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The Mineral Industry of Brazil

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Brazil is one of the leading mining countries in the world, producing a wide array of industrial minerals, metals, and mineral fuels. In 2019, Brazil was the world's leading producer of niobium, accounting for about 92% of the world's production. It was the second-ranked producer of tantalum, accounting for 23% of world production; iron ore (iron content and usable ore), accounting for 17% each of world production; and magnesium compounds, accounting for 6% of world production. In 2019, Brazil also ranked third in the world production of vermiculite, accounting for 13% of world production; graphite, accounting for 9%; talc and pyrophyllite, accounting for 8%; and vanadium and alumina, each accounting for 7% of world production. Brazil was the world's fourth-ranked producer of asbestos, bauxite, beryllium, magnesium metal, manganese, and silicon; and the fifth-ranked producer of abrasives. Brazil also accounted for about 2% of the world's crude steel production, ranking ninth in the world, and it was the leading producer of raw steel in South America (accounting for 78% of South America's crude steel production) (World Steel Association, 2020, p. 1–2; Apodaca, 2021; Bolen, 2021a, b; Bray, 2021; Callaghan, 2021a, b; Hatfield, 2021; Jaskula, 2021; Merrill, 2021a, b; Olson, 2021; Polyak, 2021; Schnebele, 2021a, b; Sheaffer, 2021; Simmons, 2021; Tuck, 2021).

Brazil was among the world leaders in reserves of some mineral commodities. Brazil's estimated share of world reserves of niobium amounted to 85%; tantalum, 38%; graphite (natural), 24%; manganese, 17%; iron ore (iron content), 19%; rare earths, 18%; tin, 15%; nickel, 12%; bauxite, 9%; titanium (ilmenite), 6%; and uranium, 5% (World Nuclear Association, 2019; Agência Nacional de Mineração, 2020; Anderson, 2020; Bray, 2020; Corathers, 2020; Gambogi, 2020a, b; McRae, 2020; Olson, 2020; Padilla, 2020a, b; Tuck, 2020).

In 2019, Brazil's real gross domestic product (GDP) was $1.82 trillion (in constant 2015 dollars) which ranked it as the eighth largest economy in the world. Brazil's real GDP increased by about 1.1% in 2019 compared with that in 2018. The Instituto Brasileiro de Mineração (IBRAM) reported that exports of mineral goods accounted for about 13% of the country's total exports (Instituto Brasileiro de Mineração, 2020a, p. 112; World Bank, The, 2020; U.S. Central Intelligence Agency, 2021).

Minerals in the National Economy

Brazil's mineral production in 2019 was valued at $38 billion (representing about 3% of the GDP) compared with $34 billion in 2018. According to Brazil's Agência Nacional de Mineração [National Mining Agency] (ANM), a total of 2 million people were engaged in the mining sector, 175,000 of which were directly employed in mining. The Economic Commission for Latin America and the Caribbean noted that Brazil's foreign direct investment (FDI) inflows decreased to $69.2 billion in 2019 from $78.2 billion in 2018, which was a significant decrease from the level of FDI received in 2011 of $102.4 billion (Instituto Brasileiro de Mineração, 2020a, p. 28, 110, 113; Economic Commission for Latin America and the Caribbean, 2020, p. 27).

Government Policies and Programs

Brazil's mineral industry is governed by the Mining Code [Decree-law (Act) No. 227 of 1967], which establishes the rights and duties of the holders of mining rights. In addition to the Mining Code, the country follows the 1988 Constitution and various decrees to manage the mineral industry (Instituto Brasileiro de Mineração, 2020a, p. 76).

In 2019, the Federal Government of Brazil implemented Law 13.874, known as the Declaration of Economic Freedom Rights (Act). The purpose of this law is to promote entrepreneurship and innovation in the private sector with less intervention from the state. Under the act, the ANM implemented the tacit license, which is designed to accelerate the processing and approval steps during the initial procedures for establishing a mining company (L&E Global, 2019; Instituto Brasileiro de Mineração, 2020a, p. 115). Executive Order 789/2017, which was enacted on August 1, 2017, and then made into Law 13.540/2017 that was enacted on December 19, 2017, and amended by Decree No. 9.252/2017 and Decree No. 9.407/2018, changed rules regarding the collection of mining royalties, known in Brazil as Compensação Financeira pela Exploração de Recursos Minerais [Financial Compensation for the Exploration of Mineral Resources], or CFEM. Prior to the new law, the CFEM rate was based on mineral product net sales (excluding sales taxes, transportation costs, and insurance costs). Under the new law, the CFEM rate is based on the mineral commodity's gross revenue (excluding sales taxes). The ANM, which replaced the Departamento Nacional de Produção Mineral [National Department of Mineral Production] (DNPM), was to set the guidelines for the implementation of the collection of royalties. Under Executive Order 789/2017, which modified the calculation method for the collection of mining royalties, the calculation considers the gross revenue of the mineral sale, not including taxes. Before the Executive order was issued, the CFEM rate was based on net sales. The new rate modifications allow for a maximum rate of 3.5% on mineral commodities, including 1% for materials used in construction, such as clay, rocks, sand, and gravel; 1.5% for gold; 2% for diamond and other unspecified mining substances; 3% for bauxite, manganese, niobium, and rock salt; and 3.5% for iron ore (Visconti, 2017a, b; Instituto Brasileiro de Mineração, 2020a, p. 76).

Executive Order 790/2017 proposed the modification and modernization of the Brazilian Mineral Code (Decree-law No. 227/1967). However, the Executive order was challenged and not voted on. As a result, the Ministério de Minas e Energia [Ministry of Mines and Energy] (MME) introduced

Decree No. 9.406/2018, which sought to change some statutes from the Mineral Code, which included a change to consider mining activities as a public matter; to encourage and fully support the use of tailings and wastes as part of the mining process; to promote the classification of mineral reserves using internationally accepted reporting standards and the ANM's regulations on the subject; and to support mining companies to execute research studies without interruption (and with no need to request authorizations or a research extension permit) to avoid a lapse in the sequence of the work. Decree No. 9.406/2018, which is related to changes in the acquisition of mining permits, allows the miner to get a usage guide permit until the mining concession is approved or disapproved. The usage guide permit is valid for a term of 1 to 3 years, with the option of a one-time extension. The usage guide permit also allows miners to request the ANM to issue a declaration of public utility for the property for the purpose of establishing a mineral easement that would allow the miner to access the property prior to the issuance of the mining concession. Also, through Decree No. 9.406/2018, electronic auction of mining properties is allowed, providing for a faster acquisition of properties (Instituto Brasileiro de Mineração, 2020a, p. 77).

Executive Order 791/2017 (made into law No. 13.575 of December 26, 2017) and Decree No. 9.587 of November 27, 2018, orders the creation of the ANM as the Government agency responsible for the inspection, management, and regulation of mining activities in the country; for mineral research; and for other mining activities, including the issuance of the Kimberley Process certificate for the diamond industry. The ANM has administrative and financial autonomy and promotes the access and use of mineral resources as well as promoting the mineral sector as a means to develop the country economically and socially. The ANM took over the functions of the DNPM. The ANM, which is under the MME, operates under a board of five directors, each of which is appointed for a period of 5 years. Formerly, the DNPM operated under one director general, which could be removed from office at any time. The new management model is designed to minimize political interference in the appointments. Included in Executive Order 791/2017 is the creation of a "mining activities inspection fee" (also known as TFAM), which is another source that the ANM uses to collect revenue. The TFAM is to be integrated as part of the ANM's policing power on the inspection of mining activities. The TFAM fee is to be collected annually for each mineral right title holder, and the amount owed is dependent on the phase of the mining process (Felsberg E Associados Mining Department, 2017; Visconti, 2017a; Instituto Brasileiro de Mineração, 2020a, p. 76–77; Agência Nacional de Mineração, 2021).

Geologic, geophysical, geochemical, hydrologic, and hydrogeologic mapping is performed by the MME's Companhia de Pesquisa de Recursos Minerais (CPRM) (the Geological Survey of Brazil) and includes the dissemination and management of geologic and hydrologic information. The Agência Nacional do Petróleo, Gás Natural e Biocombustíveis [National Agency of Petroleum, Natural Gas and Biofuels] (ANP), which is also part of the MME, has responsibility for regulating activities that integrate the biofuels, crude petroleum, and natural gas industries and for issuing exploration and production licenses (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020b; Companhia de Pesquisa de Recursos Minerais, 2021).

The uranium sector in Brazil is regulated by the Federal Constitution, Article 177, which establishes the state as the sole proprietor in all the dealings with uranium, and this regulatory authority is exercised in conjunction with Article 21. According to Articles 21 and 177, the conversion, enrichment, exploration, milling, mining, reprocessing, and trading of uranium are to be undertaken exclusively by the Federal Government and are permitted solely for civilian purposes, subject to the approval of Brazil's national congress. The National Nuclear Energy Commission (CNEN), and the Brazilian Nuclear Industries (INB) are responsible for carrying out research and the mining of the country's uranium ores. The Government of Brazil controls the exploration, mining, and commercialization of the country's uranium resources (Instituto Brasileiro de Mineração, 2020a, p. 89).

Production

In 2019, Brazil reported a 173% increase in the production of secondary copper. Other minerals that had significant increases in production were lithium for which the estimated output increased by 107% to 85,000 metric tons (t); pyrochlore concentrate (gross weight), by 43% to 225,885 t; manganese metal, by 40% to 1,741,000 t; niobium content of pyrochlore, by 29% to 86,374 t; potash (K_2O content), by 23% to 247,000 t; potassium chloride, by 22% to an estimated 390,000 t; mined tantalum (mineral concentrate), by 19% to an estimated 430 t; total refined copper, by 18% to 175,000 t; manganese (gross weight), by 17% to 3,726,363 t; smelted zinc, by 15% to 283,700 t; alumina by 11% to 9,170,800 t, and petroleum naphtha, by 11% to 28,189,000 barrels. Mineral production decreased for asbestos by 86% to 15,000 t; rutile (gross weight), by 70% to 600 t; ilmenite and leucoxene (gross weight), by 63% to an estimated 41,000 t; nitrogen (N content of ammonia), by 56% to an estimated 320,000 t; monazite, by 40% to an estimated 1,200 t; diamond, by 34% to 166,000 carats; beneficiated magnesite, by 29% to 1.5 million metric tons (Mt) and crude magnesite, by 26% to 1.4 Mt; ferrochromium, by 22% to 136,780 t; ferronickel (gross weight), by 21% to an estimated 186,000 t; mined tin, by 20% to 13,993 t; mined nickel, by 18% to 60,400 t; phosphate rock, by 18% to an estimated 4,700,000 t (gross weight) and 1,650,000 t (P_2O_5 content); columbite-tantalite, by 17% to 10,276 t; nickel content of ferronickel, by 15% to 55,744 t; mined lead, by 14% to an estimated 6,000 t; smelted copper, by 13% to 115,400 t; ferromanganese, by 13% to 102,000 t; and iron ore, by 12% to 404,900 t (gross weight) and 258,000 t (Fe content). Data on mineral production are in table 1.

Structure of the Mineral Industry

In 2019, Vale S.A. produced copper, gold, iron ore, manganese, and nickel in Brazil, from operations throughout the country. Petrobras, which was the sole producer of crude petroleum, had operations both onshore and offshore Brazil

and was the sole operator of Brazil's petroleum refineries. The Government held majority ownership in all petroleum production venues; in addition, the Government played a role in other parts of the mining sector in which it held an ownership share (table 2).

Eternit S.A., through its subsidiary Sociedade Anônima Mineração de Amianto S.A., owned Cana Brava, which was the only asbestos operation in the country. Bauxite was produced by Alcoa Inc. subsidiaries Alcoa Aluminio S.A. and Alcoa World Alumina Brasil Ltda.; by Companhia Brasileira de Aluminio; Mineração Paragominas S.A. (a subsidiary of Norsk Hydro Brasil Ltda.), and Mineração Rio do Norte S.A (a subsidiary of a consortium led by Vale). Caraiba Metais S.A., which was located in the State of Bahia, was the only electrolytic copper producer in the country. Grupo Votorantim, which was the only producer of zinc in the country, owned two mines (Vazante and Morro Agudo) and two metallurgy operations (Juiz de Fora and Tres Marias) located in the State of Minas Gerais. The Empresa Brasileira de Administração de Petróleo e Gás Natural–Pré-Sal Petróleo S.A. [Brazilian Company for the Administration of Oil and Natural Gas—Pre-Salt Petroleum S.A.] (PPSA) manages new pre-salt crude petroleum reserves and production; PPSA operates under the authority of the MME (Pré-Sal Petróleo S.A., 2022). Table 2 is a list of major mineral industry facilities.

Mineral Trade

Brazil's mineral exports in 2019 were valued at about $32.5 billion compared with about $30 billion in 2018; mineral exports accounted for 15% of the total exports of $224 billion. The country's major export trade partners were, in descending order of export value, China, which received 30% of Brazil's total exports, the European Union (14%), the United States (13%), Argentina (4%), and the Netherlands (3%). Iron ore accounted for 68% of the value of mineral exports, followed by gold (11%) and copper and ferroniobium (7% each) (Instituto Brasileiro de Mineração, 2020b, p. 2; Ministério da Economia, 2020).

Brazil's mineral imports in 2019 were valued at about $8.2 billion compared with about $8.5 billion in 2018; mineral imports accounted for 4% of the total imports of $186 billion. The country's major import trade partners were, in descending order of import value, China, which provided 20% of Brazil's total imports, the European Union (19%), and the United States (19%). Potassium accounted for about 42% of the primary mineral commodity exports, followed by coal (35%), copper (9%), and zinc (3%) (Instituto Brasileiro de Mineração, 2020b, p. 2; Ministério da Economia, 2020).

In 2019, Brazil's exports of crude petroleum increased by 4% to 428 million barrels (Mbbl) from 410 Mbbl in 2018. Its major crude petroleum export partners were, in descending order of exported barrels received, China (63%), the United States (14%), Chile (5%), India and Spain (4% each), and Uruguay (3%) (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 123).

In terms of trade with the United States, Brazil's total exports to the United States were valued at $30.8 billion in 2019, which was a slight decrease compared with the export value of about $31.2 billion in 2018. Brazil's crude petroleum exports to the United States in 2019 were valued at $3.6 billion and accounted for about 11.5% of the total value of exports. Other major mineral-related exports from Brazil to the United States were iron and steel mill products valued at $2.6 billion; petroleum products, $1.5 billion; stone, sand, cement, and so forth, $627 million; coal and related fuels, $408 million; fuel oil, $261 million; nonferrous metals, $227 million; bauxite and aluminum, $154 million; and gemstones, $118 million (U.S. Census Bureau, 2021b).

Brazil's imports from the United States increased by about 9% to $42.9 billion in 2019 from $39.4 billion in 2018. Significant mineral-related imports by Brazil from the United States in 2019 were fuel oil, which was valued at $5.4 billion and accounted for 12.7% of the total value of imports; petroleum products, $3.7 billion; crude oil, $1.1 billion; metallurgical-grade coal, $1 billion; coal and fuels, $508 million; natural gas liquids, $503 million; natural gas, $282 million; precious metals, $169 million; and iron and steel products, $117 million (U.S. Census Bureau, 2021a).

Commodity Review

Metals

Aluminum and Bauxite and Alumina.—In 2019, two operators produced primary aluminum in Brazil: Albras Alumínio Brasileiro S.A., which ran the Barcarena smelter in the State of Para and Companhia Brasileira de Aluminio S.A., which ran the Aluminio City smelter located in the State of Sao Paulo. The Barcarena smelter produced 326,600 t of aluminum and the Aluminio smelter produced 323,600 t of aluminum (table 2; Associação Brasileira do Alumínio, 2019b).

Bauxite production in Brazil decreased by 1.4% to 31.9 Mt in 2019 from 32.4 Mt in 2018. In 2019, the main producers of bauxite were, Mineração Rio do Norte S.A. (12.2 Mt), which accounted for 38% of bauxite production in the country; Mineração Paragominas S.A., 7.4 Mt; and the Alcoa World Alumina Brasil Ltda. facility at the Juruti Mine, 6.9 Mt (tables 1, 2; Associação Brasileira do Alumínio, 2019c).

In 2019, alumina production in Brazil increased by about 11% to nearly 9.2 Mt from 8.3 Mt in 2018, mainly owing to better production performance by the leading producers in the country. Alumina do Norte do Brasil S.A (.Alunorte) produced 4.53 Mt of alumina in 2019, which accounted for 49% of the total alumina production in the country compared with 3.71 Mt of alumina in 2018. South32 Minerals S.A. produced 1.32 Mt of alumina compared with 1.26 Mt in 2018. Production at the Poços de Caldas alumina refinery decreased to 165,100 t in 2019 from 179,700 t in 2018, and production at the Sao Luis alumina refinery increased to about 1.98 Mt from 1.90 t in 2018. Both properties were operated by Alcoa Aluminio S.A. (tables 1, 2; Associação Brasileira do Alumínio, 2019a).

Copper.—Vale was the leading producer of copper concentrates in Brazil in 2019; it produced copper concentrates at its Salobo and Sossego open pit mines located in Carajas in the State of Para. In 2019, the Salobo Mine produced 189,400 t of copper, which was a decrease of 2% from the 192,600 t produced in 2018; the Sossego Mine produced about 65,500 t of copper, which was a decrease of 41% from the

92,200 t produced in 2018. The decrease in copper production at the Salobo and the Sossego Mines was attributed to the depletion of reserves. In terms of the stockpile, the company reclassified the mineral reserves at the Salobo and the Sossego Mines from proven reserves to probable reserves owing mainly to variability in the mineral grade and the degree of oxidation (Vale S.A., 2021, p. 63, 84).

Gold.—According to IBRAM, in 2019, Brazil was among the 15 leading gold producers in the world. The State of Minas Gerais accounted for 43.6% of the country's gold production, followed by Goias (30.3%), Para (17.1%), and Bahia and Mato Grosso (2.7% each). The percentage of gold production reported by States was based on gold mining or a mining concession legally operating in the country, which included mining cooperatives and large-scale producers. These operations collectively accounted for 84% of the annual gold production. The remaining 16% of output was carried out by illegal gold miners (Instituto Brasileiro de Mineração, 2020a, p. 27–28).

Vale was one of Brazil's leading producers of gold. Total production from its Salobo and Sossego Mines was 12,800 kilograms (kg), or about 14% of Brazil's total gold production of 89,988 kg. Gold was recovered as a byproduct of copper mining from these two mines. Salobo's gold production increased by about 2% to 11,446 kg in 2019 from 11,228 kg in 2018. Sossego's gold production decreased by about 27% to 1,337 kg in 2019 from 1,835 kg in 2018. As of 2019, total proven mineral reserves at Salobo and Sossego were a reported 1,148 Mt at an average grade of 0.32 gram per metric ton (g/t) gold, and probable mineral reserves at Salobo and Sossego were 109 Mt at an average grade of 0.18 g/t gold (table 1; Vale S.A., 2021, p. 65, 85).

AngloGold Ashanti Ltd. of South Africa was another large-scale gold producer in Brazil in 2019; it mined gold in Brazil through two of its wholly owned subsidiaries, AngloGold Ashanti Corrego do Sitio Mineração (AGA Mineração) and AngloGold Ashanti Serra Grande. The combined gold production from these two companies decreased by about 2% to 15,085 kg in 2019 from 15,400 kg in 2018. AGA Mineração comprised the Cuiaba Complex, the Corrego do Sitio mining operation, and the Cuiaba and the Queiroz gold plants in the State of Minais Gerais in southeastern Brazil. AGA Mineração produced 11,300 kg of gold in 2019 and was AngloGold's third-ranked gold producer. In 2019, operations at the Cuiaba Complex were negatively affected by unstable ground conditions at the facility, which required an evaluation to add structural support and forced the company to slow down mining operations while the issues were resolved. AngloGold Ashanti experienced delays in obtaining an open pit mining license for the Rosalino deposit within the Corrego do Sitio complex. Heavy rains caused geotechnical issues at the Córrego do Sítio complex, which set back mining development plans and delayed the starting of open pit mining operations. The Serra Grande Mine reported lower gold production in 2019. The mine ran into some issues that might have affected its performance, such as the mining of lower ore grades, the reduction of drilling productivity, and a decrease in fleet availability (AngloGold Ashanti Ltd., 2020, p. 24, 76–77, 85).

Kinross Gold Corp. of Canada held a 100% interest in the Paracatu Mine, which is located in the State of Minas Gerais in southeastern Brazil. In 2019, gold production from Paracatu was 19,270 kg, which was 21% of Brazil's total gold production compared with 16,223 kg in 2018. The increase in production was mainly attributed to an increase in mill throughput, the mining of higher grade ore, and an increase in the recovery rate (Kinross Gold Corp., 2020, p. 20).

In 2019, Yamana Gold Inc. of Canada, which was the operator of the Chapada polymetallic mine located in the State of Goias, announced the sale of the mine to Lundin Mining Corp. of Canada. The Chapada Mine produced gold and silver as a byproduct of copper mining. With the sale, which was valued at $1 billion, Yamana was to receive payments consisting of $800 million cash upon closing of the agreement; additional cash payments over a period of 5 years that would vary depending upon the price of gold, a payment of $100 million contingent upon Lundin's development of a pyrite roaster to optimize copper and gold recovery rates, and a 2% net smelter return royalty on the gold produced from the Suruca project. The additional cash payments would consist of up to $125 million based on the price of gold over the 5-year period from the date of the closing of the agreement (Yamana Gold Inc., 2019b, p. 2; 2020, p. 47).

The Suruca deposit, which is located 7 kilometers (km) northeast of the Chapada Mine, was estimated to be able to produce about 1,600 kilograms per year (kg/yr) of gold (reported as 50,000 troy ounces per year) for 5 years. Proven and probable mineral reserves were 23,700 kg of gold (reported as 762,000 troy ounces). Total proven and probable mineral reserves were estimated to be 65.2 Mt grading 0.51 g/t gold. According to Yamana, the sale was part of a business strategy; the sale became final in the third quarter of 2019 (Yamana Gold Inc., 2019b, p. 2; 2020, p. 47).

Yamana Gold operated two gold mines in Brazil: the Chapada Gold Mine (part of the Chapada polymetallic mine) up until it was acquired by Lundin in mid-2019, and the Jacobina Mine. Lundin's acquisition of the Chapada polymetallic mine was made final in July 2019, and the mine produced about 3,270 kg of gold in 2019. The Jacobina Mine is located in the State of Bahia and produced 4,961 kg of gold (reported as 159,499 troy ounces) in 2019 compared with 4,501 kg of gold (reported as 144,695 troy ounces) in 2018. As a result of previous exploration and studies of the Jacobina premises, the company increased the mineral reserves of gold by 19%, to about 77,540 kg (reported as 2.493 Mt) in 2019 from 65,300 kg (reported as 2.1 Mt) in 2018. The increase extended the estimated life of the mine to 16 years. In 2019, Yamana Gold advanced a two-phase expansion project for the Jacobina Mine. Phase 1 consisted of plant upgrades to increase ore-processing capacity to 6,500 metric tons per day (t/d) from 6,200 t/d, with the goal of producing 5,300 kg/yr of gold. Phase 2 was to include a broader expansion that would increase the mine's throughput capacity to between 7,500 and 8,500 t/d of ore to produce about 7,000 kg/yr of gold. The company expected to finish the phase 1 expansion by mid-2020 and the phase 2 expansion by 2023 (Lundin Mining Corp., 2019, p. 1; Yamana Gold Inc., 2019a, p. 23; 2020, p. 5, 9, 22, 33, 42, 52).

Iron and Steel.—According to the Instituto Aço Brasil [Brazil Steel Institute], the country produced about 32 Mt of raw steel in 2019, which represented a decrease of about 8% from the 35 Mt of raw steel produced in 2018. In 2019, Brazil was Latin America's main producer of steel, accounting for about 54% of the region's total production. The Brazil Steel Institute is an association of the main steelmaking companies in the country, comprising 11 local business groups operating 30 mills with a combined installed capacity of 51.5 million metric tons per year (Mt/yr) of raw steel. About 79% of the country's steel production was concentrated in the States of Minas Gerais (32%), Rio de Janeiro (26.9%), and Espírito Santo (20.3%). The two leading steel producers in Brazil in 2019 were ArcelorMittal S.A. of Luxembourg and Gerdau S.A. of Brazil. Consumer end-products made of steel, such as billets, blooms, ingots, and slabs, accounted for about 70% of the combined apparent consumption of these products in 2019. The member companies of the Instituto Aço Brasil employed 112,222 people in 2019, which was an increase from the 108,402 people employed in 2018 (Instituto Aço Brasil, 2020, p. 11–12, 16, 19–20, 22, 73).

Iron Ore.—Brazil was the world's second-ranked producer and exporter of iron ore behind Australia; it also accounted for 19% of the world's reserves of iron ore. Iron ore was one of Brazil's main export products, accounting for an average annual revenue of $25 billion during the past decade. In 2019, the State of Minas Gerais was responsible for 60% of the country's production of iron ore. In 2019, exports of iron ore in Brazil reached about 341 Mt valued at $22.2 billion (Instituto Brasileiro de Mineração, 2020a, p. 23, 25).

In the Carajas mining area, iron ore has a high iron content with few impurities and the operating costs of mining it are lower than in Minas Gerais. According to IBRAM, the region could become Brazil's most important region for iron ore production. An important step in that transition was Vale's announcement of the CLN S11D iron ore project in 2014. The project was to increase iron ore capacity to an estimated 90 Mt/yr in the country's Northern system (one of four regional systems into which iron ore mining is divided in the country) to support the S11D Mine. The project included the construction of new rail lines and expansion and expansion of the existing railway system, acquisition of railroad cars and locomotives to transport the mined material, and the expansion of the Ponta da Madeira maritime terminal. The project was started in 2016 and by the end of 2019, the addition of the railways had been completed. The company expected to maintain the project in a monitoring phase until 2022 to allow for additional work and adjustments, mainly in the Ponta da Madeira Port. Brazil also produced iron ore from the States of Mato Grosso and Mato Grosso do Sul and had exploration projects in the States of Bahia, Ceara, and Piaui which were awaiting the completion of the feasibility studies of the deposits and the development of the appropriate infrastructure, such as rail transport, in the area (Instituto Brasileiro de Mineração, 2020a, p. 24; Vale S.A., 2021, p. 87–88, 91).

Vale's production of iron ore decreased by 21% in 2019 to 302 Mt from 385 Mt in 2018; production in 2019 accounted for 75% of Brazil's iron ore (gross weight) production of 404.9 Mt. Brazil produced about 17% of the world's iron ore output; total world production was estimated to be 2.45 billion metric tons. Vale produced iron ore from the following four regions (or "systems," as reported by Vale) in the country: the Northern system (188.7 Mt), which was located in the State of Para; the Southeastern system (73.1 Mt) and the Southern system (37.8 Mt), which were located in the State of Minas de Gerais; and the Midwestern system (2.4 Mt), which was located in the State of Mato Grosso do Sul. By yearend 2019, Vale's total proven and probable reserves of iron ore were 16,118 Mt at an average grade of about 56% iron (table 2; Tuck, 2021; Vale S.A., 2021, p. 49, 79).

The decrease in total iron ore output was mainly attributed to the release of tailings debris caused by the Brumadinho tailings dam failure in Brazil. The dam failure, which took place in January 2019 in the city of Brumadinho in the State of Minas Gerais, destroyed part of the Corrego do Feijao Mine, resulting in a decrease in mine output. The extent of the damage covered an area of 315 km. Since 2016, the dam was declared inactive owing to no additional tailings deposited since then. Shortly after the accident, Vale started to dismantle the structure of the dam and restore the surrounding area (table 1; Vale S.A., 2020, p. 94, F-20–F-21; 2021, p. 49).

Manganese.—Vale produced manganese at the Azul open pit mine, which is located in the State of Para, and at the Urucum underground mine, which is located in the State of Mato Grosso do Sul. Vale also owned the Morro de Mina open pit mine, which is located in the State of Minas Gerais. Vale produced about 1.6 Mt of manganese ore (gross weight) in 2019 compared with 1.8 Mt of manganese ore in 2018 (Vale S.A., 2021, p. 53–54).

Nickel.—Vale produced nickel at Onca Puma which was a mining and smelting operation that produced stainless-steel products for the steel industry; the operation was located in the State of Para in northern Brazil. In 2019, production of nickel contained in ferronickel at Onca Puma was 321 t compared with no production in 2018; the operation's production capacity was 27,000 t/yr of iron-nickel alloy. The low production compared with its capacity was caused by Onca Puma's closure from September 2017 until September 2019. The operations were suspended owing to an injunction issued by the Federal Court of Appeals regarding allegations of environmental damage to the Catete River caused by the Onca Puma nickel operations, which affected indigenous communities located close to the mining site (Vale S.A., 2019, p. 157; 2021, p. 58–59, 166).

Niobium.—Brazil was the world's leading producer of niobium, accounting for about 90% of total production. The Companhia Brasileira de Metalurgia e Mineração (CBMM) of Brazil supplied a variety of products to the market, such as ferroniobium, metallic niobium, niobium compounds, niobium oxide, and vacuum-grade niobium alloys. The Mineração Catalão de Goiás, which was wholly owned by China Molybdenum Co., Ltd. (CMOC), supplied ferroniobium; and the Mineração Taboca, which was wholly owned by Minsur S.A. of Peru, used tin and tantalum ore from the Pitinga Mine to produce niobium and tantalum metal alloys. About an estimated 90% of the niobium produced in the country was transformed into ferroniobium; the remaining 10% was divided into products for other applications. Niobium oxides were

used in the manufacturing of camera lenses, electric vehicle batteries, and telescope lenses. Vacuum-grade niobium alloys, which are resistant to heat, have a high level of purity and are used as raw materials for aeronautical turbines, rocket engines, and land-based electric turbines. Metallic niobium is used in the production of superconducting wires for such medical devices as CT (computed tomography) scanners and MRI (magnetic resonance imaging) machines. Metallic niobium has superconducting properties and has high resistance to corrosion (Instituto Brasileiro de Mineração, 2020a, p. 26; Callaghan, 2021a, p. 115).

Industrial Minerals

Cement.—By the end of 2018 (the latest year for which data were available), there were at least 80 cement plant operations in Brazil that produced clinker and (or) cement. The total (combined) installed capacity was about 102 Mt/yr of cement. In 2019, the Southeast region of the country accounted for about 48.7% of the country's cement production, followed by the Northeast region (20.5%), the South region (16%), the Central-West region (11%), and the North region (3.8%) (Cimento.org, 2019; Sindicato Nacional da Indústria do Cimento, 2019).

In 2019, Brazil reported an increase in annual sales of cement for the first time since 2014. Total sales amounted to 54.5 Mt of cement, which was an increase of 3.5% compared with the 52.8 Mt sold in 2018. The increase exceeded the Sindicato Nacional da Indústria do Cimento's (SNIC) forecast of 3% growth for 2019. SNIC forecasted an increase in sales of about 56.5 Mt of cement for 2020 contingent upon a favorable financial environment, low inflation, low interest rates, and the implementation of Government policies that would favor production (Global Cement, 2020).

In May, Votorantim Cimentos of Canada announced plans to invest about $50 million to upgrade the 0.2-Mt/yr grinding plant at Pecem in the State of Ceara. The upgrade would increase the unit's production capacity by 0.8 Mt/yr (Global Cement, 2019c).

In June, the Companhia Siderúrgica Nacional (CSN Cimentos) of Brazil announced plans to spend nearly $390 million in the construction of a new 3-Mt/yr cement plant in Parana State. The company obtained approval from the State to conduct an economic feasibility study for the project (Global Cement, 2019a).

In November, Itaci Cement invested $66 million to purchase 100 hectares of land in the municipality of Tabuleiro do Norte, in the northeastern Brazilian State of Ceara to develop a cement plant. The company did not disclose if the new facility would be a clinker grinding or an integrated cement plant. According to the company, when completed, the new plant would receive raw material from the Companhia Siderúrgica do Pecém (Global Cement, 2019b).

Lithium.—Sigma Lithium Resources Corp. of Canada, through its wholly owned subsidiary Sigma Mineração S.A. (SMSA), was developing a group of hard-rock lithium deposits at its Grota do Cirilo open pit project (also known as the Xuxa project). The Xuxa project, which is located about 25 km northeast of Aracua in the State of Minas Gerais, included nine past-producing lithium mines. In 2018, SMSA developed a pilot plant and started producing battery-grade lithium concentrate, samples of which the company distributed to potential customers. SMSA expected to transition from pilot plant into a commercial production plant to be commissioned by the end of 2021. According to results of the company's product-testing studies, the new commercial facility would be capable of producing low-impurity battery-grade lithium concentrates for use in the electric vehicle and renewable energy storage industry (Sigma Lithium Resources Corp., 2020, p. 2, 4, 9).

In 2019, SMSA finalized a feasibility study report for the Xuxa deposit. The estimated proven mineral reserves were 10.27 Mt grading 1.45% lithium oxide, and probable reserves were 3.53 Mt grading 1.47% lithium oxide. Measured resources were estimated to be 26.34 Mt grading 1.39% lithium oxide, indicated resources were estimated to be 19.44 Mt grading 1.37% lithium oxide, and inferred resources were estimated to be 6.6 Mt. The feasibility report included the construction of a commercial production plant with a processing capacity of 1.5 Mt/yr of spodumene ore, with the possibility to expand the capacity to 3 Mt/yr in the future. The plant design was projected to produce 220,000 t/yr of lithium oxide concentrate at a grade of 6% lithium and to have a mine life of 9.2 years (Sigma Lithium Resources Corp., 2020, p. 4). During 2019, the environmental authority in the State of Minas Gerais granted SMSA environmental licenses for the construction and installation of the lithium commercial production plant at the Xuxa project. The company also applied for an economic development plan for the Barreiro deposit, which was a study required by the country's mining regulators prior to allowing the company to start commercial mining activities. Once approved, the company could obtain an environmental license for the Barreiro deposit. SMSA sampled the Barreiro deposit as part of a prefeasibility study that was underway to determine if production of the lithium resources from the spodumene deposit was economically feasible and if lithium could be processed at the same commercial production plant designed for the Xuxa deposit (Sigma Lithium Resources Corp. 2020, p. 5).

In 2019, the Government of Brazil committed to the development of infrastructure to support lithium mining at the Jequitinhonha Valley, a municipality in the State of Minas Gerais, near SMSA's lithium projects. The Federal, State, and regional governments planned to create an industrial zone to develop the area for lithium processing. The Government also committed to develop a gas pipeline and railway network connection to facilitate product transportation (Sigma Lithium Resources Corp., 2020, p. 5).

Stone, Dimension.—In recent years, Brazil had increasingly established itself as a major player in the export of dimension stone. According to IBRAM, the country ranked fourth among the world's leading producers of dimension stone behind China, India, and Turkey. About 90% of national production came from the States of Bahia, Ceara, Espirito Santo, Goias, Minas Gerais, Paraiba, Parana, and Rio de Janeiro (Instituto Brasileiro de Mineração, 2020a, p. 29).

Mineral Fuels

According to the Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, Brazil ranked 10th in the world in crude petroleum production. In Central America and South America,

Brazil ranked second (after Venezuela) in crude petroleum reserves and natural gas reserves. Brazil's proven crude petroleum reserves (onshore and offshore) were estimated to be 12.7 billion barrels (Gbbl), and its proven natural gas reserves were estimated to be 364 billion cubic meters. About 97% of the total proven crude petroleum reserves and 81% of the total natural gas reserves were located offshore. In 2019, offshore crude petroleum production accounted for about 96% of the country's total crude petroleum production. The State of Rio de Janeiro accounted for about 75% of the total crude petroleum production. Pre-salt areas—that is, layers of oil-bearing rock of carbonate composition that are located under thick layers of salt—accounted for 62% of the total crude petroleum production. The pre-salt areas were located off the coast of the States of Espirito Santo, Rio de Janeiro, and Sao Paulo. State-owned Petróleo Brasileiro S.A. (Petrobras) was the leading participant in Brazil's petroleum and natural gas sectors, playing a significant role in upstream, midstream, and downstream operations (table 3; Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 29, 32, 42, 71, 75, 79–80; Petróleo Brasileiro S.A., 2021).

Natural Gas.—In 2019, natural gas production in Brazil increased by about 9% to 44.7 billion cubic meters from 40.9 billion cubic meters in 2018. A total of 36.4 billion cubic meters of natural gas was produced in offshore fields and accounted for 81.4% of total production. A total of 8.3 billion cubic meters of natural gas was produced onshore. In 2019, the State of Rio de Janeiro produced 25 billion cubic meters of natural gas which was an increase of 23.7% from the 20.2 billion cubic meters produced in 2018. In the State of Sao Paulo, which was the second-ranked national producer, production increased by 4.7% to 6.7 billion cubic meters from 6.4 billion cubic meters in 2018. Onshore, the State of Amazonas, which was the lead national producer, increased production by 6.8% to 5.6 billion cubic meters; the State averaged 15.3 million cubic meters per day of output and was responsible for 12.5% of the total volume produced in the country. In 2019, Brazil ranked 31st in the world ranking of natural gas producers (table 1; Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 84).

In 2019, Brazil's natural gas was processed at 14 production hubs, whose combined capacity was 107.2 million cubic meters per day. The total processing capacity of these hubs increased by 12.1% compared with that in 2018. The total volume processed in 2019 was 22.9 billion cubic meters (61.4 million cubic meters per day), which represented 64.2% of the total installed capacity. The Cabiunas hubs located in Rio de Janeiro, the Caraguatatuba hub located in Sao Paulo, the Urucu hub located in Amazonas, and the Cacimbas hub located in Espirito Santo together were responsible for 82.3% of the total volume of natural gas processed in the country (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 103).

Brazil's proven natural gas reserves decreased by 1.3% in 2019, totaling 364 billion cubic meters. Onshore reserves decreased by 2.5% to 68.1 billion cubic meters and offshore reserves decreased by 1.1% to 295.9 billion cubic meters. Total natural gas reserves decreased by 3.7% year-on-year to 549 billion cubic meters in 2019. Proven reserves of natural gas in the State of Rio de Janeiro reached 234 billion cubic meters, which accounted for 64.3% of the total national reserves. According to the Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, in 2019, Brazil ranked 32nd in the world in terms of proven natural gas reserves. The natural gas reserve life was estimated to be 8.1 years in 2019 compared with 9 years in 2018, mainly owing to the decrease in reserves (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 74, 84).

In 2019, Brazil produced 37.7 Mbbl of natural gas liquids (NGL), which was a decrease of 3.8%, compared with the 39.2 Mbbl produced in 2018. However, production in the State of Sao Paulo increased by 1.4% to 19.3 Mbbl of NGL, and production in the State of Espirito Santo increased by 3.8% to 4.3 Mbbl. Production in the State of Amazonas decreased by 3.7% to 6 Mbbl. The State of Rio de Janeiro produced 5.7 Mbbl of NGL. The two leading producing States were the State of Sao Paulo followed by the State of Amazonas, which together accounted for 67.1% of the total national production (table 1; Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 77).

In 2019, Brazil had 530 pipelines for the handling of petroleum, petroleum products, natural gas, and ethanol, totaling 21,600 km. Of this number, 110 pipelines (11,700 km) were used for the transportation of natural gas, and 19 pipelines (378 km) were reserved to handle ethanol (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 118).

Petroleum.—In 2019, Brazil's crude petroleum production increased by about 8% to 1,018 Mbbl from 944 Mbbl in 2018. Petroleum production in pre-salt areas was 634 Mbbl compared with 521.5 Mbbl in 2018; production reached an average of 1.7 million barrels per day (Mbbl/d) in 2019. Pre-salt production represented 62.3% of the total national output. Offshore petroleum production accounted for 96.3% of the total petroleum production in the country. The State of Rio de Janeiro led production in the country and was responsible for more than 75% of total production, with an average of 2.1 Mbbl/d. The State of Sao Paulo was the second-ranked producer, with an average production of 294,400 barrels per day (bbl/d) of petroleum, which was a decrease of 7.7% compared with that in 2018. The State of Espirito Santo was the third-ranked producer, with an average of 287,600 bbl/d, which was a decrease of 14.2% compared with that in 2018 (table 1; Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 77).

At the end of 2019, Brazil's total crude petroleum reserves were 21.8 Gbbl, which was 10.3% lower than reserves in 2018. Proven reserves totaled 12.7 Gbbl, which was a decrease of 5.4% compared with that of 2018; 457.6 Mbbl of reserves were located onshore and 12.3 Gbbl were located offshore. The States of Alagoas, Amazonas, Bahia, Ceara, Espirito Santo, Maranhao, Rio de Janeiro, Sao Paulo, and Sergipe reported decreases in oil reserves. The State of Rio Grande do Norte recorded a slight increase of 0.2% in its oil reserves. Rio de Janeiro remained the State with the largest amount of proven oil reserves, accounting for 85% of the total reserves in the country. All proven oil reserves in the State of Rio de Janeiro were located offshore. In 2019, Brazil ranked 15th in the world ranking for proven oil reserves (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 71).

In 2019, Brazil's production of petroleum and natural gas was extracted from a total of 7,205 wells (6,575 onshore and 630 offshore), which represented a decrease of 2.1% from the number in 2018. A total of 74 oil streams were in production in Brazil. According to the Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, the life of Brazil's petroleum reserves was estimated to be 12.5 years in 2019 compared with 14.2 years in 2018, mainly owing to a decrease in reserves and an increase in production (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 77).

As an owner, Petrobras remained the main producer of petroleum and natural gas in Brazil, accounting for 74.1% and 75% of the country's production, respectively, in 2019. As an operator, Petrobras's production represented 93.2% of the total national production of petroleum, and 95.1% of the total natural gas production (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 77).

In 2019, the Brazilian refining park had 17 oil refineries that together had the capacity to process 2.4 Mbbl/d of petroleum, in addition to a shale-processing unit with the capacity to process 7,800 t/d. The refining capacity was kept at an average utilization rate of 76.5% throughout 2019. Thirteen of the 17 refineries belonged to Petrobras and accounted for 98.6% of the total capacity. Brazil had 32 pipelines (2,700 km) for the transportation of petroleum, and 369 pipelines (6,800 km) for the transportation of petroleum derivatives (Agência Nacional do Petróleo, Gás Natural e Biocombustíveis, 2020a, p. 99, 118).

Uranium.—According to IBRAM, Brazil has significant uranium resources—on the order of 245,000 t of contained triuranium octoxide (U_3O_8)—distributed among its States. The only uranium mine in Brazil was located in the municipality of Caetite, in the State of Bahia, although conflicting information has been reported on the status of the facility. The mine's resources were estimated to be approximately 99,000 t of uranium, and the mine had the capacity to produced about 400 t/yr of uranium. The Santa Quiteria Consortium, which was a partnership between Industrias Nucleares do Brasil (INB) and the fertilizer company Galvani Group, was overseeing the exploration of the Itataia deposit, which has uranium reserves associated with phosphate ores. The Itataia deposit had estimated reserves of 8.9 Mt of phosphate and 142,000 t of uranium. The deposit is located in the municipality of Santa Quiteria in the State of Ceara. When in operation, the mine was expected to produce 1,600 t/yr of uranium concentrate (Instituto Brasileiro de Mineração, 2020a, p. 89, 91; Nuclear Engineering International, 2020).

Outlook

Brazil will likely see an increase in the production of various mineral commodities as new mining projects and upgrades to mining facilities come online in the near future, such as the Itataia deposit (uranium); the Jacobina Mine expansion (gold); and the Xuxa project, which is expected to be commissioned in 2021 (lithium). The following facilities are expected to contribute to the output of cement as they start production in the next few years: the new CSN Cimentos plant in Parana State, the new Itaci Cement plant in the State of Ceara, and the upgrade of Votorantim's grinding plant at Pecem.

According to IBRAM, the outlook for mining investments in Brazil could increase by 20% in the next 5 years. IBRAM based it forecast on the total number of active mining projects in the country, which to their understanding, could provide confidence to local and foreign investors to participate in medium- and long-term projects. Mineral exploration is also expected to increase, especially in areas with higher concentration of artisanal miners that currently operate illegally in the country, as the Government implements policies to expand legal mining activities. In recent years, the Government has been successful in supporting the registration of artisanal miners in several States, including Bahia, Goias, and Mato Grosso. IBRAM considers the importance of the legal status of Brazilian artisanal miners; as such, IBRAM has set different measures to help artisanal miners in the process of legalizing their activities (Instituto Brasileiro de Mineração, 2020a, p. 114–115).

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TABLE 1

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise specified)

Commodity[2]		2015	2016	2017	2018	2019
METALS						
Aluminum:						
Bauxite, dry basis		37,057,000	39,244,200	38,072,100	32,377,000 r	31,937,900
Alumina		10,451,500	10,885,500	11,060,600	8,258,000	9,170,800
Metal:						
Primary		772,200	792,700	801,700	659,000	650,200
Secondary		602,000	622,000	683,000	760,000 r	760,800
Total		1,370,000	1,410,000	1,480,000	1,420,000 r	1,410,000
Cadmium, refinery, primary		200 e	-- r	-- r	-- r	--
Chromium, mine, chromite, ore and concentrate		526,744	426,337	450,000 e	450,000 e	450,000 e
Cobalt:						
Mine, Co content		2,771	852	185 r	-- e	30 e
Refinery, metal		1,300 e	400	46	8	-- e
Copper:						
Mine, concentrates, cu content		350,940	338,921	384,542	385,762 r	381,000
Smelter:						
Primary		157,800	188,500	118,800	132,200	115,400
Secondary		42,400	27,000	24,800	15,300	41,700
Total smelter		200,000	216,000	144,000	148,000	157,000
Refinery:						
Primary		241,469	225,558	118,300	132,200	133,500
Secondary		29,000	38,500	24,800	15,300	41,700
Total refinery		270,000	264,000	143,000	148,000	175,000
Ferroalloys:						
Ferrochromium		173,467	150,240	171,531	175,061	136,780
Ferromanganese		84,160	83,780	123,470	117,800	102,000
Ferronickel:						
Gross weight		195,000 e	245,000 e	247,251	236,841 r	186,000 e
Ni content		54,700	68,600	68,803	65,254 r	55,744
Ferroniobium:						
Gross weight		79,200 e	67,800 e	89,600 e	96,000 r, e	91,600 e
Nb content		51,874	44,390	58,690	59,000 e	60,000 e
Ferrosilicon[e]		119,000 r	226,000 r	185,000 r	221,000 r	225,000
Silicomanganese		141,540	166,680	202,520	228,690	216,000
Gold, mine, Au content:						
Artisanal mines	kilograms	13,416	23,625	NA	NA	NA
Large-scale mines	do.	69,497	70,295	79,717	NA	NA
Total	do.	82,900 r	93,900 r	79,717 r	85,301 r	89,988
Iron ore, mine:						
Gross weight	thousand metric tons	430,838	421,358	453,704	460,000 e	404,900
Fe content	do.	276,000 r	268,000 r	289,000 r	293,000 r	258,000
Iron and steel:						
Pig iron	do.	27,803	26,129	28,331	28,655	26,166
Raw steel, excluding castings	do.	33,258	31,642	34,778	35,407	32,236
Lead:						
Mine, concentrate, Pb content		9,440	8,134	6,862 r	7,000 e	6,000 e
Refinery, secondary		152,161	156,186	166,695 r	195,000 e	195,000 e
Magnesium, primary, metal[e]		15,000	16,000 r	20,000 r	21,000 r	22,000
Manganese, mine, ore and concentrate:[3]						
Gross weight		2,868,000	2,811,000	3,334,000 r	3,188,735 r	3,726,363
Mn content		1,243,000	1,198,709	1,343,967	1,242,000 r	1,741,000
Nickel:						
Mine, undifferentiated or other, Ni content		94,800	86,400	76,800	73,800 r	60,400
Intermediate, carbonate		18,500	6,077	--	-- r	--
Metal, electrolytic		22,650	--	--	--	--

See footnotes at end of table.

TABLE 1

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise specified)

Commodity[2]		2015	2016	2017	2018	2019
METALS—Continued						
Niobium, mineral concentrate:						
Columbite-tantalite:						
Gross weight		21,975 r	10,518 r	12,455 r	12,348 r	10,276
Nb content		1,509 r	1,011 r	1,892 r	2,682 r	2,559
Pyrochlore concentrate:						
Gross weight		152,709 r	132,275 r	153,169 r	158,489 r	225,885
Nb content		57,343 r	49,741 r	56,244 r	66,910 r	86,374
Rare earths, monazite, concentrate		1,625	4,525	2,900	2,000	1,200 e
Silicon, metal[e]		104,000 r	194,000 r	164,000 r	203,000 r	200,000
Silver:						
Mine, Ag content	kilograms	49,000 r	77,000 r	86,000 r	71,000 r	72,000
Refinery, secondary	do.	32,000	31,200	31,000 e	31,000 e	31,000 e
Tantalum, mine, mineral concentrate, Ta content	do.	268,000	234,000 r	270,000 r	360,000 r, e	430,000 e
Tin:						
Mine, Sn content		18,900	19,705	17,081	17,591 r	13,993
Smelter, primary		16,531	12,542	13,796	12,900	11,927
Titanium, mineral concentrates:						
Ilmenite and leucoxene:						
Gross weight		133,300 e	106,400	67,000 r, e	110,000 e	41,000 e
TiO_2 content		78,991	63,815	60,000 e	60,000 e	60,000 e
Rutile:						
Gross weight[e]		3,300	2,700 r	1,000 r	2,000	600
TiO_2 content		1,984	2,692	2,700 e	2,700 e	2,700 e
Tungsten, mine, concentrate, W content		432	323	411 r	400 r, e	400 e
Vanadium, V content		3,254	4,461	5,206	5,500	5,936
Zinc:						
Mine, Zn content		156,926	158,197	156,348	167,250	163,394
Smelter, primary		270,715	284,457	245,200	246,400	283,700
Zirconium, mineral concentrates, gross weight[4]		22,647	21,302	21,000 e	21,000 e	21,000 e
INDUSTRIAL MINERALS						
Asbestos, fiber		232,052	177,677	129,094 r	110,000 e	15,000 e
Barite, beneficiated		17,760	12,133	NA	NA	NA
Beryl[e]		100	120	80	80	80
Cement, hydraulic	thousand metric tons	65,283	57,557	54,004	53,553	54,400 e
Clay, beneficiated:						
Bentonite		517,607	448,004 r	616,929 r	600,000 r, e	610,000 e
Kaolin		1,802,000	1,737,000	1,771,000 r	1,700,000 e	1,700,000 e
Diamond, unspecified[5]	thousand carats	32	184	255	251	166
Diatomite:						
Crude		5,530	16,408	16,000 e	16,000 e	16,000 e
Beneficiated		2,830	3,130	3,000 e	3,000 e	3,000 e
Feldspar, mine:						
Crude ore		517,597	486,684	500,000 e	500,000 e	500,000 e
Beneficiated, marketable		456,308	295,778	300,000 e	300,000 e	300,000 e
Fluorspar:						
Acid grade		5,931	6,290	6,300 e	6,300 e	6,300 e
Metallurgical grade		17,693	11,970	12,000 e	12,000 e	12,000 e
Total		23,600	18,300	18,300 e	18,300	18,300
Gemstones, quartz crystal, all grades		7,036	13,830	14,000 e	14,000 e	14,000 e
Graphite, crystalline flake, concentrate		81,762	61,687	53,332 r	95,000 e	96,000 e
Gypsum, including anhydrite		3,161,856	2,674,154	2,113,208 r	2,000,000 r, e	2,000,000 e
Lime[e]		8,300,000	8,100,000	8,300,000	8,300,000	8,100,000
Lithium, concentrate		5,781	8,804	10,547 r	41,000 r	85,000

See footnotes at end of table.

TABLE 1

BRAZIL: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise specified)

Commodity[2]		2015	2016	2017	2018	2019
INDUSTRIAL MINERALS—Continued						
Magnesite:						
Mine		1,860,702	1,802,881	2,150,000 r	1,900,000 r, e	1,400,000 e
Beneficiated		1,621,425	1,652,424	2,304,000 r	2,100,000 r, e	1,500,000 e
Mica[e]		11,000	10,800	10,100	11,000	11,000
Nitrogen, ammonia, N content		1,000,000	1,000,000 e	750,000 r, e	730,000 r, e	320,000 e
Phosphate rock, concentrate:						
Gross weight	thousand metric tons	6,100	5,850	5,200 e	5,740	4,700 e
P_2O_5 content	do.	2,100	2,046	1,560 e	2,000 e	1,650 e
Potash:						
K_2O content		304,018	316,429	306,296	201,181	247,000
Compounds, potassium chloride		481,270	500,917	490,000 e	320,000 e	390,000 e
Salt:						
Rock salt	thousand metric tons	1,476	1,410	1,382 r	1,400 e	1,400 e
Sea salt	do.	6,200	6,100 e	6,000 e	6,000 e	6,000 e
Total	do.	7,680	7,510 e	7,380 r, e	7,400 e	7,400 e
Stone, sand and gravel, construction:						
Sand and gravel	thousand metric tons	349,088	312,043	310,000 e	300,000 e	300,000 e
Stone:						
Crushed	do.	261,022	236,387	240,000 e	240,000 e	240,000 e
Dimension	do.	9,500	9,300	9,240	9,000	9,000 e
Other, size and shape unspecified, calcite	do.	29,433	32,469	37,600	43,000	40,000 e
Sulfur, byproduct, S content:						
Metallurgy		258,948	260,000 e	260,000 e	260,000 e	260,000 e
Petroleum		236,484	240,000 e	240,000 e	240,000 e	240,000 e
Total		495,000	500,000 e	500,000 e	500,000 e	500,000 e
Talc and related minerals:						
Talc and pyrophyllite		481,687	494,157	500,000 e	500,000 e	500,000 e
Beneficiated		160,864	162,870	160,000 e	160,000 e	160,000 e
Vermiculite, concentrate		70,000	58,000	50,050	50,000 e	50,000 e
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous, beneficiated, marketable	thousand metric tons	7,828	6,170	6,000 e	6,000 e	6,000 e
Coke, metallurgical	do.	9,079 r	9,233	9,837 r	10,159 r	9,260
Natural gas	million cubic meters	35,126	37,891	40,117	40,857	44,724
Petroleum:						
Crude, including condensate	thousand 42-gallon barrels	889,667	918,731	956,928	944,117	1,017,531
Natural gas liquids	million 42-gallon barrels	32,671	35,407	40,526	39,182	37,699
Refinery:						
Asphalt	do.	12,676	13,536	12,299 r	11,949 r	10,828
Fuel oil	do.	93,251 r	75,407 r	76,986 r	70,155 r	76,961
Gasoline	do.	169,338	174,348	173,985 r	157,651 r	158,447
Jet fuel	do.	35,580	36,413	38,799 r	40,105 r	38,158
Kerosene	do.	35,625	36,461	37,000 e	37,000 e	37,000 e
Liquefied petroleum gas	do.	62,252	60,778	64,854 r	62,767 r	61,739
Lubricants	do.	4,028	3,878	3,733 r	3,792 r	3,560
Naphtha	do.	28,988	19,974	19,432 r	25,475 r	28,189
Other, solvents	do.	2,253	2,114	2,076 r	2,111 r	1,994
Total	do.	444,000 r	423,000 r	429,000 r	411,000 r	417,000
Uranium, U content[e]		40	44	--	--	--

[e]Estimated. [r]Revised. do. Ditto. NA Not available. -- Zero.

[1]Table includes data available through February 11, 2021. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]In addition to the commodities listed, bismuth, crude graphite, crude sodalite, inoculant, leucite, molybdenite, precious and semiprecious stones except diamond, silica (silex), sodium compounds, and other minerals may have been produced, but available information was inadequate to make reliable estimates of output.

[3]Direct sales and (or) beneficiated (marketable product).

[4]Includes baddeleyite-caldasite.

[5]Figures represent officially reported diamond output plus official estimates of output by nonreporting miners.

TABLE 2
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2019

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
METALS			
Alumina	Alcoa Alumínio S.A. (Alcoa Inc., 100%)	Refinery, Pocos de Caldas, Minas Gerais State	390.
Do.	Alcoa World Alumina Brasil Ltda. (39.96%), South32 Ltd. (36%), Alcoa Alumínio S.A. (14.04%), Rio Tinto (10%)	Sao Luis (Alumar) refinery, Maranhao State	3,500.
Do.	Alumina do Norte do Brasil S.A. (Norsk Hydro ASA, 91%)	Alunorte refinery, Barcarena, Para State	6,400.
Do.	Companhia Brasileira de Alumínio (Votorantim Group, 100%)	Aluminio City refinery, Sao Paulo State	6,400.
Do.	Novelis do Brasil Ltda. (Hindalco Industries Ltd., 100%)	Ouro Preto refinery, Minas Gerais State	145.
Aluminum	Albras Alumínio Brasileiro S.A. (Norsk Hydro ASA, 51%, and Nippon Amazon Aluminio Co. Ltd., 49%)	Barcarena smelter, Para State	460.
Do.	Alcoa Alumínio S.A. (Alcoa Inc., 100%)	Pocos de Caldas smelter, Minas Gerais State	96.
Do.	Alcoa World Alumina Brasil Ltda. (39.96%), South32 Ltd. (36%), Alcoa Alumínio S.A. (14.04%), Rio Tinto (10%)	Sao Luis smelter, Maranhao State	447.
Do.	Companhia Brasileira de Aluminio S.A. (Votorantim Group, 100%)	Aluminio City smelter, Sao Paulo State	440.
Bauxite	Alcoa Alumínio S.A. (Alcoa Inc., 100%)	Pocos de Caldas Mine, Minas Gerais State	1,100.
Do.	Alcoa World Alumina Brasil Ltda. (Alcoa Inc., 60%, and Alumina Ltd., 40%), 100%	Juruti Bauxite Mine, Para State	6,600.
Do.	Companhia Brasileira de Aluminio S.A. (Votorantim Group, 100%)	Itamarati de Minas, Mirai, and Pocos de Caldas Mines, Minas de Gerais State	3,000.
Do.	Mineração Paragominas S.A. (Norsk Hydro ASA, 100%)	Paragominas Mine, Para State	11,400.
Do.	Mineração Rio do Norte S.A. (MRN) (Vale S.A., 40%; BHP Billiton plc, 14.8%; Rio Tinto Alcan Inc., 12%; Companhia Brasileira de Aluminio S.A., 10%; Alcoa Aluminio S.A., 8.58%; Alcoa World Alumina, 5%; Norsk Hydro ASA, 5%; Alcoa World Alumina Brasil Ltda, 4.62%)	Porto Trombetas Mine, Para State	18,100.
Chromite	Companhia de Ferro Ligas da Bahia (FERBASA) (private, 100%)	Pedrinhas Mine, Campo Formosa, Bahia State	120 (concentrate).
Do.	do.	Ipueira Mine, Campo Formosa, Bahia State	48 (concentrate).
Cobalt	Votorantim Metais (Votorantim Group, 100%)	Niquelandia Mine[1], Goias State	2 (ore).
Do.	do.	Niquelandia, Goias State and Sao Miguel Paulista refineries[1], Sao Paulo	NA.
Copper:			
Concentrate	Mineração Caraíba S/A (Ero Copper Corp., 99.5%)	Jaguarari (3 mines), Bahia State	30.
Do.	Vale S.A. (private, 100%)	Sossego Mine, Carajas, Para State	100.
Do.	do.	Salobo Mine, Carajas, Para State	200.
Do.	Lundin Mining Corp. (private, 100%)[4]	Chapada Mine, Goias State	85.
Do.	Avanco Resources Ltd. (private, 100%)	Antas Mine, Carajas, Para State	15.
Refinery	Caraíba Metais S.A. (Paranapanema S.A., 100%)	Camacari electrolytic plant[1], Bahia State	280.
Do.	Mineração Caraíba S/A (Glencore plc, 28.5%)	Jaguarari electrowinning plant[1], Bahia State	5.
Ferroalloys	Vale Manganês S.A. (Vale S.A., 100%)	Barbacena plant, Minas Gerais State	74.
Do.	do.	Ouro Preto plant, Minas Gerais State	65.
Do.	do.	Simoes Filho plant, Bahia, Mato Grosso do Sul	150.
Do.	Minasligas	NA.	60.
Do.	Mineração Taboca SA (Minsur S.A.)	Pitinga Mine, Amazonas State	NA.
Do.	Resind Indústria e Comércio Ltda.	Smelter, Sao Joao Del Rei, Minas Gerais State	NA.
Gold:			
Concentrate kilograms	AngloGold Ashanti Córrego do Sítio Mineração (AngloGold Ashanti Ltd., 100%)	Cuiaba and the Corrego do Sitio complexes (5 mines), Minas Gerais State	14,000.
Do. do.	AngloGold Ashanti Serra Grande (AngloGold Ashanti Ltd., 100%)	Serra Grande Mines near Crixas (4 mines), Goias State	6,000.
Do. do.	Avanco Resources Ltd. (private, 100%)	Antas Mine, Carajas, Para State	300.
Do. do.	Beadell Resources Ltd. (private, 100%)	Tucano Mine, Amapa State	6,200.
Do. do.	Jaguar Mining Inc. (private, 100%)	Caete Mines (2 mines), Minas Gerais State	4,000.
Do. do.	do.	Turmalina Mine, Minas Gerais State	3,000.

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2019

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
METALS—Continued			
Gold:—Continued			
Concentrate— kilograms Continued	Kinross Brasil Mineração S.A. (Kinross Gold Corp., 100%)	Paracatu Mine, Minas Gerais State	16,000.
Do. do.	Lundin Mining Corp. (private, 100%)[4]	Chapada Mine, Goias State	4,000.
Do. do.	Mineração Fazenda Brasileiro (a subsidiary of Leagold Mining)	Fazenda Brasileiro Mine, Goias State	2,000.
Do. do.	Reinarda Mineração Ltda (Troy Resources Ltd.,100%)	Andorinhas Mine, Para State	1,400.
Do. do.	Vale S.A. (private, 100%)	Salobo Mine, Carajas, Para State	8,000.
Do. do.	do.	Sossego Mine, Carajas, Para State	3,000.
Do. do.	Yamana Gold Inc. (private, 100%)	Jacobina Mine, Bahia State	4,500.
Refinery do.	AngloGold Ashanti Córrego do Sítio Mineração (AngloGold Ashanti Ltd., 100%)	Nova Lima refinery, Minas Gerais	NA.
Do. do.	Casa da Moeda do Brasil (Brazil Mint)	Refinery, Rio de Janeiro, Rio de Janeiro	NA.
Do. do.	Marsam Refinadora de Metais	Refinery, Sao Paulo, Sao Paulo State	NA.
Do. do.	Umicore Brasil Ltda.	Refinery, Guarulhos, Sao Paulo State	NA.
Iron ore and steel:			
Iron ore	Anglo American plc. (private, 100%)	Minas-Rio open pit mines, Minas Gerais State	26,500.
Do.	Companhia Siderúrgica Nacional S.A. (private, 100%)	Casa de Pedra Mine, Congonhas, Minas Gerais State	21,000.
Do.	Itaminas Comércio de Minérios S.A. (private, 100%)	Itaminas mining complex, iron ore mine, Sarzedo, Minas Gerais State	5,000.
Do.	Mineração Usiminas S.A. (Usiminas, 70%, and Sumitomo Corp., 30%)	Quadrilatero Ferrifero (4 mines), Serro Azul, Minas Gerais State	12,000.
Do.	MMX Sudeste Mineração Ltda. (private, 100%)	Tico-Tico and Ipe Mines, Serro Azul, Minas Gerais State	6,000.
Do.	do.	Corumba Mine, Mato Grosso do Sul State	1,500.
Do.	Samarco Mineração S.A. (BHP Billiton Ltd., 50%, and Vale S.A., 50%)	Alegria and Germano Mines,[1] Minas Gerais State	26,000.
Do.	Vale S.A. (private, 100%)	Carajas Mine (3 mines), Parauapebas, Para State	130,000.
Do.	do.	Carajas Serra Sul S11D Mine, Para State	90,000.
Do.	do.	Itabira, Mariana, and Minas Centrais (eight mines), Minas Gerais State	120,000.
Do.	do.	Minas Itabiritos, Vargem Grande, and Paraopeba Mines (11 mines), Minas Gerais State	90,000.
Do.	do.	Urucum and Corumba Mines, Mato Grosso do Sul State	6,500.
Do.	Zamin Ferrous Ltd., 100%	Amapa Mine, Amapa State	6,000.
Pellets	Companhia Hispano Brasileira De Pelotização S.A. (Vale S.A., 50.9%, and ArcelorMittal Group, 49.1%)	Hispanobras pellet plant, Espirito Santo State	4,300.
Do.	Samarco Mineração S.A. (BHP Billiton Ltd., 50%, and Vale S.A., 50%)	Ponta Ubu (3 pellet plants),[1] Anchieta, Espirito Santo State	30,500.
Do.	Vale S.A. (private, 100%)	Tubarao VIII pellet plant,[2] Espirito Santo State	36,700.
Do.	do.	Fabrica pellet plant, Minas Gerais State	4,500.
Do.	do.	Sao Luis pellet plant,[1] Maranhao State	7,500.
Do.	do.	Vargem Grande pellet plant, Minas Gerais State	7,000.
Do.	do.	Caue Itabiritos, and Conceicao Itabiritos II pellet plants, Para State	43,000.
Steel, raw	Gerdau Açominas S.A. (Gerdau S.A., 100%)	Gerdau Acominas steel plant, Ouro Branco, Minas Gerais State	7,600.
Do.	Aperam S.A. (private, 100%)	Timoteo specialty steel plant, Minas Gerais State	900.
Do.	ArcelorMittal Tubarão (ArcelorMittal, 100%)	Steel plant at Grande Vitoria, Espirito Santo	7,500.
Do.	Companhia Siderúrgica Nacional (private, 100%)	Volta Redonda steel plant, Rio de Janeiro State	5,600.
Do.	Usinas Siderúrgicas de Minas Gerais, S.A. (private, 100%)	Iron and Steel Mills at Ipatinga, Minas Gerais State, and Cubatao, Sao Paulo State	9,500.
Do.	Siderúrgica Norte Brasil S.A (private, 100%)	Siobras plant, Maraba, Para State	390.

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2019

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
METALS—Continued			
Lead	Votorantim Metais (Votorantim Group, 100%)	Morro Agudo Mine, Paracatu, Minas Gerais State	13.
Lithium	Advanced Metallurgical Group N.V. (AMG), 100%	Mibra Mine, Minas Gerais State	90.
Do.	Brazilian Company of Lithium (CBL) (Codemig Paritipações S.A., 67%, and Government, 33%)	Aracuai Mine, Minas Gerais State	10.
Magnesium	Rima Group	Mine at Minas Gerais State	22.
Manganese	Vale Manganês S.A. (Vale S.A., 100%)	Morro da Mina, Minas Gerais State	100.
Do.	Vale S.A. (private, 100%)	Mina do Azul, Carajas, Para State	1,900.
Do.	Mineração Corumbaense Reunida S.A. (Vale S.A., 100%)	Urucum Mine, Mato Grosso do Sul State	700.
Do.	Brazilian Manganese Corp. (BMC)-Dutch firm Ferrometals BV, 75%, and Canadian firm Cancana Resources/Meridian, 25%	Espigao Manganese Project (Jaburi and Rio Madeira plants), Rondonia State	50.
Nickel	Anglo American Niquel Brasil Ltda. (Anglo American plc, 100%)	Barro Alto refinery, Goias State	36 (metal).
Do.	do.	Barro Alto Mine, Goias State	3,000 (ore).
Do.	do.	Condemin refinery, Goias State	10 (metal).
Do.	Votorantim Metais (Votorantim Group, 100%)	Fortaleza de Minas Mine,[1] Minas Gerais State	19 (nickel matte).
Do.	do.	Niquelandia Mine,[3] Goias State	30 (ore, carbonate).
Do.	do.	Niquelandia refinery,[3] Goias State, and Sao Miguel Paulista refinery,[3] Sao Paulo	25 (electrolytic).
Do.	Vale S.A. (private 100%)	Onca Puma Nickel Mine,[2] Ourilandiado Norte, Para State	27 (iron-nickel alloy).
Niobium (columbium)	Companhia Brasileira de Metalurgia e Mineração (Moreira Salles Group., 70%)	Araxa Mine, Minas Gerais State	150 (ore).
Do.	do.	Araxa beneficiation plant, Minas Gerais State	6,000 (pyrochlore).
Do.	Copebrás S.A. (China Molybdenum Co. Ltd., 100%)	Catalao Mine, Boa Vista, Goias State	9.
Do.	do.	Ouvidor beneficiation plant, Goias State	1,300 (pyrochlore).
Silicon metal	Rima Group	Mine, Minas Gerais State	NA.
Do.	Dow Corning Brazil	NA	NA.
Do.	LIASA (silicon metal company)	NA	NA.
Do.	Minasligas	NA	40.
Silver kilograms	Lundin Mining Corp. (private, 100%)[4]	Chapada Mine, Goias State	8,000.
Tantalum metric tons	Mineração Taboca S.A. (Minsur S.A., 100%)	Pitinga Mine, Amazonas State, and Fundicion de Pinpora, Sao Paulo State	120 (concentrate).
Do. do.	AMG Mineração S.A. (Advanced Metallurgical Group N.V. (AMG), 100%)	Volte Grande (Mibra) Mine, Nazareno, Minas Gerais State	25 (concentrate).
Do. do.	LSM Brazil S.A. [Advanced Metallurgical Group N.V. (AMG)]	Polymetallic plant at Sao Joao Del Rei, Minas Gerais State	NA.
Tin	Estanho de Rondônia S.A. (Companhia Siderúrgica Nacional, 100%)	Santa Barbara Mine and Ariquemes smelter	3,600 (concentrate).
Do.	Mineração Taboca S.A. (Minsur S.A., 100%)	Pitinga Mine, Amazonas State, and Fundicion de Pinpora smelter, Sao Paulo State	6,000 (concentrate).
Do.	Coopersanta (part of Coopermetal)	Smelter at Coopersanta, Bom Futuro, Ariquemes, Rondonia State	NA.
Do.	Cooperativa Metalurgica de Rondonia Ltda. (Coopermetal) and subsidiary Coopersanta	Bom Futuro Mine and smelter at Coopersanta, District of Bom Futuro, Ariquemes Municipality, Rondonia State	2.
Titanium	Indústrias Nucleares do Brasil S/A	Polymetallic plant in San Francisco de Itabapoana, Rio de Janeiro State	NA.
Do.	Millenium Inorganic Chemicals Mineração Ltda. (Cristal Global Group, 100%)	Guaju Mine, Mataraca, Paraiba State	4,200 (ore).
Do.	do.	Mataraca beneficiation plant, Paraiba State	120 (concentrate).
Vanadium metric tons	Largo Resources Ltd. (private, 100%)	Maracas Menchen Mine, Bahia State	9,634.
Zinc	Votorantim Metais Zinco S/A (Grupo Votorantim, 100%)	Vazante Mine, Minas Gerais State	165.
Do.	do.	Morro Agudo Mine, Paracatu, Minas Gerais State	38.
Do.	do.	Tres Marias plant, Minas Gerais State	190 (metal).
Do.	do.	Juiz de Fora plant, Minas Gerais State	95 (metal).

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2019

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
METALS—Continued			
Zirconium, concentrates	Indústrias Nucleares do Brasil S/A	San Francisco de Itabapoana, Rio de Janeiro State	NA.
Do.	Millenium Inorganic Chemicals Mineração Ltda. (Cristal Global Group, 100%)	Mataraca Mine, Paraiba State	NA.
Do.	do.	Mataraca beneficiation plant, Paraiba State	NA.
INDUSTRIAL MINERALS			
Asbestos	Sociedade Anônima Mineração de Amianto S.A. (SAMA) (Eternit Group, 100%)	Cana Brava Mine and plant, Minacu, Goias State	300 (concentrate).
Cement	Companhia de Cimento Itambé (private, 100%)	Itambe plant, Balsa Nova, Parana State	2,800.
Do.	Cimento Nacional (Brennand Group, 100%)	Sete Lagoas plant, Minas Gerais State	1,000.
Do.	do.	Plant in Paraiba State	1,500.
Do.	Cimento Nassau (John Santos Group, 100%)	10 plants, States of Amazonas, Ceara, Espirito Santo, Maranhao, Para, Pernambuco, Piaui, Rio Grande do Norte, and Sergipe	8,400.
Do.	Cimento Planalto S.A. (private, 100%)	Sobradinho plant, Brasilia, Distrito Federal	1,600.
Do.	Cimento Tupi S.A. (private, 100%)	Carandai plant, Minas Gerais State; Mogi das Cruzes, Sao Paulo State; and Volta Redonda plant, Rio de Janeiro State	3,500.
Do.	LafargeHolcim (Brasil) S.A. (LafargeHolcim Ltd., 100%)	Barroso, Cantagalo, Leopoldo, Sorocaba and Vitoria plants, Sao Paulo State	5,400.
Do.	InterCement Brasil S.A. (Camargo Correa S.A., 100%)	16 plants, States of Alagoas, Bahia, Goias, Minas Gerais, Mato Grosso do Sul, Paraiba, Pernambuco, Sao Paulo, and Rio Grande do Sul	17,900.
Do.	CRH plc. (Irish Cement)	3 integrated cement plants, Minas Gerais State	2,300.
Do.	João Santos Group	Itapissuma cement plant, Piaui, northeastern Brazil	NA.
Do.	LafargeHolcim (Brasil) S.A. (LafargeHolcim Ltd., 99.76%)	5 plants, States of Bahia, Goias, Minas Gerais, Paraiba, Rio de Janeiro, and Sao Paulo	11,300.
Do.	Mizu Cimentos Especiais (private, 100%)	States of Rio de Janeiro, Rio Grande do Norte, Espirito Santo, Sao Paulo, and Sergipe (6 plants)	3,000.
Do.	Votorantim Cimentos S.A. (Grupo Votorantim, 100%)	Multiple plants, including the following: Barcarena and Primavera plants, Para State Cubatao, Ribeirao Grande, Salto de Pirapora, and Santa Helena plants Sao Paulo State Cantagalo, Sepetiba, Volta Redonda plants, Rio de Janeiro State Campo Grande and Corumba plants, Mato Grosso do Sul State Candiota,Charqueadas, Esteio, and Pinheiro Machado plants, Rio Grande do Sul State Capivari de Baixo, Imbituba, and Itajai plants, Santa Catarina State Caucaia and Sobral plants, Ceara State Cuiaba and Nobres plants, Mato Grosso State Edealina plant, Goias State Itau de Minas plant, Minas Gerais State Laranjeiras plant, Sergipe State Mineradora Ponta da Serra, Ouricuri, and Paulista plants, Pernambuco State Porto Velho plant, Rondonia State Rio Branco do Sul plant, Parana State Sobradinho plant, Distrito Federal Xambioa, Tocantins State	34,866.
Clay, kaolin	Imerys Rio Capim Caulim S.A. (Imerys Group, 100%)	Processing plant in Barcarena and 2 mines in Ipixuna, Para State	2,000.
Do.	do.	Barcarena beneficiation plant, Para State	NA.
Do.	CADAM S.A. (KaMin LLC, 100%)	Morro do Filipe Mine in Amapa and a beneficiation port and plant in the town of Munguba	500.

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2019

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
INDUSTRIAL MINERALS—Continued			
Diamond carats	Lipari Mineração Ltda. (private, 100%)	Brauna open pit mine, Bahia State	340,000.
Feldspar	AMG Mineração S.A. [Advanced Metallurgical Group N.V. (AMG), 100%]	Volta Grande (Mibra) Mine, Nazareno, Minas Gerais State	180 (ore).
Fluorspar	Mineração Nossa Senhora do Carmo Ltda. (private, 100%)	Cerro Azul (2 mines), Parana State	180 (ore).
Graphite	Extrativa Metalquimica S/A (private, 100%)	Maiquinique Mine, Bahia State	2 (concentrate).
Do.	JMN Mineração S/A (private, 100%)	Plant at Mateus Leme, Minas Gerais State	2 (concentrate).
Do.	Nacional de Grafite Ltda. (private, 100%)	Itapecerica, Pedra Azul, Salto da Divisa (3 mines and 3 beneficiation plants), Minas Gerais State	90 (concentrate).
Gypsum	Companhia Brasileira de Equipamento (private, 100%)	Codo Mine, Maranhao State, and Ipubi Mine, Pernambuco State	600 (ore).
Do.	Mineradora São Jorge S.A (private, 100%)	Mines in the municipalities of Ipubi, Ouricuri, and Trindade, Araripe Region, Pernambuco State	800.
Do.	Votorantim Cimentos (Votorantim Group, 100%)	Mateo Mine, Ceara State	NA.
Magnesite	Indústrias Brasileiras de Artigos Refractories (Ibar) Nordeste S.A. (private, 100%)	Refractory plant at Brumado, Bahia State	NA.
Do.	Magnesita Refratários S.A. (private, 100%)	Refractory plant at Contagem, Minas Gerais	1,200 (ore).
Do.	Xilolite S.A. (private, 100%)	Refractory plant at Brumado, Bahia State	NA.
Phosphate rock, gross weight	Copebrás S.A. (China Molybdenum Co. Ltd., 100%)	Ouvidor Mine, Goias State	1,350 (concentrate).
Do.	Mosaic Co.	Vale Fertilizantes, 5 mines: Araxa, Patos de Minas, and the Tapira open pit mines, located in the State of Minas Gerais; Cajati open pit mine in State of Sao Paulo; and Catalao open pit mine in the State of Goias	4,800.
Do.	Galvani (Yara, 60%)	Multiple mines in Minas Gerais State	500.
Potash	Mosaic Fertilizantes Co.	Various mines and production facilities	500.
Quartz	Rima Group	Mine in Bocaiuva, Minas Gerais State	250.
Sand	Mineração Jundu	Various mines and production facilities	NA.
Vermiculite	Brasil Minérios Ltda. (private, 100%)	Processing plant in Sao Luis dos Montes Belos, Goias State	60 (concentrate).
MINERAL FUELS AND RELATED MATERIALS			
Coal	Carbonifera Belluno Ltda. (private, 100%)	Cantao Norte and Lauro Muller Mines, Santa Catarina State	550.
Do.	Carbonifera Catarinense S.A. (private, 100%)	Bonito and 3G Plano Mines, Santa Catarina State	700.
Do.	Carbonifera Circiuma S.A. (private, 100%)	Verdinho Mine, Forquilhinha, Santa Catarina State	2,800.
Do.	Companhia Carbonífera Metropolitana S.A. (private, 100%)	Esperanca and Fontanella Mines, Santa Catarina State	1,200.
Do.	Copelmi Mineração Ltda. (private, 100%)	4 mines, Butia, Cachoeira do Sul, and Charqueadas, Rio Grande do Sul State	3,000.
Do.	Companhia Riograndense de Mineração (Government, 100%)	Candiota Mine and Leao Mine, Rio Grande do Sul State	5,000.
Do.	Indústria Carbonífera Rio Deserto Ltda. (private, 100%)	Circiuma Mine and Urussanga Mine, Santa Catarina State	2,600.
Natural gas million cubic meters	Petróleo Brasileiro S.A. (Petrobrás) (Government, 81.4%; private, 11.8%; public, 6.8%)	Offshore and onshore fields in the States of Alagoas, Amazonas, Bahia, Ceara, Espirito Santo, Rio de Janeiro, Rio Grande do Norte, Sao Paulo, and Sergipe	41,000.

See footnotes at end of table.

TABLE 2—Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2019

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity[e]
MINERAL FUELS AND RELATED MATERIALS—Continued				
Petroleum	thousand 42-gallon barrels	Petróleo Brasileiro S.A. (Petrobrás) (Government, 81.4%; private, 11.8%; public, 6.8%)	Offshore and onshore fields in the States of Alagoas, Amazonas, Bahia, Ceara, Espirito Santo, Parana, Rio de Janeiro, Rio Grande do Norte, Sao Paulo, and Sergipe	960,000.
Petroleum products	do.	do.	16 refineries in the States of Amazonas, Bahia, Ceara, Minas Gerais, Parana, Rio de Janeiro, Rio Grande do Sul, and Sao Paulo	834,025.
Uranium		Nuclear Industries of Brazil	Caetite Uranium Mine, Caetite, Bahia region	400

[e]Estimated. Do., do. Ditto. NA Not available.
[1]On care-and-maintenance status.
[2]Mining operations have been suspended since September 2017.
[3]On care-and-maintenance status since April 2016
[4]Lundin Mining Corp. acquired the Chapada Mine from Yamana Gold Inc. in the third quarter of 2019.

TABLE 3
BRAZIL: RESERVES OF MAJOR MINERAL COMMODITIES IN 2019

(Thousand metric tons unless otherwise specified)

Commodity[1]		Reserves
Asbestos, fiber		11,416
Bauxite		2,685,000
Chromite, Cr_2O_3		507,000
Clay, kaolin		7,170,000
Coal, all types		32,264 [2]
Cobalt, Co content	metric tons	70,000
Copper, Cu content		11,212
Feldspar		145,000
Fluorspar (CaF_2 content)		1,449
Gold, Au content	metric tons	2,400
Graphite		70,000
Gypsum		450,000
Iron ore		33,731,000
Lead, Pb content	metric tons	595,000
Lithium, Li content	do.	54,000
Magnesite		200,000
Manganese, Mn content		16,400
Manganese		272,567
Natural gas	million cubic meters	363,995 [3]
Nickel, Ni content		15,991
Niobium, Nb content		16,166
Petroleum, crude	million 42-gallon barrels	12,715 [3]
Phosphate rock, P_2O_5 content		300,000
Rare earths, rare-earth-element (REE) content		21,000
Talc and pyrophyllite		45,153
Tantalum, Ta content	metric tons	39,648
Tin, Sn content		416,321
Titanium minerals, TiO_2		6,145
Uranium, U_3O_8	metric tons	309,370 [2]
Vanadium, V content	do.	94,000
Vermiculite		6,600
Zinc, Zn content		2,464
Zirconium, mineral concentrates		2,319

do. Ditto.

[1]Source: Agência Nacional de Mineração, Sumário Mineral 2018.

[2]Source: Empresa de Pesquisa Energética—Balanço Enegético Nacional 2017.

[3]Source: National Agency of Petroleum Natural Gas and Biofuels, Statistical Mineral Yearbook 2020.