IDENTIFICATION OF OPPORTUNITIES FOR INCREASED RECYCLING OF FERROUS SOLID WASTE

A Summary Report

U.S. ENVIRONMENTAL PROTECTION AGENCY

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This open-file report (SW-45d.1) summarizing a study performed under a Federal solid waste management demonstration grant (No. G06-EC-00298) to the Scrap Metal Research and Education Foundation, Institute of Scrap Iron and Steel, Inc., was written by W. J. REGAN, R. W. JAMES, and T. J. McLEER of Battelle Memorial Institute, Columbus Laboratories; and is reproduced as received from the grantee.

This summary consists of the first two chapters of a 384-page report of the same title, which is available from the National Technical Information Service, Department of Commerce, Springfield, Virginia. The full report (SW-45d) of which this is an excerpt contains 126 tables and 46 figures and consists of the following sections:

U.S. ENVIRONMENTAL PROTECTION AGENCY

1972

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An environmental protection publication (SW-45d.1) in the solid waste management series

IDENTIFICATION OF OPPORTUNITIES

FOR INCREASED RECYCLING OF FERROUS SOLID WASTE

ABSTRACT

The study on which this abstract is based was conducted by Battelle-Columbus for the Office of Solid Waste Management Programs of the Environmental Protection Agency and the Scrap Metal Research and Education Foundation of the Institute of Scrap Iron and Steel, Inc., the national association of the ferrous scrap processing industry.

The United States and her people, faced with mounting environmental deterioration, are taking action to improve our environmental quality. The economic implications are large, yet the social costs of continued pollution have serious consequences.

The accumulation and increasing generation of solid waste is one important aspect of environmental damage, in addition to air and water pollution. Its problems are caused by many complex factors, which do not lend themselves to easy solution.

Ferrous solid waste is the portion of discarded iron and steel materials and the ferrous components of discarded products which is not collected and processed into iron and steel scrap by the ferrous scrap industry. While it is a minor portion of the total solid waste generated annually, it nevertheless is a highly visible and contributing factor to solid waste problems. Representing an under-utilization of a potentially valuable resource for iron and steel production, it is intimately bound to the total solid waste problem. Its alleviation should therefore have positive consequences for solid waste management.

Recycling, the continuing reuse of materials, is the positive response to the problem of waste disposal. It offers the most suitable alternative for lessening solid waste problems.

From inception, the ferrous scrap processing industry has had as its basis the recycling of ferrous solid waste into raw materials of value. This industry is best equipped to continue and accelerate solutions to the problems. Its orientation must continue to be action, and not reaction. The industry, however, must merit and receive increased cooperation from industry, its markets, government, private organizations, and individuals if success in increased recycling of ferrous solid waste is to be achieved.

Numerous problems and obstacles for increased recycling of ferrous solid waste exist. Major among them are: low growth rate of consuming industries; changing iron and steel making technology; low scrap quality from ferrous solid waste; reduced requirements for the purchased scrap proportion of total scrap consumption; poor economics of recycling ferrous solid waste; apparent discriminatory restrictions; and a lack of public awareness of the scrap processor's role in economic recycling.

The key to achieving recycling success is increased market demand for iron and steel scrap, the value produced from ferrous solid waste. However, if normal market demand does not provide for both profitable processing of ferrous solid waste by the scrap industry and its subsequent economic use by the iron and steel consuming industries, a reordering of our traditional commercial objectives based on profit and efficiency will be required in order to include the social cost of an increasingly deteriorating environment.

A number of potential opportunities exist for increased recycling of ferrous solid waste. But with few exceptions, significant effort and cooperation by all concerned--the ferrous scrap industry, the iron and steel industries, and governmental bodies--is required if the problems and obstacles to increased recycling are to be overcome and turned into opportunities. The opportunities are offered through the following channels: increased participation in current markets; development of new markets; improved scrap economics; improved scrap quality; improved logistics; minimized legal constraints; improved definition and analysis of the scrap situation; and increased public awareness of the importance of recycling and the scrap processor's role. The study presents recommendations for fulfillment of these opportunities.

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CHAPTER I
INTRODUCTION

In June, 1970, Battelle-Columbus undertook a research program for the Scrap Metal Research and Education Foundation of the Institute of Scrap Iron and Steel, Inc. (ISIS). This was through a demonstration grant of the Office of Solid Waste Management Programs of the Environmental Protection Agency.

Background of the Study

The increasing volume of solid waste in the United States is causing significant environmental problems with consequences affecting our aesthetic senses, economic costs, health, social welfare, land usage, governmental policy, and natural resources.

One approach to the reduction of solid waste pollution is to reclaim waste materials for reuse--the recycling concept. A well established industry--the ferrous scrap industry--exists to accomplish the recycling of iron and steel. Member firms of the industry have capably performed their difficult and essential functions of preparing ferrous waste materials for economic recycling as iron and steel (ferrous) scrap. This has taken place in the traditional economic environment.

However, additional dimensions have recently been added to this traditional economic environment. Improvement of the living environment and increased national concern with conservation of natural resources, the new dimensions, provide new challenges and opportunities for the recycling industry. No longer is economic gain the only driving force for recycling of waste materials. Social benefit has been added in the form of improved living conditions and preservation of resources for future generations. In an economics-based nation, this creates problems of interpretation and evaluation of noneconomics-based goals and activities.

The Institute of Scrap Iron and Steel, established in 1928, is a national association made up of approximately 1,300 processors and brokers of iron and steel (ferrous) scrap, and allied members. Member firms handle more than 90 percent of all purchased scrap consumed in the United States and exported, a $4 billion annual industry. The scrap industry plays an important part in providing three major services to our nation: reclamation or recycling of discarded ferrous products of our society and processing them into raw materials valuable for new products; conservation of natural resources through the utilization of these reclaimed materials; and beautification through the removal and elimination of these discarded materials from our landscape. The Institute, besides serving its membership's needs, is also active in projects that serve the public interest, such as beautification and training programs for the hard-core unemployed. Early recognition was given to the problems of abandoned automobiles through sponsorship of a national conference in 1964, and again in 1970.

Recognizing the need for research in the reclamation of ferrous metallics, the Institute, in 1967, formed the Scrap Metal Research and Education Foundation. The Foundation's main objective is to place more emphasis on research in the industry, though considerable work had been done in the past.

For many years, the Institute has evaluated, discussed, and worked on numerous technological, operating, and marketing problems of ferrous scrap. This has been done through its Special and Standing Committees, research contracts, government agencies including the Bureau of Mines and the Bureau of Domestic Commerce in the Departments of Interior and Commerce respectively, consumers and suppliers, and the American Iron and Steel Institute and foundry associations. Examples of studies conducted are included in the Bibliography of this report.

During this period, significant changes have occurred in the iron and steel industries, the major markets for iron and steel scrap. Iron and steel

scrap represents 50 percent of the ferrous raw material input to raw steel and iron and steel castings production; the remainder comes from iron ore based pig iron and hot metal (molten pig). The changes occurring and having major impact on the scrap industry and ferrous solid waste accumulation include: changes in iron and steelmaking technology; changes in demand for iron and steel products; changes in types of iron and steel products; and increased quality and economic considerations in scrap processing and iron and steelmaking.

To offset these changes diminishing the demand for scrap by its markets, improved scrap processing equipment has been developed to supply the desired quality product. But even with this and other improvements in the scrap industry, the demand for scrap has lagged the available supply. This results in both ferrous solid waste* and an underutilization of an important raw material resource.

It was therefore deemed appropriate by the Office of Solid Waste Management Programs of the Environmental Protection Agency and the Scrap Metal Research and Education Foundation of the Institute of Scrap Iron and Steel, both vitally concerned with iron and steel (ferrous) scrap and its movement, or lack thereof, that a major study should be conducted to define the problems and seek their solutions.

The starting point for such a study is an assessment of the ferrous scrap processing and brokerage industry, and its relationship to both its sources of supply and its markets. The study should outline problem areas that inhibit more effective recycling, and should provide a data base for further policy and investment decisions by both public and private bodies concerned with solid waste programs. The study should further identify opportunities for increased recycling, and recommend action programs to achieve this objective. It is toward those ends that Battelle-Columbus has conducted this study.

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* Ferrous solid waste is defined as that portion of discarded iron and steel materials and the ferrous components of discarded products which is not collected and processed into iron and steel scrap.

Objectives and Scope

The major objective of the study on which this report is based was to identify opportunities for increased recovery and recycling of ferrous solid waste. In order to achieve this, the following subobjectives were undertaken:

- Provision of a data base on the present iron and steel scrap processing industry
- Examination of the structure and functions of the ferrous scrap industry, and its relationships to its sources of supply and markets
- Examination of those factors that tend to inhibit the industry from performing its role to a greater extent than at present and which thereby lead to ferrous solid waste problems
- Identification of opportunities for the industry to more effectively contribute to solutions of the metallic solid waste problems of this nation.

Research Methods

To provide overall guidance and assistance in the study, a Task Force was established from the Institute's active committees having a direct bearing on the goals of the research study. These men, brought into the active participation of the Scrap Metal Research and Education Foundation, met quarterly as a group and individually as required with Battelle, and provided invaluable assistance during the progress of the study. In addition, Institute staff and consultant personnel made frequent contributions to the project.

Battelle Memorial Institute, as prime contractor, used its interdisciplinary approach to carry out five primary functions:

(1) A literature search and evaluation to assess the current documented and published information was made. References cited and having implications for the study are listed in the Bibliography and throughout the report.

(2) An extensive survey of the ferrous scrap industry to identify the industry, its capabilities, and its problems was conducted. The actual survey was subcontracted by Battelle to Chilton Research Services, a Division of the Chilton Company in Philadelphia, Pennsylvania, a qualified outside organization experienced and equipped in survey techniques. A copy of the survey questionnaire appears in Appendix A. Systematic selection on a geographical basis was made of 249 firms in the industry, representing a sample size of firms accounting for approximately 15 percent of the industry's volume. The geographic distribution of interviews is shown on page A-4. Personal interviews and telephone interviews were 50:50. Raw data from the survey appears in Appendix A. Interpretation and analysis of the data appears throughout the report, and is noted by "Source: Extensive Survey".

(3) In-depth interviews were then conducted in person by the Battelle project team to add detail and insight into the problems identified in the Extensive Survey, to identify the ferrous solid wastes most difficult to collect or process, to uncover the problems involved in disposing of the solid wastes generated during the processing of iron and steel scrap, and to determine other types of restrictive problems facing the industry. Problems peculiar to specific regions received attention.

In-depth interviews were held with over 80 individual firms, organizations, and government agencies representing the sources and markets for iron and steel scrap, members of the ferrous scrap industry, and others associated with recycling opportunities.

(4) Technical and economic evaluation to determine the obstacles and opportunities for increased recycling, based upon the information developed during the preceding functions, then began. The sources and markets for ferrous solid waste were analyzed. The ferrous scrap industry's relationships, capabilities, and problems with regard to both sources and markets were evaluated. Obstacles were defined and analyzed; potential opportunities were identified; action plans for implementation were developed.

(5) Synthesis and recommendations for further research and action leading to increased recycling, and therefore alleviating our solid waste problems, conserving natural resources, and adding to the economic and social well-being of our nation, was the final phase of the study.

NOTE: This study includes numerous statistical tables, based upon a variety of sources, e.g., American Iron and Steel Institute, U.S. Bureau of Mines, Institute of Scrap Iron and Steel, Inc., and others. In each case, the source(s) selected for a particular table was made to best illustrate that table's purpose and to provide consistency within the table. However, due to the variety of sources and methodology of statistical collection and content, some minor inconsistencies may exist in comparing one table to another.

CHAPTER II
SUMMARY

Environmental Quality

The United States and her people, faced with mounting environmental deterioration, are growing more aware than ever before that continued exploitation of our environment has grave social consequences for our nation. Our economically motivated and technology based society has given us a standard of living and a quantity of life unsurpassed in history; yet, in the process the quality of that life has been adversely affected.

Three basic types of interrelated environmental problems exist: pollution, land misuse, and natural resource depletion. And pollution, the most prominent type of environmental problem, has three sources: air, water, and solid waste. Solid waste, the unwanted residue of our society, has only recently become of national concern, due to its increased generation magnifying current disposal problems and costs, and its affront to our aesthetic senses.

Generation of solid waste in 1969 was estimated at 4,340 million tons.[1] While agricultural and mineral wastes comprise the major portion (3,980 million tons), the type most familiar, i.e., residential, commercial, institutional, and industrial waste amounted to 360 million tons, or almost 2 tons per capita in the United States. Of the latter, less than 50 percent was collected, at an annual cost of $4.5 billion.[2] Most is simply deposited on the land in open dumps, or left to accumulate at its sources.

Solid waste problems obviously exist. But these problems are complex, and defy simple solution. In addition, the economic implications of an improved environment, while difficult to measure, are great. No longer may the most efficient manufacturing process or waste disposal method be used if by doing so the environment is impaired. Pursuit of economic goals can no longer disregard basic value and environmental considerations as they have too often done in the past.

Profits will be maximized, but subject to environmental constraints. However, how far and how fast we progress in the direction of environmental quality improvement balances delicately on achieving, within our socio-politico framework, an economic cost/environmental benefit equilibrium.

Solid Waste Alternatives

Six basic alternatives exist for solid waste management. They are to:

(1) Continue polluting, which is obviously unacceptable due to both environmental and economic considerations

(2) Limit use of current materials contributing to pollution, which could have severe economic consequences

(3) Make greater use of biodegradable materials, which has some merit but is limited in their use due to economic and technological factors

(4) Develop new uses for solid waste in its present form, which offers limited applications

(5) Improve disposal of waste through improved economic and sanitary methods, which has certain merits but is a waste of potential resources

(6) Recycle as great a portion of the solid waste as possible and/or required, while at the same time improving the economics and sanitation of disposal of the residue. This is the most promising alternative, both environmentally and economically.

Recycling, the conversion and reuse of discarded products in the production of new, offers the best potential alternative for improving both our environmental and economic climate. While a totally "closed system", one in which all waste is recycled for useful and productive purposes, is not feasible, greater utilization than at present is necessary. Five basic reasons exist for the "why" of economic recycling of solid waste. They are:

(1) Alleviation of mounting solid waste problems and costs

(2) Conservation of natural resources

(3) Use of an economic raw material source

(4) Aesthetic and health considerations

(5) Avoidance of economic dislocations within processing and supplying industries.

It should be noted, however, that the effect of increased recycling on existing industries, e.g., virgin materials producers, must also be considered.

Ferrous Solid Waste

Ferrous solid waste is an integral part of our total solid waste problem. Originating in the discards of society, it represents the loss of potentially valuable resources for recycling and presents high visibility in such forms as junked vehicles, steel cans, and ferrous components of abandoned buildings. Nevertheless, when collected and processed into iron and steel scrap by the ferrous scrap processing industry, it represents a very real resource for production of iron and steel.

Iron and steel scrap represents approximately 50 percent of the raw material input for the production of iron and steel, with natural resource iron-bearing materials, e.g., iron ore, comprising the remainder. Scrap originates in three basic sources: (1) home, or mill revert scrap, generated during the production of iron and steel; (2) prompt industrial scrap, generated during the fabrication of mill products into consumer and industrial products by the metalworking industries; and (3) obsolescent scrap, the product of value obtained from society's discards, i.e., ferrous solid waste. The latter two types are collectively known as purchased scrap, as they are collected and processed externally to the iron and steel producer by the ferrous scrap industry.

Some portion of the prompt industrial scrap is properly prepared at the generating plant for use, and therefore involves only a brokerage operation with direct shipment to the consumer by the scrap industry; the remainder, however, requires handling and/or processing by the industry. Obsolescent scrap is virtually all handled and processed by the scrap industry.

In 1970, almost 86 million net tons of iron steel scrap were consumed in the United States, and over 10 million tons were exported. Domestically, home scrap represents about 60 percent of total consumption; prompt industrial 20-25 percent; and obsolescent scrap 15-20 percent. The respective tonnages of each in 1970 approximated 53, 20, and 14 million net tons.

Home scrap is generally consumed within the plant in which it originated, although some interplant shipments take place. Prompt industrial scrap also normally flows smoothly in the recycle chain, due to its known composition and quality. But ferrous solid waste, the raw material for obsolescent scrap, because of its heterogeneous sources, unknown quality, and containment in complex final products, presents the major problem for increased recycling. Only about 60 percent of the total obsolete ferrous materials becoming available each year is processed and used as scrap; the remainder becomes ferrous solid waste. It is estimated that its current accumulation approximates 750 million tons. A simplified flow chart of the scrap cycle and ferrous solid waste appears as Figure II-1.

Markets for Ferrous Solid Waste

Iron and steel have formed the structural framework of our economy. Annual production of raw steel and shipments of iron and steel castings currently approximates 150 million tons. Two major sources of ferrous raw materials are used for this production: iron ore, a natural resource which is reduced in

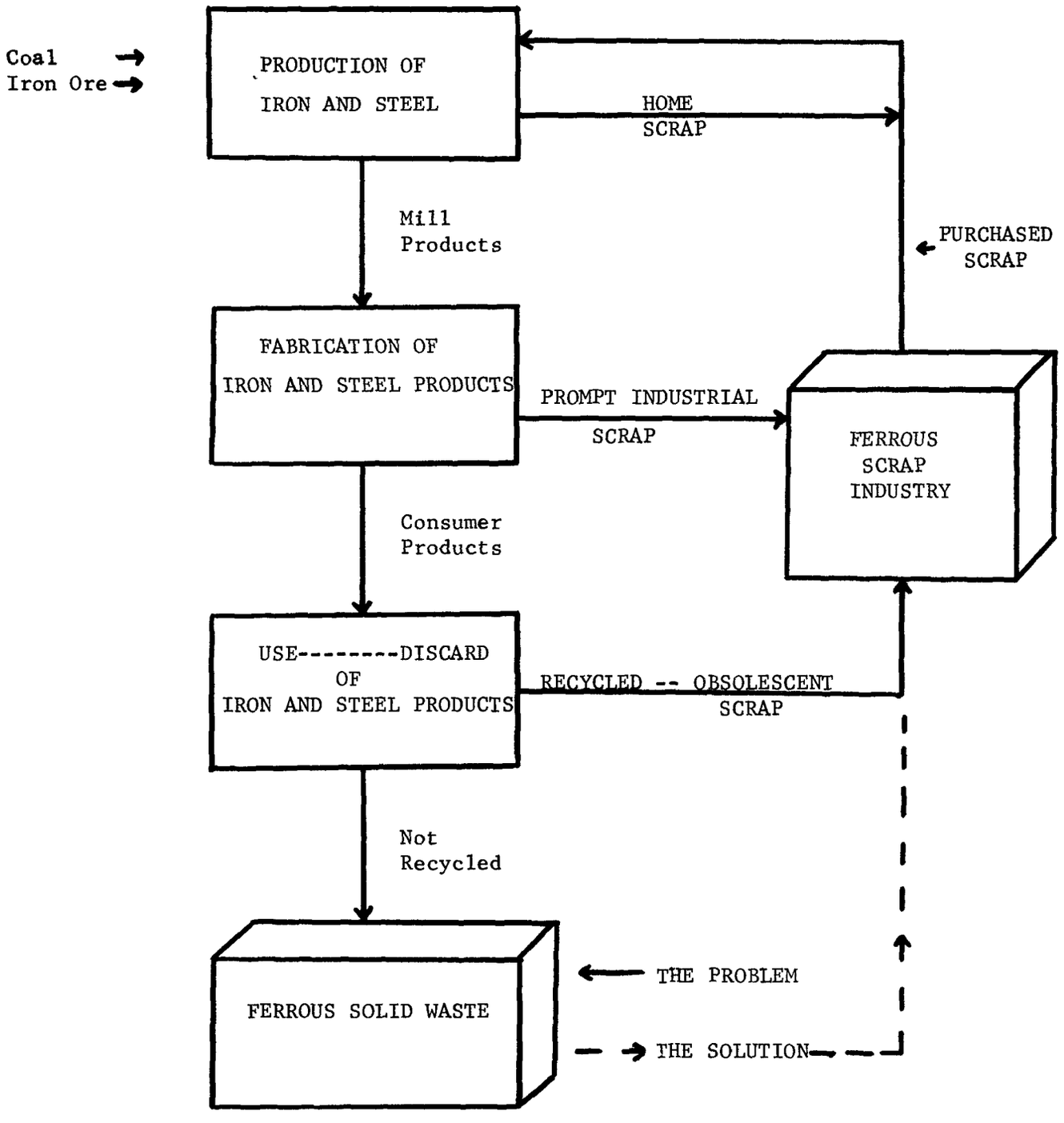

FIGURE II-1. THE SCRAP CYCLE AND FERROUS SOLID WASTE

blast furnaces to pig iron for foundry consumption or hot metal (molten pig iron) for steelmaking consumption, and iron and steel scrap, the end product of the scrap processing industry, and the by-product of iron and steel production and fabrication.

The markets for iron and steel scrap are the iron and steel industries. The domestic steel industry consumes about 75 percent of total scrap, the ferrous foundry industry consumes 15 percent, and the remaining 10 percent goes to export markets and minor uses.

The steel industry in 1970 produced 131.5 million tons of raw steel and consumed 69.3 million tons of scrap in that production, of which approximately 65 percent was home scrap and 35 percent purchased (prompt industrial and obsolescent) scrap. The ratio between hot metal and scrap usage approximated 55:45, and has been maintained over a number of years. Steel is produced in three basic types of furnaces, each using scrap and hot metal in different proportions.

The basic oxygen furnace, which currently produces over half of this nation's raw steel, typically uses a 30 percent scrap charge; the open hearth furnace, 35 percent of the total production, typically uses a 45 percent charge; and the electric furnace, 15 percent production, uses virtually a 100 percent scrap charge.

Iron and steel castings shipments in 1970 were 16.5 million tons. Scrap consumption was 16.2 million tons of which approximately 35 percent was home scrap and 65 percent purchased. The vast majority of gray iron castings are produced in cupola furnaces, which use an approximate 85 percent scrap charge, the remainder being pig iron. Most steel castings are produced in electric furnaces, using basically a 100 percent scrap charge.

The third major market for scrap is the export market, consuming 10.6 million tons in 1970, almost 25 percent of total purchased scrap.

Other minor markets exist, such as the use of can scrap for copper precipitation, but the future for increased recycling is tied to the above three market outlets.

The Ferrous Scrap Industry--The Vital Link Between Ferrous Solid Waste and Its Markets

The vital link which connects the sources of ferrous solid waste and its markets is the ferrous scrap industry. Since its inception in the 1800's, its major objective has been the profitable recycling of ferrous waste materials into raw material resources useful for new products.

The ferrous scrap industry produces value, in the form of iron and steel scrap, from potential wastes, thereby providing the means for preventing both greater ferrous solid waste accumulation and natural resource depletion. The basic functions of the industry are to collect ferrous scrap, process or manufacture it into physical forms and quality grades required by its markets, and to manage its purchase and sale. While there are a number of major firms, the general structure of the industry centers around small, family owned and operated enterprises. Three basic types of firms exist: the processor who assembles and prepares the scrap for sale; the processor/broker who assembles, prepares, and sells the scrap to the consuming markets; and the broker who buys from the processor or other sources direct, such as prompt industrial scrap from industrial accounts, and sells to the markets direct with little or no processing on his part. It has been estimated that approximately 50 firms are brokers, 150 are processor/brokers, and the remainder are processors and collectors. In total, the number of firms approximates 1,800 operating slightly over 2,000 establishments.

Scrap processing has become an increasingly complex and sophisticated operation, due to the incoming variety of materials and changing requirements of

the marketplace. The quality required by the iron and steel producing industries has increased markedly as the requirements of their customers for improved iron and steel products have increased. On the other hand, the complexity and increasing amounts of nonferrous materials used in consumer goods, a major source of obsolescent scrap, has made separation and preparation of quality scrap more difficult.

To effectively deal with these trends and increasing labor costs, the scrap industry, together with its equipment suppliers, has developed processing equipment capable of producing quality scrap products. Three major pieces of equipment have contributed to this upgrading. The 1940's witnessed wide-spread installation of hydraulic balers, with their capacity to bundle the increasing amount of light, flat-rolled material. In the late 1950's, the hydraulic guillotine shear and conveyor systems provided properly sized and segregated scrap. However, scrap processing made vast strides in the 1960's. The advent of shredding or fragmentizing equipment capable of producing the most uniform scrap yet developed from complex consumer goods was a major contribution. Further contributions to improve scrap quality were made by wide-spread adoption of shears, sorting conveyor systems, improved briquetting and baling equipment, as well as other equipment and processing innovations. But this progress has been expensive. A continuous flow of material through this equipment is required for profitable operation, a characteristic often lacking in scrap demand.

Maintenance and improvement of the current scrap cycle is vital to increased recycling success. The ferrous scrap industry is equipped to continue and accelerate solutions to many of our ferrous solid waste problems. Orientation must continue to be action, not reaction. Increased cooperation among the scrap industry, other industries, government, and private organizations and individuals is required if success in increased recycling of ferrous

solid waste is to be achieved, as numerous problems and obstacles exist to increased recycling.

Major Problems and Obstacles to Increased Recycling

Numerous problems and obstacles exist for increased recycling of ferrous solid waste. They appear on the following page in charted form (Figure II-2). Some have a direct inhibiting effect on increased recycling, while others have only an indirect or minor effect. In addition, a number of the problems listed within the scrap industry are applicable primarily to only the small or medium-sized processor. The major ones are subsequently discussed.

Low Growth Rate of Consuming Industries

Increased recycling of ferrous solid waste is dependent to a great extent on increased demand for iron and steel scrap by its major markets--the domestic iron and steel industries. A key determinant of this demand is the increased sale of iron and steel products and the associated growth in scrap demand for supplying the required metallic charge for iron and steelmaking.

The domestic iron and steel industries are not keeping pace with the growth in the American economy. Over the past decade, the economy as measured by gross national product, industrial production, its durable manufacturing components, or any number of other indicators, has grown at an annual rate in excess of 5 percent versus about 3 percent for iron and steel. Continuation of these trends is expected, with perhaps the gap even widening between iron and steel growth and that of the economy. Growth in annual iron and steel castings shipments is estimated at an annual 3 percent rate, with steel production expected to increase at an annual 2.5 percent rate.

Three basic reasons exist for the slower growth in the steel industry, the major market for iron and steel scrap. Disappearance of a historic export

LOCATION: / TYPE:	At Sources	Within Ferrous Scrap Industry	Markets: For Scrap	Markets: Within Markets	Other
Economic	Logistics accessibility collection transportation to processor Price inadequate to induce movement Segregation costs	Increasing capital investment Labor availability/quality/costs Residue disposal Inventory holding requirements Lack of continuous operation re: cyclical markets Equipment financing problems Transportation inequities and costs Increasing operating costs	Price volatility vs. competitive products stability New uses minor Tied to two markets Availability of high quality scrap at low cost	Low growth rate Low profit industries	Lack of accurate problem definition
Technological	Complexity of goods Alloy content of mill products Low value prompt industrial scrap, e.g., turnings, borings, and chips	Equipment utilization and maintenance Difficulty of establishing "in line processing" Cyclical markets resulting in processing inefficiencies Identification and segregation deficiencies Difficulty in upgrading certain forms of obsolete scrap Products do not lend themselves to chemistry specifications	Melting practice changes Increased home scrap generation Known analysis of competitive product Quality variation Bypass systems	Past practice dominance Scrap usage technological gap	Recycling system technology limited Realistic specifications lacking
Social	Public apathy re: meaningful action Attitude toward scrap industry	Public image Site appearance		Limited recognition of environmental goals and applications Attitude toward scrap industry	Environmental/ecology "excesses" Lack of general understanding of processor's role
Political	Legal obstacles to movement, e.g., auto titling Waste handling local problem	Classification as wholesale trade vs. manufacturing Pollution control costs Discriminatary legal restriction		Pollution controls restrictions Import quotas re: tons, not value	Government tax incentive for competition, e.g., iron ore depletion allowances Multi-effort, diverse approaches
Business	Orientation toward disposal, not recycling Inefficient municipal collection units	Need for improved management techniques Individualistic nature of firms Equipment manufacturer relations Industry structure	Dominance of major producers with metallics flexibility Cyclical markets Trading vs. marketing Lack of involvement with markets	Governmental pressures	Small collector/processor decrease
Other	±15 percent nonrecoverable: product design or size or usage losses: corrosion, abrasion, and process loss, war and shipping losses	Legislative controls by those not fully cognizant of problems Transportation service, e.g., car supply and loading	Some regional imbalance re: supply and demand for scrap Export markets "cloudy"		Probable need for artificial demand stimuli Scrap accumulation/supply exceeds demand

FIGURE II-2. PROBLEMS AND OBSTACLES TO INCREASED RECYCLING OF FERROUS SOLID WASTE

balance in steel mill products to a position where imports account for approximately 15 percent of apparent domestic steel supply has had the major effect. In 1970 alone, a year in which exports, due to booming foreign demand, were at their highest levels since before World War II, imports still exceeded exports by over 6 million tons, at a cost of 9 million ingot tons, and a loss of almost 2 million tons of purchased scrap consumption. Two years earlier, in 1968, the spread of imports over exports exceeded 15 million tons, equivalent to a decrease in purchased scrap requirements of almost 4 million tons, a loss exceeding 10 percent of purchased scrap in that year. And these numbers are exclusive of both the 2 million ton export balance enjoyed during the 1950's and the increase in imports of ferrous containing consumer items such as automobiles, which if considered, would make the loss of purchased scrap even greater.

The other two factors, difficult to quantify but nevertheless significant contributors to reduced growth, are the replacement of iron and steel by competitive materials such as aluminum, concrete, and plastics, and the increased utilization of lighter iron and steel products with improved properties at the expense of heavier sections, such as high strength-low alloy steels and "thin-tin" container stock.

The major effect of this low growth rate is to reduce requirements for obsolescent scrap, the product of ferrous solid waste. Generation of home and prompt industrial scrap follows closely trends in iron and steelmaking, causing little excesses over the amount required. Ferrous solid waste, however, accumulates continuously in our disposal-oriented economy.

Changing Iron and Steelmaking Technology

Two key elements affecting the use of iron and steel scrap are the type of melting furnace employed by the iron and steel industries and the

availability and cost of competitive ferrous charge materials (pig iron, hot metal, or direct-reduced ores) relative to scrap.

The greatest effect has been felt in the steel industry. Only 10 years ago, almost 90 percent of all steel produced was melted in open hearth furnaces, which at that time used a 40 percent scrap charge, now at 45 percent. Today, less than 40 percent of total steel is produced in open hearths, and this is expected to decrease to less than 15 percent by 1980. Open hearth steelmaking has been displaced primarily by the basic oxygen furnace, which uses an approximate 30 percent scrap charge, consisting mostly of home scrap. This has the effect on a ton to ton basis of reducing scrap requirements by over 30 percent based on current charging practices. Fortunately for scrap consumption, significant increases have occurred in electric furnace steelmaking and ferrous castings production using virtually a 100 percent scrap charge, which has kept the total scrap percentage at about its former levels. Thus, future scrap consumption is tied closely to achieving the continued increase in electric furnace melting to offset the decreases caused by the rise of the basic oxygen furnace at the expense of traditional open hearths.

One other factor of increasing importance to ferrous scrap consumption is the continuous casting of semifinished products directly from the steelmaking furnace. This technique requires less total steelmaking raw material charge and reduces the amount of home scrap generated during production because of its increased yields over traditional steel ingot practices. The effect is to increase the amount of purchased scrap requirements per finished ton. This would benefit recycling of ferrous solid waste, assuming the increased availability of hot metal is not used to replace scrap. On the other hand, the use of direct-reduced ores, i.e., iron ore reduced by means other than the blast furnace to a high iron content and charged directly to the steelmaking furnace, could partially offset these gains by its substitution for scrap. However,

it may complement scrap and promote an acceleration in installation of electric furnace steelmaking, which in the long run would be beneficial to scrap consumption.

The technical feasibility of using increased scrap proportions in iron and steelmaking charges has been amply demonstrated. The melter will, however, make his decision on economic operating practices and quality considerations. He will use the most economic ferrous raw material available. The scrap industry can influence that decision by providing lower cost, higher quality products and improved technical service on optimum scrap usage.

Quality of Scrap From Ferrous Solid Waste

Scrap quality is an extremely important consideration for the consumer of iron and steel scrap. The key quality factors, from his standpoint as well as that of the scrap processor, are size and shape, density, and metallic and nonmetallic impurities. Size, shape, and density are related basically to operating practices for the melting furnaces; impurities, while obviously influencing charging and melt practices, are of major concern with regard to further mill finishing and properties in the final mill product.

The iron and steel industries are under continuous pressure from their markets for mill products that will meet increasingly rigid specifications. Their operating practices and the raw materials from which iron and steel are produced are therefore subject to increasing quality requirements.

The main competitor to scrap as a ferrous charge raw material is iron ore, in its reduced form as pig iron, a product of known chemistry and consistent size, shape, and density. Two forms of scrap, home and prompt industrial, are also basically of known chemistry, within a limited range, and with modern scrap processing equipment and techniques can be manufactured into the desirable

physical form. As a result, they move freely into the scrap cycle, presenting no real quality problems.

However, obsolescent scrap, the product of ferrous solid waste, is significantly different. Occurring in many shapes and forms, from steel cans to junked autos, it presents a number of quality problems. Great strides have been made by the scrap industry toward processing of this material into the required physical forms with lower residuals, through the use of shredding systems and other modern equipment. However, the complexity and increasing amounts of non-ferrous materials used in consumer and industrial goods, have made extremely difficult the separation and elimination of the undesirable residual elements for iron and steelmaking, such as copper, lead, and tin. As a result, except in periods of peak demand or hot metal shortages, the availability and low cost of higher quality, e.g., prompt industrial scrap, forms of ferrous charge materials diminish any real incentive for the scrap consumer to use or the scrap processer to collect and process obsolete scrap with its potential quality problems.

Reduced Requirements for Purchased Scrap of Total Scrap Consumption

The ratio of scrap consumption to total iron and steel produced has remained fairly stable over the past twenty years, with a scrap to pig iron ratio approximating 50:50. However, in 1950, purchased scrap accounted for about 50 percent of the total scrap consumed. It now amounts to under 40 percent, a decrease of 20 percent in purchased scrap requirements.

This has primarily been caused by decreasing yields in producing mill products, resulting in an increased generation of home scrap. In the steel industry alone, finished steel shipments as a percent of raw steel production

during the period 1950-54 were 74.2 percent versus 68.0 percent in 1965-69. Caused by a number of factors such as the changing product mix toward lighter sections, increased finishing operations, and more rigid product specifications, the net result has been an unwanted increase in "self-supply" by the iron and steel industries of their scrap requirements. The basic oxygen furnace, for example, can be almost totally self-sufficient, except for short-term disequilibriums.

Therefore, while the total scrap consumed over the past 20 years has followed closely the growth in iron and steel production, the absolute amount purchased has shown little, if any, increase over this period.

Poor Economics of Recycling Ferrous Solid Waste

It is generally accepted that the vast majority of potential ferrous solid waste that can be economically recycled is currently being recycled. Scrap produced from ferrous solid waste is the most costly to collect and process, and due to its relatively low quality, brings a low price without extensive and costly upgrading. In addition, the "break-even" point for the scrap processor has been steadily increasing due to higher labor and transportation costs coupled with increased equipment expenditures and operating costs.

As a result, there is little economic incentive, except in periods of high demand, to attempt to separate ferrous solid waste from other municipal waste, or to scour our countryside for discarded products containing ferrous materials of potential value.

Apparent Discriminatory Restrictions

Iron ore and scrap are the two sources of iron units available to the iron and steel producer. They compete metallurgically, and while subject to

certain operating considerations, are equally of value to the melter in obtaining iron. Iron ore has a typical iron (Fe) content of 60 percent, and is used to produce hot metal in the blast furnace which has a typical Fe content of 94 percent. Scrap, the other source of iron for steelmaking, has a nominal Fe content exceeding 90 percent.

Two apparent benefits exist for the iron ore producer as he competes with the scrap processor as an iron source. The first involves rail freight rates. Transportation is a major cost for the scrap processor. Rail is the primary land mode of transportation for both iron ore and processed scrap. Conceptually, transportation rates should not alter the competitiveness of alternative inputs to any manufacturing process; iron ore and scrap are metallurgically competitive.

A recent study at Battelle indicated that iron ore has an apparent competitive advantage of approximately $1.50 per gross ton over ferrous scrap because of the rate structure. The relative Fe contents, the coal energy equivalent for reduction of the oxide ore to metallic form, and the relative role of rail transportation in the movement of ore, scrap, and coal were considered in this analysis.

In reviewing the economic sensitivity of steelmaking cost to scrap cost, it appears that scrap consumption is impeded by the existing freight rate discrimination. In the short run, the removal of the discrimination by lowering scrap freight rates would enable a significant reduction in the finished cost of steel ingots; in the long run, an improved expected rate of return would be realized in scrap-based steelmaking investment.

Therefore, the apparent discriminatory rate structure is a contributing factor toward present scrap markets being impeded in preference to the rate-favored use of iron ore; future markets being curtailed through the

artificial diversion of investment to ore-intensive steelmaking that might otherwise be applied to scrap-intensive steelmaking; natural resources being exploited when they could be conserved; potential scrap that could be recycled does not move; and the environment is polluted by the accumulation of ferrous solid waste.

The second benefit for iron ore producers involves federal tax laws, which allow a 15 percent depletion deduction from gross income in computing their net taxable income. No such advantage accrues to the scrap processor.

Another area of apparent discrimination involves local zoning, licensing, or other legal restrictions placed upon the scrap processor due to lack of recognition of his function. For example, urban renewal projects normally make provision for relocation of industrial firms, but not for the processor or collector who could formerly serve those accounts economically due to their proximity. Another example occurs when fencing regulations are applied equally to the scrap processor, a manufacturer, as well as to the junkyard or auto wrecker, two distinct other categories of business.

Lack of Public Awareness of the Scrap Processor's Role in Economic Recycling

While environmental concern is exhibited everywhere and "recycling" is today's popular concept, there is still little public awareness of the scrap processor's role in achieving the concept. Still often thought of as junk collectors who serve no useful purpose other than their own, the vital role the scrap industry performs in cleaning up our environment and providing the means for conservation of our natural resources is not generally known. As a result, the scrap industry often has been bypassed in environmental decision-making.

Major Opportunities for Increased Recycling of Ferrous Solid Waste and Recommendations for Achievement

The key to achieving recycling success is increased profitable demand for iron and steel scrap, the value produced from ferrous solid waste. However, if economic demand is not present, a reordering of our traditional commercial objectives based on profit and efficiency will be required, in order to include the social cost of an increasingly deteriorating environment.

A number of potential opportunities exist for increased recycling of ferrous solid waste. However, with few exceptions, significant effort and cooperation on the part of all concerned--the ferrous scrap industry, the iron and steel industries, and governmental bodies--is required if the numerous problems and obstacles to increased recycling are to be overcome and turned into opportunities.

The opportunities fall into eight basic areas. In many cases they are interrelated, mutually dependent, or could be classified in other than the selected area. A detailed listing outlining the opportunity areas and the recommended actions to capitalize on those opportunities appear on pages 37 - 41.

Increased Participation in Current Markets

(1) Provide Greater Technical Service to Markets (SI)*. With the exception of the major scrap firms, little, if any, technical service regarding the optimum use of scrap in melting operations to provide the best finished product at the lowest cost is available. The relationship between the scrap dealer and his customer has been one basically of trading. The scrap processor has limited knowledge of melting problems or the use of his products, other than when complaints

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* Recommended for action by: (SI) scrap industry, (M) markets for scrap, (S) sources of scrap, (G) government, (E) equipment manufacturers.

occur. By the same token, scrap usage by the iron and steelmaker is often dictated by past practice. Scrap today is a much different product than in the past; so is melting technology and scrap requirements.

In general, the metallurgical capabilities in medium and small firms are limited regarding optimum scrap usage. It is recognized that development of such capabilities is also expensive. It is therefore recommended that this technical assistance be provided by the Institute of Scrap Iron and Steel through addition of a Technical Director to its staff. His main function would be to provide the latest in metallurgical technology and optimum scrap utilization to member firms and the consuming industries.

In addition, it is recommended that the Institute investigate the merits of publication of a basic technical textbook/handbook on the Metallurgy of Scrap ala "The Making, Shaping, and Treating of Steel." Numerous textbooks, handbooks, etc., are available on the production of iron and steel. The information provided on optimum scrap usage, a basic raw material for ferrous products, is minimal.

(2) Expand Research, Both Technical and Economic, on Increasing the Scrap Proportion of the Metallic Charge (SI-M-G). Iron ore and ferrous scrap compete metallurgically for the iron input to iron and steelmaking. Recognizing that certain technological and economic constraints dictate the current relative charge materials, there are still numerous opportunities for increasing the scrap proportion within those constraints.

Chief among the areas worthy of investigation, and detailed in the Technology section of the report, are: blast furnace tuyere injection of scrap granules or powder and increased use of properly sized scrap as part of the blast furnace burden; internal and external scrap preheating by electrical resistance heating; large line-frequency induction furnaces for superheating hot metal for BOF steelmaking; continuous charging of scrap to electric arc furnaces; and the use of higher-powered electric arc furnaces.

(3) Increase Artificial Demand Stimuli (G). Numerous suggestions have been made to promote the use of recycled products, such as tax incentives for using recycled materials or governmental purchasing policies favoring products made from recycled materials. Such policies would increase scrap demand. However, the effect and mechanisms for such proposals require detailed analysis.

While sounding simple in concept, the control and/or certification of "recycled content" for iron and steel products would be difficult in practice. Recycling certification would only help the ferrous solid waste problem if tied primarily to usage of obsolescent scrap. Because of the variety of sources and scrap yard/mill materials handling practices, the segregation and certification of product content would undoubtedly contribute to additional costs for both processor and user.

Careful analysis should be made of the mechanism for and cost/benefit from such proposals including their effect on other areas of the economy and nation.

(4) Increase Price Stability (SI-M). Scrap is bought and sold in a free market environment, resulting at times in extreme price volatility. While characteristic of this environment, and at times an aid to the movement of scrap, it nevertheless is a psychological and economic deterrent to increased scrap utilization.

A major influence is the lack of a continuing and steady market for scrap. Every attempt should be made by the scrap industry and its markets to provide quality product at profitable levels for both. A better understanding of complex price determinants and forecasting would help achieve stability. The implications of long-term purchase contracts should be analyzed in detail.

(5) Make In-Depth Analysis of Export Markets for Scrap (SI-G). A fluctuating market for ferrous scrap is the export market. Certain scrap surplus areas of this country are dependent on exports for scrap movement. However, many traditional foreign markets are becoming more self-sufficient in scrap and/or hot metal supply.

If our goal is to achieve increased recycling of American ferrous solid waste, and if domestic markets cannot effectively absorb all that could be made available, a detailed analysis of the export potential for excess supply should be undertaken. Export barriers should be identified, as should the effect of increased exports on our domestic supply and/or costs.

(6) Promote Interdependency and Involvement with Markets, Together With Emphasis on Marketing Versus Trading (SI-M). Too often, the scrap industry and its consuming markets deal at "arm's length". Yet each is mutually dependent on the other for their success. Greater

involvement and mutual understanding of each other's problems is required.

Obviously, "over night" changes are not possible. It is a "two way street". Increased participation by the scrap industry in technical associations is a move in this direction.

Increased emphasis should be placed on marketing scrap, e.g., promoting its value as a raw material source, providing technical assistance on its use, etc., in today's economic environment, rather than operating in the traditional trading atmosphere.

Development of New Markets

While the major opportunities for increased recycling of ferrous solid waste lie in increased participation in current markets, new market opportunities should be sought. It is therefore recommended that:

(1) Provide Preferential Financing/Tax Incentives for New Firms Based on Usage of Recycled Raw Materials or Products Containing High Recycled Content (G). Financial assistance for the establishment and initial operations of firms whose manufactured products make use of ferrous solid waste or its products, e.g., scrap-using mini mills may offer increased recycling potential. The effect on existing firms must also be considered.

(2) Expand Research to Find New Economic Uses for Ferrous Solid Waste (G). One example of such research is the Bureau of Mines' work on the reduction roasting of nonmagnetic taconites with automobile scrap. Others include the Bureau's research on the use of shredded automotive scrap for copper precipitation, and the use of light-gauge auto body scrap as a reinforcing core in concrete building blocks.

Detailed in this report's Technology section are two other areas worthy of consideration: development and execution of a preliminary experimental program on the use of relatively small scrap particles as reinforcement in concrete; and evaluation of the technical possibilities for the use of electrolytic processes for the conversion of scrap to usable form.

Improved Economics

Critical to increased recycling of ferrous solid waste is the development of lower-cost, higher-quality scrap products.

The following recommendations, if implemented, should assist in improving the economics of scrap products:

(1) Study Methods to Improve the Continuity of Ferrous Scrap Processing and Movement (SI-M). Continuous movement and processing of scrap for traditional cyclical markets is difficult to attain. Yet it is required for economic and efficient processing and increased removal of ferrous solid waste from our landscape.

Capital equipment investment is becoming of increasing importance to recycling of ferrous scrap. Continuous throughput of material is required to profitably utilize equipment. The average processing facility operates less than 48 hours/week--80 percent of all firms fall in this category. Even those with multi-million dollar capital investments seldom operate over 80 hours/week. While downtime for maintenance is obviously required for certain equipment, such as shredding systems, it is clearly indicated that the industry's capacity to produce is underutilized. Nonproductive time is costly.

A number of suggestions have been made to improve the continuity of operations, such as government stockpiling of processed material or collection subsidies in periods of low demand. Improved continuity should be studied in detail, to provide optimum processing efficiencies resulting in lower cost scrap and continual removal of ferrous solid waste from our landscape.

(2) Improve Logistics of Ferrous Solid Waste Collection, Assembling and Transportation (S-SI-G). More favorable logistic factors would obviously enhance the economic recycling of ferrous solid waste. Specific recommendations are included in a subsequent opportunity area--"Improved Logistics".

(3) Expand Research on Economic Separation and Marketing of Nonferrous Byproducts of Current Value (SI-E-G). Ferrous solid waste, as previously noted, contains large amounts of entrapped nonferrous materials, some of significant potential value if economically separated from the ferrous materials. For example, a recent Bureau of Mines study indicated that an average shredder discards approximately $400,000 worth of nonferrous values annually.(3)

Air classification systems are one approach to recovery; heavy media separation is another. Commercial development of an economic method should provide operating and financial benefits for the scrap processor, increasing the total value obtainable from ferrous solid waste, therefore increasing its utilization.

(4) Develop Appropriate Processing/Transportation Equipment (SI-E). Two areas of equipment development deserve continuing attention. One involves the development of portable equipment to assist in the logistics of ferrous solid waste. Examples developed to date are the auto flatteners, and mobile balers; other portable processing equipment may also offer some opportunities.

Another area is the development of processing equipment tailored for the medium and small processor. Scaled-down shredders and incinerators are two examples that have been already helpful.

(5) Study In-Depth the Effect of Depletion Allowances for Iron Ore on Scrap Recycling Rate (G). An apparent advantage of iron ore, the chief competitor to ferrous scrap, is the 15 percent depletion deduction from gross income in computing net taxable income for iron ore producers. No such advantage accrues to the scrap processor, and is, in effect, an incentive to use natural resources at the expense of ferrous scrap.

The effect of this advantage on recycling should be studied in detail. Remedial action to provide equity economics for scrap should be taken if warranted.

(6) Expand Research on Economic Disposal/Recycling of Residual Solid Waste Products (G). An increasing cost factor for the scrap processor and auto wrecker is the disposal of residual solid wastes, such as tires, glass, plastics, fibers and wood, and miscellaneous trash.

At least two approaches are possible: development of commercial disposal equipment, such as low-cost, pollution-free incinerators or development of new uses/recycling opportunities for the residue. Either would improve the recycling economics of ferrous solid waste.

Improved Scrap Quality

Due to the increasing complexity of consumer and industrial goods, major sources of ferrous solid waste, the separation of the ferrous content from residual impurities is becoming increasingly difficult. Substantial processing and upgrading is required. The following recommendations are aimed at alleviating the inherent problems:

(1) Develop Realistic Product Specifications (SI-M). In order to facilitate both processing and use of ferrous solid waste, the development of realistic product specifications is required. Quality scrap is required for today's sophisticated iron and steel products, but how good is good? The scrap industry in cooperation with its markets should attempt to further quantify chemical specifications for its products. Necessary to accomplish this goal are improved identification methods, improved measurement of scrap quality, and improved segregation methods at all levels of the scrap cycle--and price levels to support these improvements.

(2) Design End Products With Recycling in Mind (S-M). Today's emphasis on recycling is somewhat "after the fact". Products are designed for optimum service at lowest cost. This recommendation suggests a new dimension be included in product design--ease of recycling after being taken out of service. It further suggests some economic trade-off. To quote a recent study, "the materials and manufacturing techniques that have steadily reduced appliance prices have also steadily made it more difficult to separate the materials". [4] The effects on recycling and economic cost of alternate materials or placement for easy removal should be studied to see if improvements in scrap quality are possible at an appropriate cost/benefit level.

(3) Develop Improved Processing Equipment and Methods (SI-E-G).* While shredding equipment has made tremendous strides toward the lowering of residual content of obsolete scrap, further decreases are required. One approach, discussed in detail in the Technology section of this report, is cryogenic processing; other possibilities involve thermal or chemical removal of impurities. Continuous effort is required to provide improved product quality at competitive prices. Development of improved quality control methods, including identification and segregation, would help.

Improved Logistics

In order to achieve increased recycling of ferrous solid waste, its collection and movement must be greatly improved. Toward those ends, the following recommendations are made:

(1) Make an In-Depth Analysis of Transportation and its Recycling Role (G). Transportation is a major cost element affecting recycling of ferrous solid waste. Increased in-depth analysis should be conducted on the effect of its current economics and apparent inequity with iron ore on the recycling rate. Improved transportation methods and equipment should also be included, as should be the effect of establishing preferential freight rates for problem scrap, such as abandoned motor vehicles and steel containers.

(2) Make an In-Depth Analysis of Collection Methods and Economics (G). A major problem, tied closely to transportation, is the collection and assembling of ferrous solid waste on an economical basis. Particular emphasis should be given to that waste occurring in rural areas or in

*Note from the publisher, the U.S. Environmental Protection Agency: The development of this kind of equipment is clearly the task of private industry because of the potential for profit benefits from such development.

other areas where scrap assembly for processing and use is different. Municipal solid waste separation is another facet of this problem. Provision of collection subsidies should be analyzed for their cost/benefit on increased recycling.

(3) Increase Funding for Demonstration Grants Aimed at Large Scale Recovery From Municipal Solid Waste (G).* Further detailed study is required on current operations and development of an optimum system for major metropolitan areas--and subsequent markets for the recovery products.

(4) Investigate the Feasibility of "Optimum Disposal and Recycling Facility" (SI-G). While there is merit in current specialized disposal and recycling activity, increased attention is being given to the effect and implications of central waste disposal, recycling centers, or environmental facilities parks. This approach envisions an optimum facility which accepts, processes, and uses waste materials at central locations.

Such facilities would undoubtedly be best managed and operated by the present ferrous scrap industry and other current recyclers, perhaps as subsidiary operations, and not by governmental units competing with current viable enterprises. This evaluation should be closely coordinated with the ferrous scrap industry, and should include such considerations as impact on the current recycling industry, increased market demand for recovered and processed materials, cost-benefit analysis, and alleviation of solid waste problems.

Minimized Legal Constraints

A number of apparent legal obstacles exist to more efficient movement of ferrous solid waste and operations of a scrap processing business. Two quasi-legal

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*Note from the publisher, the U.S. Environmental Protection Agency: EPA has recently funded (in 1972) four projects to demonstrate various technological approaches to resource recovery. These projects, plus perhaps a few others, should be sufficient to demonstrate existing resource recovery technology.

obstacles have previously been discussed, i.e., depletion allowances for competition, and transportation rate inequities. Recommendations for minimizing other legal constraints are as follows:

(1) Promote Recognition by State and Local Government Units of the Distinct Function and Role of the Scrap Processor in the Economy and in Recycling (SI-G). Recognition should provide an adequate base for elimination of discriminatory licensing, zoning, and other restrictions. Adoption of realistic pollution controls should also be more easily gained.

This recognition will have to be promoted and earned by the scrap industry itself. Increased involvement with legislative authorities to promote this understanding is required, as is representation whenever possible on regulatory bodies affecting legislative matters and restrictions.

(2) Pursue Adoption of Uniform Titling Legislation for Motor Vehicles (G). A deterrent to efficient movement of motor vehicles to scrap processors involves various de-titling obstacles. Adoption of the model legislation, or some modification thereof, as proposed by the Council of State Governments and the Institute of Scrap Iron and Steel in 1967 would lessen this problem. A number of other policy alternatives for state and local governments on the abandoned vehicle problem are included in the Obsolete Motor Vehicle section of this report.

Improved Definition and Analysis of Scrap Situation

In order to adequately analyze problems and seek their solutions, the best possible definition and quantification of those problems is required. Basic data are provided by the Bureau of Mines' monthly Mineral Industry Surveys and annual Minerals Yearbook section on Iron and Steel Scrap, as well as

publications by the Department of Commerce and others. In addition, a substantial data base was developed during the course of this study.

However, there still exists a need for more detailed, periodic statistical data on iron and steel scrap. For example, the second largest category of scrap by type listed in the Bureau of Mines' publication is "All Other Carbon Steel Scrap"; stainless and alloy scrap are shown only by grade totals; and scrap statistics by state have been eliminated beginning in 1971. The scrap market is quite cyclical, and better current data are required for good analysis.

It is therefore recommended in view of the above that:

(1) The Feasibility and Usefulness of Further Detailed Monthly Statistical Consumption Information Should Be Analyzed, and Provided If Warranted (G).

In addition, it is recommended that:

(2) Continue Periodic Regional and National Ferrous Scrap Demand/Supply Analysis on a Regular Basis (G). Dramatic changes affecting ferrous scrap consumption are occurring with increasing momentum in today's environmental, economic, and technological society. Continuous study and analysis of the situation are required if achievement of increased recycling and alleviation of solid waste problems is to be accomplished. In addition, the regional characteristics of these changes and their implications vary. The Bureau of Mines has provided an excellent base for analyzing these changes through a series of regional scrap surveys on generation, utilization, and consumption of iron and steel scrap. However, many of these are now dated.

Periodic (3 - 5 years) regional and national ferrous scrap analyses should be conducted on a continuing basis in order to improve the definition and understanding, identify new problems, and measure progress toward solutions.

(3) Undertake a Comprehensive Analysis/Census of the Available Supply of Ferrous Solid Waste Accumulation on a Regional and National Basis (G). If ferrous solid waste is to be considered a potentially valuable raw material resource, a better definition of its location, volume, and availability is required. The brief, cursory examination of the national availability in this report indicated a calculated amount approaching 750 million tons. What is a more accurate number? Where is this untapped reserve? What is its availability? In what forms does it exist? Answers to these and other questions should provide useful information for long-range programs aimed at maximizing this nation's supply of resources.

Increased Public Awareness of the Importance of Recycling and the Scrap Processor's Role

The scrap industry suffers from considerable public misunderstanding of its role in our society. Not always blameless, its public image, while improving, is still less than desirable. Recommendations to improve this situation are as follows:

(1) Expand the Current Commendable Public Relations Efforts of the Institute of Scrap Iron and Steel, Inc. (SI)

(2) Expand Community and School Education Efforts on Recycling and the Scrap Industry's Role (SI)

(3) Promote Mass Media Promotional Programs on Recycling by Individual Scrap Processing Firms, Regional Chapters, and Institute of Scrap Iron and Steel, and/or in Cooperation With Suppliers or Markets. (SI)

All of these recommendations are aimed at enabling the scrap industry to capitalize on this nation's ever increasing awareness of environmental problems and potential solutions, such as recycling. As the American Metal Market of April 20, 1971, proclaimed in an editorial, it is truly a "Golden Hour for Scrap." But it will not be achieved without the increasing positive action on the part of the ferrous scrap industry.

TABLE II-1. OPPORTUNITIES FOR INCREASED RECYCLING OF FERROUS SOLID WASTE AND RECOMMENDATIONS FOR ACHIEVEMENT

Opportunity For	Recommendations	By*	Relative Priority Rating**
• Increased Participation in Current Markets	(1) Provide greater technical service to markets	SI	17
	(2) Expand research, both technical and economic, on increasing the scrap proportion of the metallic charge	SI-M-G	17
	(3) Increase artificial demand stimuli, e.g., recycling incentives	G	16
	(4) Increase price stability	SI-M	14
	(5) Make in-depth analysis of export markets	SI-G	13
	(6) Increase involvement with markets and interdependency concept, including increased emphasis on marketing versus trading	SI-M	11
• Development of New Markets	(1) Provide preferential financing/ tax incentives for new firms based on usage of recycled raw materials or products containing high recycled content	G	14
	(2) Expand research to find new economic uses for ferrous scrap, with particular emphasis on low quality scrap	G	12

* SI - Ferrous scrap industry
M - Markets for scrap
S - Sources of scrap
G - Government
E - Equipment manufacturers

** The priority rating system is described in detail in Appendix C of this report. The priority number shown is to indicate the relative importance of recommendations within categories as a framework for action plans. 20 is the maximum achievable rating. The factors considered in assigning the rating were: (1) the extent that achievement of the recommendation's objective would have on increased recycling; (2) the feasibility of achieving the objective; and (3). the cost/benefit relationship of achievement. Scoring then was based on the effect, significant, moderate, or limited, that the recommendation would have on each category. The increased recycling category was given a maximum weight of 10, feasibility a maximum weight of 6, and cost/benefit a maximum weight of 4.

TABLE II-1. (Continued)

Opportunity For	Recommendations	By	Priority
• Improved Economics	(1) Study methods to improve the continuity of ferrous scrap processing and movement	SI-M	16
	(2) Improve logistics of ferrous solid waste collection, assembling, and transportation	S-SI-G	15
	(3) Expand research on economic separation and marketing of non-ferrous by-products of current value	SI-E-G	14
	(4) Develop appropriate processing/ transportation equipment	SI-E	13
	(5) Study in-depth the effect of depletion allowances for iron ore on scrap recycling rate	G	13
	(6) Expand research on economic disposal/recycling of residual solid waste products	G	11
• Improved Scrap Quality	(1) Develop realistic product specifications	SI-M	14
	(2) Design end products with recycling in mind	S-M	13
	(3) Develop improved processing equipment and techniques	SI-E-G*	12
• Improved Logistics	(1) Make an in-depth analysis of transportation and its recycling role, including effect of preferential freight rates for problem scrap	G	16
	(2) Make an in-depth analysis of collection methods and economics, including effect of collection subsidies	G	16
	(3) Demonstrate feasibility of large scale recovery	G**	13
	(4) Investigate feasibility of optimum disposal/recycling facilities	SI-G	12

*See footnote, page 33

**See footnote, page 34

TABLE II-1. (Continued)

Opportunity For	Recommendations	BY	Priority
• Minimized Legal Constraints	(1) Promote recognition by state and local government units of the distinct function and role of the scrap processor in the economy and in recycling	SI-G	14
	(2) Pursue adoption of uniform titling legislation for motor vehicles	G	11
• Improved Definition and Analysis of Scrap Situation	(1) Evaluate feasibility and merit of more comprehensive monthly consumption statistical data	G	13
	(2) Initiate periodic regional and national scrap demand/supply analyses	G	13
	(3) Undertake a comprehensive analysis/ census of ferrous solid waste accumulation	G	11
	(4) Prepare a current census of prompt industrial scrap generation	G	10
• Increased Public Awareness of the Importance of Recycling and the Scrap Processor's Role	(1) Expand the current commendable public relations efforts of the Institute of Scrap Iron and Steel, Inc.	SI	13
	(2) Expand community and school educational efforts on recycling and the scrap industry's role	SI	12
	(3) Promote mass media promotional programs on recycling by individual scrap processing firms, regional chapters, and Institute of Scrap Iron and Steel, and/or in cooperation with suppliers or markets	SI	11
	(4) Increase involvement of firms and its individual members in community affairs	SI	10

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4. National Industrial Pollution Control Council. The disposal of major appliances; Sub-Council report. Washington, U.S. Government Printing Office, June 1971. p.17.

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