CHAPTER 3

Problems, Issues, and Findings

Contents

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Introduction

This chapter discusses 40 topics which, taken together, give a detailed view of the entire report supplementing the brief summary in chapter 1. Each of the 40 discussions is self-contained and usually draws from several chapters of the report.

Because each topic stands alone, the reader may tackle them in any order and may skip questions without sacrificing comprehension. Within each of the eight groups of topics, the higher priority problems or issues are addressed first.

The question-and-answer format should promote a fresh look at a number of longstanding and much publicized topics. Moreover, by defining a relatively large number of questions, attention is given to important problems, particularly of a long-range nature, which are normally hidden by short-range, crisis-type questions facing Government and industry.

Reasons for Congressional Concern

1 What does competitiveness mean?

The term "competitiveness" does not have much meaning when it is taken out of context. One oversimplified meaning of competitiveness is how much of a product is sold by one producer relative to another; in this sense, market share becomes the dominant measure of competitiveness. There are, however, many ways to sell more of a product than a competitor does, especially if maximizing profit is not a goal.

If profits are a secondary consideration, then prices are not necessarily linked to costs. A steel company may be price competitive and, indeed, may have a price advantage over other firms in the same marketplace, rather than mere parity with them; but it still may not be cost competitive. Cost competitiveness is determined by many factors, only one of which is the production technology; other factors include management, labor, capital investment, financial structure, marketing strategies, strength of national currency, Federal regulatory costs, and ownership of physical resources and technology. In many complex ways these other factors are also linked to technology.

Technological competitiveness refers to the type of technology used, the extent to which new technologies have been adopted, and the resources and infrastructure related to the creation of new technology, such as R&D facilities, staff, and funding levels.

In addition to price competitiveness, cost competitiveness, and technological competitiveness, there are considerations of product quality, performance, dependability, consistency, and range. Technology plays a role in some of these factors, too, particularly in the sense that the technology used to make steels will, to some extent, determine the physical and chemical characteristics of the steels produced. Customer service, including technical services, financing, and deliverability, is also important.

Lastly, Federal Government policies can affect competitiveness, particularly in the international market. Direct and indirect Federal support to steel producers can easily offset any competitive disadvantage a company or industry may have (see Topic 30). Policies that have the effect of limiting increases in capacity also limit the opportunities for adopting new technology and achieving maximum technological competitiveness.

2 Is the U.S. steel industry homogeneous?

Three factors can cause confusion in an analysis of the U.S. steel industry:

- There are a great number of companies involved in ferrous materials that are best not considered as part of the domestic steel industry.
- The domestic steel industry is not homogeneous.
- Some companies usually treated as steelmaker have diversified out of steel and are continuing to do so.

Companies not considered part of the domestic steel industry in this analysis include: foundries, ferroalloy producers, steel distribution companies, steel fabricating companies, companies producing or processing raw materials only (e.g., coal, iron ore, scrap, coke); and the design, construction, consulting, and equipment companies that serve steelmaker. In this analysis, the U.S. steel industry includes only those firms that at one point in their production sequence make molten steel and subsequently sell mill forms and perhaps some primary products.

Because the industry is not homogeneous, OTA has found it useful for purposes of analysis to distinguish three major segments:

- integrated steelmaker,
- nonintegrated steelmaker, and
- alloy and specialty steelmaker.

The first group, integrated steelmaker, convert iron ore to molten iron in blast furnaces, with coke as the reducing agent, and then convert the molten iron to commodity carbon steels in either basic oxygen, electric arc, or open hearth furnaces. The second group, nonintegrated steelmaker, do not have ore conversion facilities; they depend mainly on ferrous scrap to feed electric arc furnaces, and produce a relatively small range of simple, low-price carbon steels. The third category, alloy/specialty steelmaker, use a variety of processes to make higher priced, higher performance steels than those produced in the other segments.

Some companies may have plants in more than one of these three categories, and this makes company classification difficult: some integrated companies are installing scrap-based electric furnaces, and both integrated and nonintegrated facilities may also make alloy or specialty steels, Nonintegrated companies may be able to install direct reduction (DR) facilities to convert iron ore into solid iron that is substitutable for and superior to some grades of ferrous scrap in electric furnaces (see Topic 16). A company taking this route could become integrated, whereas a company purchasing direct reduced iron (DRI) would remain nonintegrated.

It is also difficult to classify steel producers by size. The term “minimill” was originally coined to describe nonintegrated producers who made relatively small amounts of steel, on the order of 45,000 tonne/yr. Many of these companies have grown substantially and now produce in the same range as the smaller integrated companies (up to 1 million tonne/yr); these facilities are now sometimes called “midimills” or market mills.

Diversification of steel companies out of steelmaking has made analysis of some issues even more difficult, particularly analysis of financial performance and R&D activities. (See Topic 8.) How a steel company that produces its own raw materials, such as coal and iron ore, figures its steelmaking costs greatly affects its profitability. Its input costs may be based on market price, actual production cost, or something in between. For some companies, the profitability of their steelmaking business is actually much worse than available data indicate, because the profits from their nonsteel operations offset steel losses. For example, according to one analysis, U.S. Steel Corp., the Nation's largest steelmaker (with 21 percent of domestic shipments), actually lost over $15/tonne shipped in 1978, although the corporation as a whole showed a net profit on investment of 5.3 percent.

3 Are other engineering materials displacing steel?

Steel has been and remains the most important engineering material in American society. It plays a vital role in all primary manufacturing and construction and is a strategic material that is especially and increasingly critical for economic and military security.

Domestic consumption of steel continues to increase, though at a slower rate than during the early stages of industrialization. In real terms, however, the consumption of steel has declined: during the 1950's, 230 lb of steel were consumed annually per $1,000 of gross national product (GNP) (in constant 1971 dollars), 194 lb during the 1960's, and 176 lb for 1970-77. The consumption of aluminum and plastics per $1,000 of GNP increased substantially during the same period. In recent decades, the growth rate in steel consumption has been approximately 2 percent per year; in aluminum, 6 percent; and in plastics, 8 percent. Nevertheless, the per capita consumption of aluminum and plastics is only about 60 and 140 lb annually, respectively, compared to approximately 1,000 lb of steel.

Although the use and role of steel appear to be declining according to some measures, many analysts believe that there will be a surge in steel demand as the steel-using structures, such as bridges, buildings, railroads, and primary manufacturing facilities, built in the United States during the last 50 years wear out. Furthermore, in many applications, there are still no cost-competitive performance substitutes for steel.

One frequently mentioned case in which other materials are being substituted for steel is in automobile manufacture. The need to reduce vehicle weight in order to meet fuel-economy standards has driven manufacturers to substitute plastic and aluminum for steel, even though these substitutes may increase costs. Much of the steel in an automobile cannot be economically replaced or eliminated, however, and the use of steel alloys to make strong, lightweight components is limiting further substitution of nonferrous materials. If automobile sales grow enough to outweigh the reduction in steel per automobile, there might even be a small net increase in steel consumption. If foreign automobile companies continue to increase their U.S. manufacturing operations and use domestic steel, this too could increase the consumption of steel for automobiles. It is still likely, however, that the use of steel in the automobile market will be steady or decline.

To the extent that aluminum, plastics, and cement can be substituted for steels, the consumption growth rate differences among these materials may reflect price differences. During the past two decades the average price for steel increased by about 30 percent in constant 1971 dollars, while prices for cement and aluminum stayed about the same, and prices for plastics decreased by about 40 percent. However, prices vary greatly within each material category.

Steel's future price competitiveness with other materials may improve as a result of energy and raw material cost changes, which have much stronger adverse impacts on aluminum and plastics. Aluminum prices have already started to increase sharply and will continue to do so as electricity costs increase in the future. The aluminum industry also is very dependent on imported raw materials, although new technology and increased recycling may lessen this dependence. Prices of plastics are dependent on natural gas and petroleum prices. Here, too, technological changes may improve the situation. In contrast, cementmakers can switch from oil and gas fuels to coal, and new cement technology reduces energy use by nearly half. Steelmaking already depends primarily on domestic coal and can use domestic ore and scrap as raw materials.

4 To what extent has the U.S. steel industry lost its ability to compete in domestic and foreign markets?

On the basis of price, product quality, customer service, and dependability, all three segments of the domestic steel industry are still competitive for the vast majority of steels in most domestic markets (see Topic 2). European steelmaker have higher production costs than U.S. companies, and although some foreign producers, such as Japan and a few developing nations, may have lower production costs for some steels, these cost advantages are not great enough to offset transportation and other costs associated with exporting to many inland U.S. markets. But other nations sometimes sell steel below costs—and possibly below their domestic prices—suffering economic losses in order to achieve social goals such as maintaining employment levels. Domestic trade laws and policies have not, from the industry's perspective, successfully eliminated "dumped" or unfairly traded steels from the market.

U.S. technological disadvantage, while serious, is not yet overwhelming; most innovations are not so unique as to rule out competition from older processes or products. Thus, although the domestic steel industry has very low levels of adoption for a number of new technologies and a very high percentage of obsolete facilities, it does have market and product competitiveness at the present time. The industry could be on the brink of losing its competitiveness in domestic markets, however, because it has little proprietary technology, low adoption rates for existing technologies, and insufficient capital for an ambitious program of plant modernization, expansion, and construction. In contrast, some foreign steel industries have already modernized considerably and are still expanding, using the latest innovative technology. In a few cases, where foreign producers also have abundant resources of energy, raw materials, and relatively low-cost labor, they could soon achieve a cost and price advantage over American producers in some domestic markets. Currency exchange rates also play an important role; a declining dollar in world money markets somewhat reduces foreign cost and price competitiveness.

The domestic industry's future ability to compete in its home markets will depend on: 1) the degree to which old, obsolete facilities are closed, 2) the level of investment in modernizing remaining plants, and 3) the rate of construction of new facilities based on technologies innovative enough to offer net cost reductions. With present limits on capital for investment, these steps can be carried out only with a net reduction of domestic steelmaking capacity; the remaining capacity, however, will probably be cost competitive in the domestic market. The closing of obsolete facilities is most likely in the integrated segment of the industry; in the other two segments, continued modernization and expansion are far more likely.

Domestic steelmaker are not competitive in foreign markets, with the exception of some technology-intensive high-priced alloy and specialty steels. Domestic producers of most commodity carbon steels do not have sufficiently lower production costs to be competitive after adding transportation costs and other costs of marketing in a foreign nation. Domestic producers of the high-technology steels lack experience in exporting and face trade restrictions in many nations, as well as stiff competition from other nations whose industries are often less profit-motivated than U.S. companies. Many foreign steel industries are directly or indirectly supported by their governments, especially in export activities (see Topic 32). Currency exchange rate changes may also favor the competitiveness of some foreign industries, and the unpredictability of these changes tends to dissuade domestic firms from developing export business. Nevertheless, the recently completed Multilateral Trade Agreement could facilitate exports by domestic steel companies; much depends on how effectively this agreement can be implemented and enforced (see Topic 33).

5 How does the R&D effort of the U.S. steel industry compare to that of foreign industries?

There has been a steady decline in domestic industrial R&D in steel (see Topic 25). The current emphasis is on using existing technology to solve immediate problems in order to secure a fast payoff rather than creating new knowledge, new technology, and major new opportunities. In this respect the United States is more similar to the Japanese steel industry than to the West German, French, British, or Swedish. These European industries place great emphasis on new knowledge and major innovations. Japanese "innovation," on the other hand, is more an efficient (and often brilliant) application of technical knowledge to a particularly well-chosen problem, in order to obtain maximum economic benefits rather than a profoundly new scientific concept. But despite this conceptual similarity, the United States lacks Japan's closely integrated, symbiotic industry-government-university R&D infrastructure, and this may prevent its reaching the level of success the Japanese enjoy.

In the U.S. steel industry, R&D personnel usually do not have a major role in the strategic planning decisions of the firm, not even those regarding adoption of new technology (see Topics 24 and 26). The R&D function is not well integrated into the corporate structure: the emphasis is on new products, and R&D is more closely connected to sales and marketing than to production or corporate planning. Production problems may be worked on and solved by R&D, because production problems quickly manifest themselves in poor corporate performance; but the strong, continuous flow of creative ideas and useful information from production to R&D, which could stimulate innovative work, is lacking. This is in marked contrast to Japan and some developing nations, where there is a much closer relationship between production and R&D personnel. R&D programs have the prestige to attract capital and talent in Japan; except for a few companies in the United States, R&D is regarded as a service function, particularly technical service to customers, rather than a long-term investment for the future.

In European steel industries there is more mobility of technical personnel among firms, universities, and government facilities than in this country. Working on R&D is highly regarded in all of these sectors, and the very best scientific and technical personnel are attracted to R&D activities. The economic plight of these industries seems to intensify their use of R&D, rather than to diminish its importance as in the United States. Much of R&D effort in European universities and research institutes is government funded; in the United States, there has been a decline in academic steelmaking programs largely because of a lack of Government support. There are no national institutes for steel R&D, such as those in West Germany, in which companies join with university personnel in long-range R&D projects, including a great deal of basic research.

Consequences of Continuing Loss of Competitiveness

6 In future periods of strong world demand, what would be the consequences of contraction of the U.S. steel industry and increased imports of steel?

Contraction of the domestic steel industry can improve the profitability of individual companies. However, increased dependence on imports could, in periods of strong world demand, place the United States in a shortage and price situation similar to that stemming from the dependence on foreign oil. Many analysts contend that consumers benefit from low-priced imported steels and that imports should be allowed to increase. The attempt to hold down unfairly traded imports through the trigger-price mechanism has also had the effect of raising import prices.

The industry view is that, except in times of world oversupply, domestic steels are cheaper than most imports and that, in times of tight world supply, import prices are markedly higher than those permitted for domestic steels. This was the case during 1973-74, when import prices were as much as $110/tonne higher than domestic prices. The industry also notes that increasing dependence on imports reduces domestic employment, makes long-term investments in technology difficult, affects national security adversely, and contributes significantly to the trade deficit.

The cyclical nature of the domestic and world steel industries determines import prices. During the past several years, imports have risen to relatively high levels—about 18 percent of domestic consumption, not counting the steel in imported products such as automobiles. Domestic demand and capacity utilization have been relatively high, but world markets have been depressed, foreign capacity utilization has been low, and steel has been in oversupply. Thus, after the 1973-74 short-supply period, imports have been relatively cheap.

However, there is a distinct possibility that worldwide supply will tighten within the next 5 to 10 years. Even as demand steadily increases, many industrialized nations (including Japan, apparently) will be maximizing capacity utilization and profitability by closing obsolete facilities, reducing the number of products made, and designing modern capacity for largely domestic demands. Many steel industries, particularly in Europe, would like to avoid the large losses that have occurred in the past, when capacity was geared to exports and peak demand levels. The large increase in Third World steelmaking capacity will also turn traditional exporters toward their domestic markets. The result could be a very tight supply situation in the worldwide export market, with excess capacity to be found only in a few energy-rich less developed countries (LDCs). Even if steel imports should be available in such a period, their price would probably rise dramatically, both because of normal market forces and because steel from recently built plants (with high fixed financial costs) will cost more than steel from old plants.

7 Do the low profits of the domestic steel industry make it an unattractive investment?

The profitability of the steel industry, compared to other domestic manufacturing industries, is poor and getting worse. The average return on equity for the steel industry during the 1950's was 10.7 percent; during the 1960's, 7.8 percent; and during 1970-78, 7.6 percent, as compared to 11.3, 11.2, and 12.5 percent, respectively, for all manufacturing, Thus, the ratio of steel profitability to that of all manufacturing industries was 95, 70, and 61 percent for the above periods. Even though steel sales and profits are cyclical, the industry's better years do not offset its poor years.

Compared to those few foreign steel industries operated for profit, however, the U.S. industry is one of the most profitable. Comparisons with Japan are difficult to make because the Japanese industry is so highly debt financed, almost twice as much so as the U.S. steel industry, with banks having ownership in the form of loans so that return payments take the form of interest rather than dividends. Only the much smaller Canadian steel industry, with its much shorter depreciation schedule (2-1/2 years v. 12 years in the United States) is significantly and consistently more profitable than the U.S. steel industry.

When the industry is disaggregated into its three major segments, the financial data reveal that the nonintegrated and alloy/specialty producers have markedly higher profits than integrated companies. For example, in 1978 the average return on investment for 12 integrated companies (accounting for 63 percent of domestic shipments) was 6.2 percent; for 6 nonintegrated producers (accounting for 61 percent of their segment's shipments) the average was 12.3 percent; and for 9 of the major alloy/specialty companies the average was 11.1 percent. (For the last segment import quotas were in effect for several years.)

The financial data for the integrated companies are somewhat misleading because substantial nonsteel business is generally included. Without nonsteel profits, financial results for integrated companies would be substantially worse; indeed, for some companies steelmaking itself generally loses money. In contrast, the best performing of the nonintegrated and alloy/specialty companies have profitabilities considerably above the averages for their segment and are often considered growth companies. (For example, an outstanding nonintegrated producer has had an annual growth rate of close to 40 percent for earnings and production during the past 10 years.) These are precisely the companies that use the latest technology.

Most steel companies have increased their borrowing, although their debt limits may have been reached. The low-profitability companies are generally viewed as poor investment opportunities, but it can be argued that this is a consequence rather than a cause of their underinvestment in new technology, since investment capital is generally linked to perceptions of future success rather than past performance.

There is considerable evidence of continued financing of foreign steel industries by U.S. banks and financial institutions. However, it is not clear that, as some industry leaders have asserted, domestic steelmaker have been unable to secure comparable financing from the same sources. During the past 10 years, the debt-to-equity ratio for the entire steel industry rose from 36.5 to 44 percent, indicating that financing has been available. In this same period, stock dividends remained relatively stable and high, totaling $5.3 billion as compared to $4.1 billion for interest and charges on long-term debt.

Foreign investments in and purchases of domestic steel companies have been increasing as a result of undervalued stocks, a weak dollar, decreasing domestic competition and capacity, increasing domestic demand, relatively abundant domestic resources. and highly efficient labor. This trend toward increased foreign participation in U.S. steel companies is likely to accelerate, particularly for nonintegrated companies with good profitability.

8 What will be the impact of continued diversification into nonsteel operations by domestic steel companies?

There is some controversy about the impact of diversification on steelmaking capacity and investment in new technology. On the one hand, industry maintains that nonsteel profits help finance steelmaking. On the other hand, critics outside the industry contend that diversification siphons off investment capital needed for new technology and contributes significantly to the decline of domestic steelmaking capability.

For the past 2 years, domestic capacity has declined by at least 1.8 million tonnes, or 1.5 percent of raw steel capacity, per year. It appears likely that this rate of decline will continue for the next several years as unprofitable plants continue to close. The actions of the Nation's two largest steelmaker, U.S. Steel Corp. and Bethlehem Steel Corp., accounted for much of this capacity reduction. During the past 3 years, U.S. Steel's nonsteel assets grew by 80 percent, to $4.7 billion, while steel assets increased only 13 percent, to $5.9 billion, and capacity actually decreased. Although Bethlehem Steel has not undertaken major diversification, it has reduced its steelmaking capacity by closing obsolete facilities to improve its profitability. U.S. Steel is apparently now doing the same,

Diversification out of steel is likely to continue. This contributes to declining, but more modern and competitive, domestic steelmaking capacity. The net result, however, is likely to be a further increase in imports. The nonintegrated producers (whose profits are healthy) may continue to expand, but they are too small to reverse the decline in overall capacity.

Industry argues that, without diversification into profitable nonsteel activities, more plants and perhaps whole integrated companies would simply shut down. In this case, the demise of the Nation's steel industry would be much faster and more dramatic than if present slow shrinkage continues, and the social dislocations would likely be severe enough to require substantial Government intervention.

9 Does the domestic steel industry have the capability to innovate, or has it become dependent on buying proven foreign technologies?

Innovation requires new knowledge, inventions, capital, highly competent and creative people, risk-taking, determination, and excellent insights into existing and potential markets. The steel industry knows enough about domestic markets and its own process needs to utilize market-pull insights, but it does not appear to have sufficient profitability to support a level of capital formation that would create an R&D base strong enough for future innovation. Considering the low levels of basic research and R&D in the industry itself, as well as in universities and Government laboratories, it is doubtful whether the domestic industry now has the capability to create major process or product innovations (see Topics 5 and 25). However, it undoubtedly has a significant capability to create incremental innovations.

Because the industry lacks adequate capital for high-cost innovation, it leans towards purchasing patent rights, technology, and know-how from foreign steel companies, from foreign research, consulting, and technology transfer companies, and from domestic design, consulting, construction, and equipment companies. Often, these latter domestic companies are acting as agents for foreign-owned technology. Foreign technology, if adopted at a sufficiently rapid rate, can provide competitive parity, but not competitive advantage.

Paradoxically, during the past few years, when the U.S. steel industry has been more profitable than almost all foreign steel industries, foreign R&D and innovation have accelerated. There has been a steady stream of foreign inventions and innovations that are likely to place foreign industries at a distinct advantage and to exacerbate American dependence on foreign technology. Developing nations have produced impressive numbers of innovations that place great emphasis on suiting their fast-growing industries to the efficient use of local resources and conditions. Some developing nations are pursuing strategies of exporting their production rather than merely using this production at home and reducing imports. These countries also export technology to industrialized and less developed nations.

Factors Affecting Competitiveness

10 What factors are most important in determining total production costs, both domestically and abroad?

Unusually large cost increases for raw materials were responsible for most of the 133-percent increase in domestic steel production costs during the 1970's, Although hourly employment costs are higher than the all-manufacturing average and recent increases have been considerable, the relative significance of unit labor costs is declining as a result of skyrocketing raw material costs, particularly for energy. During the past decade, raw materials (including energy) were responsible for almost 60 percent of the total costs of producing a tonne of steel in the United States; labor, for slightly more than 30 percent; and financial costs, for about 9 percent.

Although financial expenditures are generally a small fraction of production costs, they have important indirect effects on the productivity of equipment, labor, and energy. In turn, improved factor productivity plays an important role in determining total production costs. Thus, the indirect impact of financial costs on total costs is much greater than their share of total production costs would indicate, because increased capital expenditures decrease the per-unit costs of other inputs. American steelmaker have also benefited from high operating rates and a declining dollar over the last decade (see Topic 13).

Foreign steel industries have a roughly similar breakdown of production costs. During the early 1970's, both materials and financial costs abroad were a somewhat larger share, and employment costs a smaller share, of total production costs than in the United States. During the past decade, however, despite major increases in raw material costs, particularly for energy, all major producing countries except the United States have slightly reduced the proportion of raw material costs in total costs. Only in the United States have materials and energy costs increased at a much faster rate than either employment or financial costs. This is probably a consequence of lower domestic energy prices (which are only now reaching international levels), smaller energy conservation improvements than in some other countries, and greater foreign financial costs.

Major European and Japanese steelmaker, since at least the late 1960's, have made larger capital investments than U.S. producers relative to their total steelmaking costs. In Europe, financial costs hovered between 13 and 17 percent of total production costs during most of the decade. Japan, already burdened with a financial cost component of 20 percent, was the only major producing country in which financial costs increased faster than either employment or raw material costs.

Many of these differences result from the high debt-to-equity ratios of foreign industries and the higher value of new assets requiring financing. This is particularly true of the Japanese steel industry, whose accelerated investment has resulted in the construction of larger plants with optimum layout and process control and, consequently, higher productivity of raw materials, energy, and labor. The fact that Japanese producers continue to have lower production costs, despite currency changes favoring U.S. producers, can be explained largely by their investment strategies.

The average 1978 cost of Japanese steel (f.o.b. Japan) was about $385/tonne (materials, labor, capital costs) —some 10 to 20 percent below U.S. production costs. But the additional costs for exporting the steel—including transportation, warehousing, sales, and marketing— must be added to production costs. These costs are substantial, and transportation costs in particular are steadily increasing, These export costs may offset any advantage in production costs, as is usually the case for Japanese steel exports to the United States, especially for inland locations.

During the next several years, total production costs (in dollars) for the major producing countries are expected to draw closer, with an approximate 15-percent margin between the highest (France) and lowest costs (Japan). In local currencies, Japanese and West German total production costs have increased at a much slower rate than U.S. costs. Japan is expected to retain its present leadership in total production costs, and West Germany and Japan are expected to continue as leaders in the more efficient use of raw materials, with cost increases at only about half the U.S. rate. Furthermore, materials costs in these countries are expected to remain a smaller proportion of total costs than in the United States.

With respect to near-term capital investments, Japan is expected to continue its current strategy of slowing down its plant construction program, while continuing to introduce more energy-saving equipment. Depending on actual operating rates, Japanese financial expenditures will decrease or only marginally increase during the next few years. Relative to their current production costs, the French and British steel industries are expected to be the major benefactors of restructuring and modernization among major steel-producing nations. Nevertheless, these countries will likely remain noncompetitive.

11 What are the impacts of environmental regulations on the competitiveness of the U.S. steel industry?

Compared to other basic industries, steel is faced with a major environmental cost burden. This may be attributed in part to the fact that most steelmaking processes were developed (and most facilities constructed) during a time when environmental considerations were an insignificant factor in equipment design. There has been little recent construction, which might allow the incorporation of environmental technology, and the industry has been forced to follow the less efficient retrofit approach.

The steel industry has reported environmental equipment expenditures from 1969 to 1978 averaging $280 million per year, or about 13 percent of annual capital investments. Future regulatory investments will increase to between $550 million and $800 million annually, according to Federal and industry estimates respectively. In addition, the industry will incur substantial costs in operating and maintaining environmental control equipment, particularly for increased energy use. Steelmaker have estimated that future environmental costs will be about 20 percent of the industry's total capital investments per year.

Industry claims that regulatory costs have contributed to low profitability and capital formation, particularly because the regulations apply to the large number of old plants, not just new ones. This claim cannot be disregarded, but neither can the important benefits of health and environmental regulations for steelworkers and society as a whole. New plants benefit from optimal control technologies and lower compliance costs, but the U.S. industry is not likely in the foreseeable future to build completely new integrated plants like those in Japan and the LDCs. To some extent, compliance with environmental regulations can even be used by management to justify reduced investments. The Environmental Protection Agency (EPA) stresses compliance, while the industry is concerned about modernization. Both are worthy social goals, and it may be possible to reconcile them through innovative technology that is environmentally cleaner than existing processes.

U.S. regulatory costs are expected to increase over the next several years because firms are still in an earlier stage of compliance; Japanese steelmaker, whose pollution abatement investments have until recently been higher than U.S. levels, are beginning to enjoy an opposite trend. If other major steel-producing countries should in the future face similar levels of environmental costs, the financing of environmental expenditures could become an important factor affecting international competition. In the United States, environmental costs are borne directly by producers and indirectly by consumers only to the extent that Government and the marketplace permit these costs to be passed on in the form of higher steel prices. Industry claims that Government has not permitted enough of the costs to be passed on, and to the extent that Government has limited price increases and allowed the entry of unfairly traded imports, industry's claim is justified. Steel producers in other major industrialized nations generally do not need to rely on the market mechanism to distribute their environmental costs, because those industries often are government owned or financed. Direct or indirect government support programs help them finance environmental expenditures, perform environmental R&D, or gain more favorable tax laws.

As steelmaker from developing nations, such as Venezuela, Mexico, Brazil, and South Korea, increase their share of the international market, these producers will join those in the European Economic Community (EEC) in having an international trade advantage over the United States in the form of lower environmental costs or greater government assistance to meet compliance costs. In a world industry in which profits are low or absent, environmental costs can be significant even though they may amount to only a small percentage of total costs.

12 What are the potential impacts of OSHA regulations on the steel industry?

The Occupation Safety and Health Administration (OSHA) was established by Congress in 1970, but thus far OSHA regulatory costs have been rather limited. They are the steel industry's greatest regulatory uncertainty: the costs to industry of OSHA regulations are not well understood, and information on future costs is speculative. As enforcement activities gain momentum and regulatory costs increase during the next several years, more detailed reporting systems and analyses will probably be developed.

The industry reported OSHA-related expenditures of about $4 I million for 1977, Expenditures in 1978 and 1979 are estimated to have totaled about $80 million, When judicial challenges are settled, and the Agency begins actively enforcing major regulations affecting the steel industry, these expenditures may increase considerably. In a number of cases, however, environmental and occupational regulations overlap, so that combined regulatory costs will be less than those for EPA and OSHA evaluated separately and summed. Cokemaking will remain the industry's main occupational health hazard for the foreseeable future. Thus, integrated producers, especially the older and smaller ones, will be affected more severely than others in the near future. However, anticipated revisions in noise and metallics standards could have a substantial impact on all industry segments.

OSHA has little specific statutory guidance on questions of technological or economic feasibility. It can require the transfer of promising abatement technologies between industries, but it cannot require major private-sector R&D to develop such technologies. Its standards may not be "prohibitively expensive" or disrupt a whole industry, but OSHA is not required to consider the impact of its regulations on the profit margins or viability of individual companies. Under these circumstances, the industrial sector has developed a strong interest in cost-benefit analysis. Although the industry is able to provide cost data, the Government and labor interests have had difficulty providing a dollar figure for safety and health benefits. A Supreme Court ruling is expected soon on this controversial subject.

Another problem is how the costs of OSHA regulations should be distributed. To the extent possible, the industry passes these costs on in the form of higher prices. However, industry claims that Government policy restricts price increases.

There is inadequate information on the effect of OSHA's regulations on international competitiveness. On the whole, producers in other industrialized nations are also faced with increasingly stringent regulations, but they generally enjoy government assistance or tax privileges in financing health and safety expenditures. Thus, for comparable requirements, U.S. steelmaker are typically at a competitive disadvantage. At least for the time being, producers in developing countries have the greatest advantage because they have the fewest occupational health and safety requirements.

13 What is the impact of domestic labor productivity on international cost competitiveness?

There is considerable disagreement on international comparisons of labor productivity. However, most sources suggest that the U.S. steel industry no longer leads its international rivals in labor productivity as measured by man-hour requirements per tonne of steel. Japan has overtaken the United States as the world's leader in labor productivity because of differences in labor/management relationships and because of Japan's greater investment in new technology.

Since at least the early 1960's, the U.S. steel industry has had a lower labor productivity growth rate than the average either for other U.S. manufacturing industries or for foreign steel industries. Nevertheless, actual domestic labor productivity levels remained competitive with international rivals until the mid-1970's. Japanese steel labor productivity probably exceeded that of the United States for the first time in about 1975.

Looking into the mid-1980's, it is expected that labor productivity growth rates will be the highest in Europe, followed by the United States and Japan. Even assuming a continuing phaseout of older U.S. plants, Japan is likely to maintain its lead in labor productivity. Between now and the mid-1980's, Japanese man-hour requirements are expected to be reduced by 3 percent per year; by then they will be only 90 percent of U.S. requirements. Of the major European countries, only West Germany is in a position to approach overall U.S. labor productivity levels by the mid-1980's.

Because labor productivity is closely related to the capability of the equipment being used, it is a good measure of the technological competitiveness of the domestic steel industry. What matters even more on the international market, however, is the interaction between labor productivity, hourly employment costs, and currency values. These factors, taken together, determine unit (per tonne) labor costs,

From 1969 to 1978, the declining value of the dollar has had a major offsetting impact on high hourly employment costs, and U.S. steelmaker experienced small improvements in unit labor costs compared to other steel-producing countries. U.S. labor productivity improved modestly compared to its major competitors, but foreign hourly employment costs (in dollars) rose 1-1/2 to 3 times faster than in the United States. As a result, U.S. unit labor costs moved from highest to second lowest, and they are currently only about 25 percent higher than Japan's, which remained the world's lowest during the entire period.

The United States generally has enjoyed more favorable capacity utilization rates than its competitors during recent years. During the past 7 years, U.S. operating rates have been very high—more than 85 percent —while EEC and Japanese rates averaged slightly more than 70 percent. High operating rates increase equipment and labor efficiency and reduce unit labor costs.

The United States is not expected to maintain its favorable international position with respect to unit labor costs into the mid-1980's. Assuming the European steel industry reduces capacity and narrows its product lines, West Germany and perhaps England are expected to reduce their cost below the United States; Japan is expected to continue its clear lead until well into the mid-1980's.

Depending on actual operating rates, U.S. near-term productivity growth rates will continue to be no more than half of Japanese and West German growth rates. Furthermore, some foreign currencies are expected to increase in value relative to the dollar at a much lower rate than during the past decade; if so, international monetary changes would favor U.S. steel producers less than they have previously.

New Technologies for U.S. Steel making

14 Can new technology help solve major industry problems of competitiveness, capacity, and capital?

Long-range planning for and expedient adoption of a variety of new steel technologies could effectively reduce production costs, thereby improving competitiveness and slowing the rate of decline in domestic steelmaking capacity. The new technologies also might have lower capital requirements than more conventional technology for similar levels of capacity replacement or expansion.

There is particular need to recognize the self-fulfilling aspect of the description of steel as a "mature" industry (see Topic 24). The industry must recognize that the economic, social, and political world in which it operates is changing and that technology must be used to cope with externalities as well as to produce steel. There are substantial opportunities for change and innovation. New technologies, some already commercially available and others with significant likelihood of successful development and demonstration, could potentially reduce energy consumption, improve yield, reduce use of coke, improve labor productivity, reduce capital costs, allow greater use of domestic ferrous scrap and low-grade coals, permit faster construction of new plants, and offer greater flexibility for importing certain raw materials and semifinished steels rather than finished steel products.

15 What is the most important technological change for domestic steelmaking during the next decade?

Two major changes in steelmaking have developed since World War II. Basic oxygen steelmaking has already been widely adopted by the integrated segment; continuous casting has not, even though it is a well-proven and accepted technology.

Simply put, continuous casting replaces with one operation the several steps of ingot casting, mold stripping, heating of ingots in soaking pits, and primary rolling of ingots into various shapes. The basic concept in continuous casting is the use of an open-ended mold to cast an indefinite length of the desired cross section. The molten steel solidifies from the outer cooled surfaces inward during the casting process, and the semifinished slab, bloom, or billet that emerges can be cut into desired lengths.

The main benefits of continuous casting over ingot casting are:

- It saves a considerable amount of energy directly by eliminating energy-intensive steps and indirectly by reducing scrap and thereby increasing yield; the sum of direct and indirect energy savings is approximately 3.3 million Btu/tonne cast, or almost 10 percent of total steelmaking energy consumption.

- It increases process yield, in that more finished steel is produced from the same amount of liquid steel, thereby reducing all unit costs.
- It improves labor productivity by eliminating a number of steps, increasing yield, improving worker conditions, and sharply reducing production time.
- It produces a better quality of steel because it requires fewer production steps and allows greater automatic control of the process.
- It reduces pollution by eliminating soaking pits and reheating furnaces, reducing primary energy requirements, reducing exposure of hot steel to atmosphere, and requiring less primary ironmaking and cokemaking because of the increase in yield.
- It reduces capital costs compared to ingot casting and, considering the overall yield and economic advantages, compared to other means of increasing steelmaking capacity.
- It increases the use of purchased scrap (where iron output is constant and steel output increases) to replace the scrap lost because of improved yield (see Topic 21).

These advantages are not being fully captured by the domestic steel industry, because it has fallen behind almost all other steel industries in the adoption of continuous casting. For example, in 1978, Japan continuously cast 50 percent of its steel, the European Community 29 percent, but the United States only 15 percent. Although U.S. adoption is increasing, so is that of foreign industries.

Nonintegrated facilities, by and large constructed quite recently, continuously cast at least 52 percent of their raw output in 1978, but they produce less than 10 percent of domestic raw steel. For the integrated companies who produce approximately 87 percent of raw tonnage, the lag in adoption of continuous casting is even worse than the published figures indicate.

The reasons for the low domestic adoption rate of continuous casting include the following:

- The industry has inadequate discretionary capital with which to replace existing, and perhaps not fully depreciated, ingot casting facilities.
- Substantially modifying an operating plant is difficult and costly.
- Additional capital costs would be incurred in constructing downstream facilities to process the increased semifinished steel production.
- There are technical problems with some types of steels and perhaps with small production runs.
- There are difficulties in expediting EPA permits and compliance costs linked to the granting of such permits.
- Uncertainties exist about the extent to which future steel imports will capture domestic markets.

Nevertheless, the overall economic benefits of continuous casting justify greater adoption. A key question is how much continuous casting could and should be adopted by the American steel industry, and in what time frame. OTA finds that, to achieve increased technological competitiveness at a minimum cost, 50-percent continuous casting is needed for the whole industry by 1990. Technically, this goal appears to be feasible; but even though returns on investments in this technology could be approximately 20 percent or greater, there is probably insufficient capital now and in the foreseeable future (given present price levels, import levels, and Federal policies) for this large an increase in the use of continuous casting.

16 What other major new technologies could aid the domestic industry during the next 10 to 20 years?

During the 1990's, several radical changes in steelmaking could occur:

- direct casting of sheet and strip from molten steel, which would save considerable energy, time, and labor;

- direct, one-step steelmaking (from ore to molten steel), which might reduce all costs;
- plasma arc steelmaking, which may offer a low-cost alternative to the blast furnace, particularly suitable for making alloy steels and for use by small plants; and
- formcoking, which offers the possibility of an environmentally clean way to make coke from low-grade coals, while still producing valuable byproducts (see Topic 20).

But the technological development with the greatest advantages and best possibility of limited commercial adoption within 5 to 15 years is coal-based DR of iron. DR refers to a number of processes that are alternatives to blast furnaces for converting ore to iron. DR processes typically involve lower temperatures than do blast furnaces and use solid-state ore conversion. Natural gas is the simplest reductant to use, but low-grade coals (which the United States has in abundance) can be used directly as the reductant, as can the products of coal gasification. The capital costs of DR plants would be relatively low, and by replacing both blast furnaces and coke ovens DR could revitalize integrated plants. DR might have a greater impact on nonintegrated steelmaking than continuous casting, particularly if small units become commercialized, if merchant DR plants are constructed, or if imported DRI becomes readily available.

There are several ways in which the Nation could benefit from greater use of DR:

- DR might be used by integrated steelmaker in conjunction with coal gasification plants to create new ironmaking capacity at competitive cost.
- DRI can be used as a substitute or complement for scrap and could have a moderating effect on scrap prices as demand rises and less usable scrap is generated.
- DRI also can be used as a substitute for ore in blast furnaces to improve their productivity and thus reduce the amount of coke required to fuel them; greater use of DR would reduce our growing dependence on imported coke and would reduce pollution from coke burning, the greatest source of dangerous pollution in steelmaking; DR might also be based on available coke oven gas, with a net economic advantage.
- DR can be used with other technological developments that are on the horizon, including nuclear steelmaking, which the Japanese are developing for the year 2000, and magnetohydrodynamic steelmaking, expected in the 21st century.

Yet, there has been little domestic investment in DR, largely because: 1) integrated companies are committed to blast furnaces and coking, which uses company-owned metallurgical coke, 2) relatively low-cost scrap is readily available, 3) future steel import levels are uncertain, and 4) R&D capital is limited. Some domestic companies have studied DR technology and have attempted to develop gas-based processes, but thus far the results have not compared with those of improving blast furnace efficiency.

Gas-based DR is undergoing rapid expansion in nations with abundant natural gas; several such plants exist in Canada and Mexico. Several coal-based DR processes have been used for a number of years on a relatively small scale, particularly in South Africa and Brazil, with varying levels of success. A number of foreign firms, especially in Sweden, are aggressively developing new processes based on coal, some of which promise energy savings. A very attractive American coal-based DR process—the Calderon Ferrocal process—is now ready for demonstration.

DRI is likely to become a world-traded commodity in the years ahead, especially by nations like Venezuela and Mexico that have large supplies of natural gas, If the U.S. steel industry does not build domestic DR facilities, it may find itself importing DRI in great quantities as nonintegrated mills expand and scrap becomes more expensive. With DR facilities and huge reserves of coal, the United States could satisfy its own steelmaking needs and perhaps export coal-based DR technology; instead of exporting scrap, it might export DRI.

17 What incremental or evolutionary technological changes will be significant for the next several decades?

Literally hundreds of incremental technological changes are likely during the next several decades, including the creation of new steels. The following are most significant on the basis of likelihood of successful development, economic benefits, energy savings, and large-scale applicability to most of the domestic steel industry:

- External desulfurization, which removes sulfur from molten pig iron rather than having it removed in the blast furnace, could be used very widely. This process can use high-sulfur coal and thereby reduce coke use.
- High-temperature sensors would allow better control of crucial variables during the finishing stages, and thus offer improved quality control, increased yield, energy savings, and improved labor productivity y.
- Energy recovery techniques are possible—for example, the use of blast furnace top-gas pressure to generate electricity, the use of steelmaking furnace gases, and the recovery of waste heat from furnaces.
- Continuous (direct/inline) rolling could avoid intermediate cooling and reheating of ingots, slabs, or billets by rolling or forming continuously cast products without any break in the processing sequence.
- Self-reducing pellets, which are a combination of finely divided iron oxide from ores or wastes, carbonaceous material, and fluxes, can be used in blast furnaces or in DR furnaces to obtain iron in relatively short times.
- Computer process control (automation) can improve process efficiency and product quality.

Impacts of New Technologies on the U.S. Steel Industry

18 How **would technological changes affect the restructuring of the domestic steel industry?**

Industry restructuring refers to shifts in methods of production, nature of products, size of firms, rate of technological change, raw materials used, or types of markets served. A significant restructuring of all three segments of the industry—integrated, nonintegrated, and alloy/specialty producers—is already in progress. Technological changes are playing an important role in this restructuring, which is best understood as a change in the relative importance of each segment and a trend toward decentralization of the industry. Restructuring is also shaping technological needs.

The dominance of integrated plants is declining. This results from increasing advantages of plants of the other two types and from structural changes in the integrated firms themselves. These changes include: 1) shifts in the raw material used, primarily from original domestic sources of iron ores to the lower grade taconite ores and to imported ore; 2) shifts in markets from the Northeast and North Central States to those in the South and West; 3) increasing concerns over heavily concentrated sources of pollution; 4) greater oscillations in market demand; 5) a gradual physical deterioration of old plants and inadequate capital to construct new plants; and 6) significant changes in the technology of steelmaking, which require a fundamentally new plant layout to achieve maximum efficiency.

The steadily increasing growth of nonintegrated firms is difficult to quantify precisely because accurate and comprehensive data distinguishing nonintegrated from integrated producers are not collected by Federal agencies or trade associations. However, during the past decade this industry segment has roughly tripled its output. In 1978 the nonintegrated producers accounted for approximately 10 percent of raw steel tonnage and 13 percent of all domestic shipments; their dollar share is smaller because their plants produce lower price steels.

Factors promoting growth of the nonintegrated segment include: 1) markedly lower capital costs per tonne of annual capacity and much shorter construction times than integrated plants; 2) the availability of relatively low-cost, local ferrous scrap; 3) increasing numbers of large local markets; 4) rising transportation costs, which improve competitiveness of local suppliers using local resources; 5) relatively low-cost electricity (in comparison to integrated steelmaking fuels) and low energy consumption; 6) highly efficient, and improving, process technology consisting primarily of electric arc furnaces and continuous casters; 7) use of nonunion labor in less industrialized regions; 8) high labor productivity; 9) less import competition among the lower value steels; 10) fewer environmental problems and lower control costs; 11) an advantage over integrated producers in times of slack steel demand because the cost of scrap declines, whereas the cost of iron ore does not; and 12) relatively low entry costs,

The future growth of the nonintegrated segment will depend on shifting their production to more complex and higher priced steels, including perhaps alloy and specialty steels. This trend is already beginning, but it would be accelerated by introducing DR facilities in nonintegrated plants; by increasing the number of merchant DR plants, which serve many steelmaker; or by importing DRI. The use of a combination of DRI and scrap would have technical and economic benefits that would promote the expansion of nonintegrated firms. The next most important technological development would be the introduction of small rolling mills for sheet and strip suitable for nonintegrated plants, which do not now make flat steel products. This is beginning. Even in the absence of flat product manufacture, nonintegrated firms could greatly increase their production, perhaps by 100 percent in the next 10 years, but cost and availability of scrap and electricity will be important determinants. Very low R&D levels may inhibit future growth and cost competitiveness.

The alloy/specialty segment is increasing largely because of the ever-increasing use of such steels for demanding applications. During the past 10 years, shipments of alloy steels increased from 9.4 to 12 percent of all domestic shipments. Technologically, the firms in this segment are advanced, innovative, responsive to market demands, and competitive with any foreign industry. Apparently, they used several years of import quotas effectively to improve their competitiveness. They tend to be the lowest cost producers for the domestic market and for many foreign markets as well. Specific new technologies that offer promise for these companies are: powder rolling for the direct production of sheet and strip from alloy powders, plasma arc melting furnaces for improved melting and alloying efficiencies, and greater use than at present of recycled high-alloy-content waste materials. It is noteworthy that some integrated companies have shifted toward producing more alloy and specialty steels.

The alloy/specialty segment might also be able to export more of its products, although there is some uncertainty about the future. Quotas on imports of steels in this segment are being removed; foreign producers would like to export these higher priced, higher profit products, and significant excess foreign capacity exists for producing some of these steels. Domestic companies are concerned that the Government vigorously enforce the new Multilateral Trade Agreement to support exports and prevent the entry of unfairly traded imports (see Topic 33).

19 How will future technological changes affect the amount and type of energy used by the domestic steel industry?

The steel industry is the single largest industrial user of energy in the Nation, accounting for close to 5 percent of total consumption. Just over 60 percent of the energy used in steelmaking derives from metallurgical coal, approximately 20 percent comes from natural gas, somewhat more than 5 percent is from oil, and about 5 percent is purchased electricity. The steel industry is the second largest user of electricity after the aluminum industry.

In 1978, integrated plants used an average of 35 million Btu/tonne of shipped products, whereas nonintegrated plants making carbon steels used an average of 10 million Btu/tonne shipped. It must be noted, however, that nonintegrated plants do not reduce iron ore to iron and generally make simpler products which require less processing than others. A goal established pursuant to the Energy Policy and Conservation Act is to reduce the steel industry's energy use by 9 percent by 1980. The industry indicates that it will meet that target. Even without that motivation, the industry has a financial incentive to reduce energy use. Ten years ago, energy accounted for about 10 percent of steelmaking costs; today, it is more than 20 percent.

A great many technological changes are helping the industry to reduce energy consumption. The most significant is the increasing use of continuous casting, which can lead to almost a 10-percent reduction in energy use for integrated plants. The second most important change is the ever-increasing use of scrap-based electric furnaces, which, because they do not require the production of new iron units from ore, use considerably less energy than integrated production. The shift to more continuous casting reduces coal, fuel oil, and natural gas consumption; and although the shift to electric furnaces increases the industry's use of purchased electricity, it reduces total energy use.

One of the factors pushing the industry to more electric furnace use is the substantial increase in the cost of constructing new coking facilities; these are largely environmental compliance costs. Replacement of old coking facilities has lagged so much that a considerable amount of coke is being imported (see Topic 20).

The increasing costs of coking and of metallurgical coals have also made the potential use of DR (which uses the cheaper, lower grade steam coals) increasingly attractive. Critics of DR point out that the process offers no apparent energy savings, but large-scale coal-based DR technology is only in its infancy and further experience could lead to energy savings. Moreover, numerous innovations are taking place in this technology, some of which should lead to significant improvements in energy efficiency. Developments in coal gasification and synfuels could also promote DR; Brazil and West Germany are investing in development of coal-gasification-based DR.

Many other incremental and major technological changes during the next several decades should do much to reduce steel industry energy consumption. Greater adoption of available new technologies could reduce energy consumption by one-third. The continued closing of old, obsolete, and energy-inefficient plants will perhaps have an even more significant effect on the industry's energy consumption.

The degree to which improved technology and energy conservation measures can reduce energy consumption is illustrated by the remarkably low energy use of the Japanese steel industry. In 1976, Japan used 70 percent as much energy as the United States on a per-tonne-shipped basis, and West Germany 85 percent as much. The Japanese attribute much of their energy savings to continuous casting and concerted energy conservation efforts.

20 To what extent can technological changes reduce increasing U.S. reliance on foreign coke?

In 1972, the United States imported 168,000 tonnes of coke, mostly from Canada; in 1978, 5,190,000 tonnes were imported, 70 percent of which came from West Germany. Coke imports contributed nearly $500 million to the U.S. balance-of-trade deficit in 1978, and this amount increases as imported coke prices rise. Moreover, when coke is imported, there is a loss of increasingly valuable cokemaking byproducts, such as coke oven gas, tars, and distillates, which the steel industry uses itself or sells. Domestic cokemaking capacity decreased from 55.9 million tonnes in 1974 to 47.6 million tonnes in 1978. Associated with this decrease has been a loss of 5,000 jobs in the steel industry and 9,500 jobs in the coal industry. Forecasts indicate a further loss of 4.8 million tonnes of coke capacity by the end of 1985, with a possible domestic shortfall of 7.3 million to 10.9 million tomes. Other analyses, however, predict no shortage of domestic cokemaking capacity in the near future,

The industry's explanations for decreasing domestic cokemaking capability include: 1) a large fraction of domestic cokemaking facilities are very old and reaching the end of their useful lives, 2) the cost of a new coke plant has increased 150 percent in the last 10 years and 40 percent in the last 5 years, 3) from 22 to 30 percent of the plant costs are for unproductive regulatory compliance, 4) many old plants cannot be cleaned up at reasonable costs, 5) enforcement of EPA regulations has reduced plant capacities and efficiencies, 6) there are limitations on sites for new plants, 7) capital is scarce and uncertainty exists about long-range opportunities to meet domestic demand, and 8) there is uncertainty about future regulatory requirements and their impacts on technology choices.

In addition, relatively cheap foreign coke has been available on the world market because most foreign steel industries, particularly those in Europe, have been in a depressed state. But as foreign steel industries reach higher levels of capacity utilization, domestic producers fear that coke will become less available and much more costly. If coke is not available from foreign sources in sufficient quantity, steel imports might have to increase instead.

Other than importing more coke and steel, or constructing more conventional coke facilities, the ways in which coke shortages can be alleviated include: 1) increasing the use of scrap-based electric furnace steelmaking to the extent that scrap is available; 2) introducing coal-based DR to supplant blast furnace technology based on coke; 3) modifying blast furnace processes to reduce the amount of coke used; and 4) promoting the use of cheaper nonmetallurgical grade coals, including high-sulfur coals, by adopting new, environmentally cleaner formcoking technology.

Formcoking is the generic name given to a number of processes, as yet unproven on a large scale, to convert low-grade coals into coke. It is possible that these processes may offer economic benefits to domestic steelmaker, and environmental advantages for some formcoke processes are possible. Large sums will be required for demonstration plants, however, and it will be a considerable time before results are sufficient to affect domestic cokemaking.

21 **How** will technological changes affect the cost and availability of ferrous scrap?

There are four technological developments that will affect the demand for and availability of ferrous scrap: 1) an increase in the use of electric arc furnaces by integrated and nonintegrated steelmaker; 2) the introduction of DRI, which can substitute for scrap; 3) greater use of continuous casting and other process changes that will allow more use of purchased scrap; and 4) continuing increases in the use of alloy steels and nonferrous materials in automobiles and certain improvements in domestic manufacturing, both of which may reduce the supply of readily available and easily processed scrap.

Technological changes within integrated steelmaking will increase the demand for ferrous scrap. The two most important changes are: 1) the increased use of continuous casting, which reduces inplant scrap generation and makes it necessary to use more purchased scrap to supply steelmaking furnaces, and 2) changes in basic oxygen steelmaking furnaces that allow them to use more ferrous scrap, at perhaps a 40- to 50-percent level rather than the present 30 percent, but also increase energy consumption.

Electric arc furnace processes use significant amounts of scrap, and the use of electric furnaces by integrated and nonintegrated steelmaker is increasing at a rapid rate. During the past 10 years the amount of domestic carbon steel made in electric furnaces has nearly doubled, and the trend is similar around the world. This has offset the decline in scrap use that resulted from open hearth furnace shutdowns. Many steel analysts believe that one-half of the domestic capacity installed during the coming decade will use electric furnaces, assuming that adequate electricity is available. Electric furnace steelmaking is certainly not a new technology, but for several reasons its benefits are more significant today than ever before. These reasons include: 1) a relatively low cost for ferrous scrap during the past several decades, although users have found it difficult to cope with the large gyrations in scrap prices; 2) a relatively low energy requirement, because scrap embodies energy (nearly as much energy is used to convert iron ore to iron as to make steel from iron); 3) a high labor productivity, which has improved more for electric furnace steelmaking than for any other process of the steel industry—nearly 50 percent during the past decade, compared to 13 percent for blast furnaces and 26 percent for other types of steelmaking furnaces; 4) minimal pollution problems; 5) very low capital costs; and 6) relatively short construction times.

Because the competitiveness of electric furnace steelmaking depends on the cost and availability of ferrous scrap, domestic nonintegrated steelmaker are sensitive to the uncontrolled export of ferrous scrap. Historical data show a connection between exports and cyclic changes in scrap prices. It is also believed that exports of scrap help feed foreign steel exports to the United States and threaten future domestic availability of scrap. The scrap industry argues that there is a large domestic supply of scrap, particularly a great deal of obsolete scrap, such as discarded automobiles and appliances scattered around the Nation, and scrap in wastes and garbage. The cost of retrieving such scrap is very high, however, and ferrous scrap in general is becoming more costly to collect, process, and distribute. The increasing use of alloy steels, especially in automobiles, is making scrap processing more difficult and costly, and impurities and minor alloy additions build up as more and more scrap is repeatedly recycled. The general trend in manufacturing—to improve process efficiency and reduce raw material and energy costs—means that less industrial scrap will reach the market.

The most likely competition for ferrous scrap is DRI, which offers a number of technical advantages over scrap and has greater price stability. As scrap prices rise, DRI becomes more competitive; conversely, low scrap prices act as a disincentive to the development of DR. Thus, the price of DRI, whether imported or manufactured domestically, is a potential way for the marketplace to stabilize scrap prices. In the long run, DRI availability will likely be a decisive determinant of increased electric furnace use (see Topic 16).

22 How does changing technology affect the timing and strategy of capacity expansion?

The technological and cost competitiveness of domestic integrated companies suffers from the exceedingly small amount of new facilities added during the past several decades. Industry argues, and correctly so, that optimum technology and efficiency require new plants with proper layouts that will allow new technologies to be introduced and integrated into all phases of the steelmaking process. The major obstacle to the construction of new integrated plants is their extremely high capital cost (about $1,320/tonne of annual capacity) and the large plant size needed to capture economies of scale; capital costs could reach many billions of dollars per plant. Considering the industry's capital shortage, uncertainties over future Government policies affecting capital formation, and the continuing problem of imports capturing domestic markets, it is quite unlikely that new integrated plants, based on modern blast furnace technology, will be built in the near future.

Even if sufficient capital and financing could be obtained, it can be questioned whether such costly capital projects should be built. Such plants take many years to complete, and by that time new and innovative technology, with greater production cost savings, and possibly with reduced capital costs, may be available and perhaps may even be adopted by foreign steel industries. It can be argued that this is exactly what happened to the domestic steel industry in the 1950's and 1960's, when considerable plant construction and expansion took place before basic oxygen furnace and continuous casting technologies, the two most important developments after World War H, were proved on a large scale. Important technological developments may be commercialized within the next several decades. One distinct possibility is the large-scale use of some form of DR (see Topic 16). There are so many current developments in this area that success is likely, especially if U.S. companies, much like the Japanese, creatively apply available foreign research to develop major innovative technologies by the end of the century.

An alternate strategy, then, is to modernize and expand capacity at existing plants. The capital cost per tonne of annual capacity for this approach is generally about half that of building a new plant, but varies considerably. Naturally, there are limits to the amount of new capacity that could be added by this means. When coupled with new plant construction in the nonintegrated segment, which is proceeding at a significant pace, this would probably create enough additional capacity for the next decade. Capital costs of new nonintegrated plants range from $154 to $275 per annual tonne today—about 10 to 20 percent of the cost for new integrated plants —and although they cannot produce the full range of steel products, expansion of their product mix is occurring with moderate increases in capital costs.

A domestic strategy based on modernizing and expanding existing plants and constructing new nonintegrated plants during the next decade could lead to a distinct technological advantage. There will be little steelmaking capacity expansion in Western industrialized nations, and the present large-scale expansion of steelmaking in the Third World and Communist-bloc countries is based on either blast furnace steelmaking or first-generation gas-based DR processes. Thus, by developing one or more major domestic technological innovations before building new integrated plants, the United States could gain technological superiority. By adopting foreign innovations, the domestic industry would avoid repeating the past mistake of investing in rapidly outdated technology that it could not afford to replace quickly. Thus, even the worst case means the United States obtains technological parity with foreign industries, something it does not have now.

Financial, Regulatory, and Institutional Barriers to the Adoption of New Technology

23 To what extent is insufficient capital a barrier to the increased use of new technology?

Industry contends that its problem is not lack of adequate technology to improve cost competitiveness, but rather insufficient capital to adopt new technology. This position has considerable merit. Industry argues that if companies had sufficient capital, they could select and use the best technology for modernizing existing plants and constructing new ones. Industry also maintains that Government policies have contributed to low profitability and insufficient capital for new technology by: 1) keeping steel prices too low, 2) requiring high, nonproductive regulatory expenses, 3) permitting unfairly traded imports, and 4) not providing adequate tax incentive for investment, such as faster depreciation schedules. Capital is surely necessary to utilize technology, and there have been relatively low levels of capital available to the industry from its own profits.

Both OTA and the American Iron and Steel Institute (AISI) have analyzed the industry's capital needs for a major program of modernization and expansion for the next 10 years. Both analyses assume the same increase in shipment tonnage capability by 1988, both agree on the need to improve profitability, and both assume no radical technological changes. They do assume a very large increase in continuous casting, elimination of open hearth furnaces, substantial modernization of blast furnaces and finishing mills, and replacement of about half of the present coke ovens.

The differences between the scenarios are more instructive. The OTA analysis assumes: 1) a greater expansion of nonintegrated steel companies at relatively low capital costs, and 2) lower modernization and replacement costs for integrated plants. The AISI analysis projects a need for nearly $5 billion per year (in 1978 dollars) during 1978-88 for investment in productive steelmaking, an increase of 150 percent over the annual average for the past decade; OTA finds a need for only $3 billion per year, an increase of 50 percent. The OTA analysis of future capital formation leads to a projected deficit of at least $600 million per year for the modernization and expansion program. Unlike the OTA scenario, the AISI analysis concludes that substantial real price increases will be needed, regardless of other impacts on capital formation, in order to achieve improved profitability at the higher levels of investment.

The real issue is not whether the industry buys any modern technology with its available capital for modernization and new plants, but rather how much of what types of new and innovative technology its limited capital will buy. A key issue is whether new technology can reduce production costs sufficiently to justify large capital expenditures. The OTA scenario delays investment in large integrated plants until the 1990's, which is made practicable by renewing the industry in the 1980's through minimum-cost modernization and replacement and maximum expansion of nonintegrated companies.

Integrated companies, particularly the largest ones, have the lowest propensity among the three industry segments to use capital for risky, major types of innovative technological changes. Nonintegrated steelmaker generally show more inclination to adopt rapidly the newest types of technology; however, their technological opportunities are fewer because of their dependence on scrap and their smaller range of products. The alloy/specialty producers generally exhibit the greatest tendency to use capital for rapid adoption of major technological changes and for development of proprietary innovations for both processes and products; however, the demanding applications for their products are more conducive to technological change than is the case for the other segments. The greater inclination of both the nonintegrated and alloy/specialty producers to use new technology is also linked to their greater profitability and, to a lesser degree, to their more rapid growth. Profitability and expansion may be a consequence of using new technology, however, rather than a cause of it.

Virtually all calculations of likely levels of capital formation indicate that, for the next 10 years, domestic integrated steel companies will not have sufficient capital (at current levels of profits and borrowing) to create and adopt enough new technology to maintain domestic capacity and competitiveness. The four most likely means of providing this additional capital are: 1) raising domestic steel prices substantially, 2) changing tax and depreciation laws, 3) providing direct Federal support such as loan guarantees or industrial revenue bonds, and 4) greatly reducing regulatory demands. Raising equity capital, increasing borrowing from the private banking and financial community, and greatly reducing dividends are also possible, but most analysts doubt that these methods could be effective, Foreign investment is increasing, however, and could be a significant (if uncertain) source of equity capital. Should the capital shortfall not be met by any of these means, however, it is possible that steel imports (if available) will claim 40 percent or more of the U.S. market by the end of the 1980's.

24 **Do** steel companies use effective long-range strategic planning for technological innovation in order to gain competitive advantage over domestic and foreign producers?

More often than not, steel industry executives express a desire to be second with proven technology, not first with new technology. This attitude is clearly a barrier to innovation that does not exist in many other industries. Under the currently accepted definition of innovation—the first successful commercial use of a technological invention—most domestic steel companies, with the exception of some alloy/specialty producers, do not appear to emphasize innovation in their long-range strategic planning.

The steel industry apparently perceives the advantage of innovation (over "modernization" with available new technology) as insufficiently rewarding. This is evidenced by the industry's relatively low levels of spending for R&D and for the more expensive stages of pilot and demonstration work, as well as its historical record of importing foreign innovations. These factors combine to form a second barrier to innovation. The ease of buying new technology from foreign sources encourages reemphasis of domestic innovation, and lack of sufficient capital is used to justify this trend. Domestic firms also tend to sell whatever innovative technology they do create, as quickly as possible, in order to maximize immediate profits, instead of keeping the technology proprietary and thereby gaining a competitive advantage. Industry claims that this is also done by foreign firms.

This lack of emphasis on technological innovation may be symptomatic of a generally low level of planning by steel management or simply unsuccessful planning that does not sufficiently appreciate the potential of technology. Historical studies of the domestic steel industry have examined several issues indicative of poor planning: 1) the rapid decline of profitability and eminence after World War II, 2) the lack of response to rapidly rising steel demand in Third World and industrialized nations, 3) the lengthy and costly resistance to compliance with environmental regulations, and 4) the large integrated producers' lack of attention to demographic changes and opportunities for local markets. One explanation for these and other such shortcomings is a lack of dedicated, long-range strategic planning by domestic steel companies, particularly by integrated producers.

Industry needs to develop appropriate scenarios, risk/reward analyses, and corporate options in order to anticipate and respond to major changes in both the domestic and world economies, as well as to changes in Federal policies. The AISI scenario is a first step in this direction. Domestic steel industry management must examine the consequences of continuing to concentrate on low-risk, incremental technological changes; defensive rather than aggressive business strategies; product rather than process changes; traditional domestic markets rather than exports; promoting from within, rather than recruiting personnel from other industries, universities, and Government; and making profits from their raw materials (iron ore and metallurgical coal) investments. It appears that much of the industry, and particularly the integrated segment, has endorsed the self-fulfilling notion that steel is a low-technology, “mature” industry, with little potential for growth or substantial technological changes. The consequences over the last 20 years have been a decline in capacity, a fivefold increase in imports, and numerous missed opportunities in both technology and foreign trade. Neither the industry nor the Nation can afford the consequences of another 20 years of poor planning and missed opportunities.

25 **Is there sufficient steel-related** R&D in the United States to meet the goal of future technological competitiveness?

The total amount of industry, Government, and university R&D devoted to steel in the United States is woefully inadequate for future technological competitiveness. Within the industry itself, what little R&D exists is focused on short-range, quick-payoff activities; very little goes into basic research. The industry does not aggressively pursue major technological changes and innovations for long-term growth, and even spending for incremental improvements is minimal. What is often termed R&D in the steel industry would not be accepted as such in other industries because the work is too applied and tied so closely to manufacturing or sales. The industry does emphasize R&D in raw materials processing and products, but for research in ironmaking and steelmaking processes it depends on foreign producers and domestic equipment suppliers.

The steel industry insists that it lacks adequate funds to invest heavily in long-range R&D, both because of generally low levels of available capital and because of other demands on that capital. R&D spending levels in steel appear to be geared to the low part of the business cycle; when net income is markedly greater than in preceding years, there is no corresponding increase in R&D spending.

The total amount of steel industry spending on R&Din 1978 was $259 million. In 1977 and 1978, steel industry R&D spending was 0.5 percent of industry sales; in 1975 and 1976, it was 0.6 percent; and during 1963-71, it was 0.7 percent. These are very low figures: the only domestic manufacturing industry with a lower level of R&D spending is the textile industry; the aluminum industry spends about twice as much. Steel R&D spending measured as a fraction of industry profits appears more reasonable, but it is still about half of the national industry average. In addition, much steel R&D is aimed at dealing with Government regulations; about 20 to 25 percent of R&D personnel work on environmental problems (see Topic 27).

Steel-related R&D in universities and Government facilities also appears to be minimal. AISI funds only about $1 million of research per year at universities, and Federal funding is also very low, accounting for only 1.5 percent of steel R&D in 1977. By comparison, the Federal Government funds 9 percent of R&D for the chemical industry, 14 percent for the machinery industry, 47 percent for the electric equipment industry, and 78 percent for the aircraft industry.

There are no hard data available to delineate the difference among the three industry sectors with regard to R&D spending, but it appears that at least some alloy/specialty producers are much more involved in R&D

than most firms in the other two segments. The integrated steelmaker spend very little on R&D; the nonintegrated producers, who have become quite dependent on equipment manufacturers for technological developments, appear to spend even less.

Although the U.S. steel industry is one of the world's most profitable, it appears to lag behind foreign steel industries in R&D spending; the Japanese, for example, now spend about 1 percent of sales on R&D. Much of foreign R&D in steel is directly or indirectly supported by governments. At the present time, for example, $36 million is spent annually on steel R&D by the Commission of European Communities, of which $20 million is supplied by governments. In Japan, there also appears to be significant government support of university research in steelmaking.

26 Does the domestic steel industry employ enough technical personnel and use them effectively to enhance its technological competitiveness?

The steel industry has been criticized for its loss of technical leadership, slow adoption of new technologies, and low levels of R&D. It is therefore relevant to consider industry use of technically trained personnel. In comparison to average employment levels of technical personnel by domestic manufacturing industries, the steel industry's use of technical personnel is low. As a percentage of its total employees, steel employs only about one-third the number of scientists and engineers in the petroleum, refinery, and chemical industry, and about half the number in the electrical equipment industry.

Moreover, for the entire steel industry only about 18 percent of all technical personnel are used in R&D. Engineers typically start in R&D and reach higher levels of management by moving to other areas. This practice has the potential disadvantage of driving many of the best technical people out of R&D, because they can achieve higher salaries and greater prestige in other departments. These technical personnel may not have the appropriate expertise for business management and policy work; on the other hand, they have a better understanding of the technological basis of the company and the effective use of technical knowledge for process improvement and market development.

The steel industry draws few technical personnel from high-technology industries. There appears to be a trend toward retired steel personnel going from industry to Government and universities; there appears to be little return flow of midcareer professionals to the industry, however, as is typical of intersectoral mobility and training in West Germany.

There is also some criticism of the industry because training and development of technical staff are geared to managerial and executive development rather than to technical specialties. Most companies have tuition support programs for undergraduate and graduate education, but there is generally much less support for publishing in professional journals or for sabbaticals at domestic and foreign universities. While technical personnel in R&D are given some opportunity to attend meetings and conferences, those in other company areas have fewer such opportunities. This treatment of technical personnel appears consistent with the "mature industry" image accepted by most integrated companies—why upgrade technical skills when steel technology will not change in major ways? (See Topic 24.)

Industry representatives seem satisfied with the availability of new technical personnel, but college recruiters are concerned that more growth-oriented industries may be attracting the best technical talent. Personnel availability may be adequate to present industry needs, given its limited R&D and its current use of technical people: but should the industry choose to change its strategies, it could face difficulty in recruiting the numbers and types of people it will need. Unlike other nations, where steel research is regarded as important and exciting, the U.S. industry could have problems attracting the best technical people away from high-technology, R&D-intensive, high-growth industries.

27 What are the impacts of EPA and OSHA regulations on steel industry modernization?

Social regulations do have an impact on steel industry modernization, and environmental regulations have a greater impact than do occupational regulations, for several reasons. First, environmental regulations have been actively implemented since the late 1960's, but implementation of OSHA regulations has been limited until recently. Second, EPA regulations have an impact on the entire range of production technologies, while those of OSHA have had their greatest impact on cokemaking. Future OSHA regulations may more significantly affect the entire range of operations, but OSHA has a certain degree of administrative flexibility. OSHA compliance deadlines, unlike those of EPA, are not prescribed in authorizing legislation. This gives OSHA greater potential for successfully integrating industry modernization programs with regulatory compliance schedules.

Both sets of regulations have both positive and negative impacts on the steel industry. On the positive side, both EPA and OSHA are forcing the industry to consider technological improvements or substitutes for existing steelmaking processes. An indirect, near-term consequence of regulatory enforcement has been increased use of electric furnaces and an accelerated phaseout of aging and inefficient facilities. An unanticipated, long-range consequence of social regulations may be increased incentive to develop safer and cleaner new processes that are also more cost effective. Continuous casting and DR are among future alternatives showing promise in this regard.

On the negative side, the expenditures (capital and operating) required to comply with environmental regulations divert corporate funds from modernization investments that might otherwise be undertaken. Industry reports suggest that in recent years steel companies have invested about $450 million annually in environmental control facilities. Environmental expenditures are mainly for retrofitting existing equipment and involve gradual improvements in control technology, and to a lesser extent for in-process changes. Because of limited replacement and expansion activity during the past decade, there has been little opportunity to integrate environmental expenditures with new plant construction, and expensive retrofitting has occurred instead. In fact, regulations have been cited as a cause of some capacity reduction, especially in cokemaking, in which import dependence has become a growing concern. The next decade may offer more opportunities.

Available incentives, in and of themselves, have not stimulated industry management to choose technological innovation rather than delay as a cost-effective response to regulations. EPA's incentives are limited to extended compliance schedules and penalty-payment exemptions which allow, to some extent, for new technology development by the steel industry. The Agency does not provide regulatory guarantees or financial support should the innovative approach fail to meet regulatory requirements. OSHA's regulatory incentives are not strongly oriented towards stimulating industrial innovation either. Although OSHA may issue variances in response to operational constraints within the steel industry, stimulating innovation is not a specifically authorized goal in the issuance of these variances. OSHA's only specific authority to stimulate innovation is through its judicially interpreted "technology forcing" policy, which allows it to require the adoption of promising new pollution abatement technologies or practices that have been developed by other industries. Such forced transfers must be limited to the regulation of toxic materials in the workplace, however, and they may not involve new equipment or controls that would necessitate major industry R&D.

A final important consideration is that neither EPA nor OSHA can complement their regulatory requirements with significant economic incentives to encourage the industry to develop more cost-effective technologies. EPA does have a limited environmental technology RD&D program that involves industry cost sharing. Both agencies lack vigorous anticipatory RD&D programs designed to develop greater Government and industry awareness of the environmental implications of emerging steelmaking technologies. This is particularly significant because some new process technologies could be less polluting or hazardous than conventional ones.

28 How might labor practices affect the introduction of innovative technology?

The adoption of new steelmaking equipment or technology affects steelworkers in several ways: retraining may be needed, job classifications may need to change to accommodate skill changes; and local practices may need to allow for flexibility in work assignments. On the whole, however, it appears that labor conditions have not been a constraint to the adoption of improved steelmaking equipment. Job classification schedules, periodically updated, are sufficiently flexible to accommodate gradual shifts in skill requirements resulting from technological change. There is some concern, however, particularly among those in the academic community, that apprenticeship and retraining programs do not adequately train people for changing job requirements associated with the adoption of new technologies.

There is a consensus that the work force generally cooperates with management when modern equipment is introduced. The 2-B "local practices" clause in most labor contracts gives management the right to unilaterally change past practices concerning crew size and other staffing agreements when such change is required by "changed conditions, " including technological innovation. However, it appears that the 2-B clause makes it difficult to extend past practices to adjacent production areas not directly involved with the new equipment. Such changes are subject to negotiation with local union affiliates. National union leadership is concerned with technological displacement, but does not resist the introduction of new technology. The industry's view is that—with the possible exception of a few plants—there are no difficulties with steelworkers when new technology is introduced. Thus, it appears that the 2-B contract provision has had no limiting effect on industry adoption of new steelmaking technologies.

Policy Considerations

29 Can the domestic steel industry stay competitive without changes in Federal policies?

The need for policy support of the steel industry varies among its three segments. By almost any measure of economic and technological health, the integrated segment is steadily declining. There are trends toward more dependence on steel imports (although they did decline in 1979), less employment, only modest gains in steel demand, aggressive competition from other engineering materials, lower profitability, high debit-to-equity ratios, less investment in R&D, more dependence on foreign technology, a higher proportion of obsolete facilities, smaller domestic steelmaking capacity, and inadequate capital formation for modernization.

Not even large domestic demand and high capacity utilization are likely to reverse the slow decline of the integrated segment. The situation may have already deteriorated to such an extent that profitability cannot be markedly reversed, nor sufficient capital generated, without changes in Federal policies. The only major external factors that might change this pattern are: 1) a large influx of foreign investment and equity capital, and 2) a devaluation of the dollar significant enough to reduce imports and spur substantial domestic expansion.

Current trends might be reversed by changes in Federal policies that permit substantially higher steel prices, fewer unfairly traded imports, and faster capital recovery, or policies that provide more support for R&D and innovation and more direct financial support, such as loan guarantees. (Topics 34 through 40 deal in detail with these policy options.)

The future looks less bleak for the other two segments of the industry. The nonintegrated segment should grow, remain profitable, serve more markets with a greater range of steels, and provide increasing and necessary competition to the larger integrated firms. (Such intra-industry competition will probably have even greater benefits than the competition presently provided by imports.) This segment, too, could gain from changes in Federal policies, particularly those affecting the supply and cost of electricity, but it is likely to prosper even under present policies. There will still be a need for a large domestic ironmaking base to convert iron ore to new iron units.

The alloy/specialty producers are in a period of adjustment to changing Federal policies with regard to imports. It remains to be seen whether the loss of protective import quotas and the enforcement of the new Multilateral Trade Agreement will be adequate to ensure the continuation of this segment's healthy economic condition. Without direct Federal support, however, high-technology steel exports are not likely to increase dramatically.

30 Can the experiences of the steel industry contribute to the formulation of more effective Federal policies for other domestic industries?

The steel industry may be only the first of several domestic industries facing a decline in preeminence and prosperity. As the less industrialized nations begin to lower production costs and to consume more commodities, they become more economically attractive than highly industrialized countries as a location for established industry. Established industries in industrialized countries may also decline if they lose domestic markets through product substitution or replacement, or if they do not produce sufficient technological innovations to reduce production costs or improve products.

These explanations do not appear as valid in today's world economic order as they once were, because government policies have introduced so many imperfections to the free-market and free-trade system that the impact of traditional economic factors on international competitiveness has been fundamentally changed. None of the above factors can adequately explain the decline of the domestic steel industry.

In the first place, no major foreign steel industry has enjoyed a more advantageous combination of labor costs, energy costs, raw material costs, and industrial and technological infrastructure than the United States. At best, foreign steelmaker have had slight advantages in one or two of these factors, but such advantages have generally been short-lived and insufficient in themselves to account for penetration of export markets, particularly the U.S. market.

What has occurred is that foreign governments have adopted policies that provide many direct and indirect benefits to their steel industries, and many of these industries have in fact been built with public funds to serve social and political goals. Even though foreign demand for steel has increased substantially, foreign steel is often exported rather than used to satisfy domestic needs. This has promoted growth, but not necessarily prosperity. The American steel industry, as a private, profit-motivated enterprise, is becoming increasingly unique in the international market (see Topic 32).

Secondly, although steel has faced stiff and increased competition from other materials—notably aluminum, concrete, and plastics—it still possesses a unique combination of properties, forms, and costs that ensure it substantial and growing markets. There has been little technological displacement of steel in the marketplace.

Thirdly, contrary to accepted wisdom, there have been major technological changes in domestic steelmaking and steel products during the past several decades. All signs are that this trend will continue. Some domestic firms have justified their lack of progress on the basis of the "mature industry" image (see Topic 24); others, in the meantime, have moved ahead with boldness and optimism, taking risks, investing in the newest technology, and capturing the profits that are there to be made.

One lesson to be learned from the steel industry's experiences, then, is that domestic industries can find themselves losing price competitiveness because Government policies are not comparable to those of other nations. Foreign government policies have distorted the workings of the marketplace, sometimes in ways unique to a particular industrial sector. The steel experience has shown that Federal policies can improve the profitability of foreign industries while depressing those at home. But in spite of Government policies that have not permitted domestic prices to equal import prices in periods of strong demand, that have limited capital recovery and hence restricted capacity replacement and expansion, and that have not provided R&D assistance comparable to foreign governments, the American steel industry is still the most profitable major steel industry in the world. Surely, more competitive Government policies could help make steel and other "sick" industries well.

High-technology industries have captured much of the public's attention, and basic industries like steel have lost stature. Their critical role in the economy and national security has been overlooked. Government policies must be reexamined to determine whether they allow industries to wither and save only the inept and unprofitable, or whether instead they create a climate in which competent and profitable companies can grow. There is a need to examine, for steel as well as domestic industry in general, the long-term benefits of closing plants that are inefficient, poorly located, or possibly mismanaged. The costs Government incurs in dealing with local, short-term social dislocations may be less in the long run than those of continuing Federal assistance to industrial facilities incapable of technological rejuvenation.

Another lesson to be learned from the past experience of the steel industry—and perhaps the most important lesson—is that sector policies may be needed for major domestic industries if international competitiveness is to be achieved. Foreign governments, particularly the Japanese, have adopted sector policies to build competitive industries. Without a coordinated policy, improvement efforts may be at cross-purposes or fail to address critical issues. For example, the steel industry's emphasis on the need to raise adequate capital for modernization and capacity expansion ignores the need for additional efforts in R&D and innovation. Domestic policies that deal effectively with only one of these areas would not help, in the long run, to ensure a profitable and competitive industry, nor would trade policies that deal effectively with imports but fail to support technology, innovation, and the means of production. The risks of adopting a steel sector policy include: 1) an overemphasis on the welfare of the steel industry, particularly large integrated steelmakers, to the exclusion of other domestic industries and smaller steel producers, and 2) insufficient attention to social goals and impacts, such as environmental protection, pollution control, and worker safety. Such risks must be examined for any industry for which a sector policy is considered.

31 Should the steel industry be singled out for a sector policy?

Some critics contend that the steel industry should not be singled out for Federal help and that legislation affecting all domestic industry should be sufficient. Steel has a unique combination of problems and assets, however, and it has already been uniquely and adversely affected by many Federal policies. For the following reasons, not all of which apply to any other domestic industry, singling out the steel industry for a sector policy presents difficult choices and opportunities for policymakers:

- The industry is essential to the domestic economy and national security, but it is contracting and diversifying out of steelmaking, which can only result in increased imports.
- The current cost-price squeeze and capital shortfall are, to a substantial extent, the results of prices that are too low to provide adequate profits, Government policies that have led to high regulatory costs, and unfairly traded imports that have captured domestic market growth and contributed to artificially low prices.
- There is a nucleus of companies with plants that are extremely competitive in costs and technology, and these could contribute positively to the trade balance by exporting more high-technology steels or impeding imports of commodity steels.
- There are many short- and long-term technological opportunities for strengthening the industry and recapturing the premier status it once possessed.
- The industry has available to it the domestic material resources of iron ore, coal, and ferrous scrap and the human resources of a highly competent labor force, a large national R&D infrastructure, and a reservoir of managerial and entrepreneurial talent.

32 How do foreign government policies affecting their steel industries compare to U.S. policies?

Most foreign governments have placed considerable strategic and economic emphasis on developing and preserving their steel industries, which they view as national assets, essential for industrialization, economic development, and economic stability. In fact, 45 percent of world steelmaking capacity, and more than 50 percent of European capacity, was government-owned in 1979. Foreign governments support their steel industries in a number of other ways, as well, including government planning and financial assistance, favorable tax policies, direct export incentives, tariff and nontariff barriers to steel imports, and the subsidizing and stockpiling of raw materials. American steelmaker see these forms of government support and ownership as trade-disturbing practices that should be met with equivalent U.S. policies.

Foreign governments support their steel industries to such an extent because their industries are not just instruments of production and profits: they also have a role in social, economic, and foreign policy. Their industries are used to:

- sustain employment levels,
- train technical and management personnel for industrialization,
- maintain social stability in certain geographical areas,
- make use of domestic natural resources,
- provide a cheap feedstock for other industries,
- obtain foreign currency through exports,
- gain access to international industrial activities,
- reduce dependence and improve negotiating positions with other nations,
- enhance their national images, and
- improve their military and economic security,

The steel industries in Japan and West Germany are mostly privately owned, as in the United States. Unlike those countries, however, the United States: 1) lacks a national consensus to preserve and modernize its steel industry, 2) enacts laws and regulations that have considerable costs for its steel industry, without providing offsetting direct or indirect benefits, 3) does not use trade laws vigorously to prevent unfairly, or even fairly, traded imports, and 4) provides little support for the development and export of new technology.

Japan makes maximum use of government planning and a coordinated steel sector policy. Through its Ministry of International Trade and Industry, it provides its steel industry with marketing guidance, long-range forecasts, target production goals, plans for domestic and export cartels, support for RD&D, assistance in procuring raw materials, and, most importantly, financial assistance in conjunction with the Japanese banking community. The United States has no comparable programs.

The EEC has been particularly active in providing government financial assistance, some through individual governments and some through regional programs. Such assistance takes the form of: grants-in-aid for antipollution compliance, technical aid, and research: low-interest and preferential-interest loans: and writeoffs of bad debts. Although the United States has used loan guarantees to a small degree, financial assistance here is at a far lower level than in other countries. Domestic producers must rely on direct credit, and they are subject to all the financial tests of the free enterprise system. Moreover, domestic firms argue that U.S. private and public funds, such as Export-Import Bank financing, often go to foreign steel industries at far lower financial costs than domestic companies can obtain.

Direct export incentives used by foreign governments include: export credit and financing, including guarantees to private banks of a favorable interest rate; export insurance with liberal coverage against losses not within the control of the exporter; tax rebates, generally in the range of 10 to 20 percent of the value-added tax in Europe and a like percentage of the export sales price or export value in developing nations; government assistance for trade missions, exhibitions, market research, and export promotion schemes; and assistance to exporters for joint foreign marketing efforts, offices, warehousing, and sales facilities. The United States has been a very attractive export market for foreign steel industries, with markedly fewer and lower tariff and nontariff barriers to imports than most other nations. Although the United States has the Export-Import Bank and appears to be embarking on a more aggressive export incentives program, the domestic steel industry is not particularly experienced in or inclined toward exports. Some domestic companies are attempting to sell technology, particularly in the raw materials area, but direct incentives to export do not match those of many foreign nations.

Foreign governments are also giving more attention to raw materials subsidization and economic stockpiling. European nations have heavily subsidized their coal industries, and most developing nations have state-owned ore and energy resources that provide substantial benefits to steel exporters. Government stockpiling of critical alloying elements, such as nickel, chromium, cobalt, and tungsten, is also widespread. Japan grants bank credits to domestic producers of raw materials, especially coal, under adverse economic conditions. Sweden has a program of tax credits for steel companies that stockpile raw materials and finished steel during periods of declining prices. The United States subsidizes energy resources through controlled energy prices, but this has benefited the domestic steel industry only slightly since over 60 percent of its energy comes from coal, and in any event U.S. energy prices are being gradually decontrolled. The level of assistance provided in energy-rich developing nations with rapidly growing steel industries, such as Mexico, is very great, and energy costs in such nations are far below their market value.

33 What will be the effect of the new Multilateral Trade Agreement on the domestic steel industry?

Vigorous enforcement of the trade agreement is necessary, but not sufficient, to bring about a revitalization of the domestic steel industry. Lax enforcement is sufficient to extend present trends and to ensure the slow but inevitable demise of much of the industry.

Even if the new trade agreement is vigorously enforced by the United States and its trading partners, it could do little to solve the fundamental problems of the domestic steel industry, At best, there would be an uncertain decline in steel imports and an increase in exports. The most important benefit of an effective trade agreement would be to reduce steelmaker' uncertainty about their potential for capturing domestic growth in demand; this could offer them clearer rewards for long-term investments in technology. If the new trade agreement is not vigorously enforced, other steps to aid the industry could be nullified by unpredictable surges in unfairly traded imports or by the industry's fear of such surges.

Policy Options

34 How can increased Federal assistance to the steel industry be justified?

The steel industry is necessary for military and economic security. It is also a major source of employment. Other materials could not even theoretically substitute for most steels; where theoretical substitutions exist, they could not be implemented in any reasonable period of time at manageable cost. And to become dependent on foreign steel is comparable to becoming dependent on foreign food or energy.

There are arguments to be made for providing more Federal assistance to the steel industry, but there is an equally valid case to be made for the industry's fundamental strength. The industry is not, as some argue, composed entirely of inefficient, mismanaged firms using inefficient industrial processes. The industry has an extremely strong infrastructure, an excellent labor pool, access to one of the world's best markets and to abundant domestic resources, a high-quality knowledge base, and a number of highly profitable, well-managed companies upon which to base industry reinvestment, restructuring, and growth. It can thus be argued that the U.S. steel industry has comparative advantages over many foreign steel industries and that these advantages should be used to rejuvenate the industry.

Any Federal policy that helps the steel industry invariably brings objections from other domestic industries or from steel companies that may not benefit equally. The chief objection is that such policies disturb free-market competitive forces either within the steel industry or between steel and competing materials. Other direct Government actions affect various industries unequally, however, and past Government actions have contributed to steel's present problems. The industry can point to market imperfections and uncertainties, resulting from both domestic and foreign policies, that have led to its current low profitability, poor capital formation, and apprehension about high-risk ventures.

A free-market economy for steel has not existed in the United States for some time. There is indirect control of import and domestic steel prices through Government import policies, particularly the trigger-price mechanism used in the past. The Government has used jawboning to keep steel prices within limits that policymakers believe to be non-inflationary. At the same time, rising costs have reduced steelmaker' profits. The loan guarantee program of the Economic Development Administration (EDA) has provided assistance to selected companies that have economic problems, operate in areas of high unemployment, or need assistance with environmental compliance; but stronger and larger steel companies, despite low profitability or inadequate capital, generally have not benefited from this program. They and others have expressed concern that such a program merely postpones the collapse of fundamentally unsound companies.

It can also be argued that, because steel has been so dependent on coal, it has benefited less than some other industries from Federal energy policies that maintain relatively low prices for other energy sources. The aluminum industry, for example, relies extensively on the low-cost Government-controlled hydroelectricity of the Pacific Northwest. Similarly, the plastics industry has benefited from low petroleum feedstock prices.

The social benefits of environmental and occupational safety regulations are inarguable, but the costs of compliance have not been equitably distributed because they have not been fully passed on to the consumer. Limitations on prices, coupled with substantial regulatory costs, have contributed to the steel industry's loss of profitability and capacity. Many other industries also have substantial regulatory costs, but the very nature of the steelmaking process, the industry's large proportion of old facilities, and the lack of Federal support for long-range development of cleaner technologies have all imposed more severe regulatory costs on steel than on most other manufacturing industries.

Other reasons for increasing the Federal Government's support of steel include: 1) neither the low-profitability integrated companies nor the small nonintegrated firms are able to support long-term, risky innovations, even though such innovations may have substantial social and economic benefits; 2) imported steel contributes significantly to a negative trade balance, but steel and technology exports could offset some of this deficit; and 3) the lack of Federal policy support, especially compared to foreign support of their steel industries, reinforces the perception that the United States is losing its leadership in technology and industry, and this contributes to a weakened dollar and a further decline in U.S. influence in the international business community.

A possible long-range negative consequence of more favorable Federal policies toward the steel industry is that they could lead to Federal subsidization or even ownership. Critics argue that such policies led to the nationalization of many foreign steel industries and that, generally, these industries are inefficient and operate at a large loss. This is not a necessary outcome of Federal assistance, however, if policies are designed to help private steelmaker regain sufficient economic health to once again be viable profitmaking enterprises.

35 Is there a need for direct Federal financial assistance to the steel industry?

Clearly, a number of steel industry problems result from inadequate capital for modernization with the newest available technologies and investment in future innovations. The situation has not yet become critical enough to justify broad, direct Federal subsidies to support normal operations and investments, but an argument can be made for selective Government assistance to promote modernization as long as profit levels are low.

Loan guarantees and industrial revenue bonds have become popular forms of Federal assistance because they are not expenditures and bypass the normal budget process. In fact, Government usually shows a profit from the low interest recipients pay. The problem with loan guarantees is that they could disrupt normal competitive forces among individual producers. There are very large differences in costs and profits among companies, as well as among industry segments. Loan guarantees that offer assistance to the least profitable companies act as disincentives to other firms to manage and invest so as to maximize profits. Federal assistance policies also need to provide incentives to companies that are relatively strong, both economically and technologically, and are able to share the risks with Government.

The EDA loan guarantee program, now in its last stages, did not specifically focus on the adoption of new technologies, and it has been criticized by a number of steelmaker for its tendency to help unsuccessful companies. If loan guarantees are to be offered, it would be more efficient to use them to encourage and reward high-risk innovations, increased capacity, better use of domestic resources, products for export, reduced energy consumption, increased overall productivity, and environmentally cleaner processes.

The terms of such a technology-stimulating, limited-term loan guarantee program might require: 1) evidence of the company's inability to raise capital through all conventional means, including selling new stock issues; 2) a degree of risk and innovativeness proportional to the relative level of past profitability, so that successful firms would be stimulated to develop risky, long-range, major innovations, while less profitable firms would still be able to share in Federal assistance; 3) commitments to delay diversification out of steelmaking until companies meet certain objectives, such as achieving mutually agreed-upon steelmaking capacities, productivity improvements, energy-use reductions, or pollution-abatement improvements. This approach, though complex, would least disturb relative competitiveness among domestic companies while still providing a means of regaining domestic capacity and international competitiveness.

Industrial revenue bonds benefit the companies by providing lower interest rates, but they have an indirect cost to the Government in the form of reduced taxes. There are also problems with defining the social benefits of technology-related investments and with allocating such bonds among competing needs.

36 What effect would changes in Federal tax laws have on capital formation?

Insufficient capital to modernize, expand capacity, and innovate is an increasingly critical problem for most of the steel industry, which has long argued that changes in Federal tax policies could help to correct its capital shortfall. There is little doubt, for example, that appropriately designed investment tax credits or reduced depreciation schedules could yield large amounts of additional capital. Furthermore, these methods do not require expenditure of Federal funds and therefore bypass the Federal budget process. Tax credits already exist for energy-saving investments; they could also be directed toward other specific steel-related objectives such as increased scrap use, increased direct use of coal, or plant demonstrations of major innovations.

In the area of the reduced depreciation periods, the Jones-Conable Capital Cost Recovery Act of 1979 (H.R. 4646), if enacted, would allow machinery and equipment to be depreciated over 5 years instead of the present 15. The Department of the Treasury has calculated that, 5 years after its passage, this Act would generate an additional $0.5 billion to $1 billion per year for the steel industry. This amount would probably provide sufficient investment capital over the next decade to achieve the minimum degree of modernization and expansion that is needed to improve profitability and competitiveness.

If tax assistance of any kind were provided to the steel industry, there is no assurance that the additional capital gained thereby would be used for: 1) steelmaking operations of companies already committed to diversification out of steel, or 2) more innovative and risky technologies. While diversification cannot be prevented, it may be blunted by policy changes that the industry perceives to be favorable. Technological innovation could be encouraged by targeting tax assistance for technologies that are likely to result in reduced pollution, lower energy use, greater labor productivity, lower capital costs, or increased use of abundant domestic raw materials and wastes. Critics of legislation that deals directly with technological choices, rather than performance objectives, point to the difficulty and undesirability of having the Federal Government evaluate technology. Those in favor of such legislation point to the risks involved in not requiring the beneficiaries of Federal assistance to emphasize technologies with long-range national and corporate benefits, rather than those that are less risky and more likely to increase the short-term profits of individual companies.

37 Should there be more Federal support for steel R&D and innovation?

The Nation's commitment to the future international competitiveness of the domestic steel industry would be demonstrated most clearly and most effectively by increased Federal support of research. There is a severe lack of basic steel research, especially in universities, and any truly radical innovations in steelmaking will be based on new knowledge. New knowledge might emanate from totally undirected research, but it is much more likely to be produced in basic research programs that focus on the needs of steelmaking.

An attractive approach for improving the level of basic steel research would be to create federally supported research centers, located at universities but with close relationships with industry to ensure eventual use of the research by steelmaker. Financial support for such centers could also be solicited from industry (after clarification of antitrust laws). Because of their low profitabilities and their need for fast paybacks, individual companies are not likely to spend significant sums on basic research; they might, however, contribute to joint efforts. The National Science Foundation has taken a step in this direction by funding a planning grant for a center dealing with research for nonintegrated steelmaking.

Funding is also needed for pilot- and demonstration-plant evaluations of the new process technologies that are vital for the near-term survival of the industry. Policy changes in this area would also require more liberal interpretations of antitrust laws, as well as either assurances of appropriate licensing to all interested companies or provisions to grant proprietary or financial rights to participating firms. Proponents of such funding argue that the lack of sufficient discretionary capital in the industry has limited applied evaluation programs in the past. Risky, large-scale projects generally require many hundreds of millions of dollars for evaluation before commercialization can proceed, and few individual companies can mount such efforts. The cost to the Government could be minimized by using a buyback agreement that allows a company or consortium to purchase the facility upon successful demonstration.

Opponents contend that the Government should not interfere with the private sector's ability to choose, evaluate, and fund projects, and that in any event Government lacks sufficient experience and expertise to make the critical choices. They argue that sufficiently worthwhile projects that offer adequate returns on investment will, regardless of risk, attract venture capital. The determination of risk and return on investment for new steel technology is filled with uncertainty, however, and the present lack of favorable conditions for capacity expansion worsens the risk/reward assessment. Furthermore, biases and attitudes toward the industry can be used to make a promising technology look more risky or less beneficial than it really is. OTA has found that even worthwhile projects are damaged by the generally negative views of those outside the industry and the pessimism of steel executives who do not believe in the feasibility of technological innovations. For these reasons, the arguments against Government assistance are not compelling, although they do identify concerns which should be examined in policy formulation.

An equally important role for Government might be the coordination of steel R&D with other federally sponsored research activities. A good example of such linkage would be with activities in coal gasification and synfuels, which might supply the necessary technology for handling reductants in coal-based DR processes. This linked technology could yield the extremely advantageous combination of a wise, efficient use of abundant domestic resources and a cleaner, low-capital-cost steelmaking process.

Government could also give greater encouragement to innovative efforts by small firms and individual inventors who are outside the basic steel industry and have little access to its resources. It is well known that small firms have a very high rate of successful innovation compared to large corporations. OTA has found a surprising number of such firms and individuals with new steelmaking inventions and processes that are promising, but difficult to assess. Their difficulty is insufficient funding at the pilot and demonstration stage to fully prove or disprove the new technology or to assess accurately its operating and capital costs. The Calderon Ferrocal process, a form of coal-based DR, is an example of a promising invention that is having difficulty obtaining adequate funding for demonstration. It is difficult to envision how means other than direct Federal funding could be used to assist such efforts.

The facilities of the Bureau of Mines, formerly used for research in steelmaking, could be resurrected by the Government with a minimal investment to establish an effective RD&D program with industry, especially the small nonintegrated companies. Both the former Bureau policy (which apparently prevented cooperative research with industry) and the present policy (which prevents research in the materials production area) seem to ignore the needs and opportunities of domestic steelmaking.

38 What regulatory changes could be considered that are simultaneously aimed at improving environmental and occupational protection and at revitalizing the steel industry?

Environmental policy should be reexamined taking into consideration the unique needs, problems, and technological opportunities of the different steel industry segments.

The social goals of environmental and worker safety and health are fundamentally sound. Nevertheless, industry's concern over the long-term economic effects of such regulations are also legitimate. For instance, industry investment in EPA- and OSHA-mandated technology and facilities is a considerably higher percentage of total capital investment than for other manufacturing industries and may continue to increase during the next several years, Costs of operating these facilities are also very high. In addition, needed improvements in environmental technologies will assume growing importance as toxic pollutant guidelines affecting the steel industry are issued within the next few years.

Possible changes in environmental policy that merit examination and evaluation include:

- Giving industry more flexibility in selecting the most effective means to attain environmental compliance, such as by regulating emissions on a plant rather than an individual process basis.
- Analyzing the regulation of pollutants with the goal of providing tradeoffs be-

tween economic costs and environmental benefits.

- Providing regulatory options for marginal plants with a limited life expectancy, so that environmental goals can be better coordinated with both near-term plant phaseouts and the maintenance of domestic capacity.
- Using EPA and OSHA penalty payments for noncompliance to fund R&D in these areas.
- Clarifying the industry's responsibilities concerning RD&D for improved control technologies that will meet EPA standards.
- Complementing the existing regulatory approach, as embodied in the innovation waivers, with economic incentives to encourage industry RD&D of needed improvements in environmental technology,
- Increasing Federal support of environmental technology R&D, particularly with respect to in-process changes.
- Increasing emphasis by regulatory agencies on innovative steelmaking technologies and process changes that present a number of advantages in addition to improved pollution abatement and worker safety and health.

39 What will be the effects of continuing to export ferrous scrap?

U.S. scrap exports are a positive contribution to the Nation's trade balance, but they are relatively small, in terms of both dollars and tonnage, compared to imports of steel, ore, and coke. For 1979, scrap exports probably equaled about 15 percent of the net steel-related deficit. The scrap industry favors free export of scrap, contending that there is sufficient domestic scrap to export, that more scrap becomes available as prices increase, and that historically the integrated steel producers have not attempted to maximize their use of scrap. To some extent the latter has been true, but that situation appears to be changing (see Topic 21).

By exporting scrap, the United States is exporting a valuable domestic resource. Scrap is a source of both iron and embodied energy (about 19 million Btu/tonne). The more scrap used in domestic steelmaking, the less energy, time, money, and labor are expended to mine and process iron ore and then make iron in blast furnaces.

Some of the exported scrap is used by foreign steelmaker to produce government-subsidized steels, which are then sold back to the United States, with adverse impacts on the domestic steel industry. Scrap exports drive up the domestic price of scrap, but foreign producers can still obtain a net advantage because of the devalued dollar and their inherently greater energy costs. Domestic producers must contend with both high scrap costs and price controls on their output, which put them in a cost-price squeeze.

Continuous casting and other improvements have decreased the amount of home (inplant) scrap being produced; simultaneously, the greater use of electric furnaces and the modification of basic oxygen furnaces have increased the demand for scrap. As a result, steelmaker are becoming more dependent on purchased scrap, which however is declining in quality as "tramp" contaminants build up over numerous recycling. The domestic demand for scrap is so great and growing so rapidly that the scrap industry may have no long-range economic need to export. As nonintegrated electric furnace steelmaker expand in the 1980's, it is even possible that a domestic shortage of ferrous scrap may develop.

Perhaps the most significant long-range consequence of continuing to export scrap is the possible detrimental impact on the nonintegrated steel producers. If formal or informal Government price controls cannot be released quickly enough to offset rapidly rising costs, quickly rising scrap prices (driven by high foreign demand) may put a substantial cost-price squeeze on these firms and even drive them out of the market. This impact is particularly acute now, when coal-based DR has not been developed domestically and when DRI is not yet readily available as an import.

40 Are Federal Government targets for utilization of ferrous scrap and other recovered materials needed, feasible, and the best approach?

The Government has been reluctant to put controls on scrap exports, but two legislative acts have attempted to maximize the use of scrap and other waste sources of iron generated in steel plants. These acts foresaw neither the difficulty of setting meaningful and feasible targets nor the long-range consequences of this approach. For purely economic reasons, scrap use by the steel industry has been increasing. As an alternative to setting targets, the Government could consider direct incentives to the industry, such as an investment credit, to adopt technology that would use more scrap (see Topic 21).

The requirements of the two acts may be summarized as follows:

- Section 461 of the National Energy Conservation Policy Act (Public Law 95-619) of 1978 mandates that the Department of Energy set targets for the use of recovered materials for the entire ferrous industry, including ironmakers and steelmaker, foundries, and ferroalloy producers. Such targets, which have now been set, are voluntary, but steel producers are concerned that they might become mandatory. The target set for 1987 was almost met in 1979.
- Section 6002 of the Resource Conservation and Recovery Act (Public Law 94-580) of 1976 amends the Solid Waste Disposal Act and deals with Government procurement. It sets forth the requirement that Federal procuring agencies shall procure items composed of the highest percentage of recovered materials practicable, and it instructs the EPA Administrator to promulgate guidelines for the use of procuring agencies in carrying out this requirement. It also requires suppliers to the Government to certify the percentge of recovered materials in the total material used in the items sold. As yet, EPA has not set these guidelines, nor has it proposed a schedule.

Although it is in the national interest to maximize the use of recovered materials in order to save energy, the setting of scrap-use targets or guidelines presents a number of problems. It may not be technically or economically feasible in all cases to use recovered materials to the extent suggested or required by the Government. A major problem has been that DOE and EPA do not appear to recognize the different steel industry segments and the unique constraints and opportunities they each have in regard to scrap use. Another problem is that a numerical target rests on many assumptions—about future scrap availability and use, as well as total steel demand and changes in technology—which are themselves highly controversial.

Targets could, in fact, be counterproductive to the original goals of maximizing recovered materials and saving energy. Unrealistic targets could be circumvented, for example, by companies buying and selling one another's home scrap on paper. Should targets and guidelines be effective in increasing demand for purchased scrap, and thereby raise prices, the impact on nonintegrated companies would be much worse than on integrated steelmaker; if this led to a decrease in nonintegrated output, it could ultimately result in lower total scrap use. Technically and economically, it would be extremely difficult for integrated steelmaker to increase substantially their use of recovered materials in existing facilities, and the modification to increase scrap use in basic oxygen furnaces also increases the consumption of oil or natural gas. Credits for scrap-enhancing changes in facilities would thus appear to be more effective than targets, since they ensure that investments would be productive and economically justified.

With the advent of DR and the availability of DRI, electric furnace steelmaker could use less scrap. Hence, targets or guidelines could act as a disincentive to the introduction of DR, a technology that may offer benefits for both the companies and the Nation. Industry cannot totally rely on scrap, so it needs DR, which produces new iron units from ore. Even though the percentage of scrap used per unit of output would decrease in electric furnace shops using DRI, it can be argued that the use of DRI in conjunction with scrap would promote an expansion of electric furnace steelmaking, resulting in a net increase in the use of purchased scrap (see Topic 16).