

# 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. Virtually all (about 98%) iron ore is consumed by the steel industry.

Domestic and international iron ore production levels rose in 1997, with international production reaching a record level of 1,035.9 million metric tons. Domestically, shipments exceeded those of 1996 by 1.0% although consumption fell slightly. Companhia Vale do Rio Doce (CVRD), the world's largest iron ore producer, was privatized, reversing Brazilian Government policy that had been in effect for more than 50 years.

## Production

U.S. iron ore production in 1997 was 63.0 million tons. To put that figure into perspective, the U.S. iron ore industry produced an annual average of 82.4 million tons of ore from 1965 through 1981. As the result of the severe recession of the early 1980's, during which the U.S. steel industry permanently closed mills with a combined annual capacity of 40 million tons, U.S. iron ore production fell from 73.4 million tons in 1981 to 36.0 million tons in 1982. Production from 1982 through 1997 averaged 53.1 million tons. (See figure 1.)

The nine Taconite mining operations in Michigan and Minnesota accounted for virtually all domestic iron ore production. Seven of these operations were on the Mesabi iron range in northeastern Minnesota: EVTAC Mining (formerly Eveleth Mines), Hibbing Taconite Co. (Hibtac), Inland Steel Mining Co., LTV Steel Mining Co., National Steel Pellet Co., Northshore Mining Corp., and the US Steel Group of USX Corp. (Minntac). The two taconite operations on the Marquette iron range in the Upper Peninsula of Michigan were the Empire and 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 99.5% 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 98.6% was pelletized. Combined United States and Canadian production represented 9.7% of the world output of usable ore in 1997 in terms of metal content. The leading producer was Brazil, which accounted for 17.8% of world output, followed by Australia, with 15.3%. Trends in world mine production since 1993 are shown on a country basis in table 17.

Domestic iron ore production, at 63.0 million tons, increased by 1.4% over that of 1996. Ten 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 declined slightly. An average of 3.6 tons of crude ore was mined in 1997 for each ton of usable ore produced, an 8.3% increase over that of 1996. Low-grade ores of the taconite type mined in Michigan and Minnesota accounted for 99.5% of total usable ore production. U.S. production of pellets totaled 62.1 million tons. The average iron content of usable ore produced was 63.6%. Fluxed pellets accounted for 53.6% of total pellet production.

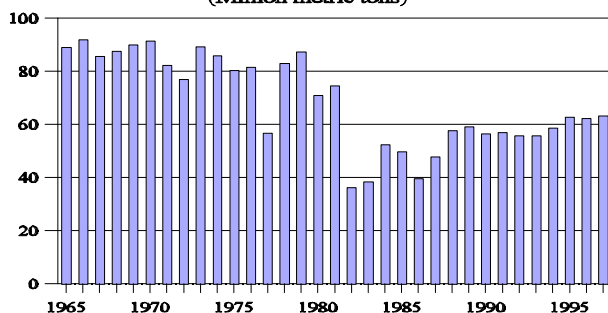
**Michigan.**—Michigan accounted for 23.3% of the output of usable ore in 1997. All of the State's production was from the Empire and Tilden Mines near Ishpeming, Marquette County, and nearly all was pelletized. Both mining ventures are managed by Cleveland-Cliffs Inc.' (Cliffs) Cleveland-Cliffs Iron subsidiary.

**Minnesota.**—Minnesota produced 76.2% of the national output of usable ore in 1997. All of the State's production came from open pit mines on the Mesabi Range. Production of pellets totaled 47.1 million tons.

Minntac, the largest U.S. iron ore producer, began the switch from trains to trucks for moving crude ore from its East Pit to the crusher. As the East Pit became deeper, the railroad grade from the pit became steeper and increasingly difficult for trains to negotiate. In the winter of 1995-1996, bitter cold weather slowed

FIGURE 1

U.S. IRON ORE PRODUCTION  
(Million metric tons)



trains at Minntac as they climbed from the taconite pit some 300 feet deep, and heavy snow blocked railroad tracks. Modern production trucks are less affected by bad weather. They can climb steeper grades, be more easily dispatched, and deliver crude ore to the crushing plant faster than trains. Minntac will have a new fleet of five \$2-million, 240-ton-capacity production trucks (Bloomquist, Lee, reporter, Duluth News-Tribune, End of the line, accessed October 12, 1997, at URL <http://www.duluthnews.com/>).

Minnesota's two largest iron ore producers exchanged 421 hectares (1,040 acres) of State-leased and company-owned land, that reportedly contain about 300 million tons of taconite reserves. The producers, Minntac and Hibbing Taconite, each gained by the exchange because each mining company now has access to taconite reserves closer to its processing plants. Faced with processing low-grade taconite as its current mines got deeper, both taconite operations have been searching for new deposits of high-grade taconite. For Minntac, the newly acquired land amounts to a 364-hectare (900-acre), 1.6-kilometer (1-mile) extension of the company's 7.2-kilometer (4-1/2-mile) long West Pit. Because taconite within the extension has an iron content of about 20.2% compared with Minntac's current iron content average of about 19.5%, ore from the extension will be blended with the lower grade ore to produce a richer mixture. Minntac began developing the West Pit extension in 1997; Hibtac isn't expected to begin mining its addition for several years (Bloomquist, Lee, reporter, Duluth News-Tribune, Minntac about to get boost from new mine; Newly acquired Ontario reserve to provide 20 years of high-quality ore, accessed December 23, 1997, at URL <http://www.duluthnews.com/>).

A Taconite Research Post was established at the University of Minnesota at Duluth. The position was created by the Minnesota State Legislature with endowment funds supplied by taconite companies and the University of Minnesota. The chair will be responsible for developing new technologies to enable taconite producers to become more efficient and reduce costs of pellet production (Skillings Mining Review, 1997c).

**Missouri.**—The Pea Ridge Iron Ore Co. produced iron oxide powder at its mining complex near Sullivan, MO. 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, 98.3% in 1997, 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 1.3 million tons.

Iron ore consumption was virtually unchanged, while pig iron production increased by 0.5%. Crude steel production increased by 2.7%. Iron ore consumption fell in relation to crude steel

production as the result of the increased use of scrap in steelmaking and higher levels of imports of pig iron and direct reduced iron (DRI). The ever increasing share of minimills in total U.S. steel production in 1997 was 43.2%.

The number of blast furnaces in operation during the year ranged from 35 to 39. Consumption of iron ore and all types of agglomerates reported to the AISI by integrated producers of iron and steel totaled 77.5 million tons. This included 64.4 million tons of pellets; 11.5 million tons of sinter, briquettes, etc.; and 1.6 million tons of natural coarse ore. Of the ore consumed, 81.7% was of domestic origin, 9.4% came from Canada, and 8.8% 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-owned blast furnaces) and therefore does not reach the open market. The average free-on-board mine value of usable ore shipped in 1997 was \$30.06 per ton, somewhat higher than that of 1996. This average value should approximate the average commercial selling price less the cost of mine-to-market transportation.

Because of relatively weak market conditions in the steel sector in the period preceding price negotiations, there was little price movement in iron ore. Prices of fine ores marketed in Europe in U.S. cents per 1% iron per ton, fell by about 1% while fines to Japan rose by the same amount. Prices of lump ore to Europe fell while prices of lump ore shipped to Japan were unchanged. Pellet prices to Europe and Japan fell slightly. The price of Carajás fines, a grade of ore produced by CVRD, when denominated in U.S. dollars and adjusted for inflation using the U.S. Consumer Price Index for Urban Consumers, fell 24.5% between 1990 and 1997.

## Transportation

Virtually no iron ore is consumed near where it is produced, requiring most ores to be transported, often great distances. Nearly all iron ore leaves the mine by rail, after which much of it is 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 160 kilometers (100 miles) from Lake Superior or Lake Michigan, and most are much closer. From 1993 through 1997, an average of 92.7% of all domestic ore produced was transported on the Great Lakes. For the same period, iron ore constituted 43.5% of U.S.-flag cargoes, more than twice that of stone and gypsum, the next largest dry bulk material category shipped. Including transshipments, U.S.-flag carriers moved 57.5 million tons of iron ore in 1997, an increase of 4.6% compared with the 1996-97 season.

## Foreign Trade

U.S. exports of iron ore were somewhat higher than those of 1996. 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 18.6 million tons were 1.2% higher than those of 1996. Net imports, which averaged 11.6 million tons from 1989 through 1997, were 12.3 million tons in 1996. This was equivalent to 14.5% of U.S. ore consumption. Canada's share of U.S. imports was 53.6%; Brazil's was 27.3%.

## World Review

**Production.**—World iron ore production reached a record high of 1,035.9 million tons, a 1.2% increase over that of 1996. Although iron ore production was widely distributed, occurring in about 50 countries, the bulk of world production came from just a few countries. The five largest producers, in decreasing order of production of gross weight of ore, were China, Australia, Brazil, Russia, and India. These countries accounted for more than 70% of the world production. China was the largest producer in gross weight of ore produced, but because its ore is of such low grade, the country ranked well below Australia and Brazil in iron content. Of the largest producing countries, Australia experienced the highest growth rate at 12.6%.

**Consumption.**—World steel production at 793.5 million tons reached a record high in 1997, the result of a relatively strong world economy. Although growth in the world's economies was mixed in 1997, the overall world economy grew because North American economies experienced strong growth and because those of Western Europe grew at a faster rate than in 1996. World growth was restrained by a decline in the economies of the Pacific region, which, fueled by the Southeast Asia currency crisis, tumbled toward recession during the second half of 1997. China, for the second consecutive year, was the largest steel producer at 107.3 million tons. The three largest steel-producing nations, China, Japan, and the United States, whose combined production accounted for 39% of world production, had a robust average increase in production of 13.1%. Among the top 10 producing countries, only Russia experienced a drop in production. World pig iron production rose by 5.0% to 543.9 million tons. The largest increase in pig iron production was in China.

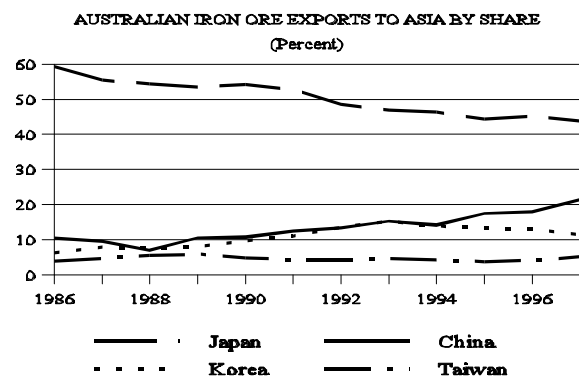
**Trade.**—In 1997, 46.1% of world iron ore production was exported, up from 42.4% in 1996. At 474.8 million tons, world exports increased by 9.5%, the largest such increase since 1984. Seaborne ore shipments totaled 402.3 million tons, accounting for 84.7% of exports. Australia and Brazil continued to strengthen their combined market position, increasing their combined share of exports from 61.1% to 62.3%. Australia was the leading exporter of iron ore, shipping 155.6 million tons to world markets, followed by Brazil, which exported 140.4 million tons. The next largest exporter was Canada at 32.3 million tons. Of the additional 41 million tons of ore exported in 1997, Australia accounted for 49.0% and Brazil 26.1%. Australia's chief export customers were Japan (43.9%), China (21.5%), the Republic of Korea (11.5%), and Taiwan (5.3%). Although the portion of

Australian exports to Asia did not change much from 1986 (80.8%) to 1997 (82.8%), the quantities imported by Asian countries have changed. Chinese imports from Australia experienced the most growth. (See figure 2.)

Brazil's primary export customers were Western Europe (40.6%) and Asia (40.2%). Of Brazil's exports, 50.9% went to four countries: Japan (20.3%), Germany (15.9%), China (7.5%), and the Republic of Korea (7.2%).

Japan, as usual, was the leading importer, accounting for 27.0% of world iron ore imports. The next largest was China, which took 11.8% of total world imports, followed by Germany at 9.0%. Australia supplied the bulk of Japan's iron ore needs. Asia, which has been taking an increasingly larger share of imports, accounted

FIGURE 2



for 51.6% of world imports, and Asian countries occupied three of the top four positions among importing countries.

**Australia.**—Australia continued to be the world's leading exporter of ore in 1996. BHP Iron Ore Pty. Ltd. planned the development of Ore Body 18, a satellite deposit of its Mount Whaleback Mine. The deposit is 32 kilometers (20 miles) east of Newman in the Pilbara region of Western Australia and reportedly has minable reserves of 105 million tons of Brockman-type hematite. Ore Body 18 is central to BHP's plan to increase shipments in 1999 and beyond. The ore will be shipped by rail to Nelson Point in Port Hedland, where it will be blended with ores from other mines in the Newman area. Other BHP Iron Ore plans include the development of the Area C iron ore deposit 35 kilometers (22 miles) south of its Yandi operations. The deposits initially proposed to be developed reportedly have reserves of 610 million tons. BHP shipped 67.6 million tons of ore during the year (Mining Engineering, 1997).

In other iron ore mining operations in which BHP has interests, BHP Whyalla Steelworks iron ore operations in South Australia railed 2.9 million tons of iron ore and BHP New Zealand Steel Ltd. produced 2.5 million tons of iron sand (BHP Iron Ore Pty. Ltd., written commun., 1998).

Rio Tinto's wholly owned subsidiary, Hamersley Iron, began development of the US\$515 million Yandicoogina Mine. The first shipments are expected to be made in mid-1999; production will begin at 5 million tons per year of high-grade pisolitic ore, all in the form of fines, and reach 15 million tons per year as market demand grows. Proven high-grade reserves are reported to be in

excess of 300 million tons. Located in the Pilbara region, 90 kilometers (56 miles) northeast of Newman, Western Australia, the mine will be linked to Hamersley's existing rail facilities. The project will be unique in that Hamersley bypassed the lengthy and uncertain requirements of the Native Title Act by negotiating directly with the Gumala Aboriginal Corp., which represents three Aboriginal Peoples. The agreement includes training and employment opportunities as well as business and community development packages, which could cost as much as A\$60 million over the next 20 years. Hamersley's iron ore shipments in 1997 were 61.8 million tons (Metal Bulletin, 1997b).

Robe River Mining Co. Ltd. Pty. completed prefeasibility studies for the large West Angelas project in Western Australia, which would exploit Marra Mamba ore. Following that, a \$20 million feasibility study was begun. Robe River's shipments at 30.4 million tons exceeded 30 million tons for the first time (Metal Bulletin, 1997j).

In December 1996, Cliffs. closed the Savage River Mine in Tasmania. The mine had been active for 30 years and, at the time of closure, consisted of an open pit mine and concentrator at Savage River and a pellet plant and loading dock at Port Latta. Australian Bulk Minerals purchased the property from the Tasmanian Government, reopened it, and was shipping pellets by yearend 1997 (The TEX Report, 1997).

**Brazil.**—In what was easily the event of the year in the iron ore industry, the Brazilian Government relinquished its controlling interest in CVRD, the world's largest iron ore producer, selling a 34% share of the company, on May 6 (Kepp, 1997b). Founded in 1942, CVRD produces and exports ore on a massive scale (Companhia Vale do Rio Doce, 1995). In 1997, shipments amounted to 106 million tons, of which 80 million tons was exported (Companhia Vale do Rio Doce 1997 Annual Report, accessed July 16, 1998, at URL <http://www.cvr.com.br/cvr/ing/ra98i/index.htm>; Skillings Mining Review, 1998a). CVRD owns and operates two railroads and, in 1962, established a subsidiary, Rio Doce Navegação, which operates a fleet of 20 bulk carriers weighing as much as 310,000 dead weight tons (Mining Journal, 1997a).

The company produces iron ore in two integrated mine-rail-port systems known as the Southern and Northern systems. The Carajás iron district, with reported reserves of 18,000 million tons of high-grade (66% iron) hematite ore, is in the Northern system. Ore is transported by the Carajás Railroad to the port of Ponta da Madeira, which can accommodate some of the largest bulk carriers in the world. The Southern system reportedly has 17,000 million tons of reserves. 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 tons per year. A seventh plant, which will add 4 million tons per year, is under construction. Two of the plants belong to CVRD, and the others are joint ventures with foreign clients.

In 1995, the Brazilian Government announced that CVRD would be privatized (Metal Bulletin, 1995). At the time, the Government controlled 51% of CVRD through the ownership of common and preferred shares. Before the sale, the Government published a prospectus with rules designed to make it impossible for companies whose strategic interests could run counter to those

of CVRD, such as large Australian iron ore producers or Japanese steelmakers, to attain individual control of the company. The rules also stated:

- ! A combination of iron ore consumers and traders could not own more than 45% of the controlling block shares.
- ! Single large consumers, those which consume more than 8 million tons per year, and single large traders, those which sell more than 30 million tons per year, could not own more than 10% of the shares. This rule was to prevent large iron ore consumers from controlling CVRD and selling the ore to themselves at low prices (Kepp, 1997a).
- ! No single buyer could purchase more than 45% of the controlling block shares; this meant that at least three firms would share control of the company.

The decision to sell the giant iron ore producer was not without its opponents. Operating in 10 Brazilian States, CVRD had played a large role in the social and economic development of large areas of the Brazilian interior and was seen as a national asset. Many Brazilian politicians were reluctant to see CVRD pass into the hands of private enterprise. There were fears that the sale would result in a reduction of jobs. To allay those concerns, the Government retained a "golden share," which gave it the right of veto. The Government also announced that one-half of the proceeds of the sale would be put into a new fund, the Economic Reconstruction Fund (FRE). This fund would be used to help fund infrastructure projects at low interest rates. The other one-half of the proceeds was to be used to reduce public sector debt. The establishment of the FRE was also intended to help maintain the momentum of Brazilian regional development.

A number of consortia competed for the sale of CVRD. The winner was Valepar, which paid \$3.1 billion for a 34% voting share. The Valepar consortium was led by Cia. Siderurgica Nacional (CSN), a Brazilian steelmaker, which owns 25%; other members include a block of pension funds (39%), Eletron (17%), Bndespar (9%), U.S.-based Nations's Bank (9%), and Investvale (1%), an employee stock fund. CSN, which was privatized in 1993, is Latin America's largest integrated steelmaker, and is the only steelmaker that runs its own captive mine, Casa de Pedro in Minas Gerais State. The Casa de Pedro supplies CSN with 7 million tons per year of ore—25% as lump and 75% as sinter feed. CSN operates four sinter plants with a combined capacity of 6 million tons per year. The CSN led consortium was obliged to retain its shares in CVRD for at least 5 years. As the result of a bidding war between Valepar and another strong consortium, Consorcio Valecom, the amount paid for CVRD was nearly 20% above the Government-set minimum price. Consorcio Valecom, was led by Votorantim, Brazil's largest industrial group, which produces aluminum and paper and pulp. The remainder of the Government's interest in CVRD was to be sold later in the year. About one-fifth was to be sold to CVRD employees and the balance to the public.

Minerações Brasileiras Reunidas S.A. (MBR), Brazil's second largest iron ore producer, was implementing plans involving its mines in Minas Gerais State. The Águas Claras and Mutuca Mines, which are expected to be depleted in 2002, will be closed.

The plan calls for the mining equipment at those mines to be moved to other mines, while the processing, loading, and transportation facilities at the Mutuca Mine will be left in place to treat and move ores from other mines. One of those mines is the Tamanduá, whose production is expected to rise from the 3 million tons that was produced in 1997 to 14 million tons in 2003. Production at the Capitão do Mato Mine, which began operations during the year, is expected to reach a level of 3.7 million tons per year. MBR had exports of 22.9 million tons (Minerações Brasileiras Reunidas S.A., 1997).

Samarco Mineração S.A. commissioned its new 6-million-ton-per-year pellet plant at Ponta do Ubu on the coast of Espírito Santo, doubling the company's pellet production capacity. Nearly all production will be exported, making Samarco Brazil's second largest pellet exporter. The \$325 million expansion involved the second pellet plant at Ponta do Ubu, and the concentration plant at Samarco's Germano Mine at Mariana in Minas Gerais State. The capacity of the Germano concentrator will be increased from 9.5 million tons per year to 13.2 million tons per year. Of the 12 million tons per year of pellets to be produced by Samarco, 6.5 million tons per year will be direct reduction grade pellets and 5.5 million tons per year blast furnace pellets. Samarco exported 9.5 million tons of ore in 1997. Among other Brazilian iron ore producers, Ferteco exported 11.8 million tons and Samitri exported 11.5 million tons in 1997 (Samarco Mineração S.A., 1997).

**Canada.**—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 37.3 million tons, increased by 4.6% over that of 1996 (Mourits, 1998).

North Limited, an Australian resources company, purchased the controlling interest in IOC. North also controls and manages the Robe River iron ore project in Western Australia. The 59.3% interest in IOC was purchased from two U.S. steel companies, Bethlehem Steel Corp., Bethlehem, PA (37.6%), and National Steel Corp., Mishawah, IN (21.7%), for US\$230 million.

The mining operations of IOC, Canada's largest iron ore producer and one of the world's largest pellet producers, are located at Carol Lake, Labrador. The operation has five open pits, a concentrator, and a pellet plant. The mine is connected by a company-owned 420-kilometer (261-mile) railroad to its port facility in Sept-Îles, Quebec, which also has an 8-million-metric-ton-per-year idled pellet plant. IOC plans to expand pellet annual production capacity at Carol Lake from 11.5 million tons to 12.5 million tons. A flotation plant is also being installed at an estimated cost of \$23.0 million, enabling IOC to produce a low-silica direct-reduced grade pellet which can be sold to DRI producers that supply the expanding electric arc furnace market. Completion is expected by mid-1998. Also, in the concentrating plant, the company replaced the dry mill with a new wet mill, which lowered dust emissions. IOC is undertaking expansion feasibility studies, which include recommissioning the Sept-Îles pellet plant, moth-balled in 1981. Decisions on both of these studies should be made sometime in 1998 (North Limited, news release, January 31, 1997, accessed February 13, 1997, at URL

<http://www.north.com.au/news-releases/index.html>).

IOC was planning to create two superpits that were expected to make its mining operations much more efficient. The first superpit, which would combine the Humphrey pit and the Humphrey West pit, was under development in 1997. A decision was made in 1997 to create the second large pit by developing the Luce deposit (Iron Ore Company of Canada, oral commun., 1997).

Cliffs purchased Inland Steel's 15.1% interest in the Wabush Mines iron ore joint venture in Labrador, Canada, effective January 1, 1997. The \$15 million transaction raised Cliffs' interest in Wabush to 22.8%. The additional interest represented about 900,000 tons of capacity raising Cliffs' Wabush capacity share to 1.4 million tons per year. The balance of the ownership consists of Stelco and Acme Steel Co., Riverdale, IL, (15.1%). Wabush shipped 5.9 million tons of pellets in 1997.

Wabush Mines, which started operations in 1965, reportedly has reserves of 270 million tons and a capacity of 6.1 million tons per year. The Wabush pelletizing plant is in Pointe Noire, Quebec, on the southern shore of Sept-Îles Bay. Feed for the pelletizing plant is railed from the company's Scully Mine at Wabush Lake in Newfoundland. A dedicated 61-kilometer (38-mile) rail line connects the mine to the Quebec North Shore and Labrador Railway at Ross Bay Junction. From there, the iron ore concentrate is hauled an additional 385 kilometers (239 miles) via Sept-Îles to Pointe Noire (Robertson, 1997; Skillings Mining Review, 1997b; Skillings Mining Review, 1998b).

QCM, which experienced a minor change in ownership, produced a record 8.6 million tons of pellets.

Algoma Steel Inc. announced that it would be closing its Wawa iron ore operation in Ontario. The closure plan called for the cessation of operations at the facility in June 1998 (Algoma Steel Inc., December 2, 1997, Press release, accessed July 16, 1998, at URL <http://www.algoma.com/>).

**Chile.**—Cia. Minera del Pacifico SA (CMP) began developing the Colorados Este pit at its Los Colorados iron ore deposit. Design work has also begun for the new pit's beneficiation plant, which is expected to begin operations in July 1998. The nearby Los Colorados pit has been in production for some time, but produces only 1.2 million tons per year of pellet feed. The new pit would replace the Algarrobo pit, which is expected to close in March 1998. The Colorados Este pit is expected to produce about 5.4 million tons per year. The project, named Cia. Minera Huasco (CMH), is a 50-50 joint venture between CMP and Mitsubishi Corp. The 4-million-ton-per-year Huasco pellet plant, which remains CMP's property, will be leased to CMH. The plant is expected to produce 3.2 million tons per year of blast furnace pellets and 0.8 million tons per year of pellets for direct reduction (Metal Bulletin, 1997a).

**France.**—Terres Rouges, the last iron ore mine in the Lorraine district, was closed because its owner, Arbed, a Luxembourg steelmaker, switched from blast furnace to electric arc furnace steel production and no longer needed the ore. The mines of Lorraine once produced more than 50 million tons per year of iron ore that was primarily exported to Belgium, Germany, and Luxembourg (Metal Bulletin, 1997f).

**India.**—India's state-owned National Mineral Development Corp. (NMDC) is planning to increase its iron ore mining capacity

from its current 15 million tons per year to 24 million tons per year by 2002. NMDC operates two large iron ore mines in Madhya Pradesh and one in Karnataka and is developing a new mine at Bailadila deposit numbers 10 and 11A. Kudremukh Iron Ore Co. is considering a project to reclaim the 117 million tons of tailings lying in its Lakya Dam, which would be expected to yield about 21 million tons of concentrate (Metal Bulletin, 1997i).

**Iran.**—Steel production by National Iranian Steel Co. (Nisco) continues to increase. The company moved from being the world's 30th largest steel producer in 1996 to 26th in 1997 (International Iron and Steel Institute, Steel News, world crude steel production in 1997, January 20, 1998, accessed March 28, 1998, at URL <http://www.worldsteel.org/steelnews/world97mo.htm>). The increased steel production prompted increased iron ore production in an effort to achieve Iran's goal of becoming self-sufficient in iron ore. Iran has four main iron ore deposits that are currently being mined or are under development—Chadormalu, Choghart, Gol-e Gohar, and Sangan. The US\$900-million Chadormalou Mine and concentrator complex, 120 kilometers (75 miles) north of Tchoghart, began operating and is expected to be producing 5 million tons per year in about 2 years. The mine is intended to supply most of the feed for the Mobarekah steelworks in Central Iran. The Choghart iron ore mine at Bafq near Yazd supplies about 5.2 million tons per year to the Isfahan steelworks. The addition of a US\$115-million ore processing plant is underway. The Gol-e Gohar Mine, 55 kilometers (34 miles) southwest of Sirjan, provides 2.5 million tons per year of iron ore concentrate to the Mobarakeh steel complex. Its capacity is expected to rise to 5 million tons per year of concentrate by 1999. The Sangan Mine, about 250 kilometers (155 miles) southeast of Mashad close to the border with Afghanistan, is under development and is expected to have an initial capacity of 3.4 million tons per year of concentrate (Metal Bulletin, 1997c; Mining Journal, 1997b).

**Japan.**—Japan's Mitsui & Co. Ltd. changed its ownership in major iron ore producers in Brazil and Canada. Mitsui sold part of its holdings in the Canadian producer, QCM and then purchased 40% of CAEMI Mineração & Metalurgia S.A. (CMM), the Brazilian co-owner of MBR. The transaction reduced Mitsui's ownership in QCM from 25.0% to 20.0%, while increasing Mitsui's equity in MBR from 16.3% to 35.5% (Metal Bulletin, 1997g).

**Mexico.**—Altos Hornos de Mexico SA de CV through its wholly owned subsidiary, Minera del Norte, completed rehabilitation and began operations at the La Perla iron ore mine near Camargo in the northern Mexican State of Chihuahua. The mine was closed in 1991 after producing 41 million tons of iron ore over a 35-year period. After being treated by magnetic separation and flotation, the ore is pumped through an 86-kilometer (53-mile) pipeline to the company's Hercules Mine. From the Hercules Mine, the final concentrate is pumped 290 kilometers (180 miles) to the steelworks in Monclova (Skillings Mining Review, 1997a).

**Russia.**—A new mine, the Yakovlevo, was developed in the Belgorod region of Russia by Yakovlevsky Rudnik Co. The deposit reportedly has an iron content of 68.4%. The first stage of development is expected to reach full production of 1.5 million

tons per year by the second half of 1998. The company plans to sell ore to the Novolipetsk and Magnitogorsk steelworks and also hopes to export some ore (Metal Bulletin, 1997h).

**Sweden.**—Luossavaara Kiirunavaara AB (LKAB), the state-owned iron ore producer, continued to expand and upgrade its mines. The company began mining the new 1,045-meter level at its Kiruna Mine. LKAB plans to mine this level and the old 775-meter level until 1999, after which all mining will be done at the deeper level. LKAB decided to upgrade the concentration and pelletizing plant at Svappavaara, which treats ore from the nearby Kiruna Mine. The plant's electrical distribution, instrumentation, and water and waste processing systems will be improved. The life of the 3.8-million-ton-per-year plant will be extended until 2020. The Svappavaara Mine has been closed for some time. The company also decided to expand its other mine, the MalMBERGET, by adding a deeper level, as it had done at Kiruna. The new level will be at 1,000 meters. This is expected to gain access to 110 million tons of ore and extend the life of the mine by 10 years. The current main level at 815 meters, began operation in 1989 and is expected to be active until 2001. As part of the expansion effort, the company decided to mine that part of the Kiruna main ore body which extends under Lake Luossajärvi. Mining operations towards the north in the underground mine at Kiruna were restricted because of the risk of water seeping into the mine from the nearby lake. LKAB was 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. Preparations for the mining of the Lake ore began in the summer of 1997 with dredging and damming along the rail causeway. Drainage will begin in 1998 and is expected to reach completion by 2002. The Lake ore Project is expected to add 4 years to the operating life of the mine.

LKAB constructed and began operating an experimental pilot scale blast furnace at Luleå. The furnace was expected to reduce lead times for product development and market introduction and result in better test methods for use in the production of pellets (Luossavaara Kiirunavaara AB, March 11, 1997, Press release accessed April 20, 1998, at URL <http://www.lkab.se/english/indexenglish.html>; Luossavaara Kiirunavaara AB, 1997; Metal Bulletin, 1997d; Metal Bulletin, 1997e).

**Zimbabwe.**—A feasibility study was launched on the proposed Beira Iron Project, which would cost between US\$450 million and US\$650 million. The project would mine and beneficiate iron ore in Zimbabwe (from the KweKwe area) and ship it by rail to Manica over the Mozambique border, where it would be reduced using natural gas from the Temane Gasfield in Central Mozambique. The product—hot briquetted iron—would then be exported through the port of Beira, Mozambique (Engineering and Mining Journal, 1997).

## Current Research and Technology

The International Metals Reclamation Company (Inmetco) DRI production system was to be used to produce DRI at the Nakornthai Strip Mill (NSM) of Thailand. Although it was the most recent DRI system to be introduced, it is not at all new. The technology has been used by Inmetco, Ellwood City, PA, to

reclaim nickel, chromium, and iron from stainless steel wastes since 1978. NSM was expected to install a rotary hearth furnace with a production capacity range of 300,000 to 500,000 tons per year. In the 1980's, Inmetco conducted tests by using its blending and pelletizing circuit and its rotary hearth furnace to produce DRI. Several types of feed and coal were used (Metal Bulletin, Monthly, 1997).

The reduction of silica by the use of column flotation was examined. Column flotation reportedly has become widely accepted throughout the minerals industry—its main benefits being improved metallurgical performance, low capital cost, low maintenance costs, and superior control and stability due to the adaptability to automatic controls (Wyslouzil, 1997).

## Outlook

In the United States, iron ore reserves, at current consumption rates, are adequate 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 8.5% of the iron ore produced from 1990 through 1997 was exported, with virtually all of it being pellets going 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.

Any hope for significant expansion in the domestic iron ore industry is that one or more of the direct reduction processes will prove to be economic for existing and potential Great Lakes producers. If this occurs, the industry can supply the rapidly expanding minimill sector of the steel industry. Electric arc furnaces currently account for 42.1% of total crude steel production and, by 2000, 15 million tons per year of new production capacity is expected, which will increase electric arc furnace 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 over the next 25 years.

Internationally, iron reserves are sufficient to meet demand, at current consumption rates, for at least 100 years. Based on 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 in Asia will be from newly constructed minimills, but unlike the United States, 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 size modern blast furnaces with a combined 11.6 million tons per year capacity have been built and six more with a combined 12.5 million tons per year capacity are being constructed or are committed for 1997 to 2002. 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. Continued growth will depend on the severity of the recent economic downturn in Asia.

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<sup>1</sup>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)

	1993	1994	1995	1996	1997
<b>United States:</b>					
<b>Iron ore (usable, 3/ less than 5% manganese):</b>					
Production	55,676 r/	58,454 r/	62,501 r/	62,083 r/	62,971
Shipments	56,300	57,800 r/	61,100	62,200	62,800
Value	\$1,380,000	\$1,410,000	\$1,730,000	\$1,770,000	\$1,890,000
Average value at mines, dollars per ton	\$24.50	\$24.40 r/	\$28.30 r/	\$28.50	\$30.10
Exports	5,060	4,980	5,270	6,260	6,350
Value	\$167,000	\$163,000	\$184,000	\$232,000	\$235,000
Imports for consumption	14,100	17,500	17,600	18,400	18,600
Value	\$419,000	\$499,000	\$491,000	\$556,000	\$552,000
Consumption (iron ore and agglomerates)	76,800	80,200	83,100	79,600 r/	79,500
<b>Stocks, Dec. 31:</b>					
At mines, plants and loading docks 4/	2,500	2,790	4,240	4,650	4,860
At receiving docks 5/	2,290	2,230	2,140	2,260	2,890
At consuming plants	16,500	16,300	17,100	18,800	20,200
Total 6/	21,300	21,300	23,500	25,700	27,900
World: Production	953,316 r/	981,979 r/	1,019,582 r/	1,024,136 r/	1,035,942 e/

e/ Estimated. r/ Revised. NA Not available.

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 (79,500 thousand metric tons in 1997) appears in table 1 and is the sum of the AISI consumption number (77,500) plus reported consumption of iron ore in direct reduced iron (DRI) production and nonsteel uses. The second consumption number (71,800 thousand metric tons in 1997) 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 (77,500 thousand metric tons in 1997) 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 (73,800 thousand metric tons in 1997) appears in table 8 and is the sum of the AIOA consumption number (71,800) and two other numbers. These are quantities of ore consumed in DRI production and nonsteel 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 1997, BY DISTRICT AND STATE 1/

District and State	Average number of employees	Worker-hours (thousands)	Production (thousand metric tons)				Average per worker-hour (metric tons)		
			Crude ore	Usable ore	Iron contained (in usable ore)	Iron content, natural (percent)	Crude ore	Usable ore	Iron contained
Lake Superior:									
Michigan	1,790	3,720	42,700	14,700	9,080	61.9	11.50	3.95	2.44
Minnesota	5,560	11,700	166,000	48,000	30,700	64.1	14.13	4.09	2.62
Total or average	7,360	15,400	208,000	62,600	39,800	63.6	13.49	4.06	2.58
Other States 2/	99	218	534	338	216	64.0	2.45	1.55	0.99
Grand total or average	7,450	15,700	209,000	63,000	40,000	63.6	13.34	4.02	2.56

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 MINED IN THE UNITED STATES IN 1997,  
BY DISTRICT, STATE, AND MINING METHOD 1/ 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	42,700	--	42,700
Minnesota	8	166,000	--	166,000
Total	10	208,000	--	208,000
Other States:				
Missouri	1	--	487	487
Other 3/	1	47	--	47
Total	2	47	487	534
Grand total	12	208,000	487	209,000

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 1997, 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	67	--	14,600	14,700
Minnesota	454	52	47,500	48,000
Total	522	52	62,100	62,600
Other States:				
Missouri	8	264	18	291
Other 3/	47	--	--	47
Total	55	264	18	338
Grand total	577	316	62,100	63,000

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 1997 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	63	--	14,400	14,500	37.4	W
Minnesota	454	140	47,400	47,900	63.4	\$1,430,000
Total reportable or average	517	140	61,800	62,400	57.4	1,430,000
Other States:						
Missouri	7	275	18	300	70.1	W
Other 3/	57	38	--	94	14.3	1,660
Total reportable or average 3/	64	313	18	394	56.7	1,660
Total withheld	581	--	--	--	--	454,000
Grand total or average	581	453	61,800	62,800	63.0	1,890,000

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 AT U.S. IRON AND STEEL PLANTS 1/ 2/

(Thousand metric tons)

Year	Iron ore originating areas						Total
	U.S. ores		Canadian ores		Foreign ores		
	Great Lakes	Other U.S.	Great Lakes	Other Canada			
1996	56,800	--	2,060	5,420	7,400	71,700	
1997	58,700	--	714	6,070	6,320	71,800	

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	1996	1997
Blast furnaces:		
Direct-shipping ore	862	1,540
Pellets	64,900	64,400
Sinter 2/	11,600	11,300
Total	77,400	77,300
Steelmaking furnaces:		
Direct-shipping ore	83	80
Pellets	20	32
Sinter 2/	178	126
Total	281	238
Grand total	77,700	77,500

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
1996	64,900	87	6,670	58	71,700	684	1,260 r/	73,300 r/
1997	64,900	86	6,660	146	71,800	752	1,270	73,800

r/ Revised.

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	1996		1997	
	Quantity	Value	Quantity	Value
Canada	6,240	230,000	6,340	235,000
India	(2/)	5	--	--
Mexico	10	891	1	141
Netherlands	--	--	(2/)	41
Venezuela	1	117	(2/)	135
Other	7	719	12	255
Total	6,260	232,000	6,350	235,000

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	1996			1997		
	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	12	430	\$36.23	23	595	\$26.32
Coarse ores	1	39	30.36	--	--	--
Fine ores	34	1,070	31.81	14	490	35.00
Pellets	6,200	229,000	36.99	6,300	234,000	37.11
Briquettes	(3/)	14	NA	(3/)	39	NA
Other agglomerates	7	735	NA	2	111	48.33
Roasted pyrites	3	305	89.55	4	270	72.54
Total	6,260	232,000	36.99 4/	6,350	235,000	37.09 4/

NA Not available.

1/ Data 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	1996			1997		
	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)
Australia	511	3,510	6.87	742	6,200	8.36
Brazil	5,170	132,000	25.53	5,080	131,000	25.81
Canada	9,800	326,000	33.27	9,970	317,000	31.79
Chile	164	2,790	17.01	228	4,110	18.04
Mauritania	275	5,090	18.51	--	--	--
Peru	43	476	11.07	252	3,020	11.96
Sweden	48	2,050	42.71	57	2,200	38.56
Venezuela	2,140	78,300	36.59	2,090	80,600	38.64
Other	238	6,220	26.13	199	7,540	37.88
Total	18,400	556,000	30.25	18,600	552,000	29.64
Concentrates	1,490	26,500	17.77	1,450	24,500	16.92
Coarse ores	1,370	51,000	37.31	1,300	50,300	38.82
Fine ores	3,370	55,900	16.60	3,060	50,700	16.57
Pellets	11,400	402,000	35.28	11,600	398,000	34.42
Briquettes	--	--	--	--	--	--
Other agglomerates	757	20,400	26.89	1,230	27,300	22.26
Roasted pyrites	10	490	50.98	11	551	50.09
Total	18,400	556,000	30.25 3/	18,600	552,000	29.64 3/

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 1997,  
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	71	--	671	--	--	--	742
Brazil	731	83	2,150	1,660	456	(2/)	5,080
Canada	595	--	--	8,840	535	--	9,970
Chile	--	--	192	--	36	--	228
Finland	--	--	--	--	--	11	11
Mexico	--	--	--	--	16	--	16
Norway	--	--	--	92	--	--	92
Peru	--	--	15	54	183	(2/)	252
South Africa	--	13	--	--	--	--	13
Spain	--	--	4	--	--	--	4
Sweden	51	--	2	4	--	--	57
United Kingdom	--	--	23	--	--	--	23
Venezuela	--	1,160	2	924	--	--	2,090
Other	--	40	--	--	--	--	40
Total	1,450	1,300	3,060	11,600	1,230	11	18,600

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 13  
AVERAGE UNIT VALUE FOR SELECTED IMPORTS OF IRON ORE  
AND AGGLOMERATES IN 1997

Type of product	Country of origin	Average unit value 1/ (dollars per metric ton gross weight)
Concentrates	Brazil	16.40
Do.	Canada	17.10
Coarse ores	Venezuela	38.80
Fine ores	Australia	8.41
Do.	Brazil	18.90
Pellets	Brazil	36.80
Do.	Canada	33.60
Do.	Venezuela	37.40

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	1996		1997	
	Quantity	Value	Quantity	Value
Baltimore	4,130	101,000	4,340	102,000
Charleston	602	20,600	815	29,600
Chicago	3,200	78,900	2,780	62,000
Cleveland	802	28,100	662	20,000
Detroit	1,910	71,200	2,220	80,600
Houston-Galveston	72	1,980	67	2,030
Mobile	4,080	144,000	4,390	152,000
New Orleans	1,340	28,100	1,400	33,000
Philadelphia	2,180	79,400	1,900	70,200
Other	83	2,310	37	888
Total	18,400	556,000	18,600	552,000

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	1996		1997	
	Quantity	Value	Quantity	Value
Brazil	1,730	65,500	1,660	61,000
Canada	8,770	302,000	8,840	297,000
Norway	--	--	92	3,590
Peru	--	--	54	649
Sweden	--	--	4	297
Venezuela	899	34,400	924	35,400
Total	11,400	402,000	11,600	398,000

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)

Country and producer	Ore types	April 1 - March 31	
		Fiscal year 1996	Fiscal year 1997
<b>Australia:</b>			
Hamersley Iron Pty. Ltd. and Mount Newman Mining Co. Pty. Ltd.	Lump ore	37.68	37.68
Do.	Fines	28.78	28.78
Robe River Iron Associates	do.	23.53	23.85
Savage River Mines Ltd.	Pellets	47.37	--
<b>Brazil:</b>			
Cia. Nipo-Brasileira de Pelotizacao (Nibrasco)	do.	50.05	49.76
Cia. Vale do Rio Doce (Carajas)	Fines	26.30	26.58
Do.	Lump ore	(1/)	--
Cia. Vale do Rio Doce (Itabira)	do.	28.07	28.07
Do.	Fines	25.80	26.08
Mineracoes Brasileiras Reunidas S.A.	do.	27.45	27.45
Do.	do.	26.30	26.59
Samarco Mineracão S.A.	Pellet feed	21.67	21.91
<b>Canada:</b>			
Iron Ore Co. of Canada (Carol Lake)	Concentrates	25.02	25.30
<b>Chile:</b>			
Minera del Pacifico S.A. (El Algarrobo)	Pellets	46.65	46.37
Minera del Pacifico S.A. (El Romeral)	Fines	19.98	20.20
<b>India:</b>			
Minerals and Metals Trading Corp. (Bailadila)	Lump ore	36.33	36.33
Do.	Fines	27.63	27.93
<b>Peru:</b>			
Empresa Minera del Hierro del Peru S.A.	Pellets	19.61	19.83
<b>South Africa, Republic of: 2/</b>			
South African Iron and Steel Industrial Corp. Ltd.	Lump ore	30.50	30.50
Do.	Fines	21.89	22.13

1/ No quotation published.

2/ Price per dry metric ton unit.

Source: Trust Fund Project on Iron Ore Information, Iron Ore 1996.



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

(Thousand metric tons)

Country 2/	Gross weight 3/					Metal content 4/				
	1993	1994	1995	1996	1997 e/	1993	1994	1995	1996	1997 e/
Albania e/ 5/	150	--	--	--	--	85	--	--	--	--
Algeria	2,311	2,047	2,202 r/	2,245 r/	2,250	1,250 e/	1,000 e/	1,100 r/	1,100 r/	1,100
Argentina e/	3	42	3 r/	3 r/	3	1 r/ 6/	28 r/ 6/	(7/) r/ 6/	1 r/	1
Australia	120,534	128,493	142,936	147,100	157,766 6/	74,767	80,900 e/	88,653	93,000	97,916 6/
Austria	1,435	1,655	-- r/	1,853 r/	2,000	452	520 e/	660 e/	504 r/	540
Azerbaijan	300 e/	200 e/	150 e/	150 e/	NA	165	110 e/	83 e/	83 e/	NA
Bolivia	51	3	-- e/	--	--	32	2	-- e/	--	--
Bosnia and Herzegovina e/	250	200	150	150	150	100	70	52	50	50
Brazil	150,000	168,245 r/	174,643 r/	183,600 r/	183,000	90,000 r/	103,227 r/	107,151 r/	121,961 r/	122,000
Bulgaria	428 r/	462 r/	483 r/	497 r/	500	270 r/	290 r/	290 r/	320 r/	320
Canada 8/	31,830	37,703	36,628	36,030	37,284 p/	19,990	24,235	23,416	23,034 e/	23,750 p/
Chile	7,010	8,341	8,432 r/	9,082 r/	8,738 6/	4,390	5,167 r/	5,233 r/	5,275 r/	5,437 6/
China e/	234,660	240,200	249,350	249,550	243,000	70,400	72,050	75,000	75,000	73,500
Colombia	546	610	734	550	NA	283	317	382 e/	286 e/	NA
Egypt	2,229	3,870	2,042 r/	2,429 r/	2,500	1,250 e/	2,100 e/	1,237 r/ e/	1,700 e/	1,700
France	3,520	2,418	1,496	1,464 r/	1,400	1,055	706	432	430 r/	425
Germany	146	146	125	100 e/	200	23	21	18	15 e/	28
Greece e/ 5/	1,416	1,990	1,970	1,990 e/	NA	575	810	800	810 e/	NA
Guatemala e/	3	3	3	3	3	2	2	2	2	2
India	57,375	60,473	65,173 r/	66,657 r/	67,000	36,720	37,368	41,710 r/	42,660 r/	42,900
Indonesia	341	335	340 e/	335 e/	345 6/	198	194 e/	197 e/	194 e/	200
Iran 9/	9,870	8,690	9,080	9,000 e/	9,000	4,800 e/	4,300 e/	4,500 e/	4,500 e/	4,500
Japan	11	3	3	3	3 6/	6	1	1	1	1 6/
Kazakhstan	13,129 r/	10,521 r/	14,900	13,200 r/	13,700	7,200 e/	5,700 e/	8,200 e/	7,200 r/	7,500
Korea, North e/	10,500	11,000	11,000	11,000	10,000	4,900	4,900	5,100	5,100	4,700
Korea, Republic of	219	191	184	221	296 6/	122	107	103	124	166 6/
Macedonia e/	15 r/	15 r/	15 r/	15 r/	15	9 r/	9 r/	9 r/	9 r/	9
Malaysia	246	243	202	325	269 6/	150	148	123	208	172 6/
Mauritania	9,360	11,440	11,330	11,400 e/	11,700	5,900 e/	7,000 e/	7,000 e/	7,000 e/	7,000
Mexico 10/	11,435	8,538	7,065	7,794	8,000	7,433	5,516	4,592 r/	5,066 r/	5,200
Morocco	66	64 r/	47 r/	12 r/	15	41 e/	39 r/	32 r/	8 r/	9
New Zealand 11/	2,389	2,080	2,362	2,334 r/	2,300	800 e/	600 e/	900 e/	800 r/ e/	800
Nigeria e/	400	300	200	200	100	200	150	100	100	50
Norway	2,162	2,364	2,012	1,705 r/	1,000	1,360	1,532	1,348	1,023 r/	660
Peru	4,930	7,430	6,235	4,364 r/	4,439 6/	3,475 r/	4,637 r/	3,948 r/	2,916 r/	2,966 6/
Portugal 12/	16 e/	14	15	19 r/	18	6	5	5	7 r/	7
Romania	904	951 e/	570 e/	670 e/	650	130	198	147	175	170
Russia	76,100	73,300	75,900	69,600	70,800	41,900	40,200	41,700	39,600 r/	38,900
Serbia and Montenegro	106	32	116	115 e/	115	34	10 e/	37	37 e/	35
Slovakia e/	920	870	820	850 6/	850	250	230	225	240	240
South Africa 13/	29,385	30,489	31,946	30,830	33,125 6/	19,100 e/	18,903	19,806	19,115 e/	20,472
Spain 14/	2,475	2,082	2,307	1,269 r/	588	1,109	992	1,073	588 r/	265
Sweden	18,728	19,663	19,058	20,273	21,893 r/	11,901	12,587	12,211	12,975 e/	13,912
Thailand	209	143	34	86 r/	44	115 e/	78 e/	17 e/	43 r/ e/	22
Tunisia	299	288 r/	224 r/	239 e/	252 6/	153 e/	129	122 r/	130	137
Turkey	6,480	5,755	4,931	6,404 r/ e/	6,000	3,324 e/	3,148 e/	2,754	3,500 r/ e/	3,500
Ukraine	65,500 r/	51,300	50,400	47,600 r/	53,000	36,000	28,200	27,700	26,200 r/	29,200
United Kingdom	1	1	1	1	1 6/	(7/)	(7/)	(7/)	(7/) e/	(7/)
United States	55,676 r/	58,454 r/	62,501 r/	62,083 r/	62,971 6/	35,245	36,762	39,577	39,243	40,022 6/
Venezuela	16,871 r/	18,318	18,954 r/	18,412 r/	18,359 6/	8,739 r/	9,489 r/	9,818 r/	9,537 r/	9,510
Zimbabwe	375	4	311	324 r/ e/	300	225 e/	3 e/	160 e/	160 r/ e/	100
Total	953,316 r/	981,979 r/	1,019,582 r/	1,024,136 r/	1,035,942	496,635 r/	514,692 r/	537,726 r/	552,028 r/	560,093

See footnotes at end of table.

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

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e/ Estimated. p/ Preliminary. r/ Revised. NA Not available.

1/ Table includes data available through July 16, 1998.

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

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

11/ Concentrates from titaniferous magnetite beach sands.

12/ Includes manganiferous iron ore.

13/ Includes magnetite ore as follows, in thousand metric tons: 1992--4,650; 1993--4,340; 1994--3,460; 1995--2,325; 1996--2,070; and 1997--not available.

14/ Includes byproduct ore.

TABLE 18  
IRON ORE: WORLD PELLETTIZING CAPACITY,  
BY CONTINENT AND COUNTRY IN 1997

	Rated capacity (million metric tons, gross weight)
North America:	
Canada	27.3
Mexico	13.7
United States	65.9
Total	<u>106.9</u>
South America:	
Argentina	2.0
Brazil	37.3
Chile	4.4
Peru	3.4
Venezuela	9.9
Total	<u>57.1</u>
Europe:	
Belgium	.7
Netherlands	3.8
Norway	1.4
Russia	34.0
Sweden	16.4
Turkey	1.0
Ukraine	32.0
Total	<u>89.3</u>
Africa:	
Liberia	3.0
South Africa	.6
Total	<u>3.6</u>
Asia:	
Bahrain	4.0
China	20.0
India	8.2
Iran	9.0
Japan	3.0
Kazakstan	8.4
Total	<u>44.5</u>
Oceania: Australia	<u>4.0</u>
World total	<u>305.3</u>

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.