



2019 Minerals Yearbook

SOUTH AFRICA [ADVANCE RELEASE]

THE MINERAL INDUSTRY OF SOUTH AFRICA

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The Republic of South Africa remained one of the world's leading mining and mineral-processing countries. In 2019, South Africa's estimated share of world mined ruthenium production by volume amounted to 92%; mined rhodium, 84%; mined iridium, 83%; mined platinum, 72%; refined rhodium, an estimated 61%; refined platinum, an estimated 59%; vermiculite, 41%; chromium, 37%; mined palladium, 36%; manganese, 30%; ferrochromium, refined palladium, and zircon, 26% each; industrial garnet, 16%; ilmenite, 14%; rutile, 13%; vanadium, 9%; refined gold, 7%; diamond, 5%; coal and ferromanganese, 4% each; mined gold, 3%; fluorspar and iron ore, 3% each; mined nickel, 2%; and aluminum, mined cobalt, ferrosilicon and silicon metal, mined lead, stainless steel, silicomanganese, sulfur and zinc, 1% each. South Africa's share of world diamond production by value was 6% in 2019. South Africa also played a globally significant role in the production of kyanite and related materials (CPM Group., 2019, p. 6–7, 106–107, 172–173; Rand Refinery Ltd., 2019, p. 4; BP p.l.c., 2020, p. 46; Kimberley Process Rough Diamond Statistics, 2020; Merafe Resources Ltd., 2020, p. 11–12; South32 Ltd., 2020; World Gold Council, 2020; Apodaca, 2021; Bray, 2021; Gambogi, 2021; Hatfield, 2021a, b; Klochko, 2021; McRae, 2021a, b; Olson, 2021a–c; Polyak, 2021; Sangine, 2021; Schnebele, 2021a–c; Schulte, 2021a–c; Sheaffer, 2021; Shedd, 2021; Tolcin, 2021; Tuck, 2021; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

In 2019, South Africa's estimated share of the world's coal consumption was 2.4%, and petroleum products, 0.6%. The country also accounted for 85% and 14% of African coal and refined petroleum products consumption, respectively, in 2019 (BP p.l.c., 2020, p. 20, 47).

Minerals in the National Economy

The mineral industry accounted for 8.3% of South's Africa gross domestic product (GDP) in 2019 compared with 8.1% in 2018 and 8.8% in 2009; the share of the mineral industry in the provincial GDP varied widely by province. The mineral industry's share in North West Province's GDP was 34.1%; Northern Cape Province, 24.1%; Mpumalanga Province, 19.5%; Free State Province, 8.7%; Gauteng Province, 1.8%; and Eastern Cape Province, 0.2% (Minerals Council South Africa, 2020, p. 10, 15).

Employment in the mineral industry was 460,015 workers in 2019 compared with 456,438 in 2018 and 491,794 in 2009. In 2019, platinum-group metals (PGM) mining accounted for 36.5% of the mineral industry's employment; coal, 20.5%; gold, 20.2%; chromite, 4.5%; iron ore, 4.3%; diamond, 3.3%; manganese, 2.4%; and other minerals, 8.3%. In 2009, PGM mining accounted for 37.4% of the mineral industry's employment; gold, 32.5%; coal, 14.4%; iron ore, 2.8%; diamond, 2.4%; chromite, 2.2%; manganese, 1%; and other minerals, 7.3%. Coal and iron ore employment increased

substantially between 2009 and 2019. Coal mining operations appear to have become substantially more labor intensive, whereas labor intensity changed much less in iron ore mining operations (Minerals Council South Africa, 2020, p. 16).

Mineral exploration spending in South Africa was \$98 million in 2018 compared with \$206 million in 2009. South Africa's share of world mineral exploration decreased to 1% in 2018 from 2.6% in 2009 (Mokwena and others, 2019, p. 12).

Government Policies and Programs

Mining of minerals and mineral fuels was governed by the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA), which became effective in May 2004. Section 100(2)(a) of the MPRDA allowed for the establishment of a Mining Charter. The Mining Charter was published in 2004 and modified by the Amended Mining Charter of 2010.

Under the Amended Mining Charter of 2010, the Government's Black Economic Empowerment (BEE) program required that black ownership of mining companies reach 26%. Companies were allowed to use the value of their domestic beneficiation activities as credit for up to 11% of their black ownership requirements. Companies were required to purchase 70% of their services, 50% of their consumable goods, and 40% of their capital goods from BEE entities. Companies were also required to report progress annually on the development of near-mine communities, the sustainability of growth and development, and mineral beneficiation (Creamer, 2010).

In June 2017, the Government introduced a new Mining Charter that made several changes to BEE requirements. The black ownership requirement was increased to 30% from 26%. Of the 30% black ownership in mining companies, at least 20% was required to be held by BEE entrepreneurs and at least 5% each by employee share ownership plans and mine communities to be invested in a community trust. The beneficiation credit was reduced to 5%. Mining rights held by companies with 26% black ownership at the time of the passage of the Charter would be recognized as in compliance (Beech and Livingston, 2017; Liedtke, 2018).

The requirement to purchase services from South African companies established by the Amended Mining Charter of 2010 was increased to 80% under the new Mining Charter. The requirement to purchase goods from South African companies was increased to 70%. The Mining Charter was officially introduced in Parliament in late 2018 and went into effect at the start of March 2019 (Beech and Livingston, 2017; Liedtke, 2018; Bulbulia, 2019b).

In the Witwatersrand basin, acid mine drainage from gold mining operations threatened to contaminate water supplies in Gauteng Province with increased levels of toxic heavy metals and radioactive particles. The acid mine drainage was the result of leaching from tailings piles and from abandoned deep underground mines that filled with water that became acidic.

The oxidation of pyrite led to acid mine drainage. South Africa had about 270 tailings piles in the Witwatersrand basin that contained about 6 billion metric tons of pyrite; acid mine drainage also occurred at abandoned coal mines. The tailings piles also contained an estimated 600,000 metric tons (t) of uranium. In 2019, the Government was engaged in an acid mine drainage remediation program that had an estimated cost of \$520 million (Solomons, 2017; Gilliland, 2019).

The Government also was engaged in remediation of abandoned asbestos mines in 2019; the total cost of remediation was estimated to be about \$120 million. The total cost of remediation of other abandoned mines was estimated to be nearly \$2.8 billion (Gilliland, 2019).

The mining industry was regulated by the Department of Mineral Resources. Exploration and production of natural gas and petroleum were regulated by Petroleum Agency South Africa. Environmental regulations were enforced by the Department of Environmental Affairs. The Department of Mineral Resources issued environmental permits for mining operations; decisions regarding permits could be appealed to the Department of Environmental Affairs.

Production

In 2019, plastic clay production increased by 502%; zinc, by 345%; sulfur, by an estimated 285%; fire clay, by 43%; pyrophyllite, by 37%; natural gas liquids, by 25%; flint clay and mined lead, by 22% each; silver, by 20%; kaolin, by 17%; anthracite, by 15%; manganese ore, by 14%; mined copper and vermiculite, by 12% each; and magnesite and refined PGMs other than palladium, platinum, and rhodium, by an estimated 10% each. In 2019, talc production decreased by 75%; mica, by 72%; bentonite, by 39%; fuller's earth and industrial garnet, by 36% each; silicon metal, by an estimated 35%; uranium, by 30%; hot-rolled steel, by an estimated 29%; diamond, by 28%; phosphate fertilizers, by 25%; direct-reduced iron, by 21%; fluorspar, by an estimated 19%; pig iron, by 18%; brick clay and phosphoric acid, by 16% each; stainless steel, by 15%; gypsum and sand for construction, by 14% each; nickel chemicals, by an estimated 13%; refined gold and phosphate rock, by 11% each; and mined gold, by 10% (table 1; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

In 2019, manganese and zinc production increased because of the opening of new mines. The decrease in construction sand and brick clay production could be attributable to reduced investments in infrastructure. Industrial garnet output decreased because of lower ore grades. Decreased hot-rolled steel production was attributable to lower demand. Silicon metal production decreased in 2019 because of plant closures. The decrease in uranium production could be attributable to lower production from gold mines that produced uranium as a coproduct. Data on mineral production are in table 1.

Structure of the Mineral Industry

Most of the South African mineral industry was privately owned; Government-owned Petroleum Oil and Gas Corporation of South Africa operated a gas-to-liquids plant

and produced natural gas. The production of diamond and gold, which were produced mostly by artisanal miners in some African countries, was dominated by large-scale producers in South Africa. The leading producer's share of total output varied widely by commodity. Ammonia, primary refined aluminum, industrial garnet, mined lead, magnesite, manganese metal, stainless steel, vermiculite, and wollastonite were produced by only one domestic company each. The leading producer of raw steel accounted for about 72% of national production in 2019; iron ore, 59%; diamond, 49%; mined nickel, 43%; mined gold, 36%; mined manganese, 22%; and coal, 18%.

South Africa also had many producers of aggregates, clay and shale, and sand for construction; capacity, location, ownership, and production information was not readily available for most of these operations. Table 2 is a list of major mineral industry facilities.

Reserves and Resources

South Africa's estimated share of world reserves of PGMs was 91%; manganese, 40%; chromite, 35%; vanadium, 16%; fluorspar, 13%; zirconium, 10%; and gold and ilmenite, 5% each. The country also had substantial reserves of andalusite, antimony, coal, iron ore, nickel, phosphate rock, uranium, and vermiculite (table 3; Gambogi, 2021; Hatfield, 2021b; McRae, 2021a; Sangine, 2021; Schnebele, 2021a; Schulte, 2021a, b; Sheaffer, 2021; Polyak, 2021).

Mineral Trade

Crude mineral products (which included refined metals other than aluminum and silicon) accounted for about 28% of the value of South Africa's total exports in 2019, which was \$90.1 billion. About 65% of crude mineral products, by value, were exported in 2019. South Africa's exports of iron ore were valued at \$4.5 billion in 2019; coal, \$3.8 billion; platinum, \$3.3 billion; palladium, \$3.1 billion; manganese ore, \$3 billion; gold, \$2 billion; and rhodium, \$1.8 billion. Other mineral exports included chromite, which had a value of \$724 million in 2019; antimony, ilmenite, rutile, and zircon, a total of \$699 million; diamond, \$531 million; nickel, \$424 million; iridium, \$262 million; industrial minerals, a total of \$248 million; zinc, \$244 million; and ruthenium, \$151 million. In 2018 (the latest year for which data were available), crude mineral products accounted for 27% of the value of total exports, which was \$94.6 billion (Minerals Council South Africa, 2020, p. 12–13; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

In 2018, processed mineral products accounted for an additional 6% of total exports. About 82% of processed mineral products, by value, were exported in 2018. Exports of ferrochromium were valued at \$2.5 billion; vanadium alloys and other vanadium products, \$514 million; manganese alloys, \$302 million; and aluminum, antimony trioxide, phosphoric acid, silicon metal and alloys, and titanium slag, a total of \$1.9 billion (Galane, 2019; Minerals Council South Africa, 2020, p. 12–13).

The percentage of export sales of mineral commodities produced in South Africa varied widely by commodity.

In 2019, exports of manganese, by volume, amounted to 94% of total sales; iron ore, 89%; diamond, 87%; granite, 56%; chromite, 34%; coal, 27%; and lime, 2%. All sales of aggregates, clays and shale other than flint clay, feldspar, gypsum, natural gas, salt, sand for construction, sodium sulfate, and talc were domestic. In the second quarter of 2019, phosphate rock exports accounted for 34% of total sales. Fluorspar exports accounted for 96% of total sales in 2018 (the latest year for which data were available), and vermiculite, 87% (Modiselle, 2019a; Muravha, 2019b, c; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

In 2018, South Africa's total imports were valued at \$93.6 billion. Imports of crude petroleum were valued at \$11 billion, distillate fuel oil, \$3 billion; crude industrial minerals, \$240 million; and potash and potassium fertilizers, \$156 million (Motsie, 2019; Rammonedi, 2019; South Africa Market Insights, 2019).

South Africa depended entirely on imports to meet its requirements for bauxite, borates, crude petroleum, marble dimension stone, potash, and potassium fertilizers in 2018. The country's import dependence by volume for mica was about 98% in 2018; talc, 76%; gypsum, 50%; salt, 49%; bentonite, 45%; kaolin, 38%; slate dimension stone, 13%; and fire clay, less than 1%. In 2009, the country's import dependence on bentonite had been 23%, and on gypsum and salt, less than 1% each (Motsie, 2010a, 2019; Rammonedi, 2019).

Commodity Review

Metals

Aluminum.—South Africa produced primary aluminum from alumina imported from Australia. South32 Ltd. of Australia operated the Hillside primary aluminum smelter at Richards Bay; production at Hillside remained nearly unchanged at 717,000 t in 2019. South32 planned to produce at the rate of more than 720,000 metric tons per year (t/yr) in the first half of 2020. Aluminum exports were about 474,000 t in 2018 and domestic sales, 212,000 t. Construction accounted for about 24% of domestic sales; transportation, 20%; packaging, 18%; and machinery and equipment, 17% (South32 Ltd., 2019, 2020; Tshetlhanyane, 2019).

Chromium.—Most South African chromite production was metallurgical-grade. In 2019, chromite production was about 17.66 million metric tons (Mt) compared with a revised 17.85 Mt in 2018 and 10.87 Mt in 2010. Increased production since 2010 was partially attributable to PGM mining companies producing chromite as a co-product. In 2019, ferrochromium production was estimated to be about 3.6 Mt, which was nearly unchanged from 2010. Ferrochromium production was constrained by power supply problems (Galane, 2018; Creamer, 2019b; Merafe Resources Ltd., 2020, p. 11–12, 15; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Samancor Chrome (Pty) Ltd. (International Mineral Resources BV of the Netherlands, 70%) operated the Eastern Chrome Mines in Limpopo Province and the Western Chrome Mines

in North West Province. Based on Samancor Chrome's ferrochromium production levels, the company was producing chromite at the rate of about 4.3 million metric tons per year (Mt/yr) in April 2019 for its plants. An additional 500,000 t/yr was produced for export (EESTech Inc., 2019; Khaile, 2019a; Samancor Chrome (Pty) Ltd., undated).

At the start of 2019, Samancor Chrome operated five ferrochromium plants that had a total capacity (combined) of about 2 Mt/yr. In April, the company was producing at the rate of more than 1.7 Mt/yr of ferrochromium. Samancor Chrome signed an agreement with EESTech Inc. of Delaware (United States) in which EESTech would process Samancor Chrome's ferrochromium slag to recover additional ferrochromium. In early December, Samancor Chrome announced plans to reduce its production of chromite and ferrochromium. Production of ferrochromium also was reportedly reduced by severe power shortages in December (Creamer, 2016a; EESTech Inc., 2019; Tex Report, The, 2019b, h).

Hernic Ferrochrome (Pty) Ltd. (a subsidiary of Mitsubishi Corp. of Japan) operated the Bokone and the Morula Mines, which had a capacity of 1.5 Mt/yr, and a ferrochromium plant with a capacity of 420,000 t/yr. The company filed for bankruptcy in April 2017 because of the high cost of its mining operations. Hernic continued production while in bankruptcy until the end of August 2019, when its power supply was cut off for nonpayment. In November, Samancor Chrome purchased Hernic's plant (table 2; Creamer, 2016a; Tex Report, The, 2019d).

Glencore plc of Switzerland and its joint-venture partner Merafe Resources Ltd. operated the Boshhoek, the Helena, the Kroondal, the Magareng, the Thorncliffe, and the Waterval Mines. Glencore and Merafe produced about 3.62 Mt of chromite in 2019 compared with 3.99 Mt in 2017 (Merafe Resources Ltd., 2020, p. 5, 21).

Glencore and Merafe operated the Boshhoek, the Lion, the Lydernburg, the Rustenburg, and the Wonderkop ferrochromium plants, which had a total capacity of 2.34 Mt/yr. The companies produced 1.81 Mt in 2019 compared with 1.99 Mt in 2018. Production decreased because of several factors, including power outages and safety stoppages. Glencore planned to produce between 1.65 Mt and 1.72 Mt of ferrochromium in 2020 and between 1.79 Mt and 1.86 Mt each in 2021 and 2022 (Tex Report, 2019c; Glencore plc, 2020, p. 15, 17; Merafe Resources Ltd., 2020, p. 21).

Sibanye-Stillwater Ltd. operated the Marikana and the Rustenburg PGM mines and produced chromite as a coproduct. The company purchased Lonmin plc of the United Kingdom, which previously operated Marikana, in June 2019. In the second half of 2019, Sibanye-Stillwater was producing chromite from the Upper Group 2 (UG2) layer of ore in the Bushveld Complex at Marikana and Rustenburg at the rate of 2.45 Mt/yr. In 2018, Lonmin's sales of chromite from Marikana were at the rate of 1.7 Mt/yr and Sibanye-Stillwater produced at the rate of more than 820,000 t/yr from its Waterval plant at Rustenburg (Lonmin plc, 2018, p. 183; 2019; Sibanye-Stillwater Ltd., 2020b).

Assore Ltd. operated the Dwarsrivier Mine in Mpumalanga Province. In the second half of 2019, the company was producing chromite at the rate of about 1.54 Mt/yr, which was nearly unchanged from that of the same period in 2018 (Tex Report, The, 2020c).

In fiscal year 2019 (which started on October 1, 2018, and ended on September 30, 2019), Tharisa Minerals (Pty) Ltd. of Cyprus produced about 1.29 Mt of chromite at the Tharisa Mine compared with 1.45 Mt in fiscal year 2018. The decreased production was attributable to lower ore grades. Tharisa Minerals planned to produce between 1.45 Mt and 1.55 Mt in fiscal year 2020. The company also planned to increase production to 2 Mt/yr by the end of 2020. The remaining life of the open pit was estimated to be 14 years, which could be followed by an underground mine with a life of 40 years (Tharisa Minerals (Pty) Ltd., 2019, p. 2, 37).

Anglo American Platinum Ltd. (Amplats) operated a plant at the Amandelbult Mine that produced chromite from UG2 ore. In 2019, Amplats produced 908,700 t of chromite compared with 831,000 t in 2018 and 654,400 t in 2017; the increased production was attributable to a new plant that recovered chromite from ore in the Merensky layer. The company also approved the development of a new chromite recovery plant at the Modikwa Mine with a capacity of 288,000 t/yr. Amplats planned to start production at the new plant by the first quarter of 2021 (Anglo American Platinum Ltd., 2020, p. 7, 54, 103).

In 2019, Northam Platinum Ltd. produced 865,882 t of chromite from UG2 ore at its Booysendal, Eland, and Zondereinde Mines compared with 707,297 t in 2018. Production at the Booysendal Mine increased to 450,417 t in 2019 from 357,207 t in 2018 as PGM mining operations expanded. The Eland Mine reopened in 2019 and produced 51,150 t by yearend. Northam's output was expected to increase to 1 Mt/yr as its PGM operations expanded (Creamer, 2016b; Northam Platinum Ltd., 2019, p. 13, 23; 2020, p. 22, 33, 37).

African Rainbow Minerals Ltd. (ARM) and its joint-venture partner MMC Norilsk Nickel (Nornickel) of Russia operated the Nkomati Mine. Chromite sales from Nkomati increased to 424,000 t in 2019 from 290,000 t in 2018. Chromite sales from the Two Rivers Platinum Mine, which was a joint venture between ARM and Impala Platinum Holdings Ltd. (Implats), decreased to 211,868 t in 2019 from 218,540 t in 2018. The Nkomati Mine was expected to close by the end of September 2020; ARM planned to continue sales of more than 200,000 t/yr of chromite from Two Rivers Platinum through at least mid-2022 (African Rainbow Minerals Ltd., 2019a, p. 57, 60–61, 63; 2019b, p. 55, 58; 2020, p. 11, 13).

Eastern Platinum Ltd. (Eastplats) of Canada recovered chromite from UG2 tailings at the Crocodile River Mine. In 2019, Eastplats produced 598,034 t of chromite at Crocodile River, which is located in the North West Province (Eastern Platinum Ltd., 2020).

ASA Metals (Pty) Ltd. [Eastern Asia Metals Development of China, 60%, and Limpopo Economic Development Enterprise (LEDA), 40%] operated the Dilokong chromite mine near Burgersfort until March 2016 when the company entered bankruptcy proceedings because of its high-cost mining operation. Cheetah Chrome South Africa (Pty) Ltd. purchased the Dilokong Mine in 2017. At the end of 2019, Cheetah was engaged in a legal dispute with LEDA regarding ownership of the mine, which remained on care-and-maintenance status (Creamer, 2016a; Ritchie, 2020).

Richards Bay Alloys (Pty) Ltd. shut down its ferrochromium plant at the end of 2017; the plant remained closed at the end of 2019 after being purchased by the Traxys Group. The closure of the plant could be attributable to a lack of an integrated supply of chromite (Creamer, 2016a, 2020).

Cobalt.—ARM and Nornickel produced 737 t of mined cobalt at the Nkomati Mine in 2019 compared with 746 t in 2018. Refined cobalt production at Implats's Base Metals Refinery was 900 t in the company's 2019 fiscal year (which started on July 1, 2018, and ended June 30, 2019) (African Rainbow Minerals Ltd., 2019a, p. 63; 2019b, p. 58; 2020, p. 13; Impala Platinum Holdings Ltd., 2019b, p. 55).

Copper, Lead, and Zinc.—In 2019, mined copper production increased to 52,501 t from a revised 46,900 t; mined lead, to 42,936 t from a revised 35,118 t; and mined zinc, to 125,157 t from 28,129 t in 2018. The Black Mountain Mine, which was operated by Vedanta Resources Ltd. of the United Kingdom, produced copper, lead, silver, and zinc. Vedanta also started the first phase of mining at the Gamsberg open pit mine in Northern Cape Province in late 2018. The company planned to produce at Gamsberg's full capacity of 250,000 t/yr of zinc in concentrate by late 2019. As of yearend, the mine had not reached full capacity (Kotze, 2018b; Piper, 2019; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Vedanta planned to increase production at Gamsberg to 450,000 t/yr of zinc in concentrate in its second phase of mining. The development of the second phase could start as soon as full capacity was reached in the first phase. Vedanta also was considering a third phase of mining that would increase production to 650,000 t/yr; the third phase would require the opening of an underground mine. The company was engaged in a feasibility study on a new smelter and refinery at Gamsberg that would produce 250,000 t/yr of zinc metal. The development of the smelter and refinery depended on the availability of an additional 200 megawatts (MW) of power (Kotze, 2018b; Piper, 2019; Ryan, 2019).

In June 2019, Orion Minerals Ltd. of Australia completed a feasibility study on restarting mining at the Prieska project in Northern Cape Province. Production shut down at Prieska in 1991. Orion planned to produce between 70,000 and 80,000 t/yr of zinc in concentrate and between 20,000 and 24,000 t/yr of copper in concentrate during the estimated 10-year life of the mine. The estimated capital cost of the project was \$378 million. Depending on financing, construction could start in 2020 (Andrews, 2019a; Piper, 2019).

Gold.—The long-term decline in South Africa's mined gold output continued in 2019, with production decreasing to 105,185 kilograms (kg) from a revised 117,144 kg in 2018 and about 198,000 kg in 2009. Decreased output was primarily attributable to mines operating at depths of as great as 4 kilometers, which led to difficult geologic conditions, high ore haulage and refrigeration costs, and low labor productivity. The Rand refinery's production of refined gold decreased to about 330,000 kg in its fiscal year 2019 (which started on October 1, 2018, and ended on September 30, 2019) from 389,596 kg in fiscal year 2009 (Rand Refinery (Pty) Ltd., 2011,

p. 43; 2019, p. 4; du Venage, 2013; Galane, 2018; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

In every year between 2013 and 2019, input cost inflation in the gold mining subsector exceeded the average of the mining sector. Power costs accounted for 24% of the intermediate input costs for the gold mining subsector compared with 11% for the mining sector (Minerals Council South Africa, 2020, p. 7, 34).

Harmony Gold Mining Company Ltd. (which was the leading producer of mined gold in South Africa) produced a total of 37,382 kg of gold from its South African operations in 2019 compared with 38,778 kg in 2018. The Tshepong Mine produced 8,224 kg in 2019; the Moab Khotsong Mine, 7,732 kg; the Kusasaletu Mine, 4,223 kg; the Doornkop Mine, 3,139 kg; Kalgold, Phoenix, and other surface operations, 2,767 kg; the Bambanani Mine, 2,535 kg; the Masimong Mine, 2,365 kg; the Target 1 Mine, 2,321 kg; the Joel Mine, 1,680 kg; the Kalgold Mine, 1,263 kg; and the Unisel Mine, 1,133 kg. Production at Joel increased by more than 14% in 2019; at Masimong, by 4%; and at Unisel, by nearly 2%. In 2019, production at the Target 1 Mine decreased by 16%; at Doornkop, by nearly 12%; at Kusasaletu and Unisel, by 8% each; at Bambanani, by 6%; and at Tshepong, by nearly 4% (Harmony Gold Mining Company Ltd., 2019a, p. 8; 2019b, p. 9, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34; 2020, p. 8).

For fiscal year 2020 (which started on July 1, 2019), Harmony's planned production at Tshepong was about 9,000 kg; Moab Khotsong, between 7,600 and 7,700 kg; Kusasaletu, between 5,200 and 5,300 kg; Doornkop, 3,500 kg; Kalgold, Phoenix, and other surface operations, 2,700 kg; Target 1, 2,600 kg; Bambanani, about 2,400 kg; Masimong, between 2,100 and 2,200 kg; Joel, about 1,900 kg; Kalgold, 1,300 kg; and Unisel, 1,000 kg. The remaining life of Tshepong was 19 years; Doornkop, 17 years; the surface operations, at least 14 years; Kalgold, 12 years; Joel, 10 years; Moab Khotsong, 9 years; Target 1, 7 years; Kusasaletu, 5 years; and Bambanani, 4 years. Masimong and Unisel were expected to close by the end of 2020 (Harmony Gold Mining Company Ltd., 2019b, p. 7).

Sibanye-Stillwater mined gold at the Beatrix, the Driefontein, and the Kloof Mines, and at the Cooke Operations. Production at the Kloof Mine decreased to 10,863 kg in 2019 from 15,253 kg in 2018; at Beatrix, to 6,118 kg from 8,536 kg; at Driefontein, to 5,155 kg from 9,573 kg; and at the Cooke Operations, to 1,291 kg from 1,394 kg. Sibanye also held a 38.05% interest in DRDGold Ltd, which produced gold at the Ergo and the Far West Gold Recovery Operations (FWGR). Ergo and FWGR produced a total of 5,582 kg in 2019. Sibanye-Stillwater closed some mine shafts at Beatrix and Driefontein and placed others on care-and-maintenance status in 2019 (Sibanye-Stillwater Ltd., 2020a, p. 51, 132–133).

Sibanye-Stillwater started the reopening of the Burnstone Mine in 2017. The company had planned to restart mining at Burnstone in the second half of 2018 and to produce at the full capacity of 3,900 kilograms per year (kg/yr) of gold between 2022 and 2028. Average production during the estimated 20-year life of the mine was expected to be nearly 3,000 kg/yr. In May 2018, the development of the project was halted. As of the end of

2019, the reopening of the mine was planned for 2021 (Sibanye Gold Ltd., 2018, p. 50; Sibanye-Stillwater Ltd., 2020a, p. 137).

AngloGold Ashanti Ltd. produced nearly 7,600 kg at the Mponeng Mine in 2019 compared with 8,200 kg in 2018. Production at the Surface Operations increased to nearly 5,500 kg in 2019 from 5,300 kg in 2018. Ore grades decreased at Mponeng and increased at the Surface Operations. As of May 2019, the estimated remaining life of the Mponeng Mine was 8 years. AngloGold Ashanti planned to make an investment decision on the phase 2 extension of Mponeng, which could increase the mine's life by 20 years, between November 2020 and May 2021 (Creamer, 2019a; AngloGold Ashanti Ltd., 2020, p. 85).

Gold Fields Ltd. produced 6,907 kg of gold at the South Deep Mine in 2019 compared with 4,885 kg in 2018 and about 8,700 kg in 2017. The company's production target in 2019 was 6,000 kg. Decreased production in 2018 was partially attributable to a labor dispute. Increased productivity led to higher output in 2019. Gold Fields planned to produce about 8,000 kg in 2020 (Secombe, 2019; Gold Fields Ltd., 2020, p. 40).

In its 2019 fiscal year (which started on July 1, 2018, and ended on June 30, 2019), Pan African Resources plc produced 5,364 kg of gold compared with 4,990 kg in fiscal year 2018. Production at the Barberton Mine was 2,344 kg in fiscal year 2019; the Elikhulu Tailings Retreatment Project (Elikhulu), 1,437 kg; the Barberton Tailings Retreatment Project (BTRP), 747 kg; and the Evander Mines' 8 Shaft, 525 kg. The estimated remaining life of the Barberton Mine was 20 years; Elikhulu, 13 years; the BTRP, 9 years; and the Evander Mines' 8 Shaft, 3 years. Pan African planned to produce a total of nearly 5,800 kg in its 2020 fiscal year (Pan African Resources plc, 2019, p. 2–3, 6, 54).

Village Main Reef Ltd. (a subsidiary of Heaven-Sent Capital Group of China) operated the Kopanang and the Tau Lekoa Mines. The company produced about 2,600 kg/yr at Kopanang and 2,300 kg/yr at Tau Lekoa (Village Main Reef Ltd., [undated]a, b).

Amplats and its joint-venture partners produced about 2,300 kg of gold from their South African PGM mining operations in 2019 compared with 2,200 kg in 2018. The Mogalakwena Mine, which accounted for 36% of the companies' total PGM production in 2019, produced 84% of the gold (Anglo American Platinum Ltd., 2020, p. 52, 54, 56, 60, 62).

Gold One International Ltd. operated the Modder East Mine in Gauteng Province, which produced gold at the rate of nearly 1,900 kg/yr. The mine was expected to be depleted in 2019. In November 2018, Gold One started a plant expansion to treat lower-grade ore that could continue mining at Modder East until 2029 (Casey, 2018; Mir, 2018).

In its scoping study on its Theta Hill project in the Transvaal gold field, Theta Gold Mines Ltd. of Australia (formerly Stonewall Resources Ltd.) planned to produce nearly 2,100 kg/yr during an estimated mine life of between 7 and 8 years. Theta Gold started a feasibility study on the project in late 2018; the study was completed in May 2019. Planned production in the feasibility study was revised to 1,250 kg/yr during an estimated mine life of 5 years. The construction period for the mine was estimated to be 9 months. Theta Gold planned to use the project to finance an expansion to 3,100 kg/yr. As of yearend, development of the mine had not started (Barradas, 2018b; Andrews, 2019b; Nedbank Group Economic Unit, 2020, p. 9).

White Rivers Exploration (Pty) Ltd. and Harmony were considering the development of the Beisa project, which was located adjacent to Harmony's Target 1 Mine. Depending on the results of prefeasibility and feasibility studies, the companies could produce at least 7,500 kg/yr of gold between years 4 and 17 of mining operations. The planned average production during the estimated 33-year life of the project was 6,300 kg/yr. White Rivers planned to complete a prefeasibility study in June 2017 and a feasibility study in June 2018. The completion of the prefeasibility study subsequently was delayed until the fourth quarter of 2018. As of the end of 2019, it was unclear when the study would be completed (Andrews, 2017; White Rivers Exploration (Pty) Ltd., 2017, p. 6, 9, 11–12; Washbourne, 2018).

Rand Refinery Ltd. (AngloGold Ashanti, 42.41%; Sibanye-Stillwater, 33.15%; DRDGold, 11.3%; Harmony, 10.38%; and Gold Fields, 2.76%) refined most of the newly mined gold in South Africa. The company produced at about 80% of its capacity of 410,000 kg/yr in its fiscal year 2019 compared with 90% in fiscal year 2018. Decreased production was attributable to reduced supplies of gold from mines in South Africa and Zimbabwe. Rand Refinery sourced the majority of its gold from imports (Rand Refinery Ltd., 2019, p. 4, 14–15).

Iron Ore and Iron and Steel.—In 2019, iron ore production was about 72.4 Mt compared with a revised 74.3 Mt in 2018 and 55.3 Mt in 2009. The long-term increase was attributable to the opening of the Khumani and the Kolomela Mines. From 2009 to 2019, export sales of iron ore increased to 60.6 Mt from 44.6 Mt and domestic sales decreased to 7.5 Mt from 8.4 Mt (Galane, 2018; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Kumba Iron Ore Ltd.'s iron ore production decreased to 42.4 Mt in 2019 from 43.1 Mt in 2018; the company was South Africa's leading producer of iron ore. In 2019, production at the Sishen Mine remained nearly unchanged at 29.2 Mt. At the Kolomela Mine, output decreased to 13.2 Mt from 13.9 Mt. The company's exports sales decreased to 39.8 Mt in 2019 from 40 Mt in 2018; domestic sales decreased to 2.2 Mt from 3.3 Mt because of the closure of the Saldanha steel plant. Kumba planned to produce a total of between 42 and 43 Mt/yr at Kolomela and Sishen between 2020 and 2022 (Tex Report, 2019a; Anglo American plc, 2020, p. 8–9).

Assmang (Pty) Ltd. produced iron ore at the Beeshoek and the Khumani Mines. In 2019, total production increased to 18.4 Mt from 18.2 Mt in 2018. The company planned to maintain production at Khumani and Beeshoek at 14 Mt/yr and 3.5 Mt/yr, respectively. About 82% of Assmang's sales were exports; most of Khumani's output was exported and most of Beeshoek's was sold domestically. Khumani's estimated remaining life was 21 years, and Beeshoek's, 7 years (African Rainbow Minerals Ltd., 2019a, p. 4, 66–67, 76, 2019b, p. 51; 2020, p. 7).

Palabora Mining Company Ltd. produced magnetite from the Palabora Mine. Foskor (Pty) Ltd. sold magnetite from a stockpile at its phosphate rock mine at Phalaborwa; the company did not produce or process magnetite. In its fiscal year 2019 (which started on April 1, 2018, and ended on March 31, 2019), Government-owned Transnet SOC Ltd. shipped 8 Mt of magnetite on its railways, most of which was attributable

to Palabora Mining. Foskor planned to start beneficiating 1.4 Mt/yr of low-grade magnetite from its stockpile to produce iron ore by the end of the first quarter of 2020 (Khaile, 2018, p. 20–24; Foskor (Pty) Ltd., 2019, p. 6, 25, 44; Transnet SOC Ltd., 2019, p. 8).

Afrimat Ltd. produced iron ore at the Diro Mine in Northern Cape Province. In August 2017, the company was producing at the rate of between 450,000 and 500,000 t/yr. Since August 2018, Afrimat produced at the rate of nearly 1 Mt/yr, of which 900,000 t/yr was exported by Transnet (Louw, 2020).

ArcelorMittal South Africa Ltd.'s (which was the leading producer of raw steel in South Africa) production of raw steel decreased to 4.41 Mt from 5.09 Mt in 2018. The Saldanha plant was scheduled for permanent closure in the second quarter of 2020 because of high iron ore costs and the plant's inability to process fine iron ore (ArcelorMittal South Africa Ltd., 2020, p. 2–3, 36).

Manganese.—In 2019, manganese ore production was about 17 Mt compared with 14.92 Mt in 2018 and 7.17 Mt in 2010. The long-term increase was attributable to increased production from the Mamatwan, the Nchwaning, and the Wessels Mines and the opening of the Kalahari, the Kudumane, and the Tshipi Borwa Mines. Total production of manganese alloys decreased to 404,000 t in 2019 from nearly 790,000 t in 2010; decreased ferromanganese production was attributable to increased power costs (table 1; Creamer, 2015; Galane, 2018; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Assmang (which was the leading producer of manganese ore in South Africa) produced manganese ore at the Gloria and the Nchwaning Mines. Total output increased to 3.71 Mt in 2019 from 3.59 Mt in 2018; average ore grades were about 43% manganese. Assmang increased production at Gloria and Nchwaning to its targeted rate of 4 Mt/yr in the second half of 2019. The company's plans to expand its total capacity to 5 Mt/yr by late 2021 or early 2022 depended on the availability of Transnet's railways. The estimated remaining life of Assmang's manganese mines was more than 30 years (Barradas, 2018a; Khaile, 2018, p. 20; African Rainbow Minerals Ltd., 2019a, p. 4, 31, 68, 77; 2019b, p. 52; 2020, p. 8).

In 2019, Assmang's production of ferromanganese at the Cato Ridge plant was 160,000 t compared with 171,000 t in 2018. Assmang planned to maintain sales of ferromanganese at about 130,000 t/yr through at least mid-2022 (African Rainbow Minerals Ltd., 2019a, p. 75, 77; 2019b, p. 52; 2020, p. 9).

Hotazel Manganese Mines (Pty) Ltd. (South32 Ltd., 60%) operated the Mamatwan and the Wessels Mines near Hotazel in Northern Cape Province. In 2019, Hotazel's output of manganese ore increased to 3.58 Mt from 3.49 Mt in 2018. Production was limited by a shutdown of Wessels for maintenance in the fourth quarter of 2019. Ore grades from the company's sales were about 40% manganese in 2018 and 2019. Hotazel planned to produce at the rate of about 3.4 Mt/yr in the first half of 2020 (South32 Ltd., 2019, 2020).

Samancor Manganese (Pty) Ltd. produced manganese alloys at Meyerton. The company's production was 117,000 t in 2019 compared with 127,000 t in 2018 (South32 Ltd., 2019, 2020).

Jupiter Mines Ltd. of Australia held a 49.9% share in Tshipi e Ntle Manganese Mining (Pty) Ltd., and Ntsimbitntle Mining (Pty) Ltd., a 38.1% share. In the fiscal year ending in February 2019, Jupiter and Ntsimbitntle produced 3.45 Mt of manganese ore from the Tshipi Borwa Mine in Northern Cape Province compared with 3.64 Mt in fiscal year 2018. Between September and November, production was at the rate of about 3.06 Mt/yr. Lumpy ore mined at Tshipi Borwa had a grade of 36.5% manganese, and fine ore, 35.5% manganese. The mine had a capacity of 3.6 Mt/yr and an estimated remaining life of more than 100 years (Khaile, 2018, p. 28; Jupiter Mines Ltd., 2019, p. 11–12, 14; Tex Report, The, 2019i).

United Manganese of Kalahari (Pty) Ltd. (UMK) (Majestic Silver Trading 40 (Pty) Ltd., 51%, and Renova Group of Russia, 49%) operated the Russik Mine in Northern Cape Province. The company produced 3 Mt/yr of manganese ore at a grade of 37.5% manganese. In 2018, the remaining life of the Russik Mine was estimated to be more than 30 years (Khaile, 2018, p. 29; Davies and others, 2020; United Manganese of Kalahari (Pty) Ltd., undated).

Manganese ore from the Kalahari deposit was used by Transalloys (Pty) Ltd. (Renova, 23.78%) in the production of silicomanganese. The company had a capacity of 180,000 t/yr; planned production for 2020 was 170,000 t of silicomanganese. In December 2019, production reportedly was reduced by power outages. Transalloys' production was exported primarily to European countries and the United States (table 2; Tex Report, The, 2019b, 2020d).

Asia Minerals Ltd. (AML) of Hong Kong operated the Kudumane Mine at Farm York. The company produced about 1.4 Mt of manganese ore in 2019 compared with nearly 1.5 Mt in 2018; ore grades were between 36% and 37% manganese. AML started large scale-mining at Farm Hotazel, which adjoined Farm York, in November 2018. Planned production at Farm Hotazel was 400,000 t/yr of ore at a grade of 40% manganese. AML's total production was limited to 1.6 Mt/yr because of constraints in Transnet's rail capacity (Tex Report, The, 2017; Nippon Denko Co. Ltd., 2020, p. 20).

In March 2018, Kalagadi Manganese (Pty) Ltd. [Kalagadi Alloys (Pty) Ltd., 44%; Kalahari Resources (Pty) Ltd., 36%; and Industrial Development Corp., 20%] started operations at a new underground mine at Hotazel. Kalagadi produced 484,000 t of manganese ore by the end of March 2019. The company was producing at the rate of about 250,000 t/yr in the first quarter of 2019; production was expected to increase to 2.4 Mt/yr by the first quarter of 2020. Kalagadi planned to produce 3 Mt/yr of manganese ore at a grade of nearly 39% manganese upon reaching full capacity (Khaile, 2018, p. 29; Kalagadian, The, 2019).

Kalagadi operated a plant to beneficiate its mine's output into sintered ore (which is heated and compressed to increase its grade). In 2019, Transnet signed an agreement with Kalagadi to transport 650,000 t of sintered ore by rail. Kalagadi would increase its supply to 1 Mt/yr of sintered ore at a grade of nearly 47% manganese subsequently and reach the sintering plant's full capacity of 2.4 Mt/yr in 2023 (Khaile, 2018, p. 29; McKay, 2019).

Aquila Resources (Pty) Ltd. of Australia planned to develop the Avontuur project. The project was delayed by a dispute regarding mining rights with Pan African Mineral Development Co., which was owned by the Governments of South Africa, Zambia, and Zimbabwe. In November 2016, the Gauteng division of the High Court of South Africa ruled in favor of Aquila. In November 2017, the Supreme Court of Appeals overturned the lower court's decision. In February 2019, the Constitutional Court upheld the High Court's decision (Creamer, 2018a; Bulbulia, 2019a).

In its 2019 fiscal year (which started on April 1, 2018, and ended on March 31, 2019), Transnet shipped 14.3 Mt of manganese ore to ports in South Africa. The company planned to ship 15.1 Mt in fiscal year 2020 and to increase the capacity of its railways for manganese export to 18 Mt/yr from 15 Mt/yr by the second half of 2022 (McKay, 2019).

Nickel.—Amplats (which was the leading producer of nickel in South Africa) produced 23,100 t of refined nickel in 2019, which was nearly unchanged from that in 2018. About 18,500 t of nickel was mined at the company's South African PGM mining operations in 2019 compared with 18,900 t in 2018; the Mogalakwena Mine's production remained nearly unchanged at 15,700 t. Implats produced 16,100 t of refined nickel in 2019 compared with 16,400 t in 2018. About 6,300 t was attributable to the company's South African PGM mining operations in 2019 compared with 3,000 t in 2018. The remainder was attributable to the Two Rivers Mine, Implats's operations in Zimbabwe, recycling, and toll refining (Impala Platinum Holdings Ltd., 2019a, p. 80, 100, 107, 121; 2019b, p. 65, 67, 75; 2020, p. 71, 73, 81; Anglo American Platinum Ltd., 2020, p. 48, 52, 54, 56, 60, 62).

ARM and Nor Nickel produced 12,971 t of nickel at the Nkomati Mine in 2019 compared with 13,193 t in 2018 as reserves were depleted. The mine was expected to close by the end of September 2020 (African Rainbow Minerals Ltd., 2019a, p. 57, 63; 2019b, p. 58; 2020b, p. 13).

In September 2018, Lonmin and Thakadu Group started construction of a new nickel sulfate plant at Lonmin's Base Metals Refinery. The companies planned to complete the plant in April 2019 and to start commercial production by June. Lonmin and Thakadu planned to produce as much as 25,000 t/yr of high-purity nickel sulfate from Lonmin's crude nickel sulfate. As of yearend, the plant was not completed (Mining Weekly, 2018).

Platinum-Group Metals.—In 2019, total mined PGM production was 268,068 kg compared with 270,646 kg in 2018 and about 271,400 kg in 2009. Total refined PGM production was estimated to be about 294,000 kg in 2019 compared with 296,000 kg in 2018. In 2018, about 33,000 kg of PGMs were used locally in the production of catalytic converters. Mine production remained nearly unchanged between 2009 and 2019 because of such factors as power and water shortages and a lack of investment in new mines (Creamer, 2019d; Ninji and Mazneva, 2020; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

In recent years, the share of platinum in PGM mining companies' earnings decreased and the shares of palladium and rhodium increased. The share of platinum in South Africa's

PGM production decreased to 50% in 2019 from 52% in 2009; decreased platinum prices and increased palladium and rhodium prices were the most important factors in the shift in earnings (Moumakwa, 2010; Minerals Council South Africa, 2020, p. 26).

In 2019, Amplats produced about 156,700 kg of refined PGMs compared with 145,500 kg in 2018. The company's production of refined platinum was 78,200 kg in 2019; refined palladium, 50,851 kg; refined rhodium, 10,084 kg; and refined iridium and ruthenium, a total of about 17,500 kg. Amplats's production of refined platinum was 74,779 kg in 2018; refined palladium, 46,711 kg; refined rhodium, 9,107 kg; iridium and ruthenium, a total of about 15,000 kg (Anglo American Platinum Ltd., 2020, p. 48).

About 99,100 kg of PGMs was produced by the South African mining operations of Amplats and its joint-venture partners in 2019, which was a decrease of about 1% compared with that in 2018. Production was limited by a labor dispute at Mototolo and power shortages. Platinum accounted for 46,500 kg in 2019; palladium, 34,100 kg; ruthenium, 9,500 kg; rhodium, 6,740 kg; and iridium, 2,300 kg. Production of mined ruthenium decreased by about 2% in 2019, and that of mined palladium and rhodium, by about 1% each. Mined platinum and iridium output was nearly unchanged (Anglo American Platinum Ltd., 2020, p. 7, 52, 54, 56, 60, 62).

In 2019, total PGM production at Amplats's Mogalakwena Mine was 35,872 kg; the Amandelbult Mine, 27,390 kg; the Kroondal Platinum Mine (which was a joint venture with Sibanye-Stillwater), 19,421 kg; the Modikwa Platinum Mine (which was a joint venture with ARM), 8,964 kg; and the Mototolo Platinum Mine, 7,477 kg. Total PGM production increased at Mogalakwena by 4% in 2019 and at Amandelbult, by 2%. In 2019, production at Modikwa decreased by 12% and production at Kroondal remained nearly unchanged (Anglo American Platinum Ltd., 2020, p. 52, 54, 56, 60, 62).

Mogalakwena, which accounted for 36% of Amplats and its joint-venture partners' total mined PGM output in 2019, produced 51% of the companies' palladium, 30% of the platinum, 17% of the rhodium, and 11% each of the iridium and ruthenium. Mogalakwena was located in the Northern Limb of the Bushveld Complex, which hosted PGM deposits that tended to be relatively richer in palladium. Amandelbult, which accounted for 28% of the companies' total mined PGM output in 2019, produced 40% of the iridium, 38% of the ruthenium, 37% of the rhodium, 31% of the platinum, and 18% of the palladium. Kroondal, which accounted for nearly 20% of the companies' total mined PGM output in 2019, produced 30% of the ruthenium, 28% of the iridium, 26% of the rhodium, 20% of the platinum, and 15% of the palladium. Amandelbult and Kroondal were located in the Western Limb and the Eastern Limb of the Bushveld Complex, respectively, which hosted PGM deposits that tended to be relatively richer in iridium, rhodium, and ruthenium (Impala Platinum Holdings Ltd., 2008; Anglo American Platinum Ltd., 2020, p. 52, 54, 56, 60, 62).

Amplats was engaged in a feasibility study on mining the Der Brochen resource, which was located adjacent to the Mototolo Mine, and a prefeasibility study on expanding capacity at Mototolo. Depending on the results of the studies, the remaining life of Mototolo could increase to 30 years from 5 years, and

total PGM production could increase by 33% (Anglo American Platinum Ltd., 2020, p. 5, 104).

Amplats also planned to start a feasibility study on an expansion of the Mogalakwena Mine in the second quarter of 2020, which was expected to be completed in 2021. Depending on the results of the study, total PGM production at Mogalakwena could increase by more than 15,500 kg/yr as early as 2024 (Anglo American Platinum Ltd., 2020, p. 5, 104).

Implats produced 86,888 kg of refined PGMs in 2019 compared with 95,799 kg in 2018. Platinum accounted for about 43,000 kg in 2019; palladium, 25,800 kg; rhodium, 5,800 kg; and gold, iridium, ruthenium, a total of about 12,300 kg. The company's production of refined platinum in 2018 was about 50,300 kg; refined palladium, 28,200 kg; refined rhodium, 6,400 kg; and gold, iridium, and ruthenium, a total of about 10,800 kg. Implats's South African mining operations accounted for about 50,700 kg of refined PGM production in 2019. The remainder was attributable to the Two Rivers Mine, Implats's operations in Zimbabwe, recycling, and toll refining (Impala Platinum Holdings Ltd., 2019a, p. 80, 107; 2019b, p. 75; 2020, p. 81).

The Impala Rustenburg Mines near Rustenburg in North West Province produced about 43,800 kg of PGMs (including gold) in 2019 compared with 41,400 kg in 2018. Implats's platinum production was about 22,600 kg in 2019; palladium, 11,700 kg; and rhodium, 3,150 kg. Total gold, iridium and ruthenium was 6,300 kg in 2019, of which ruthenium and iridium accounted for an estimated 69% and 17%, respectively, based on data from Prill splits (the relative proportions of PGMs). Palladium production increased by 17% in 2019; rhodium, 13%; and platinum, 2%. Iridium and ruthenium production decreased by an estimated 2% each. Implats planned to focus on profitable operations that would reduce platinum production at Impala Rustenburg to about 16,000 kg/yr by 2022 (Impala Platinum Holdings Ltd., 2008; 2019a, p. 95, 100; 2019b, p. 65; 2020, p. 71).

Palladium output at the Marula Mine was about 2,730 kg in 2019; platinum, 2,660 kg; rhodium, 550 kg; and gold, iridium and ruthenium, a total of 1,010 kg. Based on Prill split data, ruthenium production was estimated to be more than 700 kg in 2019 and iridium, more than 200 kg. All ore mined at Marula was from the UG2 layer, which was richer in iridium, palladium, rhodium, and ruthenium than the Merensky layer. Implats's production of palladium was about 2,770 kg in 2018; platinum, 2,700 kg; rhodium, 570 kg; and gold, iridium and ruthenium, a total of 1,060 kg. The company planned to produce between 2,500 and 3,000 kg of platinum in fiscal year 2020 (Impala Platinum Holdings Ltd., 2008; 2019a, p. 121; 2019b, p. 67; 2020, p. 73).

Lonmin produced 39,211 kg of refined PGMs at its refinery at Brakpan in 2018. The company's production of refined platinum was 20,587 kg; refined palladium, 9,465 kg; refined ruthenium, 4,977 kg; refined rhodium, 3,095 kg; and refined iridium, 1,087 kg. Lonmin was purchased by Sibanye-Stillwater in June 2019. Refined platinum production decreased to an estimated 17,000 kg in 2019; the production of other refined PGMs was estimated to have decreased by 17% (Lonmin plc, 2018, p. 183; 2019; Johnson Matthey plc, 2020, p. 7).

Lonmin's mining operations produced 36,527 kg in 2018, most of which was attributable to the Marikana Mine.

Platinum accounted for 19,156 kg of PGM mine production in 2018; palladium, 8,961 kg; ruthenium, 4,676 kg; rhodium, 2,757 kg; and iridium, 977 kg. Sibanye-Stillwater produced platinum at the rate of 16,200 kg/yr in the second half of 2019; palladium, 7,500 kg/yr; ruthenium, 4,000 kg/yr; rhodium, 2,400 kg/yr; and iridium, 1,100 kg/yr (Lonmin plc, 2018, p. 182; 2019; Sibanye-Stillwater Ltd., 2020b).

In 2019, Sibanye-Stillwater produced 24,930 kg of PGMs at the Rustenburg Mine compared with 27,523 kg in 2018. The company's production of platinum at Rustenburg was 12,864 kg in 2019; palladium, 6,586 kg; ruthenium, 2,954 kg; rhodium, 1,860 kg; and iridium, 666 kg. Sibanye-Stillwater's production of platinum was 14,459 kg in 2018; palladium, 7,220 kg; ruthenium, 3,230 kg; rhodium, 1,896 kg; and iridium, 719 kg. Decreased output was partially attributable to lower recovery rates (Sibanye-Stillwater Ltd., 2020a, p. 131; 2020b).

Northam Platinum Ltd. operated the Booysendal, the Eland, and the Zondereinde Mines; the company sold its production to Heraeus South Africa (Pty) Ltd. for refining. Heraeus' production of refined platinum at Port Elizabeth increased to 11,165 kg in 2019 from 10,664 kg in 2018 and refined palladium, to 5,448 kg from 5,071 kg. Iridium, rhodium, and ruthenium were exported to Germany for refining (Northam Platinum Ltd., 2019, p. 13; 2020, p. 21).

Platinum production from the Booysendal, the Eland, and the Zondereinde Mines was 10,858 kg in 2019; palladium, 5,090 kg; ruthenium, 2,661 kg; rhodium, 1,582 kg; iridium, 579 kg; and gold, 207 kg. Northam's production of platinum was 9,333 kg in 2018; palladium, 4,423 kg; ruthenium, 2,207 kg; rhodium, 1,368 kg; iridium, 488 kg; and gold, 239 kg. Increased production in 2019 was attributable to the expansion of the Booysendal Mine and the reopening of the Eland Mine (Northam Platinum Ltd., 2019, p. 12; 2020, p. 21, 32, 37, 41).

Northam planned to increase its production of PGMs (including gold, but not ruthenium or iridium) to more than 31,000 kg/yr, of which Booysendal would account for about 15,500 kg/yr; Zondereinde, nearly 11,000 kg/yr; and Eland, about 4,700 kg/yr. At Booysendal, the company planned to reach full capacity at Central UG2 and Central Merensky by mid-2023 and mid-2024, respectively. Northam planned to start processing ore from the Kukuma Shaft at Eland by mid-2021. Increased production from Zondereinde would be attributable to the Western extension project. The estimated remaining life of Zondereinde was more than 30 years and Booysendal, more than 25 years (Northam Platinum Ltd., 2020 p. 4–5, 44–45).

Royal Bafokeng Platinum Ltd. (RBPlat) produced PGMs at the Bafokeng Rasimone Platinum Mine (BRPM) and the Styldrift Mine; the company acquired Amplats's 33% share in BRPM in 2019. Production of PGMs (including gold, but not ruthenium or iridium) was about 12,500 kg in 2019 compared with 11,400 kg in 2018. At BRPM, total production of PGMs decreased to 7,500 kg in 2019 from 8,270 kg, and platinum, to 4,850 kg from 5,380 kg. Total production of PGMs at Styldrift increased to 5,000 kg in 2019 from 3,170 kg in 2018, and platinum, to 3,270 kg from 2,050 kg. Based on Prill split data, BRPM and Styldrift produced a total of about 3,400 kg of palladium and 670 kg of rhodium in 2019 (Royal Bafokeng Platinum Ltd., 2020, p. 12, 55–56, 109).

RBPlat planned to produce a total of between 14,000 kg and 15,000 kg of PGMs at BRPM and Styldrift in 2020. The company planned to increase production at Styldrift to its full capacity of nearly 10,000 kg/yr by 2021. The estimated remaining life of Styldrift was more than 40 years and BRPM, about 30 years (Royal Bafokeng Platinum Ltd., 2020, p. 12, 60, 67).

ARM and Implats operated the Two Rivers Platinum Mine; output decreased to 9,040 kg of PGMs in 2019 from 10,285 kg in 2018. Platinum accounted for about 47% of Two Rivers' PGM output; palladium, 27%; ruthenium, 14%; rhodium 8%; iridium, 3%; and gold, 1%. In the second half of 2019, ARM approved an expansion of the concentrator plant capacity that was expected to increase total production to between 11,200 and 11,800 kg/yr. The plant could be completed by November 2021. The estimated remaining life of the Two Rivers Platinum Mine was more than 30 years (African Rainbow Minerals Ltd., 2019a, p. 4, 61; 2019b, p. 55; 2020, p. 11).

ARM and Nor Nickel produced PGMs at the Nkomati Mine. Output increased to 3,057 kg of PGM in 2019 from 2,954 kg of PGM in 2018. Based on Prill split data, palladium accounted for about 66% of production; platinum, 28%; and rhodium, 4%. The mine was expected to close at the end of September 2020 (Impala Platinum Holdings Ltd., 2008; African Rainbow Minerals Ltd., 2019a, p. 57, 63; 2019b, p. 58; 2020, p. 13).

In 2018, Siyanda Resources (Pty) Ltd. produced platinum at the Union Mine at the rate of about 5,400 kg/yr. The company's palladium production was estimated to be about 2,500 kg/yr; ruthenium, between 1,400 and 1,500 kg/yr; rhodium, 990 kg/yr; and iridium, 360 kg/yr. The Union Mine was expected to continue production until 2030 (Moumakwa and Rakhudu, 2018; Anglo American Platinum Ltd., 2019, p. 56).

In fiscal year 2019, Tharisa Minerals produced 4,345 kg of PGMs compared with 4,734 kg in fiscal year 2018. Platinum accounted for 55.1% of production by volume in fiscal year 2019; palladium, 16.9%; ruthenium, 14%; rhodium, 9.5%; and iridium, 4.3%. Decreased production was attributable to lower recovery rates. Tharisa Minerals planned to produce between 4,800 and 5,100 kg in fiscal year 2020. The company also planned to increase production to a rate of 6,200 kg/yr of PGM by the end of 2020 (Tharisa Minerals (Pty) Ltd., 2019, p. 2, 37, 39).

Sedibelo Platinum Mines Ltd. produced 3,960 kg of PGMs (including gold, but not ruthenium or iridium) at its Pilanesberg Platinum Mines in 2019 compared with 4,677 kg in 2018. Decreased production was attributable to lower ore grades and recovery rates. Mining was expected to continue at Pilanesberg until at least 2027 (Moumakwa and Rakhudu, 2018; Sedibelo Platinum Mines Ltd., 2020, p. 5).

In 2018, Wesizwe Platinum Ltd. was engaged in the development of the Bakubung Mine in North West Province. The company planned to start mining in the fourth quarter of 2018 and reach the full capacity of 13,000 kg/yr of PGMs (including gold, but not ruthenium or iridium) in 2021. Platinum was expected to account for 62.4% of PGM production; palladium, 28%; rhodium, 7.4%; and gold, 2.2%. In March 2019, Wesizwe announced that the startup of mining would be delayed until 2021. The initial planned capacity of the mine would be reduced by two-thirds; the company could expand capacity after a 5-year mining period based on market conditions (Engineering & Mining Journal, 2015; Cornish, 2018a; Moumakwa, 2019).

In 2019, Ivanhoe Mines Ltd. of Canada was engaged in the construction of a new mine at its Platreef project, which is located in the northern limb of the Bushveld Complex. In the first phase of mining, Ivanhoe would mine about 4 Mt/yr of ore. Production was likely to be 9,500 t/yr of nickel, 5,900 t/yr of copper, and 14,800 kg/yr of PGMs (including gold, but not ruthenium or iridium). In the second phase, ore production could increase to 8 Mt/yr, and in the third phase, to 12 Mt/yr. Mining could start at Platreef in early 2022 (Engineering & Mining Journal, 2017; Moumakwa, 2019).

In 2019, Platinum Group Metals Ltd. of Canada completed a feasibility study on a new mine at the Waterberg project, which is located in the Northern Limb of the Bushveld Complex. The company expected to receive a mining license in the first quarter of 2020 and to make a final investment decision subsequently. Mining could start in late 2023 depending on the results of the decision. Waterberg's planned capacity of about 13,000 kg/yr of PGMs (including gold, but not ruthenium or iridium) could be reached by 2027. Palladium accounted for 63% of production in a prefeasibility study completed in 2016; platinum, 30%; gold, 6%; and rhodium, 1%. Mining was expected to continue until 2066 (Engineering & Mining Journal, 2016, 2019).

Rare Earths.—As of November 2019, Steenkampskraal Holdings Ltd. had completed 80% of the infrastructure for the Steenkampskraal Mine in Western Cape Province. Planned production was 2,700 t/yr of rare-earth oxides, of which neodymium oxide would account for 480 t/yr; praseodymium oxide, 138 t/yr; dysprosium oxide, 26 t/yr; and terbium oxide, 5 t/yr. The company had all the required regulatory approvals to start construction; mining could start within 12 to 18 months (Arnoldi, 2019b).

Silicon.—At the end of June 2016, Ferroglobe plc of the United Kingdom shut down silicon metal production at eMalahleni and Polokwane because of high power costs and reduced demand in world markets. In August 2017, the National Energy Regulator of South Africa approved Government-owned power company Eskom Holdings SOC Ltd.'s application to provide power to the plants at a reduced price. By late May 2018, eMalahleni and Polokwane were operating at full capacity. Ferroglobe put Polokwane on care-and-maintenance status at the start of August 2019 (Njobeni, 2017; Slabbert, 2018; Ferroglobe plc, 2019).

Titanium and Zirconium.—Richards Bay Minerals (Pty) Ltd. (RBM) (Rio Tinto plc, 74%; Blue Horizon Investments, 24%; and RBM permanent employees, 2%) of the United Kingdom produced ilmenite, rutile, and zircon at the Zulti North deposits in KwaZulu Natal Province; ilmenite was processed to titanium slag. The company's production decreased in recent years because of such factors as lower ore grades and civil unrest that shut down operations during several periods between 2014 and 2016 and in 2018 and 2019 (Richards Bay Minerals (Pty) Ltd., 2017, p. 12; Ramane, 2018; Barradas, 2019).

RBM's production of titanium slag decreased to 563,264 t in 2019 from 880,844 t in 2012. Based on titanium slag production, ilmenite production was estimated to have decreased to 1.1 Mt from 1.7 Mt. RBM's titanium slag had a titanium dioxide (TiO₂) content of 85% (Richards Bay Minerals (Pty) Ltd., 2013, p. 10; 2017, p. 8; 2020, p. 4).

RBM's zircon and rutile capacity was 250,000 t/yr and 100,000 t/yr, respectively. The company's zircon production decreased to 141,645 t in 2019 from 263,673 t in 2012, and rutile, to 46,176 t from 97,489 t. RBM's rutile had a TiO₂ content of about 94%. Most of the company's rutile and zircon production was exported (Richards Bay Minerals (Pty) Ltd., 2013, p. 10; 2017, p. 8; 2020, p. 4; Ramane, 2018).

In April 2019, RBM approved the Zulti South project, which would maintain capacity and extend the life of its operations. Mining was expected to start at Zulti South by late 2021. The company shut down production and stopped construction on Zulti South in December because of civil unrest. RBM planned to restart mining in early January 2020 and to evaluate restarting Zulti South (Barradas, 2019; Thomson Reuters, 2019).

Tronox Holdings plc of the United States' Namakwa Sands project produced 121,000 t of zircon in 2019 compared with 119,000 t in 2018. Titanium slag production decreased to 172,000 t in 2019 from 181,000 t in 2018; rutile production remained unchanged at 32,000 t. The company's ilmenite production was estimated to be about 340,000 t in 2019 compared with 350,000 t in 2018 (Tronox Holdings plc, 2019, p. 37; 2020, p. 32–33).

Tronox also produced mineral sands at the Fairbreeze Mine. In 2019, the company produced 167,000 t of titanium slag, 55,000 t of zircon, and 25,000 t of rutile. Ilmenite production was estimated to be about 330,000 t in 2019. Titanium slag production was 194,000 t in 2018; zircon, 53,000 t; and rutile, 22,000 t. Ilmenite production was estimated to be 380,000 t in 2018. Fairbreeze had a capacity of 500,000 t/yr of ilmenite, 55,000 t/yr of zircon, and 25,000 t/yr of leucoxene and rutile (table 2; Tronox Holdings plc, 2019, p. 34, 37; 2020, p. 32–33).

Mineral Commodities Ltd. (MCL) of Australia operated the Tormin Mine in Western Cape Province. In 2019, the company produced 49,937 t of ilmenite, 6,633 t of zircon, and 1,527 t of rutile. In 2018, production was 108,630 t of ilmenite, 11,610 t of zircon, and 2,962 t of rutile. Production decreased in 2019 because of lower ore grades. MCL planned to produce between 80,000 and 110,000 t of ilmenite and a total of between 16,000 and 20,000 t of rutile and zircon in 2020. Increased output depended on the approval of mining rights for the higher-grade Inland Strand and Northern Beach mining areas in the first quarter of 2020 (Mineral Commodities Ltd., 2020, p. 4–5, 16–17).

Most of the titanium slag produced in South Africa was exported before additional processing. In 2017, Nyanza Light Metals Ltd. (Arkein Group of Companies, 80%) announced plans to build a new TiO₂ pigment plant in the Richards Bay Industrial Development Zone. The company planned to produce 50,000 t/yr of TiO₂ pigment starting in 2019; pigment would be produced using titanium-rich wastes from Highveld's iron ore and vanadium mining operations. Africa's consumption of TiO₂ pigment was estimated to be 130,000 t/yr, of which South Africa accounted for 35,000 t/yr. As of the end of 2019, construction on the plant had not started (Tshetlhanyane, 2017; Richards Bay Industrial Development Zone, 2020).

Vanadium.—Glencore produced vanadium pentoxide (V₂O₅) and ferrovanadium at the Rhovan Mine and smelter in Brits. In 2019, the production of V₂O₅ at Rhovan was nearly unchanged at about 9,200 t. The estimated remaining life of the Rhovan Mine was between 11 and 12 years based on reserves at yearend (Glencore plc, 2020a, p. 15; 2020b, p. 44).

Bushveld Minerals Ltd. of the United Kingdom operated the Vametco Mine and Brits plant. In 2019, the company produced 2,833 t of contained vanadium from magnetite ore at Vametco compared with 2,560 t in 2018. Bushveld planned to produce between 3,000 t and 3,200 t of contained vanadium in 2020. Vametco also was expected to be processed into ferrovandium at the Vanchem plant. The company planned to increase production at Vametco to 4,200 t/yr eventually; capacity was increased to 3,750 t/yr in June 2018 (Kotze, 2018a; Bushveld Minerals Ltd., 2020a; 2020b, p. 13).

In November 2019, Bushveld purchased and reopened the Vanchem ferrovandium plant. In 2020, Bushveld planned to produce between 960 t and 1,160 t of contained vanadium from stockpiles. Bushveld was engaged in a feasibility study on mining the Main Magnetite Layer at its Mokopane project; the study was expected to be completed in the second half of 2020. Depending on the results of the study, Mokopane could be the primary source of ore supplying Vanchem. Bushveld planned to increase production at Vanchem to 4,200 t/yr of contained vanadium by late 2024 (Bushveld Minerals Ltd., 2020a; 2020b, p. 7).

Industrial Minerals

Cement.—South Africa had six cement producers with a total capacity of 20.5 Mt/yr of cement. Pretoria Portland Cement Co. (Pty) Ltd. (PPC) had a combined cement capacity of 7 Mt/yr; AfriSam Consortium (Pty) Ltd., 4.6 Mt/yr; Lafarge Industries South Africa (Pty) Ltd., 3.2 Mt/yr; Dangote Cement South Africa (Pty) Ltd., 2.9 Mt/yr; Natal Portland Cement Co. (Pty) Ltd., 1.8 Mt/yr; and Mamba Cement Company (Pty) Ltd., 1 Mt/yr (table 2; International Cement Review, 2018).

In 2019, cement sales in South Africa by domestic producers were 12.7 Mt compared with 13.7 Mt in 2018 and 14.1 Mt in 2017. Cement imports were at the rate of nearly 1.3 Mt/yr between January and August 2019, which was an increase of 5% compared with the same period in 2018. Decreased cement sales could be attributable to reduced investments in infrastructure (Levitt Kirson Business Services (Pty) Ltd., 2020; Perilli, 2020).

Clay and Shale.—In 2019, South Africa's total sales of brick clay and shale decreased to 5.99 Mt from 6.94 Mt in 2018. Brick clay sales decreased to 4.71 Mt in 2019 from a revised 5.59 Mt in 2018 and shale for use in cement, to 252,000 t from 305,000 t. Sales of shale for use in bricks remained nearly unchanged in 2019 at 1.04 Mt. Decreased sales of brick clay and shale could be attributable to reduced investments in infrastructure. In early 2018, brick clay and shale were produced at as many as 146 mines (Lourens and DeWater, 2018, p. 48, 59–67, 87, 89, 92–93, 104, 108, 112; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Corobrik (Pty) Ltd. produced about 1 billion bricks per year. Based on a brick size of between 3 and 3.5 kg, the company was estimated to produce between 3 and 3.5 Mt/yr of brick clay. Corobrik was building a new brick plant at Driefontein that would replace its existing plant. Capacity would double to 100 million bricks per year by November 2020; the new plant would require additional brick clay production of between

150,000 and 175,000 t/yr (Ceramic World Web, 2020; Clay Brick Association of Southern Africa, [undated]).

Diamond.—In 2019, diamond production was 7.18 million carats compared with a revised 9.91 million carats in 2018 and 6.11 million carats in 2009. Kimberlites accounted for about 93% of diamond production in 2019; alluvial deposits, 5%; and marine deposits, 2%. Between 2009 and 2019, employment in the diamond cutting and polishing industry decreased to 250 polishers from 4,500. The decrease was attributable to such factors as insufficient supplies of suitable rough diamond, a lack of new companies entering the market, high labor costs, and narrowing margins between rough and polished diamond prices (State Diamond Trader, 2015, p. 24–25, 27–30; Galane, 2018; de Klerk, 2019; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

In 2019, Petra Diamonds Ltd. was South Africa's leading producer of rough diamond. At the Finsch Mine, production decreased to 1.72 million carats in 2019 from 1.98 million carats in 2018. Production increased at the Cullinan Mine to 1.71 million carats in 2019 from 1.59 million carats in 2018 and at the Koffiefontein Mine to about 82,000 carats from 53,000 carats. Decreased output at Finsch was attributable to lower ore grades and the depletion of tailings piles (Petra Diamonds Ltd., 2019, p. 12–14; 2020, p. 12–15).

De Beers Group of Companies produced 1.92 million carats of diamond in 2019 compared with 4.68 million carats in 2018. The Venetia Mine's production decreased to 1.92 million carats from 4.24 million carats as near-surface reserves approached depletion. De Beers produced 433,000 carats at the Voorspoed Mine in 2018 before placing the mine on care-and-maintenance status (Anglo American plc, 2020, p. 2–3).

In 2019, De Beers was engaged in the construction of the Venetia underground mine, which would extend the life of the Venetia Mine to 2045. Production from the Venetia underground mine was expected to start by 2021 and the mine would reach its full capacity of 4.5 million carats per year by 2026 (Cornish, 2018c; Anglo American plc, 2020, p. 1).

Ekapa Mining (Pty) Ltd. operated the Kimberley Mine, which produced nearly 756,000 carats between July 2017 and June 2018. The mine was expected to continue operations until 2035. In May 2018, Ekapa allowed artisanal miners who were illegally mining on its property into the Batho Pele cooperative and gave them a license to mine its tailings. As of November 2019, civil unrest resulted from disputes between artisanal miners who were not members of Batho Pele with the members of the cooperative and Ekapa. Batho Pele was expected to continue operations until late 2024. South African mining law had no provisions for artisanal miners (Mining Magazine, 2018; Heiberg and Reid, 2019).

Fluorspar.—Minerales Y Productos Derivados SA of Spain held an 85% share in the Vergenoeg Mine, which was South Africa's only active fluorspar mine at the start of 2019. Vergenoeg had the capacity to produce 250,000 t/yr of acid-grade fluorspar and 30,000 t/yr of metal-grade fluorspar powder and briquets. Fluorspar exports were about 236,000 t in 2018, and domestic sales, 9,000 t (table 2; Modiselle, 2019a).

Sephaku Fluoride Ltd. (SepFluor) started operations at its plant at the Nokeng Mine in March 2019 and officially opened the mine in August. Nokeng, which was located at Rust de Winter, had the capacity to produce 180,000 t/yr of acid-grade fluorspar and 30,000 t/yr of metallurgical-grade fluorspar. SepFluor made its first shipment of 10,000 t at a grade of 97% calcium fluoride (CaF_2) in December; the company made small shipments at lower grades of CaF_2 starting in August. SepFluor had planned to start shipments in January and to reach Nokeng's full capacity in July; delays were attributable to such factors as heavy rains in late 2018 and the need to increase CaF_2 grades (Modiselle, 2019a; Roskill Information Services, 2020).

Eurasian Resources Group (ERG) of the United Kingdom and SA Fluorite (Pty) Ltd. were considering the development of the Doornhoek project. The companies planned to complete a feasibility study on a new mine at Doornhoek in 2020. Depending on the results of the study, ERG and SA Fluorite could produce between 120,000 and 150,000 t/yr of fluorspar. Mining could start in 2022; Doornhoek was estimated to require fluorspar prices of \$200 per metric ton to break even (Modiselle, 2019a).

Garnet, Industrial.—MCL produced industrial garnet from the Tormin Mine. In 2019, the company produced 179,057 t compared with 278,205 t in 2018. Decreased production in 2019 was attributable to lower ore grades. MCL planned to produce between 180,000 and 220,000 t of industrial garnet in 2020. Increased output depended on the approval of mining rights for the higher-grade Inland Strand and Northern Beach mining areas in the first quarter of 2020 (Mineral Commodities Ltd., 2020, p. 4–5, 16–17).

Gemstones.—In 2018 and 2019, Magnum Mining & Exploration Ltd. of Australia engaged in trial production at the Gravelotte Mine. The company produced 2 kg/yr of emerald. Between 1929 and 1982, Gravelotte and other nearby mines produced a total of 22,500 kg of emerald. Gravelotte was the world's leading emerald producer in the 1950s and 1960s. Magnum was considering restarting large-scale mining at Gravelotte at an initial rate of 600 kg/yr (Magnum Mining & Exploration Ltd., 2019, p. 4, 6, 9; 2020, p. 1, 4).

In recent years, artisanal miners produced quartz at Boekenhouthoek, of which a small percentage was amethyst. Production was estimated to be about 500 kg/yr, which was likely at much lower levels than in the early-to-mid-2000s (table 1; Cairncross, 2012; Mabena, 2017).

Kyanite and Related Materials.—South Africa was the world's leading producer of andalusite. In 2018, production increased to an estimated 200,000 t in 2018 from 180,000 t in 2017. Output was limited by heavy rains in early 2017. In 2019, production decreased to an estimated 190,000 t (table 1; Ghilotti, 2018).

Imerys South Africa (Pty) Ltd. (a subsidiary of Imerys Group of France) operated the Annesley, the Segorong, and the Thabazimbi Mines. The company accounted for a substantial majority of domestic andalusite production. Andalusite Resources (Pty) Ltd. operated the Maroeloesfontein Mine, which had a capacity of more than 70,000 t/yr. In June 2019, Andalusite Resources shut down its mining operations for about one month because of liquidity problems. The estimated remaining life of the Maroeloesfontein Mine was about 100 years (Lassetter, 2020).

Lime.—In 2019, lime sales decreased to 1.24 Mt from a revised 1.33 Mt in 2018 and nearly 1.38 Mt in 2009. Sales for use in the chemical industry accounted for 57% of total sales in 2019; pyrometallurgical applications, 37%; and water purification, 4%. Pyrometallurgical applications accounted for 50% of sales in 2009; the chemical industry, 44%; and water purification, nearly 4% (Motsie, 2010b; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Phosphate Rock.—In 2019, phosphate rock production decreased to 1.83 Mt from 2.06 Mt in 2018 and 2.08 Mt in 2017. In 2018, domestic sales of phosphate rock were at the rate of nearly 1.39 Mt/yr, and exports, 692,000 t/yr. In the second quarter of 2019, domestic sales were at the rate of more than 860,000 t/yr, and exports, 440,000 t/yr. Decreased sales were attributable to world market conditions. South Africa was a net importer of fertilizers (Muravha, 2019a, b).

Foskor was South Africa's leading producer of phosphate rock. The company used phosphate rock from its mine at Phalaborwa in the production of phosphoric acid and fertilizers, including monoammonium phosphate and diammonium phosphate at its plant in Richards Bay. In its 2019 fiscal year (which ended on March 31, 2019), Foskor produced 382,000 t of phosphoric acid compared with 453,000 t in fiscal year 2018. Fertilizer production decreased to 266,000 t from 357,000 t. Decreased production was attributable to labor disputes, equipment problems, and safety stoppages. Between fiscal years 2020 and 2022, Foskor planned to produce an average of 2.2 Mt/yr of phosphate rock, 550,000 t/yr of phosphoric acid, and 350,000 t/yr of fertilizers (Foskor (Pty) Ltd., 2019, p. 3, 25, 29).

In 2019, Foskor was engaged in the North Pit Pushback project, which would extend the life of mining operations at the company's North Pit at Phalaborwa to 2049. The company planned to complete the North Pit Pushback project by 2022 (Muravha, 2019a).

Kropz Elandsfontein (Pty) Ltd. and African Rainbow Capital (Pty) Ltd. planned to restart production at the Elandsfontein Mine, which is located in Western Cape Province, by the end of 2019. The companies planned to produce 1 Mt/yr of phosphate rock at a grade of 32% phosphorus pentoxide and to reach full capacity by the end of 2020. The opening of the mine subsequently was delayed until the fourth quarter of 2020 (Arnoldi, 2019a; Muravha, 2019a).

Salt.—In 2019, South Africa's production of salt increased to about 510,000 t from a revised 478,000 t in 2018 and 408,000 t in 2009. From 2009 to 2018, the number of salt producers decreased to 17 from 28. During the same period, the total market share of South African salt producers decreased to 51% from more than 99% because of low-cost imports from Botswana and Namibia. The food industry used about 12% of the salt mined in South Africa; most of the remainder was used in other industries, including petroleum refining and the manufacturing of animal feed, cooling brines, and petrochemicals (Motsie, 2010a, 2019; ResearchAndMarkets.com, 2020; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Sand, Construction.—In 2019, South Africa's sales of aggregates and sand for construction were 59 Mt compared with a revised 61.9 Mt in 2018. Sales of aggregates decreased to 47.2 Mt in 2019 from a revised 48.2 Mt in 2018 and sand for construction, to 11.8 Mt from a revised 13.7 Mt. Decreased sales of aggregates and sand for construction could be attributable to reduced investments in infrastructure. In early 2018, aggregates and construction sand were produced by cement producers and other companies at as many as 627 mines (Lourens and DeWater, 2018, p. 59–60, 63, 66–67, 72, 74–77, 80–114; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Sand, Industrial.—In 2019, South Africa's production of silica sand was 2.27 Mt, which was nearly unchanged from that in 2018. In early 2018, silica sand was produced at as many as 30 mines. Silica sand was used by Consol Glass (Pty) Ltd., Nampak Glass (Pty) Ltd., and other companies in the production of glass (Lourens and DeWater, 2018, p. 52, 73, 80–81, 88, 112, 116; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

As of April 2019, Incubex Minerals Ltd. had completed 90% of the planned expansion of its mine near Boshhoek. The company planned to increase its capacity to 144,000 t/yr from 72,000 t/yr. Production was expected to increase to 144,000 t/yr of silica by June 2021 from 48,000 t/yr in June 2018 (Incubex Minerals Ltd., 2018, p. 8; 2019, p. 8, 12).

Stone, Crushed.—In 2019, South Africa's production of limestone decreased to 22.3 Mt from a revised 22.7 Mt in 2018. In early 2018, limestone was produced by cement companies and other producers at as many as 46 mines. Limestone sales for use in cement were 14.5 Mt in 2019; metallurgy, 1.79 Mt; agriculture, 1.31 Mt; and other industries, 1.39 Mt (Lourens and DeWater, 2018, p. 65, 73–77; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Stone, Dimension.—In 2019, South Africa's sales of granite dimension stone were 384,019 t compared with a revised 387,397 t in 2018 and 396,300 t in 2009. About 44% of granite sales were domestic in 2019 compared with 84% in 2009; decreased domestic sales could be attributable to competition with engineered stone products. Granite accounted for more than 99% of the volume of national dimension stone sales. In 2018, granite was produced at as many as 57 mines; slate, 8 mines; sandstone, 7 mines; and other dimension stone, 8 mines. South Africa also had 45 dimension stone processing plants (Galane, 2018; Modiselle and Maredi, 2018, p. iii; Motsie, 2018; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Sulfur.—South Africa's sulfur production was estimated to be 920,000 t in 2019 compared with a revised 239,000 t in 2018 and about 536,000 t in 2009. Most domestic sulfur was recovered as a byproduct of petroleum refining in 2017 and 2018; sulfur also was recovered from copper and PGM mining. Imports of crude sulfur increased to 1.1 Mt in 2018 from 534,000 t in 2017 and 384,000 t in 2016. South Africa was a net

importer of sulfur because of the shortage of refining capacity for petroleum products. Copper and cobalt mining companies in Congo (Kinshasa) imported about 450,000 t/yr of sulfur, most of which was attributable to South Africa (Modiselle, 2019b; Reid and Shabalala, 2020; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Foskor used sulfur in the production of sulfuric acid; the company produced 1.36 Mt in its 2019 fiscal year compared with 1.38 Mt in fiscal year 2018. Output was limited by equipment problems, labor disputes, power failures, and water restrictions (Foskor (Pty) Ltd., 2019, p. 89).

Vedanta was engaged in a feasibility study on the development of a new zinc smelter and refinery at the Gamsberg Mine. Depending on the results of the study and obtaining reliable power supplies, the refinery could produce nearly 370,000 t/yr of sulfuric acid (Piper, 2019).

Vermiculite.—In 2019, Palabora Mining's production of vermiculite at the Palabora Mine was 158,013 t compared with 141,346 t in 2018 and 166,084 t in 2017. In 2018, South Africa's exports of vermiculite were 94,200 t and domestic sales were 13,600 t. Sales decreased in the second quarter of 2018 because of lower demand and insufficient supplies of medium and coarser grades of vermiculite. About 80% of vermiculite sold in South Africa was used in agricultural and horticultural applications and 20% was used in construction and insulation. Mining was expected to continue at Palabora until 2045 (Motsie, 2018; Golder Associates Inc., 2019, p. 20; Muravha, 2019c; Bulelwa Satsha, Administrative Officer, Department of Minerals and Energy of the Republic of South Africa, written commun., August 28, 2020).

Wollastonite.—Incubex produced wollastonite at its mine near Garies at the estimated rate of 1,100 t/yr in June 2018; production was also estimated to be at 1,100 t/yr in 2019. The company planned to increase production to 1,800 t/yr by June 2020. South Africa's wollastonite consumption was estimated to be between 2,400 and 4,800 t/yr; wollastonite was imported from China (table 1; Incubex Minerals Ltd., 2018, p. 10; 2019, p. 17–18).

Mineral Fuels and Related Materials

Coal.—In 2019, total coal production was about 259 Mt compared with 253 Mt in 2018 and 250.5 Mt in 2009. Bituminous coal accounted for 97% of South Africa's coal production in 2019. From 2010 to 2018, net investment in the coal subsector decreased by 44%. Coal accounted for more than 70% of the power generated in South Africa (table 1; Galane, 2018; Ryan, 2020).

In 2019, Eskom purchased 118 Mt of coal for use in its power stations. Coal exports from Richards Bay were 72 Mt in 2019, of which India accounted for 41.6 Mt, and Pakistan, 12 Mt. Nearly 73.5 Mt was exported from Richards Bay in 2018, of which India accounted for 35.3 Mt; Pakistan, 9.37 Mt; the Republic of Korea, 6.73 Mt; the Netherlands, 3.14 Mt; Spain, 1.38 Mt; and Egypt, 1.33 Mt. About 40 Mt of coal was used in the domestic production of synthetic fuels (Creamer, 2019c; Sasol Ltd., 2019, p. 47; Ryan, 2020).

Exxaro Resources Ltd.'s coal production decreased to 45.3 Mt in 2019 from 46.7 Mt in 2018; the company was South Africa's

leading producer of coal. Output at the Grooteegeluk Mine in the Waterberg Coalfield in Limpopo Province decreased to 27.8 Mt in 2019 from 29.7 Mt in 2018; metallurgical coal decreased to 2.07 Mt from 2.32 Mt. Grooteegeluk accounted for a majority of South Africa's metallurgical coal production. Exxaro planned to produce a total of nearly 49 Mt in 2020 and 53 Mt in 2021; metallurgical coal production was expected to increase to 2.8 Mt in 2020 (table 1; Tex Report, The, 2020a, b).

Exxaro started production at the Leeuwpans mine life expansion project in the second half of 2018; full production of 2.7 Mt/yr was expected by the second half of 2020. In the third quarter of 2019, Exxaro started mining at its new Belfast Mine in Mpumalanga Province. Belfast was expected to reach its full capacity of 2.7 Mt/yr by 2023. The company also started production from an expansion of the Dorstfontein Mine's capacity by 800,000 t/yr in 2019; the project was expected to be completed in the first half of 2020 (Exxaro Resources Ltd., 2020, p. 93).

Exxaro also was engaged in the expansion of Grooteegeluk's capacity by 1.7 Mt/yr in 2019; production could start by the second half of 2020. In 2019, Eskom approved partial funding to increase production at Matla to 10 Mt/yr from 6 Mt/yr. Exxaro planned to complete the expansion by 2023. As of yearend, the development of the new Thabametsi Mine was on hold indefinitely because of legal disputes (Exxaro Resources Ltd., 2020, p. 37, 40, 93; Ryan 2020).

In fiscal year 2019 (which started on July 1, 2018, and ended on June 30, 2019), Sasol Ltd.'s coal production decreased to 37.5 Mt from 38.8 Mt in fiscal year 2018. The Syferfontein Mine accounted for 10.1 Mt; the Twistdraai Mine, 8.7 Mt; Middelbult Mine, 7.1 Mt; the Bosjesspruit Mine, 4.9 Mt; the Impumelelo Mine, 4.8 Mt; the Sigma Mine, 1.4 Mt; and the Brandspruit Mine, 0.5 Mt. Most of Sasol's coal production was used in the company's synthetic fuel operations (Sasol Ltd., 2019, p. 46).

Glencore and ARM operated the Goedevonden Complex, the Impunzi Complex, and the Tweefontein Complex. Output at Goedevonden increased to 6.59 Mt in 2019 from 6.34 Mt in 2018 and decreased to a total of 14 Mt from 15.9 Mt at Impunzi and Tweefontein. Glencore and ARM planned to increase total sales from Impunzi and Tweefontein to between 17 and 18 Mt/yr by mid-2022. The companies also planned to maintain sales from Goedevonden at about 7 Mt/yr through mid-2022. The estimated remaining life of Goedevonden was 21 years, and at Impunzi and Tweefontein, 20 years (African Rainbow Minerals, 2019a, p. 5, 81–83; 2019b, p. 60, 62; 2020, p. 15, 17).

Izimbiwa Coal (Pty) Ltd. (Phembani Group, 50.01%, and Glencore, 49.99%) operated the Middelburg Complex; salable coal production was about 3.4 Mt in 2019. Umcebo Mining Ltd. (Glencore, 48.7%) operated the Wonderfontein Mine; production at Wonderfontein was about 3.3 Mt in 2019. The estimated remaining life of Wonderfontein was 11 years, and Middelburg, 5 years (Glencore plc, 2020b, p. 64–65).

Glencore also produced more than 1 Mt at Zonnebloom in 2019. Based on an estimated remaining mine life of 23 years, production at Zonnebloom could be as much as 3.3 Mt/yr of salable coal (Glencore plc, 2020b, p. 64).

Seriti Coal (Pty) Ltd. operated the Kriel, the New Denmark, and the New Vaal Mines. New Vaal produced 17 Mt/yr of coal and Kriel and New Denmark, 5 Mt/yr each. About 24 Mt/yr of

Seriti's production was supplied to Eskom. Seriti expected to continue production at New Denmark and New Vaal until 2039, and at Kriel, until 2029 (Seriti Coal (Pty) Ltd., undated).

Seriti planned to complete a feasibility study on a mine at the New Largo project in Mpumalanga Province in early 2020. Depending on the results of the study, the company could start trial mining at the New Largo project by mid-2020. Full production at New Largo was estimated to be 12 Mt/yr of thermal coal, which would be sold to Eskom. The estimated life of the mine was at least 50 years (Hancock, 2019).

Anglo American produced 26 Mt in 2019 at the Goedeheop, the Greenside, the Isibonelo, the Khwezela, and the Zibulo Mines compared with 26.4 Mt in 2018. Production at Goedeheop increased to 6.07 Mt from 5.44 Mt; at Khwezela, to 5.76 Mt from 5.53 Mt; and at Greenside, to 4.85 Mt from 4.45 Mt. In 2019, production at Zibulo decreased to 5.36 Mt from 6.38 Mt in 2018 and at Isibonelo, to 4 Mt from 4.6 Mt. About 65% of the company's sales were exports in 2019 (Anglo American plc, 2020, p. 11).

South32 produced coal at the Khutala, the Klipspruit, the Middelburg, and the Wolverkrans Mines in Mpumalanga Province. In 2019, the company's output decreased to 24.6 Mt from 26 Mt in 2018. South32 planned to produce at the rate of more than 28 Mt/yr in the first half of 2020. Seriti and South32 signed an agreement for Seriti to purchase South32's share in Khutala, Klipspruit, Middelburg, and Wolverkrans; the sale was not completed as of mid-December 2019 (Hancock, 2019; South32 Ltd., 2019, 2020).

Mbuyelo Coal (Pty) Ltd. (Mbuyelo Group, 49% and IchorCoal N.V. of the Netherlands, 45.18%) operated the Manungu, the Vlakvarkfontein, and the Welgemeend Mines. The company produced a total of between 7.2 Mt/yr and 8 Mt/yr of thermal coal at its mines for use in Eskom's power stations. IchorCoal agreed to sell its share in Mbuyelo to Africa Coal Partners in October 2019; the sale was expected to be completed at the end of January 2020 (Tex Report, 2019e).

Universal Coal plc of the United Kingdom operated the Kangala Mine, the North Block Complex (NBC), and the New Clydesdale Colliery (NCC) in Mpumalanga Province. The company purchased NBC from Exxaro in November 2018. In the company's fiscal year 2019 (which started on July 1, 2018, and ended on July 1, 2019), sales were 6.68 Mt compared with about 4.75 Mt in fiscal year 2018. NCC accounted for more than 2.5 Mt of sales in fiscal year 2019; Kangala, 2.4 Mt; and NBC, more than 1.7 Mt. As of mid-2018, the remaining life of NCC was estimated to be 20 years (Cornish, 2018b; Arnoldi, 2019c; Tex Report, The, 2019k).

Universal planned to produce about 8.4 Mt of salable coal in fiscal year 2020 and 9.6 Mt in fiscal year 2021. Planned sales from NBC were 3 Mt; NCC, 2.8 Mt; and Kangala, 2 Mt. The company planned to start production at its new Ubuntu Mine in 2019. Planned production at Ubuntu was 1.2 Mt/yr of salable coal for a period of 6 years; the mine had not opened as of yearend. Universal also planned to start mining at the Eloff project, which would increase production and extend the life of Kangala by 20 years (Tex Report, The, 2019g, j; 2020e).

Wescoal Holdings Ltd. operated the Elandspruit, the Khanyisa, and the Vangatfontein Mines in Mpumalanga Province.

Total sales from the company's operations were at the rate of 6.2 Mt/yr between April and September 2019 compared with 4.8 Mt/yr during the same period in 2017. Production was limited by labor disputes in April and May. As of May, Vangatfontein had an estimated remaining life of 8 years; Elandspruit, 6 years; and Khanyisa, 4 years. Wescoal planned to start mining at the Moabsvelden project, which could produce between 1.5 and 2 Mt/yr of run-of-mine coal, in 2020 (Kotze, 2017; Liedtke, 2019; Tex Report, The, 2020f, g).

Iyanga Mining (Pty) Ltd. operated three mines in Mpumalanga Province. The company produced about 6 Mt/yr of coal at the Klipfontein, the Leeuwpoort, and the Welgelegen Mines in the Witbank Coalfield (Beryl Group, undated).

Menar Holding (Pty) Ltd. of Luxembourg held controlling interests in Canyon Coal (Pty) Ltd., which operated the Hakhamo, the Khanye, the Phalanndwa, and the Singani Mines, and in Zululand Anthracite Colliery (Pty) Ltd. In December 2018, Menar completed the acquisition of Kangra Coal (Pty) Ltd. Kangra produced about 2 Mt/yr of salable coal from the Savmore Mine in Mpumalanga Province and Khanye, about 1.4 Mt/yr of salable coal out of 2.4 Mt/yr run-of-mine coal. Menar planned to increase total run-of-mine production at its operations to 20 Mt/yr from 7.5 Mt/yr in late 2019 (James, 2019; Moodley, 2019; Canyon Coal (Pty) Ltd., undated).

Menar's new projects included De Wittekrans, Palmietkuilen, and Springfield. Canyon planned to start mining at De Wittekrans and Palmietkuilen in 2020, and Springfield in 2021. Run-of-mine production at De Wittekrans was expected to be 3.6 Mt/yr, of which about 2.4 Mt/yr was estimated to be salable. The estimated life of Springfield was 40 years; Palmietkuilen, 27 years; and De Wittekrans, 24 years (Holman, 2013; Moodley, 2019).

Resource Generation Ltd. (Resgen) of Australia planned to build the new Boikarabelo Mine in the Waterberg coalfield. The company hoped to obtain financing by March 2020 and to start mining by 2022. Resgen planned to produce 15 Mt/yr of run-of-mine coal at Boikarabelo, of which 6 Mt/yr would be salable (Resource Generation Ltd., 2020).

MC Mining Ltd. of Australia planned to develop the Makhado project at the Southpansberg coalfield in Limpopo Province. The company planned to produce about 1.8 Mt/yr of salable coal. Thermal coal was expected to account for between 900,000 t/yr and 1 Mt/yr, and metallurgical coal, between 800,000 and 900,000 t/yr. The development of Makhado depended on the resolution of disputes with local landowners, which MC Mining hoped to resolve by early 2020 (Creamer, 2018b).

Eskom's power generating capacity was between 44,000 and 46,000 MW. The company had planned to reach full capacity at its Kusile and Medupi coal-fired power stations in 2015. The completion of Medupi was delayed until 2020 or 2021, and of Kusile, until 2023. The delays in completing Kusile and Medupi led to power rationing by Eskom. In early December 2019, Medupi was shut down by flooding. Eskom requested a reduction in power usage of more than 20% from the mining and manufacturing industries as a result. Some mines reportedly shut down because of the power shortages (Burkhardt and Cohen, 2019; Tex Report, The, 2019b, f).

Outlook

Numerous producers are planning new mines and plants and capacity expansions of existing operations for chromite, coal, copper, ferrovanadium, fluorspar, gold, iron ore, manganese ore, nickel, PGMs, phosphate rock, rare-earth, sulfuric acid, vanadium, and zinc. Challenges to the industry included aging mines, decreasing ore grades, increasing costs, labor disputes, low levels of exploration activity, and power outages (Louw, 2017; Tex Report, The, 2019b, f).

Increased coal production depended on the construction of new mines in the Waterberg coal field. Development of new mines could be constrained by the lack of infrastructure and water, the distances from domestic consumers and export terminals, the greater mine depths, and the relatively low quality of the coal. Other factors included legal challenges to new coal-fired power stations and difficulties in obtaining financing (Prevost, 2017; Ryan, 2020).

Increased manganese production depended on the expansion of Transnet's rail capacity. Ferromanganese production was likely to be constrained by power supply problems. Gold production could be constrained by increasing costs (McKay, 2019).

Increases in ferrovanadium production depended on the relative prices of ferroniobium and ferrovanadium. Substitution of ferroniobium for ferrovanadium was expected to take place at ferrovanadium prices of at least \$50 per kilogram (Khaile, 2019b).

In the PGM mining subsector, production could shift away from platinum and towards palladium. Many PGM mining companies are producing less ore from the platinum-rich Merensky layer and more from the palladium-rich UG2 layer. Production also could shift away from platinum with the development of more palladium-rich deposits in the Northern Limb of the Bushveld Complex. For iridium, rhodium, and ruthenium, increased production because of the shift from the Merensky layer to the UG2 ore layer could be offset by decreased production because of the shift from the Western and Eastern Limbs to the Northern Limb (Impala Platinum Holdings Ltd., 2008).

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TABLE 1
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons, gross weight, unless otherwise specified)

Commodity	2015	2016	2017	2018	2019
METALS					
Aluminum, metal, primary	695,000	701,000	716,000	714,000	717,000
Antimony, mine, Sb content, concentrate	302	350	--	--	--
Chromium, mine, chromite:					
44% to 48% Cr ₂ O ₃ thousand metric tons	2,127	1,935	2,010	1,133 ^r	1,428
Less than 44% Cr ₂ O ₃ do.	13,528	12,772	14,661 ^r	16,718 ^r	16,227
Total	15,700	14,700	16,700 ^r	17,900 ^r	17,700
Cobalt:					
Mine, Co content ^e	3,000 ^r	2,300	2,300	2,300	2,100
Refinery, metal powder and sulfate	1,362 ^r	1,101	1,062	1,089	1,000 ^e
Copper, Cu content:					
Mine, concentrates	77,400	65,300	65,500	46,900 ^r	52,500
Smelter, primary	71,800	68,700	70,000	70,000	75,000
Refinery, primary	70,900 ^r	68,800 ^r	70,000 ^r	70,000 ^r	75,000
Ferroalloys:					
Ferrochromium thousand metric tons	3,685	3,596	3,700 ^e	3,900 ^e	3,600 ^e
Ferromanganese do.	512	335	257	236	232
Ferrosilicon do.	92	73	48	98 ^e	98 ^e
Ferrovanadium ^e do.	15	7	7	7	7
Silicomanganese ² do.	210	144	160	164	172
Gold:					
Mine, Au content kilograms	144,504	142,202	137,290 ^r	117,144 ^r	105,185
Refinery ^{e, 3, 4} do.	340,000	300,000	300,000	370,000 ^r	330,000
Iron ore, mine:					
Gross weight thousand metric tons	72,806	66,456	75,091 ^r	74,273 ^r	72,407
Fe content do.	46,000	43,000 ^r	47,600	47,200	46,100
Iron and steel:					
Direct-reduced iron do.	1,125	702	925	835	661
Pig iron do.	4,464	4,311	4,352	4,611	3,791
Steel:					
Raw steel do.	6,417	6,141	6,301	6,327	6,152
Products, hot-rolled ^e do.	5,700	5,450	5,600	5,650	4,000
Products, stainless do.	515	582	591	550	469
Lead:					
Mine, Pb content, concentrate	34,573	39,344	48,150	35,118 ^r	42,936
Refinery, secondary ^e	52,000	54,000	54,000	56,000	56,000
Manganese:					
Mine, metallurgical:					
Gross weight:					
30% to 40% Mn thousand metric tons	7,340	8,290	10,441 ^r	10,512 ^r	11,718
40% to 45% Mn do.	2,499	1,082	2,884	2,189	2,786
45% to 48% Mn do.	1,195 ^r	1,434	1,209	2,219	2,226
More than 48% Mn do.	--	--	119	--	270 ^e
Total do.	11,000	10,800	14,700 ^r	14,900	17,000
Mn content ^e do.	4,300	4,200	5,700 ^r	5,800	6,600
Electrolytic, metal ^e do.	30	30	30	30	30
Nickel, Ni content:					
Mine, sulfide ore, concentrate	56,689	48,994	48,463 ^r	43,236	43,443
Intermediate, matte, for domestic use ^e	39,000	38,000	39,000 ^r	35,000 ^r	35,000
Chemicals	5,300 ^e	4,743	4,966	5,281	4,600 ^e
Refinery, metal, electrolytic	41,910	42,332	42,362	39,500	39,100

See footnotes at end of table.

TABLE 1—Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons, gross weight, unless otherwise specified)

Commodity		2015	2016	2017	2018	2019
METALS—Continued						
Platinum-group metals:						
Mine, primary:						
Iridium, Ir content	kilograms	6,230	6,624	6,057 ^r	6,357	6,464
Palladium, Pd content	do.	82,691	76,273	80,713 ^r	80,629	80,684
Platinum, Pt content	do.	139,125	133,241	132,500 ^r	137,053	132,989
Rhodium, Rh content	do.	18,722	19,237	18,665 ^r	18,608	19,545
Ruthenium, Ru content	do.	28,747	28,278	24,821 ^r	27,999	28,386
Total	do.	276,000	264,000	263,000 ^r	271,000	268,000
Refinery:						
Palladium, Pd content	do.	89,815	88,719	93,126	89,299	90,000 ^e
Platinum, Pt content	do.	151,156	150,300	154,295	155,915	145,000 ^e
Rhodium, Rh content	do.	18,220	19,360	19,830	18,550	18,000 ^e
Other, elemental content ⁵	do.	34,800	37,450	34,840	31,800	35,000 ^e
Total	do.	294,000	296,000	302,000	296,000	294,000 ^e
Selenium, anode slimes, Se content ^c	do.	14,000	14,000	12,000	9,300 ^r	8,500
Silicon, metal	thousand metric tons	46	27	5	51 ^e	33 ^e
Silver, mine, Ag content	kilograms	51,861	55,622	62,536	46,467	55,903
Tellurium, refinery, Te content, anode slimes ^e		6,600	6,700	5,300	4,200 ^r	3,900
Titanium:						
Ilmenite and leucoxene ^c	thousand metric tons	1,900 ^r	1,700 ^r	2,100 ^r	1,900 ^r	1,800
Rutile	do.	110 ^{r,e}	120 ^{r,e}	110 ^{r,e}	110 ^e	105
Total	do.	2,010 ^r	1,820 ^r	2,210 ^r	2,010 ^r	1,910
Titaniferous slag	do.	930 ^{r,e}	800 ^{r,e}	1,000 ^e	950 ^{r,e}	903
Vanadium, V content		17,788	8,163	7,959	7,700	8,030
Zinc, mine, Zn content, concentrate		29,040	26,695	30,778	28,129	125,157
Zirconium, baddeleyite and zircon		377,767	377,430	361,813	330,000 ^{r,e}	324,000
INDUSTRIAL MINERALS						
Cement, hydraulic ⁶	thousand metric tons	12,992	14,457 ^r	14,134 ^r	13,680 ^r	12,726
Clay and shale:						
Bentonite		165,535	148,742	165,141	173,486	105,084
Brick clay ⁶	thousand metric tons	6,945	6,668	7,103 ^r	5,588 ^r	4,706
Fire clay		751,711	985,333	430,650	525,853	751,238
Flint, raw and calcined		19,785	10,203	10,064	4,421	5,390
Fullers earth, attapulgite		17,627	16,374	18,286 ^r	17,246 ^r	11,090
Kaolin		20,126	21,141	31,186 ^r	23,724	27,827
Plastic clay		4,554	--	--	2,092	12,604
Shale: ⁶						
For brickmaking	thousand metric tons	963	1,363	1,036 ^r	1,043 ^r	1,035
For cement	do.	354	395	356	305	252
Diamond, gem and industrial	thousand carats	8,233	8,306	9,693 ^r	9,912 ^r	7,181
Feldspar		130,184	127,872	116,705	76,803	76,255
Fertilizers, phosphate fertilizers ^{7, 8}		296,567	198,251	324,020	357,286	266,345
Fluorspar ^e						
Acid grade		110,000	146,000	206,000 ^r	240,000 ^r	190,000
Metallurgical grade		11,000	31,000	12,000 ^r	20,000 ^r	20,000
Total		121,000	177,000	218,000 ^r	260,000 ^r	210,000
Garnet, industrial		284,990	254,693	211,394	278,205	179,057
Gemstones:						
Amethyst ^c	kilograms	500	500	500	500	500
Emerald	do.	--	--	--	2	2
Gypsum, mine		231,688	262,457	320,685	321,988 ^r	277,102
Kyanite and related materials, andalusite ^c		190,000	160,000	180,000	200,000	190,000
Lime ⁶	thousand metric tons	1,119	1,131	1,221	1,332 ^r	1,239

See footnotes at end of table.

TABLE 1—Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons, gross weight, unless otherwise specified)

Commodity	2015	2016	2017	2018	2019
INDUSTRIAL MINERALS—Continued					
Magnesite, mine ^c	40,000	60,000	80,000	90,000	99,000
Mica, ground and scrap	29	8	21	32	9
Nitrogen, ammonia, N content	480,000 ^r	450,000 ^r	500,000 ^r	470,000 ^r	460,000
Perlite ^c	1,000	1,000	1,000	1,000	1,000
Phosphate rock:					
Gross weight thousand metric tons	1,852	1,697	2,079	2,058	1,826
P ₂ O ₅ content do.	685	636	769	761	676
Phosphoric acid ^{7,8}	392,760	307,476	449,697	452,526	382,035
Salt	517,159	473,339	492,860 ^r	478,285 ^r	510,012
Sand and gravel, industrial, unspecified thousand metric tons	2,278	1,886	2,401	2,288 ^r	2,269
Sodium, compounds, sodium sulfate, natural	38,374	26,248	57,493	44,008	42,581
Stone, sand, and gravel, construction:					
Sand and gravel: ⁶					
Aggregate thousand metric tons	48,991	51,035	52,102 ^r	48,223 ^r	47,172
Sand do.	14,788	14,594	14,306 ^r	13,707 ^r	11,778
Stone:					
Crushed, limestone, including dolomite do.	22,927	23,355	23,752 ^r	22,746 ^r	22,275
Dimension:					
Granite, including norite ⁶	263,333	307,540	291,148 ^r	387,397 ^r	384,019
Slate	6,497	60	848	2,000 ^c	2,000 ^c
Sulfur, byproduct, S content:					
Metallurgy	108,579	85,114	62,824	58,000 ^c	720,000 ^c
Petroleum	169,051	195,716	193,786	181,000 ^c	180,000 ^c
Total	278,000	281,000	257,000	239,000 ^c	920,000 ^c
Sulfur compounds, sulfuric acid: ^{7,8}					
Gross weight thousand metric tons	1,436	1,062	1,412	1,378	1,360
S content do.	470	347	461	450	445
Talc and related minerals:					
Pyrophyllite, wonderstone	17,352	19,114	55,048	98,245	134,451
Talc	4,497	4,462	3,728	3,897	979
Vermiculite	138,290	166,483	166,084	141,346	158,013
Wollastonite ^c	1,100	1,100	1,100	1,100	1,100
MINERAL FUELS AND RELATED MATERIALS					
Coal, marketable:					
Anthracite thousand metric tons	3,396 ^r	2,635	3,336 ^r	3,317	3,808
Bituminous ^c do.	246,000	244,000	247,000 ^r	246,000	251,000
Metallurgical ^c do.	2,700	4,000	2,300 ^r	3,900	4,000
Total ^c	252,000	251,000	253,000	253,000	259,000
Coke, metallurgical, marketable do.	2,009	1,940	1,900 ^c	1,900 ^c	1,900 ^c
Natural gas million cubic meters	1,464	901	822	685	734
Petroleum:					
Natural gas liquids, refinery thousand 42-gallon barrels	738	406 ^r	322 ^r	250 ^r	312
Refinery:					
Distillate fuel oil do.	46,498 ^r	58,524 ^r	43,723 ^r	40,411 ^r	40,000 ^c
Gasoline do.	47,623	65,621 ^r	51,035 ^r	48,348 ^r	48,000 ^c
Jet fuel do.	18,564 ^r	17,613 ^r	16,352 ^r	16,011 ^r	16,000 ^c
Kerosene do.	3,548	4,313 ^r	4,785 ^r	4,677 ^r	4,700 ^c
Liquefied petroleum gas do.	3,468 ^r	4,872 ^r	4,698 ^r	2,854 ^r	2,900 ^c
Residual fuel oil do.	25,248	3,899 ^r	5,961 ^r	18,335 ^r	18,000 ^c
Other, including lubricants and greases do.	3,636	4,606 ^r	4,068 ^r	3,852 ^r	3,900 ^c
Total do.	149,000 ^r	159,000 ^r	131,000 ^r	134,000 ^r	134,000 ^c
Uranium, mine, U content	448	382	310 ^c	196	138

See footnotes at end of table.

TABLE 1—Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES¹

^cEstimated. ¹Revised. do. Ditto. -- Zero.

¹Table includes data available through July 6, 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.

²Reported by the International Manganese Institute.

³Data are for the Rand Refinery (Pty) Ltd.

⁴Production is based on fiscal year, with a starting date of October 1 of the year shown.

⁵May include small amounts of gold.

⁶Sales.

⁷Data are for Foskor (Pty) Ltd..

⁸Production is based on fiscal year, with an ending date of March 31 of the year shown.

TABLE 2
SOUTH AFRICA: 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
Aggregates	AfriSam Consortium (Pty) Ltd.	18 mines in Gauteng, KwaZulu Natal, Mpumalanga, and Western Cape Provinces	10,000.
Do.	Lafarge Mining South Africa (Pty) Ltd. (LafargeHolcim Ltd., 76.3%)	21 mines in Eastern Cape, Free State, KwaZulu Natal, Limpopo, Mpumalanga, and Western Cape Provinces	6,000. ^c
Do.	Pretoria Portland Cement Co. (Pty) Ltd. (Barloworld Trust Co. Ltd., 68%)	Mines at Francistown, Kgale, Laezenia, and Mooiplaas	3,000.
Aluminum	South32 Ltd.	Hillside smelter at Richards Bay	726.
Andalusite	Imerys South Africa (Pty) Ltd. (Imerys Group)	Annesley and Segorong Mines at Penge, and Thabazimbi Mine near Thabazimbi	250. ^c
Do.	Andalusite Resources (Pty) Ltd. [African Mineral Trading and Exploration (Pty) Ltd.]	Maroeloesfontein Mine, near Thabazimbi, Northern Province	75. ^c
Antimony metric tons	Stibium Mining (Pty) Ltd.	Cons Murch Mine near Gravelotte ¹	5,500.
Cement	Pretoria Portland Cement Co. (Pty) Ltd. (Barloworld Trust Co. Ltd., 68%)	De Hoek, Dwaalboom, Hercules, Jupiter, Riebeeck, and Slurry plants	7,000.
Do.	AfriSam Consortium (Pty) Ltd.	Dudfield, Roodepoort, and Ulco plants	4,600.
Do.	Lafarge Industries South Africa (Pty) Ltd. (LafargeHolcim Ltd., 76.3%)	Lichtenburg plant in North West Province	3,200.
Do.	Dangote Cement South Africa (Pty) Ltd. (Dangote Industries Ltd., 64%)	Plants near Delmas in Mpumalanga Province and at Lichtenburg	2,900.
Do.	Natal Portland Cement Co. (Pty) Ltd. (Cimentos de Portugal SGPS, S.A., 98%)	Simuma plant in KwaZulu-Natal Province	1,800.
Do.	Mamba Cement Co. (Pty) Ltd.	Plant near Northam	1,000.
Chromium:			
Chromite	Samancor Chrome (Pty) Ltd. [International Mineral Resources BV, 70%, and Batho Barena (Pty) Ltd., 28%]	Eastern Chrome Mines in Limpopo Province and Western Chrome Mines in North West Province	5,000. ^c
Do.	Glencore plc, 79.5%, and Merafe Resources Ltd., 20.5%	Magareng Mine in Mpumalanga Province	1,200.
Do.	do.	Thorncliffe Mine at Steelpoort	995.
Do.	do.	Kroondal Mine at Rustenburg	850.
Do.	do.	Helena Mine at Steelpoort	825.
Do.	do.	Waterval Mine in North West Province	650.
Do.	do.	Boshhoek Mine in North West Province	NA.
Do.	Sibanye-Stillwater Ltd.	Marikana Mines (Eastern Platinum, Karee, and Western Platinum) and Pandora Mine	1,700. ^c
Do.	do.	Waterval plant near Rustenburg Mine	830. ^c
Do.	Tharisa Minerals (Pty) Ltd.	Tharisa Mine in North West Province	1,920.
Do.	Assore Ltd.	Dwarsrivier Mine in Mpumalanga Province	1,600. ^c
Do.	Hernic Ferrochrome (Pty) Ltd. (Mitsubishi Corp., 51%)	Bokone and Morula Mines near Brits ¹	1,500.
Do.	Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats)	Plants at Amandelbult Mine near Northam	1,000. ^c
Do.	Eastern Platinum Ltd. (Eastplats)	Crocodile River Mine in North West Province	1,000. ^c
Do.	Northam Platinum Ltd. [Zambezi Platinum (RF) Ltd., 31.37%, and Coronation Asset Management (Pty) Ltd., 27.71%]	Booyssendal Mine near Roossenekal, Eland Mine near Brits, and Zondereinde Mine near Northam	1,000. ^c
Do.	Nkomati Joint Venture (African Rainbow Minerals Ltd., 50%, and MMC Norilsk Nickel, 50%)	Nkomati Mine in Mpumalanga Province	900.
Do.	Cheetah Chrome South Africa (Pty) Ltd.	Dilokong Mine, near Burgersfort in Mpumalanga Province ¹	800.
Do.	Afarak Group Oyj	Mecklenburg, Stellite, and Zeerust Mines ¹	500. ^c
Do.	Siyanda Resources (Pty) Ltd.	Masa Plant at Union Mine near Northam	330.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: 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
Chromium:—Continued			
Chromite—Continued	Two Rivers Platinum Mine (Pty) Ltd. (African Rainbow Minerals Ltd., 55%, and Impala Platinum Holdings Ltd., 45%)	Two Rivers Platinum Mine near Steelpoort	320. ^c
Ferrochromium	Samancor Chrome (Pty) Ltd. [International Mineral Resources BV, 70%, and Batho Barena (Pty) Ltd., 28%]	Plants near Brits, Burgersfort, eMalahnai, Lydenburg, ² Middelburg, and Rustenburg	2,400.
Do.	Glencore plc, 79.5%, and Merafe Resources Ltd., 20.5%	Lion plant at Steelpoort	720.
Do.	do.	Wonderkop plant at Marikana	553.
Do.	do.	Rustenburg plant at Rustenburg	430.
Do.	do.	Lydenburg plant at Lydenburg	396.
Do.	do.	Boshoeck plant at Boshoeck	240.
Do.	Traxys Group	Plant at Richards Bay ¹	150.
Do.	Afarak Group Oyj	Mogale plant	55 ^c .
Clay and shale:			
Brick clay	Corobrik (Pty) Ltd.	Quarries at Bellville, Durban, Glencoe, Kempton Park, Klerksdorp, Oberholzer, Pietersburg, Potchefstroom, Pretoria, Roodeport, Springs, Welcom, Westonaria, and Witbank	3,600. ^c
Do.	Brikor Ltd.	Ilangabi Mine in Gauteng Province	800.
Fire clay	Ceramic Industries Ltd.	Quarries at Pretoria, Vereeniging, and Waterberg	530. ^c
Coal	Exxaro Resources Ltd. (BEE Holdco, 52.3%)	Grooteegeluk Mine in Limpopo Province	33,400.
Do.	do.	Matla Mine in Mpumalanga Province	8,500. ^c
Do.	do.	Leeuwpan Mine in Mpumalanga Province	7,000. ^c
Do.	Exxaro Resources Ltd., 50%, and Wescoal Holdings Ltd., 50%	Arnot Mine in Mpumalanga Province ¹	5,000.
Do.	Anglo American plc, 50%, and Exxaro Resources Ltd., 50%	Mafube Mine near Sasolburg	4,200.
Do.	Exxaro Resources Ltd. (BEE Holdco, 52.3%)	Belfast Mine in Mpumalanga Province	2,700.
Do.	do.	Dorstfontein Complex in Mpumalanga Province	2,500. ^c
Do.	do.	Forzando Complex in Mpumalanga Province	2,000. ^c
Do.	Sasol Ltd.	Syferfontein Mine near Secunda	11,000.
Do.	do.	Twistdraai Mine near Secunda	9,700.
Do.	do.	Middelbult Mine near Secunda	8,000.
Do.	do.	Impumelelo Mine near Secunda	6,800.
Do.	do.	Bosjesspruit Mine near Secunda	6,300.
Do.	do.	Brandspruit Mine near Secunda ¹	3,300.
Do.	do.	Sigma Mine near Sasolburg	1,900.
Do.	South32 Ltd.	Middelburg and Wolverkrans Mines in Mpumalanga Province	17,000.
Do.	do.	Khutala Mine in Mpumalanga Province	12,000.
Do.	do.	Klipspruit Mine in Mpumalanga Province	7,000.
Do.	Anglo Coal Ltd. (Anglo American plc, 100%)	Khwezela Mine near Witbank	8,700.
Do.	do.	Zibulo Mine in Mpumalanga Province	8,000.
Do.	do.	Goedehoop Mine in Mpumalanga Province	7,500.
Do.	do.	Isibonelo Mine in Mpumalanga Province	5,000.
Do.	do.	Greenside Mine near Witbank	5,000. ^c
Do.	Seriti Coal (Pty) Ltd.	New Vaal Mine near Vanderbijlpark	18,000.
Do.	do.	Kriel Mine in Mpumalanga Province	10,000.
Do.	do.	New Denmark Mine in Mpumalanga Province	5,000.
Do.	Glencore plc, 79.8%, and African Rainbow Minerals Ltd., 20.2%	Impunzi Complex and Tweefontein Complex at Witbank	18,000. ^c
Do.	do.	Goedevonden Complex at Witbank	7,700.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: 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
Coal—Continued		Exxaro Resources Ltd. (BEE Holdco, 52.3%)	Grootegeeluk Mine in Limpopo Province	33,400.
Do.		Glencore plc	Zonnebloem Mine in Mpumalanga Province	3,300. ^c
Do.		Optimum Coal Mine (Pty) Ltd. [Tegeta Exploration & Resources (Pty) Ltd., 67.6%]	Optimum Complex in Mpumalanga Province ¹	10,000.
Do.		do.	Koornfontein Mine in Mpumalanga Province ¹	3,500.
Do.		Wescoal Holdings Ltd.	Vanggatfontein Mine in Mpumalanga Province	4,000.
Do.		do.	Elandspruit Mine in Mpumalanga Province	3,100.
Do.		do.	Khanyisa Mine in Mpumalanga Province	1,200.
Do.		Mbuyelo Coal (Pty) Ltd. (Mbuyelo Group, 49%, and IchorCoal N.V., 45%)	Manungu, Vlakvarkfontein, and Welgemeend Mines in Mpumalanga Province	8,000. ^c
Do.		Universal Coal plc	New Clydesdale Colliery in Mpumalanga Province	3,000.
Do.		do.	North Block Complex in Mpumalanga Province	2,600.
Do.		do.	Kangala Mine in Mpumalanga Province	2,400.
Do.		Canyon Coal (Pty) Ltd. [Menar Holding (Pty) Ltd.]	Hakhano, ¹ Khanye, Phalanndwa and Singani Mines in Mpumalanga Province	3,700. ^c
Do.		Menar Holding (Pty) Ltd.	Savmore Mine in Mpumalanga Province	2,000. ^c
Do.		Zululand Anthracite Colliery (Pty) Ltd. [Menar Holding (Pty) Ltd., 76%]	Mine near Emakhalathini	870. ^c
Do.		Iyanga Mining (Pty) Ltd.	Klipfontein, Leeuwpoot, and Welgelegen Mines in Mpumalanga Province	6,000. ^c
Do.		Hosken Consolidated Coal (Pty) Ltd.	Palesa Mine in Mpumalanga Province	3,300. ^c
Do.		do.	Mbali Mine in Mpumalanga Province	1,500. ^c
Do.		Izimbiwa Coal (Pty) Ltd. (Phembani Group, 50.01%, and Glencore plc, 49.99%)	Middelburg Complex	3,800. ^c
Do.		Umcebo Mining Ltd. (Glencore plc, 48.7%)	Wonderfontein Mine near Belfast	3,700. ^c
Do.		Vunene Mining (Pty) Ltd. (IchorCoal N.V., 76%)	Vunene Mine in Mpumalanga Province	2,100. ^c
Do.		do.	Mbali Mine in Mpumalanga Province	1,600.
Do.		Eyethu Coal (Pty) Ltd.	Mooifontein and other mines in Mpumalanga Province	3,100. ^c
Do.		Imbawula Group	Spitzkop and Tselentis Mines near Ermelo	2,800.
Do.		Kuyasa Mining (Pty) Ltd.	Delmas Mine	2,000.
Cobalt:				
Mine	metric tons	Nkomati Joint Venture (African Rainbow Minerals Ltd., 50%, and MMC Norilsk Nickel, 50%)	Nkomati Mine in Mpumalanga Province	1,200. ^c
Do.	do.	Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Amandelbult, Kroondal, Modikwa, Mogalakwena and Mototolo Mines in Bushveld Complex	500. ^c
Refined	do.	Impala Platinum Holdings Ltd. (Implats)	Base metals refinery	900. ^c
Copper:				
Mine		Palabora Mining Co. Ltd.	Palabora Mine at Phalaborwa	65. ³
Do.		Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Amandelbult, Kroondal, Modikwa, Mogalakwena and Mototolo Mines in Bushveld Complex	13. ³
Do.		Nkomati Joint Venture (African Rainbow Minerals Ltd., 50%, and MMC Norilsk Nickel, 50%)	Nkomati Mine in Mpumalanga Province	10.
Do.		Impala Platinum Holdings Ltd. (Implats)	Impala Rustenburg Mine near Phokeng	7. ³
Do.		Black Mountain Mineral Development Co. (Pty) Ltd. (Vedanta Resources Ltd., 69.6%)	Black Mountain Mine near Aggeneys in Northern Cape Province	6. ³
Smelter		Palabora Mining Co. Ltd.	Smelter at Phalaborwa	110. ³
Do.		Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Rustenburg Smelter near Rustenburg	11. ³
Do.		Impala Platinum Holdings Ltd. (Implats)	Smelter near Phokeng	7. ³

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: 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
Copper:—Continued				
Refined		Palabora Mining Co. Ltd.	Refinery at Phalaborwa	140. ³
Do.		Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Refinery near Rustenburg	13. ³
Do.		Sibanye-Stillwater Ltd.	Refinery at Brakpan	9. ³
Do.		Impala Platinum Holdings Ltd. (Implats)	Refinery at Springs	7. ³
Diamond	thousand carats	De Beers Consolidated Mines Ltd. (DeBeers Group of Companies, 76%)	Venetia Mine in Northern Province	7,500.
Do.	do.	do.	Voorspoed Mine ¹ in Free State Province	800.
Do.	do.	Petra Diamonds Ltd.	Finsch Mine in Northern Cape Province	2,000.
Do.	do.	do.	Cullinan Mine in Gauteng Province	1,700.
Do.	do.	do.	Koffiefontein Mine in Free State Province	85.
Do.	do.	DiamondCorp plc	Lace Mine ¹ near Kroonstad	500.
Do.	do.	Jagersfontein Developments (Pty) Ltd.	Jagersfontein Mine in Free State Province	250. ^c
Do.	do.	West Coast Resources (Pty) Ltd. (Trans Hex Group, 67.2%)	Namaqualand operations	130. ^c
Do.	do.	Batho Pele cooperative ⁴	Near Kimberley Mine in Northern Cape Province	NA.
Fertilizers, phosphate		Foskor (Pty) Ltd.	Plant at Richards Bay	350.
Fluorspar		Vergenoeg Mining Corp. (Pty) Ltd. (Minerales Y Productos Derivados SA , 85%)	Vergenoeg Mine at Rust de Winter	250 acid-grade; 30 metallurgical grade.
Do.		Sephaku Fluoride Ltd. (SepFluor)	Nokeng Mine at Rust de Winter	180 acid grade; 30 metallurgical grade.
Garnet, industrial		Mineral Commodities Ltd. (MCL)	Tormin Mine in Western Cape Province	300.
Gemstones:				
Amethyst	kilograms	Artisanal miners	Mines at Boekenhouthoek	500. ^c
Emerald	do.	Magnum Mining & Exploration Ltd.	Gravelotte Mine	600.
Gold:				
Mine ⁵	do.	Harmony Gold Mining Co. Ltd.	Tshepong Mine in Free State Province	9,000.
Do.	do.	do.	Moab Khotsong Mine in Free State Province	7,700.
Do.	do.	do.	Kusasaletu Mine in Gauteng Province	5,300.
Do.	do.	do.	Doornkop Mine in Gauteng Province	3,500.
Do.	do.	do.	Kalgold, Phoenix, and other surface operations	2,700.
Do.	do.	do.	Target 1 Mine in Free State Province	2,600.
Do.	do.	do.	Bambanani Mine in Free State Province	2,400.
Do.	do.	do.	Masimong Mine in Free State Province	2,200.
Do.	do.	do.	Joel Mine in Free State Province	1,900.
Do.	do.	do.	Unisel Mine in Free State Province	1,000.
Do.	do.	Sibanye-Stillwater Ltd.	Kloof Mine in Gauteng Province	17,000. ^c
Do.	do.	do.	Beatrix Mine in Free State Province	6,800. ^c
Do.	do.	do.	Driefontein Mine in Gauteng Province	5,800. ^c
Do.	do.	do.	Burnstone Mine ¹ in Mpumalanga Province	3,900.
Do.	do.	do.	Cooke operations in Gauteng Province	1,600. ^c
Do.	do.	AngloGold Ashanti Ltd. (Anglo American plc, 41.8%)	Mponeng Mine in Gauteng Province	10,000.
Do.	do.	do.	Tau Tona Mine ¹ in Gauteng Province	8,100.
Do.	do.	do.	Surface Operations in North West Province	7,000. ^c
Do.	do.	Gold Fields Ltd.	South Deep Mine in Gauteng Province	9,200.
Do.	do.	Pan African Resources plc	Barberton Mine in Mpumalanga Province	3,400.
Do.	do.	do.	Elikhulu Tailings Retreatment Project in Mpumalanga Province	2,300.
Do.	do.	do.	Evander Mines' 8 Shaft in Mpumalanga Province	1,200.
Do.	do.	do.	Barberton Tailings Retreatment Project in Mpumalanga Province	780.
Do.	do.	DRDGold Ltd. (Sibanye-Stillwater Ltd., 38.05%)	Ergo and Far West Gold Recovery Operations in Gauteng Province	6,200. ^c

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: 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
Gold:—Continued				
Mine— Continued	kilograms	Village Main Reef Ltd. (Heaven-Sent Capital Group)	Kopanang Mine in Free State Province	2,900. ^c
Do.	do.	do.	Tau Lekoa Mine in North West Province	2,500. ^c
Do.	do.	Gold One International Ltd.	Modder East Mine in Gauteng Province	4,700.
Do.	do.	Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Amandelbult, Kroondal, Modikwa, Mogalakwena and Mototolo Mines in Bushveld Complex	3,000. ^c
Refined	metric tons	Rand Refinery (Pty) Ltd. (AngloGold Ashanti Ltd., 42.41%, and Sibanye-Stillwater Ltd., 33.15%)	Plant at Germiston in Gauteng Province	410.
Iron and steel:				
Iron ore		Kumba Iron Ore Ltd.	Sishen Mine at Sishen	38,000.
Do.		do.	Kolomela Mine in Northern Cape Province	14,000.
Do.		Assmang (Pty) Ltd.	Khumani Mine in Northern Cape Province	16,000.
Do.		do.	Beeshoek Mine near Postmasburg	4,000.
Do.		Palabora Mining Co. Ltd.	Palabora Mines at Phalaborwa	10,000.
Do.		Sedibeng Iron Ore (Pty) Ltd. [Black Ginger (Pty) Ltd., 64%]	Mine at Postmasburg in Northern Cape Province	2,000
Do.		Foskor (Pty) Ltd.	Foskor Mine and plant at Phalaborwa	1,400.
Do.		Afrimat Ltd.	Diro Mine in Northern Cape Province	1,000.
Pig iron		ArcelorMittal South Africa Ltd.	Plants at Vanderbijlpark	3,200.
Do.		do.	Plant at Newcastle	1,800.
Do.		Richards Bay Minerals (RBM) (Rio Tinto plc, 74%, and Blue Horizon Investments, 24%)	Smelter at Richards Bay	550.
Steel, raw		ArcelorMittal South Africa Ltd.	Plant at Vanderbijlpark	2,900.
Do.		do.	Plants at Newcastle and Vereeniging	1,900.
Do.		do.	Plant at Saldanha ¹	1,300.
Do.		Columbus Stainless (Pty) Ltd. (Acerinox SA, 76%)	Stainless steel plant at Middelburg	750.
Do.		Scaw Metals Group	Germiston plant, Johannesburg	600.
Do.		Davsteel Division (Cape Gate Pty. Ltd.)	Plant at Vanderbijlpark	485.
Do.		Cape Town Iron & Steel Works (Pty) Ltd. (Cisco)	Kuils River plant, Cape Town ¹	300.
Steel, rolled		Davsteel Division (Cape Gate Pty. Ltd.)	Plant at Vanderbijlpark	460.
Do.		Cape Town Iron & Steel Works (Pty) Ltd. (Cisco)	Kuils River plant, Cape Town ¹	300. ^c
Do.		Duferco Steel Processing Ltd.	Cold-rolled slab steel plant at Saldanha Bay	240.
Lead, mine		Black Mountain Mineral Development Co. (Pty) Ltd. (Vedanta Resources Ltd., 69.6%)	Black Mountain Mine near Aggeneys in Northern Cape Province	55.
Lime		Idwala Lime [Idwala Industrial Holdings (Pty) Ltd.]	Plant at Daniëlskuil	1,000.
Do.		PPC Lime Ltd. (Pretoria Portland Cement Company Ltd.)	Plant at Lime Acres	900.
Do.		Inca Lime (Pty) Ltd. [Inca Mining (Pty) Ltd.]	Plant at Immerpan, Limpopo Province	100.
Magnesite		Chamotte Holdings	Strathmore Magnesite Mine	100. ^c
Manganese:				
Mine		Hotazel Manganese Mines (Pty) Ltd. (South32 Ltd., 60%)	Mamatwan Mine near Hotazel in Northern Cape Province	3,500 ore.
Do.		do.	Wessels Mine near Hotazel in Northern Cape Province	1,000 ore.
Do.		Assmang (Pty) Ltd.	Gloria and Nchwaning Mines near Black Rock	4,000 ore.
Do.		United Manganese of Kalahari (Pty) Ltd. (UMK) (Majestic Silver Trading 40 (Pty) Ltd., 51%, and Renova Group of Russia, 49%)	Russik Mine in Northern Cape Province	4,000 ore.
Do.		Tshipi e Ntle Manganese Mining (Pty) Ltd. [Jupiter Mines Ltd., 49.9%, and Ntsimbitntle Mining (Pty) Ltd., 38.1%]	Tshipi Borwa Mine in Northern Cape Province	3,600 ore.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: 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
Manganese:—Continued				
Mine—Continued		Kalagadi Manganese (Pty) Ltd. [Kalagadi Alloys (Pty) Ltd., 44%; Kalahari Resources (Pty) Ltd., 36%; and Industrial Development Corp., 20%]	Mine at Hotazel	3,000 ore; 2,400 sinter.
Do.		Asia Minerals Ltd. (AML)	Mines at Farm Hotazel and Farm York	1,900 ore.
Do.		Guangxi N&H Metallurgy Development Co.	Lomoteng Mine	600 ore.
Ferromanganese		Assmang (Pty) Ltd.	Cato Ridge plant in KwaZulu Natal Province	300.
Do.		do.	Machadodorp plant in Mpumalanga Province ¹	290.
Do.		Samancor Manganese (Pty) Ltd. (South32 Ltd., 60%)	Plant at Meyerton	500.
Silicomanganese		Transalloys (Pty) Ltd. (Renova Group, 23,78%)	Plant at Witbank	180.
Do.		Afarak Group Oyj	Mogale plant	55. ^e
Metal		Manganese Metal Co. Pty. Ltd. (Bright Resources, 70%, and To The Point Growth Specialists (Pty) Ltd., 30%)	Electrolytic plant at Nelspruit	30.
Nickel:				
Mine		Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Amandelbult, Kroondal, Modikwa, Mogalakwena and Mototolo Mines in Bushveld Complex	33. ^e
Do.		Nkomati Joint Venture (African Rainbow Minerals Ltd., 50%, and MMC Norilsk Nickel, 50%)	Nkomati Mine in Mpumalanga Province	21.
Do.		Impala Platinum Holdings Ltd. (Implats)	Impala Rustenburg Mine near Phokeng	7. ^e
Do.		Sibanye-Stillwater Ltd.	Marikana and Pandora Mines near Marikana	4. ^e
Sulfate		do.	Refinery at Brakpan	4. ^e
Refined		Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Refinery near Rustenburg	33.
Do.		Impala Platinum Holdings Ltd. (Implats)	Refinery at Springs	16. ^e
Nitrogen, ammonia		Sasol Ltd.	Plants at Sasolburg and Secunda	660.
Petroleum, refined	thousand 42-gallon barrels	South African Petroleum Refineries (BP Southern Africa, 50%, and Shell SA Energy, 50%)	Sapref refinery in Durban	65,700.
Do.	do.	Engen Ltd. (62%)	Enref refinery in Durban	43,800.
Do.	do.	National Petroleum Refiners of South Africa (Pty) Ltd. (Sasol Ltd., 63.6%)	Natref refinery in Sasolburg	39,400.
Do.	do.	Caltex Oil SA (Pty) Ltd.	Chevref refinery in Cape Town	36,500.
Phosphate rock		Foskor (Pty) Ltd.	Foskor Mine and plant at Phalaborwa	2,800.
Phosphoric acid		do.	Plant at Richards Bay	720.
Platinum-group metals:				
Mine	kilograms	Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Mogalakwena Mine at Ga-Masanya	16,000 platinum; 17,500 palladium; 1,200 rhodium; 1,000 ruthenium; 260 iridium.
Do.	do.	do.	Amandelbult Mine near Northam	16,000 platinum; 7,300 palladium; 3,600 ^e ruthenium; 2,600 ^e rhodium; 950 ^e iridium.
Do.	do.	Kroondal Platinum Mines [Anglo American Platinum Ltd. (Amplats), 50%, and Sibanye-Stillwater Ltd., 50%]	Kroondal Platinum Mine near Rustenburg	11,000 platinum; 6,000 palladium; 3,500 ruthenium; 2,200 rhodium; 800 iridium.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: 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
Platinum-group metals:—				
Continued				
Mine— Continued	kilograms	Modikwa Platinum Mine [African Rainbow Minerals Ltd., 50%, and Anglo American Platinum Ltd. (Amplats), 50%]	Modikwa Mine at Makgemeng	4,200 platinum; 4,000 palladium; 1,200 ruthenium; 820 rhodium; 310 iridium.
Do.	do.	Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Mototolo Mine at Steelpoort	3,300 platinum; 2,100 palladium; 990 ruthenium; 570 rhodium; 220 iridium.
Do.	do.	Sibanye-Stillwater Ltd.	Marikana and Pandora Mines near Marikana	24,900 platinum; 11,600 palladium; 5,300 ruthenium; 3,400 rhodium; 1,100 iridium.
Do.	do.	do.	Rustenburg Mine near Rustenburg	24,000 platinum; 11,900 palladium; 3,100 rhodium; 5,500 iridium and ruthenium.
Do.	do.	Impala Platinum Holdings Ltd. (Implats)	Impala Rustenburg Mine near Phokeng	29,500 platinum; 16,000 palladium; 6,600 ruthenium; 4,000 rhodium; 1,600 iridium.
Do.	do.	do.	Marula Mine at Bothashoek	3,000 platinum; 3,100 palladium; 730 ruthenium; 620 rhodium; 220 iridium.
Do.	do.	Northam Platinum Ltd. [Zambezi Platinum (RF) Ltd., 31.37%, and Coronation Asset Management (Pty) Ltd., 27.71%]	Booyssendal Mine near Roossenekal	6,200 ^e platinum; 3,000 ^e palladium; 1,800 ^e ruthenium; 1,000 ^e rhodium; 360 ^e iridium.
Do.	do.	do.	Zondereinde Mine near Northam	6,100 platinum; 2,900 palladium; 1,400 ruthenium; 850 rhodium; 330 iridium.
Do.	do.	do.	Eland Mine near Brits	1,400 ^e platinum-group metals.
Do.	do.	Siyanda Resources (Pty) Ltd.	Union Mine near Northam	10,700 platinum; 4,600 palladium; 1,800 rhodium; 3,100 iridium and ruthenium.
Do.	do.	Royal Bafokeng Platinum Ltd. (RBPlat) (Royal Bafokeng Nation, 100%)	Styldrift Mine near Phokeng	6,900 platinum; 3,100 palladium, rhodium, and gold.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: 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
Platinum-group metals:— Continued				
Mine— Continued	kilograms	Royal Bafokeng Platinum Ltd. (RBPlat) (Royal Bafokeng Nation, 100%)	Bafokeng Rasimone Platinum Mine near Phokeng	5,900 platinum; 2,400 palladium; 790 ruthenium; 460 rhodium; 150 iridium.
Do.	do.	Two Rivers Platinum Mine (Pty) Ltd. (African Rainbow Minerals Ltd., 55%, and Impala Platinum Holdings Ltd., 45%)	Two Rivers Platinum Mine near Steelpoort	5,500 platinum; 3,200 palladium; 1,600 ruthenium; 930 rhodium; 350 iridium.
Do.	do.	Nkomati Joint Venture (African Rainbow Minerals Ltd., 50%, and MMC Norilsk Nickel, 50%)	Nkomati Mine in Mpumalanga Province	2,900 ^c palladium; 1,200 ^c platinum; 200 ^c rhodium.
Do.	do.	Sedibelo Platinum Mines Ltd.	Pilanesberg Mine in North West Province	5,400 platinum; 1,700 palladium; 490 rhodium.
Do.	do.	Atlatsa Resources Corp., 51%, and Anglo American Platinum Ltd. (Amplats), 49%	Bokoni Mine at Sefateng ¹	4,100 platinum; 2,700 palladium; 470 rhodium.
Do.	do.	Tharisa Minerals (Pty) Ltd.	Tharisa Mine in North West Province	2,800 platinum; 860 palladium; 720 ruthenium; 490 rhodium; 220 iridium.
Do.	do.	Sylvania Platinum Ltd.	Sylvania Dump Operations	1,100 ^c platinum; 520 ^c palladium; 290 ^c rhodium.
Smelted	do.	Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Polokwane smelter at Polokwane, Mortimer smelter at Swartklip, and Waterval smelter	85,000 platinum; 55,000 palladium; 12,000 rhodium.
Do.	do.	Impala Platinum Holdings Ltd. (Implats)	Smelter near Phokeng	81,000 platinum; 52,600 palladium; 11,600 rhodium; 17,000 gold, iridium, and ruthenium.
Refined	do.	Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Precious metals refinery near Rustenburg	81,000 platinum; 54,000 palladium; 11,000 rhodium; 18,800 iridium and ruthenium.
Do.	do.	Impala Platinum Holdings Ltd. (Implats)	Refinery near Springs	71,500 platinum metal; 46,400 palladium metal; 10,200 rhodium metal; 15,000 gold, iridium, and ruthenium.
Do.	do.	Sibanye-Stillwater Ltd.	Refinery at Brakpan	31,000 platinum metal; 14,600 palladium metal; 7,000 ruthenium metal; 4,300 rhodium metal; 1,400 iridium metal.
Do.	do.	Heraeus South Africa (Pty) Ltd.	Refinery at Port Elizabeth	20,000 ^c platinum metal; 10,000 ^c palladium metal.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: 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		
Pyrophyllite		Idwala Industrial Minerals (Benoni)		Ottsdal Mine in North West Province		15.		
Do.		Wonderstone Ltd. (The Associated Ore & Metals Corp. Ltd.)		Pyrophyllite (wonderstone) mine, North West Province		NA.		
Do.		G&W Base and Industrial Minerals Pty. Ltd.		Piet Retief Mine		NA.		
Salt		Salt Refiners and Packers Holdings (Pty) Ltd.		Mine in Gauteng Province		100.		
Do.		Kalkpoort Soutwerke CC		Mine in Northern Cape Province		60.		
Do.		Cerebos Ltd.		Mine in Eastern Cape Province		40.		
Do.		Orange River Salt Works (Pty) Ltd.		Mine in Northern Cape Province		30.		
Sand, industrial		Thaba Chehu Mining (Pty) Ltd.		Samquarz Mine at Delmas		1,100. ^c		
Do.		Maxima Silica (Pty) Ltd. (Incubex Minerals Ltd., 100%)		Mine near Boshhoek		72.		
Selenium	kilograms	Impala Platinum Holdings Ltd. (Implats)		Impala and Marula Mines		12,000. ^c		
Do.	do.	Palabora Mining Co. Ltd.		Palabora Mine and plant at Phalaborwa		2,700. ^c		
Silicon:								
Metal		Ferroglobe plc		Polokwane plant, near Pietersburg ¹		55.		
Do.		do.		eMalahleni plant		12.		
Ferrosilicon		do.		New Castle plant at Ballengeich ¹		45.		
Do.		do.		eMalahleni plant		40.		
Silver:								
Mine	metric tons	Black Mountain Mineral Development Co. (Pty) Ltd. (Vedanta Resources Ltd., 69.6%)		Black Mountain Mine near Aggeneys in Northern Cape Province		50.		
Refined	do.	Rand Refinery (Pty) Ltd. (AngloGold Ashanti Ltd., 42.41%, and Sibanye-Stillwater Ltd., 33.15%)		Plant at Germiston in Gauteng Province		60.		
Stone, dimension		Kelgran Investments (Pty) Ltd.		Quarry at Rustenburg in North West Province		58 granite blocks.		
Do.		do.		Quarry in Limpopo Province		18 granite blocks.		
Do.		do.		Quarry near Garies in Northern Cape Province		8 granite blocks.		
Do.		do.		Quarry in Western Cape Province		8 granite blocks.		
Do.		do.		Quarry near Springbok		6 granite blocks.		
Do.		Leka Hartebeespoort Mining (Pty) Ltd.		Quarry near Hartbeespoort		40 granite blocks.		
Sulfur		Sasol Synthetic Fuels (Pty) Ltd.		Plant at Secunda		180.		
Do.		South African Petroleum Refineries (BP Southern Africa, 50%, and Shell SA Energy, 50%)		Plant at Durban		63.		
Do.		Engen Petroleum Ltd.		do.		47.		
Do.		National Petroleum Refiners of South Africa (Pty) Ltd. (Sasol Ltd., 63.6%)		Plant at Sasolburg		44.		
Do.		Caltex Oil SA (Pty) Ltd.		Plant at Cape Town		30.		
Sulfuric acid		Foskor (Pty) Ltd.		Plant at Richards Bay		2,200.		
Synthetic fuels	thousand 42-gallon barrels	Sasol Synthetic Fuels (Pty) Ltd.		Coal to oil plant at Secunda		58,400.		
Do.	do.	Petroleum Oil and Gas Corporation of South Africa		Natural gas to petroleum products plant at Mossel Bay		16,400.		
Tellurium		kilograms		Impala Platinum Holdings Ltd. (Implats)		Impala and Marula Mines		5,000. ^c
Do.		do.		Palabora Mining Co. Ltd.		Palabora Mine and plant at Phalaborwa		2,200. ^c
Titanium:								
Titanium concentrates		Richards Bay Minerals (RBM) (Rio Tinto plc, 74%, and Blue Horizon Investments, 24%)		Open cast operations, near Richards Bay		2,000 ilmenite; ^c 100 rutile.		
Do.		Tronox Holdings plc		Namakwa Sands near Brand-se-Baai and mineral separation plant at Koekenaap		540 ilmenite; 31 rutile.		
Do.		do.		Fairbreeze Mine in KwaZulu Natal Province		500 ilmenite; 25 rutile.		
Do.		Mineral Commodities Ltd. (MCL)		Tormin Mine in Western Cape Province		180 ^c ilmenite; 5.5 rutile.		
Titanium slag		Richards Bay Minerals (RBM) (Rio Tinto plc, 74%, and Blue Horizon Investments, 24%)		Smelter at Richards Bay		1,050.		
Do.		Tronox Holdings plc		Empangeni smelter near Richards Bay		220.		
Do.		do.		Smelter at Vredenberg, Saldanha Bay area		190.		

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: 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
Uranium oxide	metric tons	AngloGold Ashanti Ltd.	Surface operations in North West Province	180. ^c
Do.	do.	Sibanye-Stillwater Ltd.	Cooke operations in Gauteng Province	120. ^c
Vanadium	do.	Vanchem Vanadium Products (Pty) Ltd. (Bushveld Minerals Ltd., 100%)	Vanchem plant at Witbank	4,200.
Do.	do.	Vametco Minerals Corp. (Bushveld Minerals Ltd., 100%)	Vametco Mine and Brits plant	3,750.
Do.	do.	Glencore plc	Rhovan Mine at Brits	5,600.
Do.	do.	do.	Rhovan plant at Brits	6,000 ferrovanadium.
Vermiculite		Palabora Mining Co. Ltd.	Palabora Mine and plant at Phalaborwa	200.
Wollastonite	metric tons	Incubex Minerals Ltd.	Mine near Garies	1,800.
Zinc, mine		Vedanta Resources Ltd., 69.6%	Gamsberg Mine in Northern Cape Province	250.
Do.		Black Mountain Mineral Development Co. (Pty) Ltd. (Vedanta Resources Ltd., 69.6%)	Black Mountain Mine near Aggeneys in Northern Cape Province	40.
Zirconium		Richards Bay Minerals (RBM) (Rio Tinto plc, 74%, and Blue Horizon Investments, 24%)	Open cast mines near Richards Bay	250 zircon in concentrate.
Do.		Tronox Holdings plc	Namakwa Sands near Brand-se-Baai and mineral separation plant at Koekenaap	125 zircon in concentrate.
Do.		do.	Fairbreeze Mine in KwaZulu Natal Province	55 zircon in concentrate.
Do.		Mineral Commodities Ltd. (MCL)	Tormin Mine in Western Cape Province	38 zircon in concentrate.

^cEstimated. Do., do. Ditto. NA Not available.

¹Not operating at the end of 2019.

²Joint venture with Sinosteel Corp.

³Data from International Copper Study Group.

⁴Unlicensed artisanal miners also produced diamond near the Kimberley Mine in Northern Cape Province.

⁵Artisanal miners also produced gold from abandoned large-scale gold-mining operations.

TABLE 3
SOUTH AFRICA: RESERVE BASE OF MAJOR MINERALS IN 2019¹

(Million metric tons, unless otherwise specified)

Commodity	Reserves
Alumino-silicates ²	96
Antimony	thousand metric tons 27
Chromite ore	200
Coal, recoverable	66,700
Cobalt	thousand metric tons 40
Copper	11
Fluorspar	41
Gold	thousand metric tons 3
Iron ore	640
Lead	thousand metric tons 300
Manganese, ore	230
Nickel	thousand metric tons 3,700
Phosphate rock	1,400
Platinum-group metals	thousand metric tons 63
Titanium minerals	42
Uranium	thousand metric tons 322
Vanadium	do. 3,500
Vermiculite	14
Zinc	15
Zirconium	thousand metric tons 7

¹Metallic minerals are contained metal, except for titanium, which is titanium dioxide content, and zirconium, which is zirconium dioxide content.

²Includes aluminosilicate and sillimanite.