



2007 Minerals Yearbook

IRON ORE

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U.S. iron ore production decreased slightly in 2007 compared with that of 2006; consumption decreased by 6%. Worldwide iron ore production and consumption once again rose in 2007. China, by far the leading consumer, led gross tonnage production of iron ore (relatively low-grade ore). Brazil was the leading producer of iron ore in terms of iron content (tables 1, 17). For the fourth consecutive year, worldwide iron ore trade increased. Prices continued to rise at a much greater rate than in 2006.

The supply of iron ore—the basic raw material for producing iron and steel—is critical to the economy of the United States, as it is to that of all industrialized nations. Scrap, a supplement to iron ore in steelmaking, has become a major feed material, but owing to inadequate supply of high-quality scrap, its use has limitations. Direct reduced iron (DRI), although an alternative to scrap, requires iron ore for its production.

Hematite (Fe_2O_3) and magnetite (Fe_3O_4), the primary commercial ore minerals of iron, are iron oxides. Taconite, the principal iron ore mined in the United States, contains hematite and magnetite in varying proportions and is found in hard, fine-grained banded iron formations with low (20% to 30%) iron content. Almost 99% of domestic iron ore production is transformed into molten iron in a blast furnace by the iron and steel industry. Most molten iron goes directly to a basic oxygen furnace (BOF) to be converted to steel by removing most of the residual carbon. The remainder is poured into molds to produce pig iron.

In 2007, the United States consumed 54.8 million metric tons (Mt) of iron ore, a decrease of 3.4 Mt compared with the revised consumption for 2006, and produced 36.3 Mt of pig iron, a 4% decrease from that of 2006 and the lowest level since before World War II. Raw steel production at 98.1 Mt decreased slightly compared with that of 2006. U.S. steel consumption decreased to 114 Mt from 120 Mt in 2006. Domestically produced iron ore is supplemented with imported iron ore to produce pig iron, which is used along with imported pig iron, DRI, and scrap to produce raw steel. Integrated steel mills produce steel from iron ore; minimills produce steel from DRI and scrap. In 2007, the minimill sector of the steel industry produced 42% of the raw steel in the United States.

Substitutes for iron ore can help the highly cyclical steel industry avoid the shutdown of blast furnaces and associated layoff of production workers when demand for raw steel falls. Imports of pig iron and semifinished steel allow integrated steelmakers to increase shipments of steel mill products without increasing blast furnace production, thus avoiding the costly startup of less efficient blast furnaces held in reserve and the employment of additional skilled workers. In 2007, net U.S. imports of iron ore substitutes were 0.4 Mt, just 6% of what they were in 2006. This decrease was mainly a result of a 27%

increase in net exports of scrap steel, a 32% increase in net imports of semifinished steel products, and a 13% increase in net imports of pig iron. The net imports of DRI remained constant at 2.6 Mt. During the year, along with the slight decrease in raw steel production and a 5% drop in steel consumption, iron ore consumption declined 6% from 2006 levels.

Legislation and Government Programs

No changes were passed to the taconite production tax in the 2007 Minnesota legislative session. Therefore, the tax rate for concentrates produced in 2007 increased to \$2.258 from \$2.203 per taxable long ton (Minnesota Department of Revenue, 2007, p. 6).

Production

The U.S. Geological Survey (USGS) develops U.S. iron ore production data through an annual “Iron Ore” survey, which provided the production listed in tables 1 through 5. This information is supplemented by employment data, mine inspection reports, and information from consumers. The American Iron Ore Association no longer provides data on ore shipments from loading docks on the Upper Great Lakes nor receipts at transfer docks and furnace yards nationwide. The steel plant data are compiled by the American Iron and Steel Institute (AISI).

In 2007, domestic iron ore production was 52.5 Mt, a slight decrease from the 2006 production of 52.7 Mt. Michigan and Minnesota taconite mines accounted for almost all domestic iron ore production—six mines operated on the Mesabi Range in northeastern Minnesota, and two, on the Marquette Range in Michigan’s Upper Peninsula. Domestic iron ore supply (production minus exports) met 79% of domestic demand in 2007, 7% more than the average from 2002 through 2006.

Cleveland-Cliffs Inc announced 2007 production for its North American operations, as follows (United States, unless otherwise specified): Empire, 5.0 Mt; Hibbing Taconite, 7.5 Mt; Northshore, 5.3 Mt; Tilden, 7.3 Mt; United Taconite, 5.4 Mt; and Wabush (Canada), 4.7 Mt. Cleveland-Cliffs’ ownership share of the total production, 35.2 Mt, was 22.1 Mt. The company’s share of total North American production increased by 5% compared with that of 2006, and overall iron ore sales revenue increased by 12% compared with that of 2006 to \$1.75 billion (Cleveland-Cliffs Inc, 2008a).

Michigan.—Michigan accounted for about 24% of U.S. usable iron ore output in 2007. Nearly all Michigan’s output was pellet production. The Empire Mine production was standard and flux pellets. The Tilden Mine produced magnetite and hematite flux pellets, and reported a production increase

of 4% compared with that of 2006. The increase in 2007 was owing to unplanned repairs in 2006 that resulted in operating improvements in 2007 and a larger proportion of lower productivity magnetite pellets being produced in 2006 (Cleveland-Cliffs Inc, 2008b, p. 45; Koch, 2008, p. 8–11).

Cleveland-Cliffs sold the Republic Mine, closed since 1996, and adjacent property. Neither the buyer nor price was disclosed. A final site cleanup plan had been approved by the Michigan Department of Environmental Quality in December 2006. The sales agreement did not include the 931-hectare (2,300-acre) Republic Wetlands Preserve (Skillings Mining Review, 2007c).

Cleveland-Cliffs, manager of the Empire and Tilden Mines, which both receive power from Wisconsin Electric Power Company (WEPCO), settled its dispute over energy charges with the utility. The dispute of WEPCO's unilateral change to methods for determining electricity rates began in 2005. Cleveland-Cliffs received \$32.5 million from its escrowed payments and a rebate of \$2.6 million for over-the-cap payments (Cleveland-Cliffs Inc, 2007d, p. 31).

Cleveland-Cliffs announced a 10-year alliance with Kobe Steel Ltd. (Japan) to license a proprietary process for the production of high-purity iron nuggets. These iron nuggets can be used as direct feed to electric arc furnaces for the production of steel. Cleveland-Cliffs planned to construct an iron nugget production facility at the Empire Mine in Palmer, MI. Production of 0.5 million metric tons per year (Mt/yr) of iron nuggets containing more than 96% iron was expected to start in 2010. The joint venture with Kobe Steel would take advantage of increasing demand by steel's growing minimill sector. It was anticipated that the construction of the nugget plant would also extend the life of the Empire Mine (Cleveland-Cliffs Inc, 2007b, c).

Minnesota.—Minnesota produced 76% of the usable iron ore in the United States in 2007; nearly all the output was pellet production. All production from the State came from open pit mines on the Mesabi Iron Range. Minnesota pellet production, grouped by operating company, was summarized as follows: (a) Hibbing Taconite Co. produced pellets; (b) Northshore Mining Co. produced 5.3 Mt of standard pellets and a small amount of sinter material; (c) United Taconite Co., LLC [owned by Cleveland-Cliffs (70%) and China's Laiwu Steel Group (30%)] produced pellets; (d) ArcelorMittal USA Inc. (Chicago, IL) produced 2.7 Mt—98% was flux pellets, and 2%, pellet chips—from its Minorca Mine; and (e) United States Steel Corp. (Pittsburgh, PA) (U.S. Steel) produced 5.2 Mt of pellets from its Keewatin Taconite operations and 2.4 Mt of acid pellets and 11.3 Mt of flux pellets from its Minntac operations.

Hibbing Taconite's production decreased as a result of the shutdown in late February 2007 resulting from severe weather conditions that caused significant buildup of ice in the basin supplying water to the processing facility. At the Northshore facility, construction activity was reinitiated to restart an idled pellet furnace that would increase capacity by approximately 0.6 Mt/yr of pellets in 2008 and add 0.8 Mt/yr to capacity thereafter (Cleveland-Cliffs Inc, 2008b, p. 45; Koch, 2008, p. 5, 14, 18–19, 22–23).

India's Essar Global Ltd. acquired Algoma Steel Inc. of Canada for \$1.64 billion. Three days later Essar announced its

plan to acquire Minnesota Steel Industries, LLC. Essar planned to take advantage of synergies between Algoma, a manufacturer of rolled steel products, based in Sault Ste. Marie, Ontario, and Minnesota Steel, a company planning a mine, ore processing facility, direct reduction works, and steel slab-making facilities on Minnesota's Mesabi Iron Range. The proposed complex would cost about \$1.6 billion (Algoma Steel Inc., 2007; Robertson, 2007).

In March, Steel Dynamics, Inc. announced plans to move forward with the Mesabi Nugget project in Hoyt Lakes, MN. By November, the company proceeded to break ground for the \$235 million joint-venture project with minority partner Kobe Steel to develop a 0.5-million-metric-ton-per-year-capacity iron-making plant. The plant was planned to produce iron nuggets of 96% to 98% iron content based on Kobe Steel's iTmk3 process, which had been successfully pilot tested at the site in 2003. The Governor of Minnesota announced that the State had approved \$26.5 million in nonrecourse financing for the project (Steel Dynamics, Inc., 2007b; 2008, p. 19). In December, Steel Dynamics announced the purchase of approximately 2,400 hectares (6,000 acres) of land with associated mineral rights at Hoyt Lakes from Cleveland-Cliffs for \$18 million. Steel Dynamics planned to reopen a mine operated by the former LTV Steel Mining Co. and construct an iron ore concentrator, which would feed the Mesabi Nugget facility. The mine and concentrator were expected to cost approximately \$165 million and begin operation about yearend 2009 (Bloomquist, 2007; Steel Dynamics, Inc., 2007a).

Utah.—Palladon Ventures Ltd. continued construction activities on its Iron Mountain project near Cedar City. Jiangshu Shagang Group Co. Ltd. (China) signed a letter of intent to purchase 50% of the Palladon Ventures project. Shagang, the leading private steel company in China, planned to complete due diligence studies before finalizing the agreement (Palladon Ventures Ltd., 2007).

Consumption

U.S. iron ore consumption declined by 6% to 54.8 Mt from the revised 2006 figure of 58.2 Mt (table 1). Pig iron production at 36.3 Mt was 13% below the 10-year average of 41.9 Mt/yr for 1998 through 2007. Raw steel production using BOF technology decreased by 4% to 40 Mt—the lowest production level in more than 10 years and 14% below the average production for the past decade.

Consumption of iron ore, including agglomerates, reported to the AISI by producers of iron and steel totaled 53.7 Mt, including 46.3 Mt of pellets; 6.8 Mt of sinter, briquettes, and other products; and 0.5 Mt of natural coarse ore (table 7). Of the ore consumed, 83% was domestic; 10%, from Canada; 6%, from Brazil; and 1%, from other countries. Other iron-bearing materials charged to blast furnaces included mill scale, slag scrap, and steel furnace slag.

The three consumption numbers used in this annual review are reported in tables 1, 7, and 8. The first consumption number (54.8 Mt in 2007 in table 1) is the sum of the ore consumed by input type reported by the AISI, the ore consumed in DRI production, and the ore consumed in nonsteel uses, as reported

to the USGS (American Iron and Steel Institute, 2008, p. 81). The second consumption number (53.7 Mt in 2007 in table 7) is the ore consumed in U.S. iron and steel plants by type of ore reported by the AISI. The third consumption number is no longer being reported, but 2003 consumption is listed in table 8. This consumption figure was the ore consumed in U.S. iron and steel plants by ore type, as reported by the AISI, plus the ore consumed in DRI production (0.38 Mt in 2007) and nonsteel uses (0.72 Mt in 2007). Data on iron ore consumption in nonsteel end uses (table 8) were compiled from USGS surveys.

Prices

The first iron ore contract for the year beginning April 1, 2007, was agreed between Baosteel Co., Ltd. and Companhia Vale do Rio Doce (CVRD) on December 21, 2006. This agreement marked several milestones—the first time that Chinese steelmakers established the benchmark price, the earliest benchmark settlement in the past 11 years, and the fifth straight year of iron ore price increases. The price for lump and fines increased by 9.5% from that of March 31, 2007 (table 16). These lump and fines prices represented an increase of 189% since 2002. Australia's BHP Billiton Ltd. and Rio Tinto plc agreed to basically the same terms shortly thereafter. On December 28, CVRD announced what appeared to be a benchmark agreement with Italian steelmaker ILVA S.p.A. on a pellet price increase of 5.28% (Garside, 2007a; Mining Journal, 2007f).

In August, a shortage of fines for sintering drove the spot price of iron ore pellets sold to China by India up to as much as \$150 per metric ton—a week-on-week increase of 7%. A slight increase in price for fines mainly reflected the recent increase in freight costs owing to high demand for transport (Li, 2007b). By November, the spot price for iron ore imported into China was reported to have fallen to \$190 per metric ton for ore with 63.5% iron content, following a relatively fast run-up from \$103 per ton at the beginning of August, from a high of more than \$200 per metric ton. About 50 small steel mills in Hebei Province ceased production owing to the high cost of iron ore (Li, 2007a).

By midyear, forecasts by leading bankers indicated that iron ore prices might rise between 17.5% and 25% in the 2008–09 contract year. Chinese iron ore imports were expected to grow by 20% during 2007, while domestic production was expected to slow. This was anticipated as the seventh straight year for price increases in the world iron ore market (Mining Journal, 2007e).

In anticipation of price negotiations for the 2008–09 contract year, the chief executive of Rio Tinto suggested that Australian iron ore producers should seek a premium for their product because Chinese steelmakers pay more for delivered Brazilian iron ore through higher transport charges. Even without this potential freight equalization, most analysts forecast a price increase of about 30% (Wilson, 2007). While Australian iron ore miners called for this transportation price differential, Brazil's CVRD indicated that it had no plans to establish freight rate sharing agreements. CVRD planned to continue selling ore on a free-on-board basis (Metal Bulletin, 2007b).

Downstream effects of the high price of raw materials became evident as ArcelorMittal SA announced that the company would be transferring a portion of the rising energy and raw materials costs for steel production to its customers beginning in 2008. ArcelorMittal's steel price would increase by \$40 per short ton in January 2008 in addition to an increase of \$20 per ton on October 1, 2007 (Matthews, 2007a).

Transportation

The Lake Carriers' Association reported that the heaviest cargo of iron ore in December was 14% less than the maximum load through the Soo locks on the Great Lakes. Continued lack of dredging and falling water levels reduced payloads significantly in the latter part of the year. Owing to the continued dredging crisis, shipments of iron ore, the largest single commodity by weight moved in Great Lakes vessels from Great Lakes ports for 2007, totaled 44.2 Mt, a 3% decrease compared with that of 2006. This was a 2% increase from average annual figures for the 2002–06 period. The last boat of the 2006–07 shipping season cleared the Poe lock on January 16. The locks were scheduled to be closed until March 25 (Masson, 2007; Lake Carriers' Association, 2008a, b).

Foreign Trade

In 2007, U.S. net imports (imports minus exports) of iron ore were 87,000 metric tons (t), which represented 0.2% of domestic consumption. Exports increased by 13%, while imports decreased by 18% compared with 2006 figures. Nearly all U.S. iron ore exports were pellets (9.2 Mt), and 79% of the exports was shipped via the Great Lakes to Canadian steel companies, while 12% was shipped to China, 6% to Algeria, 2% to Mexico, and the rest to five other countries. U.S. imports totaled 9.4 Mt, of which Canada's share increased to 59% from 54% in 2006 and Brazil's share decreased to 34% from 39% in 2006 (tables 1, 9–15).

World Industry Structure

Consumption.—Although global iron ore consumption is not measured directly, there are guides that indicate whether it rises or falls—imports of iron ore and production of crude steel, DRI, and pig iron. DRI and pig iron production tend to be more direct indicators of iron ore consumption than crude steel production because a large part of steel production comes from scrap-consuming minimills. Unless a country's ore production remains static, iron ore net imports are not a straightforward indicator of a change in iron ore consumption in countries that produce iron ore. Estimates indicate that world consumption of iron ore increased as a result of an 8% increase in pig iron production compared with 2006 levels. Of the nine countries that produced 3% or more of total pig iron production in 2007, only the United States had negative change when comparing 2007 production with its average pig iron production from 1998 through 2007. All others had increases for this period, as follows: China, 97%; Ukraine, 26%; India, 18%; Brazil, 17%; Russia, 11%; the Republic of Korea, 11%; Japan, 7%; and Germany, 5%. Of the

four leading producing countries of pig iron in 2007, only two showed an increase in production from that of 2006—China, 15%, and Japan, 3%—while production in the United States and Russia decreased by 5% and 1%, respectively.

Interest in mine development was ignited by sustained consumption of iron ore. The increased consumption continued to be driven by China's economic growth. In spite of new iron ore production capacity, world supply of iron ore was expected to remain tight through 2007, owing to increased domestic consumption and steel exports by China.

World crude steel production surpassed 1.3 billion metric tons (Gt) and rose by 7% from that of 2006. Four countries accounted for 5% or more of world production in 2007. Of those countries, China produced about 66 Mt more crude steel in 2007 than in 2006. The others (Japan, Russia, and the United States) combined produced less than 5 Mt more crude steel in 2007 than in 2006. Annual world crude steel production, excluding China, increased by almost 27 Mt. The four previously listed countries, along with Germany and the Republic of Korea, accounted for more than 60% of combined world crude steel production between 1998 and 2007. China's 2007 production was almost double the average for the 10-year period, while that of the United States increased by 2% (United Nations Conference on Trade and Development, 2008, p. 103–107).

Production.—World iron ore production of 2.0 Gt, gross weight, surpassed 2006 production by 12%. Annual world production has been more than 1 Gt, gross weight, since it first exceeded that level in 1995. Australia's and Brazil's combined share of world production from 2003 through 2007 averaged 34%. In 2007, iron ore was produced in 46 countries, with production exceeding 1 Mt, gross weight, in 28 of those countries. World DRI production rose to 67.2 Mt, which was 12% more than that of 2006 (Midrex Technologies, Inc., 2008).

Trade.—World iron ore imports of 883 Mt rose by 8% compared with 2006 levels. Following large year-on-year increases in imports for the past 5 years (21% in 2002, 33% in 2003, 40% in 2004, 32% in 2005, and 19% in 2006), China posted another sharp rise to 383 Mt in 2007 from 326 Mt in 2006—a gain of more than 17%. Since 2001, four countries have accounted for more than 60% of world iron ore imports. Germany's share of imports in that period decreased to 6% from 8%, Japan's share decreased to 17% from 26%, and the Republic of Korea's share decreased to 6% from 9%. China's share more than doubled during this 7-year period to 46% from 19%. Australia's and Brazil's combined share of world iron ore exports decreased slightly to just below 65% in 2007 compared with their share in 2006. Five countries represented almost 84% of world iron ore exports. In decreasing order of market share, Brazil held 33%; Australia, 32%; India, 11%; South Africa, 4%; and Canada, 3% (United Nations Conference on Trade and Development, 2008, p. 87–90).

Mergers and Acquisitions.—Following a mandate by the U.S. Department of Justice (DOJ), ArcelorMittal SA reached agreement in July to sell its Sparrows Point steel mill (Baltimore, MD) for an estimated \$1.35 billion to a joint-venture among Esmark Inc. (Chicago, IL), Brazil's CVRD, and Industrial Union of Donbass Corp. (Ukraine). DOJ had required the sale to alleviate antitrust concerns related to Mittal's

acquisition of Arcelor in 2006. In December, the joint-venture agreement for the purchase of the steel plant with capacity of 3.5 Mt/yr was terminated, although ArcelorMittal continued to pursue the mandated divestiture (ArcelorMittal, 2007; Matthews, 2007b).

In August, U.S. Steel announced an agreement to purchase Canada's Stelco Inc., owner of the Lake Erie and Hamilton Works in Ontario, Canada, and joint-venture interests in iron ore operations and a hot-dip galvanizing line. In 2006, Stelco had emerged from bankruptcy protection, reduced its workforce by 15%, and settled a new 4-year contract with the United Steelworkers' union. In late October, U.S. Steel received approval for the acquisition from the Canadian Minister of Industry under the Investment Canada Act. Two days later U.S. Steel completed the acquisition of Stelco, which was renamed U.S. Steel Canada Inc. The acquisition cost of about \$1.2 billion was financed through cash on hand, borrowings of \$900 million of term loans, and \$400 million of sales under a receivables purchase agreement (United States Steel Corp., 2007a–c).

Brazil's Companhia Siderúrgica Nacional (CSN) acquired Companhia de Fomento Mineral e Participações (CFM), also of Brazil, for \$440 million. CFM's operations are located near CSN's principal iron ore asset, Casa de Pedra, and the acquisition expanded CSN's production capacity by 8 Mt/yr. Casa de Pedra was producing about 16 Mt/yr of iron ore and planned to expand mine capacity to 53 Mt/yr (Metal Bulletin, 2007a).

Dofasco Inc. (owned by ArcelorMittal) exercised the option to buy out the other two partners in the Wabush Mines joint venture—Stelco (now U.S. Steel Canada) and Cleveland-Cliffs. Exercising this option, for more than \$64 million plus certain existing liabilities, would take precedence over a previous bid by Consolidated Thompson Iron Mines Ltd. (Toronto, Ontario) to purchase the 71% stake in the joint venture. Wabush Mines has the capacity to produce 4.8 Mt/yr of iron ore pellets and includes a mine, pelletizing plant, port, and other ancillary facilities in Quebec, Canada (CBC News, 2007).

BHP Billiton outlined the key elements and benefits of its November proposal to combine with Rio Tinto to form one company. The offer was an exchange of three BHP Billiton shares for each share of Rio Tinto, with continued participation for Rio Tinto shareholders through 41% ownership of the combined group. BHP Billiton stated that benefits would result from the optimization of several mineral basin positions and infrastructure throughout the world, development of an enhanced platform for future growth through more efficient infrastructure development, and unique synergies derived from economies of scale and elimination of administrative overlap. Rio Tinto countered that the offer was too low and that, based on port capacity, Rio Tinto was better positioned to take advantage of any increases in Chinese demand than was BHP Billiton (BHP Billiton Ltd., 2007a; Jones, 2007).

India's Tata Steel Limited completed the takeover of Anglo-Dutch Corus Group plc begun in 2006. The \$12 billion acquisition created the fifth-leading steelmaker with a combined crude steel production capacity of 27 Mt/yr (Ritchie, 2007).

World Review

Afghanistan.—The Afghanistan Geological Survey and the U.S. Geological Survey, through a joint team of mineral resource specialists, confirmed the presence of several sedimentary- and igneous-based iron ore deposits in Afghanistan. One of these, Haji Gak, is a large iron oxide deposit hosted in sedimentary rocks and was estimated to contain 2.2 Gt, grading between 63% and 69% iron (Mining Journal, 2007i; Peters and others, 2007, p. 348–354).

Australia.—BHP Billiton announced full-year production figures for 2007. BHP Billiton's share of salable quantities of iron ore (wet) were as follows (Australia, unless otherwise specified)—Area C Joint Venture (JV) (85% owned), 21.3 Mt; Goldsworthy JV (85% owned), 0.6 Mt; Jimblebar (85% owned), 4.9 Mt; Mt. Newman JV (85% owned), 30.4 Mt; Samarco (Brazil) (50% owned), 8.0 Mt; and Yandi JV (85% owned), 37.5 Mt. BHP Billiton's share of total world mine production was 102.9 Mt, a 4% increase from that of 2006 (BHP Billiton Ltd., 2008a, p. 4).

Although the Rapid Growth Project 3 (RPG3) tie-in activities and cyclones negatively affected production during the first quarter of 2007, BHP Billiton was able to complete engineering, procurement, and construction on the project before the end of the year. Ramp-up at the mine was underway and port expansion was operating at design levels, exceeding 129 Mt/yr of iron ore rates for the month of December. The project when at full production will add 20 Mt/yr of iron ore capacity. Rapid Growth Project 4 (RPG4) was begun as an overlap to RPG3 to add an additional 26 Mt/yr of iron ore system production capacity by midyear 2010. By yearend 2007, engineering and construction on RPG4 was 70% and 15% complete, respectively (BHP Billiton Ltd., 2007b, p. 3; 2008b, p. 3).

Rio Tinto announced full-year production figures for 2007. Rio Tinto's share of salable quantities of iron ore plus pellets were as follows (Australia, unless otherwise specified): Channar (60% owned), 6.3 Mt; Corumba (Brazil), 1.8 Mt; Eastern Range, 6.9 Mt; Hamersley, 94.6 Mt; Hope Downs (50% owned), 32,000 t; Iron Ore Company of Canada (IOC) (58.7% owned), 7.8 Mt; and Robe River (53% owned), 27.3 Mt. Rio Tinto's share of total world mine production was 144.7 Mt, a 9% increase from that of 2006 (Rio Tinto plc, 2008a, p. 64).

Rio Tinto announced an additional expansion to iron ore export capacity in Western Australia. The capacity of the port at Cape Lambert will be increased to 80 Mt/yr from 55 Mt/yr at a cost of \$860 million. Including the port upgrade, Rio Tinto's has invested \$5 billion in infrastructure development in Pilbara since 2003 (Rio Tinto plc, 2007a).

The Environmental Protection Authority (EPA) of Western Australia released a report blocking Rio Tinto's planned \$10 billion iron ore expansion at the Mesa A/Warramboe project near Pannawonica in the Pilbara region. Five species of rare underground troglobites (spider-like invertebrates less than 5 millimeters in length) were found to inhabit the planned mining zone. The EPA later reversed its recommendation on appeal by Rio Tinto in favor of the project's development after the company provided more information on the creatures and amended its mining proposal (Mining Journal, 2007g; Klinger, 2008).

Rio Tinto's Yandicoogina Mine, in the Pilbara region of Western Australia, reached its rated capacity of 52 Mt/yr with the completion of the Junction South East expansion. It became the leading iron ore mine in terms of output in Australia. Rio Tinto's Hope Downs Mine started producing iron ore in November and was expected to reach 30 Mt/yr production capacity by 2009 (Rio Tinto plc, 2007b, p. 2, 10; 2008b, p. 1).

Fortescue Metals Group Ltd. (FMG) of East Perth, Australia, began operations at its Cloudbreak Mine, and by yearend had stockpiled 0.665 Mt of iron ore. Mine construction was expected to be completed by mid-March 2008, with the first loaded train arriving at the port facilities that month. The first ore was scheduled to be on ship in mid-May 2008 (Fortescue Metals Group Ltd., 2008).

FMG agreed to supply iron ore from its Western Australian operations to China's Tangshan Iron and Steel Co. (Taigang) for 10 years beginning in 2008. The new Cloudbreak Mine in the Pilbara's Chichester Range was expected to have an initial production capacity of 45 Mt/yr. Taigang agreed to purchase 11% of initial production, up to 5 Mt/yr and up to an additional 15 Mt/yr after FMG's planned expansion. In March, FMG signed a similar agreement with Baosteel Group Corp., China's leading steelmaker (Mining Journal, 2007d).

Additionally during 2008, FMG reported a discovery of inferred resources exceeding 1.0 Gt, with an average grade of 56% iron at its Solomon project also in the Pilbara region of Western Australia. The Solomon project is located 100 to 150 kilometers (km) west of FMG's main deposits at Cloudbreak and Christmas Creek. A 100-km railway spur, estimated to cost A\$300 million, would access FMG's existing rail and port facilities. The 100-km spur, however, might not be needed if Australia's National Competition Council approves FMG's petition to transport ore on the nearby rail lines operated by BHP Billiton and Rio Tinto (Barta, 2007; Dixon, 2007).

Chinese investment continued toward the goal of increased ownership of foreign iron ore sources by Chinese steelmakers. Shagang Group Co. Ltd. bought a 90% share in the Savage River Mine and plant from Stemcor Group (United Kingdom), owner of the 2.5-Mt/yr iron ore mine and pelletizing facility in Tasmania, Australia. Based on feasibility studies, the mine's production life was extended from 2010 to 2023 with the subsequent production of an additional 30 Mt of pellets during that period (Metal Bulletin, 2007e).

CITIC Pacific Ltd., formerly part of the China International Trust and Investment Co., planned to develop a third 1.0-Gt iron ore project near Balmoral in the Pilbara region of Western Australia. The project is adjacent to Australasia Resources Ltd's \$2.1 billion Balmoral South iron ore project currently under development with partner Shougang Corp. CITIC, currently developing another iron ore deposit in the area, expected the project to cost \$1.75 billion for 24 Mt/yr of production capacity, including mine, rail, and port facilities, being built under contract with China Metallurgical Group Corp. (Mining Journal, 2007a).

The Government of Western Australia approved plans for a new \$202 million berth at Port Hedland. The new export berth, with capacity of 18 Mt/yr, was expected to begin operation at midyear 2009. This berth capacity would serve

120,000-deadweight-ton Cape class vessels and would be used to ship chromite, iron, and manganese ores (Ho, 2007).

Bolivia.—The Government of Bolivia officially endorsed the development of a large iron ore deposit. Bolivia signed a formal contract with India's Jindal Steel and Power Ltd. (JSPL) for the development of the Mutún iron ore deposit, a 450-megawatt natural gas-fired powerplant, and a 1.7-Mt/yr steel production complex. JSPL anticipated the production of 10 Mt/yr of iron ore pellets within 5 years from the development of the \$2.1 billion project (Garside, 2007b).

Brazil.—CVRD announced 2007 production based on consolidated Brazilian generally accepted accounting practices. CVRD's total iron ore production increased by 12.0% from 2006 to 2007, and CVRD's share of salable quantities of iron ore was as follows, in decreasing order of tonnage: Southeastern System, 113.8 Mt; Carajás, 91.7 Mt; Southern System, 89.3 Mt; Samarco, 7.2 Mt; and Urucum, 1.1 Mt. CVRD's 2007 pellet production was 36.0 Mt, an increase of 8.4% from that of 2006. The breakdown of salable quantities of iron ore pellets was as follows, in decreasing order of pellet production: Samarco, 7.1 Mt; São Luís, 7.1 Mt; Tubarão I and II, 6.4 Mt; Nibrasco, 4.6 Mt; Fábrica, 4.1 Mt; Kobrasco, 2.5 Mt; Hispanobras, 2.2 Mt; and Itabasco, 2.0 Mt. A large part of the increase in pellet production in 2007 was the result of the recovery from the 2006 shutdown of the São Luís plant from April to July. The iron ore production increases resulting from the continued ramp up of production at Brucutu were partially offset by a heavy rainy season in many of the iron ore mining areas (Companhia Vale do Rio Doce, 2008).

Anglo American plc (London, United Kingdom) announced an agreement to purchase 49% of the MMX Minas-Rio iron ore project from MMX Mineração e Metálicos S.A. (Rio de Janeiro) for \$1.15 billion. The project was scheduled to start up at the end of 2009 with a production capacity of 26.6 Mt/yr and an estimated cost of \$2.5 billion. The project included mines in Minas Gerais State and a 525-km pipeline to the new port of Açú in Rio de Janeiro State. An as-yet-unscheduled expansion to the project envisioned a production capacity increase to 56.6 Mt/yr, with Anglo holding a 50% stake (Kinch, 2007). Gulf Industrial Investment Co., a producer of direct reduction grade iron oxide pellets in Bahrain, doubled the contract offtake from MMX. This represented an annual offtake agreement of 13 Mt/yr of iron ore fines (MMX Mineração e Metálicos S.A., 2007).

Cleveland-Cliffs completed the purchase of a 30% interest in MMX's Amapá iron ore mine in Brazil for \$133 million. An additional \$350 million was expected to be required to bring the 6.5-Mt/yr project into production by late 2007. The project includes development of the iron ore deposit and construction of a 192-km railway to an existing port on the Amazon River (Cleveland-Cliffs Inc, 2007a).

Canada.—IOC [owned jointly by Labrador Iron Ore Royalty Income Fund (15.1%), Mitsubishi Corp. (26.18%), and Rio Tinto (58.72%)] produced 1.9 Mt of iron ore concentrates and 11.3 Mt of iron ore pellets. ArcelorMittal Mines Canada (formerly Québec Cartier Mining Co. produced 13.6 Mt of iron ore concentrates. Wabush Mines Ltd. [owned jointly by ArcelorMittal (28.6%), Cleveland-Cliffs (26.8%), and U.S. Steel Canada (44.6%)] produced 4.7 Mt of iron ore pellets. In 2007,

IOC's iron ore production was affected by a 7-week strike, which took place in the first half of the year and concluded with a 5-year wage agreement (Koch, 2008, p. 6, 27; Rio Tinto plc, 2008b, p. 20).

Baffinland Iron Mines Corp., under the management of Aker Kvaerner, planned to complete a definitive feasibility study of Deposit No. 1 of its Mary River project in early 2008. The Mary River project, on Baffin Island, Nunavut Territory, was a direct shipping ore project. The definitive feasibility study and additional studies of satellite deposits included expanding the proposed output at Deposit No. 1 to 18 Mt/yr (dry basis) from 10 Mt/yr, making Steensby Inlet on the south coast of Baffin Island the principal deepwater port (thus increasing the shipping season from 9 months to year round), preparing a scoping study for Deposit No. 2, and completing a "Blue Sky" study for development of other deposits, which would increase output to 25 Mt/yr. Since 2004, Baffinland had spent about Can\$60 million on exploration drilling and preparation of a scoping study completed in May 2006 (Baffinland Iron Mines Corp., 2007).

At the beginning of 2007, New Millennium Capital Corp. (Westmount, Quebec) was considering supplementing its planned 15-Mt/yr pellet operation with an additional 7 to 8 Mt/yr of concentrate production. The cost estimate for the LabMag project, prior to bankable feasibility and the addition of the concentrate product, was \$2.75 billion, which included a slurry pipeline, port terminal at Pointe Noire, Quebec, and a pelletizing plant with two pelletizing lines of 7.5 Mt/yr each (Metal Bulletin, 2007d). In March, New Millennium filed National Instrument 43-101 in accordance with Canadian Government regulations for its KéMag property. The results indicate 1.3 Gt of mineral resources with an additional 1.0 Gt of inferred mineral resources. This, combined with the LabMag property, increased the resource in the area to more than 5.0 Gt, which includes 3.5 Gt of reserves that are considered proven or probable (New Millennium Capital Corp., 2007).

Breton Banville & Associates completed a final feasibility study for Consolidated Thompson Iron Mines Ltd.'s Bloom Lake iron ore deposit in Quebec, about 10 km north of ArcelorMittal's Mount Wright Mine. The planned mine would produce 7 Mt/yr of iron ore concentrates. The project's capital cost was estimated to be \$333 million with a total operating cost of \$19.76 per metric ton of concentrate. Development work on the project began in November after signing an offtake agreement with a Chinese company for the sale of 5.0 Mt/yr of iron ore concentrates (Consolidated Thompson Iron Mines Ltd., 2007; Skillings Mining Review, 2007d).

Chile.—Chile's Compañía de Aceros del Pacífico S.A. (CAP) approved an investment of \$637 million for a new iron ore mine and a new steel plant. The iron ore mine was expected to produce 4 Mt/yr of pellet feed. The projects were estimated to come online in 2010 (Skillings Mining Review, 2007a). In 2007, production by Compañía Minera del Pacífico (a fully owned subsidiary of CAP) increased by 1.9% to 7.9 Mt of iron ore pellets (standard, self-fluxing, and direct reduction), pellet chips, pellet feed, lumps, and fines.

China.—In mid-2007, the Chinese Academy of Geological Sciences (CAGS) reported total Chinese iron ore reserves of 59.4 Gt—26.7 Gt of these reserves was already developed. The

remaining 32.7 Gt reportedly was the undeveloped reserve base. Most of these reserves were low-grade, according to CAGS, averaging between 30% and 35% iron. Sichuan was the leading Province, with a reserve base of 7.9 Gt (Skillings Mining Review, 2007b).

China's production of iron ore for 2007 reached 701 Mt, an increase of 18% from that of 2006. Production of iron ore has more than doubled since 2004, but the iron content of the ores on average has been declining. China was the world's leading importer of iron ore in 2007, with imports rising to 383 Mt in 2007, an increase of 17% from that of the previous year. Major mines accounted for about 20% of total iron ore production, while medium- to small-scale mines produced the bulk of the ore. There were about 53 major mines, but there were nearly 8,000 total mines in the country. State-owned enterprises accounted for about 65% of production; a large number of collective mines, for about 14%; and privately held entities accounted for the remaining 21% (United Nations Conference on Trade and Development, 2008, p. 33–35).

India.—In an attempt to conserve iron ore resources, India imposed an export tax of 300 rupees (about \$6.66) per metric ton on all iron ore exported from the country effective March 1. The export tax appeared to be particularly onerous to low-grade ore producers because the tax was based on the gross weight of the ore. Several large exporters with long-term contracts needed to absorb the additional costs caused by the new tax (Nair, 2007).

Mumbai-based Vedanta Resources plc agreed to buy a 51% share in Sesa Goa Ltd.—India's leading private iron ore producer and exporter—from Japan's Mitsui & Co. Ltd. for \$981 million. Vedanta made an open offer to Sesa Goa shareholders to acquire an additional 20% of the company, but only succeeded in raising its stake to 51.2%. Sesa Goa had 207 Mt of reserves and resources in India and exported more than 95% of its 10-Mt/yr production to Chinese, European, and Japanese steel companies. Vedanta planned to increase production of iron ore to 15 Mt/yr within 2 years (Mining Journal, 2007j).

Maoist rebels targeted railway property and mine infrastructure. The rebels damaged the water pumping station at Essar Steel Holdings Ltd.'s iron ore beneficiation plant and attacked National Mineral Development Corp.'s rail line from the Bailadila mines—both in Chhattisgarh State. These were the latest in a series of attacks aimed at preventing the development of India's iron and steel industries and were reportedly launched in support of the Communist Party of India's proagrarian policies in the State (Metal Bulletin, 2007c).

Mauritania.—Australia's Sphere Investments Ltd. announced the results of a prefeasibility study prepared on the Guelb el Aouj iron ore deposit in Mauritania by Golder Associates. Estimates of capital and operating costs were \$1.44 billion and \$30.33 per metric ton of pellet produced (including royalty), respectively. Proven and probable reserves at 25% iron cutoff were 178 Mt and 294 Mt, respectively—sufficient reserves for a 30-year mine life for a complex that would include a 7-Mt/yr pelletizing plant. Qatar Steel purchased a 15% stake in the project and was investigating the possibility of increasing its share to 49.9% (Age, The, 2007; Mining Journal, 2007h).

Russia.—In 2007, JSC Severstal increased ore production capacity at its Karelsky Okatysh Mine in Karelia to 30 Mt/yr of run-of-mine ore with 29% contained iron and had record production of 10 Mt of 65%-iron ore pellets. With the opening of the new underground Olenegorsky Mine in 2007, Severstal increased the capacity of its Olkon operations to 16.5 Mt/yr from 12 Mt/yr of run-of-mine ore with 28% contained iron (Mining Magazine, 2008, p. 55–56).

Senegal.—ArcelorMittal signed an agreement with the Senegalese Government to develop the Faleme iron ore project. Kumba Resources Ltd. had previously obtained the rights to conduct a prefeasibility study with an option to acquire an 80% interest in the project. The agreement with ArcelorMittal outlined an iron ore mine, a new port near Dakar, and a 750-km railway linking the mine and the port. At full production, the mine was designed to produce 25 Mt/yr of high-grade iron ore from 750 Mt of magnetite and hematite reserves contained in four deposits. The capital cost of the project was expected to be about \$2.2 billion, with production starting in 2011 (Mining Journal, 2007b, c).

Sweden.—Luossavaara-Kiirunavaara Aktiebolag (LKAB) increased pellet production to 18.8 Mt from 16.9 Mt and decreased production of fines to 5.0 Mt from 5.6 Mt in 2006. The new pellet plant at Malmberget moved into full production in 2007, and construction of a new concentrator, which included a flotation plant, and pelletizer continued at Kiruna. Iron ore production in 2007 was slightly below plan owing to labor conflicts and a cable fire in the Svappavaara pelletizing plant (Luossavaara-Kiirunavaara Aktiebolag, 2008, p. 25, 41).

Ukraine.—Ferrexpo plc (Switzerland) announced the start of a \$158 million project to expand mine production at its Gorishne-Plavninskoye Lavrikovskoye (GPL) Mine to 32 Mt/yr by 2011 from the current 28 Mt/yr. The additional ore production would permit Ferrexpo to increase pellet (65% iron) production at the underutilized existing plant by 1.3 Mt/yr (Ferrexpo plc, 2007).

Vietnam.—Construction began on the Quy Sa Van Ban iron ore mine in Vietnam's Lao Cai Province. The Vietnam-China Minerals and Metallurgy Company was scheduled to begin production at the mine in early 2008 at an average annual rate of 1.5 to 3.0 Mt. Plans also included building a steel plant in the Bao Thang district in 2008 (Skillings Mining Review, 2007e).

Outlook

It appears that U.S. production in 2008 could increase slightly from that of 2007, but all indications are that an economic downturn could affect steel and iron ore production in the latter part of 2008 and well into 2009. Most U.S. iron ore production is sold directly to the domestic steel industry, although some domestic ore is shipped to Canada, while some ore has been traded for Canadian ore subsequently shipped to China. The domestic dependence is not expected to change in the near future, although with the sale of the Chinese stake in United Taconite to Cleveland-Cliffs, the trade of Canadian ore to China may be affected.

Trends in steel industry are provided in the "Outlook" section in the Iron and Steel chapter of the 2007 USGS Minerals

Yearbook, volume I, Metals and Minerals. Growth of the U.S. iron ore industry within the next few years can be expected to be tied to the growth of the integrated steelworks in the Great Lakes region and to the development of projects in northern Minnesota and northern Michigan, which would use new and existing direct reduction technology.

International imports of iron ore and production of iron ore and pig iron—key indicators of iron ore consumption—point toward continued dependence by the international iron ore industry on growing Chinese iron ore consumption. China's increasing involvement in overseas projects through equity participation may well accelerate the recent weak open market demand for iron ore. Downward price pressures may be caused by China's apparent decreased iron ore demand combined with steelmakers continued acquisition of equity in upstream iron ore producing facilities.

The environmental emphasis on ("greening of") steelmaking processes in recent years, including decreased energy consumption, reduced emissions, and the use of alternate fuels, may slow down as funds for capital construction become increasingly difficult to obtain in a tight credit market. Increased pressure by nongovernmental organizations and Western government entities through tariffs and legislation aimed at improving industries environmental efforts may help to offset the impact of tight credit, but it may also trigger a shift in short-term trade patterns of iron ore to countries with relaxed environmental standards related to steelmaking.

With the economic downturn expected to continue in late 2008 and well into 2009, those companies that have taken advantage of lower operating costs by investing some of their profits in modernization during the past few years could now be better able to weather the recession. Those iron ore mines producing the most marketable products at the lowest cash operating costs could expect to outperform their higher cost competitors. Companies that have focused on reducing mining, pelletizing and other processing, loading facility, and land and water transport costs could fare best in the difficult economic times.

Merchant sellers of iron ore could be affected in a different manner than those that produce for their own downstream facilities. Existing iron ore contracts and terms could become increasingly important. Upcoming contract negotiations between steel producers and iron ore producers can be expected to be hard fought and could require additional concessions from both sides.

New developments in the steelmaking industry along with growth of DRI technology could allow the iron ore industry to become a major supplier to an expanding minimill sector of the U.S. steel industry. Imported DRI already plays an important role for coastal U.S. steel producers since minimum specification steel alloy purity cannot be readily achieved with traditional scrap alone. However, even in the event of strong global DRI growth during the next decade, DRI can replace only a small portion of the world's blast furnace production. The blast furnace, although aging technology, is expected to remain the mainstay of the iron and steel industry in the immediate future.

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TABLE 1
 SALIENT IRON ORE STATISTICS¹

(Thousand metric tons and thousand dollars unless otherwise specified)

	2003	2004	2005	2006	2007
United States, iron ore, usable, less than 5% manganese: ²					
Production	48,600	54,700	54,300	52,700	52,500
Shipments:					
Quantity	46,100	54,900	53,200	52,700	50,900
Value ^c	1,490,000	2,080,000	2,370,000	2,840,000	3,040,000
Average value at mines dollars per metric ton	32.30	37.92	44.50	53.88	59.64
Exports:					
Quantity	6,770	8,400	11,800	8,270	9,310
Value	248,000	334,000	584,000	636,000	719,000
Imports for consumption:					
Quantity	12,600	11,800	13,000	11,500	9,400
Value	328,000	371,000	532,000	611,000	543,000
Consumption, iron ore and agglomerates	61,600	64,500	60,100	58,200 ^r	54,800
Stocks, December 31:					
At mines, plants and loading docks ³	4,910	3,930	2,040	1,650 ^{r,4}	2,090 ⁴
At receiving docks ⁵	1,630	(6)	(6)	(6)	(6)
At consuming plants	10,900	(6)	(6)	(6)	(6)
Total ⁷	17,500	(6)	(6)	(6)	(6)
Additional stocks, December 31:					
Crude ore at mines and plants	688	496	915	1,140 ⁴	749 ⁴
Unagglomerated concentrates for pelletizing plants	1,560	1,820	1,870	1,260	1,550
World, production ⁸	1,210,000 ^r	1,360,000 ^r	1,540,000 ^r	1,820,000 ^r	2,030,000 ^c

^cEstimated. ^rRevised.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Direct-shipping ore, concentrates, agglomerates, and byproduct ore.

³Excludes byproduct ore.

⁴Crude ore stocks and unagglomerated concentrates for pelletizing plants removed. Marketable stocks only.

⁵Transfer and/or receiving docks of lower Great Lake ports.

⁶American Iron and Steel Institute no longer collects this data as of 2004.

⁷Sum of stocks at mines, consuming plants, and U.S. docks.

⁸Gross weight.

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 2007, BY DISTRICT AND STATE¹

District and State	Average number of employees	Worker hours (thousands)	Production				Average quantity per worker hour (metric tons)		
			Crude ore (thousand metric tons)	Usable ore (thousand metric tons)	Iron contained in usable ore (thousand metric tons)	Iron content natural (percent)	Crude ore	Usable ore	Iron contained
Lake Superior:									
Michigan ²	1,260	2,810	33,100	12,700	7,700	60.6	11.76	4.52	2.74
Minnesota	3,170	6,640	132,000	39,800	25,500	64.1	19.96	5.99	3.84
Total or average	4,420	9,450	166,000	52,500	33,200	63.3	17.52	5.56	3.51
Other States ³	34	63	9	9	5	54.0	0.15	0.15	0.08
Grand total or average	4,450	9,510	166,000	52,500	33,200	63.3	17.41	5.52	3.49

¹Data are rounded to no more than three significant digits, except "Average per worker hour, crude ore" may not add to totals shown.

²Does not include professional or clerical workers at mines, pelletizing plants, maintenance shops, or research lab workers.

³Includes California and South Dakota.

TABLE 3
CRUDE IRON ORE MINED IN THE UNITED STATES IN 2007, BY DISTRICT, STATE, AND MINING METHOD^{1,2}

District and State	Number of mines	Open pit (thousand metric tons)	Underground (thousand metric tons)	Total (thousand metric tons)
Lake Superior:				
Michigan	2	33,100	--	33,100
Minnesota	6	132,000	--	132,000
Total	8	166,000	--	166,000
Other States	4	9	--	9
Grand total	12	166,000	--	166,000

-- Zero.

¹Includes some byproduct ore. Excludes ore containing 5% or more manganese.

²Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 4
USABLE IRON ORE PRODUCED IN THE UNITED STATES IN 2007, BY DISTRICT, STATE, AND TYPE OF PRODUCT^{1,2}

(Thousand metric tons)

District and State	Direct		Other		Total
	shipping ore	Concentrates	Sinter	agglomerates ³	
Lake Superior:					
Michigan	--	--	--	12,700	12,700
Minnesota	--	69	61	39,700	39,800
Total	--	69	61	52,300	52,500
Other States ⁴	--	9	--	--	9
Grand total	--	79	61	52,300	52,500

-- Zero.

¹Excludes ore containing 5% or more manganese.

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Data may include pellet chips, screenings, and sinter.

⁴Includes California and South Dakota.

TABLE 5
SHIPMENTS OF USABLE IRON ORE FROM MINES IN THE UNITED STATES IN 2007^{1,2}

District and State	Gross weight of ore shipped (thousand metric tons)					Average iron content, natural (percent)	Value (thousands)
	Direct shipping ore	Concentrates	Sinter	Other agglomerates	Total		
Lake Superior:							
Michigan	--	--	--	12,200	12,200	60.6	W
Minnesota	--	68	171	38,500	38,800	64.1	W
Total reportable or average	--	68	171	50,700	50,900	63.3	\$3,040,000 ^c
Other States ³	--	9	--	--	9	54.0	457
Grand total or average	--	77	171	50,700	50,900	63.3	3,040,000 ^c

^cEstimated. W Withheld to avoid disclosing company proprietary data. -- Zero.

¹Includes byproduct ore. Excludes ore containing 5% or more manganese.

²Data are rounded to no more than three significant digits; may not add to totals shown.

³Includes California and South Dakota.

TABLE 6
IRON ORE-PRODUCING MINES IN THE UNITED STATES IN 2007

State and mine	County	Operator	Source of iron ore
California:			
Baxter Mine	San Bernardino	Hahm International Inc	Quarried ore.
Dredge 21	Yuba	Cal Sierra Development Inc.	Dredged sands.
Silverlake Mine	San Bernardino	Hahm International Inc	Quarried ore.
Michigan:			
Empire	Marquette	Cleveland-Cliffs Inc	Magnetite taconite ore.
Tilden	do.	do.	Hematite-magnetite taconite ore.
Minnesota:			
Hibbing Taconite	Saint Louis	do.	Magnetite taconite ore.
Keewatin Taconite	do.	United States Steel Corporation	Do.
Minntac	do.	do.	Do.
Minorca	do.	ArcelorMittal	Do.
Northshore	do.	Cleveland-Cliffs Inc	Do.
United Taconite	do.	do.	Do.
South Dakota, CF & I Pit	Lawrence	Pete Lien & Sons Inc.	Quarried ore.

Do., do. Ditto.

TABLE 7
CONSUMPTION OF IRON ORE AT U.S. IRON
AND STEEL PLANTS, BY TYPE OF PRODUCT¹

(Thousand metric tons)

Type of product	2006	2007
Blast furnaces:		
Direct-shipping ore	36	--
Pellets	49,300	46,300
Sinter ²	6,990	6,830
Total	56,400	53,100
Steelmaking furnaces:		
Direct-shipping ore	522	499
Sinter ²	95	86
Total	617	585
Grand total	57,000	53,700

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes briquettes, nodules, and other.

Source: American Iron and Steel Institute.

TABLE 8
U.S. CONSUMPTION OF IRON ORE, BY END USE^{1,2}

(Thousand metric tons)

Year	Blast furnaces ³	Steel furnaces ³	Sintering plants ^{3,4}	Miscellaneous ^{3,5}	Subtotal integrated iron and steel plants ⁶	Direct-reduced iron for steelmaking ⁷	Nonsteel end uses ⁸	Total
2003	53,800	133	5,650	--	59,500	315	791	60,600
2004	NA	NA	NA	NA	NA	270	794	NA
2005	NA	NA	NA	NA	NA	330	928	NA
2006	NA	NA	NA	NA	NA	360	867 ^r	NA
2007	NA	NA	NA	NA	NA	375	722	NA

^rRevised. NA Not available. -- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes agglomerates. Excludes ore containing 5% or more manganese.

³Data provided by American Iron and Steel Institute.

⁴Excludes dust, mill scale, and other revert iron-bearing materials.

⁵Sold to nonreporting companies or used for purposes not listed.

⁶Data provided by American Iron Ore Association.

⁷U.S. Geological Survey estimates based on production reports compiled by Midrex Corp.

⁸An estimate, which 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.

TABLE 9
U.S. EXPORTS OF IRON ORE, BY COUNTRY OF DESTINATION^{1,2}

(Thousand metric tons and thousand dollars)

Country	2006		2007	
	Quantity	Value	Quantity	Value
Algeria	340	14,900	570	25,100
Canada	7,610	604,000	7,350	597,000
China	100	5,440	1,130	78,000
Colombia	9	1,050	7	1,060
Japan	--	--	7	214
Mexico	214	10,600	148	13,500
Romania	--	--	87	3,820
Peru	--	--	5	134
Other ³	2	326	10	854
Total	8,270	636,000	9,310	719,000

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes agglomerates.

³"Other" represents 15 countries in 2006 and 17 countries in 2007.

Source: U.S. Census Bureau.

TABLE 10
U.S. EXPORTS OF IRON ORE, BY TYPE OF PRODUCT^{1,2}

Type of product	2006			2007		
	Quantity (thousand metric tons)	Value (thousands)	Unit value ^{3,4} (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value ^{3,4} (dollars per metric ton)
Concentrates	58	\$3,380	58.03	51	\$4,670	92.25
Coarse ores	6	158	27.57	6	449	78.85
Fine ores	42	1,800	43.29	51	2,380	46.87
Pellets	8,070	624,000	77.39	9,170	709,000	77.28
Briquettes	23	1,050	45.07	1	85	65.59
Other agglomerates	77	5,260	67.90	22	2,270	105.29
Roasted pyrites	1	93	72.83	11	986	92.16
Total	8,270	636,000	76.86	9,310	719,000	77.26

¹Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

²Includes agglomerates.

³Unit values shown are calculated from unrounded data.

⁴Weighted average calculated from unrounded data by dividing total value by total tonnage.

Source: U.S. Census Bureau.

TABLE 11
U.S. IMPORTS OF IRON ORE, BY COUNTRY AND TYPE OF PRODUCT^{1,2}

Country and type of product	2006			2007		
	Quantity (thousand metric tons)	Value (thousands)	Unit value ^{3,4} (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value ^{3,4} (dollars per metric ton)
Country:						
Australia	8	\$135	18.00	--	--	--
Brazil	4,530	228,000	50.29	3,210	\$183,000	57.13
Canada	6,240	359,000	57.44	5,520	326,000	59.08
Chile	283	14,000	49.35	279	15,700	56.17
Finland	9	331	36.78	8	385	46.87
Greece	15	386	25.73	--	--	--
Mexico	17	439	25.82	35	1,630	46.49
Norway	--	--	--	8	365	45.63
Peru	52	1,710	32.90	137	4,160	29.78
Sweden	(⁵)	6	35.29	141	8,959	63.33
Trinidad and Tobago	299	6,870	22.97	--	--	--
Venezuela	23	439	19.09	58	2,580	44.94
Other	1	58	58.00	2	35	257.22
Total	11,500	611,000	53.21	9,400	543,000	57.81
Type of product:						
Concentrates	2,380	96,400	40.54	1,280	57,500	44.91
Coarse ores	--	--	--	176	10,800	61.57
Fine ores	2,450	106,000	43.35	1,790	83,900	46.79
Pellets	6,620	407,000	61.49	6,050	387,000	63.90
Other agglomerates	17	440	25.28	87	3,930	45.04
Roasted pyrites	10	387	37.58	10	511	47.65
Total	11,500	611,000	53.21	9,400	543,000	57.81

-- Zero.

¹Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

²Includes agglomerates.

³Unit values shown are calculated from unrounded data.

⁴Weighted average calculated from unrounded data by dividing total value by total tonnage.

⁵Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 12
U.S. IMPORTS OF IRON ORE IN 2007, BY COUNTRY AND TYPE OF PRODUCT^{1,2}

(Thousand metric tons)

Country of origin	Concentrates	Coarse ores	Fine ores	Pellets	Briquettes and other agglomerates	Roasted pyrites	Total
Australia	--	--	--	--	--	--	--
Brazil	436	10	1,500	1,260	--	--	3,210
Canada	614	--	159	4,680	71	--	5,520
Chile	230	49	--	--	--	--	279
Finland	--	--	--	--	--	8	8
Mexico	--	--	--	19	16	--	35
Norway	--	--	8	--	--	--	8
Peru	--	--	128	9	--	--	137
Sweden	--	117	--	24	--	--	141
Venezuela	--	--	--	58	--	--	58
Other	--	--	--	--	--	2	2
Total	1,280	176	1,790	6,050	87	10	9,400

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes agglomerates.

Source: U.S. Census Bureau.

TABLE 13
AVERAGE UNIT VALUE FOR SELECTED IMPORTS OF IRON ORE IN 2007¹

Type of product	Country of origin	Average unit value ² (dollars per metric ton, gross weight)
Concentrates	Brazil	50.47
Do.	Canada	36.51
Do.	Chile	56.63
Fine ores	Brazil	49.69
Do.	Canada	34.29
Do.	Peru	28.36
Pellets	Brazil	67.78
Do.	Canada	63.03

Do. Ditto.

¹Includes agglomerates.

²Weighted averages of individual customs values.

Source: U.S. Census Bureau.

TABLE 14
U.S. IMPORTS OF IRON ORE, BY CUSTOMS DISTRICT^{1,2}

(Thousand metric tons and thousand dollars)

Customs district	2006		2007	
	Quantity	Value	Quantity	Value
Baltimore, MD	3,930	221,000	3,130	191,000
Buffalo, NY	1	18	--	--
Charleston, SC	1	57	3	170
Chicago, IL	1,740	67,100	1,330	59,600
Cleveland, OH	3,040	164,000	3,120	178,000
Detroit, MI	131	7,460	(3)	2
Houston, TX	50	2,650	65	4,490
Mobile, AL	5	153	33	528
New Orleans, LA	2,550	147,000	1,610	102,000
Nogales, AZ	25	569	16	403
Philadelphia, PA	9	331	8	385
Port Arthur, TX	--	--	71	4,030
Providence, RI	--	--	8	365
Tampa, FL	--	--	13	1,520
Other	(3)	22	1	164
Total	11,500	611,000	9,400	543,000

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes agglomerates.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 15
U.S. IMPORTS OF PELLETS, BY COUNTRY¹

(Thousand metric tons and thousand dollars)

Country	2006		2007	
	Quantity	Value	Quantity	Value
Brazil	1,650	107,000	1,260	85,700
Canada	4,940	299,000	4,680	295,000
Mexico	--	--	19	1,220
Peru	--	--	9	404
Sweden	--	--	24	1,870
Trinidad and Tobago	15	965	--	--
Venezuela	23	439	58	2,580
Total	6,620	407,000	6,050	387,000

-- Zero.

¹Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 16
SELECTED PRICES FOR IRON ORE IN THE JAPANESE MARKET¹

(Cents per dry long ton unit of iron unless otherwise specified)

Country and producer	Ore types	April 1–March 31	
		Fiscal year 2006	Fiscal year 2007
Australia:			
Hamersley Iron Proprietary Limited and Mount Newman Mining Company			
Proprietary Limited	Lump ore	93.74	102.64 ²
Do.	Fines	73.45	80.42 ²
Robe River Iron Associates	do.	58.55	64.10 ²
BHP Billiton (Yandi)	do.	69.04	80.42 ²
Brazil:			
Companhia Nipo-Brasileira de Pelotizacao (Nibrasco)	Pellet feed	108.68	114.42 ²
Companhia Vale do Rio Doce (Carajás)	Fines	66.85	73.20 ²
Companhia Vale do Rio Doce (Itabira)	do.	65.85	72.11
Minerações Brasileiras Reunidas Societe Anonyme	Lump ore	88.82	97.26
Do.	Fines	68.21	74.69
Samarco Mineração Societe Anonyme	Pellet feed	56.55	61.92
Canada, Iron Ore Company of Canada (Carol Lake)	Concentrates	64.90	71.06
Chile:			
Minera del Pacifico Societe Anonyme (Huasco)	Pellets	99.72 ¹	104.99
Minera del Pacifico Societe Anonyme (El Romeral)	Fines	51.84 ¹	56.76
India:			
Minerals and Metals Trading Corporation (Bailadila)	Lump ore	92.34	101.11
Do.	Fines	71.64	78.45
Peru, Shougang Hierro Peru S.A.A.	Pellet feed	51.18	56.04
South Africa:			
Kumba Resources Limited (Iskor)	Lump ore	77.10	84.42 ²
Assmang Limited	do.	76.18	83.42 ²
Do.	Fines	54.86	60.07 ²

¹Revised. Do., do. Ditto.

¹Free on board shipping port basis.

²Cents per dry metric ton unit.

Sources: Trust Fund Project on Iron Ore Information, The Iron Ore Market 2007–2009. The TEX Report, Iron Ore Manual 2007.

TABLE 17
IRON ORE: WORLD PRODUCTION, BY COUNTRY^{1,2}

(Thousand metric tons)

Country ⁵	Gross weight ³					Metal content ⁴				
	2003	2004	2005	2006	2007 ^c	2003	2004	2005	2006	2007 ^c
Algeria	1,378	1,554	1,579 ^r	2,340 ^r	1,982 ⁶	700	780 ^e	800 ^{r,c}	1,180 ^r	1,000
Australia	212,981	233,994	261,855	275,098 ^r	299,009 ⁶	132,257	145,282	165,621	170,934	186,000
Austria ^c	2,119 ⁶	1,882 ⁶	2,000	2,000	2,000	703 ⁶	602	640	600	600
Azerbaijan	3	19	7	11	17 ⁶	2 ^e	10 ^e	4 ^e	6 ^e	9
Bosnia and Herzegovina	127	281 ^r	3,177 ^r	3,440 ^r	3,500	63	125 ^e	1,500 ^r	1,700 ^r	1,700
Brazil	230,707	261,696 ^r	281,462 ^r	317,800 ^r	354,674 ^{p,6}	153,190	173,752	186,870	207,524 ^r	233,700 ^{p,6}
Bulgaria	466	83	--	--	--	127	27	--	--	--
Canada ⁷	33,322	28,596	30,387	33,543 ^r	32,834 ⁶	20,993	17,801	19,333 ^r	21,341 ^r	20,751 ^{p,6}
Chile	8,011	8,003	7,862	8,628 ^r	8,818 ⁶	4,865	4,850	4,707	5,235	5,350
China ^{e,8}	261,000	320,000	420,000	601,000 ^r	707,000	86,000	105,000	138,000	198,000 ^r	233,000
Colombia	625	587 ^r	608	644	624 ⁶	344 ^e	323 ^r	334 ^e	354 ^r	343
Egypt ^c	2,237 ⁶	2,400	2,600	2,500	2,500	1,119 ⁶	1,200	1,300	1,200	1,200
Germany ⁹	429	412	362	412 ^r	412	60	58	38 ^r	44 ^r	44
Greece ^{e,10}	1,500	1,500	1,500	1,500	1,500	575	575	575	575	575
Guatemala	2	3	11	7	7	2	2	8 ^r	5	5
India	99,100	120,600	140,000 ^e	160,000 ^e	180,000	63,400	77,200 ^e	90,000 ^e	102,000 ^e	115,000
Indonesia	245	90	32 ^r	11 ^r	8	140 ^e	51 ^e	18 ^r	6 ^r	5
Iran ¹¹	18,287	18,205	19,000 ^e	26,244 ^r	31,538 ⁶	9,000	8,900	9,000 ^e	13,000 ^e	15,000
Kazakhstan	19,281	20,403 ^r	19,471 ^r	22,263 ^r	23,834 ⁶	10,100 ^r	11,600 ^r	11,100 ^r	12,700 ^r	13,600
Kenya	1	1	(12)	(12) ^e	(12)	(12)	(12)	(12)	(12) ^e	(12)
Korea, North ^c	4,430	4,580	5,000	5,040 ^r	5,130	1,260	1,300	1,400	1,400	1,400
Korea, Republic of	174	226	213	227	291 ⁶	97	127	119	155 ^r	175
Macedonia ^c	10	10	10	10	10	6	6	6	6	6
Malaysia	597	664	950	667 ^r	700	382	424	606	426 ^r	440
Mauritania	10,377	10,674	10,752	10,658 ^r	11,817 ⁶	6,890	6,900	7,000	6,950 ^{r,c}	7,700
Mexico ¹³	11,265	11,483	11,687 ^r	10,983 ^r	12,205 ⁶	6,759	6,890	7,012	6,590	7,323 ⁶
Morocco ^e	6 ⁶	10 ⁶	10	10	10	3	5	5	5	5
New Zealand ¹⁴	1,947	2,329	2,270	2,146 ^r	2,200	580 ^e	690 ^e	654 ^e	620 ^{r,c}	620
Nigeria ^c	--	--	60 ^r	150 ^r	50	--	--	22 ^r	54 ^r	18
Norway	500	600	620	620	620	340	408	420	420	400
Pakistan ¹⁵	40	50	50	95 ^r	207	20	25	25	48 ^r	104
Peru	5,240	6,439	6,810	7,250	7,740	3,541	4,315	4,565	4,861 ^r	5,185 ⁶
Portugal ^{e,16}	14	14	14	14	14	10	10	10	10	10
Romania	304 ^r	275 ^r	265 ^r	40 ^r	11 ⁶	82	74	69 ⁶	3 ^r	3
Russia	91,760	96,980	96,764	102,000	105,000	53,000 ^e	56,200 ^e	56,100 ^e	59,100 ^e	60,800
Slovakia	930 ^r	850 ^r	850 ^r	700 ^r	3,627 ⁶	326 ^r	302 ^r	259 ^r	250 ^r	1,300
South Africa ¹⁷	38,086	39,322	39,542	41,326	42,083 ^{p,6}	24,000 ^e	24,800 ^e	25,000 ^e	26,100 ^e	26,600

See footnotes at end of table.

TABLE 17—Continued
IRON ORE: WORLD PRODUCTION, BY COUNTRY^{1,2}

(Thousand metric tons)

Country ⁵	Gross weight ³					Metal content ⁴				
	2003	2004	2005	2006	2007 ^e	2003	2004	2005	2006	2007 ^e
Sweden ^c	21,500	22,300	23,300	23,300	24,700	14,100 ⁶	14,700	15,300	15,000	16,000
Thailand	10	136	231 ^r	264	1,555 ⁶	5 ^e	68 ^e	116	132 ^e	892 ⁶
Tunisia	164	256 ^r	206	214 ^r	220	87 ^e	134 ^{r,e}	108 ^{r,e}	112 ^{r,e}	115
Turkey	3,429	3,857	4,598 ^r	3,251 ^r	3,800	1,830 ^e	2,060 ^e	2,450 ^{r,e}	1,730 ^{r,e}	2,020
Ukraine	62,498	65,550	68,570	74,000	77,900 ⁶	34,300 ^e	36,000 ^e	37,700 ^e	40,700 ^e	42,800
United Kingdom ^c	1	1	(12) ^r	(12) ^r	(12)	(12)	(12)	(12)	(12)	(12)
United States	48,600	54,700	54,300	52,700	52,500 ⁶	30,600	34,500	34,200	33,300	33,100 ⁶
Venezuela ¹⁸	17,954	19,196	20,000 ^e	23,000 ^e	23,000	11,936	12,669	13,000 ^e	15,200 ^e	15,000
Vietnam	1,080 ^r	990 ^{r,e}	1,009 ^r	1,020 ^r	1,060	540 ^r	495 ^{r,e}	505 ^r	510 ^r	530
Zimbabwe ^e	367	283	377	104 ^r	100	180 ^e	154 ^e	200 ^e	52 ^{r,e}	50
Total	1,210,000	1,360,000	1,540,000	1,820,000 ^r	2,030,000	675,000	751,000 ^r	837,000 ^r	950,000 ^r	1,050,000

^cEstimated. ^pPreliminary. ^rRevised. -- Zero.

¹Estimated data and world totals are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through July 11, 2008.

³Insofar as availability of sources permit, gross weight in this table represent the nonduplicative sum of marketable direct-shipping iron ores and concentrates; iron 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.

⁴Data 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: Azerbaijan, Kazakhstan, North Korea, and Ukraine.

⁵In addition to the countries listed, Cuba may also produce iron ore, but definitive information on output levels, if any, is not available.

⁶Reported figure.

⁷Series represented gross weight and metal content of usable iron ore (including byproduct ore) actually produced, natural weight.

⁸China's gross weight iron ore production figures are significantly higher than that of other countries, because China reports crude ore production only with an average iron content of 33%, whereas other countries report production of usable ore.

⁹Iron ore is used domestically as an additive in cement and other construction materials but is of too low a grade to use in the steel industry.

¹⁰Nickeliferous iron ore.

¹¹Data are for year beginning March 21 of that stated.

¹²Less than 1/2 unit.

¹³Gross weight calculated from reported iron content based on grade of 60% iron.

¹⁴Concentrates from titaniferous magnetite beach sands.

¹⁵Pakistan iron ore is based on a July-to-July fiscal year and 50% of production is used from each reported year.

¹⁶Includes manganiferous iron ore.

¹⁷Includes magnetite ore as follows, in thousand metric tons: 2003—2,307; 2004—2,893; 2005—2,957; 2006—3,830; and 2007—3,781.

¹⁸Official data reported by the Ministerio de la Industria Básica y Minería (formerly Ministerio de Energía y Minas) may differ from those published by Venezuela's only producer C.V.G. Ferrominera Orinoco CA.

TABLE 18
IRON ORE: WORLD PELLETIZING CAPACITY,
BY CONTINENT AND COUNTRY IN 2007¹

	Rated capacity, gross weight (million metric tons)
North America:	
Canada	27.5 ^e
Mexico	15.0 ^e
United States	55.8
Total	98.3
South America:	
Brazil	56.0 ^e
Chile	5.3
Peru	3.5
Venezuela	10.8 ^e
Total	75.6
Europe and Central Eurasia:	
Kazakhstan	8.4
Netherlands	4.4 ^e
Russia ²	31.4
Slovakia	0.5
Sweden	21.0
Turkey	1.5
Ukraine	33.5
Total	101.0
Asia:	
Bahrain	4.0
China	45.0 ^e
India	18.3
Iran	12.3 ^e
Japan	3.0
Total	82.6
Oceania, Australia	4.0 ^e
Grand total	361.0

^eEstimated.

¹Data may not add to totals shown because of independent rounding.

²Includes Kazakhstan and Ukraine.

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