presence of which in the ambient air results from numerous or diverse mobile or stationary sources; and

(C) for which air quality criteria had not been issued before the date of enactment of the Clean Air Amendments of 1970, . . .

Simultaneously with the issuance of criteria under subsection (a), the Administrator shall, after consultation with appropriate advisory committees and Federal departments and agencies, issue to the States and appropriate air pollution control agencies information on air
pollution control techniques, which information shall include data relating to the technology and costs of emission control. Such information shall include such data as are available on available technology and alternative methods of prevention and control of air pollution. Such fuels, processes, and operating methods which will result in elimination or significant reduction of emissions (3, pp. 1678-1679).

This Act, through tougher emission standards and control, had the effect of forcing the closing of obsolescent solid waste municipal incinerators and open burning dumps. Thus the Clean Air Amendments of 1970 further forced evaluation and implementation of alternative methods of solid waste disposal and helped in establishing additional resource recovery perspectives.

Resource Recovery Act of 1970

The Resource Recovery Act of 1970 (PL 91-512), amending the 1965 Solid Waste Disposal Act, is perhaps the most important single act influencing the development of reverse channels of distribution. The Resource Recovery Act provides for research and development, planning and operational grants to state and local agencies and requires federal agency compliance with environmentally sound waste disposal practices (20, pp. 348-349). The Act took measures to specifically broaden the Solid Waste Act of 1965 and orient it more toward recovery of nonrenewable resources. The expanded purposes of the Solid Waste Disposal Act as amended by the Resource Recovery Act are contained in Section 101 and read as follows:
Section 202. (b) of the Solid Waste Disposal Act is amended to read as follows:  
The purposes of this Act therefore are--

1. to promote the demonstration, construction, and application of solid waste management and resource recovery systems which preserve and enhance the quality of air, water and land resources;

2. to provide technical and financial assistance to States and local governments and interstate agencies in the planning and development of resource recovery and solid waste disposal programs;

3. to promote a national research and development program for improved management techniques, more effective organizational arrangements, and new and improved methods of collection, separation, recovery, and recycling of solid wastes, and the environmentally safe disposal of nonrecoverable residues;

4. to provide for the promulgation of guidelines for solid waste collection, transport, separation, recovery, and disposal systems; and

5. to provide for training grants in occupations involving the design, operation, and maintenance of solid waste disposal systems (17, pp. 1227-1228).

This legislation indicates the growing interest of the federal government in curbing solid waste pollution and suggests its willingness to support the development of new and improved solid waste recovery techniques. Section 205 of the Resource Recovery Act is concerned with special study and demonstration projects on recovery of useful energy and materials. This section further points out the turning away from an orientation of simple solid waste disposal to an orientation of meaningful resource recovery. Section 205. (a) reads as follows:

The Secretary shall carry out an investigation and study to determine--
1. means of recovering materials and energy from solid waste, recommended uses of such materials and energy for national or international welfare, including identification of potential markets for such recovered resources, and the impact of distribution of such resources on existing markets;

2. changes in current product characteristics and production and packaging practices which would reduce the amount of solid waste;

3. methods of collection, separation, and containerization which will encourage efficient utilization of facilities and contribute to more effective programs of reduction, reuse, or disposal of wastes;

4. the use of Federal procurement to develop market demand for recovered resources;

5. recommended incentives (including Federal grants, loans, and other assistance) and disincentives to accelerate the reclamation or recycling of materials from solid wastes, with special emphasis on motor vehicle hulks;

6. the effect of existing public policies, including subsidies and economic incentives and disincentives, percentage depletion allowances, capital gains treatment and other tax incentives and disincentives, upon the recycling and reuse of materials, and the likely effect of the modification or elimination of such incentives and disincentives upon the reuse, recycling, and conservation of such materials; and

7. the necessity and method of imposing disposal or other charges on packaging, containers, vehicles, and other manufactured goods, which charges would reflect the cost of final disposal, the value of recoverable components of the item, and any social costs associated with nonrecycling or uncontrolled disposal of such items (17, pp. 1228-1229).


PL 91-512 contains two important solid waste related legislative actions. Title I of PL 91-512 is the Resource Recovery Act of 1970 which amended the Solid Waste Disposal
Act of 1965. Title II, known as the National Materials Policy Act, established the National Materials Policy Commission in order to "utilize present resources and technology more efficiently, to anticipate the future materials requirement of the nation and the world, and to make recommendations on the supply, use, recovery, and disposal of materials (13, p. 1234).

Creation of the National Materials Policy Commission is an acknowledgment of increasing materials resources scarcity, and along with the National Environmental Policy Act, is a first step toward the development of a comprehensive and fully integrated solution to materials management, resources scarcity and solid waste pollution. In developing a national materials policy the commission is directed to consider, without being limited to, the following:

1. National and international materials requirements, priorities, and objectives, both current and future, including economic projections;

2. the relationship of materials policy to (A) national and international population size and (B) the enhancement of environmental quality;

3. recommended means for the extraction, development, and use of materials which are susceptible to recycling, reuse, or self-destruction, in order to enhance environmental quality and conserve materials;

4. means of exploiting existing scientific knowledge in the supply, use, recovery, and disposal of materials and encouraging further research and education in this field;

5. means to enhance coordination and cooperation among Federal departments and agencies in materials usage so that such usage might best serve the National materials policy;
6. the feasibility and desirability of establishing computer inventories of national and international materials requirements, supplies and alternatives; and

7. which Federal agency or agencies shall be assigned continuing responsibility for the implementation of the National materials policy (13, p. 1235).

Federal Water Pollution Control Act Amendments of 1972

In October of 1972 Congress passed the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) which amended the Federal Water Pollution Control Act. The passage of this Act overrode a presidential veto by President Nixon and became what has been described as "the most comprehensive and expensive environmental legislation in the nation's history" (4). This highly comprehensive bill attempted to integrate water pollution control into the developing National Environmental and Materials Policy framework. This orientation is evidenced in Section 101.(a), the declaration of goals and policy.

1. It is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;

2. it is the national goal that wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983;

3. it is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited;

4. it is the national policy that Federal financial assistance be provided to construct publicly owned waste treatment works;
5. it is the national policy that areawide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State; and

6. it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans (\textit{7, p. 316}).

This comprehensive Act affects solid waste disposal primarily through its requirements for implementation of the best practicable waste treatment technology of all waste discharge. This Act further initiated enforcement of specific and strict effluent guidelines, established effluent discharge limits and limited discharge of sludges and harmful leachates (\textit{6, p. 3}).

\textbf{Energy Reorganization Act of 1974}

The Energy Reorganization Act of 1974 (PL 93-438) was enacted to reorganize and consolidate certain functions of the Federal government into a new Energy Research and Development Administration and a new Nuclear Regulatory Commission in order to promote more efficient management of such functions. Efficient management of energy needs is related to the development of reverse channels of distribution because solid waste is seen by many as a valuable potential source of energy and because of the reductions in energy usage which are possible through recycling and reuse. Thus solid waste and resource recovery are important variables in energy problems. This importance is pointed out in the priorities section (Sec. 2.(e)) of the Act.
Determination of priorities which are warranted should be based on such considerations as power-related values of an energy source, preservation of material resources, reduction of pollutants, export market potential (including reduction of imports), among others. .. (5, p. 1234).

Non-Nuclear Energy Research and Development Act of 1974

The Non-Nuclear Energy Research and Development Act (PL 93-577) has a similar orientation as the Energy Reorganization Act and mandates a comprehensive energy plan and environmental waste resource assessment. PL 93-577 provides for federal and joint federal-industry experiment and demonstration enterprises (20, p. 32). Again solid waste recycling is seen as an important element in federally supported energy projects. This emphasis is clearly delineated in Section 5901 of the Act.

The Administrator shall assign program elements and activities in specific non-nuclear energy technologies to the short-term, middle-term, and long-term intervals, and shall present full and complete justification for these assignments and the degree of emphasis for each. These program elements and activities shall include, but not be limited to, research, development, and demonstrations designed to advance energy conservation technologies, including but not limited to—
1. productive use of waste, including garbage, sewage, agricultural wastes, and industrial waste heat;
2. reuse and recycling of materials and consumer products; .. (14).

Resource Conservation and Recovery Act of 1976

The Resource Conservation and Recovery Act of 1976 (PL 94-580) was enacted on October 21, 1976. This Act is the most significant solid waste related piece of legislation
enacted in the last several years. The Act provides technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials and for the safe disposal of discarded materials (16). The Act amends the Solid Waste Disposal Act and attempts to further integrate solid waste and resource recovery into national environmental policy. The Resource Conservation and Recovery Act acknowledges the interrelationship of environmental issues and the need to cope with these issues as related in Section 1002.(b)(3). The Act states,

As a result of the Clean Air Act, the Water Pollution Control Act, and other Federal and State laws respecting public health and the environment, greater amounts of solid waste (in the form of sludge and other pollution treatment residues) have been created. Similarly, inadequate and environmentally unsound practices for the disposal or use of solid waste have created greater amounts of air and water pollution and other problems for the environment and for health (16).

The Resource Conservation and Recovery Act has four major areas of interest—solid waste, environment and health, materials and energy. While all four areas affect the development of reverse channels of distribution, perhaps the materials emphasis has the greatest single impact. The orientation of the Act with respect to materials is established in Section 1002.(c) which reads,

MATERIALS—The Congress finds with respect to materials, that—

1. millions of tons of recoverable materials which could be used are needlessly buried each year;

2. [Remaining text continues, but not fully visible in the provided excerpt.]
2. Methods are available to separate usable materials from solid waste; and

3. The recovery and conservation of such materials can reduce the dependence of the United States on foreign resources and reduce the deficit in its balance of payments (16).

Thus the overall objectives of the Act are essentially (1) to promote the protection of health and the environment, and (2) conserve valuable material and energy sources. These objectives further emphasize recycling perspectives, and are forcing the development of both municipal and private reverse channels of distribution. The specific objectives of the Resource Conservation and Recovery Act are considered extremely important to channel development and are provided below,

1. Providing technical and financial assistance to State and local governments and interstate agencies for the development of solid waste management plans (including resource recovery and resource conservation systems) which will promote improved solid waste management techniques (including more effective organizational arrangements), new and improved methods of collection, separation, and recovery of solid waste, and the environmentally safe disposal of nonrecoverable residues;

2. Providing training grants in occupations involving the design, operation, and maintenance of solid waste disposal systems;

3. Prohibiting future open dumping on the land and requiring the conversion of existing open dumps to facilities which do not pose a danger to the environment or to health;

4. Regulating the treatment, storage, transportation, and disposal of hazardous wastes which have adverse effects on health and the environment;
5. providing for the promulgation of guidelines for solid waste collection, transport, separation, recovery, and disposal practices and systems;

6. promoting a national research and development program for improved solid waste management and resource conservation techniques, more effective organizational arrangements, and new and improved methods of collection, separation, and recovery, and recycling of solid wastes and environmentally safe disposal of nonrecoverable residues;

7. promoting the demonstration, construction, and application of solid waste management, resource recovery, and resource conservation systems which preserve and enhance the quality of air, water, and land resources; and

8. establishing a cooperative effort among the Federal, State, and local governments and private enterprise in order to recover valuable materials and energy from solid waste (16).

Summary of Major Federal Solid Waste Pollution Control Legislation

The orientation of solid waste pollution has changed significantly since the Rivers and Harbors Act of 1899. Early environmental and more specific solid waste pollution legislation was directed toward specific environmental issues. Such acts include the Rivers and Harbors Act of 1899, the Clean Air Act of 1963, the Water Quality Act of 1965, the Solid Waste Disposal Act of 1965 and the Air Quality Act of 1967.

In 1969, however, emphasis and orientation of subsequent environmental pollution legislation changed substantially. From 1969 environmental legislation has taken a broader view of the environment acknowledging the interdependencies of
air, water and solid waste issues. This broader "systems" approach has attempted to develop comprehensive policy designed to deal with interrelated environmental issues. Lettie McSpadden Wenner particularly emphasizes this point in his book, *One Environment Under Law*. Wenner indicates,

Analogous to policy phases which resist separation into distinct entities, environmental problems are frequently so closely interrelated that a solution for one creates a new problem elsewhere. . . . Both governmental and private institutions have always dealt separately with the three problems of land, water and air pollution regardless of their interdependence. The administrative trend today is admittedly toward a wholistic approach in which super-agencies such as the National Environmental Protection Agency (EPA) undertake to control all three types of waste. This has not been the practice in the past, nor is it the practice everywhere today (23, pp. 33-34).

The United States has therefore made strides toward the development of an integrated national materials, pollution and disposal policy. These steps are evidenced in such legislation as the National Environmental Policy Act of 1969, the Clean Air Amendments of 1970, the Resource Recovery Act of 1970, the National Materials Policy Act of 1970, the Federal Water Pollution Control Act of 1972, the Energy Reorganization Act of 1974, the Non-Nuclear Energy Research and Development Act of 1974, and the Resource Conservation and Recovery Act of 1976. The time sequence of the major solid waste related legislation is depicted in Figure 1. Table I presents a summary of the provisions of the major federal legislation affecting solid waste disposal and resource recovery.
Fig. 1--Timing of Major Federal Solid Waste Pollution Related Legislation
<table>
<thead>
<tr>
<th>Act</th>
<th>Administrative Agency</th>
<th>Public Law</th>
<th>Impact on the Development of Solid Waste Reverse Channels of Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refuse Act of 1899</td>
<td>U.S. Army Corp of Engineers</td>
<td></td>
<td>Limits discharge or deposit of solid waste materials into navigable waterways of the United States</td>
</tr>
<tr>
<td>Clean Air Act of 1963</td>
<td>Secretary of Health, Education &amp; Welfare</td>
<td>PL 88-206</td>
<td>Initiated the development of guidelines for evaluating hazardous air pollutants, forced abatement modification for sources which exceed guidelines</td>
</tr>
<tr>
<td>Water Quality Act of 1965</td>
<td>Secretary of the Interior</td>
<td>PL 89-234</td>
<td>Mandated the formation of enforceable water quality criteria, initiated enforcement of specific effluent guidelines</td>
</tr>
<tr>
<td>Solid Waste Disposal Act of 1965</td>
<td>Secretary of Health, Education &amp; Welfare and Secretary of the Interior</td>
<td>PL 89-272</td>
<td>Provides for research demonstration grants and technical and financial assistance for resource recovery</td>
</tr>
<tr>
<td>Air Quality Act of 1967</td>
<td>Secretary of Health, Education &amp; Welfare</td>
<td>PL 90-148</td>
<td>Broaden the scope of air pollution control and expanded State and Federal enforcement powers, expanded research and study provisions</td>
</tr>
<tr>
<td>Act</td>
<td>Administrative Agency</td>
<td>Public Law</td>
<td>Impact on the Development of Solid Waste Reverse Channels of Distribution</td>
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<tr>
<td>National Environmental Policy Act of 1969</td>
<td>Council on Environmental Quality</td>
<td>PL 91-190</td>
<td>Enacted to establish a single environmental policy, required environmental impact assessments on major projects, forced solid waste disposal planning</td>
</tr>
<tr>
<td>Clean Air Amendments of 1970</td>
<td>Secretary of Health, Education &amp; Welfare</td>
<td>PL 91-604</td>
<td>Shored up State and Federal control over air pollution, limited manner in which solid waste can be disposed, strengthened the air quality criteria, forced obsolescence of municipal incinerators and burning dumps</td>
</tr>
<tr>
<td>Resource Recovery Act of 1970</td>
<td>Secretary of Health, Education &amp; Welfare and Secretary of the Interior</td>
<td>PL 91-512</td>
<td>Provides for planning and operational grants, guidelines for solid waste disposal, provides incentives for resource recovery, places emphasis on recovery of resources</td>
</tr>
<tr>
<td>Act</td>
<td>Administrative Agency</td>
<td>Public Law</td>
<td>Impact on the Development of Solid Waste Reverse Channels of Distribution</td>
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<tr>
<td>Federal Water Pollution Control Act Amendments of 1972</td>
<td>Environmental Protection Agency</td>
<td>PL 92-500</td>
<td>Integrates water pollution control into national environmental policy, requires and enforces treatment technology of solid waste discharge</td>
</tr>
<tr>
<td>Energy Reorganization Act of 1974</td>
<td>Energy Research and Development Admin-</td>
<td>PL 93-438</td>
<td>Created the Energy Research and Development Administration and Nuclear Regulatory Commission, promotes efficient management of energy using and producing sources</td>
</tr>
<tr>
<td>Non-Nuclear Energy Research and Development Act of 1974</td>
<td>Energy Research and Development Admin-</td>
<td>PL 93-577</td>
<td>Mandates a comprehensive energy plan, provides for research in energy conservation by productive use of wastes and technology development</td>
</tr>
<tr>
<td>Resource Conservation and Recovery Act of 1976</td>
<td>Environmental Protection Agency</td>
<td>PL 94-580</td>
<td>Provides technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials and for the safe disposal of discarded materials</td>
</tr>
</tbody>
</table>
Significant State Solid Waste Legislation

Many states have followed the federal government's lead in passing solid waste disposal and resource recovery legislation. Most of the state legislation, however, has been directed toward solid waste removal and disposal rather than toward materials recovery. State bills are primarily concerned with protecting the public health, safety and welfare and with the prevention of the spread of disease. An additional emphasis is the development of facilities for the safe and sanitary processing of solid waste through comprehensive solid waste disposal systems. Only a few states have legislated resource recovery bills and these so-called "bottle bills" essentially ban nonreturnable drink containers and provide for a deposit system and local collection. Several states' solid waste and resource recovery acts will be reviewed in subsections of this chapter. These state acts are considered representative of state legislative effort in the area of solid waste disposal and resource recovery.

Ohio Solid Waste Projects (1970)

The Ohio Revised Code Chapter 6123 provides that the Ohio water development authority may: (1) make loans and grants for construction of solid waste projects, (2) issue solid waste revenue bonds and notes, and (3) acquire, construct, enlarge, equip and maintain solid waste projects and establish rules and regulations for such projects (20, p. 356).
Such limited power and duties suggest the solid waste disposal orientation of the Ohio Solid Waste Projects Act and a lack of emphasis toward resource recovery.

The purpose of the Ohio Solid Waste Projects Act of 1970 as outlined in paragraph 6123-03 does cite the importance of salvage and reuse; however, the bill provides no specific means to implement such strategies. The purposes of the Ohio Solid Waste Act are illustrated as follows:

It is hereby declared to be public policy of the state through the establishment, operation and maintenance of solid waste projects . . . for the comfort, health, safety and general welfare of all employees and other inhabitants of the state and for the conservation of the land, air and water resources of the state through efficient and proper methods of disposal, salvage and reuse of solid wastes thereby eliminating or decreasing accident and health hazards. . . . . . . In furtherance of such public policy, the Ohio water development authority may initiate, acquire, construct, maintain, repair and operate solid waste projects. . . (20, p. 356).

Oregon Minimum Deposit Act

Reverse channels of distribution have been given considerable impetus by the state enacted "bottle bills" which ban nonreturnable drink containers. States which have enacted such recycling laws are Oregon, Vermont and South Dakota, with the Oregon law being the most comprehensive. The Oregon Minimum Deposit Act, which became effective in October of 1972, requires retailers to pay refunds on all empty beer and soft drink cans and bottles (for most a minimum of five cents, but two cents on some small reusable beer bottles) (15, p. 10).
The refund requirement is provided for in paragraph 459.820 of the Oregon Revised Statutes.

1. Except as provided in subsection (2) of this section, every beverage container sold or offered for sale in this state, shall have a refund value of not less than five cents.

2. Every beverage container certified as provided in ORS 459.860, sold or offered for sale in this state, shall have a refund value of not less than two cents (20, p. 360).

Additionally, the Oregon law requires that cans and bottles have to be collected and counted by the retailer and placed in plastic bags for pickup by beverage suppliers. Thus at present in Oregon the beverage retailers and distributors are performing the channel middleman functions of sorting and accumulation. However, both the retailer and distributors are unhappy with their new role and food stores are complaining that they are being made into garbage collectors (15, p. 10). Provisions for establishing the reverse channel of distribution in Oregon are provided for in paragraph 459.830 of the Oregon Revised Statutes.

1. A dealer shall not refuse to accept from a consumer any empty beverage containers of the kind, size and brand sold by the dealer, or refuse to pay to the consumer the refund value of a beverage container as established by ORS 459.820.

2. A distributor shall not refuse to accept from a dealer any empty beverage containers of the kind, size and brand sold by the distributor, or refuse to pay the dealer the refund value of a beverage container as established by ORS 459.820 (20, pp. 360-361).
Tennessee Solid Waste Disposal Act

The Tennessee Solid Waste Disposal Act is representative of legislation in those few states which have adopted balanced solid waste bills. This excellent piece of legislation provides for both safe and sanitary processing and disposal of solid wastes and for recovery of energy producing and recyclable materials. Moreover, the Tennessee statute provides for a coordinated statewide program of control of solid waste processing and disposal in cooperation with federal, state, and local agencies responsible for the prevention, control or abatement of air, water and land pollution (20, p. 358). The Tennessee Act acknowledges the interrelationships not only between federal, state and local environmental efforts but also between air, water and solid waste issues. The wide scope of the Tennessee Solid Waste Disposal Act and apparent understanding of environmental issues by the Tennessee legislators is pointed out in Section 53-4339 of the Tennessee Code, Chapter 43.

A municipality shall have the power to construct, purchase, improve, operate, and maintain within its corporate limits or within the limits of the County wherein it is located, an energy recovery facility or facilities and/or resource recovery facility or facilities for the production of energy from said energy recovery facility for heating or cooling and/or the production of fuel mixtures or fuel supplements and recovery of recyclable materials from solid waste and the sale of said fuel supplements and recyclable materials . . . (20, p. 359).
Summary of State Enacted Solid Waste Legislation

The three state enacted solid waste bills discussed above are, of course, by no means all such state initiated legislation. (See Appendix C for a listing of states with significant solid waste related legislation.) These three state bills are, however, representative of the types of solid waste legislation enacted at the state level. The first type represented by the Ohio Solid Waste Projects Act is directed solely toward solid waste disposal. Unfortunately at the present this is the most popular type of state enacted solid waste bill and also the type with the narrowest perspectives.

The second type of solid waste related bill is demonstrated by the Oregon Minimum Deposit Act. This Act is oriented toward elimination of environmental pollution and resource recovery in limited areas. The third type of state enacted solid waste legislation is the balanced solid waste bill which attacks solid waste problems from both a disposal and recovery viewpoint. Such legislation is represented by the Tennessee Solid Waste Disposal Act. This bill attempts to realistically integrate environmental problems and initiate a comprehensive solution.

Federal and State Solid Waste and Resource Recovery Legislative Atmosphere

Federal and state solid waste and resource recovery legislation have, in the past, been influential in the
development of reverse channels of distribution. Evidence suggests that such legislation will have an even more profound effect in the future. There continues to be a wide variety of federal legislative proposals, senate and house hearings and numerous investigations which are placing primary emphasis on the conservation of natural resources and raw materials.

An important theme running through such hearings and investigations is the need for developing formal mechanisms which will initiate and aid in recycling. For example, a section in the Railroad Revitalization and Regulatory Reform Act of 1976 (PL 94-210) provides for the investigation of discriminatory freight rates for the transportation of recyclable or recycled materials (10, p. 49). Moreover, PL 94-568, which amends the Internal Revenue Code of 1954—Exempt Organizations, Etc., provides for a complete study of tax incentives for recycling. The Act calls for investigation of all provisions of the Internal Revenue Code "which currently impede or discourage the recycling of solid waste materials, and shall determine what actions Congress may take under the internal revenue laws to increase and encourage the recycling of solid waste materials (11)."

At the federal level there also continues to be an ongoing debate on how to best implement resource recovery, solid waste disposal and recycling. Since the late sixties such subcommittees and committees as the Subcommittee on
Environment of the Committee on Commerce, the Subcommittee on Priorities and Economy in Government of the Joint Economic Committee, the Subcommittee on Transportation and Commerce of the Committee on Interstate and Foreign Commerce, the Special Subcommittee on Science, Technology and Commerce of the Committee on Commerce, and the Subcommittee of the Committee on Government Operations have directed much of their efforts toward solid waste disposal and materials recovery issues.

These committees have produced a variety of proposed recycling legislation, much of which is still under consideration in some form or has been consolidated into other bills. Examples of such acts are the Resource Conservation and Recycling Incentives Act of 1973 (S.1122), the Interstate Recycling Expansion Act of 1973 (S.2753), the Solid Waste Reduction and Recycling Incentives Act of 1973 (S.1879), the Resource Recycling and Conservation Act of 1973 (S.1593), the National Resource and Materials Information Act (S.1410), the Materials Information and Economic Forecasting Act of 1975 (S.1415), the Solid Waste Management Act and Resource Recovery Act (H.R. 9438) and the Solid Waste Energy and Resource Recovery Act (H.R. 9438). Thus at the federal level the solid waste legislative atmosphere remains active. Additional federal legislation undoubtedly will be forthcoming which will further influence the development of reverse channels of distribution.
At the state level there also continues to be a great deal of concern and debate directed toward the enactment of environmental legislation. Historically, the states have followed the lead of the federal government on environmental legislation. For example, most states have passed "Water Quality Acts" and "Clean Air Acts" which are similar to the Federal Water Pollution Control Act Amendments of 1972 and the Clean Air Act of 1970.

A recent survey, however, of state Attorneys General indicated that the states were not following the federal lead in passing laws paralleling the National Environmental Policy Act of 1969 (NEPA) (9). The survey showed that seven years after the enactment of the National Environmental Policy Act the majority of states (thirty-six) still do not have mini NEPA's. Of these states, only two indicate that they have definite plans to enact legislation similar to NEPA. Even if mini NEPA's were passed by each state with "definite plans," which, as time passes, seems more unlikely, there would still be 34, or 68 percent, of the states without mini NEPA's (9, p. 4).

Statements, however, by the Attorneys General indicate that the lack of passage of legislation similar to the National Environmental Policy Act may be the exception to the rule. The Attorneys General suggested that the reason mini NEPA's did not pass in their states was primarily because of the large amount of paper work required by "environmental
assessment statements," an integral part of the National Environmental Policy Act (9, pp. 5-7).

In the area of solid waste legislation the states have followed the lead of the federal government and, in some cases, anticipated the federal laws. There are thirty-nine states with significant legislative provisions for some type of specific solid waste management. With federal funds being made available to the states for solid waste management, this number promises to increase, and state programs already in existence will most likely be expanded.

In addition, many states have enacted legislation pertaining specifically to resource recovery activities. There are nine states with grant or loan programs for resource recovery, twelve with planning and/or regulation for resource recovery, five with operating authorities for resource recovery and an estimated fifteen which will have energy recovery systems by 1980 (10, p. 39). It therefore appears that the individual states will remain active in passing legislation which is directed toward solid waste management and resource recovery.
CHAPTER BIBLIOGRAPHY


CHAPTER III

THE RECYCLING ENVIRONMENT

In recent years Americans have generally become aware of the nation's environmental crisis and are beginning to understand that meaningful solutions to environmental problems are far from simple. It is also becoming more readily acknowledged that comprehensive approaches are required to solve interrelated environmental problems. Solutions to pollution and material scarcity problems must consider each and every distinct segment of the environment as well as their interrelationships.

Massive material and product recycling is an increasingly important and potentially successful method of solving our complex environmental pollution problems. At the same time, recycling holds great potential for energy and materials conservation. More specifically, the recycling of materials and products provides a means to recover valuable resources, cuts waste disposal problems, improves the quality of the air and water, and conserves limited energy sources.

Recycling is at the heart of the reverse channels of distribution. Therefore it is appropriate to briefly analyze the various extant forces which are providing impetus to the recycling movement. Important forces impacting on materials
recycling that will be reviewed in this chapter include
(1) the dwindling availability of United States virgin raw
materials, (2) the energy shortages and energy conservation
requirements of the nation, and (3) the advancing available
solid waste management technology. These important forces
which are encouraging recycling will be analyzed in relation
to the solid waste problem and will be prefaced by a brief
presentation of recycling historical perspectives and a con-
ceptualization of the salvage industry.

Historical Perspectives of Recycling
There has been a recent surge of interest in the United
States concerning recycling and solid waste management. This
interest has been generated, in part, because recycling repre-
sents a sound and intelligent method for halting the depletion
of the nation's scarce raw materials and energy resources.
Recycling also is an appealing approach toward abating solid
waste pollution. However, material recycling has been around
a long time and has been an important force in America's
economy since its founding.

Recycling of basic materials seems to be a phenomenon
that has been present in all economies with inadequate re-
sources. The practice of recycling considerably precedes
even the American frontier. There is substantial evidence of
extensive recycling efforts taking place in ancient Greece,
Mesopotamia, Egypt and China (13, p. 2). The positive
relationship between materials scarcity and recycling efforts appears quite consistent throughout much of world history.

Material scarcity was an inherent part of American frontier life, and recycling was an important source of valuable raw materials. For instance, scrap copper, iron and other basic metals were melted down and recast; rags were widely collected for papermaking; wool garments were garnetted, respun and rewoven into new apparel and other textile products (13, p. 2). Other evidence of the importance of recycling to the American frontier was the ever present peddlers and scrap dealers. These peddlers and scrap dealers traveled between colonial towns bartering trade goods for used and cast-off materials.

However, as America developed and acquired the means of tapping its vast available natural resources, material scarcity became largely a thing of the past. America became thought of as the land of plenty with unlimited amounts of resources. This change in general attitude toward scarcity was accompanied by a distinct change in waste and materials recovery philosophy. The change in waste and scarcity philosophy in America has been one of the primary inhibiting factors in the development of extensive recycling efforts. In this regard, the National Association of Recycling Industries, Inc. has pointed out,

The Industrial Revolution, and the rapid conquest of the Frontier and subsequent emphasis on the development of the country's forestry and mineral resources, set in
motion another wave of thinking in American life. By
the third quarter of the 19th Century "waste not, want
not" began to give way to the theory of "limitless re-
sources" and the "throw away" concept soon became imbued
in national policies and public attitudes (13, p. 5).

There are signs that this throw-away philosophy is now
reversing, which perhaps reflects the new reality that
America is no longer the land of plenty with unlimited re-
sources and, indeed, never was. A change in material recovery
philosophy is reflected in a change of emphasis in pollution
and materials legislation, as discussed in the preceding
chapter, as well as in what seems to be a modification of in-
dividual attitudes. Changes in individual attitudes toward
waste and recycling are seen in the growing support for munici-
pal recovery facilities, in the movement toward energy saving
transportation, in the increasing number of garage and rummage
sales and in the increasing tonnage of materials being col-
lected for reprocessing. For example, there was a 51 percent
increase in the number of aluminum cans reclaimed from 1973
to 1974 and another 70 percent increase from 1974 to 1975
(1, p. 38; 2, p. 38).

Thus recycling is not a new phenomenon but rather has
been an important element in all economies with limited re-
sources. The resurgence of recycling values and policy in
America is just an acknowledgment of that fact coupled with
a genuine concern for environmental pollution.
The Salvage Industry

The United States salvage or secondary materials industry consists of some 10,000 firms, most of which are extremely small companies of limited scope (18, p. 19). Moreover, in recent years the recovery of secondary materials has become quite institutionalized and a trade group—the National Association of Recycling Industries—has grown to approximately 1,000 member firms (15, p. 3).

The thousands of companies involved in recycling range from the individual entrepreneur to large corporations. These firms are engaged in the processing and handling of a multitude of materials. However, the bulk of the materials recovery industry is concerned with the processing of metals, paper, glass, textiles and rubber. The formal channel positions of the salvage industry are the dealers, processors and brokers who accept secondary materials from many sources, sometimes process them, and finally sell them to industrial users (8, p. 2).

To fully understand this complex industry, the various stages or levels of the industry and the actual flow of materials from product consumption to scrap-consuming industries should be conceptualized. The salvage industry essentially represents the available reverse channels of distribution for waste materials. In Figure 2 a conceptualization of the salvage industry's major alternative reverse channels of distribution and various extant combinations of those channels is
Fig. 2--Alternative reverse channels of distribution
presented. The first channel is the direct channel which is very similar to the manufacturer's traditional direct channel. This channel is owned and operated by the manufacturer and designed to interface directly with the consumer in recycling specialized products of interest to the manufacturers.

The next major salvage reverse channel is supported by the junkman or scavenger. This channel intermediary is usually an individual or small firm who supports himself in part or entirely by picking up waste materials from sources such as small machine shops or printing shops and selling them to secondary materials dealers (8, p. 3). The independent junkman may sell his materials to a variety of solid waste dealers and brokers. The "small dealer" in this channel usually handles metals, paper and textiles. However, the small dealer seldom handles quantities large enough to make it worthwhile to develop extensive contacts with industrial buyers. Therefore, the small dealer accumulates quantities of materials and usually sells the accumulation directly to larger dealers (8, p. 4). Small dealers may occasionally sell directly to manufacturers, especially when located near the manufacturers' processing facilities.

The "dealer-processor" is the core of the secondary materials industry and is involved in the processing and upgrading of wastes before delivering them to the scrap-consuming industries. The dealer-processor is the important institution in the third major available reverse channel depicted in Figure 2.
In some cases, the dealer-processor may obtain materials from smaller dealers sufficiently processed to be simply forwarded to scrap-consuming industries. Dealer-processor firms are usually fairly large with revenues ranging into the 100 millions (15, p. 6). (See Appendix D for a listing of the largest dealer-processor firms and their earnings.) The most important dealer-processor firms include Browning-Ferris, Ogden Corporation, Proler International and U.S. Reduction. The recycling, processing and upgrading of waste materials is the main emphasis of these companies. In addition, municipalities processing solid waste materials for ultimate sale to the scrap-consuming industries may be considered as participating in this channel.

The fourth major solid waste channel depicted in Figure 2 is made up primarily of the "specialist dealers." The specialist dealers handle only one particular commodity, and, in many cases, materials management may not be the primary function of the enterprise. The specialist dealer may be involved in some basic material processing, and he generally buys waste materials from a variety of channel sources. Firms participating in this channel are primarily those firms dealing exclusively in glass or specialized metals. The beverage companies engaged in recycling can be included as important intermediary members in this reverse channel.

The last channel depicted in Figure 2 is the broker or agent middleman channel. The waste material broker buys and
sells commodities, but he generally does not take physical possession of the materials. The broker usually sells large quantities of recyclable materials to the scrap-consuming industries, and he arranges for direct shipment from various channel sources.

Hence there are five major identifiable reverse channels of distribution. The intermediary firms participating in these channels range from the individual entrepreneur to the large corporation, from those with only part-time recovery operations to those recovering materials on a full time basis, and from firms which have an ancillary emphasis in material recovery to firms with a primary materials recovery interest. The salvage industry is also supported by a variety of equipment manufacturers and solid waste management/engineering consulting firms. (See Appendixes E and F respectively for a partial listing of equipment manufacturers by equipment category and solid waste management/engineering consulting firms.)

Evidence suggests the direct manufacturer's channel and the specialist dealer channel provide the bulk of the recycling efforts for aluminum packaging and containers. The direct channel is owned and operated by a primary aluminum manufacturer providing recycled aluminum as an input to the manufacturing process. The major portion of the packaging and container aluminum processed by the specialist dealer is handled by various beverage producing companies which have
entered the reverse channels of distribution as a secondary function. These two important aluminum packaging and container reverse channels are analyzed in Chapter IV.

United States Virgin Raw Materials Availability

The importance of materials recycling and the further development of reverse channels of distribution is pointed out most clearly through a review of the current United States mineral commodity resources posture. Basic minerals provide the core of the materials which are amenable to recycling and their continued supply is essential if the quality of life in the United States is to be maintained.

The United States' known reserves of most minerals are relatively small in relation to long-term demand, and the large deficits can be made up only through a combination of four actions:

1. Reducing the demand, through substitution of other minerals, reduction of waste, or elimination of some uses;

2. Supplementing the raw (primary) material supply, through recovery and recycling of scrap and used materials;

3. Importing raw or refined materials from foreign powers;

4. Increasing our reserves, through discovery of new mineral deposits and through development of technology for the feasible recovery of low-grade deposits (12, p. 2).

Major emphasis for solving impending material scarcity problems might best be placed on action number two above. A
major emphasis upon action number one implies a serious reduction in America's standard of living. Many feel that this is an unacceptable proposition. Emphasizing action number three would place a greater dependency on foreign mineral sources and ultimately upon foreign governments. In addition, action number three still does not solve world depletion problems. Action number four, the increasing of reserves, is quite speculative in nature and developing necessary technology is usually a long-term prospect. Yet, probably no one of these actions alone will be enough to solve the United States' long-range mineral supply problems. Demand in all mineral categories is outstripping supply in the United States and the current long-term outlook is for major mineral scarcity.

At present, the United States, in comparison to most nations of the world, is still in a fairly favorable position for many mineral materials. However, the United States is now substantially dependent on imports for a number of very important mineral materials, including many officially designated as "strategic and critical" (16, p. 154). Table IX indicates the United States' dependence on foreign sources for many important minerals.

What is perhaps more important than current United States mineral dependence is the total demand of mineral resources over the next several years versus the capacity of the United States reserves to serve these needs. Table X shows a
**TABLE IX**

**UNITED STATES MINERAL DEPENDENCE ON FOREIGN SOURCES**

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Percentage Imported</th>
<th>Major Foreign Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strontium</td>
<td>100</td>
<td>Mexico, United Kingdom, Spain</td>
</tr>
<tr>
<td>Columbium</td>
<td>100</td>
<td>Brazil, Malaysia, Zaire</td>
</tr>
<tr>
<td>Mica (sheet)</td>
<td>99</td>
<td>India, Brazil, Malagasy</td>
</tr>
<tr>
<td>Cobalt</td>
<td>98</td>
<td>Zaire, Belgium-Luxembourg, Finland, Norway, Canada</td>
</tr>
<tr>
<td>Manganese</td>
<td>98</td>
<td>Brazil, Gabon, South Africa, Zaire</td>
</tr>
<tr>
<td>Titanium (rutile)</td>
<td>97</td>
<td>Australia, India</td>
</tr>
<tr>
<td>Chromium</td>
<td>91</td>
<td>USSR, South Africa, Turkey, Philippines</td>
</tr>
<tr>
<td>Tantalum</td>
<td>88</td>
<td>Australia, Canada, Zaire, Brazil</td>
</tr>
<tr>
<td>Aluminum (ores &amp; metal)</td>
<td>88</td>
<td>Jamaica, Australia, Surinam, Canada</td>
</tr>
<tr>
<td>Asbestos</td>
<td>87</td>
<td>Canada, South Africa</td>
</tr>
<tr>
<td>Platinum Group Metals</td>
<td>86</td>
<td>United Kingdom, USSR, South Africa</td>
</tr>
<tr>
<td>Tin</td>
<td>86</td>
<td>Malaysia, Thailand, Bolivia</td>
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<tr>
<td>Fluorine</td>
<td>86</td>
<td>Mexico, Spain, Italy</td>
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<tr>
<td>Mercury</td>
<td>82</td>
<td>Canada, Algeria, Mexico, Spain</td>
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<td>Bismuth</td>
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<td>Nickel</td>
<td>73</td>
<td>Canada, Norway</td>
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<td>Gold</td>
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<tr>
<td>Silver</td>
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<td>Selenium</td>
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<td>Zinc</td>
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<td>Tungsten</td>
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<td>Canada, Bolivia, Peru, Thailand</td>
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<td>Potassium</td>
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<tr>
<td>Cadmium</td>
<td>53</td>
<td>Mexico, Canada, Australia, Japan</td>
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<tr>
<td>Antimony</td>
<td>46</td>
<td>South Africa, Mexico, P.R. China, Bolivia</td>
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<td>Tellurium</td>
<td>41</td>
<td>Peru, Canada</td>
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<tr>
<td>Barium</td>
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<td>Ireland, Peru, Mexico</td>
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<td>Vanadium</td>
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<td>South Africa, Chile, USSR</td>
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<tr>
<td>Gypsum</td>
<td>37</td>
<td>Canada, Mexico, Jamaica</td>
</tr>
<tr>
<td>Petroleum (inc. Nat. Gas liq.)</td>
<td>35</td>
<td>Canada, Venezuela, Nigeria, Netherlands, Anti., Iran</td>
</tr>
<tr>
<td>Iron</td>
<td>23</td>
<td>Canada, Venezuela, Japan, Common Market (EEC)</td>
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</table>
projection of the minimum anticipated cumulative demand for key mineral commodities from year 1968 to the year 2000 and the amounts of known United States mineral reserves. Table X demonstrates that the United States mineral reserves are quite inadequate to meet the growing mineral demand for a large percentage of commodities. Particularly critical are aluminum, nickel, tin, manganese, cobalt, chromium, tantalum and niobium. Other mineral resources shortages are not as critical but still in serious short supply.

American society is greatly dependent on minerals and without a steady supply the society could not long survive as it exists today. The basic resource problem in the United States de­cocts to the simple fact that "the United States does not have an adequate known domestic supply of all the

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Percentage Imported</th>
<th>Major Foreign Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium (ilmenite)</td>
<td>23</td>
<td>Canada, Australia</td>
</tr>
<tr>
<td>Lead</td>
<td>21</td>
<td>Canada, Peru, Australia, Mexico</td>
</tr>
<tr>
<td>Copper</td>
<td>18</td>
<td>Canada, Peru, Chile, South Africa</td>
</tr>
<tr>
<td>Pumice</td>
<td>8</td>
<td>Italy, Greece</td>
</tr>
<tr>
<td>Salt</td>
<td>7</td>
<td>Canada, Mexico, Bahamas, Chile</td>
</tr>
<tr>
<td>Magnesium (nonmetallic)</td>
<td>6</td>
<td>Greece, Ireland, Austria</td>
</tr>
<tr>
<td>Cement</td>
<td>4</td>
<td>Canada, Bahamas, Norway, United Kingdom</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>4</td>
<td>Canada</td>
</tr>
</tbody>
</table>

Source: Adapted from Hearings before the Committee on Commerce, U. S. Senate, 94th Congress, 1st Sess., December 2, 1975, p. 138.
### TABLE X

PRINCIPAL UNITED STATES MINERAL RESOURCES AND DEMAND

<table>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>$1,983</td>
<td>4,707,000</td>
<td>290,000,000</td>
<td>13,000,000</td>
<td>4.5%</td>
</tr>
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<td>Copper</td>
<td>1,300</td>
<td>2,351,000</td>
<td>96,400,000</td>
<td>110,000,000</td>
<td>114.1</td>
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<td>Iron</td>
<td>1,294</td>
<td>86,000,000</td>
<td>3,280,000,000</td>
<td>2,000,000,000</td>
<td>61.1</td>
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<td>Titanium</td>
<td>414</td>
<td>440,000</td>
<td>22,100,000</td>
<td>30,940,000</td>
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<td>Zinc</td>
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<td>1,535,000</td>
<td>57,000,000</td>
<td>20,000,000</td>
<td>52.6</td>
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<td>Nickel</td>
<td>300</td>
<td>230,000</td>
<td>8,100,000</td>
<td>200,000</td>
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<td>259</td>
<td>9,400,000</td>
<td>372,000,000</td>
<td>82,000,000</td>
<td>22.0</td>
</tr>
<tr>
<td>Lead</td>
<td>243</td>
<td>1,435,000</td>
<td>37,000,000</td>
<td>56,000,000</td>
<td>151.4</td>
</tr>
<tr>
<td>Platinum Group</td>
<td>202</td>
<td>1,430,000[^d]</td>
<td>43,600,000</td>
<td>3,000,000[^d]</td>
<td>6.9</td>
</tr>
<tr>
<td>Tin</td>
<td>196</td>
<td>67,000[^e]</td>
<td>6,200,000[^e]</td>
<td>38,000[^e]</td>
<td>.6</td>
</tr>
<tr>
<td>Silver</td>
<td>193</td>
<td>137,000,000[^d]</td>
<td>1,300,000,000[^d]</td>
<td></td>
<td>35.1</td>
</tr>
<tr>
<td>Silicon</td>
<td>148</td>
<td>470,000</td>
<td>22,900,000</td>
<td></td>
<td>common element inexhaustible</td>
</tr>
<tr>
<td>Magnesium</td>
<td>144</td>
<td>1,100,000</td>
<td>40,900,000</td>
<td></td>
<td>common element inexhaustible</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>90</td>
<td>23,400</td>
<td>1,550,000</td>
<td>3,150,000</td>
<td>203.2</td>
</tr>
<tr>
<td>Manganese</td>
<td>64</td>
<td>1,260,000</td>
<td>47,000,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tungsten</td>
<td>43</td>
<td>6,600</td>
<td>550,000</td>
<td>119,000</td>
<td>21.6</td>
</tr>
<tr>
<td>Cobalt</td>
<td>26</td>
<td>7,000</td>
<td>260,000</td>
<td>28,000</td>
<td>1.1</td>
</tr>
<tr>
<td>Chromium</td>
<td>24</td>
<td>420,000</td>
<td>20,100,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vanadium</td>
<td>20</td>
<td>7,200</td>
<td>420,000</td>
<td>115,000</td>
<td>27.4</td>
</tr>
<tr>
<td>Tantalum</td>
<td>11</td>
<td>564</td>
<td>31,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Niobium</td>
<td>6</td>
<td>2,135</td>
<td>138,000</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


[^b]: Millions.

[^c]: Short tons except as noted.

[^d]: Troy ounce.

[^e]: Long Tons.
minerals needed to maintain our society for the foreseeable future" (10, p. 1). In the past the United States could easily obtain materials from abroad. However, today, nationalization of mines in some countries has discouraged participation by American mining companies. Cartel agreements among the major producing nations can suddenly and dramatically raise prices or even halt supply, as happened recently with petroleum. Moreover, developing nations are now competing in the world market for the purchase of raw materials (10, p. 1). Thus the United States materials supply position has eroded considerably over the last few years. Additionally, in some basic materials there are serious world shortages, even now. (See Table XI for a summary of the world and United States resource position concerning, most importantly for this study, resource adequacy, productive capacity, exchange drain, vulnerability to foreign disruptions, inadequate recycling, and environmental impacts.)

It is evident from Table XI that all four actions for solving material scarcity outlined above will have to be employed if the United States is to continue to enjoy the relatively high standard of living that it has achieved. Yet, significant emphasis must be placed on the role of recycling and material recovery. Recycling is certainly one of the least painful and most economical methods of maintaining our present quality of life. Solid waste discard can provide a tremendous source of raw materials if properly utilized.
**MINERAL PROBLEMS**

**1976 AND BEYOND**

**PRELIMINARY DATA, SEPTEMBER 1976**

**BUREAU OF MINES**

| Major problems from the national viewpoint |
| Moderate problems from the national viewpoint |
| Minor or more localized problems |

---

**TABLE XI**

- a. World resource inadequacy, next 4 decades
- b. U.S. high-grade resource inadequacy, next 4 decades
- c. U.S. low-grade resource inadequacy, next 4 decades
- d. U.S. reserve inadequacy, next 4 decades
- e. U.S. foreign exchange drain
- f. U.S. vulnerability to foreign dislocations
- g. Mineral industry health and safety problems
- h. Mineral industry manpower problems
  1. Significant energy use
  2. Inadequate recycling
  3. Significant environmental impact on air
  4. Significant environmental impact on water
  5. Significant environmental impact on land
  6. Heavy load on U.S. transport system
  7. Lack of access to mineral lenses
  8. Lack of incentive to explore or develop domestic resources
  9. Exploration methods inadequacy
  10. U.S. productive capacity inadequacy (mine or mill)
  11. U.S. productive capacity inadequacy (mine or processing plant)
  12. Inadequate substitutes
  13. Inadequate recovery from current extraction and processing
  14. Inadequate recovery of byproducts and coproducts

---

...
**MINERAL PROBLEMS**

1976 AND BEYOND
PRELIMINARY DATA, SEPTEMBER 1976
BUREAU OF MINES

<table>
<thead>
<tr>
<th>Major problems from the national viewpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate problems from the national viewpoint</td>
</tr>
<tr>
<td>Minor or more localized problems</td>
</tr>
</tbody>
</table>

- a World resource inadequacy, next 4 decades
- b US high-grade resource inadequacy, next 4 decades
- c US low-grade resource inadequacy, next 4 decades
- d US reserve inadequacy, next 4 decades
- e US foreign exchange drain
- f US vulnerability to foreign disruptions
- g Mineral industry health and safety problems
- h Mineral industry manpower problems
- i Significant energy use
- j Inadequate recycling
- k Significant environmental impacts on air
- l Significant environmental impacts on water
- m Significant environmental impacts on land
- n Heavy load on US transport system
- o Lack of access to mineral lands
- p Lack of incentive to explore or develop domestic resources
- q Exploration methods inadequacy
- r US productive capacity inadequacy (mine or well)
- s US productive capacity inadequacy (smelter or processing plant)
- t Inadequate substitutes
- u Inadequate recovery from current extraction and processing
- v Inadequate recovery of byproducts and coproducts

---

**TABLE XI--Continued**

<table>
<thead>
<tr>
<th>Mineral Product</th>
<th>Problem Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesite (incl. Plagioclase)</td>
<td>a</td>
</tr>
<tr>
<td>Mica, Soap &amp; Flake</td>
<td>b</td>
</tr>
<tr>
<td>Mica, Sheet &amp; Flakes</td>
<td>c</td>
</tr>
<tr>
<td>Magnesite</td>
<td>d</td>
</tr>
<tr>
<td>Nickel</td>
<td>e</td>
</tr>
<tr>
<td>Elenite</td>
<td>f</td>
</tr>
<tr>
<td>Oil, Gas</td>
<td>g</td>
</tr>
<tr>
<td>Petroleum</td>
<td>h</td>
</tr>
<tr>
<td>Petroleum</td>
<td>i</td>
</tr>
<tr>
<td>Petroleum</td>
<td>j</td>
</tr>
<tr>
<td>Petroleum</td>
<td>k</td>
</tr>
<tr>
<td>Petroleum</td>
<td>l</td>
</tr>
<tr>
<td>Petroleum</td>
<td>m</td>
</tr>
<tr>
<td>Petroleum</td>
<td>n</td>
</tr>
<tr>
<td>Petroleum</td>
<td>o</td>
</tr>
<tr>
<td>Petroleum</td>
<td>p</td>
</tr>
<tr>
<td>Petroleum</td>
<td>q</td>
</tr>
<tr>
<td>Petroleum</td>
<td>r</td>
</tr>
<tr>
<td>Petroleum</td>
<td>s</td>
</tr>
<tr>
<td>Petroleum</td>
<td>t</td>
</tr>
<tr>
<td>Petroleum</td>
<td>u</td>
</tr>
<tr>
<td>Petroleum</td>
<td>v</td>
</tr>
</tbody>
</table>
The importance of the role of recycling in a world which is rapidly being depleted of many of its natural resources is perhaps best suggested in the Geological Survey Professional Paper Number 940.

The popular misconception that a steady supply of minerals from the crust of the Earth is simply a matter of favorable economics and technology has induced widespread public complacency. This notion ignores that fundamental factor governing mineral supply: geologic availability. Neither technologic magic nor astronomical dollar value can make it possible to extract iron, aluminum, gold, sulfur or phosphorus from rocks in which they are not present (10, p. 23).

Recycling and Energy Considerations

Two of the most important challenges that must be faced by the United States during this decade are those of solid waste disposal and energy conservation. The 1973 Arab oil embargo was merely a harbinger of energy scarcity problems which plague the United States seemingly more each day. Yet, solid waste disposal and energy conservation are highly interrelated. Many authorities suggest that by solving our solid waste problems, valuable contributions toward energy conservation and energy production can be made.

The Environmental Protection Agency (EPA) has indicated that there are essentially four opportunities to conserve energy through better discarded materials management. The first opportunity is through source reduction. Source reduction involves the reducing of consumption of products or the reuse of products, resulting in the use of less energy and
materials and in the reduction in discarded materials generation. The second opportunity for energy conservation lies in energy recovery. Energy recovery involves using discarded materials as a fuel in place of coal, oil or gas. A third method to conserve energy through materials management is through materials recycling. The energy benefits of recycling are realized through the use of recycled materials that consume less energy than virgin materials in the manufacturing process. The fourth area for energy savings suggested by the EPA lies in improved collection methods. Improved collection is manifest in using waste collection trucks more efficiently and reducing fuel consumption (6, p. 1). Table XII shows the possible energy savings that may be realized through source reduction, energy recovery, recycling and improved collection.

Of the four opportunities for energy conservation through materials discard management suggested by the Environmental Protection Agency, energy recovery and recycling are most closely related to reverse channels of distribution. Energy saving from the two methods which utilize reverse channels of distribution will be briefly analyzed.

**Energy Recovery from Discarded Materials**

The conversion of solid materials to energy is becoming an increasingly popular method to solve disposal and energy problems. While methods for energy conversion have been
### TABLE XII

**POSSIBLE ENERGY SAVINGS FROM SOURCE REDUCTION, ENERGY RECOVERY, RECYCLING AND IMPROVED COLLECTION**

<table>
<thead>
<tr>
<th></th>
<th>B/DOE&lt;sup&gt;c&lt;/sup&gt; (Thousand)</th>
<th>B/YOE&lt;sup&gt;d&lt;/sup&gt; (Million)</th>
<th>BTU's&lt;sup&gt;e&lt;/sup&gt; (Trillion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source Reduction</td>
<td>115</td>
<td>42</td>
<td>244</td>
</tr>
<tr>
<td>Energy Recovery</td>
<td>393</td>
<td>143</td>
<td>832</td>
</tr>
<tr>
<td>Recycling</td>
<td>80</td>
<td>30</td>
<td>172</td>
</tr>
<tr>
<td>Improved Collection</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>


<sup>b</sup>It should be noted that in consideration of Table XII, the energy saved in one area may reduce the potential for savings in another (e.g., recycling combustible materials like paper will reduce the amount of discarded materials available for energy recovery).

<sup>c</sup>Barrels per day of oil equivalent.

<sup>d</sup>Barrels per year of oil equivalent.

<sup>e</sup>British thermal units.

Available for a number of years, only now are state and city governments seeing it as a viable and indeed necessary alternative. The United States Environmental Protection Agency indicates that converting municipal solid waste into energy is a solid waste management option that has recently become attractive, both environmentally and economically. Although a number of European countries have been generating electricity from municipal solid waste for years, in the United States recovery of heat from municipal solid waste had been limited. Until recently, it consisted of relatively inefficient waste-heat boilers installed in
conventional incinerators. In the past five years, however, more sophisticated solid waste incinerators have been built, which incorporate boilers for the recovery of steam (7, p. 1).

Municipalities entering in the reverse channel of distribution for the recovery of energy take on the functions of the present dealer-processor and carry out the operations of the sorting and the processing of solid wastes. (See Figure 2). Whether the operation is publicly owned or private is unimportant as the functions are essentially the same. In addition, where municipalities dominate the reverse channel through their garbage collection facilities it is likely that this dealer-processor channel will be supplemented to a great extent by the specialist dealers channel handling high profit materials such as aluminum, copper and steel.

It appears that energy recovery from solid waste is limited to densely populated areas. Energy recovery systems require large quantities of discarded materials (at least 200 to 250 tons per day) delivered for processing at one site in order to achieve economies of scale (9, p. 67). Thus for the present energy recovery from solid waste may be limited to the larger Standard Metropolitan Statistical Areas (SMSA's).

Although energy recovery may be limited to the larger SMSA's, it is a valuable, largely untapped, source of energy that must not be wasted. Table XIII presents an illustration of the energy potentially recoverable in theory from residential and commercial discarded materials.
TABLE XIII
ENERGY POTENTIALLY RECOVERABLE FROM RESIDENTIAL AND COMMERCIAL SOLID WASTE\textsuperscript{ab}

<table>
<thead>
<tr>
<th></th>
<th>1973</th>
<th></th>
<th>1980</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BTU\textsuperscript{c} (Trillion)</td>
<td>B/DOE\textsuperscript{d} (Thousand)</td>
<td>B/YOE\textsuperscript{e} (Million)</td>
<td>BTU (Trillion)</td>
</tr>
<tr>
<td>Theoretical</td>
<td>1,194</td>
<td>564</td>
<td>206</td>
<td>1,440</td>
</tr>
<tr>
<td>Available\textsuperscript{f}</td>
<td>899</td>
<td>424</td>
<td>154</td>
<td>1,085</td>
</tr>
<tr>
<td>Projected Recovery</td>
<td>. . .</td>
<td>. . .</td>
<td>. . .</td>
<td>85</td>
</tr>
</tbody>
</table>


\textsuperscript{b}These estimates are a function of (1) population, (2) the average amount of residential and commercial solid waste generated per person, and (3) the energy content of the waste.

\textsuperscript{c}BTU: British thermal unit.

\textsuperscript{d}B/DOE: Barrels per day of oil equivalent.

\textsuperscript{e}B/YOE: Barrels per year of oil equivalent.

\textsuperscript{f}Based on all Standard Metropolitan Statistical Areas.

Energy Conservation through Recycling

Material recycling also has great potential for energy savings. In most production systems the use of recycled or secondary materials consumes less energy than a system using virgin materials. This savings can become exceptionally large when all stages of material acquisition, processing and transportation are included (9, p. 69). Table XIV is an
### TABLE XIV

**NATIONAL ENERGY SAVINGS FROM MAXIMUM POSSIBLE RECYCLING OF ALUMINUM, FERROUS, AND GLASS\(^{ab}\)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum (46% to 56%)(^c)</td>
<td>82</td>
<td>115</td>
<td>164</td>
<td>212</td>
<td>274</td>
</tr>
<tr>
<td>Ferrous (63% to 67%)</td>
<td>81</td>
<td>87</td>
<td>95</td>
<td>107</td>
<td>116</td>
</tr>
<tr>
<td>Glass (50% to 52%)</td>
<td>8</td>
<td>13</td>
<td>15</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Total Energy</td>
<td>172</td>
<td>215</td>
<td>274</td>
<td>335</td>
<td>406</td>
</tr>
</tbody>
</table>


\(^b\)In trillions of BTU's--Energy savings are based on "total system" analysis which include primary energy required for raw material acquisition and electricity input as well as for principle refining process.

\(^c\)Percent assumed to be recoverable from a "maximum possible" recovery effect. Lower percentages are for earlier years, higher percentages for latter years when larger proportions of the population is expected to rise.

Illustration of the total national energy savings possible from recycling of aluminum, ferrous metals and glass. As demonstrated in Table XIV, there is a tremendous energy savings which can be realized through massive recycling of these commodities.

Table XIV indicates the total national saving for several of the commodity classes. However, it is also useful to compare virgin and recyclable material more directly. Table XV
shows energy requirements and energy savings differences for the processing of key virgin metals and pulp versus the processing of recycled metals and paper. As is apparent in Table XV, a substantial energy saving can be realized by substituting recycled materials for virgin materials. These savings also promise to become greater as recycling processing, sorting and collection technologies improve.

**TABLE XV**

ENERGY REQUIREMENTS AND SAVINGS

<table>
<thead>
<tr>
<th>Virgin Material Requirement Kwh/Ton</th>
<th>Recycled Materials Requirement Kwh/Ton</th>
<th>Kwh Savings for Each Ton of Recycled Material</th>
<th>Barrels of Oil Saved Per Ton of Recycled Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>51,379</td>
<td>2,000</td>
<td>49,379</td>
</tr>
<tr>
<td>Copper</td>
<td>13,532</td>
<td>1,727</td>
<td>11,805</td>
</tr>
<tr>
<td>Iron</td>
<td>4,270</td>
<td>1,666</td>
<td>2,604</td>
</tr>
<tr>
<td>Magnesium</td>
<td>90,821</td>
<td>1,875</td>
<td>88,946</td>
</tr>
<tr>
<td>Paper</td>
<td>6,730</td>
<td>2,520</td>
<td>4,210</td>
</tr>
<tr>
<td>Titanium</td>
<td>126,115</td>
<td>52,416</td>
<td>73,699</td>
</tr>
</tbody>
</table>


**Energy and Aluminum Container and Packaging**

David P. Reynolds, vice chairman of the Board of Reynolds Metals Company and Chairman of the Aluminum Association, U.S.A., stated at the 6th International Conference on Light Metals,

Because of its light weight, its strength, durability, electrical conductivity, ability to reflect or conduct heat, and its recyclability, aluminum is the energy efficient material (14, p. 6).
Moreover, many environmentalists, government officials, American industry and concerned citizens agree that aluminum is the leading candidate for the solution to the nation's urban solid waste and energy conservation problems.

Because of the inherent attributes of aluminum, its usage has grown substantially, particularly in the packaging and container industry. Aluminum is being called upon in many packaging forms—from storage silos to large shopping containers, from beverage cans to meat and vegetable packages (14, p. 9). In addition, the popularity of the aluminum can has grown worldwide and new aluminum packaging applications may have an even greater potential. For example, a food package of the future is the retortable aluminum pouch, which replaces the traditional tin can for the packaging of perishable foods (14, p. 10).

Much of the enthusiasm for the growth of aluminum packaging materials lies with its recyclability and energy savings. The energy savings are derived through the differences in the processing of virgin and recycled aluminum. P. R. Atkins, technical coordinator for the Health and Environment Department of the Aluminum Company of America indicates,

Recovery of primary aluminum and subsequent can sheet fabrication represent complex processing operations. To generalize briefly, aluminum production involves mining of bauxite (or other alumina-rich material); refining the ore with a caustic leach and crystallization and calcination to produce commercially pure alumina (Al₂O₃); and electrolytic smelting of alumina dissolved in molten cryolite to recover molten aluminum (4, p. 1).
However, the recycling of aluminum requires less than five percent of the energy required to make virgin aluminum. Recycling merely requires shredding used metal and remelting it at aluminum's relatively low melting point (3, p. 8).

Perhaps of greater importance in aluminum production is that the energy used to produce the primary metal from ore is not lost when the metal is fabricated into a product. Since aluminum can be recycled with a relatively small amount of energy input, smelted aluminum represents a "resource bank" in which energy has been invested. The resource can be used again and again to produce final demand products with a small amount of energy (4, p. 4). This important combination of aluminum characteristics makes recyclable aluminum a valuable resource which is currently economically purchased for reprocessing for $360 per ton.

The United States is increasingly utilizing its aluminum "energy bank" as Americans returned a record 3.9 billion all-aluminum cans to recycling centers in 1975, a 70 percent increase over 1974 (2, p. 38). Currently one out of every four aluminum cans shipped is being successfully recycled (2, p. 38). (See Table XVI for aluminum can reclamation data for 1972-1975 period.)

Aluminum may indeed be the packaging and container material of the future. Aluminum's attributes make it an excellent packaging material and at the same time reduces solid waste pollution through its eminent recyclability. The extensive
### TABLE XVI
ALUMINUM CAN RECLAMATION DATA 1972-1975

<table>
<thead>
<tr>
<th>Year</th>
<th>Pounds of Aluminum Reclaimed</th>
<th>Number of Aluminum Cans Reclaimed</th>
<th>Aluminum Cans Reclaimed As A Percentage of Aluminum Cans Used By Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>53 million</td>
<td>1.2 billion</td>
<td>12.9%</td>
</tr>
<tr>
<td>1973</td>
<td>68 million</td>
<td>1.6 billion</td>
<td>14.7%</td>
</tr>
<tr>
<td>1974</td>
<td>103 million</td>
<td>2.3 billion</td>
<td>16.9%</td>
</tr>
<tr>
<td>1975</td>
<td>174 million</td>
<td>3.9 billion</td>
<td>25.4%</td>
</tr>
</tbody>
</table>


Usage of aluminum is a first positive step toward zero solid waste pollution, solving material scarcity problems and the conservation of scarce energy resources. As David P. Reynolds has emphasized,

One of the great human breakthroughs in the twentieth century is our new vision of how all things on earth are interrelated and interdependent. Among other things, we now see how not only the quality of life, but civilization itself is tied to the proper utilization and distribution of energy. Seen in this perspective, aluminum—earth's most abundant metal, the energy efficient metal—takes on a new and awesome importance (14, p. 12).

### Available Solid Waste Processing Technology

In May of 1972 Beverage Industry reported, "The technology exists today that would permit the recovery from solid waste of all materials of value—paper, glass, steel, aluminum,
copper, zinc, and sand" (17, p. 1). Today municipalities and private solid waste firms are beginning to utilize this available technology. By the end of this year twenty-five cities will have full-scale solid waste recovery systems in operation and another twenty-five will be in the planning or construction stage (5, p. 2). A status report of the most sophisticated and comprehensive resource recovery systems in the United States as outlined by the National Center for Resource Recovery, Inc. is included in Appendix G.

Several integrated materials recovery systems have been developed during the last several years to recover materials from mixed municipal refuse including several systems developed by the United States Bureau of Mines (11, p. 5). The United States Bureau of Mines has conducted extensive research into the recovery of selected materials from both raw unprocessed solid waste and the residual material remaining after waste processing in incinerators. This experience with waste utilization has led to the development of a model separation method of materials recovery which is typical of more effective systems now being employed (11, p. 331). This system is depicted in Figure 3.

While the available solid waste processing systems differ in specific details and approaches to specialized problems, all are nearly identical in the early steps of processing waste (5, p. 2). As shown in Figure 3, most all systems begin by shredding solid waste materials to reduce the size of
Fig. 3—United States Bureau of Mines solid waste recovery system

garbage particles. (See Appendix H for the currently available size reduction equipment.) Perhaps the most typical shredder is the hammermill, like the one used in the waste recovery operations of the City of St. Louis. The St. Louis hammermill shredder consists of 30 large metal hammers which swing around a horizontal shaft, grinding the solid waste against an iron grate until the material is shredded into particles small enough to drop through the grate openings (7, p. 4).

Materials in the typical recovery system are then moved to a magnetic separator which separates ferrous from nonferrous metals, or the materials are moved to an air classifier that separates the lighter components from the dense material such as glass and heavy metals. The order of these two operations varies among the available systems. After magnetic separation and air classification, the collected glass and metals are subjected to screen separation which is feasible because of the very small average size of the glass particles (11, p. 332). Glass particles may then be sorted by color by an optical sorter.

The light materials obtained from the primary air-classifier shown in Figure 3 often are subjected to a second shredding operation (11, p. 332). After this second shredding operation, further air-classification is used to separate the materials into a relatively heavy and lighter grouping (11, p. 332). The heavier materials are then subjected to
further separation usually by utilizing an air table or vibrating table. The air table employs a strong air stream in which light materials are carried out of a zigzag chute and into a waiting recepticle (11, p. 321). These light materials are then joined with the light materials coming from the secondary air-classifier and are subjected to processing in a toothed shredder suitable for operation on ductile material. This shredder effectively divides the light materials into a plastics fraction and paper fiber fraction (11, pp. 321-322). Paper fiber fraction can be utilized as fuel in energy recovery systems.

After the air table operation the remaining nonferrous metals can then be subjected to a variety of nonferrous metals separation methods, designated as "heavy media separation" or "jigging machine" in Figure 3. These methods are particular to aluminum separation and will be reviewed more closely below.

**Nonferrous Metals Sorting**

There are three primary classifications of nonferrous metals sorting methods—(1) gravity separation methods, (2) electric or magnetic field separation methods, and (3) chemical or thermal separation methods. Various separation technologies under each classification will be briefly outlined.

Gravity separation methods include heavy media or sink/float separation, tabling and jigging. In the heavy media or sink/float a heavy liquid is used as a medium. When a mixture
of aluminum and other nonferrous metals is placed in the heavy liquid, the particles with the greater specific gravity than the liquid will sink, while the lighter particles will rise to the top and are skimmed (5, p. 3). A medium of intermediate density between 2.9 and 3.1 is used to separate aluminum from other metals (5, p. 3).

In tabling, separation is achieved by flowing a pulp across a riffled table. The table is vibrated in the direction of the riffles and washed by water flowing in right angles to the direction of the vibration (5, p. 4). Lighter materials are washed over the riffles and ultimately collect on the low side of the table, while the heavier particles migrate along the riffles toward the end of the table (5, p. 4).

The last method of separation by gravity separation presented here is jigging. This method provides for materials to be separated by the pulsation of liquid through a bed of materials. This process causes the materials to be stratified in layers, with heavy particles in the bottom and lighter particles on the top (5, p. 4). The stratified layers are removed by means of baffles and spigots (5, p. 4).

The second primary category of nonferrous metal separation is electric or magnetic field separation. There are two currently used methods in this category—the eddy current or "aluminum magnet" and electrostatic separation. In the eddy current or aluminum magnet method, eddy currents are produced when an electro-magnet generates a magnetic field
that passes through a nonferrous, conductive metal surface (5, p. 5). The interaction of the eddy currents and magnetic field exerts a repellent force on the aluminum thus separating it (5, p. 5). In electrostatic separation electrostatic equipment can be used to separate aluminum from glass because aluminum is a conductor of electricity while glass is not (5, p. 5).

The third major classification of nonferrous separators is chemical/thermal separation methods. There are three widely used chemical/thermal technologies. The first is sweating which is a process utilizing the different melting points of metals to separate them (5, p. 6). The second chemical/thermal method is froth flotation and involves separating metals by floating one of them in a foam on the surface of a liquid. This process can separate materials regardless of their densities because it depends on their surface characteristics, not relative weight (5, p. 6). The last chemical/thermal method is cryogenic separation. When exposed to an extremely cold environment, some waste materials such as aluminum and copper remain malleable, while others such as steel, rubber, zinc and plastics become brittle (5, p. 6). In cryogenic separation, mixed materials are placed in a cold substance, such as liquid nitrogen, and the more brittle materials are shattered by impact. Then screening is used to separate the various components (5, p. 6).
Summary of the Recycling Environment

While recycling has been economically important for many years the salvage industry still remains relatively unsophisticated and underdeveloped. However, as a result of greater emphasis being placed on recycling by federal and state governments, environmentalists, and concerned citizens formal distinct reverse channels of distribution are emerging. These reverse channels of distribution contain a variety of important institutions which provide the means for returning consumer discard to manufacturers for reprocessing. Aluminum container and packaging recycling is accomplished utilizing essentially only two of the identifiable reverse channels--the manufacturers' direct channel and the specialist dealer channel.

The development of recycling reverse channels of distribution stems, most notably, from three important and critical influences. These influences are (1) the dwindling availability of raw materials, (2) energy shortages, and (3) new technology which is making mass recycling economical.

The United States, and indeed, world supplies of many important raw materials are becoming dangerously low and yet demand for these materials continues to accelerate. Moreover, the United States does not have adequate known sources of many necessary minerals to maintain the present standard of living into the foreseeable future. Recycling of basic commodities is an important part of a comprehensive solution to alleviate this shortage problem.
The second major influence on reverse channel development is the current energy shortages. Solid waste disposal and the energy problems plaguing the United States are highly interrelated. Recycling can help conserve energy sources in two important ways. First, many sorted solid waste materials can be used as fuels through "energy recovery" systems and, second, substantial amounts of energy can be saved by utilizing recycled materials. This saving is possible because less energy is often consumed using recycled materials instead of virgin materials in the manufacturing process. The importance of aluminum in energy conservation is that processed aluminum essentially serves as a "resource bank" which can be reprocessed for a fraction of the original energy requirements.

The technology to sort and process solid waste materials is now readily available and many private firms as well as municipalities are now employing efficient recovery systems. Such technology has made recycling economically feasible and has allowed for further reverse channel development. Methods for sorting aluminum from other nonferrous metals is also available and should further aid in extensive aluminum recycling in the future.
CHAPTER BIBLIOGRAPHY


CHAPTER IV

ALUMINUM PACKAGING AND CONTAINER REVERSE CHANNELS OF DISTRIBUTION

The major reverse channels of distribution for aluminum container and packaging materials are (1) the direct channel owned and operated by primary aluminum manufacturers, and (2) the specialist dealer channel which is dominated by large beverage producers. These two groups of reverse channel intermediaries represent the bulk of the institutions performing reverse channel functions for aluminum container recycling.

This chapter provides an analysis of these important aluminum container and packaging reverse channels of distribution by profiling the activities of (1) the twelve primary aluminum manufacturers (the direct channel), and (2) the ten largest brewers and five largest soft-drink franchisers (the specialist dealer channel). Company profiles were established through the use of current literature, company reports and documents, and specific information obtained through mail survey. Emphasis for these company profiles is placed on recycling operations, recycling organization and recycling philosophy.

Consumer Interface

Both the manufacturers and the specialist dealer channels must ultimately interface with the consuming public. Therefore,
before providing profiles of companies in these two channels
some generic problems regarding the reverse channels interface
with consumers are briefly reviewed.

Until the end of World War II significant amounts of
solid waste materials were salvaged from the municipal solid
waste stream. For the most part solid waste materials were
separated at the source—in the home (4, p. 6). In many com-
munities workers on trucks or at dumps then removed salvageable
materials such as newspapers, cardboard, metals, glass and
rags (4, p. 6). Separation of waste materials was a quite
natural activity for the individual household. However, as
labor costs rose and the compactor truck was introduced, opera-
tions became more expensive and difficult. New expenses and
difficulties, coupled with the growing consumer attitude
toward convenience as suggested in Chapter III of this study,
caused sorting operations to be slowly abandoned (4, p. 6).

Even though there are signs of increased interest in re-
cycling, the average consumer still seems reluctant to sort
his solid waste discard. However, if the manufacturers and
specialist dealers are to develop highly efficient, indepen-
dent, specialized channels, consumer sorting of materials is
of extreme importance.

In the absence of legislation requiring the sorting of
solid waste at the source to facilitate reclamation of valu-
able materials, interested channel members have turned to
money to motivate consumers. As early as the late 1960's
several reverse channel leaders launched recycling programs paying 10 cents per pound for aluminum beverage cans, regardless of the brand. Most significant among these early programs was the Reynolds Recycling Program, Alcoa's "Yes we can" campaign and Coor's "cash-for-cans" program. By mid 1974 the price per pound of aluminum had risen to 15 cents, and in late 1976 the price rose an additional 3 cents to 18 cents per pound. This price makes aluminum the most valuable material found in any significant quantity in the nation's solid waste stream (2, p. 2). Channel intermediaries predict additional price hikes in the near future (5).

The present system of aluminum container recycling requires that cans be collected, sorted and transported to the local recycling center for processing by consumers. In the past much of this activity was carried out by community groups, charities, and environmentalists. Today, however, even some community spirited recyclers are taking note of the profit potential in aluminum recycling. Those same people are now selling for their own pocketbooks (8). Further, if prices of aluminum scrap continue to soar, it is likely that individual consumer participation in the sorting and transportation of aluminum cans will increase. As prices approach one or even two cents a beverage can (prices presently are at .75 cents per can), a quasi deposit system will be in effect via the marketplace. Such a system will no doubt expand consumer recycling efforts as well as reverse channel middlemen efforts.
Moreover, it is suspected that as aluminum scrap prices rise, additional and more convenient collection points will be established, such as at supermarkets, drug stores and convenience food stores as has occurred with returnable bottles. It is doubtful at this stage that home pick up of sorted scrap aluminum as a specialty item will ever occur. Additionally, at such prices it is doubtful that consumers will be inclined to simply discard beverage cans into the municipal solid waste stream. Thus at the consumer level, aluminum recycling, if allowed to function through the forces of supply and demand, may operate in a manner similar to the present returnable bottle system.

Profile of Aluminum Packaging and Container Recycling in the United States

As previously noted, consumer scrap aluminum packaging and container materials flow essentially through two reverse channels of distribution—the direct channel and the specialist dealer channel. These two channels can be regarded as organizationally and philosophically exclusive; however, distinct subgroups also emerge within each channel classification. Therefore, the general attributes of these discrete channel subgroups are highlighted and distinctive category features are analyzed in some detail. In addition, because of assurances of confidentiality in the survey conducted for this study and several companies' concern in this respect, all references to specific firms have been eliminated. The organizational
structures, operations and management philosophies do, however, accurately depict actual existing company situations.

The Manufacturers' Direct Reverse Channel of Distribution

The manufacturers' direct aluminum packaging and container reverse channel of distribution is composed of primary aluminum manufacturers that engage in consumer scrap recycling. The twelve primary aluminum manufacturers operating in the United States are: Aluminum Company of America (Alcoa), ALUMAX Incorporated, Anaconda Aluminum Company, Consolidated Aluminum Corporation, Howmet Aluminum Corporation, Kaiser Aluminum and Chemical Corporation, Martin Marietta Aluminum Incorporated, National Aluminum Company, Noranda Aluminum Incorporated, Revere Copper and Brass Incorporated, Reynolds Metals Company and Southwire Company (see Table V, page 26). These primary aluminum manufacturers were surveyed by mail questionnaire in order to assess the frequency and degree to which they have extended their organizations toward the final consumer as a source of raw materials. The organizational vehicle which makes this possible is, of course, the reverse channel of distribution.

All aluminum manufacturers recycle new scrap. New scrap is the scrap generated by aluminum plants making end products. New scrap is not in the form of a used end product, but rather it includes aluminum borings and turnings, clippings and punchings, forgings, dross, skimmings and slag (7, p. 1171).
This scrap is simply returned to the process at the plant. Only a few primary aluminum manufacturers, however, recycle old scrap. Old scrap is recovered from metal that has been used by consumers and returned to plants for making ingot and mill products. These types of recycling add to the total metal supply (7, p. M171).

The portion of total United States aluminum supply accounted for by scrap was about 24 percent in 1975. Total recycled old scrap accounted for nearly 6.5 percent of the total aluminum production in 1975. Almost 2 percent of the total aluminum production in 1975 came solely from recycled aluminum beverage cans (174,000,000 pounds) (1, pp. 17, 38 and 39). While the figure for aluminum beverage cans seems small, it must be emphasized that only 25 percent of the available beverage cans were recycled. If all the available beverage cans were recycled, the figure would, indeed, be quite significant and would represent a tremendous material and energy savings.

Most of the recycled aluminum beverage cans are ultimately remanufactured into new beverage cans. Recycled aluminum is earmarked for the production of "can stock" because metal purity requirements for beverage cans is not as stringent as for many other aluminum usages. In addition, aluminum manufacturers feel a moral obligation to the various beverage producers to return their recycled beverage cans to can stock.
Where primary aluminum manufacturers do not manufacture can stock, there is little incentive to develop a reverse channel of distribution. Beverage producers, however, do have a tremendous incentive to recycle beverage cans in order to insure adequate supplies of new beverage cans in the future. When aluminum shortages occur, as happened in 1974, pure aluminum finds its way to higher priority, higher price usages.

Eight out of the twelve aluminum manufacturers responded to the mail questionnaire initiated by this study. This data combined with current literature, company reports and information provided by the Aluminum Association is utilized to profile the manufacturers’ direct channel of distribution. Analysis of this information indicates that the aluminum manufacturers can be divided into two distinct segments with regard to their involvement in aluminum packaging and container consumer scrap recycling. These segments represent (1) companies which have developed reverse channels of distribution for the recycling of aluminum packaging and containers, and (2) companies which, for a number of reasons, have chosen not to enter into consumer scrap recycling as of this time. These two segments of the United States aluminum industry will be profiled separately as to their reverse channel perspectives.

Aluminum manufacturers with reverse channels of distribution.—There are only four United States primary aluminum manufacturers currently involved in consumer scrap recycling.
These companies dominate the aluminum industry and jointly represent almost 70 percent of the United States primary aluminum capacity. All four companies responded to the mail questionnaire survey. Together these firms accounted for over seven billion cans recycled in 1976 and virtually all of their recycling efforts were directed toward aluminum beverage cans. Only two firms accept other types of consumer scrap aluminum, mostly household aluminum scrap. These companies accept clean household scrap such as pie plates, foil, frozen food and dinner trays and dip, pudding and meat containers. These firms will also accept certain other items, including aluminum siding, gutters, storm door and window frames, old cast and sheet aluminum, auto scrap and lawn furniture tubing redeemed at a slightly lower price. This material is not mixed with beverage cans at the recycling centers because it will have a different ultimate usage.

The actual operations of the three largest manufacturers' direct reverse channels are quite similar. All three of these companies operate on a nationwide basis. The important sorting functions of accumulation and sorting out are performed at any one of the company affiliated collection points located across the country. The number of aluminum scrap collection points for the involved aluminum manufacturers range from 57 for the smallest recycling operation to nearly 800 for the largest. Recycling facilities are established in metropolitan
areas having an abundance of all-aluminum cans. Consumers are encouraged to bring in used all-aluminum cans and clean household aluminum for redemption and are paid 17 to 18 cents per pound on the spot. At the center, cans are magnetically separated, flattened and then shipped to a larger recycling facility. At the regional facilities the scrap aluminum is either shredded into popcorn-sized pellets or compacted and baled for shipment to smelting plants that make sheet aluminum. These sheets are ultimately fabricated into beverage cans.

The fourth manufacturer’s direct channel is supplied solely through purchase of scrap from private dealers and processors. Three of the four primary aluminum manufacturers with reverse channels of distribution have augmented their recycling operations with scrap aluminum delivery contracts with major beer producers. These contractual arrangements are non-binding and cover a number of logistical matters rather than the quantity of scrap to be delivered. In addition, two of the recycling aluminum manufacturers also have such contractual arrangements with municipalities and receive sorted aluminum scrap from municipal recovery systems. There are no delivery contracts between primary aluminum manufacturers and the five leading soft drink franchisers. All four manufacturers also interface with individual consumers paying them the current going rate for aluminum scrap.

Only one of the four primary aluminum manufacturers reported their packaging and container reverse channels as being
unprofitable. The other three companies reported their operations were currently making a profit but that profit was not their original motivation for developing reverse channels. Typical of the comments made by primary aluminum manufacturers which have profitable recycling operations is the following: "In the beginning aluminum scrap recycling was purely for public relations reasons, now it's a business." Another typical comment which suggests the current profit approach of manufacturers' recycling program is the following:

This pilot project of 1967 has grown dramatically into a solid business enterprise, operating on a sound financial and economic basis. . . . We believe the best way for our program to be permanent--not short-ranged--is to develop it on a basis which gives the public a cash incentive yet allows us to buy aluminum on a profitable basis.

Aluminum companies indicate the greatest problem concerning the development of their recycling programs has been making participation convenient for consumers. The most difficult tasks in this regard have been the location of convenient collection sites and the need for expansion of permanent recycling facilities. Another common problem among the aluminum manufacturers concerning their recycling operation is control at the buying level. Often there is a large amount of foreign material mixed with the aluminum which causes considerable "shrinkage" and sorting difficulties. In many cases, manufacturers end up paying for material other than aluminum which is mixed with scrap aluminum. This foreign material decreases the profitability of these channel operations.
Primary aluminum manufacturers with reverse channels of distribution utilize a variety of organizational arrangements to effectuate their recycling efforts. Two of the manufacturers have created wholly owned subsidiaries to perform channel functions. Another firm has split its recycling management between the sales and marketing department and the operations department. The decentralized recycling groups report through the sales and marketing department while the buying and recycling logistics are the responsibility of the operations department. The recycling centers report through the sales and marketing department because of the promotional aspects of recycling. The corporate manager of reclamation in the operations department provides centralized coordination and control. This firm is, however, currently considering creating a separate subsidiary for its reverse channel operations.

These three reverse channel operations are reported as being profitable. The firm which indicated that its reverse channel operations are unprofitable apparently has made no specific organizational arrangement for recycling activities. The department responsible for consumer scrap recycling in the firm reporting unprofitable reverse channel operations is the Administrative Systems Department. Reverse channel responsibilities in the Administrative Systems Department are assigned to personnel with other primary duties. There are no full-time personnel, at either the management or nonmanagement levels. This company is the only company which does not have
full-time management personnel assigned to recycling operations at the company level.

Specific organizational arrangements coupled with distinct responsibilities, authority and objectives seem to be an important factor in the success of aluminum industry reverse channels of distribution. Moreover, the more decentralized from the main business of the company the better. Firms with wholly owned recycling subsidiaries are most enthusiastic about their growth potential and profit picture.

The decision to create a separate subsidiary or at least centralized controls for the operation of the reverse channels of distribution seems important for efficient functioning of the channel. This top management decision acknowledges that the required channel functions represent a distinct and autonomous business. As such, this business should properly have its own full time personnel, goals, objectives, strategies, tactics and policies. Channel operations can make greater contributions to company operations if they are allowed to stand alone and are not intertwined in departments with other primary objectives.

Primary aluminum manufacturers have entered into consumer scrap recycling essentially for two reasons: (1) to recover metal and thus add to the total metal supply, and (2) to take advantage of the efficient processing of recycled aluminum. All of the firms with reverse channels cite reasons like "to clean up the environment" and "to provide the public with an
acceptable alternative to littering or disposing of aluminum cans” as supporting reasons for their decisions to develop reverse channels. As one aluminum manufacturer phrased it,

As a major supplier of aluminum to the packaging industry, [the company] feels it has an obligation to help in solving litter and solid waste problems. The success of our program means to us that recycling all-aluminum cans is an economically feasible method of fighting this problem and, at the same time, preserving the supply of a valuable natural resource for reuse. . . . Once it is produced, aluminum becomes an Energy Bank—because aluminum does not deteriorate, and recycling it for reuse requires less than 5 percent of the energy used to make the aluminum originally. This 95 percent energy saving makes every aluminum can an Energy Bank—energy that may be saved over and over again, each time the metal is recycled. And, because of aluminum's high scrap value, the aluminum can is less likely than other containers to be littered or thrown away, and more likely to be picked up or saved for recycling.

All four primary aluminum manufacturers believe that the use of aluminum for packaging will continue to grow and are currently expanding their recycling operations. One firm plans to double its capacity during the 1977-78 period. Other companies cite the opening of new regional centers to further exploit the expanding supply of consumer scrap aluminum. This expansion reflects the feeling of all the primary aluminum manufacturers involved in reverse channels of distribution. The primary aluminum manufacturers believe that consumer scrap will continue to be an important source of raw materials in the future. Because of the relative complexity of this channel, important reverse channel variables are summarized in Table XVII.
TABLE XVII
PROFILE OF IMPORTANT VARIABLES IN THE MANUFACTURERS' DIRECT ALUMINUM PACKAGING AND CONTAINERS REVERSE CHANNEL OF DISTRIBUTION

<table>
<thead>
<tr>
<th>Company</th>
<th>Material Recycled</th>
<th>Logistical Operations</th>
<th>Delivery Contracts</th>
<th>Channel Is Profitable</th>
<th>Channel Organization</th>
<th>Plan to Expand Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Beverage cans only</td>
<td>Company affiliated recycling centers</td>
<td>Beer companies, municipalities, independent dealers</td>
<td>Yes</td>
<td>Department</td>
<td>Yes</td>
</tr>
<tr>
<td>B</td>
<td>All aluminum materials</td>
<td>Company affiliated recycling centers</td>
<td>Beer companies, municipalities, independent dealers</td>
<td>Yes</td>
<td>Subsidiary</td>
<td>Yes</td>
</tr>
<tr>
<td>C</td>
<td>Beverage cans only</td>
<td>Company affiliated recycling centers</td>
<td>Beer companies, independent dealers</td>
<td>No</td>
<td>None</td>
<td>Yes</td>
</tr>
<tr>
<td>D</td>
<td>All aluminum materials</td>
<td>Supplied through purchase of scrap from private dealers</td>
<td>Independent dealers</td>
<td>Yes</td>
<td>Subsidiary</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Aluminum manufacturers without reverse channels of distribution.--The second category of primary aluminum manufacturers contains those manufacturers which have not developed reverse channels of distribution. Four out of the eight firms placed in this grouping responded to the mail survey questionnaire initiated by this study. These firms, while relatively large in number, comprise only approximately 30 percent of the United States primary aluminum capacity. Moreover, many of these companies produce only specialty aluminum products such as electrical wire and cable. Therefore, their noninvolvement in recycling is understandable.

The main reasons suggested by these manufacturers for not developing aluminum packaging and container reverse channels were (1) because primary metal supply has been sufficient to meet current company needs, and (2) because the company does not manufacture sheet aluminum for can production.

These companies, for the most part, have very little interest in recycling of consumer scrap because the activity does not fit within the scope of their present operations. For companies which do not produce can stock, consumer scrap is not a raw material. Therefore, these companies have no need for any recyclable aluminum containers. The companies that do make some sheet aluminum have limited supply needs that are adequately met by traditional raw material supplies. Only one of the responding firms in this category is studying the possibility of future participation in consumer scrap aluminum
recycling. In addition, beverage producers which do large amounts of beverage container recycling prefer sending their beverage cans to large capacity sheet aluminum producers. This practice better assures that the main objective of their recycling efforts will be realized—turning old cans into new cans.

The Specialist Dealer Reverse Channel of Distribution

The second major reverse channel of distribution through which aluminum packaging and container materials flow from consumers back to manufacturers is the specialist dealer channel. This highly specialized reverse channel is dominated by the major beverage producers which utilize aluminum containers. The segments of the beverage industry that use aluminum packaging for their products are the beer and soft drink producers.

The principal beer producers and soft drink franchises were surveyed to establish the extent of their present and planned participation in the specialist dealer reverse channel of distribution. Results of the survey coupled with available literature suggest that these two segments of the beverage industry form fairly homogeneous groups with regard to reverse channel involvement. Perspectives toward reverse channel organizations, recycling operations and waste management philosophies of the largest ten beer producers proved to be quite distinct from those of the five largest soft drink franchises. These two unique divisions of the specialist dealer channel will be analyzed and profiled separately.
Beer producing companies.—The first major subgrouping of reverse channel intermediaries in the specialist dealer channel consists of the beer producing companies. The ten largest United States brewers were surveyed in order to assess the extent of their entry into the aluminum packaging and container reverse channel of distribution. The ten leading brewers (by barrel sales) accounted for 84 percent of industry shipments and include Anheuser-Busch Incorporated, the Joseph Schlitz Brewing Company, the Pabst Brewing Company, the Miller Brewing Company, the Adolph Coors Company, the F. & M. Schaefer Brewing Company, the Olympia Brewing Company, the Stroh Brewing Company, the Falstaff Brewing Corporation, and the George Heileman Brewing Company (see Table VI, page 29).

Seven out of the ten beer producing companies responded to the mail survey. These data considered together with available literature, company reports and conversations with a representative of the United States Brewers Association, Incorporated provided considerable amounts of information concerning the composition of this segment of the specialist dealer reverse channel. An analysis of the information gathered by this study indicates that the ten largest United States brewers can be subdivided into three fairly discrete groups with regard to reverse channel activities.

The three subcategories of brewers are: (1) brewers that have developed extensive and sophisticated aluminum packaging and container reverse channels of distribution, (2) brewers
that provide "support" for recycling activities and projects, and (3) brewers that are not involved in recycling. These three distinct classifications will be profiled separately in order to better composite the brewers' category of the specialist dealer aluminum packaging and container reverse channels of distribution.

The first subcategory of brewers participating in the aluminum packaging and container reverse channel of distribution comprises those brewers which are widely involved in forming reverse channel intermediary functions. Only three out of the ten brewers surveyed are extensively involved in the important reverse channel sorting functions of sorting out and accumulation of aluminum packaging and containers. These three brewers are among the seven who responded to the survey.

These three brewers recycled a total of nearly two billion aluminum cans in 1976, which is more than the total number of cans recycled by all recycling companies in 1973. While 1976 aluminum can recycling totals are not yet available from the Aluminum Association, it is expected that the three brewers which have developed aluminum packaging and container reverse channels of distribution may account for as much as 35 percent of the total aluminum cans recycled in 1976. These three brewers represent a significant force in the total recycling effort of aluminum packaging and container materials.
Of the three brewers which have developed aluminum packaging and container reverse channels of distribution, two distribute their products regionally and one has a national distribution system. All three companies recycle only aluminum containers (beverage cans) and do not accept other forms of aluminum for recycling. In addition, all three companies have also developed nonbinding aluminum scrap delivery contracts with primary aluminum producers in order to assure a ready market for their recycled containers. Moreover, aluminum delivery contracts apparently, if tacitly, go one step further in helping to assure a supply of sheet aluminum for can production. As one brewer suggested,

There is no questioning the fact that in 1974 we nearly ran out of aluminum for cans and the only thing that carried us through the metal shortage then was our recycling program. Our nation today is again facing critical shortages of energy and mineral resources which can only get worse as time goes on. Every one of our distributors should be made well aware—and I think this is a point we need to stress—that the aluminum shortage is again beginning to intensify. From here on out it can only get worse, not better. And we have to look at the principal source of our aluminum for new cans coming from recycled cans. . . . If you want to get down to pragmatic business survival, recycling aluminum is a guarantee that they're [the distributors] going to have beer in cans to sell. It is the distributors' obligation to collect and send the recycled cans back to us. They are a part of the closed loop recycling system that is going to insure the future survival of our company. . . . . . . A vital purpose of our recycling system particularly in times of aluminum shortage is to supply the company with aluminum for new cans, not to make money. If the distributors don't get the job done, we don't get the cans to fill with beer. It's as simple as that!
The recycling systems of the three reverse channels are supported by the introduction of equipment for the inspection, weighing, crushing, shredding, transportation and baling of cans at the distributor level. The sophistication and extent of introduction of these additional technologies varies from distributor to distributor. No new technologies have been required at the company level.

All of the brewers with reverse channels of distribution reported that their recycling operations are profitable. However, the brewers also attached additional qualifying comments to their statements on the profitability of their operations such as the following:

The purchase and resale of recyclable cans are designed to break even. Administrative and publicity costs on the part of the beer wholesaler and the . . . company are an investment in corporate citizenship, goodwill, and consumer acceptance of our product.

We are trying to maintain a breakeven posture in aluminium thus maximizing the incentive to consumers and other middlemen.

While the recycling operations of these firms is seen as profitable and as making valuable contributions to company investments, the development of reverse channels in this segment of the specialist dealer channel is not without problems. The major problems listed by the brewers concerning the development of their reverse channels were quite similar. All three firms were concerned about the expansion of their program and the commitment of the necessary capital in the face of pending restrictive container legislation which may make such programs
obsolete. Two firms also found major problems in (1) the logistics of transporting and processing of scrap cans while still attempting to minimize total costs (a traditional channel problem) and (2) educating the public and the distributors on the importance of recycling.

Organization seems to be an important element of the successful specialist dealer reverse channels of distribution. All three companies involved in extensive recycling programs have made explicit organizational provisions for their programs. At the local level, the three companies utilize their present distribution systems to perform the essential sorting functions of accumulation and sorting out. Local distributors may also be involved in processing (crushing and baling) and transportation functions. At the company level, two of the companies' reverse channel operations are organized as separate profit centers, while all three have established distinct organizational entities to direct and coordinate channel intermediary functions. Direction and coordination of channel operations is derived primarily out of the recycling or environmental affairs department's authority for reverse channel policy formation. The number of personnel involved in channel responsibilities at the company level is quite small in all companies. (See Table XVIII for personnel involvement in management of the reverse channel.)

This centralization of reverse channel responsibility and concomitant authority brings channel management out of part
TABLE XVIII
PERSONNEL INVOLVED IN REVERSE CHANNEL MANAGEMENT

<table>
<thead>
<tr>
<th>Company</th>
<th>Market Coverage</th>
<th>Profit Center</th>
<th>Management Full Time</th>
<th>Management Part Time</th>
<th>Nonmanagement Full Time</th>
<th>Nonmanagement Part Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Regional</td>
<td>Yes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>National</td>
<td>No</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>Regional</td>
<td>Yes</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

time or supplemental posture and provides the full-time emphasis it deserves. The brewers have seen fit to departmentalize their reverse channel for the same reasons many companies departmentalize forward channel management—coordination, control and economies of scale.

Using the word "centralization" to describe the reverse channel operations of the brewers is somewhat misleading. While it is true that these brewers have centralized certain important functions of their channel operations, such centralization is merely a requirement of coordinating and controlling a large and complex operation. The reverse channel organizational arrangements of the brewers, in reality, more closely parallel Peter Drucker's concept of federal decentralization (3, pp. 572-591). The brewers' recycling reverse channels operations are acknowledged and managed as separate businesses. These businesses have their own sources of supply, their own technology and their own markets and yet must fit into the
total strategic and philosophical framework of each company. The "center" establishes broad policy and provides for coordination and consistency, while the relatively autonomous "parts" operate their recycling business within these guidelines. Thus what is actually in effect is a system of "centralized controls" which bring clarity, adaptability, stability, economy and purpose to the channel effort.

These companies have developed aluminum packaging and container reverse channels of distribution for a variety of reasons. All have the full commitment of top management. In all three companies top management has realized the importance of recycling and has provided the necessary support. Reasons cited for top management's decision to enter the specialist dealer channel are best exemplified by the following response.

[Recycling operations were begun] initially as a deterrent to punitive container legislation and to fulfill a management philosophy that implies responsibility for environmental programs. . . . More recently, recycling is justified as a source of scrap aluminum and [because of] the commercial implications with our primary suppliers. . . . [In addition recycling was initiated] to illustrate that non-legislated recycling is feasible.

All three of the companies have moved to the all-aluminum can and suggest that it is the optimal container if restrictive container legislation does not force conversion to bottles. Moreover, all three companies expect to expand, advertise and further merchandise their aluminum reclamation programs. Typical of the companies' planned future participation in scrap aluminum recycling is the following response:
As long as scrap can recovery programs benefit the distributor and his relationships within the marketplace, and . . . relationships with our aluminum suppliers, we will continue voluntary recycling until such time as mandatory deposits on cans take effect.

The second subgroup of brewers contains those which have not developed aluminum reverse channels of distribution. Grouped in this category are brewers that support recycling programs, antilitter public awareness campaigns and solid waste research but are not physically involved in recycling. Two out of the seven remaining brewers which were included in this study are placed in this category and both responded to the mail survey. These national companies consider themselves as "actively involved" in recycling but they have not developed reverse channels of distribution. Although these two companies encourage local distributors to participate in local community recycling projects, they have no centralized coordination of or accounting for such efforts. The involvement of these brewers is limited to support and research in broad environmental areas.

One of the involved companies has established an Industry and Environmental Affairs Department to analyze and pursue solutions to the nation's litter, solid waste, resource and energy problems. This department has primarily emphasized (1) the creation of company policy on environmental issues and legislation, (2) the development of programs for antilitter public awareness, and (3) the support of independent analysis and research on resource recovery.
Both of these firms have taken very strong stands against any form of container legislation aimed at reducing litter and solid waste. The general reasoning underlying these companies' objections to container legislation is summarized in the following: (1) restrictive packaging laws do little or nothing to reduce litter and solid waste, (2) packaging systems which result from such laws cause drastic economic dislocations for container manufacturers, beverage producers, distributors and retailers, (3) such laws are discriminatory in that they attempt to regulate only a small portion of the total litter and solid waste mainstream, and (4) consumers pay more for beverages without receiving compensating environmental benefits.

These producers are extremely wary of the effects of forced deposit legislation. For this reason these producers have chosen not to go completely into the all-aluminum can. In addition they see some possible economies in balancing steel and aluminum can production. As one firm suggested in evaluating the future of aluminum packaging for beverages,

[The Company] divides its total can production, approximately 50-50 between steel and aluminum. Since both metals make excellent containers, we do this to insure that the steel industry and the aluminum industry compete with each other for the beverage can business.

Both of these firms are interested in supporting independent recycling efforts which approach solid waste litter from a total systems viewpoint. These companies recommend a total approach to the litter problem on state, city and community levels. It is their belief that total systems of recovery
are far more effective than company organized container recycling. Therefore, planned participation in future recycling efforts for these companies will be in the areas of (1) anti-litter campaigns using national media, along with sound motivational appeals, to encourage responsible individual behavior and to stimulate community action and (2) support of "total" resources recovery systems. Apparently these companies do not plan to more fully develop their own recycling operations. They suggest that increased distribution, handling, accounting and storage costs would mean significant price increases to consumers.

An example of these companies implementing their philosophy of total recovery as the answer to the resource problem is their providing funds and support for the National Center for Resource Recovery (NCRR), an independent, non-profit organization established to analyze and research resource recovery. This organization assists a number of states and local governments in assessing the economies and technology available to help solve their waste and energy problems.

These firms' top management thus believe that recycling is important to the national well being, but they also believe that recovery systems should be made comprehensive by recycling a wide range of recoverable materials. These two firms' executives suggest that their corporate responsibility is not to develop their own systems of limited material recovery but rather to support community reclamation systems. Therefore,
corporate interest and effort have been directed toward these objectives—programs of anti-litter and legislative impact awareness and support for independent analysis and research on resource recovery.

The third subdivision of brewers is composed of the five remaining companies included in this study which, for the most part, are not at all involved in recycling activities. As might be expected, only two companies in this subgroup responded to the survey. Information obtained from this survey and conversations with the United States Brewers Association as to the operations of the nonreporting firms are used in establishing a profile for this segment of the industry.

These brewers are not involved in aluminum packaging and container recycling. These brewers are regional and cite the uncertainty of pending "bottle bill" legislation as keeping them out of the recycling business. Other reasons for not directly entering into consumer scrap recycling are problems of manning, control and logistics. All of these companies have no apparent plans for future participation in aluminum packaging and container reverse channels of distribution.

Soft drink franchise companies.—The second major subgrouping of the specialist dealer channel is comprised of the soft drink franchise companies. The five leading soft drink franchises were also surveyed by mail questionnaire to determine the extent of their participation in the specialist
dealer reverse channel. These franchises include the Coca-Cola Company, PepsiCo Incorporated, the Seven-Up Company, the Dr. Pepper Company and the Royal Crown Cola Company. These companies in the aggregate accounted for 74.9 percent of the total soft drink industry volume. (See Table VII, page 29.)

Four out of the five soft drink franchises responded to the mail survey. These firms form a homogeneous group with regard to their recycling operations and perspectives. The homogeneity of this subgrouping lies in the fact that none have moved to develop aluminum packaging and container reverse channels of distribution. In addition, the soft drink franchises have somewhat unique franchise organizations, and all have about the same philosophy on the support of recycling programs.

All of the reporting soft drink franchises claimed to be "actively involved" in the recycling of consumer scrap. However, this involvement is in reality limited to the support of local community projects, the provision of recycling information to local bottlers and some support of national organizations, such as Keep America Beautiful, Incorporated. As one franchise indicated regarding its participation in recycling, "We provide the . . . bottling companies with information concerning recycling and of the more productive total solid waste resource recovery systems. We encourage them to participate in recycling of aluminum and other materials through the community recycling stations. . . ."
The soft drink industry is organized via the franchise. Local franchise holders (franchisees) have considerably more autonomy in the production and marketing of their product than is the case in the beer industry. The franchise company (franchiser) provides a variety of services including advertising and marketing leadership, sales promotions, aid in product quality control, research, legal counsel, public affairs, environmental planning and other administrative functions. Production is local, however, and local franchisees have substantial influence regarding demand and supply contingencies. Therefore, the local soft drink bottlers perhaps have a greater degree of autonomy in carrying out local operations than do their beer industry counterparts. This autonomy is reflected in the local bottlers' recycling efforts, the lack of centralized channel organization and the channel management philosophy of the soft drink franchisers.

Since the soft drink franchisers have no recycling programs of their own, there is, of course, no centralized accounting of quantities of beverage cans recycled nor have soft drink franchisers developed any scrap aluminum delivery contracts with aluminum producers or scrap middlemen. Whatever contribution to the recycling of aluminum packaging and containers that the soft drink industry makes is a result of independent bottlers' efforts in conjunction with local recycling projects.
Organization of recycling efforts at the company or franchiser level consists only of additional part-time duties for already established positions. For instance, in one company the Director of Governmental Affairs has "environmental affairs" responsibility which is inclusive of recycling. Assignments of recycling responsibility in the remaining reporting soft drink franchiser companies is even less formalized. In addition, no new technologies have been integrated into operations at either the company or local level to handle the recycling of aluminum packaging and containers.

The soft drink franchisers' management philosophy toward the use of aluminum packaging and their planned future participation in consumer scrap aluminum recycling is also quite consistent among the reporting firms. Aluminum cans continue to play an increasingly important role in the packaging of soft drinks, up 3 percent in 1975 to 32 percent of the total soft drinks distributed (6, p. B72). The growth in aluminum can packaging is attributed to advantages in convenience for both the consumer and companies rather than for recycling reasons. Cans offer the manufacturer ease of lithography imprinting; cost advantage of high-speed filling, durability, absence of breakage problems; quick-chilling quality, easy open features, less weight, and is less energy intensive than bottles (6, p. B72). Only one company stated explicitly that it was moving into the aluminum can as their number one package throughout the United States. Other reporting companies
made noncommittal statements as to the future of aluminum packaging for beverages. Typical of such statements is the following:

The company encourages the packaging industry to develop and produce forms of packaging which made optimal use of materials or energy resources, and which minimize impact on litter and solid waste consistent with good packaging standards and with packaging choices that meet consumer needs and preferences.

None of the reporting soft drink franchisers indicate having any plans to expand their present systems to include a recycling reverse channel of distribution. The soft drink franchisers plan to maintain their present systems of local distributor participation on an individual basis with encouragement and information provided by company headquarters.

Three of the companies reporting indicated that the best recovery systems are those which are developed as "total" systems operated by municipalities that recycle a variety of commodities. In addition, the soft drink manufacturers did not express concern over mandatory deposit legislation as did beer producers. Perhaps their returnable bottle system (approximately 47 percent of distributed soft drinks) partially insulates the franchisers from such legislative impact. At any rate, forced deposit legislation is not a key concern of the soft drink franchisers.

Reverse Channels of Distribution Contingencies

Certainly generic influences such as federal and state legislation, material scarcity, and energy shortages have had
a profound impact on companies' decisions to develop extensive reverse channels of distribution. These macro environmental influences play an important role in shaping management philosophy and in dictating organizational alternatives. However, there also seem to be some critical company contingencies which are also central to management's final decision to commit capital to the development of reverse channels of distribution. Those companies that have chosen to extend their organizations toward the consumer as a source of raw material have, without exception, done so with the conviction that it is in the best long-run interests of the company. In this section some of the more important general company contingencies surrounding a decision to create aluminum packaging and container reverse channels of distribution are delineated. Acknowledging these contingencies should provide a better perspective of the variables inherent in reverse channel development.

**Aluminum Manufacturers' Contingencies**

1. Company size certainly seems to be an important variable in decisions by primary aluminum manufacturers to enter into aluminum packaging and container direct reverse channels of distribution. Aluminum manufacturers with less than 5 percent of the United States primary aluminum capacity have no interest in developing reverse channels of distribution. With large company size (primary aluminum capacity) comes a need for large amounts of raw materials. Apparently the increased
raw material supply requirements of large firms have made top management more aware of alternative sources of raw materials.

2. A perhaps more important variable in the decision to exploit the consumer scrap packaging and container market is company production facilities. Beverage containers are generally reprocessed into sheet aluminum (can stock) for shipment to can manufacturers because of purity requirements for other aluminum usages. Only those companies which manufacture sheet aluminum are involved in consumer scrap recycling. Companies which do not make can stock have little motivation and no apparent plans to begin consumer scrap recycling activities.

3. Companies which engage in the recycling of consumer scrap packaging and containers have developed contractual arrangements for the delivery of scrap aluminum to insure a steady supply. These contracts appear to be important assurances that plants producing only sheet aluminum will have large amounts of raw materials. Such, usually nonbinding, contracts are made with beer producers, municipalities and independent recyclers.

4. The profitability and efficiency of operation of the reverse channel seems to be directly related to the degree of decentralization in reverse channel activities. Companies which have created fairly autonomous subsidiaries directing and coordinating channel efforts were the companies which stressed economical operation and profitability objectives. The only recycling primary aluminum manufacturer which reported
that no organizational changes were necessitated as a result of their decision to enter into consumer scrap recycling operations was also the company to report that its recycling operation was not profitable. The benefits of utilizing independent organizations to effectuate channel operations are derived from the establishment of distinct responsibilities, authority, objectives and policies.

**Beverage Producers' Contingencies**

1. Apparently company size has little to do with beverage companies' decisions to initiate recycling activities. Packaging and container reverse channels of distribution were developed by regional as well as national producers. Conversely both large and small beverage producers have made decisions not to develop reverse channels. However, the major market which is served by the producer may be of some influence on management's decision to begin recycling activities. The regional firms located in the environmentally conscious far west have developed aluminum packaging and container reverse channels, while regional producers in other parts of the United States have not engaged in the recycling of aluminum packaging and containers.

2. The degree to which beverage companies are committed to the all-aluminum can also seems an important determinant as to whether a beverage producer will develop reverse channels of distribution. For instance, those beer producing
companies fully committed to the all-aluminum can have developed reverse channels, while those that utilize steel cans plus aluminum cans have not engaged in recycling. Commitment to the all-aluminum can has made these companies aware of possible supply problems and thus has aided in the recycling decision. In addition, these beverage companies are recycling used cans because of assurances that their efforts will be translated into new aluminum earmarked for new can production.

3. Explicitly organizing for recycling operations seems to be important in insuring the profitability of reverse channel operations of the recycling beverage producers. All beverage producers which recycle aluminum containers report having decentralized operations with centralized controls. Explicit organizations are appropriate because recycling does not fit into the traditional operation of the beverage company. Like the aluminum manufacturers' reverse channels, separate objectives and policies are a requirement for efficient and profitable operations.

4. The soft drink industry's loose franchise type operations do not seem amenable to the development of reverse channels of distribution. The lack of a strong centralized entity to initiate and coordinate reverse channel development and the relatively high degree of autonomy by independent bottlers may be the primary reasons for no reverse channels in the soft drink industry. An additional reason for the
lack of aluminum reverse channels may be the extensive returnable bottle system of the soft drink franchises.
CHAPTER BIBLIOGRAPHY


CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Recycling and the operation of reverse channels of distribution are appropriately receiving increased attention as rampant solid waste pollution, frequent energy shortages and serious materials scarcity are recognized as realities of our modern age. If organizations are to survive in this modern era, they will necessarily have to plan, organize and manage specifically for environmental, energy and materials contingencies. No longer will business enterprises be able to add to the pollution of an already strained environment. Moreover, business will be required to utilize processes which conserve energy and aid in the reuse of discarded materials.

In the past, unrestricted growth, unlimited and cheap energy, and an abundance of raw materials were the central values of contemporary business enterprise. The future, however, seems to offer a new business organizational paradigm based on controlled growth, energy conservation, and materials reuse. This study reveals that some segments of the United States economy are already beginning to implement these new management and organizational paradigms. Business practice and philosophy are evolving as it is acknowledged that we do
indeed live in a world of finite resources and limited energy supplies.

The Reverse Channel of Distribution

Central to this new business paradigm is the reverse channel of distribution. In the reverse channel of distribution, producers of recyclable and reusable solid waste material are conventional consumers and the final users of these materials are traditional producers. Thus to be effective in implementing reverse channels, manufacturers must go beyond classic concepts of marketing and look toward consumers not only as potential buyers, but also as potential raw materials sources.

Organizational paradigms based on recycling reverse channels of distribution provide impetus for a variety of new channel institutions and a change in sorting emphasis for existing intermediaries. The essential intermediary sorting functions in the reverse channel are sorting out and accumulation. Sorting out and accumulation are essential to the efficient operation of the reverse channel; however, these important sorting functions also have proved to be major problems. Motivation of the public and industry to engage in mass recycling to provide for the economical accumulation of solid waste materials and the acquiring of technology to efficiently segregate these valuable materials have, in the past, been serious stumbling blocks to the full development of reverse
channels. Today most of the technological problems have been solved and public awareness of our energy and materials shortages is contributing to the solution of the motivational problem.

Purpose and Delimitations

The primary purpose of this study was to analyze the developing organizational and management paradigms in the aluminum packaging and container industry. Aluminum container and packaging recycling reverse channels of distribution are perhaps the best developed extant reverse channels and offer an excellent vehicle for studying organizations which are "closing the distribution circle." Of the several reverse channels available to recycle aluminum, the most important in terms of volume and for purposes of this study are the manufacturers' direct channel and the specialist dealer channel. The direct reverse channel is owned and operated by primary aluminum manufacturers as a source of raw materials. The specialist dealer reverse channel is comprised primarily of the present forward distribution channels of major beverage producers. The stages of development and degree of sophistication of reverse channels vary among its members but do show marked patterns of organization and management philosophy.

Influences on Aluminum Reverse Channels of Distribution

Patterned recycling organization and management philosophy are largely the result of several generic and pervasive
influences operating upon the aluminum and beverage industries. Most important among these influences are: (1) federal and state environmental legislation, (2) a growing scarcity of raw materials, (3) widespread energy shortages, and (4) recent availability of economical solid waste management technology.

**Federal and state environmental legislation.**—A primary factor in the development and maturing of reverse channels of distribution is federal and state environmental legislation. Federal solid waste and related legislation have impacted on business enterprise through: (1) the creation of national pollution enforcement powers, (2) the establishment of specific and measurable environmental standards, (3) the setting of stringent implementation guidelines, and (4) the awarding of solid waste research and development grants.

Prior to 1969 most federal environmental legislation was created on an ad hoc basis directed toward specific environmental issues. From 1969, however, federal environmental legislation has been directed toward the entire environmental system. Such legislation acknowledges the interdependencies and interrelationships of air, water and solid waste issues. This change in approach in federal legislation has allowed for a comprehensive, holistic, and indeed, more realistic environmental policy.

Most of the individual states have followed the federal government's lead and have passed solid waste disposal and
resource recovery legislation. State solid waste legislation can be generally categorized into three types. The three general classifications are: (1) legislation directed solely toward solid waste disposal, (2) legislation oriented toward elimination of pollution and resource recovery in limited areas, and (3) balanced solid waste laws which attack the solid waste problem from both a disposal and recovery viewpoint. The best of these balanced approaches to the solid waste problem recognizes the importance of systematic and total materials recycling and does not burden the existing retail and wholesale systems with container deposit legislation.

It appears at present that both the federal and state governments will continue to be active in legislating against solid waste pollution. Further, such legislation will most likely be systems oriented--directed toward comprehensive environmental issues. Legislators now appear to realize that future solid waste legislation must consider the effects upon air pollution and water pollution as well as the effects on business enterprise, the economy and public needs.

Raw materials scarcity. A second major influence on reverse channel development is material scarcity. The United States is already substantially dependent on foreign imports for a number of important raw materials, a number which continues to grow. In addition, the United States does not have mineral reserves to meet the growing demand for a majority of
commodities. In particular shortage are aluminum, nickel, tin, manganese, cobalt, chromium, tantalum and niobium. Even world supplies for several critical materials are in serious short supply.

Recycling must be viewed as an important element of any overall plan to solve material scarcity problems. There are tremendous amounts of raw materials available in the solid waste stream and reverse channels of distribution must be utilized to move these materials back to the manufacturers for reprocessing. Material scarcity promises to be one of the significant forces underlying the full development of recycling reverse channels of distribution.

Energy shortages.—Energy conservation is also extremely influential in aiding the development of reverse channels of distribution. Solid waste disposal and energy conservation are highly interrelated and the solving of solid waste problems may make important contributions toward energy conservation. Energy savings can be realized primarily by (1) converting segregated municipal solid waste into fuels and (2) using less energy through the reprocessing of recyclable materials.

Aluminum is particularly important in the saving of energy because of its eminent recyclability. Aluminum's light weight saves transportation energy throughout each of its many lives. Moreover, each time aluminum is recycled, 95 percent of the energy that would be needed to make primary aluminum
is saved. Perhaps of greater importance is the fact that since aluminum can be recycled with a relatively small amount of energy input, smelted aluminum represents a "resource bank" in which energy has been invested. The more recyclable aluminum produced, the greater the raw material reserves which are created. Thus the extensive use of aluminum is a first positive step toward reduced solid waste pollution coupled with substantial energy savings.

Solid waste management technology.—A final aid to the development of reverse channels of distribution discussed in this study is the availability of technology that will permit the economical recovery of solid waste materials. Several integrated material recovery systems have been developed in the last several years. These systems are capable of separating materials in the municipal solid waste stream. Included in such systems are primary and secondary shredders, magnetic separators, air classifiers, screening, optical sorters, air tables, high tension separators, and a variety of nonferrous metal separation methods.

The development of total recovery systems has allowed municipal governments to enter into the recycling channels for a variety of commodities. Municipalities recovering several materials may in the future be important institutions in the dealer-processor channel and may be in direct competition with such firms as Ogden Corporation, Proler International
and U.S. Reduction. Municipal entry into recycling channels will not, however, substantially affect the manufacturers' direct or specialist dealer channels where material being recycled is extremely valuable. It is doubtful such commodities will ever reach the municipal solid waste stream.

**Aluminum Packaging and Container Reverse Channels of Distribution**

The specific organization and management of the manufacturers' direct recycling reverse channel and the specialist dealer recycling reverse channel are analyzed by classifying and profiling organizational designs and management philosophies extant in these two important aluminum recycling channels. Organizational and management profiles are developed primarily utilizing current literature, company reports and documents, and information obtained through mail survey.

The direct channel.—The manufacturers' direct aluminum packaging and container reverse channel of distribution is made up of primary aluminum manufacturers vertically integrating into a potentially large raw materials market. The twelve United States primary aluminum manufacturers can be classified into two discrete subgroups—those which are involved in extensive recycling and those which do no recycling at all.

Only four aluminum manufacturers engage in recycling and have subsequently developed extensive and sophisticated reverse channels of distribution. The most successful of these
channels are organizationally decentralized into wholly owned subsidiaries and operate on a sound financial and economic basis.

The four aluminum manufacturers actually engaged in recycling initiated their recycling business early (late 1960's) and operate on a nationwide basis. These companies weigh and pay recyclers 17 to 18 cents (depending on the company) per pound for all-aluminum beverage cans and some clean household aluminum such as frozen dinner trays and aluminum foil. At the recycling plant, the metal passes through a magnetic separator to eliminate stray steel cans. The metal is then crushed and baled or passed into a shredder where it is reduced to popcorn-size chips to remove moisture and reduce its volume for shipping to company smelting plants.

These primary aluminum manufacturers have made nonbinding scrap delivery contracts with municipalities, beer producing companies and independent recyclers. For the most part recycled beverage cans are returned to can stock for delivery to aluminum can manufacturers.

Aluminum companies with reverse channels have developed these channels primarily as a source of metal for can stock and as a means of saving energy realized in reprocessing recycled materials. These companies also cite the elimination of litter and the conservation of material resources as important reasons for recycling. The more pragmatic reasons of increased supply and cost efficient production seem to have
provided the most impetus for full channel development. The recycling of consumer scrap aluminum is a situation in which involved companies have turned an undesirable environmental (societal) impact into a profitable business opportunity.

All of the companies involved in aluminum packaging and container recycling view consumer scrap aluminum as an important future source of raw materials and plan to expand their participation in consumer scrap recycling. One company plans to double the amount of consumer scrap it channels back to its plants in the 1977-1978 period.

The primary aluminum manufacturers that have chosen not to enter into consumer scrap recycling cite several reasons for this decision. These reasons were all related to the needs of the company and had little to do with pollution, energy or material scarcity. Several firms suggested that their primary metal supply has been sufficient and there was not yet a need to enter the aluminum packaging and container reverse channel. Other companies indicated that they did not manufacture can stock and therefore have not become involved in any recycling efforts in the consumer scrap area.

Thus several primary aluminum manufacturers are, indeed, implementing a new management and organizational paradigm based on environmental contingencies. Where it serves their needs, these companies have extended their organization toward the consumer, not within the cadre of marketing concept but rather as valuable sources of raw materials. These organizational
adaptations to a changing environment are being supported by a changing managerial philosophy based on new perspectives of scarcity, energy conservation and concern for environmental pollution.

The specialist dealer channel.—United States beverage producers also are important elements in aluminum packaging and container recycling and constitute the bulk of the activity of the specialist dealer reverse channel of distribution. Of the ten largest United States brewers only three have developed sophisticated and efficient reverse channels of distribution, two provide substantial support to the development of independent total resource recovery systems and five are not involved in consumer scrap recycling. None of the five leading soft drink franchisers are extensively involved in packaging and container recycling but some do encourage independent bottlers to support community and civic efforts.

The three brewers which have developed reverse channels account for a significant portion of the total number of beverage cans which are recycled. These brewers are an important force in the total recycling effort of the nation. While the operations of these brewers are considered profitable, major reasons for developing reverse channels are (1) to deter forced deposit legislation, and (2) increase a steady supply of aluminum for future can production. Consumer scrap delivery contracts to primary aluminum manufacturers appear to be an
important consideration in assuring can stock availability for company owned can manufacturers.

Forced deposit legislation is of much concern to companies with reverse channels because it could make the aluminum container obsolete. Beverage producers feel this would be a disservice to the public because of the convenience and desirability of the aluminum beverage can, increased transportation costs of other packages, more storage space requirements for other containers, increased costs of handling and accounting inherent in a deposit system, and a forced deposit system would take away the advantage of an antilitter system which would operate within the framework of market supply and demand.

All of the brewers with reverse channels utilize their distribution systems to carry out the sorting functions intrinsic to reverse channel operations. At the company level, however, these firms have departmentalized the management of the channel operations to provide for coordination, control and single purpose. The number of personnel required to perform this function is relatively small in light of the benefits.

All of the recycling beverage companies plan to promote and extend their recycling operations in the future. These companies feel that the aluminum beverage can is the optimal container and, indeed, is the container of the future.

Thus as long as it is in their best interest these brewers will continue to develop their aluminum packaging and container
reverse channels of distribution. The management philosophy and organizational structure of these brewers have been influenced by environmental contingencies. These are the same contingencies which are influencing the primary aluminum manufacturers. Self interest has forced the brewers to develop management and organizational mechanisms to contend with a new business environment—one which acknowledges pollution, energy shortages and material scarcities.

Two brewers which have not developed reverse channels are, however, extremely interested in resource recovery. These firms have taken action primarily in three areas: (1) antilitter public awareness programs, (2) stands against forced deposit legislation, and (3) support for independent total resource recovery systems.

The philosophy of these companies is that communities need to develop total recovery systems which will recycle a wide variety of products. These brewers do not feel that it is within their business purview to develop reverse channels of distribution and have no apparent plans to begin recycling aluminum containers.

The remaining brewers are not involved in aluminum recycling at all. These firms cite (1) the uncertainty of forced deposit legislation, (2) manning and control, and (3) logistics as major reasons for not developing reverse channels of distribution. These five firms have no plans to begin recycling operations.
The five major United States soft drink franchisers have not developed reverse channels of distribution. These companies have limited their involvement in recycling to encouragement and provision of information to local independent bottlers and some support of national recycling organizations.

The franchise organization of the soft drink industry may limit the development of reverse channels because of the high degree of local bottler autonomy. Therefore, any recycling which has been accomplished by the soft drink industry has been on an individual soft drink bottler basis in conjunction with community projects.

Organization has been limited at the company level as well as at the local level of the soft drink industry. Responsibility for environmental affairs is tucked away in departments with other primary duties. In addition, no recycling technologies have been introduced at the company or local levels.

While the aluminum container continues to be an increasingly important form of packaging in the soft drink industry, no soft drink franchisers plan to develop reverse channels of distribution. Neither were the soft drink franchises particularly concerned about forced deposit legislation. Perhaps their extensive return bottle system insulates the soft drink franchises somewhat from such legislative proposals.

Thus the soft drink franchises have chosen not to develop reverse channels of distribution. This decision seems to be
based on the perception of company needs. Top management does not believe developing reverse channels of distribution will benefit their particular system.

Conclusions

Based on the analysis of aluminum packaging and container reverse channels of distribution provided in this study, several general conclusions can be proffered. These conclusions are based primarily on data provided in Chapter IV of this study, supported by information presented in the earlier chapters.

1. The extent to which primary aluminum manufacturers have entered into aluminum packaging and container recycling and subsequently developed effective reverse channels of distribution is contingent upon need for resources. Aluminum manufacturers have not developed reverse channels for primarily environmental reasons but rather as a pragmatic means of accumulating "raw materials" for the processing of aluminum. Primary aluminum manufacturers which do not make sheet aluminum for can production have no need for container and packaging scrap and consequently have not integrated recycling efforts other than the recycling of their own industrial scrap.

2. The most successful recycling programs for both primary aluminum manufacturers and for the beverage companies are those which have decentralized organizations. Companies which report profitable recycling operations are those which
have made recycling more than a supplementary function of their present operation but rather they have created specific organizations with the primary function of operating a recycling "business". The most successful of such operations is the wholly owned subsidiary. The primary aluminum manufacturers have utilized the decentralized subsidiary with great success. Profit centers within existing company organizations have also been successful. Such organizational designs require a top management total commitment to recycling.

3. Beverage producers have initiated recycling programs and developed reverse channels of distribution for several important reasons. While reasons such as "to do our part to clean up litter" and "to conserve national resources and save energy" are often cited by the beverage producing companies, such reasons are often secondary to the companies' "real" concern for recycling. Perhaps more central to beverage producers' decisions to develop extensive reverse channels of distribution is the belief that recycling (1) is a deterrent to punitive container legislation, (2) is a valuable source of favorable publicity and community relations, (3) can be a source of additional company profits, and (4) can substantially improve supply relationships with primary aluminum suppliers.

4. While geographic conclusions are difficult to draw, it is interesting to note that regional beverage companies located in the environmentally conscious Far West have the
most successful and comprehensive recycling operations. Few national companies and no regional beverage companies in other parts of the United States have serious recycling programs. It can be tentatively concluded that public attitude and awareness toward environmental considerations can be an important influence on top management's decision to enter into recycling.

5. Loose organizational federations such as those of the soft drink franchise do not seem amenable to the development of reverse channels of distribution. The soft drink industry is organized somewhat differently from the beer industry. Soft drink bottlers are much more independent and rely on the company only for advertising support, marketing leadership, sales promotion, product quality control, research, legal counsel and public affairs. Local production and marketing autonomy apparently create a greater degree of independence on decisions to enter into recycling programs. Therefore, soft drink franchises have not developed recycling reverse channels of distribution.

6. Where it serves the needs of the enterprise, firms are developing sophisticated and efficient reverse channels of distribution. The institution of reverse channel intermediary functions by manufacturers and producers reflects a new management and organizational paradigm based on environmental considerations. This paradigm should become more prevalent as material, energy and pollution problems become
more acute. Management and organizational models which contend with these problems suggest manufacturers and producers will be attempting to "close the circle" with the consumer (forward through the marketing concept, backward through the reverse channel).

7. A major stumbling block to further reverse channel development is the uncertainty caused by proposed forced container legislation. The threat of such legislation has placed many beverage companies in a "wait and see" posture because such legislation could force them out of the aluminum container.

Recommendations

This study makes recommendations regarding (1) individual consumer's recycling policy, (2) federal and state government solid waste legislative policy, (3) business organizational and management policy, and (4) areas for further research. These recommendations are drawn from the entire study and are the result of a total systems approach to decision making. Such an approach attempts to formulate the most propitious recommendations with regard to the whole system while considering all the important decision making variables.

**Individual Consumers Policy Recommendations**

1. Consumers should inform manufacturers and producers that they are willing to purchase products made from and packaged in recycled materials. Consumers can perhaps best
transmit their preference for such products and packages by being knowledgeable and concerned in their buying patterns.

2. Consumers should, through their power in the marketplace, discourage manufacturers and producers from marketing throw-away products. The economy of the United States can no longer afford the "use one time and throw-away" philosophies of the past. Such throw-away attitudes consume valuable scarce resources and consumers must be willing to give up convenience today to insure a supply tomorrow.

3. Consumers must learn to extend the useful life of products and place them in the proper recycling channel when they are consumed.

4. Consumers should pay particular attention to how a product is packaged. In many cases products are "over packaged" or packaged with nonrecyclable materials. Consumers should choose product offerings with environmentally sound packages—packages and containers which can be reused or recycled with a minimum amount of material and energy loss.

5. Consumers should support recycling projects and be willing to sort refuse at the source to insure materials will be reprocessed and used again.

6. Consumers should inform local, state and federal governments of their concern for energy and material scarcity and of their support for recycling efforts. Many of the governmental decisions on solid waste will have serious social
and economic impacts, and public officials must have the support of informed and involved citizens.

**Federal and State Solid Waste Legislative Policy Recommendations**

1. Solid waste legislation, whether at the state or federal level, should consider the total system. Not only are the interdependencies of air and water pollution important but solid waste legislation must also fully consider impacts on the business community, economy and general public.

2. Comprehensive solid waste management legislation should contain material recovery and pollution abatement guidelines, the necessary regulatory authority for governmental agencies, provisions for research and technology development, financial aid and recycling incentive programs, intragovernment coordination of solid waste programs, and where possible, a permissive orientation allowing business to initiate and operate recovery programs exploiting the supply and demand forces of the market.

3. Changes should be made in the current tax policies concerning the use of recyclable materials. Tax laws should be altered to provide manufacturers with incentives for using recyclable materials in their manufacturing process.

4. State and federal governments should not enact discriminatory container legislation which forces a deposit on containers and packages. The case for reduced solid waste pollution through forced deposit legislation is unconvincing.
and may waste fuel and not save energy. Legislative plans which force producers away from efficient packaging and disrupt the potential of "free market" recycling may do more harm than good.

5. Legislation should be enacted which provides equitable transportation rates for recyclable materials. Current freight rates often discriminate against recyclable materials and are significantly higher than rates for comparable virgin materials. Such legislation would make the use of recyclable material more attractive to manufacturers.

6. State, local and federal government procurement policy should favor the use of recycled materials where possible.

Business Organizational and Management Policy Recommendations

1. Recycling by business enterprise must be a top management decision. Without the support and, indeed, the impetus of top management the development of reverse channels of distribution is a hopeless task.

2. Business organizations must begin to specifically plan, organize and manage for material scarcity and energy conservation. Business enterprise should consciously build conservation and reuse features into their organization and management philosophy. Thus business will be extending their organizations to facilitate raw materials recovery at the consumer level.
3. Business enterprise must take an active role in solving environmental issues which are an impact of its operations on society as well as helping to solve the more general environmental problems of society. Therefore, manufacturers and producers must go far beyond just objecting to and lobbying against container legislation but rather must initiate positive action in the marketplace to solve litter and material scarcity problems. If business does not take an active role in solving these problems, punitive and restrictive legislation will be soon forthcoming.

4. Company recycling operations should generally be decentralized into a fairly autonomous business. To be truly successful the recycling operation should be organized as a separate profit center generating a genuine profit with its own responsibilities and objectives. Recycling operations should not be regarded or organized as supplemental activities within another division. In such organizational arrangements one cannot simultaneously manage traditional divisional responsibilities and maximize recycling operations because recycling rarely fits into the scope, objectives, goals, technologies or processes of the original organization.

Research Recommendations

1. Further research at the micro level is required to determine the feasibility of mass recycling in other commodity categories and industries.
2. An investigation should be initiated to further measure top management philosophy regarding recycling across a wide spectrum of industry classifications. Such an investigation should assess management's willingness to undertake recycling in the future.

3. Further research is also necessary to assess the real effects of forced deposit legislation. This research should be oriented toward the economic and business effects of such legislation as well as the effects on solid waste pollution.

4. Additional research and study needs to be directed toward consumers' recycling perspectives. Such investigations should further assess the attitudes of the consumer toward recycling, possible consumer motivational appeals and an evaluation of packaging alternatives which are acceptable to the public.
APPENDIX A

LETTERS TO PRIMARY ALUMINUM MANUFACTURERS AND
MAJOR BEVERAGE PRODUCERS
April 12, 1977

Dear __________:

Growing raw materials scarcity and environmental solid waste pollution have made recycling a subject of significant importance and interest to aluminum producing and consuming companies as well as the general public. Moreover, as I am sure you will agree, aluminum recycling will become an even more important topic in the future. In exchange for a few minutes of your time I would be happy to send you a summary of a study on aluminum container recycling in the United States that I am currently compiling for use in a Ph.D. dissertation.

In order to develop a better understanding of the forces underlying aluminum recycling and predict future recycling emphasis, I am gathering pertinent data from important aluminum producers and users. These include the primary aluminum manufacturers and major beverage producers in the United States.

I have assembled much information through a review of current literature on recycling, government publications and documents, and personal contacts; however, an important part of the study revolves around perspectives of aluminum producers and user firms. Therefore, I would greatly appreciate your taking a few minutes to complete the enclosed questionnaire which will provide information about your firm and your views on certain aspects of aluminum recycling. You may want to answer some of the questions by attaching printed materials of your company. A copy of your most recent annual report would also be especially appreciated.

You can be assured that all replies are confidential and will be used only in combination with data provided by other aluminum producer and user executives from throughout the United States.

Just as soon as the study is completed, you can count on my sending you a summary copy. If you will take a few minutes today to complete the questionnaire and return it by using the enclosed postage-paid reply envelope, I will be able to send your report very soon. Thank you for your help.

Sincerely,

Peter M. Ginter
May 6, 1977

Dear __________:

Approximately four weeks ago I wrote you concerning a subject of considerable importance—aluminum recycling. As you may recall, I am gathering pertinent data from the twelve primary aluminum manufacturers and from major beverage producers in the United States in order to develop a better understanding of the forces underlying recycling and predict future recycling emphasis. I am compiling this information for use in a Ph.D. dissertation and I would greatly appreciate your participation.

While the response rate from members of the aluminum and beverage industries has been excellent, the quality of the study can be substantially improved by your participation. Your views are quite important whether or not your firm is actively engaged in recycling.

Much of the information required for this study is available from conventional sources. However, an important segment of the study concerns the perspectives of aluminum manufacturers and firms which utilize aluminum packaging. Therefore, I am enclosing another questionnaire in hopes that you will take a few minutes to provide information about your firm and your views on certain aspects of aluminum recycling. You may want to answer some of the questions by attaching printed materials of your company. A copy of your most recent annual report would also be especially appreciated.

Again, you can be assured that all replies are confidential and will be used only in combination with data provided by other aluminum producer and user executives from throughout the United States. Enclosed is a postage-paid reply envelope for your convenience.

If you have already completed the questionnaire, thank you very much for your cooperation and as soon as the study is completed, you can count on my sending you a summary copy.

Sincerely,

Peter M. Ginter
APPENDIX B

QUESTIONNAIRES FOR PRIMARY ALUMINUM MANUFACTURERS
AND BEVERAGE PRODUCERS
NAME OF COMPANY: __________________________________________

PART I. Recycling Operations

1. Is your company actively involved in the recycling of consumer scrap aluminum?
   Yes _____  No _____

   If the answer to this question is No, go to question number 16.

2. Approximately how much consumer scrap aluminum is recycled through your recycling operation?
   A. __________ short tons in 1974
   B. __________ short tons in 1975
   C. __________ short tons in 1976

3. Approximately what percentage of the consumer scrap aluminum recycled by your company was in the form of aluminum containers or packaging materials (beverage cans)?
   A. __________ / __________ percent/year (latest available year)
   B. __________ approximate number of beverage cans recycled (latest year)

4. Is your consumer scrap recycling operation considered to be profitable?
   Yes _____  No _____

   Comments: __________________________________________
   __________________________________________
   __________________________________________

5. What have been the major problems concerning your recycling operation?
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________
   __________________________________________

6. Does your company have any scrap aluminum delivery contracts with independent scrap middlemen or municipalities?
   Yes _____  No _____

   A. Delivery contracts with municipalities.
      Approximate number of such contracts __________
      Yes _____  No _____

   B. Delivery contracts with beer producing companies.
      Approximate number of such contracts __________
      Yes _____  No _____
C. Delivery contracts with soft drink producing companies. 
   Yes ___ No ___
   Approximate number of such contracts ________

D. Delivery contracts with other aluminum scrap middlemen. 
   Yes ___ No ___
   Approximate number of such contracts ________

PART II. Recycling Organization

7. Is your consumer scrap aluminum recycling operation carried out through company owned local collection centers? 
   Yes ___ No ___

If the answer to this question is No, go to question number 9.

8. How many local collection centers are involved in your consumer scrap recycling operation?

   A. ________ total centers (including mobil centers)
   B. ________ mobil centers

   Go to question number 10.

9. How is your consumer scrap recycling operation organized?

   ________________________________
   ________________________________
   ________________________________
   ________________________________
   ________________________________
   ________________________________
   ________________________________

10. Is your consumer scrap recycling operation organized as a separate profit center? 
    Yes ___ No ___

    Comments: ________________________________
    ________________________________
    ________________________________
    ________________________________
    ________________________________
    ________________________________
    ________________________________

11. What department at the corporate level has responsibility for consumer scrap recycling?

    ________________________________
    ________________________________
    ________________________________
    ________________________________
    ________________________________
    ________________________________

12. Other than at your local recycling centers, how many company personnel are involved in recycling efforts?

    Management
    A. Part time ________
    B. Full time ________

    Non-Management
    A. Part time ________
    B. Full time ________
13. What organizational changes have been necessitated as a result of your decision to enter into consumer scrap recycling operations? (What was the impact on the organization?)

14. What technological changes have been necessitated as a result of your decision to enter into consumer scrap recycling operations?

PART III. Management Philosophy

15. Why has your company entered into the recycling business?

16. How does your company view the future of the aluminum packaging and container segment of the aluminum industry as a percentage of the total aluminum market?

17. What is your company's planned future participation in consumer scrap aluminum recycling?
18. Does your company view consumer scrap aluminum recycling as an important future source of raw materials?

19. If your firm has chosen not to enter directly into consumer scrap recycling, why has it chosen not to do so?
NAME OF COMPANY: ________________________________

PART I. Recycling Operations

1. Is your company actively involved in the recycling of consumer scrap aluminum?
   Yes ___  No ___

   If the answer to this question is No, go to question number 17.

2. Approximately how much consumer scrap aluminum is recycled through your recycling operation?
   A. _______ short tons in 1974
   B. _______ short tons in 1975
   C. _______ short tons in 1976

3. Approximately what percentage of the consumer scrap aluminum recycled by your company was in the form of aluminum containers or packaging materials (beverage cans)?
   A. _______/____ percent/year (latest available year)
   B. _______ approximate number of beverage cans recycled (latest year)

4. Is your consumer scrap recycling operation considered to be profitable?
   Yes ___  No ___

   Comments: ____________________________________________________________
   ________________________________
   ________________________________
   ________________________________
   ________________________________

5. Does your company have any scrap aluminum delivery contracts with aluminum producers or other scrap middlemen?
   A. Aluminum producers  Yes ___  No ___
   B. Scrap middlemen  Yes ___  No ___

   Comments: ____________________________________________________________
   ________________________________
   ________________________________
   ________________________________
   ________________________________

6. What have been the major problems concerning your recycling operations?
   ____________________________________________________________
   ________________________________
   ________________________________
   ________________________________
   ________________________________
PART II. Recycling Organization

7. Is your consumer scrap aluminum recycling operation carried out through your present beverage distribution system?  
   Yes _____  No _____  
   If the answer to this question is Yes, go to question number 9.

8. How is your consumer scrap recycling operation organized? 

9. Approximately how many aluminum redemption centers are operated by your company system? 

10. Briefly describe the relationship between local distributors and your company with regard to recycling operations (i.e., coordination of the recycling effort, special arrangements, quotas, etc.). 

11. Is your consumer scrap recycling operation organized as a separate profit center?  
   Yes _____  No _____  
   Comments: 

12. What department at the company level has responsibility for consumer scrap recycling? 
   Comments: 

13. Other than the efforts of the local distributors, how many company personnel are involved in your recycling efforts? 
   Management  
   A. Part time _____  B. Full time _____  
   Non-Management  
   A. Part time _____  B. Full time _____  
   Comments: 

14. What organizational changes have been necessitated as a result of your decision to enter into consumer scrap recycling operations? (What was the structural impact on the organization?)

15. What new technologies (equipment, process, etc.) have been necessitated as a result of your decision to enter into consumer scrap recycling operations?

PART III. Management Philosophy

16. Why has your company entered into the recycling business?

17. How does your company view the future of aluminum packaging for beverages?

18. What is your company's planned future participation in consumer scrap aluminum recycling?

19. If your firm has chosen not to enter directly into consumer scrap recycling, why has it chosen not to do so?
APPENDIX C

STATES WITH SIGNIFICANT SOLID WASTE LEGISLATION OR PROGRAMS
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MAJOR RECYCLING COMPANIES
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PARTIAL LIST OF MAJOR EQUIPMENT MANUFACTURERS
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<td>Fairfield Engineering Co.</td>
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<td>Heil Co.</td>
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<td>Deltrak Corp.</td>
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<tr>
<td></td>
<td>Jeffrey Manufacturing Div. (Dresser Ind.)</td>
<td></td>
<td>Dresser Industries</td>
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<tr>
<td></td>
<td>Longhorn Construction Co.</td>
<td></td>
<td>Elliott Co.</td>
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<td></td>
<td>Marksman Corp.</td>
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<td>General Electric Co.</td>
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<td></td>
<td>Montgomery Industries</td>
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<td>Pacific Pumps</td>
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<td></td>
<td>Newell Manufacturing Co.</td>
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<td>Precision Piston Rings, Inc.</td>
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<td></td>
<td>Pennsylvania Crusher Corp.</td>
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<td>Skinner Engine Co.</td>
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<td></td>
<td>Pettibone Companies</td>
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<td>Studebaker Worthington, Inc.</td>
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<td></td>
<td>Saturn Manufacturing Co.</td>
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<td>Terry Corp.</td>
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<td></td>
<td>Scott Equipment, Inc.</td>
<td></td>
<td>Trane Co.</td>
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<td></td>
<td>Titan Engineering</td>
<td></td>
<td>Turbine Div., Delaval Turbine,</td>
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<tr>
<td></td>
<td>Williams Patent Crusher &amp; Co.</td>
<td></td>
<td>Inc.</td>
</tr>
<tr>
<td></td>
<td>Detroit Stoker Co.</td>
<td>Hydrapulpers</td>
<td>Turbodyne Corp.</td>
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<tr>
<td></td>
<td>Martin (UOP, Inc.)</td>
<td></td>
<td>Beloit</td>
</tr>
<tr>
<td></td>
<td>Von Roll (Wheelabrator-Frye, Inc.)</td>
<td></td>
<td>Bird Manufacturing</td>
</tr>
<tr>
<td></td>
<td>Stokers and grates</td>
<td></td>
<td>Black Clawson</td>
</tr>
<tr>
<td></td>
<td>Detroit Stoker Co.</td>
<td></td>
<td>Garbalizer Corporation of</td>
</tr>
<tr>
<td></td>
<td>Martin (UOP, Inc.)</td>
<td></td>
<td>America</td>
</tr>
<tr>
<td></td>
<td>Von Roll (Wheelabrator-Frye, Inc.)</td>
<td></td>
<td>Somat Corporation</td>
</tr>
</tbody>
</table>

APPENDIX F

PARTIAL LIST OF MANAGEMENT/ENGINEERING
CONSULTING COMPANIES
Dings Company
Eriez Magnetics Co.
J. W. Greer
Gruendler Crusher and Pulverizer Co.
Hamermills, Inc.
H Neil Co.
Jeffrey Manufacturing Division, Dresser Industries, Inc.
Mayfran Inc.
Newell Manufacturing Co.
Peabody Galion Corp.
Pennsylvania Crusher Corp.
Radar Pneumatics Co.
Rexnord
Triple/S Dynamics Systems, Inc.
Williams Patent Crusher, Inc.
Bechtel Corporation
Black, Crow, and Eidsness, Subsidiary of Hercules Corporation
Camp, Dresser and McKee
National Center for Resource Recovery
Ralph M. Parsons Company
Joseph Post Associates
I. C. Thomasson Associates
APPENDIX G

A STATUS REPORT OF SIGNIFICANT RESOURCE RECOVERY SYSTEMS
<table>
<thead>
<tr>
<th>Location</th>
<th>Process</th>
<th>Output</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akron, Ohio</td>
<td>Shredding; air classification; magnetic separation; burning of RDF product in semi-suspension stoker grate boiler</td>
<td>Steam for urban heating and cooling and industrial use; magnetic metals</td>
<td>Under construction; held groundbreaking Dec. 6, 1976</td>
</tr>
<tr>
<td>Ames, Iowa</td>
<td>Baling (waste paper); shredding; magnetic separation; air classification; screening; other mechanical separation</td>
<td>Refuse-derived fuel(RDF) for use by utility; baled paper; magnetic metals; aluminum and other non-magnetic metals</td>
<td>Operational</td>
</tr>
<tr>
<td>Baltimore, Maryland</td>
<td>Landgard process; shredding, pyrolysis, water quenching, magnetic separation</td>
<td>Steam; magnetic metals; glassy aggregate</td>
<td>In shakedown stage</td>
</tr>
<tr>
<td>Baltimore County, Maryland</td>
<td>Shredding; air classification; magnetic separation</td>
<td>RDF; magnetic metals; glass for secondary products; aluminum</td>
<td>Shredding, magnetic separation and landfilling operational; air classification and recovery of glass and aluminum to be fully operational by Spring 1977</td>
</tr>
<tr>
<td>Bridgeport, Connecticut</td>
<td>Shredding; magnetic separation; air classification; froth flotation</td>
<td>Eco-Fuel II (powdered fuel) for use in utility boiler; magnetic metals; non-magnetic metals; glass</td>
<td>Final contract signed; to be operational in 1978</td>
</tr>
<tr>
<td>Location</td>
<td>Process</td>
<td>Output</td>
<td>Status</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Brockton, Massachusetts</td>
<td>Shredding; air classification; magnetic separation; other mechanical separation</td>
<td>Eco-Fuel II for industrial boiler; magnetic metals</td>
<td>Fuel is being made; presently testing</td>
</tr>
<tr>
<td>Chicago, Illinois</td>
<td>Shredding, air classification; magnetic separation</td>
<td>RDF for use by utility; magnetic metals</td>
<td>Shakedown began Nov. 1976; operational in Jan. 1977</td>
</tr>
<tr>
<td>Dade County, Florida</td>
<td>Hydrasposal (wet pulping); magnetic and other mechanical separation</td>
<td>Steam for utility to produce electricity; glass; aluminum; magnetic metals</td>
<td>Contracts signed between County and P &amp; W; awaiting utility contract; awaiting issuing of state pollution control bonds; shakedown expected in 1979</td>
</tr>
<tr>
<td>State of Delaware</td>
<td>Shredding; air classification; magnetic and other mechanical separation; pyrolysis; anaerobic digestion</td>
<td>Magnetic metals; nonferrous metals; glass; RDF; agricultural/horticultural products</td>
<td>Bid proposals under review</td>
</tr>
<tr>
<td>Franklin, Ohio</td>
<td>Hydrasposal/Fibreclaim proprietary processes using wet pulping and magnetic separation; heavy media; jigging; electrostatic precipitation; optical sorting</td>
<td>Paper fibers; magnetic metals; aluminum; color-sorted glass</td>
<td>Production plant operating since 1971</td>
</tr>
<tr>
<td>Location</td>
<td>Process</td>
<td>Output</td>
<td>Status</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Hempstead, New York</td>
<td>Hydrosposal (wet pulping); magnetic and mechanical separation; burning of RDF product in stoker boiler</td>
<td>Electricity; color-sorted glass; aluminum; magnetic metals</td>
<td>Under construction; operational in 1978</td>
</tr>
<tr>
<td>Lane County, Oregon</td>
<td>Shredding; air classification; magnetic separation</td>
<td>RDF; magnetic metals</td>
<td>Under construction; groundbreaking held Nov. 30, 1976; in shake-down by Fall 1977</td>
</tr>
<tr>
<td>Milwaukee, Wisconsin</td>
<td>Shredding; air classification; magnetic and other mechanical separation</td>
<td>RDF for use by utility; bundled paper and corrugated; magnetic metals; aluminum; glass concentrate</td>
<td>In shakedown; expected to be fully operational April 1, 1977</td>
</tr>
<tr>
<td>Monroe County, New York</td>
<td>Shredding; air classification; magnetic and other mechanical separation</td>
<td>RDF for use by utility; magnetic metals; non-magnetic metals; mixed glass</td>
<td>Under construction; groundbreaking held Dec. 1, 1976; startup scheduled for late 1978</td>
</tr>
<tr>
<td>Nashville, Tennessee</td>
<td>Incineration</td>
<td>Steam for urban heating and cooling</td>
<td>Operational</td>
</tr>
<tr>
<td>New Orleans, Louisiana</td>
<td>Shredding; air classification; magnetic and other mechanical separation; hand-picking (paper)</td>
<td>Paper; magnetic metals; aluminum and other non-magnetic metals; glass</td>
<td>Shredding/land-filling phase; full recovery in operation by May 1977</td>
</tr>
<tr>
<td>Location</td>
<td>Process</td>
<td>Output</td>
<td>Status</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Pompano Beach, Florida</td>
<td>Shredding; air classification; magnetic separation; anaerobic digestion of air-classified light fraction with sewage sludge</td>
<td>Methane</td>
<td>In final design stage; site preparation began Dec. 1976; startup expected Dec. 1977</td>
</tr>
<tr>
<td>St. Louis, Missouri</td>
<td>Shredding; air classification; magnetic separation; &quot;magnetizing&quot;</td>
<td>RDF for use by utility; magnetic metals; mixed metals (aluminum and other non-magnetic)</td>
<td>Advanced planning stage</td>
</tr>
<tr>
<td>San Diego County, California</td>
<td>Shredding; air classification; magnetic and other mechanical separation; froth flotation; pyrolysis</td>
<td>Pyrolytic oil; magnetic and non-magnetic metals; glass</td>
<td>Construction complete; beginning shakedown; demonstration phase in mid-May 1977</td>
</tr>
<tr>
<td>Saugus, Massachusetts</td>
<td>Water-wall incineration; magnetic separation</td>
<td>Steam for industrial use; magnetic metals</td>
<td>Operational</td>
</tr>
<tr>
<td>South Charleston, West Virginia</td>
<td>Purox oxygen converter (pyrolysis); shredding</td>
<td>Fuel gas</td>
<td>Operational demonstration plant</td>
</tr>
</tbody>
</table>

APPENDIX H
CURRENT SIZE REDUCTION EQUIPMENT AND POTENTIAL
APPLICATIONS TO MUNICIPAL SOLID WASTE

201
<table>
<thead>
<tr>
<th>Basic Types</th>
<th>Variations</th>
<th>Potential Application to Municipal Solid Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushers</td>
<td>Impact</td>
<td>Direct application as a form of hammermill.</td>
</tr>
<tr>
<td></td>
<td>Jaw, roll, and gyrating</td>
<td>As a primary or parallel operation on brittle or friable material.</td>
</tr>
<tr>
<td>Cage disintegrators</td>
<td>Multi-cage or single-cage</td>
<td>As a parallel operation on brittle or friable material.</td>
</tr>
<tr>
<td>Shears</td>
<td>Multi-blade or single-blade</td>
<td>As a primary operation on wood or ductile materials.</td>
</tr>
<tr>
<td>Shredders, cutters, and clippers</td>
<td>Pierce-and-tear type</td>
<td>Direct as hammermill with meshing shredding members, or parallel operation on paper and boxboard.</td>
</tr>
<tr>
<td>Rasp mills and drum pulverizers</td>
<td>Cutting type</td>
<td>Parallel on yard waste, paper, boxboard, wood, or plastics.</td>
</tr>
<tr>
<td>Disk mills</td>
<td>Single or multiple disk</td>
<td>Direct on moistened municipal solid waste; also as bulky item sorter for parallel line operations.</td>
</tr>
<tr>
<td>Wet pulpers</td>
<td>Single or multiple disk</td>
<td>Parallel operation on certain municipal solid waste fractions for special recovery treatment.</td>
</tr>
<tr>
<td>Hammermills</td>
<td></td>
<td>Second operation on pulpable material.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Direct application or in tandem with other types.</td>
</tr>
</tbody>
</table>

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