



2016 Minerals Yearbook

IRON ORE [ADVANCE RELEASE]

IRON ORE

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In 2016, domestic iron ore production decreased for the second year in a row. U.S. iron ore production decreased by 9% to 41.8 million metric tons (Mt) of usable ore in 2016 from 46.1 Mt in 2015 (table 1). Several mines and facilities were idled permanently, were idled temporarily, or had reduced production in 2015 and 2016. In the United States, the vertically integrated structure of iron and steel companies and long-term price contracts buffered iron ore producers from falling global prices; however, low-cost steel imports increased competition in the steel industry and reduced demand for iron ore. The United States was the ninth-ranked world producer of iron ore by usable ore and iron content (fig. 1, table 9).

Global iron ore production was 2.35 billion metric tons (Gt), on a usable-ore basis, containing an estimated 1.45 Gt of iron, which was a slight increase from that of 2015. Global iron ore production, on a usable-ore basis, was led by Australia (858 Mt), Brazil (430 Mt), China (348 Mt), India (185 Mt), and Russia (101 Mt), which combined accounted for 82% of global production (table 8). Global pig iron production, the primary end use of iron ore, increased slightly to 1.16 Gt in 2016 (American Iron and Steel Institute, 2017, p. 110–111). Global raw steel production grew slightly in 2016 to 1.63 Gt (American Iron and Steel Institute, 2017, p. 113–115).

Iron ore is the primary raw material for producing steel, an alloy critical to the economies of all industrialized nations. Two iron oxides—hematite (Fe_2O_3) and magnetite (Fe_3O_4)—are the primary iron ore minerals found in the United States. The principal form of iron ore mined in the United States contains hematite and magnetite in varying proportions, averaging 25% to 30% iron content (Fe), and occurs in hard, fine-grained, banded iron formations also known as taconite. Magnetite is the main iron oxide recovered during concentration, although hematite tailings have become an economical alternative source of primary iron.

In the United States, the low-grade iron ore is concentrated to reach, on average, the 62.5% Fe or greater benchmark required globally for steel production. The concentrates can then be agglomerated using binders to create iron ore pellets, which can be more easily transported and more efficiently melted in blast furnaces. More than 98% of all domestic iron ore production is transformed into molten iron, also known as pig iron, in blast furnaces by removing residual oxygen. The pig iron then may be transferred to basic oxygen furnaces for the removal of residual carbon and conversion to steel.

Small-scale steel mills, also known as mini-mills, use electric arc furnaces (EAFs) to produce steel from iron metallics and recycled steel scrap. Iron metallics—cold pig iron, direct-reduced iron (DRI), hot-briquetted iron (HBI), and iron nuggets—are intermediate iron products that have become increasingly cost effective as supplements to lower grades of steel scrap when integrated into the EAF process. DRI, also

known as sponge iron, is produced through solid-state reduction of iron ore to 90% to 94% Fe (about the same iron content as molten pig iron); however, DRI requires special handling owing to its high susceptibility to oxidation. HBI is a higher density, premium quality form of briquetted DRI with lower susceptibility to oxidation. Iron nuggets, also known as iron nodules, are the least reactive among iron metallics, and are a premium grade of pig iron, with an average of 97% to 99% Fe and almost no gangue.

Iron ore also may be used for nonsteel applications including ballast, cement clinker production, coal washing, crushed road base material, fertilizer, dense media separation, iron oxide pigments, ferrite magnets, oil and gas well drilling, radiation shielding, water treatment, and other specialty applications. These applications represent a relatively small portion of iron ore consumption. Some applications require costly beneficiation to create high-grade products. Data for these applications are not included in the U.S. Geological Survey's (USGS's) tables for domestic iron ore consumption, exports, imports, production, shipments, or stocks, unless otherwise noted. With the exception of iron oxide pigments and cement clinker, USGS surveys do not include production or consumption of iron ore for different, nonsteel end uses.

This report includes information from surveys of domestic producers, government agency reports, company reports, and public information. Trade data in this report are from the U.S. Census Bureau. Labor statistics were based on data available from the Mine Safety and Health Administration. Percentages in the report were calculated using unrounded data and were rounded to no more than three significant digits.

Legislation and Government Programs

Regulations, legislative initiatives, and monitoring of environmental issues regarding iron ore production continued as previously reported, with no significant changes in 2016. Environmental issues relating to the production of iron ore included, but were not limited to, cross-state air pollution, effects of sulfate discharge on wild rice and associated changes to water-quality standards, greenhouse gas emissions, hazardous air pollutants, mercury discharge, regional haze, selenium discharge, sulfur dioxide and nitrogen dioxide emissions, and water conductivity as a measure of dissolved minerals (Cliffs Natural Resources, Inc., 2017, p. 10–14).

Production

The USGS developed the U.S. iron ore data shown in tables 1 and 2 through an annual “Iron Ore” survey, which was sent to 13 domestic mines and facilities that produce iron ore and iron metallics for steel production, all of which responded. Company reports, employment data, mine inspection reports, and tax

data supplemented the survey data received. Information on the capacity, production, and reserves of individual operations in the United States is provided in table 3.

Louisiana.—Nucor Steel Louisiana LLC's 2.5-million-metric-ton-per-year (Mt/yr) DRI operation resumed operations in late January 2016 and produced 1.8 Mt of DRI by yearend (Midrex Technologies, Inc., 2017, p. 8). Nucor temporarily suspended production at the plant beginning in October 2015 for planned maintenance owing to weak market demand (Nucor Corp., 2017, p. 25, 32).

Michigan.—In 2016, the Empire and Tilden Mines, operated by Cliffs Natural Resources Inc., reported combined production of 11 Mt of pellets, about the same as that in 2015 (table 2). The Empire Mine, near Ishpeming, ceased production and was indefinitely idled in August 2016. The mine had previously been scheduled for final shutdown at yearend 2015; however, the closure was postponed owing to an extended contract. The Empire Mine, operating since 1963, maintained an annual production capacity of 5.6 Mt and produced 2.8 Mt of ore during 2016 (Cliffs Natural Resources Inc., 2017, p. 33; table 3).

Minnesota.—In Minnesota, 8 iron ore facilities operated in 2016, compared with 10 facilities in 2015. The operating facilities included six collocated open pit mines, concentrators, and pellet facilities, and two tailings reclamation operations. The two tailings reclamation operations were idled in 2016 as well as the United States Steel Corp.'s (U.S. Steel's) Keewatin Taconite (Keetac) Mine. In 2016, operations in Minnesota produced 29.5 Mt of pellets, 10% less than the 32.8 Mt produced in 2015 and 32% less than the 43.2 Mt produced in 2014. Overall production of salable iron products in the State decreased by 13% to 30.8 Mt in 2016 from 35.5 Mt in 2015 and was 29% less than the 43.2 Mt in 2014 (table 2). Nonoperational deposits in Minnesota's Mesabi Range, including the former LTV Corp.'s mine and the Buhl, Kinney, McKinley, and Sherman deposits, were estimated to contain approximately 1.5 Gt of high-grade iron ore. An additional 1 Gt of iron ore in tailings ponds and stockpiles also were considered economically recoverable (Minnesota Department of Natural Resources, 2016).

In 2016, production at Cliffs' operations in Minnesota, which included the Hibbing Taconite Mine, Northshore Mining, and United Taconite Mine, was 12.7 Mt, 19% less than the 15.7 Mt produced in 2015. The Northshore and United Taconite mines were idled during the second half of 2015 and resumed production in May and August 2016, respectively (Cliffs Natural Resources Inc., 2017, p. 33–34).

In 2016, U.S. Steel reported production of 13.6 Mt at the Minntac (Mt. Iron) and Keetac Mines, 4% less than the 14.1 Mt produced in 2015. Owing to reduced steel production, the Keetac Mine was idled in May 2015 and was expected to remain idle until the first quarter of 2017 (United States Steel Corp., 2017, p. 31).

In October 2016, Magnetation LLC received approval from a bankruptcy judge to proceed with plans to shut down the company's last remaining facility in Grand Rapids, MN. The company had filed for bankruptcy in May 2015 and had shut down three other tailings reclamation operations in early 2015 and 2016. The Grand Rapids plant opened in December 2014 and had a production capacity of 2 Mt/yr of iron ore (DePass, 2016).

Essar Steel Minnesota LLC filed for bankruptcy in 2016 while constructing a 7-Mt/yr iron ore mine and pelletizing facility. The company received approval from a bankruptcy court to change the company's name to Mesabi Metallics Co. LLC. The company, then controlled by the investment firm SPL Advisors, was attempting to acquire sufficient financing to pay off its debt and complete construction (Myers, 2016).

The Minnesota Executive Council reduced mineral royalty rates by 19% for iron ore mined on State lands for Hibbing Taconite Co. (a joint venture of ArcelorMittal USA, Cliffs Natural Resources Inc., and U.S. Steel), ArcelorMittal's Minorca mine, and Cliffs' Northshore, retroactive to April 2015 through June 2016 (Myers, 2015).

Texas.—A DRI production facility operated by voestalpine Texas LLC in Portland received its first 100,000-metric-ton (t) shipment of iron ore pellets from Brazil in early May 2016. The 2-Mt/yr DRI facility was at the beginning of two stages of the commissioning process after testing began in April. The commissioning process continued throughout the year until the facility became operational at yearend 2016 (Ramirez, 2016).

Consumption

Steelmaking is responsible for the majority of iron ore consumption. It is estimated that producing 1.0 t of steel requires 1.3 t of iron ore pellets, 0.4 t of coking coal, and 0.3 t of steel scrap, as well as 6.0 million British thermal units of natural gas, using blast furnaces at normal operating conditions. In 2016, U.S. consumption of iron ore, by gross weight, reported to the American Iron and Steel Institute (2017, p. 79), totaled 34.5 Mt, including 29.0 Mt of pellets; 4.39 Mt of sinter, briquettes, nodules, and other products; and 1.16 Mt of direct-shipment ore (table 4).

Production of pig iron, the primary phase of steelmaking in which iron ore is consumed before raw steel is produced, decreased to 22.3 Mt in 2016, 12% less than the 25.4 Mt produced in 2015. Raw steel production by basic oxygen furnaces, which accounts for nearly all pig iron consumption, decreased to 25.9 Mt, 12% less than the 29.4 Mt produced in 2015. Total raw steel production decreased to 78.5 Mt, slightly less than the 78.8 Mt produced in 2015. Basic oxygen furnace production accounted for 33% of total raw steel production in 2016, nearly 4% less than that of the prior year (American Iron and Steel Institute, 2017, p. 70, 75). Although imported iron ore supplemented domestically produced iron ore, the United States remained a net exporter in 2016 with 8.77 Mt of exports and 3.01 Mt of imports, compared with 8.03 Mt of exports and 4.55 Mt of imports in 2015 (tables 5, 6).

Transportation

Domestically, iron ore is transported from mines to rail stations by heavy hauling trucks and by rail to port facilities on the Great Lakes or to processing facilities in North America. From ports, the ore is transported by ship across the Great Lakes and (or) through the St. Lawrence Seaway to the Atlantic Ocean. Bulk iron ore products are primarily transported by freighter across the Great Lakes owing to cost-effective transportation rates. Seasonal fluctuations in shipments, production, sales, and

stocks of iron ore in Minnesota and Michigan from December through April were a result of the closing and reopening of the Soo Locks at Sault Ste. Marie, MI, as well as frozen lake surfaces during winter months.

In July 2016, the Governor of Michigan sent a letter to the State's congressional representatives requesting Federal funding to upgrade the Soo Locks, a channel used to transport iron ore freighters in and out of the Great Lakes. Citing the U.S. Department of Homeland Security's 2015 analysis, the Governor predicted "significant economic consequences" if the Soo Locks were no longer operable. A failure had the potential to create raw material shortfalls in the steel industry that would carry over to the automotive and manufacturing sectors. The U.S. Army Corps of Engineers was conducting a cost-benefit analysis of the project that was expected to be completed by yearend 2018 (Pluta, 2016).

Prices

In 2016, the average unit value of iron ore in the United States was \$73.11 per metric ton, a 10% decrease from \$81.19 per metric ton in 2015, continuing a 5-year trend of decreasing values (table 1). The average value of exported iron ore was \$66.20 per metric ton, an 18% decrease from \$81.21 in 2015. The average unit value of exports totaling more than 1,000 t to any single country ranged from \$45.13 to \$121.43 per metric ton (table 5). In 2016, the average value of imported iron ore was \$79.99 per metric ton, a 20% decrease from the revised \$100.04 in 2015. The average unit value of imports totaling more than 1,000 t from any single country ranged from \$54.13 to \$98.60 per metric ton (table 6).

The average monthly spot price of imported iron ore fines, 62% Fe, at the of Tianjin Port, China, rose from \$41.88 per metric ton in January to \$60.92 per metric ton in April, fluctuated between \$51.98 per metric ton and \$60.89 per metric ton through October, and then increased to \$73.10 in November and \$80.02 in December. In 2016, the lowest average monthly spot market price, \$41.88 per metric ton in January, was 3% higher than the lowest average monthly spot price of \$40.50 per metric ton in December 2015. In 2016, the highest average monthly spot market price, \$80.02 per metric ton in December, was 17% higher than the highest average monthly spot price of \$68.23 per metric ton in January 2015 (Index Mundi, undated).

Foreign Trade

In 2016, U.S. exports were 8.77 Mt, a 9% increase from 8.03 Mt in 2015. U.S. iron ore pellet exports accounted for 95% (8.36 Mt) of total exports. Steel companies in Canada received the majority, about 80%, of the iron ore exported from the United States, followed by China with 10% and Japan and Mexico with 4% each (tables 1, 5). Imports in 2016 were 3.01 Mt, a 34% decrease from 4.55 Mt in 2015 with the leading importing countries, Brazil and Canada, accounting for 58% and 19%, respectively, of iron ore imports to the United States (table 6).

World Industry Structure

Production.—World iron ore production in 2016 was 2.35 Gt of usable ore and 1.45 Gt by iron content, slightly more than

in 2015. Australia remained the leading iron ore producer (858 Mt), followed by Brazil (430 Mt), China (348 Mt), India (185 Mt), and Russia (101 Mt) (fig. 1, table 10).

Consumption.—Crude steel and pig iron production are significant indicators of iron ore consumption, as well as iron metalics, although on a smaller scale. World consumption of iron ore was estimated to have increased slightly in 2016, as reflected by slight increases in production of crude steel, DRI, and pig iron compared with those in 2015. China was the leading producer of pig iron and crude steel, and the Middle East and North Africa region was the leading producer of DRI (American Iron and Steel Institute, 2017, p. 110–115; Midrex Technologies, Inc., 2017, p. 6).

Trade.—Global trade of iron ore rose to 1.58 Gt in 2016, a 5% increase from 1.51 Gt in 2015 (World Steel Association, 2017b, p. 104). The trend of year-on-year increases in global trade continued during the past 13 years. Since 2002, China, Germany, Japan, and the Republic of Korea have accounted for more than two-thirds of global imports, with their combined share increasing to 87% in 2014 from 62% in 2002 and decreasing slightly since then to 84% in 2016. China's stake more than tripled during this 13-year period to 68% from 21%. Australia was the leading exporter of iron ore (56%), followed by Brazil (19%) (United Nations Commodity Trade Statistics Database, undated).

Exploration.—Companies continued to expand current mines and facilities, to develop mines, and to investigate new deposits; however, reductions in price and increased availability of iron ore for global trade were expected to reduce expenditures for new projects drastically. Iron ore exploration expenditures in 2016 were estimated to be \$685 million, representing a decline of \$460 million from \$1.15 billion in 2015. Iron ore exploration expenditures were highest in Asia (38% for total iron ore exploration expenditures), followed by Australia (34%), South America (6%), Russia (4.5%), and Canada and Europe (2% each) (United Nations Conference on Trade and Development, 2017, p. 6–8).

World Review

Australia.—Production of usable iron ore in Australia was 858 Mt in 2016, 5.9% more than the 810 Mt produced in 2015. Decreased raw steel production in China in 2015 led to an oversupply of iron ore and decreased prices; however, low-cost, high-volume producers in Australia increased production by 48 Mt in 2016 (table 9). On a tonnage basis, iron ore production in Australia increased year on year by 48 Mt in 2016, 70 Mt in 2015, 130 Mt in 2014, and 90 Mt in 2013. The three leading iron-ore-mining companies in Australia—BHP Billiton Ltd., Fortescue Metals Group Ltd., and Rio Tinto Group—were among the four leading iron ore producers in the world and accounted for most of the iron ore produced in Australia.

BHP Billiton's iron ore production in Australia in fiscal year (FY) 2016, which ended June 30, 2016, decreased to 227 Mt from 232 Mt in FY 2015. The Jimblebar mining hub operated at full capacity, and the utilization rate at the Newman Ore handling plant improved. Production was expected to increase to between 265 and 275 Mt in FY 2017. Optimized operations and expansion projects were expected to increase total capacity

to 290 Mt/yr by FY 2019 (BHP Billiton Ltd., 2016, p. 84, 214). Fortescue's production in FY 2016 increased to 169 Mt, from 165 Mt produced in FY 2015, and was expected to continue at a rate of between 165 and 170 Mt/yr through FY 2017 (Fortescue Metals Group Ltd., 2016, p. 6, 17). Rio Tinto's share of iron ore production at its operations in Australia in 2016 increased to 281 Mt from 263 Mt in 2015 (Rio Tinto Group, 2017, p. 221).

Brazil.—Production of iron ore in Brazil remained virtually unchanged at 430 Mt in 2016. Vale S.A., the leading iron ore producer in Brazil, slightly increased production in 2016 to 349 Mt from 346 Mt in 2015, and slightly decreased its pellet production in 2016 to 37.7 Mt from 38.0 Mt in 2015 (Vale S.A., 2017, p. 6–10). Anglo American plc increased iron ore production in 2016 by 75% to 16.1 Mt (wet basis). The Minas-Rio operation continued to be ramped up (Anglo American plc, 2017, p. 59). In November 2015, the Fundão Dam burst at the 30.5-Mt/yr Samarco Mine in Minas Gerais. The mine was jointly owned by BHP Billiton and Vale. Operations remained suspended through 2016 (BHP Billiton Ltd., 2016, p. 6–9).

Canada.—Production of iron ore in Canada increased slightly in 2016 to 47.1 Mt from 46.2 Mt produced in 2015 (table 10). The Bloom Lake Group, several affiliates managing operations at Cliffs' Bloom Lake Mine in Quebec, began restructuring proceedings under the Government of Canada's Companies' Creditors Arrangement Act in 2015. Operations at the mine were suspended in late 2014. As of December 31, 2016, the majority of assets available to the Bloom Lake Group had been liquidated with sales of the Bloom Lake Mine, Labrador Trough South mineral claims, and rails assets in Newfoundland and Labrador to Quebec Iron Ore Inc., an affiliate of Champion Iron Mines Ltd. (Cliffs Natural Resources Inc., 2017, p. 140–142).

China.—Production in China, on a usable-ore basis, decreased in 2016 to 348 Mt from 375 Mt in 2015. Steel mills in China remained the leading consumers of iron ore in the world.

Guinea.—In October 2016, Rio Tinto announced an agreement to sell its stake in the Simandou iron ore project in Guinea to partner Aluminum Corp. of China Ltd. (Riseborough and Camara, 2016).

India.—Mining bans on iron ore were lifted by the Indian Supreme Court in April 2014, prompting a 30% increase in iron ore production of 185 Mt in 2016 from 142 Mt in 2015. NMDC Ltd., a state-owned iron ore mining company in India, set a production target of 35 Mt for 2016 and 2017. The company planned to increase production capacity to 50 Mt/yr by 2018 (Kumar, 2016). Decreased raw steel production in China in 2016 led to an oversupply of iron ore and decreased prices; however, low-cost, high-volume producers in India increased production, on a usable-ore basis, by 43 Mt in 2016 (table 9).

Outlook

Global consumption of iron ore was estimated to have increased slightly in 2016 and is expected to remain stable or decline slightly throughout the next decade owing to reduced or stable economic growth rates in Asia, reduced large-scale infrastructure spending in Europe and North America, and increased consumption of scrap as a raw material in steelmaking. Since 2012, production has increased by 281 Mt/yr, a 14.0% increase from 2012 (table 9). In 2016, some production capacity

and mine expansion projects were completed. Others were halted indefinitely following the sustained decline in prices over the 5-year period.

Imports of low-cost steel from China reduced the demand for domestic iron ore for steel production. Junior mining organizations in direct competition with dominant suppliers to China also were negatively affected. Major suppliers from Australia and Brazil are expected to continue to focus on cost savings and improving efficiencies to reduce unit cost. As these companies continue to invest in high-efficiency, high-quality, and low-cost operations, small-scale and high-cost mining operations are expected to idle additional operations as they become uneconomic.

From 2016 through 2020, companies are expected to bring more than 200 Mt of annual production capacity into production. Production of iron ore is expected to decrease in China during the next decade as high-cost mines are phased out as part of industry optimization and efforts to reduce environmental pollution.

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TABLE 1
SALIENT IRON ORE STATISTICS¹

(Thousand metric tons, gross weight, and thousand dollars, unless otherwise specified)

	2012	2013	2014	2015	2016	
Iron ore, usable:						
United States:						
Production	54,700	52,800	56,100	46,100	41,800	
Shipments	53,900	53,400	55,000	43,500	46,600	
Value:						
Minnesota: ²						
Cost of mining	dollars per metric ton	13.31	13.57	13.62	11.67	11.41
Cost of beneficiation	do.	30.78	32.66	34.49	29.75	28.09
Average value of production	do.	90.18 ^r	85.38 ^r	88.33 ^r	75.47 ^r	69.44
United States:						
Reported value at mines ³		5,080,000	4,610,000	4,730,000	3,750,000	3,050,000
Average value at mines	dollars per metric ton	92.75 ^r	87.42	84.43	81.19	73.11
Exports:						
Quantity		11,200	11,000	12,100	8,030 ^r	8,770
Value		1,440,000	1,480,000	1,320,000	652,000 ^r	581,000
Imports for consumption:						
Quantity		5,160	3,250	5,140	4,550	3,010
Value		759,000	426,000	676,000	455,000	241,000
Reported consumption, iron ore and agglomerates		46,900	44,200	44,400	38,500	34,500
Stocks, December 31		4,440	2,350	4,460	7,860	4,660
World, production		2,070,000 ^r	2,200,000 ^r	2,340,000 ^r	2,320,000 ^r	2,350,000
Iron metallics: ⁴						
United States:						
Production		404	469	1,950	1,450	2,070
Exports:						
Quantity		8 ^r	5 ^r	1 ^r	60 ^r	178
Value		5,200	4,590	3,680	2,040	37,400
Imports for consumption:						
Quantity		2,760	2,360	2,390	1,870 ^r	1,790
Value		1,020,000	831,000	859,000	490,000	360,000
World, production		73,100 ^r	74,900 ^r	74,600	72,600	72,300

^rRevised. do. Ditto.

¹Table includes data available through July 17, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²As reported in Minnesota Department of Revenue's annual Mining Tax Guide.

³Value for iron ore as reported by mines, which may refer to price or value of shipments or production as sold on the open market or within the company.

⁴Data for iron metallics may include cold pig iron, direct-reduced iron, hot-briquetted iron, iron nuggets, and solid sponge iron.

TABLE 2
EMPLOYMENT AND PRODUCTION STATISTICS FOR IRON OPERATIONS IN THE UNITED STATES IN 2016, BY STATE¹

(Thousand metric tons, unless otherwise specified)

State	Number of operations	Number of employees ²	Crude ore	Salable products			Shipments	Average iron content ⁴ (percent)	
				Pellets	Iron ore, other ³	Iron metallics			Total
Indiana	2	NA	--	(5)	--	245 ⁶	245	255 ⁶	62.2 ⁶
Louisiana	1	NA	--	--	--	1,810 ⁶	1,810	1,810 ⁶	XX
Michigan	2	905 ⁷	36,500 ⁶	11,000 ⁶	--	--	11,000	11,000	60.3 ⁶
Minnesota	8	3,080 ⁷	108,000	29,500	1,300	-- ⁶	30,800	31,800	64.2
Texas	1	NA	--	--	--	NA ⁸	--	--	XX
Total or average	14	4,800	144,000	40,500	1,300	2,070	43,800	44,800	63.2

NA Not available. XX Not applicable. -- Zero.

¹Table includes data available through July 17, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Does not include iron metallics operations. Does not include professional or clerical workers at mines, pelletizing plants, maintenance shops, or research labs.

³Includes other unspecified products not included in other categories; may include concentrates, direct-shipping ore, fines, flux, and pellet chips.

⁴Data for iron metallics (cold pig iron, direct-reduced iron, hot-briquetted iron, iron nuggets, and sponge iron) not included.

⁵Iron ore pellets were produced by Magnetation LLC but were not included in production totals because they were not primary mine production.

⁶Data reported in or calculated from publicly available company annual reports or other publications.

⁷Source: Mining Safety and Health Administration.

⁸Operations began at voestalpine Texas LLC during the fourth quarter of 2016.

TABLE 3
IRON OPERATIONS IN THE UNITED STATES IN 2016¹
(Million metric tons)

State and operation	County or parish	Operator	Primary product	Status ²	Capacity ³	Production ³	Reserves ⁴
Indiana:							
Iron Dynamics, Inc.	DeKalb	Steel Dynamics, Inc.	Hot-briquetted iron	Active	0.3	0.3	(5)
Reynolds Pellet Plant	White	Magnetation LLC	Iron ore pellets	ID (Oct. 2016)	3.3	NA	(5)
Louisiana, Nucor Steel Louisiana LLC	St. James	Nucor Corp.	Direct-reduced iron	Active	2.5	1.8	(5)
Michigan:							
Empire Mine	Marquette	Cliffs Natural Resources Inc.	Iron ore pellets	SP (Aug. 2016)	5.6	2.8	--
Tilden Mine	do.	do.	do.	Active	8.1	7.7	370
Minnesota:							
Hibbing Taconite Mine	St. Louis	do.	do.	Active	8.1	8.3	240
Keetac Mine	Itasca	United States Steel Corp.	do.	IT (May 2015–Feb. 2017)	5.4	1.7	350
Mesabi Chief Plant #1	do.	Magnetation LLC	Iron ore concentrates	SP (Feb. 2015)	0.4	--	--
Mesabi Chief Plant #2	do.	do.	do.	ID (Jan. 2016)	1.0	--	20
Mesabi Chief Plant #4	do.	do.	do.	ID (Oct. 2016)	2.0	1.1	(6)
Mesabi Nugget Delaware LLC	St. Louis	Steel Dynamics, Inc.	Iron nuggets	ID (May 2015)	0.4	NA	(5)
Mining Resources LLC	do.	do.	Iron ore concentrates	do.	1.0	--	NA
Mintac Mine	do.	United States Steel Corp.	Iron ore pellets	Active	14.5	14.0	450
Minorea Mine	do.	ArcelorMittal S.A.	do.	do.	2.8	2.8	120
Northshore Mining	St. Louis and Lake	Cliffs Natural Resources Inc.	do.	IT (Nov. 2015–May 2016)	6.1	3.3	820
United Taconite Mine	St. Louis	do.	do.	IT (Aug. 2015–Aug. 2016)	5.5	1.5	860
Texas, voestalpine Texas LLC	San Patricio	voestalpine Group	Hot-briquetted iron	Active (Oct. 2016)	2.0	--	(5)

do. Ditto. NA Not available. -- Zero.

¹Table includes data available through July 17, 2018.

²ID, idled indefinitely; IT, idled temporarily; SP, shut down permanently.

³As reported or calculated from data in company annual reports, oral communications, published online data, or U.S. Securities and Exchange Commission filings.

⁴Proven and probable reserves or equivalent, including those on owned and leased property, as reported in the company's annual public filing.

⁵Operator does not mine iron ore at this site and has no reserves.

⁶Magnetation LLC owned mineral rights for 1,400 million metric tons of unspecified iron ore stocks equivalent to resources or reserves as of April 2014.

TABLE 4
CONSUMPTION OF IRON ORE AT U.S. IRON
AND STEEL PLANTS, BY TYPE OF PRODUCT¹

(Thousand metric tons)

Type of product	2015	2016
Blast furnaces:		
Pellets	32,100	29,000
Sinter ²	4,920	4,230
Total	37,100	33,200
Steelmaking furnaces:		
Direct-shipping ore	1,320	1,160
Sinter ²	159	159
Total	1,470	1,320
Grand total	38,500	34,500

¹Table includes data available through July 17, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Includes briquettes, nodules, and other forms.

Source: American Iron and Steel Institute.

TABLE 5
U.S. EXPORTS OF IRON ORE, BY COUNTRY OR LOCALITY AND TYPE OF PRODUCT^{1,2}

Country or locality and type of product ³	2015			2016		
	Quantity (thousand metric tons)	Value (thousands)	Unit value ⁴ (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value ⁴ (dollars per metric ton)
Country or locality:						
Belgium	36	\$1,950 ^r	54.17 ^r	82	\$4,150	50.63
Canada	6,250 ^r	544,000 ^r	87.05 ^r	7,060	484,000	68.58
China	726 ^r	28,300 ^r	38.91 ^r	907	40,900	45.13
Japan	36	2,890 ^r	80.31 ^r	364	18,900	52.02
Mexico	938 ^r	71,900 ^r	76.64 ^r	352	31,500	89.54
Netherlands	(5) ^r	15 ^r	(6) ^r	7	850	121.43
Other	41 ^r	2,770 ^r	67.49 ^r	2	305	152.50
Total or average	8,030 ^r	652,000 ^r	81.21 ^r	8,770	581,000	66.20
Type of product:						
Coarse ores	(5) ^r	30 ^r	6.00 ^r	(5) ^r	192	38.40
Concentrates	279 ^r	33,000 ^r	118.34 ^r	78	9,900	126.91
Fine ores	29 ^r	2,990 ^r	103.07 ^r	119	7,680	64.56
Other agglomerates	756 ^r	45,600 ^r	60.37 ^r	213	16,300	76.39
Pellets	6,970 ^r	570,000 ^r	81.89 ^r	8,360	547,000	65.38
Total or average	8,030 ^r	652,000 ^r	81.21 ^r	8,770	581,000	66.20

^rRevised.

¹Table includes data available through July 17, 2018. Data are rounded to no more than three significant digits, except "Unit value"; may not add to

²All countries and (or) localities with less than 1,000 metric tons of exports in 2016 included in "Other."

³Includes agglomerates, excludes roasted iron pyrites.

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

⁵Less than ½ unit.

⁶Value thought to be erroneous based on individual country value(s) in excess of normal value range, included in "Total or average."

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS OF IRON ORE, BY COUNTRY OR LOCALITY AND TYPE OF PRODUCT^{1,2}

Country or locality and type of product ³	2015			2016		
	Quantity (thousand metric tons)	Value (thousands)	Unit value ⁴ (dollars per metric ton)	Quantity (thousand metric tons)	Value (thousands)	Unit value ⁴ (dollars per metric ton)
Country or locality:						
Argentina	132	\$10,600	80.45 ^r	87	\$8,600	98.60
Brazil	2,050	159,000	77.60 ^r	1,760	130,000	74.10
Canada	2,040	257,000	126.02 ^r	557	38,800	69.56
Chile	105	7,890	75.37 ^r	62	3,410	55.34
China	1	67	54.13 ^r	1	67	54.13
Honduras	6	2,590	(5) ^r	2	1,930	(5)
Ireland	--	--	--	4	1,870	(5)
Peru	22	1,210	54.86	66	19,800	(5)
South Africa	87	8,850	102.10 ^r	82	6,070	73.65
Sweden	85	6,420	75.59 ^r	351	27,700	79.21
Trinidad and Tobago	(6)	4	(5)	14	797	57.00
Venezuela	25	1,490	59.62 ^r	28	1,510	54.94
Other	(6)	58 ^r	(5) ^r	1	134	(5)
Total or average	4,550	455,000	100.04 ^r	3,010	241,000	79.99
Type of product:						
Coarse ores	54	4,230	78.28 ^r	22	2,080	94.21
Concentrates	1,020	53,500	52.25	719	32,400	45.02
Fine ores	247	18,700	75.65 ^r	265	38,500	145.46
Other agglomerates	(6)	3	0.60	--	--	--
Pellets	3,220	379,000	117.45	2,010	168,000	83.73
Total or average	4,550	455,000	100.04 ^r	3,010	241,000	79.99

^rRevised. -- Zero.

¹Table includes data available through July 17, 2018. Data are rounded to no more than three significant digits, except "Unit value"; may not add to totals shown.

²All countries and (or) localities with less than 1,000 metric tons of imports in 2016 included in "Other."

³Includes agglomerates, excludes roasted iron pyrites.

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

⁵Value thought to be erroneous based on individual country value(s) in excess of normal value range, included in "Total or average."

⁶Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS OF IRON ORE, BY CUSTOMS DISTRICT^{1,2}

(Thousand metric tons and thousand dollars)

Customs district	2015		2016	
	Quantity	Value	Quantity	Value
Baltimore, MD	328	43,700	(3)	95
Buffalo, NY	(3)	69	--	--
Charleston, SC	(3)	16	(3)	13
Chicago, IL	976	48,000	686	30,800
Cleveland, OH	1,130	172,000	--	--
Columbia-Snake, OR	23	3,170	37	4,480
Detroit, MI	11	319	1	32
Great Falls, MT	1	158	--	--
Houston-Galveston, TX	44	3,480	104	7,430
Los Angeles, CA	1	3	9	989
Miami, FL	--	--	(3)	7
Minneapolis, MN	2	120	1	67
Mobile, AL	17	2,870	--	--
New Orleans, LA	2,010	180,000	2,150	195,000
New York, NY	(3)	24	(3)	12
Norfolk, VA	--	--	(3)	12
Pembina, ND	(3)	147	--	--
Seattle, WA	--	--	(3)	2
Tampa, FL	11	1,170	23	2,230
Total	4,550	455,000	3,010	241,000

-- Zero.

¹Table includes data available through July 17, 2018. Data are rounded to no more than three significant digits; may not add to totals

²Includes agglomerates, excludes roasted iron pyrites.

³Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 8
SALIENT IRON ORE STATISTICS FOR SELECTED COUNTRIES OR LOCALITIES¹

(Million metric tons, gross weight)

Country or locality	2015				2016				Yearend, 2016	
	Production, usable ore	Calculated consumption ²	Exports ³	Imports ³	Production, usable ore	Calculated consumption ²	Exports	Imports	Reserves, crude ores	Reserves, iron content
Australia	810 ^r	8 ^r	810	3	858	8	853	1	52,000	23,000
Brazil	431 ^r	50 ^r	366	--	430	47	374	--	23,000	12,000
Canada	46	13 ^r	37	7	47	14	1	7	6,000	2,300
China	375	1,250 ^r	(4) ^r	953	348	1,260	1	1,020	21,000	7,200
Germany	--	51 ^r	(4) ^r	42 ^r	--	50	(4)	40	NA	NA
India	142 ^r	137 ^r	4	10 ^r	185	147	22	4	8,100	5,200
Iran	39 ^r	31 ^r	--	--	35 ^e	33	--	--	2,700	1,500
Japan	--	146 ^r	--	131	--	144	--	130	40	24
Kazakhstan	37 ^r	6	8 ^r	(4) ^r	34 ^e	6	8	(4)	2,500	900
Korea, Republic of	6 ^r	86 ^r	--	--	6	83	--	--	NA	NA
Russia	101	104 ^r	-- ^r	-- ^r	101	104	--	--	25,000	14,000
South Africa	73	10	42	(4) ^r	66	9	65	(4)	1,200	770
Sweden	25	5 ^r	20	(4) ^r	27	6	23	(4)	3,500	2,200
Ukraine	67	39 ^r	46 ^r	3 ^r	63	43	--	--	6,500	2,300
United States	46	48 ^r	8	5	42	43	--	--	3,000	790
Other	119 ^r	236 ^r	93 ^r	277 ^r	109	228	116	268	18,000	9,500
Total	2,320 ^r	2,220 ^r	1,430 ^r	1,430 ^r	2,350	2,230	1,460	1,470	170,000	82,000

^eEstimated. ^rRevised. NA Not available. -- Zero.

¹Table includes data available through July 17, 2018. Data are rounded to no more than three significant digits; may not add to totals shown.

²Calculation based on the production of direct-reduced iron reported by Midrex and pig iron reported by the American Iron and Steel Institute.

³Source: United Nations COMTRADE Database.

⁴Less than ½ unit.

TABLE 9
IRON ORE: WORLD PRODUCTION, BY COUNTRY OR LOCALITY^{1,2}

(Thousand metric tons)

Country or locality	Usable ore					Iron content				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
Algeria	1,784	1,067	911	944 ^r	900 ^e	946 ^r	565 ^r	483 ^r	500 ^r	477
Australia	519,356 ^r	609,730 ^r	739,682 ^r	809,882 ^r	857,726	321,953 ^r	377,760 ^r	457,409 ^r	500,994 ^r	530,891
Austria	2,142	2,323	2,437 ^r	2,783 ^r	2,780	686 ^r	743 ^r	780 ^r	891 ^r	889
Azerbaijan	207	141	91 ^r	128 ^r	26	99 ^r	68 ^r	44 ^r	61 ^r	12
Bhutan	4	21	19	43	28	2	13	12	27	18
Bosnia and Herzegovina	2,076	2,122	2,128	2,123	2,123	872 ^r	899 ^r	901 ^r	898 ^r	898
Brazil	400,822	386,270	411,183 ^r	430,836 ^r	430,000	258,129 ^r	245,668 ^r	261,500 ^r	275,590 ^r	275,000
Canada	38,892	42,063	43,173 ^r	46,220 ^r	47,083	25,000	26,000	27,000 ^r	28,000 ^r	28,873
Chile	17,330	17,109	18,866	15,448 ^r	15,506	9,429 ^r	9,088 ^r	10,149 ^r	9,148 ^r	8,528
China ³	420,206	417,287	410,123	374,838	347,594	260,528	258,718	254,276	232,400	215,509
Colombia	809	710	676	902 ^r	716	486 ^r	426 ^r	406 ^r	541 ^r	429
Egypt	3,930	1,422 ^r	1,697 ^r	1,500 ^{r,e}	1,500 ^e	2,456 ^r	889 ^r	1,061 ^r	938 ^r	940 ^e
Greece ⁴	2,306	2,221	2,317 ^r	2,264 ^r	2,209	571 ^r	550 ^r	574 ^r	561 ^r	548
India	122,491 ^r	140,416 ^r	138,000 ^r	142,399 ^r	184,511	75,900 ^r	87,060 ^r	85,560 ^r	88,287 ^r	114,397
Indonesia	11,546 ^r	22,353 ^r	5,951 ^r	3,839 ^r	3,230 ^e	7,220 ^r	14,000 ^r	3,720 ^r	2,400 ^r	2,020 ^e
Iran	43,497 ^r	48,693 ^r	48,451 ^r	39,370 ^r	35,100 ^e	21,085 ^r	25,330 ^r	25,709 ^r	25,798 ^r	22,800 ^e
Kazakhstan	52,614 ^r	51,689 ^r	51,541 ^r	37,270 ^r	33,900 ^e	14,074 ^r	14,724 ^r	14,946 ^r	11,566 ^r	10,000 ^e
Kenya	71	--	--	--	--	40	--	--	--	--
Korea, North	5,190 ^r	5,486 ^r	5,471 ^r	4,906 ^r	4,900 ^e	3,218 ^r	3,401 ^r	3,392 ^r	3,042 ^r	3,040 ^e
Korea, Republic of	3,879 ^r	5,000 ^r	5,527 ^r	5,842 ^r	5,679	2,405 ^r	3,100 ^r	3,427 ^r	3,622 ^r	3,521
Laos	316	905 ^r	1,149 ^r	1,200 ^{r,e}	1,200 ^e	196	561	712	745 ^r	744 ^e
Liberia	3,300	4,698 ^r	5,744	5,749 ^r	2,670 ^e	1,584 ^r	2,255 ^r	2,757 ^r	2,759 ^r	1,280 ^e
Malaysia	12,144	12,134	9,615	1,625 ^r	1,847	6,072 ^r	6,067 ^r	4,808 ^r	813 ^r	924
Mauritania	11,700 ^r	12,531 ^r	13,306 ^r	11,600 ^r	13,100	7,254 ^r	8,149 ^r	8,278 ^r	7,060 ^r	8,210
Mexico	14,916 ^r	18,840	16,628	13,462	12,090	9,320	11,780	10,400 ^r	8,414	7,559
Mongolia	7,561	6,794 ^r	7,558 ^r	6,061 ^r	4,228	4,537 ^r	4,076 ^r	4,535 ^r	3,637 ^r	7,146
Morocco	261	301	23	18 ^r	15	141	163	12	10 ^r	5
New Zealand ⁴	2,395 ^r	3,157 ^r	3,245 ^r	3,194 ^r	3,496	1,360 ^r	1,800 ^r	1,850 ^r	1,820 ^r	1,993
Nigeria	1	2	2	6	7 ^e	(5)	1	1	4	4 ^e
Norway	3,421 ^r	3,409 ^r	3,854 ^r	3,519 ^r	1,720 ^e	2,121 ^r	2,114 ^r	2,390 ^r	2,182 ^r	1,070 ^e
Pakistan	384 ^r	253 ^r	255 ^r	439 ^r	463	123 ^r	81 ^r	82 ^r	140 ^r	148
Peru	10,132	10,126	10,731	10,908	11,418	7,123 ^r	6,788	7,193	7,321	7,663
Philippines	1,800	1,057	154	107 ^r	7	1,148 ^r	674 ^r	98	68 ^r	4
Russia	104,010	102,157 ^r	102,019	100,985	101,358	61,400 ^r	60,300 ^r	60,200 ^r	59,600 ^r	59,819
Sierra Leone	6,800 ^r	20,300 ^r	19,429 ^r	2,624 ^r	--	3,600 ^r	11,900 ^r	11,300 ^r	1,500 ^r	--
South Africa	67,100	71,645	80,759	72,806 ^r	66,456	42,900	45,700	51,500	46,424 ^r	42,000
Swaziland	1,032	1,259	603	--	--	451 ^r	550 ^r	264 ^r	--	--
Sweden	26,200 ^r	25,300 ^r	25,700 ^r	24,500	26,900	15,720 ^r	15,180 ^r	15,420 ^r	14,700 ^r	16,100
Thailand	303	390 ^r	348 ^r	16 ^r	--	188 ^r	242 ^r	216 ^r	10 ^r	--
Togo	53	80	89	72	60 ^e	16	24	27	22	18 ^e
Tunisia	223	244	307 ^r	300 ^r	300 ^e	117 ^r	127 ^r	160 ^r	156 ^r	160 ^e
Turkey	6,557 ^r	8,492 ^r	6,982 ^r	6,010 ^r	5,900 ^e	3,967 ^r	5,138 ^r	4,224 ^r	3,636 ^r	3,600 ^e
Uganda	4	2	42	9	9 ^e	3	2	27	6	6 ^e
Ukraine ⁶	67,100 ^r	70,400 ^r	68,300 ^r	66,900 ^r	62,900	41,900 ^r	44,000 ^r	42,700 ^r	41,800 ^r	39,300
United States	54,700	52,800	56,100	46,100	41,800	34,500	33,300	35,400	28,800	26,400
Uruguay ⁷	10	10	15	12	12 ^e	4	4	6	5	5 ^e
Venezuela	15,403 ^r	11,198 ^r	11,256 ^r	11,716 ^r	11,700	9,550 ^r	7,000 ^r	7,000 ^r	7,300 ^r	7,300
Vietnam	2,842	4,708	5,130	5,086 ^r	5,951	1,506	2,495	2,719	2,691 ^r	3,154
Total	2,070,000 ^r	2,200,000 ^r	2,340,000 ^r	2,320,000 ^r	2,350,000	1,260,000 ^r	1,340,000 ^r	1,430,000 ^r	1,430,000 ^r	1,450,000

^eEstimated. ^rRevised. -- Zero.

¹Table includes data available through November 9, 2017. All data are reported unless otherwise noted. Totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Usable ore applies to all primary iron ores and direct-from-mine products used in steelmaking, excluding secondary iron products and agglomerates produced from imported iron ore. Iron content was determined using the ratios of iron contained within the usable ore from estimates, reported data, or calculated figures.

³Data for China are for reported usable ore, as opposed to crude ore.

⁴Production includes alternative iron ore source as follows: Greece (nickeliferous iron ore) and New Zealand (titaniferous magnetite sands).

⁵Less than ½ unit.

⁶Series revised to reflect change in Ukraine's geopolitical reporting areas.

⁷Production is based on fiscal year, with a starting date of April 1.



Figure 1. Global production of usable iron ore in 2016.