IRON ORE

By William S. Kirk

Iron ore is essential to the economy and national security of the United States. As the basic raw material from which iron and steel is made, its supply is critical to any industrial country. Scrap is used as a supplement in steelmaking but is limited as a major feed material because the supply of high-quality scrap is limited.

Although slightly lower than that of 1995, domestic production was still higher than any other year since 1981. The domestic iron ore industry operated at close to peak capacity. Consumption and shipments were also somewhat lower than those of 1995. Internationally, the record production levels of 1995 could not be sustained.

Legislation and Government Programs

The Minnesota Department of Natural Resources (DNR) announced a reduction on the royalty rate on crude taconite used to produce pellets or concentrate that would be used as feedstock for direct reduced iron in Minnesota. The purpose of this action was to provide an incentive for construction of direct reduced facilities in Minnesota. The DNR's intent was to charge about the same royalty for a ton of DRI as is presently charged for a ton of pellets. Currently, 99% of the ore produced on the Mesabi Range is in the form of pellets. The iron content of pellets averages about 66%, compared with an iron content of more than 90% for DRI. DRI has a market value of about three times that of pellets. Royalties would be reduced by as much as one-third on taconite used to produce DRI feed for the first 3 years that a DRI plant was in operation, provided that construction began before December 31, 2000 (Skillings Mining Review, 1996c). The Minnesota DNR began the examination of the impact on ground-water quality of in-pit taconite tailings disposal.

The Western Australia State Government continued to support increased investment in further processing of iron ore through a new initiative specifically designed to encourage value adding (The TEX Report, 1996c).

The U.S. Congress passed a law to modernize the U.S. Coast Guard Icebreaker *Mackinaw*. The Coast Guard Authorization Bill of 1996 directed the Coast Guard to develop plans and a cost estimate for reengineering and other modifications that will permit the Icebreaker to continue to operate with a reduced crew while maintaining its ability to break ice around the clock when necessary (Lake Carriers Association, 1966).

Production

Domestic iron ore production reached 62.1 million metric tons. The nine taconite mining operations in Michigan and Minnesota accounted for virtually all domestic iron ore production. These were, on the Mesabi iron range in northeastern Minnesota, Eveleth Mines LLC (EVTAC Mining; formerly Eveleth Mines), Hibbing Taconite Co. (Hibbtac), Inland Steel Mining Co., LTV Steel Mining Co., National Steel Pellet Co., Northshore Mining Corp., and the US Steel Group USX (Minntac). The two on the Marquette iron range in the Upper Peninsula of Michigan were the Empire and the Tilden Mines.

U.S. production data for iron ore are developed by the U.S. Geological Survey (USGS) from two separate, voluntary surveys of domestic operations. The annual "Iron Ore" survey (1066-A) provides 100% of total production shown in tables 1 through 4. This information is supplemented by employment data, mine inspection reports, and information from consumers. The American Iron Ore Association (AIOA) provided data on ore shipments from loading docks on the upper Great Lakes, as well as receipts at transfer docks and furnace yards nationwide. The dock and steel plant data were compiled jointly by AIOA and the American Iron and Steel Institute (AISI).

Although iron ore was produced by 14 companies, 9 of them accounted for 98.7% of all domestic production. The 14 companies operated 14 mining operations, 10 concentration plants, and 10 pelletizing plants. Of the 14 mining operations, 13 were open pit and 1 was an underground operation. Virtually all ore was concentrated before shipment, and 98.4% was pelletized.

Combined U.S. and Canadian production represented about 9.6% of the world output of usable ore in 1996. The leading producer was Brazil, which accounted for 21.3% of world output in terms of metal content, followed by Australia, with 16.9%. Trends in world mine production by country, since 1992 are listed in table 17.

At 62.1 million tons, domestic iron ore production was less than 1% lower than that of 1995. Eleven mines produced ore for the iron and steel industry, while the remainder produced ore mainly for cement plants. Productivity in the Lake Superior District in terms of tons of usable ore produced per worker-hour increased as usual. An average of 3.3 tons of crude ore was mined for each ton of usable ore produced. Low-grade ores of the taconite type mined in Michigan and Minnesota accounted for 99.7% of total crude ore production. U.S. production of pellets totaled 61.1 million tons. The average iron content of usable ore produced was 63.2%.

Cleveland-Cliffs Inc. (Cliffs) announced an international joint venture to produce and market reduced iron briquettes for the steel industry. The venture's participants, through subsidiaries,

will be Cliffs, 46.5%; LTV Corp, 46.5%; and Lurgi AG of Germany, 7%. Plans called for Cliffs to manage the project, to be located in Trinidad and Tobago, and to be responsible for sales by the venture company, Cliffs and Associates, Ltd. The plant will be designed to produce at least 0.5 million metric tons of briquettes per year. The project was to incorporate the first commercial use of the Circored fluidized bed technology developed by Lurgi Metallurgie GmbH, a member of the Lurgi Group. The iron ore fines feedstock will be supplied by Companhia Vale de Rio Doce (CVRD) of Brazil under a long-term contract. After a successful startup, Cliffs expected to increase the production capacity to 1.5 million metric tons per year) (Skillings' Mining Review, 1996b).

Michigan.—Michigan accounted for 24.3% of the output of usable ore in 1996. All the State's production was from the Empire and the Tilden Mines near Ishpeming in Marquette County and nearly all was pelletized. Both mining ventures are managed by Cleveland-Cliffs Iron, a subsidiary of Cliffs. Cliffs announced that after 16 years of being idle, the Republic Mine would be closed permanently. The Republic Mine supplied the ore for the first pellets produced in Michigan in 1956.

Minnesota.—Minnesota produced 75.1% of the national output of usable ore. All the State's production came from open-pit mines on the Mesabi Range. Production of pellets totaled 47.1 million tons.

Eveleth Mines went through a period of significant transition late in the year. First the management and ownership structures were changed after Oglebay Norton Co. announced that, as of December 31, 1996, it would not extend its contract as manager and employer of Eveleth Mines. That announcement was followed by another stating that Oglebay was selling its interest in the taconite operation that it had managed since operations were begun in 1965.

Following those changes, the operation was reorganized from Eveleth Mines to Eveleth Mines LLC (EVTAC Mining). Eveleth Mines was not a legal entity; rather it was a collective name for Eveleth Taconite Co., formed in 1965, and Eveleth Expansion Co., formed in 1976. The new company, EVTAC Mining, is 45% owned by Eveleth Taconite Co., a wholly owned subsidiary of Rouge Steel Co., Dearborn, MI; 40% owned by Virginia Horn Taconite Co., a wholly owned subsidiary of AK Steel Corp., Middletown, OH; and 15% owned by Ontario Eveleth, a wholly owned subsidiary of Stelco Inc., Hamilton, Ontario. The Thunderbird Mining Co., a wholly owned subsidiary of EVTAC Mining, has replaced Oglebay Norton Taconite Co. as the employer company at the Thunderbird Mine and the Fairlane plant

Another change is the relationship between the management of the operation and the steelmakers that own it. EVTAC is a limited liability company that is managed and operated locally and sells its product on a contract sales basis to its members as well as on the open market. That makes EVTAC the first taconite operations on the Mesabi Range to be locally managed. As part of this new relationship, EVTAC will arrange its own financing, and, unlike other iron ore operations, the company will have to deal directly with a bank or other lending institution to obtain financing.

The next part of the transition was aimed at increasing productivity at the mine and the plant. At the mine, EVTAC will buy 240-ton trucks as the 190-ton trucks are phased out. Hydraulic excavators with 25-cubic-yard-capacity buckets have been purchased. The all-hydraulic operation eliminates the need for handling large electric power cables. At the plant, production capacity will be increased through improvements to the processing facilities by the addition of centralized computer controls. Capacity is expected to increase by 10% to 5.8 million metric tons per year by 2000 at the same employment level (Skillings Mining Review, 1996a).

After National Steel Pellet Co. was closed for nearly a year in 1993 and 1994 as a result of a labor dispute, many thought the plant would not reopen. Since reopening in August 1994, however, National has become one of the lowest cost producers on the Mesabi Range and in 1996 produced its 100-millionth ton of ore. Its parent company, National Steel Corp., invested $50 million in the plant, and in 1996, National added 32 employees, for a total work force of 492. It hopes to increase annual capacity from 5.2 million tons to 5.75 million tons. The plant is in the midst of a $6 million project to increase concentrate capacity, and if a $7.5 million ported kiln project is approved, it could reach that higher production goal within a few years (Bloomquist, 1996).

The Minnesota Iron and Steel Co. (MIS), Hibbing, Minnesota, was formed to pursue the development of DRI. MIS is studying the feasibility of building a state-of-the-art taconite plant and DRI facility at the site of the Butler Taconite facility near Nashwauk, Minnesota, which closed in 1985. MIS plans to reopen mines and the tailings basin formerly operated by Butler Taconite, employing several hundred workers. Plans called for the company to sell DRI to integrated steel producers who make steel from taconite pellets and minimills who make steel from scrap. There could also be sales of pellets to the integrated steelmakers.

Missouri.—The Pea Ridge Iron Ore Co. produced iron oxide powder at its mining complex near Sullivan, Missouri. The company has the only active underground iron mine in the country. In January 1991, the company ceased pellet production and began concentrating on specialty iron oxide products, which had formerly been coproducts.

Consumption

Data on consumption and stocks of iron ore and agglomerates at iron and steel plants were provided by the AIOA. Data on consumption of iron ore for nonsteel end uses were compiled from information gathered from USGS surveys. Virtually all iron ore (98.7%) is consumed by the steel industry. Reported consumption of iron ore for manufacture of cement, heavy-medium materials, animal feed, ballast, ferrites, pigments, and other nonsteel products was 0.94 million tons.

Iron ore consumption fell from 83.1 million tons in 1995 to 79.3 million tons, a 4.6 % decrease from that of 1995. Pig iron production fell by 2.9 % and crude steel production fell by less

than one percent. The number of blast furnaces in operation during the year ranged from 36 to 40.

Consumption of iron ore and all types of agglomerates reported to the AISI by integrated producers of iron and steel totaled 77.7 million tons. This included 64.9 million tons of pellets; 11.8 million tons of sinter, and briquettes, etc.; and 0.945 million tons of natural coarse ore. Of the ore consumed, 80% was of domestic origin, 10% came from Canada, and 10% came from other countries. Other materials consumed in sintering plants included mill scale, flue dust, limestone and dolomite, slag and slag scrap, and coke breeze. Other iron-bearing materials charged to blast furnaces included steel-furnace slag, mill scale, and slag scrap.

Prices

Most iron ore prices are negotiated between buyer and seller. About 80% of domestic ore is produced by captive mines (mines producing for company smelters) and, therefore, does not reach the open market. The average f.o.b. mine value of usable ore shipped in 1996 was $29.86 per ton, somewhat higher than that of 1995. This average value should approximate the average commercial selling price less the cost of mine-to-market transportation.

Although international iron ore producers won price increases for 1996, when adjusted for inflation, prices were much lower than those of 1990. Using Carajás and Eastern Canadian fine ores as examples, their 1996 prices were 25% lower than those of 1990. The inflation adjustment factor used was the Consumer Price Index (CPI) for Urban Consumers from the Bureau of Labor Statistics. The CPI was rebased to 1982-1984.

Transportation

Because virtually no iron ore is consumed near where it is produced, the ore must be transported, often great distances. Nearly all iron ore leaves the mine by rail, and much of it is then transferred to ships. In the United States, a much larger proportion of ore is moved by water than elsewhere because of the proximity of the mines to the Great Lakes, which offer low-cost transportation. No taconite mine is more than about 100 kilometers (60 miles) from Lake Superior or Lake Michigan, and most are much closer. From 1991 through 1996, an average of 89.7% of all ore produced was transported on the Great Lakes. Iron ore, in fact, is the mainstay of U.S.-flag Great Lakes shipping. From 1992 through 1996, iron ore constituted 47.0% of U.S.-flag cargoes, followed by limestone/gypsum at 21.6%. Including transshipments, U.S.-flag carriers moved 51.8 million tons of iron ore in 1996, an increase of 2.2% compared with that of 1995. Transshipments of iron ore occur on the way to steelworks in Cleveland, OH. These steelworks must be reached via the Cuyahoga River, which cannot accommodate vessels longer than 193 meters (635 feet) with a beam of 21 meters (68 feet). Few Great Lakes vessels are this small, so the ore carried by most lakers must be taken to nearby Lorain, OH, offloaded onto smaller vessels, and transshipped to Cleveland.

World iron ore exports were 430.8 million tons in 1996, down from 439.7 million tons the previous year. International seaborne trade fell from about 400 million tons in 1995 to about 390 million tons in 1996.

Foreign Trade

U.S. exports of iron ore were 18.9% higher than those of 1995. Virtually all exports consisted of pellets shipped via the Great Lakes to Canadian steel companies that are partners in U.S. taconite projects in Michigan and Minnesota. U.S. imports of iron ore at 18.4 million tons were 4.8% higher than those of 1995. Net imports, which averaged 11.5 million tons from 1989 through 1996, were 12.1 million tons in 1995. This was equivalent to 14.5 % of U.S. ore consumption. Canada's share of imports was 53.3 %, and Brazil's was 28.1%.

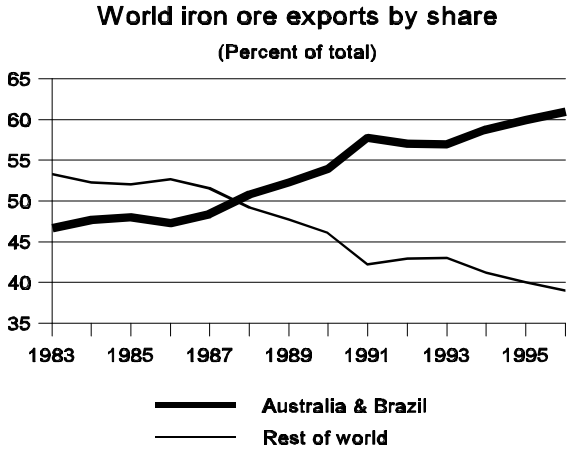
World Review

Production.—World demand eased in 1996 owing to lower crude steel production in Japan and Europe. Internationally, iron ore production fell to 1,019 million tons. Although iron mining was widespread, with production in 53 countries in 1996, a small number of countries accounted for the bulk of world production. Three countries, Australia, Brazil, and China, accounted for 56.5% of world production. In terms of gross weight, China was the largest producer, accounting for 24.5% of world production, but because of its low ore grades, was third in world iron ore production, with only 13.7 % of the total.

Consumption.—World pig iron production, the best indicator of iron ore consumption, has remained flat since 1990. Production in 1996 was virtually the same that of 1990. During this period, China, Europe, the former Soviet Union [FSU], Japan and North America have accounted for more than 80% of the world's pig iron production. In Europe, Japan and North America, pig iron production has remained virtually constant. Production fell considerably in the FSU and rose dramatically in China. Production has also increased substantially in other parts of Asia, particularly India, the Republic of Korea, and Taiwan. Asia's share of world pig iron production rose to 44.8% from 34.4% in 1990; this trend is expected to continue. Iron ore consumption in Japan, as shown by pig iron production, has been flat recently partly because of changes in the Japanese automobile industry, a major consumer of steel. Long a major consumer of iron ore, Japan produced an average of 78,625 metric tons per year of pig iron for the 5-year period from 1987 through 1991. In the next 5-year period, from 1992 through 1996, pig iron production averaged 74,032 tons per year, a decrease of almost 6% (Duisenberg, 1997). The Japanese automobile industry produced 13.5 million units in 1990, of which 3.5 million were produced overseas. In 1995, Japanese automobile production had fallen 10 million units, of which 6 million were produced overseas (The TEX Report, 1996b).

Trade.—Australia and Brazil continued to dominate the

international export market, accounting for 61.0% of world exports. (See graph below.)



In 1996, 39.7 % of world iron ore production was exported, down from 42.9% in 1995. Australia was the leading exporter of iron ore, shipping 135.7 million tons to world markets, followed closely by Brazil, which exported 129.7 million tons. The next largest exporter was India, at 7.3%. Total exports were 434.9 million tons, down from 447.3 million tons in 1995. Australia's principal export customer, Japan, accounted for 44.4% of its exports, with Asia as a whole accounting for 79.7%. Brazil's primary export customers were Asia (41.0%) and Western Europe (40.0%).

Japan was, by far, the world's largest importer, accounting for 27.7% of all iron ore imports. The next largest was China, which took 10.1% of total world imports, followed by Germany at 9.1%. Australia supplied 49.9% of Japan's iron ore needs, followed by Brazil (22.4%) and India (13.3%).

Australia.—The country continued to be the world's leading exporter of ore.

BHP Iron Ore Pty. Ltd.'s Yandi expansion project (also called Yandi 2) opened in October. It involved the development of a second mining operation based on an estimated 200 million tons of ore in the Yandi Central Mesa 1 and 2 deposits. The development also includes a 10-kilometer (6-mile) rail spur which connects to the existing Yandi line. The expansion will duplicate the existing Yandi mining operation (Yandi 1), which started in 1992. Yandi 2 was principally developed to meet increased demand and will take total capacity for the mine from 15 million tons per year to 25 million tons per year and can be further expanded to 35 million tons per year if required.

BHP expects to begin developing Orebody 18 in March 1997. The deposit is located about 32 kilometers (20 miles) east of the existing Mount Whaleback operation at Newman and reportedly contains about 116 million tons of high grade ore, which the company proposes to extract at an initial rate of 5 million tons per year, increasing during the next several years to 10 million tons per year. BHP received environmental approval late in the year. The operation will be serviced by an 8-kilometer rail (5-mile) spur from the existing Jimblebar line.

BHP began construction of a 2- to 2.5-million-ton-per-year DRI/ hot briquetted iron (HBI) plant at Port Hedland, on the coast of Western Australia. The $1.125 billion facility, which includes the HBI plant, beneficiation plant, overland conveyor, and port infrastructure for Nelson Point and Finucane Island was expected to begin production in late 1998. This is the first use of the FINMET (see Current Research and Technology) technology and the first DRI plant in Australia.

In July, BHP commissioned its Newman power station, which is rated at 105 megawatts, and uses gas from the Goldfields gas pipeline, which was completed in October. This 1,380 kilometer (857 mile) pipeline provides competitive supplies of energy to the iron-ore-producing region of eastern Pilbara, in Western Australia (Western Australian Department of Resources Development, 1997).

Hamersley Iron, Australia's largest iron ore producer, loaded its 100-billionth ton of ore at the port of Dampier in Western Australia. Hamersley currently has five mines in the Pilbara region of northwestern Australia, all located within a radius of 80 kilometer (50 miles) of Mount Tom Price, its largest mine and the first to be established 30 years ago. The company is developing a new mine at Yandicoogina, 150 kilometer (93 miles) east of Tom Price. The area reportedly contains a billion-ton resource of pisolitic ore. Hamersley expects the mine to be in production in 1999, eventually producing a rate of 15 million tons per year with a 30-year life. The mine will be linked to Hamersley's existing rail and port facilities (CRA Gazette, 1996; RTZ-CRA, 1996).

Robe River shipped its 400-millionth ton of ore. The company modernized its production fleet at its Mesa J Mine near Pannawonica with the purchase of excavators, haul trucks, and rotary blasthole drill rigs.

Cleveland-Cliffs Inc. closed its Savage River Mines in Tasmania because of the depletion of economically recoverable ore (Cleveland-Cliffs Inc., 1996). Goldamere, a Brisbane-based company, trading as Australian Bulk Minerals, planned to reopen the mine in 1998 (Metal Bulletin, 1996b).

Brazil.—CVRD, the world's largest iron ore producer, led a consortium that was building a $270 million, 210-megawatt dam in east-central Minas Gerais State. The dam will allow CVRD, with a 35% interest in the consortium, to become partially self-sufficient in energy. Named Igarapava, the dam was expected to go into operation in December 1998. To help finance the project, CVRD signed an agreement with Voest Alpine Industrienlagenbau GmbH (VAI) of Linz, Austria, to swap iron ore for electricity generators for the dam. The deal called for 3.2 million metric tons of ore to be exchanged over 5 years in return for five generators worth $57 million. VAI is Austria's largest steelmaker in addition to being a major producer of hydroelectric generators. VAI's mine, which has been worked since the Middle Ages, is scheduled to close in 1997 (International Iron and Steel Institute, 1995; Kepp, 1996).

CVRD produces iron ore in two integrated mine-rail-port systems known as the Southern and Northern systems. The Carajás iron district is located in the Northern system. Ore is transported by the Carajás Railroad to the port of Ponta da

Madeira. The Southern system includes the mines in Minas Gerais from which ore is transported by the Vitória-Minas Railroad to the port of Tubarão, where CVRD has a pelletizing complex that consists of six plants with a combined capacity of 19 million metric tons per year. The company expanded the concentration mill at its Conceição Mine in the Southern system, raising production capacity to 20 million metric ton of pellet feed (CVRD, 1996).

CVRD was building a $7 million screening plant at its Carajás complex to fulfill its contractual obligations to supply fine ore to the hot briquetted iron (HBI) plant that was to be built in Trinidad and Tobago by Cliffs and Associates, Ltd. (See Production Section.) The plant was scheduled to be producing 900,000 tons per year by February 1998. The HBI plant will have an initial capacity of at least 500,000 tons per year (American Metal Market, 1996).

Canada.—The three mining operations in the Labrador Trough area of northern Quebec and Labrador accounted for 98% of Canadian iron ore production. These were the Iron Ore Company of Canada (IOC), Quebec Cartier Mining Co. (QCM) and Wabush Mines. Canadian production, at 36 million tons, declined 4% from that of 1995 (Boyd, 1996).

India.—A newly opened railway line in the east Indian State of Orissa doubled the transport capacity for iron ore shipped from the mines at Bailadila to the Visag steel plant and port. The 164-kilometer (102-mile) railway took 9 years to complete because of the difficult terrain (Metal Bulletin, 1996c).

Essar Gujarat Ltd. began making test runs on its new 3-million-tons-per-year pellet plant in Visakhapatnam. The Lurgi type plant was completed in May 1996. Essar plans to produce 2 million tons per year for the first year and 3 million tons per year thereafter. During the first 2 years, the plant will produce pellets for the blast furnace market and will then switch to pellets for direct reduction (The TEX Report, 1996c).

The RTZ-CRA joint venture Orissa Mining Corp. formed to develop iron deposits in Orissa State received Government approval. The Gandhamardan and the Malangtoli deposits are located in the Keonjhar-Singhbum district of Orissa State. RTZ-CRA owns Hamersley Iron of Australia (Metal Bulletin, 1996a; RTZ-CRA, 1996).

Norway.—The Norwegian Parliament voted to close Sydvaranger, the world's most northerly iron mine at Bjørnevatn near Kikenes. To remain in operation, the mine would have had to convert from open-pit to underground mining, requiring further Government subsidies. The mine had been operating at a loss since the mid-1970's (Metal Bulletin, 1996d).

Spain.—Compañía Andaluza de Minas closed its iron mines at Marquesado, in Granada, in October.

Sweden.—Kiirunavaara AB (LKAB), the State-owned iron ore producer, aggressively continued its efforts to expand production, to cut costs, and to improve quality. The expansion effort resulted in decisions made to mine that part of the Kiruna main ore body that extends under Lake Luossajärvi and to develop the hematite deposits at its Malmberget Mine. Mining operations towards the north in the underground mine at Kiruna are currently restricted because of the risk of water seeping into the mine from the nearby lake. LKAB has been granted all the necessary permits for mining the Lake Ore, as it is known, and for draining the southern part of Lake Luossajärvi, which is separated from the northern part by a rail causeway. This is expected to add 4 years to the operating life of the mine.

At Malmberget, there are numerous ore bodies, most of which contain magnetite and a number of which contain hematite. When mining began, hematite, because it is virtually nonmagnetic, was too difficult and expensive to handle from a mineral processing point of view. However, with new, proven technologies, it is possible to exploit certain hematite bodies. Production is expected to be underway by May 1998. This is expected to increase production at Malmberget by 1.7 million tons per year of finished products in the form of fines and pellets, bringing the total annual production to 8.7 million tons per year.

To reduce costs, LKAB assumed control of the ore rail system and improved the harbor at Luleå, on the Gulf of Bothnia. The ore line, a 500-kilometer (310-mile) long railway, is the main artery for LKAB's ore traffic. It stretches from Luleå, to Narvik on Norway's Atlantic coast. LKAB delivered 20.6 million tons of ore products, of which 12.5 million tons was shipped via Narvik. The rest, 8.1 million tons, was delivered via Luleå. LKAB assumed control of the Norwegian part of the rail line on July 1 by acquiring 51% of the equity; the company had gained control of the Swedish part of the line some years earlier. Plans call for upgrading the railway so that it can carry heavier loads. The upgrade would raise the carload to 100 tons. Currently, railcars can carry no more than 80 tons each. This means that 8 or 9 trains a day to Narvik could carry the same cargo that requires 12 or 13 trains today.

To improve the quality of its products, LKAB decided to construct a pilot-scale blast furnace at Luleå. The pilot blast furnace is expected to reduce lead times for product development and market introduction and to result in better test methods for use in the production of pellets.

Outlook

At current consumption rates, United States iron reserves will last well into the 21st century. The domestic iron ore industry is totally dependent on the steel industry for sales. This dependence is not expected to change in the near future. Because of this relationship, the reader is referred to the outlook section in the "Iron and Steel" chapter. It is difficult for the United States to compete elsewhere in the world iron ore market because of the inland location of its mines and high labor and energy costs. Only 8.3% of the iron ore produced from 1990 through 1996 was exported; virtually all of it was pellets that went to steelworks in Ontario. For the near term, growth of the U.S. iron ore industry is tied to the growth of the integrated steelworks along the Great Lakes. The hope for the domestic iron ore industry is that one or more of the new direct reduction processes will prove to be economic for Lake producers. If this occurs, then the domestic industry can supply the rapidly expanding minimill sector of the steel industry. Electric arc

furnaces (EAF) currently account for 42% of total crude steel production, and, by 2000, 15 million tons per year of new production capacity is expected, which will increase EAF output by 30% and raise its share of steel produced in the United States to nearly 50%.

Steel products require lower residual alloy content than can be readily achieved with scrap. This indicates a role for imported DRI in the coastal regions of the United States. The growth of gas-based DRI production capacity outside North America has been spectacular in recent years. Although a large part of this growth has occurred in Venezuela, the bulk of the construction has been spread evenly through a variety of countries that have surplus natural gas. It is too early to tell whether coal-based DRI production will be economically feasible in the United States. No matter how spectacular DRI growth is over the next decade, it will not be able to replace more than a fraction of the world's blast furnace production because of technological restrictions. The blast furnace is expected to remain the mainstay of the iron and steel industries in most developed countries during the next 25 years.

At current consumption rates, international iron reserves are sufficient to meet demand, for at least 100 years. On the basis of recent growth rates in Asia, additional iron ore production capacity will be needed. As in the United States, much of the increase in consumption of iron will be from newly constructed minimills. Unlike the United States, however, where the consumption of iron ore in blast furnaces is declining, much of the additional ore needed will go to feed blast furnaces. Since 1992, four major-sized modern blast furnaces with an ll.6-million-ton-per-year capacity have been built and six more with a 12.5-million-ton-per-year capacity are being constructed or are committed between 1997 and 2002 (Skillings Mining Review, 1996d). Because iron ore prices have not risen substantially and industry observers see no reason to believe that they soon will, it seems unlikely that future increases in supply will come from greenfield operations. Supply increases would, instead, come from low-cost brownfield expansions by existing producers in the major supplier countries, such as Australia and Brazil.

Most of the recent growth in iron ore consumption has come from Asia, particularly China, the Republic of Korea, and Taiwan.

Since 1990, Australia, Brazil, and India provided 84.8% of the ore for the primary Asian iron ore importing countries of China, Japan, Korea, and Taiwan. During this period, these importers accounted for 96.6% of total Asian imports and 48.2% of world imports. Australia's share of this export market is the largest and fastest growing. From 1990 through 1996, Australia's share was 48.6%, compared with 23.3% and 12.9% for Brazil and India, respectively. Australia's exports to the four Asian importing countries rose by 34.2% during this period, while those of Brazil increased by 9.6% and those of India fell slightly.

Current Research and Technology

A joint venture project that marked the first commercial use of the Circored fluidized bed technology began during the year. The venture's participants, through subsidiaries, were Cleveland-Cliffs Inc., 46.5%; LTV Corp, 46.5%; and Lurgi AG of Germany, 7%. The process was developed by Lurgi Metallurgie GmbH, a member of the Lurgi Group (Engineering and Mining Journal, 1996; Metal Bulletin, 1996e).

The Circored process differs from most DRI technologies in that it does not require that ore be pelletized. Instead, iron ore fines are reduced by hydrogen in a two-step process at about 600° and 60 pounds per square inch, gauge. First, 50 to 70% reduction is obtained in a circulating fluidized bed in 15 to 20 minutes, then reduction is completed in 2 to 4 hours in a bubbling fluidized bed (Chemical Engineering, 1996; New Steel, 1996). The final product contains no carbon, and the only byproduct is water. Trinidad and Tobago was chosen as the location for the plant because of its abundant supply of natural gas and proximity to a source of iron ore fines (Cleveland-Cliffs Inc, 1996).

BHP began construction of a DRI/HBI plant using FINMET technology, which involves the reduction of fine iron ore concentrate by using reformed natural gas. Test results have shown that BHP fines will work well with this process. The FINMET process is an improvement on the fluidized iron ore reduction (FIOR) process and was developed by FIOR de Venezuela and Voest Alpine Industrienlagenbau. The process uses three or four conventional bubbling fluid beds to preheat and reduce ore fines that range in size from 0.01 to 12 millimeters. The product from the process is briquetted. The reducing gas is produced by a steam reformer, and top gas is recycled from the reactors. Both gas streams are scrubbed to remove CO_2, and the combined stream is heated in a gas-fired heater before entering the reactor system. One of the major advantages claimed for the process is that it can use iron ore fines without agglomeration (BHP Minerals, 1995).

Midrex Direct Reduction Corp. and its parent company, Kobe Steel Ltd., have developed a new direct reduction process known as the spouted iron reduction (Spirex) process. The new process uses iron ore fines as feed and natural gas as the reductant to produce DRI fines, which can be hot-briquetted. The companies plan to build a demonstration-scale plant for the process near Opco, Kobe Steel's subsidiary that produces HBI. Opco, located in Puerto Ordaz in the eastern Venezuelan State of Guayana, has available land and access to natural gas and iron ore fines. The plant is expected to begin operations in the second quarter of 1998 with an annual capacity of 30,000 metric tons. An advantage of the Spirex process is that it should be able to use a wide range of iron ore fines. Turbulent movement of the fines in the preheater and the first stage reactor is supposed to degrade the iron ore particles into smaller sizes and thus make them more uniform in size.

If the process proves to be commercially feasible, then it should enable Midrex to offer its customers a wider range of options. Midrex is the leader in providing direct reduction

technology. Its standard process, currently in use around the world, accounted for 65% of DRI production in 1995. In this process, iron ore lumps or pellets are reduced by using natural gas. Midrex and Kobe Steel are also developing the Fastmet process, which uses coal and iron ore fines to produce DRI in a rotary hearth furnace. A Fastmet demonstration plant has been operating in Japan for some time. Construction of a commercial-scale plant in Louisiana is expected to begin in the first quarter of 1997. Also, the companies earlier announced a project to develop an as-yet unnamed process that will produce liquid iron for EAF's using a self-fluxing pellet made of pulverized coal and iron ore fines.

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[1]Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT IRON ORE STATISTICS 1/ 2/

(Thousand metric tons and thousand dollars unless otherwise specified)

	1992	1993	1994	1995	1996
United States:					
Iron ore (usable, 3/ less than 5% manganese):					
Production	55,593	55,661	58,382	62,489	62,073
Shipments	55,600	56,300	57,600	61,100	62,200
Value	$1,550,000 r/	$1,380,000 r/	$1,410,000 r/	$1,730,000 r/	$1,770,000
Average value at mines, dollars per ton	$27.90 r/	$24.50 r/	$24.50 r/	$28.40 r/	$28.50
Exports	5,060	5,060	4,980	5,270	6,260
Value	$187,000	$167,000	$163,000	$184,000	$232,000
Imports for consumption	12,500	14,100	17,500	17,600 r/	18,400
Value	$396,000	$419,000	$499,000	$491,000 r/	$556,000
Consumption (iron ore and agglomerates)	75,100	76,800	80,200	83,100	79,300
Stocks, Dec. 31:					
At mines, plants and loading docks 4/	3,780	2,500	2,790	4,240 r/	4,650
At receiving docks 5/	2,980	2,290	2,230	2,140	2,260
At consuming plants	16,100	16,500	16,300	17,100	18,800
Total 6/	22,900	21,300	21,300	23,500 r/	25,700
World: Production	924,993 r/	953,099 r/	981,403 r/	1,027,136 r/	1,020,266 e/

e/ Estimated. r/ Revised.

1/ There are four consumption numbers as shown in tables 1, 6, 7, and 8. The following explains why there is more than one consumption number and how each of them is derived. The first consumption number (79,300 thousand metric tons in 1996) appears in table 1 and is the sum of the AISI consumption number (77,700) plus reported consumption of iron ore in direct reduced iron (DRI) production and non-steel uses. The second consumption number (71,700 thousand metric tons in 1996) appears in table 6 and is the quantity of ore consumed at U.S. iron and steel plants by originating area as reported by the AIOA. The number has been converted from thousands of long tons, as it appears in the AIOA annual report, to thousands of metric tons. The third consumption number (77,700 thousand metric tons in 1996) appears in table 7 and is the quantity of ore consumed in U.S. iron and steel plants by type of ore as reported by the AISI. The number has been converted from thousand short tons, as it appears in the AISI annual report, to thousand metric tons. The fourth consumption number (73,300 thousand metric tons in 1996) appears in table 8 and is the sum of the AIOA consumption number (71,700) and two other numbers. These are quantities of ore consumed in DRI production and non-steel uses as reported to the USGS. In summary, iron ore consumption for steelmaking is reported by the AIOA and the AISI. To obtain iron ore consumption for steelmaking and other uses, iron ore consumption for other end uses must be added to AIOA and AISI reported consumption, thereby generating four consumption numbers.

2/ Data are rounded to three significant digits, except "Production"; may not add to totals shown.

3/ Direct-shipping ore, concentrates, agglomerates, and byproduct ore.

4/ Excludes byproduct ore.

5/ Transfer and/or receiving docks of Lower Lake ports.

6/ Sum of stocks at mines, consuming plants, and U.S. docks.

TABLE 2
EMPLOYMENT AT IRON ORE MINES AND BENEFICIATING PLANTS, QUANTITY AND TENOR OF ORE PRODUCED, AND AVERAGE OUTPUT PER WORKER-HOUR IN THE UNITED STATES IN 1996, BY DISTRICT AND STATE 1/

			Production (thousand metric tons)				Average per worker-hour (metric tons)		
District and State	Average number of employees	Worker-hours (thousands)	Crude ore	Usable ore	Iron contained (in usable ore)	Iron content, natural (percent)	Crude ore	Usable ore	Iron contained
Lake Superior:									
Michigan	1,890	4,040	44,800	15,100	9,310	61.8	11.10	3.73	2.30
Minnesota	5,570	8,120	162,000	46,600	29,700	63.7	20.00	5.74	3.66
Total or average	7,460	12,200	207,000	61,700	39,000	63.3	17.00	5.07	3.21
Other States 2/	93	205	533	409	233	57.1	2.60	2.00	1.14
Grand total or average	7,560	12,400	208,000	62,100	39,200	63.2	16.80	5.02	3.17

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes California, Missouri, New Mexico, South Dakota, Texas, and Utah.

TABLE 3
CRUDE IRON ORE 1/ MINED IN THE UNITED STATES IN 1996,
BY DISTRICT, STATE, AND MINING METHOD 2/

(Thousand metric tons unless otherwise specified and exclusive of ore containing 5% or more manganese)

District and State	Number of mines	Open pit	Underground	Total quantity
Lake Superior:				
Michigan	2	44,800	--	44,800
Minnesota	8	162,000	--	162,000
Total	10	207,000	--	207,000
Other States:				
Missouri	1	--	533	533
Other 3/	6	--	--	--
Total	7	--	533	533
Grand total	17	207,000	533	208,000

1/ Excludes byproduct ore.
2/ Data are rounded to three significant digits; may not add to totals shown.
3/ Includes California, New Mexico, South Dakota, Texas, and Utah.

TABLE 4
USABLE IRON ORE PRODUCED IN THE UNITED STATES IN 1996, BY DISTRICT,
STATE, AND TYPE OF PRODUCT 1/

(Thousand metric tons and exclusive of ore containing 5% or more manganese)

District and State	Direct shipping ore	Concentrates	Agglomerates 2/	Total quantity
Lake Superior:				
Michigan	44	--	15,000	15,100
Minnesota	420	164	46,000	46,600
Total	464	164	61,000	61,700
Other States:				
Missouri	11	243	14	269
Other 3/	140	--	--	140
Total	152	243	14	409
Grand total	616	407	61,100	62,100

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Data may include pellet chips and screenings.
3/ Includes California, New Mexico, South Dakota, Texas, and Utah.

TABLE 5
SHIPMENTS OF USABLE IRON ORE 1/ FROM MINES IN THE UNITED STATES IN 1996 2/

(Exclusive of ore containing 5% or more manganese)

District and State	Gross weight of ore shipped (thousand metric tons)				Average iron content, natural (percent)	Value (thousands)
	Direct shipping ore	Concentrates	Agglomerates	Total		
Lake Superior:						
Michigan	48	--	15,000	15,100	61.8	W
Minnesota	420	2	46,300	46,700	63.7	$1,330,000
Total reportable or average	468	2	61,300	61,800	63.3	1,330,000
Other States:						
Missouri	14	263	14	291	70.5	W
Other 3/	87	--	--	87	57.1	1,590
Total reportable or average 3/	101	263	14	378	63.2	1,590
Total withheld	--	--	--	--	--	440,000
Grand total or average	570	265	61,300	62,200	63.2	1,770,000

W Withheld to avoid disclosing company proprietary data; included in "Total withheld."
1/ Includes byproduct ore.
2/ Data are rounded to three significant digits; may not add to totals shown.
3/ Includes California, New Mexico, South Dakota, Texas, and Utah.

TABLE 6
CONSUMPTION OF IRON ORE 1/ AT U.S. IRON AND STEEL PLANTS 2/

(Thousand metric tons)

	Iron ore originating areas					
	U.S. ores		Canadian ores			
Year	Great Lakes	Other U.S.	Great Lakes	Other Canada	Foreign ores	Total
1995	58,200	133	1,460	6,660	7,720	74,200
1996	56,800	--	2,060	5,420	7,400	71,700

1/ Excludes dust, mill scale, and other revert iron-bearing materials added to sinter.
2/ Data are rounded to three significant digits; may not add to totals shown.

Source: American Iron Ore Association.

TABLE 7
CONSUMPTION OF IRON ORE AND AGGLOMERATES AT U.S. IRON AND STEEL PLANTS, BY TYPE OF PRODUCT 1/

(Thousand metric tons)

Type of product	1995	1996
Blast furnaces:		
Direct-shipping ore	1,200	862
Pellets	67,600	64,900
Sinter 2/	12,400	11,600
Total	81,200	77,400
Steelmaking furnaces:		
Direct-shipping ore	54	83
Pellets	44	20
Sinter 2/	175	178
Total	273	281
Grand total	81,500	77,700

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes briquettes, nodules, and other.

Source: American Iron and Steel Institute.

TABLE 8
U.S. CONSUMPTION OF IRON ORE AND AGGLOMERATES, BY END USE 1/

(Thousand metric tons and exclusive of ore containing 5% ore more manganese)

Year	Blast furnaces	Steel furnaces	Sintering plants 2/	Miscella-neous 3/	Subtotal integrated iron and steel plants 4/	Direct-reduced iron for steelmaking 5/	Nonsteel end uses 6/	Total
1995	67,600	60	6,490	29	74,200	675	931	75,800
1996	64,900	87	6,670	58	71,700	684	940	73,300

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Excludes dust, mill scale, and other revert iron-bearing materials.
3/ Sold to nonreporting companies or used for purposes not listed.
4/ Data from American Iron Ore Association.
5/ U.S. Geological Survey estimates based on production reports compiled by Midrex Corp.
6/ Includes iron ore consumed in production of cement and iron ore shipped for use in manufacturing paint, ferrites, heavy media, cattle feed, refractory and weighing materials, and for use in lead smelting. Data from U.S. Geological Survey surveys.

TABLE 9
U.S. EXPORTS OF IRON ORE AND AGGLOMERATES,
BY COUNTRY OF DESTINATION 1/

(Thousand metric tons and thousand dollars)

Country	1995		1996	
	Quantity	Value	Quantity	Value
Canada	5,260	184,000	6,240	230,000
India	1	45	(2/)	5
Mexico	(2/) r/	42	10	891
Venezuela	--	--	1	117
Other	1	50	7	719
Total	5,270	184,000	6,260	232,000

r/ Revised.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 10
U.S. EXPORTS OF IRON ORE AND AGGLOMERATES, BY TYPE OF PRODUCT 1/

Type of product	1995			1996		
	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value 2/ (dollars per ton)	Quantity (thousand metric tons)	Value (thousand dollars)	Unit value 2/ (dollars per ton)
Concentrates	25	$687	$27.02	12	$430	$36.23
Coarse ores	23	414	17.97	1	39	30.36
Fine ores	51	908	17.69	34	1,070	31.81
Pellets	5,160	182,000	35.22	6,200	229,000	36.99
Briquettes	--	--	--	(3/)	14	NA
Other agglomerates	2	108	56.91	7	735	NA
Roasted pyrites	2	140	80.68	3	305	89.55
Total	5,270	184,000	34.96 4/	6,260	232,000	36.99 4/

NA Not available.
1/ Data are rounded to three significant digits, except prices; may not add to totals shown.
2/ Unit values shown are calculated from unrounded data.
3/ Less than 1/2 unit.
4/ Weighted average calculated from unrounded data by dividing total value by total tonnage.

Source: Bureau of the Census.

TABLE 11
U.S. IMPORTS OF IRON ORE AND AGGLOMERATES, BY COUNTRY AND TYPE OF PRODUCT 1/

Country and type of product	1995 Quantity (thousand metric tons)	1995 Value (thousand dollars)	1995 Unit value 2/ (dollars per ton)	1996 Quantity (thousand metric tons)	1996 Value (thousand dollars)	1996 Unit value 2/ (dollars per ton)
Australia	570	4,150	7.28	511	3,510	6.87
Brazil	4,810	104,000	21.62	5,170	132,000	25.53
Canada	9,050	278,000	30.72	9,800	326,000	33.27
Chile	57	808	14.18	164	2,790	17.01
Mauritania	317	5,520	17.41	275	5,090	18.51
Norway	14	648	46.29	--	--	--
Peru	54	763	14.13	43	476	11.07
Sweden	47	1,710	36.38	48	2,050	42.71
Venezuela	2,500 r/	91,600 r/	36.64	2,140	78,300	36.59
Other	133 r/	3,870	29.10	238	6,220	26.13
Total	17,600 r/	491,000 r/	27.95	18,400	556,000	30.25
Concentrates	1,510	24,600 r/	16.26	1,490	26,500	17.77
Coarse ores	1,970	67,700	34.43	1,370	51,000	37.31
Fine ores	3,550	56,800	15.98	3,370	55,900	16.60
Pellets	9,390	311,000	33.17	11,400	402,000	35.28
Briquettes	54 r/	5,710 r/	105.06 r/	--	--	--
Other agglomerates	1,070	23,900	22.28	757	20,400	26.89
Roasted pyrites	12	492	41.90	10	490	50.98
Total	17,600 r/	491,000 r/	27.95 3/	18,400	556,000	30.25 3/

r/ Revised.
1/ Data are rounded to three significant digits, except prices; may not add to totals shown.
2/ Unit values shown are calculated from unrounded data.
3/ Weighted average calculated from unrounded data by dividing total value by total tonnage.

Source: Bureau of the Census.

TABLE 12
U.S. IMPORTS OF IRON ORE AND AGGLOMERATES IN 1996,
BY COUNTRY AND TYPE OF PRODUCT 1/

(Thousand metric tons)

Country of origin	Concentrates	Coarse ores	Fine ores	Pellets	Other agglomerates	Roasted pyrites	Total
Australia	--	--	511	--	--	--	511
Brazil	960	147	2,120	1,730	217	--	5,170
Canada	447	73		8,770	509	--	9,800
Chile	38	--	126	--	--	--	164
Finland	--	--	--	--	--	9	9
Mauritania	--	--	275	--	--	--	275
Norway	--	--	--	--	--	--	--
Peru	--	--	--	--	--	--	--
Sweden	48	--	--	--	--	--	48
Venezuela	--	1,150	95	899	--	--	2,140
Other	(2	1	241	--	31	1	273
Total	1,490	1,370	3,370	11,400	757	10	18,400

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Less than 1/2 unit.

TABLE 13
AVERAGE UNIT VALUE FOR SELECTED IMPORTS OF IRON ORE
AND AGGLOMERATES IN 1996

Type of product	Country of origin	Average unit value 1/ (dollars per metric ton gross weight)
Coarse ores	Venezuela	35.88
Fine ores	Brazil	17.51
Do.	Mauritania	18.52
Do.	Venezuela	28.64
Pellets	Brazil	37.87
Do.	Canada	34.47
Do.	Venezuela	38.31

1/ Weighted averages of individual Customs values.

Source: Bureau of the Census.

TABLE 14
U.S. IMPORTS OF IRON ORE AND AGGLOMERATES, BY CUSTOMS DISTRICT 1/

(Thousand metric tons and thousand dollars)

Customs district	1995		1996	
	Quantity	Value	Quantity	Value
Baltimore	4,430	103,000	4,130	101,000
Charleston	600	20,000	602	20,600
Chicago	2,890	64,800	3,200	78,900
Cleveland	1,670	53,800	802	28,100
Detroit	342	13,600 r/	1,910	71,200
Houston-Galveston	43	1,010	72	1,980
Mobile	3,720	127,000	4,080	144,000
New Orleans	1,460 r/	31,600 r/	1,340	28,100
Philadelphia	2,390	76,100	2,180	79,400
Other	14	235 r/	83	2,310
Total	17,600 r/	491,000 r/	18,400	556,000

r/ Revised.
1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 15
U.S. IMPORTS OF PELLETS, BY COUNTRY 1/

(Thousand metric tons and thousand dollars)

Country	1995		1996	
	Quantity	Value	Quantity	Value
Brazil	1,180	40,200	1,730	65,500
Canada	7,200	238,000	8,770	302,000
Peru	36	507	--	--
Venezuela	911	31,400	899	34,400
Other	58 r/	1,660 r/	--	--
Total	9,390	311,000	11,400	402,000

r/ Revised.
1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 16
SELECTED PRICES FOR IRON ORE IN THE JAPANESE MARKET

(F.o.b. shipping port basis. U.S. cents per dry long ton of iron unless otherwise specified)

		April 1 - March 31	
	Ore type	Fiscal year 1995	Fiscal year 1996
Australia:			
Hamersley Iron Pty. Ltd. and Mount Newman Mining Co. Pty. Ltd.	Lump ore	35.89	37.68
Do.	Fines	27.15	28.78
Robe River Iron Associates	do.	21.90	23.53
Savage River Mines Ltd.	Pellets	44.42	47.37
Brazil:			
Cia. Nipo-Brasileira de Pelotizacao (Nibrasco)	do.	46.93	50.05
Cia. Vale do Rio Doce (Carajas)	Fines	24.84	26.30
Do.	Lump ore	(1/)	(1/)
Cia. Vale do Rio Doce (Itabira)	do.	26.73	28.07
Do.	Fines	24.34	25.80
Mineracoes Brasileiras Reunidas S.A.	do.	26.14	27.45
Do.	do.	24.81	26.30
Samarco Mineracâo S.A.	Pellet feed	20.45	21.67
Canada: Iron Ore Co. of Canada (Carol Lake)	Concentrates	23.60	25.02
Chile:			
Minera del Pacifico S.A. (El Algarrobo)	Pellets	43.75	46.65
Minera del Pacifico S.A. (El Romeral)	Fines	18.85	19.98
India:			
Minerals and Metals Trading Corp. (Bailadila)	Lump ore	34.60	36.33
Do.	Fines	26.07	27.63
South Africa 2/:			
South African Iron and Steel Industrial Corp. Ltd.	Lump ore	28.74	30.50
Do.	Fines	20.65	21.89

1/ No quotation published.
2/ Price per dry metric ton unit.

Source: Trust Fund Project on Iron Ore Information, Iron Ore 1995.

TABLE 17
IRON ORE, IRON ORE CONCENTRATES, AND IRON ORE AGGLOMERATES: WORLD PRODUCTION, BY COUNTRY 1/

(Thousand metric tons)

	Gross weight 3/					Metal content 4/				
Country 2/	1992	1993	1994	1995	1996 e/	1992	1993	1994	1995	1996 e/
Albania e/ 5/	200 6/	150	--	--	--	88	85	--	--	--
Algeria	2,523	2,311	2,047	2,000 e/	1,900	1,250 e/	1,250 e/	1,000 e/	1,000 e/	1,000
Argentina	5 r/ e/	3 r/ e/	42 r/ e/	-- r/	--	3 r/	2 r/	28	-- r/	--
Australia	112,101	120,534	128,493	142,936 r/	147,100 6/	69,761	74,767	80,900 e/	88,653	93,000 6/
Austria	1,627	1,435	1,655	2,116 e/	2,100	515	452	520 e/	660 e/	600
Azerbaijan	400	300 e/	200 e/	150 e/	150	220	165	110 e/	83 e/	83
Bolivia	55	51	3	-- e/	--	35	32	2	-- e/	--
Bosnia and Herzegovina e/	500	250	200	150	150	150	100	70	52	50
Brazil	146,447	150,000	167,900	177,000 r/	180,000	95,200	98,000	108,800	115,050 r/	117,000
Bulgaria	800 e/	880	466 r/	469 r/	770 6/	239	264 r/	140 r/	141 r/	231
Canada 8/	33,167	31,830	37,703	36,628 r/	36,030 p/	21,183	19,990	24,235	23,416 r/	23,034
Chile	7,643	7,010	8,341	8,174	8,100	5,120 r/	4,390	5,223	5,119	5,000
China e/	197,600	234,660	240,200	249,350	249,550	59,300	70,400	72,050	75,000	75,000
Colombia	674	546	610	734	550 6/	350	283	317	382 e/	286
Czechoslovakia 9/	1,414	XX	XX	XX	XX	412	XX	XX	XX	XX
Egypt	2,287	2,229	3,870	3,500 r/	3,000	1,260	1,250 e/	2,100 e/	2,000 r/ e/	1,700
France	5,707	3,520	2,418 r/	1,496 r/	1,200	1,697	1,055	706	432 r/	348
Germany	109	146	146	125 r/	100	15	23	21	18 r/	15
Greece e/ 5/	1,500	1,416	1,990 r/	1,970 r/	1,990	610	575	810 r/	800 r/	810
Guatemala e/	1 6/	3	3	3	3	1 6/	2	2	2	2
India	54,870	57,375	60,473 r/	66,751 r/	67,000	35,117	36,720	37,368	42,720 r/ e/	42,960
Indonesia	288	341	335	340 e/	335	145	198	194 e/	197 e/	194
Iran 10/	5,647	9,870	8,690	9,080	9,000	3,000 e/	4,800 e/	4,300 e/	4,500 e/	4,500
Japan	40	11	3	3	3 6/	25	6	1	1	1 6/
Kazakstan	17,300	13,000	10,400	14,900	12,600	9,500	7,200 e/	5,700 e/	8,200 e/	6,900
Korea, North e/	10,500	10,500	11,000	11,000	11,000	4,900	4,900	4,900	5,100	5,100
Korea, Republic of	222	219	191	184 r/	221 6/	134	122	107	103 r/	124 6/
Liberia e/	1,742 6/	--	--	--	--	1,000 6/	--	--	--	--
Macedonia e/	20	20	20	20	20	6	6	6	6	6
Malaysia	320	246	243	202	325 6/	195	150	148	123	208 6/
Mauritania	8,202	9,360	11,440 r/	11,330 r/	11,400	5,330 e/	5,900 e/	7,000 e/	7,000 e/	7,000
Mexico 11/	10,964	11,435	8,538	7,065 r/	7,794 6/	7,127	7,433	5,516	5,625 r/	6,109 6/

See footnotes at end of table.

TABLE 17--Continued
IRON ORE, IRON ORE CONCENTRATES, AND IRON ORE AGGLOMERATES: WORLD PRODUCTION, BY COUNTRY 1/

(Thousand metric tons)

	Gross weight 3/					Metal content 4/				
Country 2/	1992	1993	1994	1995	1996 e/	1992	1993	1994	1995	1996 e/
Morocco	83	66	65	45 r/ e/	45	51	41 e/	41 e/	30 r/ e/	30
New Zealand 12/	2,934	2,389	2,080 r/	2,362 r/	2,400	1,300 e/	1,300 e/	600 e/	900 e/	900
Nigeria e/	400	400	300	200	200	200	200	150	100	100
Norway	2,258 r/	2,162	2,364	2,012 r/	2,000	1,403	1,360	1,532	1,348 r/	1,340
Peru	2,850	4,930	7,430	6,235 r/	4,304 6/	1,845	3,205	4,830	3,968 r/	2,876 6/
Portugal 13/	15	16 e/	14 r/	15 r/	15	5	6	5	5 r/	6
Romania	1,250	904	951 e/	570 r/ e/	670	180	130	198	147 r/	175 6/
Russia	82,100	76,100	73,300	75,900 r/	69,600	45,000	41,900 r/	40,200 r/	41,700 r/	38,300
Serbia and Montenegro	551	106	32 e/	116 r/	115	176	34	10 e/	37 r/	37
Slovakia e/ 14/	XX	920	870 r/	820 r/	850 6/	XX	250	230 r/	225 r/	240
South Africa 15/	28,226	29,385	30,489	31,946	30,830 6/	18,347	19,100 e/	18,903	19,806	19,115
Spain 16/	2,967	2,475	2,082 r/	2,307 r/	2,300	1,334	1,109	992 r/	1,073 r/	1,070
Sweden	19,277	18,728	19,663	19,058 r/	20,273 6/	9,785	11,901	12,587	12,211 r/	12,975
Thailand	427	209	143	34	50	235	115 e/	78 e/	17 e/	22
Tunisia	291	299	240	225 e/	239	151 e/	153 e/	129	128	130 6/
Turkey	5,917	6,480	5,755	4,931 r/	5,000	3,200 e/	3,324 e/	3,148 e/	2,754 r/	2,800
Ukraine	75,700	65,000 e/	51,300 r/	50,400 r/	48,000	42,000	36,000 r/	28,200 r/	27,700 r/	26,400
United Kingdom	31	1	1	1	1 6/	7	(7/) r/	(7/) r/	(7/)	(7/)
United States	55,593	55,661	58,382	62,489	62,073 6/	35,251	35,245	36,762	39,577	39,243 6/
Venezuela	18,070	16,841	18,318	19,484	18,480 p/	11,807	11,010	11,980	12,743 e/	12,089
Zimbabwe	1,179	375	4	311	430	710 e/	225 e/	3 e/	160 e/	222
Total	924,993 r/	953,099 r/	981,403 r/	1,027,136 r/	1,020,266	496,875 r/	507,127 r/	522,853 r/	551,014 r/	549,328

e/ Estimated. p/ Preliminary. r/ Revised. XX Not applicable.

1/ Table includes data available through July 16, 1997.

2/ In addition to the countries listed, Cuba and Vietnam may also produce iron ore, but definitive information on output levels, if any, is not available.

3/ Insofar as availability of sources permit, gross weight data in this table represent the nonduplicative sum of marketable direct-shipping iron ores, iron ore concentrates, and iron ore agglomerates produced by each of the listed countries. Concentrates and agglomerates produced from imported iron ores have been excluded under the assumption that the ore from which such materials are produced has been credited as marketable ore in the country where it was mined.

4/ Data represent actual reported weight of contained metal or are calculated from reported metal content. Estimated figures are based on latest available iron content reported, except for the following countries for which grades are U.S. Geological Survey estimates: Albania, Azerbaijan, Kazakstan, North Korea, and Ukraine.

5/ Nickeliferous iron ore.

6/ Reported figure.

7/ Less than 500 tons.

8/ Series represent gross weight and metal content of usable iron ore (including byproduct ore) actually produced, natural weight.

9/ Dissolved Dec. 31, 1992.

10/ Data are for year beginning Mar. 21 of that stated.

11/ Gross weight calculated from reported iron content based on grade of 66% Fe.

12/ Concentrates from titaniferous magnetite beach sands.

13/ Includes manganiferous iron ore.

14/ Formerly part of Czechoslovakia; data were not reported separately until 1993.

15/ Includes magnetite ore as follows, in thousand metric tons: 1992--4,650; 1993--4,340; 1994--3,460; 1995--2,325; and 1996--2,070.

16/ Includes byproduct ore.

TABLE 18
IRON ORE: WORLD PELLETIZING CAPACITY,
BY CONTINENT AND COUNTRY IN 1996

	Rated capacity (million metric tons, gross weight)
North America:	
Canada	25.4
Mexico	13.2
United States	67.2
Total	105.8
South America:	
Argentina	2.0
Brazil	30.1
Chile	4.2
Peru	3.4
Venezuela	9.9
Total	49.6
Europe:	
Belgium-Luxembourg	.8
Netherlands	3.8
Norway	3.2
Sweden	15.9
Turkey	1.3
Former Soviet Union	80.0
Total	104.2
Africa:	
Liberia	3.0
Morocco	.8
Nigeria	1.4
South Africa	.6
Total	4.4
Asia:	
Bahrain	4.0
China	4.5
India	11.4
Iran	2.5
Japan	4.4
Total	26.8
Oceania: Australia	4.0
World total	294.8

Sources: International Iron and Steel Institute, Brussels, Belgium; United Nations Commission on Trade and Development; Trust Fund Project on Iron Ore Information; U.S. Geological Survey.