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# 2022 Minerals Yearbook

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# The Mineral Industry of South Africa

By Thomas R. Yager and Edgardo J. Pujols

The Republic of South Africa remained one of the world's top mining and mineral-processing countries. In 2022, South Africa's estimated share of world mined ruthenium production by volume amounted to 93%; mined iridium, 91%; mined rhodium, 85%; mined platinum, 71%; refined platinum, 65%; refined rhodium, 65%; chromium, 46%; titanium slag, 38%; manganese, 37%; mined palladium, 36%; vermiculite, 35%; refined palladium, 30%; ferrochromium, 25%; zircon, 21%; industrial garnet, 18%; rutile, 16%; ilmenite, 13%; vanadium, 9%; refined gold, 7%; diamond, 8%; talc and pyrophyllite, 6% each; fluorspar, 5%; coal, mined gold and iron ore, 3% each; ferromanganese and zinc, 2% each; and aluminum, mined lead, mined nickel, stainless steel, and silicomanganese, 1% each. South Africa's share of world diamond production (by value) was 10% in 2022. South Africa also played a globally significant role in the production of kyanite and related materials. In 2022, South Africa's estimated share of the world's coal consumption was 2%, and the country's share of Africa's coal consumption was 83%, a decrease from 92% in 2012 (CPM Group, 2023, p. 24–25, 30–31, 34–35, 146, 202; Energy Institute, 2023, p. 39, 42; Iluka Resources Ltd., 2023, p. 26; Merafe Resources Ltd., 2023, p. 11–12; Narvekar and Even-Zohar, 2023, p. 7; Ninji, 2023; South32 Ltd., 2023; World Gold Council, 2023; Brioche, 2024; Gambogi, 2024a, b; Hatfield, 2024; Kim, 2024a, b; Klochko, 2024; McRae, 2024a, b; Merrill, 2024; Olson, 2024a–c; Polyak, 2024; Schulte, 2023c, 2024a–b; Sheaffer, 2024; Simmons, 2024; Tolcin, 2024; Tuck, 2024; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

## Minerals in the National Economy

The mineral industry accounted for 8.1% of South Africa's gross domestic product (GDP) in 2022, a decrease from 8.5% in 2021; the share of the mineral industry in the provincial GDP varied widely by Province. The mineral industry's share in Northern Cape Province's GDP was 34.4% in 2022, that in Limpopo Province was 33.4%, that in Mpumalanga Province was 29.1%, that in North West Province was 28.3%, that in Free State Province was 9.9%, that in Gauteng Province was 2.3%, that in Western Cape Province was 0.7%, and that in Eastern Cape Province was 0.6% (Minerals Council South Africa, 2023, p. 18, 23).

In South Africa, the mineral industry employed 466,245 people in 2022 compared with 448,536 in 2021 and 524,873 in 2012. In 2022, the mining of platinum-group metals (PGMs) accounted for 37.6% of the mineral industry's employment, and that of gold, 20.4%; coal, 19.7%; other minerals, 6%; iron ore, 5%; chromite, 4.1%; diamond, 3.1%; manganese, 2.7%; and aggregate sands, 1.4%. In 2012, PGM mining accounted for 38% of the mineral industry's employment, and that of gold, 28.2%; coal, 15.3%; other minerals, 5.5%; iron ore, 4.4%; chromite, 3.3%; diamond, 2.3%; and aggregate sands and manganese, 1.5% each. Decreased employment in the gold-mining subsector between 2012 and 2022 was attributable to lower gold production (Minerals Council South Africa, 2023, p. 21, 47).

South Africa accounted for less than 1% of the world's mineral-exploration spending in 2022. In April, the Government announced plans to increase mineral-exploration spending through initiatives, including improving data on mineral deposits and providing more technical assistance to smaller mining companies. By 2025, South Africa's exploration spending was expected to increase (according to the Government's plan) to $900 million per year, which was about 5% of the world's mineral-exploration spending as of 2022. The Government planned to focus exploration on metals used in battery storage, electric vehicles, and hydrogen production (Sguazzin, 2022).

## 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 the Mining Charter. The Mining Charter was enacted 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-downstream processing 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 downstream processing, report on the development of near-mine communities, and report on the economic, environmental, and social sustainability of mining activities in the country (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%, 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 with BEE (Beech and Livingston, 2017; Liedtke, 2018).

The requirement to purchase services from companies based in South Africa established by the Amended Mining Charter of 2010 was increased to 80% under the new Mining Charter. The requirement to purchase goods from companies based in South Africa 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, 2019).

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 eventually became acidic. The oxidation of pyrite led to acid drainage in the mine. 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. As of early 2022, nearly 2,300 abandoned mines required remediation (Solomons, 2017; Dutton, 2022).

In November 2022, the Government introduced a ban on exports of copper scrap and ferrous scrap other than stainless steel. The ban was initiated because of widespread theft of infrastructure including electrical, rail, telecom cables, and rail tracks (Taylor, 2023).

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

## Production

Notable increases in production in 2022 included that of pyrophyllite, by 62%; shale for use in brickmaking, by 43%; mined lead, by 28%; industrial garnet, silver, and titanium slag, by 23% each; ilmenite, by an estimated 20%; zinc, by 16%; phosphate rock, uranium, and vermiculite, by 15% each; and feldspar and rutile, by 12% each. Plastic clay and silicon metal production restarted in 2022. Notable decreases in production in 2022 included that of natural gas, by 90%; natural gas liquids, by 69%; kaolin, by 64%; refined petroleum products, by 50%; mica, by 38%; sulfur, by 33%; fuller's earth, by 32%; mined cobalt, by 30%; phosphate fertilizers, by 25%; flint clay and shale for use in cement, by 21% each; anthracite, by 20%; granite, refined rhodium, and refined PGMs (other than palladium, platinum, and rhodium), by 19% each; pig iron, by 18%; refined palladium and slate, by 17% each; ferromanganese, mined gold, and refined platinum, by 14% each; iron ore and mined palladium, by 13% each; brick clay, gypsum, mined iridium, mined platinum, rutile, hot-rolled steel and raw steel, by 12% each; silicomanganese, by 11%; and mined rhodium, mined ruthenium, and selenium, by 10% each (Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

In 2022, natural gas production decreased because of the depletion of reserves. Refined petroleum and sulfur production decreased because of refinery closures. Ilmenite, rutile, and titanium slag production increased in 2022 after being limited by local civil unrest in 2021. Data on mineral production are in table 1.

## Structure of the Mineral Industry

Most of the mineral industry in South Africa was privately owned; the Government-owned Petroleum Oil and Gas Corporation operated a gas-to-liquids plant and produced natural gas there. The production of diamond and gold in South Africa was dominated by large-scale producers. Ammonia, primary aluminum, industrial garnet, mined lead, magnesite, manganese metal, silicon metal, stainless steel, vermiculite, and wollastonite were produced by only one domestic company per commodity. In 2022, the leading producer for each commodity accounted for a significant share of national output—approximately 63% of titanium slag production; 59% of iron ore; 57% of diamonds; 45% of mined gold; 41% of mined palladium; 32% of mined platinum; 31% of mined rhodium; 23% of coal; and 22% of mined manganese.

South Africa also had many producers of aggregates, clay and shale, and sand for construction. Capacity, location, ownership, and production information were 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 90%; manganese, 38%; chromite, 36%; fluorspar, 16%; rutile and vanadium, 13% each; gold, 10%; and zirconium, 9%. The country also had substantial reserves of andalusite, antimony, coal, iron ore, nickel, phosphate rock, uranium, and vermiculite (table 3; Gambogi, 2023a, b; McRae, 2023a, b; Polyak, 2023; Schnebele, 2023; Schulte, 2023a, b; Sheaffer, 2023).

## Mineral Trade

Crude mineral products (which included refined metals other than aluminum and silicon) accounted for more than 34% of the value of South Africa's total exports in 2022, which was \$123 billion.[1] About 78% of crude mineral products (by value) were exported in 2022. South Africa's notable exports in 2022 were as follows: coal, \$8.29 billion; rhodium, \$7.38 billion; iron ore, \$5.44 billion; gold, \$5.19 billion; palladium, \$3.66 billion; platinum, \$3.48 billion; manganese ore, \$2.83 billion; chromite, \$911 million; diamond, \$910 million; iridium, \$894 million; ilmenite, rutile, and zircon, a total of \$720 million; nickel, \$623 million; zinc, \$573 million; industrial minerals, a total of \$449 million; and ruthenium, \$393 million (Minerals Council South Africa, 2023, p. 18; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

In 2022, processed mineral products accounted for an additional 7% of total exports. Exports of ferroalloys (which included ferrochromium, ferromanganese, ferrovanadium, and silicomanganese) were \$4.24 billion; other iron and

[1]Where necessary, values have been converted from South African rand (ZAR) to U.S. dollars (US\$) at an average annual exchange rate of ZAR16.4=US\$1.00 for 2022.

steel products, \$1.78 billion; aluminum, \$1.35 billion; rolled stainless steel sheet with a width of more than 600 millimeters, \$568 million; and aluminum products, \$37 million (Industrial Development Corp., 2023; Minerals Council South Africa, 2023, p. 18).

The percentage of export sales of mineral commodities produced in South Africa varied widely by commodity. In 2022, the percentage of export sales by volume for iron ore was 90%, and for manganese, 88%; diamond, 77%; chromite and granite, 31% each; coal, 18%; and lime, less than 1%. All sales of aggregates, clays and shale (other than bentonite), feldspar, gypsum, natural gas, sand for construction, and sodium sulfate were for domestic consumption. In the second quarter of 2022, andalusite exports accounted for 69% of total sales (Modiselle, 2023; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

In 2022, South Africa's total imports were valued at \$111 billion. Imports of mineral products (which included mineral fuels) accounted for 23% of imports (by value); base metals and articles of base metal, 5.3%; and other minerals and mineral products (including precious metals, semiprecious and precious stones, and articles of cement), 2.3% (South African Revenue Service, 2023).

South Africa depended entirely on imports to meet its requirements for barite, bauxite, borates, crude petroleum, marble dimension stone, potash, and potassium fertilizers in 2019 (the latest year for which data were available). The country's import dependence (by volume) in 2019 was as follows: mica, about 99%; talc, 94%; bentonite, 55%; gypsum, 52%; salt, 47%; kaolin, 39%; slate dimension stone, 19%; and fire clay, less than 1%. Import dependence on bentonite was 23% in 2009, and gypsum and salt, less than 1% each (Motsie, 2010, 2020; Modiselle, 2020).

## 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 718,000 t in 2022. South32 planned to produce at a rate of nearly 720,000 metric tons per year (t/yr) in the first half of 2023. Hulamin Ltd. used aluminum from Hillside in the manufacture of rolled aluminum products. In 2022, Hulamin produced about 211,000 t of rolled aluminum products in 2022 compared with 209,000 t in 2021 (South32 Ltd., 2022, 2023; Hulamin Ltd., 2023, p. 36).

**Chromium.**—In 2022, chromite production was about 19.1 million metric tons (Mt) compared with 18.4 Mt (revised) in 2021 and 11.3 Mt in 2012. Increased production since 2012 was partially attributable to PGM-mining companies producing chromite as a coproduct. In 2022, ferrochromium production was estimated to be about 3.9 Mt compared with 3.06 Mt in 2012. Ferrochromium production was constrained by power-supply problems (Creamer, 2019; Galane, 2021; Merafe Resources Ltd., 2023, p. 12; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

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 a rate of more than 4 million metric tons per year (Mt/yr) for its plants in August 2022. An additional 500,000 t/yr of chromite was sold on local and export markets [Samancor Chrome (Pty) Ltd., undated; Patel-Campbell, 2022; Merafe Resources Ltd., 2023, p. 21].

Samancor Chrome operated six ferrochromium plants with a total capacity of about 2.4 Mt/yr. In August 2022, the company produced ferrochromium at a rate of more than 2 Mt/yr (Patel-Campbell, 2022).

Glencore plc of Switzerland and its joint-venture partner Merafe Resources Ltd. operated the Boshoek, Helena, Kroondal, Magareng, Thorncliffe, and Waterval Mines. Glencore and Merafe produced about 3.84 Mt of chromite in 2022 compared with 3.68 Mt in 2021 (Glencore plc, 2023a, p. 16; Merafe Resources Ltd., 2023, p. 3, 21).

Glencore and Merafe operated the Boshoek, Lion, Lydenburg, Rustenburg, and Wonderkop ferrochromium plants, which had a total capacity of 2.34 Mt/yr. As of yearend, the Lydenburg plant was on care-and-maintenance status. The companies produced 1.87 Mt of ferrochromium in 2022 compared with 1.85 Mt in 2021. Glencore planned to produce between 1.61 and 1.69 Mt of ferrochromium in 2023 (Merafe Resources Ltd., 2023, p. 3, 21; Tex Report, The, 2023c).

Assore Ltd. operated the Dwarsrivier Mine in Mpumalanga Province. The company produced chromite at a rate of about 2.4 Mt/yr; mining shifted from open pit to underground in 2022. The estimated remaining mine life was 13 years (Bekker, 2022, p. 2, 7).

Sibanye-Stillwater Ltd. operated the Marikana and Rustenburg PGM mines and produced chromite as a coproduct. In 2022, Sibanye-Stillwater produced 2.25 Mt of chromite from the Upper Group 2 (UG2) layer of ore in the Bushveld Complex at Marikana and Rustenburg compared with 2.18 Mt in 2021 (Sibanye-Stillwater Ltd., 2023b).

In fiscal year 2022 (October 1, 2021, through September 30, 2022), Tharisa Minerals (Pty) Ltd. of Cyprus produced about 1.58 Mt of chromite at the Tharisa Mine compared with 1.51 Mt in fiscal year 2021. Increased production was attributable to higher recovery rates. Tharisa Minerals planned to produce between 1.75 and 1.85 Mt in fiscal year 2023. The company also planned to increase production subsequently to 2 Mt/yr. The remaining life of the open pit was estimated to be 18 years, which could be followed by an underground mine with a life of 40 years [Tharisa Minerals (Pty) Ltd., 2022, p. 1, 14, 25].

Anglo American Platinum Ltd. (Amplats) operated plants at the Amandelbult and Modikwa Mines that produced chromite from UG2 ore. In 2022, Amplats produced 771,700 t of chromite at Amandelbult compared with 883,900 t in 2021. The company started chromite production at Modikwa in the fourth quarter of 2021 and produced 8,700 t by yearend. Production increased to 59,200 t in 2022 (Anglo American Platinum Ltd., 2023, p. 13, 16–17).

In 2022, Northam Platinum Ltd. produced nearly 1.04 Mt of chromite from UG2 ore at its Booysendal and Zondereinde Mines compared with 926,915 t in 2021. Production at the Booysendal Mine increased to 583,984 t in 2022 from 572,204 t in 2021; at the Zondereinde Mine, 412,539 t from 325,757 t in 2021; and at the Eland Mine, 38,956 t from 28,984 t. Increased production was attributable to the expansion of Northam's PGM operations (Northam Platinum Ltd., 2022, p. 47, 51, 57; 2023, p. 8–9, 114, 126, 138).

Eastern Platinum Ltd. (Eastplats) of Canada recovered chromite from UG2 tailings at the Crocodile River Mine, located in North West Province. In 2022, Eastplats produced 602,111 t of chromite at Crocodile River compared with 773,273 t in 2021 (Eastern Platinum Ltd., 2023).

Chromite sales from the Two Rivers Platinum Mine, which was a joint venture between African Rainbow Minerals Ltd. (ARM) and Impala Platinum Holdings Ltd. (Implats), decreased to 194,075 t in 2022 from 232,266 t in 2021. In 2022, ARM completed the purchase of the Bokoni Mine (which was on care-and-maintenance status) from Amplats and Atlatsa Resources Corp. As of yearend, the company was engaged in a feasibility study on reopening the Bokoni Mine. Depending on the results of the study, ARM could produce 255,000 t/yr of chromite. Mining could restart by mid-2024 (African Rainbow Minerals Ltd., 2022a, p. 69–70; 2022b, p. 6, 17; 2023, p. 5, 14).

**Cobalt.**—PGM-mining companies produced cobalt as a coproduct. National mined-cobalt production was 250 t in 2022 compared with 355 t in 2021 and 1,102 t in 2012. Decreased production was attributable to the closure of the Nkomati Mine in early 2021 (Galane, 2021; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Copper, Lead, and Zinc.**—Mined copper production decreased to 49,194 t in 2022 from 51,138 t in 2021. In 2022, mined zinc production increased to 224,356 t from 193,785 t in 2021, and mined lead, 39,974 t from 31,224 t in 2021. Vedanta Resources Ltd. of the United Kingdom operated the Gamsberg open pit mine in Northern Cape Province, which had a capacity to produce 250,000 t/yr of zinc in concentrate. Vedanta also operated the Black Mountain Mine, which produced copper, lead, silver, and zinc (Vedanta Resources Ltd., 2022; p. 138; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

In August 2022, Vedanta started the expansion of its capacity at Gamsberg to 450,000 t/yr of zinc in concentrate from 250,000 t/yr. Vedanta planned to complete its expansion in the first half of 2024. The company also planned to build a new smelter at Gamsberg, with a capacity of 300,000 t/yr of zinc metal. Depending on regulatory approvals, production could start by March 2026 (Vedanta Resources Ltd., 2022, p. 47, 138).

Orion Minerals Ltd. of Australia was considering reopening the Prieska Mine in Northern Cape Province. Production was shut down at Prieska in 1991. Orion planned to produce 70,000 t/yr of zinc in concentrate and 22,000 t/yr of copper in concentrate during the estimated 12-year mine life. The company planned to engage in trial mining between January 2023 and June 2024. The final investment decision was planned for December 2024 (Piper, 2019; Smart, 2022, p. 8, 11–12).

**Gold.**—The long-term decline in South Africa's mined gold output continued in 2022, with production decreasing to 92,573 kilograms (kg) from a revised 107,890 kg in 2021 and 155,286 kg in 2012. Decreased output was primarily attributable to mines operating at depths 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 an estimated 310,000 kg in fiscal year 2022 (September 1, 2021, through August 31, 2022) from more than 440,000 kg in fiscal year 2012 [Rand Refinery (Pty) Ltd., 2013; du Venage, 2013; Galane, 2021; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023].

Harmony Gold Mining Company Ltd. was the leading producer of mined gold in South Africa; the company produced a total of 41,228 kg of gold from its operations in 2022 compared with 44,386 kg in 2021. In 2022, its surface operations produced 7,684 kg of gold, and its Tshepong Operations, 6,901 kg. It also produced gold at the following mines: the Mponeng Mine, 6,342 kg; the Moab Khotsong Mine, 6,270 kg; the Kusasalethu Mine, 4,102 kg; the Doornkop Mine, 3,946 kg; the Masimong Mine, 2,077 kg; the Joel Mine, 1,871 kg; the Target 1 Mine, 1,438 kg; and the Bambanani Mine, 597 kg. Production decreased at the surface operations by 12%; at Moab Khotsong, by 8%; and at Mponeng, by 7%. Mining was shut down at Bambanani in the first half of 2022 (Harmony Gold Mining Company Ltd., 2022a–c; 2023).

For Harmony's fiscal year 2023 (July 1, 2022, through June 30, 2023), total planned production at the company's operations in South Africa was between 37,000 and 39,000 kg. The remaining life of Moab Khotsong was 22 years; Doornkop, 16 years; Joel and Tshepong, 8 years each; Mponeng, 7 years; the surface operations, between 6 and 17 years; Target 1, 6 years; and Kusasalethu and Masimong, 2 years each (Harmony Gold Mining Company Ltd., 2022c).

Sibanye-Stillwater Ltd. mined gold at the Beatrix, Driefontein, and Kloof Mines, and at its Cooke Operations. Production at the mines decreased year over year as follows: at the Kloof Mine, to 4,920 kg in 2022 from 10,936 kg in 2021; at the Beatrix Mine, 2,913 kg from 6,380 kg; at the Driefontein Mine, 4,893 kg from 9,265 kg; and at the Cooke Operations, 1,010 kg from 1,166 kg. Underground operations at Beatrix, Driefontein, and Kloof were shut down during the second quarter of 2022 owing to a labor dispute. Sibanye-Stillwater also held a 50.1% interest in DRDGold Ltd., which produced gold at the Ergo and Far West Gold Recovery Operations (FWGR). Ergo and FWGR produced a total of 5,565 kg in 2022 compared with 5,625 kg in 2021. Total planned production at the Beatrix, Cooke, Driefontein, and Kloof Mines in 2023 was between 23,500 and 24,500 kg (Sibanye-Stillwater Ltd., 2023a, p. 90, 113).

Sibanye-Stillwater approved the reopening of the Burnstone Mine in 2021. The company completed 47% of the project by the end of 2022; Burnstone was expected to restart mining in 2024. Planned production was nearly 4,300 kilograms per year (kg/yr) during an estimated mine life of more than 20 years (Sibanye-Stillwater Ltd., 2023a, p. 107).

Gold Fields Ltd. produced about 10,200 kg of gold at the South Deep Mine in Gauteng Province in 2022 compared with 9,102 kg in 2021. The company's production target in 2022 was 10,000 kg. Increased production in 2022 was attributable to improved efficiencies and higher recovery rates. Gold Fields planned to increase its production to nearly 11,000 kg in 2023 and 12,000 kg in 2025 (Gold Fields Ltd., 2023, p. 31, 43).

In fiscal year 2022 (July 1, 2021, through June 30, 2022), Pan African Resources plc produced 6,398 kg of gold compared with 6,276 kg in fiscal year 2021. Production in fiscal year 2022 at the Barberton Mine was 2,356 kg; at the Evander Mines, 1,809 kg; at the Elikhulu Tailings Retreatment Project (Elikhulu), 1,624 kg; and at the Barberton Tailings Retreatment Project (BTRP), 609 kg. The estimated remaining life of the Barberton Mine was 20 years; the Evander Mines, 14 years; Elikhulu, 11 years; and the BTRP, 2 years. Pan African planned to produce a total of nearly 6,400 kg of gold in fiscal year 2023 (Pan African Resources plc, 2022, p. 5, 9).

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 1,800 kg of gold from their PGM-mining operations in South Africa in 2022 compared with 2,100 kg in 2021. The Mogalakwena Mine, which accounted for 36% of the companies' total PGM production in 2022, produced 81% of the gold (Anglo American Platinum Ltd., 2023, p. 72, 74, 76, 80, 82).

Blyvoor Gold (Pty) Ltd. operated the Blyvoor Mine in Gauteng Province. The company produced gold at a rate of 1,200 kg/yr in 2022 compared with 930 kg/yr in 2021. Production was expected to increase to 2,500 kg/yr in 2023. The estimated remaining mine life was 22 years (Bulbulia, 2023; Miningmx, 2023).

In 2022, Theta Gold Mines Ltd. of Australia completed a feasibility study on its Transvaal Gold Mining Estate (TGME) underground gold mine project, which was located near Johannesburg. Theta Gold planned to start mining at four mines in the first phase of the TGME project by the second quarter of 2024. The company planned to produce gold at a rate of more than 3,100 kg/yr in its third year of mining. Production was expected to increase to 5,000 kg/yr in its fifth year of mining as Theta Gold expanded to a total of seven mines in the second phase. The estimated life of the TGME project was 13 years (Simcock, 2022).

West Wits Gold Ltd. of Australia completed a feasibility study on the first stage of a new mine at the Qala Shallows project in Gauteng Province in 2021; the company updated its study in 2022. According to the study, planned gold production was 1,700 kg/yr during an estimated mine life of 10 years. In 2022, West Wits Gold and Sibanye-Stillwater signed an agreement that would allow Sibanye-Stillwater to toll-process ore from Qala Shallows at its Cooke operations. Depending on financing, mining could start at Qala Shallows (which is in the Witswatersrand Basin) in early 2023. West Wits Gold was also engaged in a scoping study on its second phase of mining that could increase its gold production from the Witswatersrand Basin to 6,200 kg/yr (Australia's Paydirt, 2022; Piper, 2023a).

Rand Refinery (Pty) Ltd. refined most of the newly mined gold in South Africa; the majority of the company's production was sourced from gold mined in countries in Africa, including Ghana and Tanzania. In fiscal year 2022, Rand Refinery produced about 75% of its capacity of 410,000 kg/yr. The decrease in production from more than 440,000 kg in fiscal year 2012 was partially attributable to reduced production from gold mines in South Africa. The startup of new refineries in other countries in Africa reduced the supply of imported mined gold for Rand Refinery [Rand Refinery (Pty) Ltd., 2013; Ninji, 2023].

**Iron Ore and Iron and Steel.**—In 2022, iron ore production was about 63.7 Mt compared with 73 Mt (revised) in 2021 and 67.1 Mt in 2012. Nearly 87% of South Africa's iron ore output in 2022 was hematite. Exports decreased to 56.4 Mt in 2022 from 60.8 Mt in 2021. Lower exports were attributable to rail-transportation problems, such as aging locomotives, lack of spare parts, and theft of railway tracks and overhead cables (Galane, 2021; du Venage, 2023b; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

Kumba Iron Ore Ltd. was the leading iron ore producer in South Africa; the company's iron ore production decreased to 37.7 Mt in 2022 from 40.9 Mt in 2021. Production at the Sishen Mine decreased to 27 Mt in 2022 from 28 Mt in 2021, and at the Kolomela Mine, 10.7 Mt from 12.8 Mt. Ore grades decreased to 63.8% iron in 2022 from 64.1% in 2021. Kumba planned to produce a total of between 35 and 37 Mt of iron ore at Kolomela and Sishen in 2023 (Anglo American plc, 2023, p. 10–11).

Assmang (Pty) Ltd. produced iron ore at the Beeshoek and Khumani Mines. In 2022, total production decreased to 14.9 Mt from 16.8 Mt in 2021. 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 24 years, and Beeshoek's was 13 years. The company planned to maintain export sales of 13.9 Mt/yr and domestic sales of 2.7 Mt/yr through mid-2025 (African Rainbow Minerals Ltd., 2022a, p. 4, 74, 81, 83; 2022b, p. 9; 2023, p. 7).

Palabora Mining Co. Ltd. produced magnetite from the Palabora Mine. In fiscal year 2022 (April 1, 2021, through March 31, 2022), Government-owned Transnet SOC Ltd. shipped 8.6 Mt of magnetite on its railways, most of which was attributable to Palabora Mining. In May 2021, Palabora Mining was producing magnetite at a rate of 8.44 Mt/yr. In September 2022, Palabora Mining completed an upgrade to its rail infrastructure to increase efficiency at its magnetite-loading facilities (Khaile, 2018, p. 20–24; Pala Connector, 2021; Letaba Herald, 2022; Transnet SOC Ltd., 2022, p. 26).

Sedibeng Iron Ore (Pty) Ltd. produced about 2 Mt/yr of iron ore at the Sedibeng Mine in Northern Cape Province; the company could increase its production to 3 Mt/yr depending on increased rail capacity. Afrimat Ltd. produced about 870,000 t/yr from the Demaneng Mine and 500,000 t/yr from the Jenkins Mine, both of which were located in Northern Cape

Province. The company was increasing production at Jenkins to 1.25 Mt/yr (Arnoldi, 2022, p. 28).

Vedanta of India planned to start recovering magnetite from tailings at the Black Mountain Mine by September 2023. Planned production was between 0.7 and 1 Mt/yr of magnetite at a grade of more than 68% iron (Vedanta Resources Ltd., 2022, p. 22).

ArcelorMittal South Africa Ltd.'s (which was the leading producer of raw steel in South Africa) production of raw steel decreased to nearly 2.47 Mt in 2022 from 3.1 Mt in 2021. Decreased production was attributable to a labor dispute in June, power outages, and shortages of raw materials delivered by rail (ArcelorMittal South Africa Ltd., 2023, p. 34, 45).

**Manganese.**—In 2022, manganese ore production was about 19 Mt compared with 19.1 Mt (revised) in 2021 and 8.95 Mt in 2012. Total production of manganese alloys decreased to 224,000 t in 2022 from 882,000 t in 2012; decreased ferromanganese production was attributable to increased power costs. In fiscal year 2022, Transnet shipped nearly 14.5 Mt of manganese ore to ports in South Africa compared with its target of 16.3 Mt (table 1; Creamer, 2015; Galane, 2021; Transnet SOC Ltd., 2022, p. 26; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

Assmang (the leading producer of manganese ore in South Africa) operated the Gloria and the Nchwaning Mines. Total output increased to 4.24 Mt in 2022 from 4.11 Mt in 2021; the company planned to increase its exports by about 500,000 t/yr by mid-2024. Production at Gloria and Nchwaning could increase to 5 Mt/yr depending on available rail capacity. The estimated remaining life of Assmang's manganese mines was more than 30 years (Barradas, 2019; African Rainbow Minerals Ltd., 2022a, p. 4, 79, 82–83; 2022b, p. 10; 2023, p. 9).

Hotazel Manganese Mines (Pty) Ltd. (South32 Ltd., 60%) operated the Mamatwan and the Wessels Mines near Hotazel in Northern Cape Province. In 2022, Hotazel's output of manganese remained nearly unchanged at 3.86 Mt in 2022. Production was limited by a shutdown of Wessels for maintenance in the fourth quarter of 2022. Ore grades from the company's sales were nearly 40% manganese in 2022. Hotazel planned to produce at a rate of about 3.3 Mt/yr in the first half of 2023 (South32 Ltd., 2022, 2023).

Jupiter Mines Ltd. of Australia held a 49.9% share in Tshipi e Ntle Manganese Mining (Pty) Ltd., and a 37% share in Ntsimbitntle Mining (Pty) Ltd. In 2022, Jupiter and Ntsimbitntle produced 3.3 Mt of manganese ore from the Tshipi Borwa Mine in Northern Cape. Lumpy ore mined at Tshipi Borwa had a grade of 36.5% manganese and fine ore and of 35.5% manganese. The mine had a capacity of 5 Mt/yr of manganese. A maximum of 3.5 Mt/yr of manganese ore could be shipped by rail because of Transnet's capacity constraints. Tshipi Borwa's estimated remaining life was 121 years (Khaile, 2018, p. 28; Jupiter Mines Ltd., 2023; Piper, 2023b).

United Manganese of Kalahari (Pty) Ltd. (UMK) [Majestic Silver Trading 40 (Pty) Ltd., 51%] operated the Russik Mine in Northern Cape Province. The company produced 3 Mt of manganese ore at a grade of 37.5% manganese in 2018 and announced plans to increase production to 3.6 Mt/yr during the next few years in 2019. In 2022, UMK's production was about 3.4 Mt. The remaining life of the Russik Mine was estimated to be 147 years [Khaile, 2018, p. 29; Jupiter Mines Ltd., 2023; United Manganese of Kalahari (Pty) Ltd., undated].

Manganese ore from the Russik Mine was used by Transalloys (Pty) Ltd. (Renova, 23.78%) in the production of silicomanganese. The company, which had a capacity of 180,000 t/yr, was the only silicomanganese producer in South Africa. In 2022, Transalloys's production decreased to 134,000 t from 151,000 t in 2021 because of a loss of electric transformers in August that forced the largest furnace to be shut down (tables 1, 2; International Manganese Institute, 2023).

Asia Minerals Ltd. (AML) of Hong Kong operated the Kudumane Mine at Farm York, Northern Cape Province. In 2022, AML produced about 1.8 Mt of manganese ore. The estimated remaining life of the Kudumane Mine was 143 years (Jupiter Mines Ltd., 2023).

Kalagadi Manganese (Pty) Ltd. [Kalagadi Alloys (Pty) Ltd., 44%; Kalahari Resources (Pty) Ltd., 36%; and Industrial Development Corp., 20%] operated an underground mine at Hotazel. The company planned to produce 3 Mt/yr of manganese ore at a grade of nearly 39% manganese upon reaching full capacity. Kalagadi produced about 1.3 Mt of manganese in 2022. The estimated remaining life of the Kalagadi Mine was 77 years (Khaile, 2018, p. 29; Kalagadian, The, 2019; McKay, 2022a; Jupiter Mines Ltd., 2023).

Kalagadi operated a plant to beneficiate its mine's output into sintered ore (which is heated and compressed to increase its grade). The company planned to reach its sintering plant's full capacity of 2.4 Mt/yr at a grade of nearly 47% manganese in 2023 (Khaile, 2018, p. 29; McKay, 2019).

In March 2021, Glencore and Ntsimbitntle started production at the Mokala Mine in Northern Cape Province. The companies planned to produce more than 1 Mt/yr of manganese ore at Mokala, which had an estimated life of 44 years. In 2022, Glencore and Ntsimbitntle produced 1.1 Mt of manganese at Mokala (Creamer, 2021; Jupiter Mines Ltd., 2023).

Mn48 (Pty) Ltd. (Traxys Projects LP, 47%; South African individuals and empowered entities, 30%; and Ntsimbitntle, 23%) planned to develop the Mn48 project in Northern Cape Province. The company completed a feasibility study in January 2020. Planned production at full capacity in the study was 1 Mt/yr of manganese ore at a grade of 48%. The estimated mine life was 20 years. As of the end of 2022, production had not started [Jupiter Mines Ltd., 2023; Mn48 (Pty) Ltd., undated].

**Nickel.**—South Africa's production of mined nickel decreased to 29,033 t in 2022 from 31,848 t in 2021, and refined nickel, 37,500 t from 38,000 t. Amplats produced 21,300 t of refined nickel in 2022 compared with 22,300 t in 2021. About 17,300 t of nickel was mined at the company's PGM-mining operations in South Africa in 2022 compared with 17,400 t in 2021; the Mogalakwena Mine's production was about 14,700 t in 2022 compared with 14,911 t in 2021. Implats produced 16,241 t of refined nickel in 2022 compared with 15,677 t in 2021. About 3,705 t was attributable to the company's PGM-mining operations in South Africa in 2022 compared with 3,807 t in 2021. The remainder was attributable to the Two Rivers Mine, Implat's operations in Zimbabwe, recycling, and toll refining (Impala Platinum Holdings Ltd., 2022a, p. 80, 92; 2022b, p. 2; 2023, p. 2; Anglo American Platinum Ltd., 2023, p. 1, 72, 74, 76, 80, 82).

In 2022, Sibanye-Stillwater produced 11,661 t of crude nickel sulfate with a nickel content of 22% at its Base Metals Refinery compared with 14,950 t in 2021. Thakadu Group processed Sibanye-Stillwater's crude nickel sulfate to battery grade. Thakadu's plant had a capacity of 30,000 t/yr of battery-grade nickel sulfate; the company planned to produce 25,000 t/yr (Creamer, 2022b; Chris Law, Sibanye-Stillwater Ltd., written commun., December 1, 2023).

In early 2022, ARM was considering reopening the Nkomati Mine, which was placed on care-and-maintenance status in March 2021, because of increased nickel prices. As of the start of September, the company had not made plans to restart mining because of the costs of mining low-grade underground ore and concerns about the sustainability of higher nickel prices (Thomson Reuters, 2022).

**Platinum-Group Metals.**—In 2022, total mined PGMs production was 250,246 kg compared with 284,993 kg in 2021 and 254,338 kg in 2012. Total production of refined PGMs was estimated to be about 279,000 kg in 2022 compared with 332,000 kg in 2021. Mine production remained nearly unchanged between 2012 and 2022 because of factors including power and water shortages and a lack of investment in new mines (table 1; Ninji and Mazneva, 2020; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

Sales of rhodium, palladium, platinum, iridium, and ruthenium accounted for about 50%, 23%, 20%, 4%, and 3%, respectively, of PGM-mining companies' earnings in 2022. The share of platinum in PGM-mining companies' earnings was 68% in 2012. The share of platinum in South Africa's PGM production decreased to 50% in 2022 from 51% in 2012. Decreased platinum prices and increased palladium and rhodium prices were a much more important factor in the shift in earnings than changes in production volumes (Moumakwa, 2013; Minerals Council South Africa, 2023, p. 29–30).

In 2022, Amplats (the leading producer of PGMs in South Africa) produced about 135,900 kg of refined PGMs compared with 177,800 kg in 2021. The company's production in 2022 of refined platinum was 66,938 kg; refined palladium, 43,243 kg; refined rhodium, 9,340 kg; and refined iridium and ruthenium, a total of about 16,300 kg. Amplats's production in 2021 of refined platinum was 87,189 kg; refined palladium, 57,025 kg; refined rhodium, 12,501 kg; and iridium and ruthenium, a total of about 21,100 kg. Decreased production was attributable to delays in completing the rebuild of the Waterberg smelter in the second half of 2022 and reduced power supplies from Government-owned power company Eskom Holdings SOC Ltd. Amplats planned to produce a total of between 112,000 and 124,000 kg of refined PGMs each in 2023 and 2024 and between 103,000 and 115,000 kg in 2025 (Anglo American Platinum Ltd., 2023, p. 17, 28, 67–68, 70).

About 85,500 kg of PGMs were produced by mining operations of Amplats (located in South Africa) and its joint-venture partners in 2022, which was a decrease of about 9% compared with that in 2021. Decreased production was attributable to factors including delays in the delivery of drilling equipment resulting from supply chain disruptions, heavy rains, and power supply constraints. Of Amplats's total PGM production in 2022, platinum accounted for 39,700 kg; palladium, 29,700 kg; ruthenium, 8,200 kg; rhodium, 5,840 kg; and iridium, 2,000 kg. Production of the following decreased in 2022: mined palladium, about 10%; mined platinum, by 8%; and mined iridium, rhodium, and ruthenium, by 7% each (Anglo American Platinum Ltd., 2023, p. 12–14, 72, 74, 76, 80, 82).

In 2022, total PGM production at Amplats' Mogalakwena Mine was 30,441 kg; the Amandelbult Mine, 22,065 kg; the Kroondal Platinum Mine (which was a joint venture with Sibanye-Stillwater), 15,116 kg; the Mototolo Platinum Mine, 8,945 kg; and the Modikwa Platinum Mine (which was a joint venture with ARM), 8,883 kg. Total PGM production decreased at the mines in 2022 as follows: at Mogalakwena, by 15%; at Kroondal, by 11%; at Amandelbult, by 8%; and at Modikwa, by nearly 2%. In 2022, production at Mototolo increased by nearly 19% (Anglo American Platinum Ltd., 2023, p. 72, 74, 76, 80, 82).

Mogalakwena, which accounted for 36% of Amplats and its joint venture partners' total mined PGM output in 2022, produced 50% of the companies' palladium, 34% of the platinum, 18% of the rhodium, and 12% 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 26% of the companies' total mined PGM output in 2022, produced 37% of the iridium, 36% of the ruthenium, 35% of the rhodium, 28% of the platinum, and 17% of the palladium. Kroondal, which accounted for nearly 18% of the companies' total mined PGM output in 2022, produced 26% of the ruthenium, 25% of the iridium, 23% of the rhodium, 19% of the platinum, and 13% 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., 2023, p. 72, 74, 76, 80, 82).

In December 2021, Amplats approved mining the Der Brochen resource, which was adjacent to the Mototolo Mine. Amplats started construction of the project in February 2022. Der Brochen was expected to extend the life of Mototolo by 30 years. The company also planned to complete a feasibility study on expanding capacity at Mototolo by 33% by the end of 2023 (Anglo American Platinum Ltd., 2023, p. 7, 16).

Amplats planned to produce 31,000 to 34,000 kg/yr of PGMs at Mogalakwena between 2023 and 2025. Amplats was considering an expansion of Mogalakwena; construction of a new concentrator could start in 2024 depending on company approval. Production at Modikwa was expected to increase to 11,800 kg/yr of PGMs (including gold) by mid-2025 (Perold, 2022; Anglo American Platinum Ltd., 2023, p. 13).

Implats produced 91,631 kg of refined PGMs in 2022 compared with 103,049 kg in 2021. Of Implats's total refined PGMs production in 2022, platinum accounted for about 42,000 kg; palladium, 32,300 kg; rhodium, 5,400 kg; and gold, iridium, and ruthenium, a total of about 11,800 kg. The company's production of refined platinum in 2021 was about 46,500 kg; refined palladium, 37,400 kg; refined rhodium, 5,700 kg; and gold, iridium, and ruthenium, a total of about 13,400 kg. Implats's mining operations in South Africa accounted for about 41,800 kg of refined PGM production in

2022. The remainder was attributable to the Two Rivers Mine, Implats's operations in Zimbabwe, recycling, and toll refining (Impala Platinum Holdings Ltd., 2022a, p. 80, 92; 2022b, p. 74, 76, 82; 2023, p. 74, 82, 86).

The Impala Rustenburg Mines near Rustenburg in North West Province produced about 34,000 kg of PGMs (including gold) in 2022 compared with 39,100 kg in 2021. Implats's production at the Rustenburg mines in 2022 was as follows: platinum, about 18,200 kg; palladium, 8,640 kg; and rhodium, 2,350 kg. Total gold, iridium, and ruthenium production was 4,780 kg in 2022, of which ruthenium and iridium accounted for an estimated 69% and 17%, respectively, based on data from prill splits (the relative proportions of PGMs). At the mines, production of the following decreased in 2022: palladium, by 13%; platinum, 12%; and rhodium, 11%. Iridium and ruthenium production decreased by an estimated 16% each (Impala Platinum Holdings Ltd., 2008; 2022a, p. 80; 2022b, p. 74; 2023, p. 74).

The output of the Marula Mine in 2022 was as follows: palladium, 3,090 kg; platinum, 3,000 kg; rhodium, 620 kg; and gold, iridium, and ruthenium, a total of 1,160 kg. Based on prill split data, ruthenium production was estimated to be about 870 kg in 2022, and iridium, 240 kg. All ore mined at Marula was from the UG2 layer, which was richer in iridium, palladium, rhodium, and ruthenium than the Merensky layer. In 2021, Implats's production of palladium was about 2,980 kg, and that of platinum, 2,910 kg; rhodium, 590 kg; and gold, iridium, and ruthenium, a total of 1,120 kg (Impala Platinum Holdings Ltd., 2008; 2022a, p. 82; 2022b, p. 76; 2023, p. 82).

Sibanye-Stillwater produced 28,866 kg of refined PGMs at its Precious Metals Refinery at Brakpan in 2022 compared with 33,821 kg in 2021. The company's production of refined platinum was 15,419 kg in 2022; refined palladium, 7,055 kg; refined rhodium, 2,070 kg; and refined gold, iridium, and ruthenium, a total of 4,322 kg. Sibanye-Stillwater's production of refined platinum was 17,611 kg in 2021; refined palladium, 8,243 kg; refined rhodium, 2,494 kg; and refined gold, iridium, and ruthenium, a total of 5,473 kg. Most of the refinery's production was attributable to the Marikana Mine; Sibanye-Stillwater also refined PGM concentrates purchased from other companies (Chris Law, Sibanye-Stillwater Ltd., written commun., December 1, 2023).

Sibanye-Stillwater produced 26,996 kg of PGMs at the Marikana Mine in 2022 (compared with 31,006 kg in 2021), of which platinum accounted for 14,041 kg; palladium, 6,416 kg; ruthenium, 3,424 kg; rhodium, 2,148 kg; and iridium, 968 kg. In 2021, Sibanye-Stillwater's production of platinum at the Marikana Mine was 15,556 kg; palladium, 7,227 kg; ruthenium, 4,751 kg; rhodium, 2,349 kg; and iridium, 1,122 kg. Decreased output was partially attributable to lower ore grades at the underground mining operations (Sibanye-Stillwater Ltd., 2023b).

In 2022, Sibanye-Stillwater produced 22,611 kg of PGMs at the Rustenburg Mine compared with 24,019 kg in 2021. The company produced the following at Rustenburg in 2022: platinum, 11,470 kg; palladium, 5,997 kg; ruthenium, 2,781 kg; rhodium, 1,737 kg; and iridium, 625 kg. In 2021, Sibanye-Stillwater's production at Rustenburg was as follows: platinum, 12,363 kg; palladium, 6,356 kg; ruthenium, 2,856 kg; rhodium, 1,800 kg; and iridium, 644 kg. Decreased output was partially attributable to lower ore grades (Sibanye-Stillwater Ltd., 2023b).

Northam Platinum Ltd. operated the Booysendal, Eland, and 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 15,346 kg in 2022 from 12,030 kg in 2021, and refined palladium, 7,584 kg from 5,508 kg in 2021. Iridium, rhodium, and ruthenium were exported to Germany for refining (Northam Platinum Ltd., 2022, p. 40; 2023, p. 104).

Production from the Booysendal, Eland, and Zondereinde Mines in 2022 was as follows: platinum, 13,872 kg; palladium, 7,056 kg; ruthenium, 4,097 kg; rhodium, 2,336 kg; iridium, 920 kg; and gold, 325 kg. Northam's total production of these commodities in 2018 was as follows: platinum, 12,855 kg; palladium, 6,309 kg; ruthenium, 3,760 kg; rhodium, 2,035 kg; iridium, 848 kg; and gold, 246 kg. Increased production in 2022 was attributable to the Booysendal and the Eland Mines (Northam Platinum Ltd., 2022, p. 40, 45, 52, 58; 2023, p. 104, 114, 128, 140).

Northam planned to increase its production of PGMs (including gold, but not ruthenium or iridium) to 32,000 kg/yr, of which Booysendal, Zondereinde, and Eland were expected to account for about 15,500 kg/yr, nearly 11,000 kg/yr, and about 5,600 kg/yr, respectively. The company planned to reach full capacity at Booysendal by mid-2025 and at Eland by 2028. Increased production from Zondereinde would be attributable to the Western extension project, which features a high-grade underground PGM resource. The estimated remaining life of Eland and Zondereinde was more than 30 years each, and Booysendal, more than 25 years (Northam Platinum Ltd., 2023, p. 8–9, 16–17).

Royal Bafokeng Platinum Ltd. (RBPlat) produced PGMs at the Bafokeng Rasimone Platinum Mine (BRPM) and the Styldrift Mine. Production of PGMs (including gold, but not ruthenium or iridium) was about 14,000 kg in 2022 compared with 14,500 kg in 2021. Platinum production decreased to 8,900 kg in 2022 from 9,400 kg in 2021. Based on prill split data, BRPM and Styldrift produced a total of about 3,800 kg of palladium and 890 kg of rhodium in 2022 compared with 4,000 kg of palladium and 860 kg of rhodium in 2021. At BRPM, total production of PGMs increased to 8,300 kg in 2022 from 7,700 kg in 2021. Total production of PGMs at Styldrift decreased to 5,700 kg in 2022 from 6,800 kg in 2021 (Royal Bafokeng Platinum Ltd., 2023, p. 18, 60, 70).

RBPlat planned to produce a total of between 14,600 and 15,200 kg of PGMs at BRPM and Styldrift in 2023. The company planned to produce an average of more than 19,000 kg/yr between 2023 and 2032. The estimated remaining life of BRPM was more than 43 years, and Styldrift, 41 years (Perold, 2022; Royal Bafokeng Platinum Ltd., 2023, p. 67, 72).

ARM and Implats operated the Two Rivers Mine, which produced 9,415 kg of PGMs in 2022 compared with 9,219 kg in 2021. Platinum accounted for about 47% of Two Rivers' PGM output; palladium, 28%; ruthenium, 13%; rhodium, 8%; iridium, 3%; and gold, 1%. ARM planned to increase total production to 11,200 kg/yr by mid-2023. The estimated remaining life of the Two Rivers Mine was more than 30 years

(African Rainbow Minerals Ltd., 2022a, p. 70; 2022b, p. 17; 2023, p. 16; Perold, 2022).

Siyanda Resources (Pty) Ltd. operated the Union Mine near Northam. In 2022, the company produced an estimated 5,400 kg of platinum, 2,600 kg of palladium, and 870 kg of rhodium. Siyanda produced 4,800 kg of platinum, 2,300 kg of palladium, and 780 kg of rhodium in 2021. The Union Mine was expected to continue production until 2033 [CPM Group, 2023, p. 32, 125, 190; Siyanda Resources (Pty) Ltd., undated].

In fiscal year 2022, Tharisa Minerals produced 5,574 kg of PGMs compared with 4,908 kg in fiscal year 2021. The following comprised Tharisa Minerals' total production of PGMs by volume in fiscal year 2022: platinum, 55%; palladium, 17%; and rhodium, 10%. Increased production was attributable to higher ore grades. Tharisa Minerals planned to produce between 5,400 and 5,800 kg in fiscal year 2023. The company also planned to increase production to a rate of 6,200 kg/yr of PGM [Tharisa Minerals (Pty) Ltd., 2022, p. 25, 36].

Sedibelo Resources Ltd. (formerly Sedibelo Platinum Mines Ltd.) sold 2,135 kg of PGMs (including gold, but not ruthenium or iridium) at the company's Pilanesberg Platinum Mines in 2022 compared with 3,037 kg in 2021. Decreased production was attributable to lower ore grades and recovery rates. Mining was expected to continue at Pilanesberg until 2034 (Sedibelo Resources Ltd., 2023, p. 5, 10).

In 2022, Wesizwe Platinum Ltd. was developing the Bakubung Mine in North West Province. The company's original planned capacity of 13,000 kg/yr of PGMs (including gold, but not ruthenium or iridium) was reduced by two-thirds in 2019. Platinum was expected to account for 62.4% of PGM production; palladium, 28%; rhodium, 7.4%; and gold, 2.2%. Wesizwe could expand capacity after a 5-year mining period based on market conditions. As of yearend, production had not started (Engineering & Mining Journal, 2015; Moumakwa, 2019; Mining Weekly, 2022; Parker, 2023).

Ivanhoe Mines Ltd. of Canada was constructing a new mine at its Platreef project, which is located in the Northern Limb of the Bushveld Complex. In 2022, the company completed an updated feasibility study on the new mine. In the first phase of mining (predicted to begin in the third quarter of 2024), Ivanhoe was expected to produce nearly 2,300 t/yr of nickel, 1,400 t/yr of copper, and 3,500 kg/yr of PGMs (including gold, but not ruthenium or iridium). In the second phase (in 2027), PGM production was expected to increase to more than 18,000 kg/yr of PGMs, 12,000 t/yr of nickel, and 7,300 t/yr of copper (Barradas, 2023b).

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. Depending on the results of the decision, mining could start in late 2023. Waterberg's planned capacity of about 13,000 kg/yr of PGMs (including gold, but not ruthenium or iridium) could be reached by 2027. In a prefeasibility study completed in 2016, palladium accounted for 63% of production; platinum, 30%; gold, 6%; and rhodium, 1%. As of October 2022, construction had not started, and the company was planning to update its feasibility study (Engineering & Mining Journal, 2016, 2019; Mining Review Africa, 2022).

As of yearend, ARM was engaged in a feasibility study on reopening Bokoni. Depending on the results of the study, the company could produce 9,300 kg/yr of PGMs (including gold). Mining could restart by mid-2024 (African Rainbow Minerals Ltd., 2022b, p. 6; 2023, p. 5).

**Rare Earths.**—Frontier Rare Earths of Luxembourg updated its prefeasibility study on a new mine at the Zandkopsdrift project in 2022. Planned production in the prefeasibility study was 17,000 t/yr of rare-earth oxides and 100,000 t/yr of battery-grade manganese sulfate during a mine life of at least 45 years. Cerium oxide was expected to account for 44% of rare earths production; lanthanum oxide, 25.4%; neodymium oxide, 15.9%; praseodymium oxide, 4.6%; yttrium oxide, 4.1%; samarium oxide, 2.8%; gadolinium oxide, 1.4%; and dysprosium oxide, 0.8%. The company planned to start a feasibility study in 2023; mining could start in 2027, depending on the results of the study (Frontier Rare Earths, 2023).

In October 2022, Rainbow Rare Earths Ltd. of the United Kingdom completed a preliminary economic analysis on reprocessing phosphogypsum tailings from phosphate rock mining operations at Phalaborwa. Planned production was nearly 1,900 t/yr of rare-earth oxides during a project life of 14 years. Depending on the results of further studies, mining could start in 2026 (Rainbow Rare Earths Ltd., 2022).

**Silicon.**—In October 2022, Ferroglobe plc of the United Kingdom announced plans to restart production from Polokwane, which had a capacity of 55,000 t/yr of silicon metal. Production was shut down in 2019 owing to high power costs and reduced demand in world markets. Ferroglobe planned to produce silicon at a rate of nearly 14,000 t/yr initially and to increase production to 45,000 t/yr by the end of the second quarter of 2023 (Ferroglobe plc, 2019, Tex Report, The, 2022a).

**Titanium and Zirconium.**—In 2022, South Africa's production of ilmenite increased to an estimated 1.8 Mt from 1.5 Mt in 2021; rutile production increased to 100,000 t in 2022 from 89,000 t in 2021. 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 factors including civil unrest, lower ore grades, and power-supply constraints. RBM's mining operations were shut down between late June and late August 2021 owing to local civil unrest (Barradas, 2019; Ryan, 2022).

Titanium slag at RBM was produced at a rate of between 550,000 and 600,000 t/yr in 2022 compared with 377,000 t in 2021 and 881,000 t in 2012. The company was the leading producer of titanium slag in South Africa; its production had a titanium dioxide ($TiO_2$) content of 85%. Based on titanium slag production, ilmenite production was estimated to have decreased to 1.1 Mt in 2022 from nearly 1.7 Mt in 2012. RBM's titanium slag furnaces required 400 megawatts (MW) of power to operate at the furnaces' full capacity of 1 Mt/yr. However, production was constrained because power supplies from Eskom were limited to 215 MW of generating capacity. RBM planned to build a new solar-power station with a capacity of 130 MW to increase its production [Richards Bay Minerals (Pty) Ltd., 2013, p. 10; 2017, p. 8; Ryan, 2022; Iluka Resources Ltd., 2022, p. 23; 2023, p. 26].

RBM's zircon and rutile production capacities were 250,000 t/yr and 100,000 t/yr, respectively. The company's zircon production was about 144,000 t in 2022 compared with 108,000 t in 2021 and 264,000 t in 2012. Rutile production was about 55,000 t in 2022 compared with 36,000 t in 2021 and 97,000 t in 2012. RBM's rutile had a $TiO_2$ 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; Ramane, 2018; Iluka Resources Ltd., 2022, p. 23; 2023, p. 26].

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 2019 owing to civil unrest. As of October 2022, production at Zulti South remained suspended (Barradas, 2019; Thomson Reuters, 2019; Ryan, 2022).

Tronox Holdings plc of the United States produced ilmenite, rutile, and zircon at the Fairbreeze and the Namakwa Sands Mines; ilmenite was processed to titanium slag. The company's titanium slag production at Fairbreeze and Namakwa Sands was estimated to be 336,000 t in 2022 and 363,000 t in 2021. Total titanium slag capacity at Fairbreeze and Namakwa Sands was 410,000 t/yr. Based on titanium slag capacity utilization, production in 2022 was estimated to be as follows: ilmenite, 660,000 t; zircon, 148,000 t; and rutile, 46,000 t. In 2021, production of the same commodities was estimated to be 710,000 t, 159,000 t, and 50,000 t, respectively (table 2; Iluka Resources Ltd., 2022, p. 23; 2023, p. 26).

Mineral Commodities Ltd. (MCL) of Australia operated the Tormin Mine in Western Cape Province. The company produced 35,256 t of ilmenite, 5,394 t of zircon, and 1,279 t of rutile in 2022 compared with 89,013 t of ilmenite, 9,861 t of zircon, and 2,612 t of rutile in 2021. Decreased production was partially attributable to lower ore grades. MCL's production target for 2022 for ilmenite was between 40,000 and 70,000 t, and for rutile and zircon, a total of between 8,000 and 12,000 t. MCL planned to increase production by completing a new processing plant by the fourth quarter of 2023. The company also planned to start downstream processing of ilmenite by completing a new garnet and ilmenite mineral-separation plant by the first quarter of 2024 (Mineral Commodities Ltd., 2023).

South Africa imported most of its downstream titanium products. In March 2022, Nyanza Light Metals Ltd. (Arkein Group of Companies, 80%) completed the first phase of its new $TiO_2$ pigment plant in the Richards Bay Industrial Development Zone. The plant had a capacity of 700 t/yr of $TiO_2$ pigment. The company planned to increase its capacity to 80,000 t/yr starting in early 2025, depending on the ability to obtain financing by the first half of 2023. Pigment would be produced using 250,000 t/yr of titanium-rich wastes from previous iron ore and vanadium-mining operations (Tshethlanyane, 2017; Richards Bay Industrial Development Zone, 2020; Africa Finance Corp., 2022).

**Vanadium.**—Glencore produced vanadium pentoxide ($V_2O_5$) and ferrovanadium at the Rhovan Mine and smelter in Brits. In 2022, production of $V_2O_5$ at Rhovan decreased to about 9,000 t from 9,300 t in 2021. The estimated remaining life of the Rhovan Mine was 10 years based on reserves at yearend 2022 (Glencore plc, 2023b, p. 30; Tex Report, The, 2023c).

Bushveld Minerals Ltd. of the United Kingdom operated the Vametco Mine and Brits plant. In 2022, the company produced 2,705 t of contained vanadium from magnetite ore at Vametco compared with 2,453 t in 2021. Bushveld also produced 1,137 t of contained vanadium at its Vanchem operations in 2022, which was nearly unchanged from that in 2021. About 200 t of contained vanadium was lost because of load shedding at Vanchem in the second half of 2022. Bushveld planned to increase total production at Vametco and Vanchem to between 4,200 and 4,500 t of contained vanadium in 2023 and between 5,000 and 5,400 t/yr subsequently (Bushveld Minerals Ltd., 2023).

Vanadium Resources Ltd. of Australia completed a feasibility study on a new mine at the Steelpoortdrift project in Limpopo Province in October 2022. Planned production in the study was more than 19,000 t/yr of $V_2O_5$ during an estimated mine life of 25 years. Depending on the results of a final investment decision scheduled for June 2023, construction could start by the first quarter of 2024, and production could start by the fourth quarter of 2025 (Vanadium Resources Ltd., 2022, p. 1, 3, 40).

### *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 Co. (Pty) Ltd., 1 Mt/yr. As of late 2022, the cement industry was producing at a rate of 12 Mt/yr. Cement imports were more than 1 Mt/yr. Production was limited by factors including high import costs, import competition, and low rates of investment in infrastructure (table 2; International Cement Review, 2018; Creamer, 2022c; Cokayne, 2023).

**Clay and Shale.**—In 2022, South Africa's total sales of brick clay and shale decreased to 6.23 Mt from 6.58 Mt in 2021 and 7.77 Mt in 2012. Brick clay sales decreased to 4.88 Mt in 2022 from 5.53 Mt in 2021, and shale for use in cement, to 197,000 t from 248,000 t. Sales of shale for use in bricks increased to nearly 1.15 Mt in 2022 from 802,000 t in 2021. Decreased sales of brick clay and shale since 2012 could be attributable to reduced investments in infrastructure. In early 2022, brick clay and shale were produced at as many as 133 mines (Galane, 2021; DeWater, 2022, p. 89–100, 110–113; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., March 15, 2022, April 3, 2023, and July 27, 2023).

Corobrik (Pty) Ltd. produced about 1 billion bricks per year. Based on a brick weight of between 3 and 3.5 kg, the company was estimated to produce between 3 and 3.5 Mt/yr of brick clay. In November 2020, Corobrik completed a new brick plant at Driefontein to replace its existing facility. The new plant doubled production capacity to 100 million bricks per year and reached full operational capacity by the end of March 2022. To support this increased output, the new plant is expected to require additional brick clay production of between 150,000 and 175,000 t/yr [Ceramic World Web, 2020; Corobrik (Pty) Ltd., 2022; Clay Brick Association of Southern Africa, 2022].

Brikor Ltd. operated the Ilangabi Mine, which had a capacity of about 800,000 t/yr of brick clay. The company's brickmaking plants in Nigel had a total capacity of more than 160 million bricks per year (Slater, 2022).

**Diamond.**—In 2022, diamond production in the country totaled 9.68 million carats compared with a revised 9.73 million carats in 2021 and 7.25 million carats in 2012. Kimberlites accounted for about 96% of diamond production in 2022, and alluvial and marine deposits, 2% each. Increased production since 2012 was primarily attributable to the Venetia Mine. Employment in the diamond cutting and polishing industry decreased to fewer than 300 polishers in 2021 from 4,500 in 2009. The decrease was attributable to 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; de Klerk, 2019; Galane, 2021; Slier, 2021; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

De Beers Group of Companies was South Africa's leading producer of rough diamond. The company produced 5.52 million carats of diamond at the Venetia Mine in 2022 compared with 5.31 million carats in 2021. The Venetia Mine's open pit reserves were depleted in December 2022; De Beers planned to start underground operations in 2023. The estimated life of the Venetia Underground mine was 24 years. Planned production at full capacity was 4.5 million carats per year (Cornish, 2018; Anglo American plc, 2023, p. 3).

In 2022, Petra Diamonds Ltd. produced about 2.7 million carats compared with nearly 3.2 million carats in 2021. Production at the company's mines decreased as follows: at the Cullinan Mine, to 1.6 million carats in 2022 from 1.9 million carats in 2021; at the Finsch Mine, 1.07 million carats from 1.24 million carats; and at the Koffiefontein Mine, about 19,000 carats from 46,000 carats. Petra shut down production at Koffiefontein in the fourth quarter of 2022 (Petra Diamonds Ltd., 2022a, p. 50, 52, 56; b, p. 17–19; 2023, p. 13, 37).

In the first half of 2023, Petra planned to produce at a rate of between 1.3 and 1.5 million carats per year at both Cullinan and Finsch. By mid-2024, the company planned to increase production at Cullinan to between 1.7 and 1.9 million carats per year. Mining was expected to continue until at least 2033 at Cullinan and to at least 2031 at Finsch (Petra Diamonds Ltd., 2023, p. 10, 38–39).

**Fluorspar.**—In 2022, fluorspar production was estimated to be 406,000 t in 2022 compared with 401,000 t in 2021 and 218,000 t in 2017. Minerales y Productos Derivados SA of Spain held an 85% share in the Vergenoeg fluorspar mine. Vergenoeg's capacity of acid-grade fluorspar was 250,000 t/yr, and its capacity of metallurgical-grade fluorspar powder and briquette was 30,000 t/yr. Sephaku Fluoride Ltd. (SepFluor) operated the Nokeng Mine, which is located at Rust de Winter. Nokeng had a capacity of 180,000 t/yr of acid-grade fluorspar and 30,000 t/yr of metallurgical-grade fluorspar. Increased production (since 2017) was primarily attributable to the opening of the Nokeng Mine (table 2; Maredi, 2020).

**Garnet, Industrial.**—MCL produced industrial garnet from the Tormin Mine. In 2022, the company produced 178,766 t of industrial garnet compared with 144,874 t in 2021. MCL's production target for 2022 was between 180,000 and 210,000 t of garnet. MCL planned to increase production by completing a new processing plant by the fourth quarter of 2023. The company also planned to start downstream processing of garnet by completing a new garnet and ilmenite mineral-separation plant by the first quarter of 2024 (Mineral Commodities Ltd., 2023).

**Gypsum.**—Saint-Gobain Construction Products SA (a subsidiary of Compagnie de Saint-Gobain S.A. of France) produced gypsum from the Boesmanland and the Dikpens Mines in Northern Cape Province and the Maskam Mine in Western Cape Province. Gypsum was also mined by five other companies, including PPC. In 2022, South Africa's gypsum production was 243,052 t compared with 277,376 t in 2021 and 558,242 t in 2012. The long-term decrease in production was attributable to import competition (Motsie, 2010, 2020; Galane, 2021; DeWater, 2022, p. 109, 117; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Kyanite and Related Minerals.**—South Africa was the world's leading producer of andalusite. In the second quarter of 2022, kyanite and related minerals in the county were produced at a rate of about 160,000 t/yr, and exports, 110,000 t/yr. Production was constrained by factors including flooding, power-supply interruptions, and shipping problems (Modiselle, 2023; Hatfield, 2024).

Imerys South Africa (Pty) Ltd. (a subsidiary of Imerys Group of France) operated the Annesley, Segorong, and Thabazimbi Mines. The company accounted for a substantial majority of domestic andalusite production. At the beginning of 2022, Andalusite Resources (Pty) Ltd. operated the Maroeloesfontein Mine, which had a capacity of 72,000 t/yr. In May 2022, ARM Andalusite (Pty) Ltd. purchased the mine from Andalusite Resources. The estimated remaining life of Maroeloesfontein was about 100 years [Lassetter, 2022; ARM Andalusite (Pty) Ltd., 2023].

**Lime.**—In 2022, sales of lime decreased to 1.07 Mt from 1.15 Mt in 2021 and 1.21 Mt in 2012. Sales for use in the chemical industry accounted for 64% of total sales of lime in 2022; pyrometallurgical applications, 29%; and water purification, 5%. In 2012, sales for use in pyrometallurgical applications and the chemical industry accounted for 47% each of that year's total sales of lime and water purification, 4% (Motsie and Malematja, 2014; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Phosphate Rock.**—In 2022, national phosphate rock production was nearly 1.99 Mt compared with 1.73 Mt (revised) in 2021 and 2.24 Mt in 2012. Foskor (Pty) Ltd. accounted for most of South Africa's production of phosphate rock. Foskor's production was limited by factors including delays in importing ammonia and sulfur because of backlogs at the Richards Bay harbor, local political unrest, power and water-supply interruptions, and rail-transport problems (Cilliers, 2022; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

Foskor used phosphate rock from its mine at Phalaborwa for the production of phosphoric acid and fertilizers, including monoammonium phosphate and diammonium phosphate at its plant in Richards Bay. In fiscal year 2022 (April 1, 2021, through March 31, 2022), the company produced 294,000 t of phosphoric acid compared with 301,000 t in fiscal year 2021. Fertilizer production decreased to 197,000 t from 264,000 t. Between fiscal year 2020 and fiscal year 2022, Foskor had planned to produce 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].

Kropz Elandsfontein (Pty) Ltd. planned to restart production at the Elandsfontein Mine, which is located in Western Cape Province, in the first quarter of 2022. The company planned to produce 1 Mt/yr of phosphate rock at a grade of 31% phosphorus pentoxide, and the estimated mine life was 11 years. As of yearend, Kropz's production was at least 30,000 t [Kropz Elandsfontein (Pty) Ltd., 2022a; b, p. 5, 13].

**Salt.**—In 2022, South Africa's production of salt increased to 570,012 t from 545,942 t in 2021 and 399,135 t in 2012. From 2009 to 2019, the total market share of salt producers in South Africa decreased to 53% from more than 99% because of low-cost imports from Botswana and Namibia (Motsie, 2010, 2020; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Sand, Construction.**—In 2022, South Africa's sales of aggregates and sand for construction were 56.3 Mt compared with 55 Mt in 2021. Sales of aggregates increased to 44.8 Mt in 2022 from 42.9 Mt in 2021. Sales of sand for construction decreased to 11.6 Mt in 2022 from 12.1 Mt in 2021. In early 2022, aggregates and construction sand were produced by cement producers and other companies at as many as 638 mines (DeWater, 2022, p. 42, 89–100, 110–113, 118–119, 121–172; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Sand, Industrial.**—In 2022, South Africa's production of silica sand was 1.86 Mt compared with 2.07 Mt in 2021 and 3.23 Mt in 2006. Silica sand production decreased as South Africa's glass recycling rate increased to 44% from 18% in 2006. In May 2021, the Government's Extended Producer Responsibility (EPR) Regulations became effective. The EPR Regulations set a target of 54% for glass recycling by 2026 (Galane, 2021; Ardagh Group, 2023; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Stone, Crushed.**—In 2022, production of limestone in the country decreased to 22.3 Mt from 24 Mt in 2021. In early 2022, limestone was produced by cement companies and other producers at as many as 47 mines. In 2022, limestone sales for use by the cement, agriculture, metallurgy, and other industries were 15 Mt, 2.49 Mt, 1.48 Mt, and 1.56 Mt, respectively (DeWater, 2022, p. 65, 99, 110–114, 148; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Stone, Dimension.**—In 2022, South Africa's sales of granite dimension stone were 392,740 t compared with 485,596 t in 2021 and 271,489 t in 2012. About 69% of granite sales were domestic in 2022 compared with 52% in 2012. Granite accounted for nearly 99% of the volume of domestic dimension stone sales in 2022. In early 2022, granite was produced at as many as 61 mines; slate, 9 mines; sandstone, 7 mines; and other dimension stone, 4 mines (Galane, 2021; DeWater, 2022, p. 106–107; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Sulfur.**—South Africa's sulfur production decreased to 70,640 t in 2022 compared with 105,924 t in 2021 and 257,019 t in 2012. Decreased sulfur production was attributable to the closure of petroleum refineries that recovered sulfur as a byproduct. Imports of crude sulfur decreased to 580,000 t in 2019 from 1.1 Mt in 2018 (Modiselle, 2020; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

Foskor used sulfur in the production of sulfuric acid; the company produced an estimated 1.2 Mt in fiscal year 2022 compared with 1.3 Mt in fiscal year 2021. Production was limited by factors including delays in importing sulfur because of backlogs at the port of Richards Bay (table 1; Cilliers, 2022).

**Talc and Pyrophyllite.**—Idwala Industrial Holdings (Pty) Ltd., Sino Rock (Pty) Ltd., and Wonderstone Ltd. mined pyrophyllite in North West Province. In 2022, domestic production of pyrophyllite was 438,698 t compared with 270,944 t in 2021 and 18,734 t in 2012. Increased production was partially attributable to higher demand in foreign markets (Galane, 2021; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Vermiculite.**—In 2022, Palabora Mining's vermiculite production at the Palabora Mine was 171,898 t compared with 150,104 t in 2021 and 118,223 t in 2020. In the second quarter of 2022, export sales were at a rate of about 176,000 t/yr. Palabora Mining started an upgrade to its rail infrastructure in 2021 to increase efficiency at its vermiculite loading facilities; the upgrade was completed in September 2022 (Letaba Herald, 2022; Modiselle, 2023; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

**Wollastonite.**—Namaqua Wollastonite (Pty) Ltd. [a subsidiary of Incubex Minerals (Pty) Ltd.] produced wollastonite at its mine near Garies at an estimated rate of 1,300 t/yr. Wollastonite also was imported from China. Companies in South Africa used wollastonite in the production of brake pads and cement. The company planned to increase production to 12,000 t/yr eventually [Namaqua Wollastonite (Pty) Ltd., 2020, p. 17].

### *Mineral Fuels and Related Materials*

**Coal.**—In 2022, total coal production was about 230 Mt compared with 234 Mt in 2021 and 259 Mt in 2012. The Witbank Coalfield accounted for most of South Africa's production. In recent years, numerous attempts to open coal mines in the Waterberg Coalfield were unsuccessful owing to 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. Bituminous coal accounted for 97% of South Africa's coal production in 2022, and anthracite accounted for 1.4%. Coal consumption in 2022 by power stations was 100 Mt; for industrial uses, 47 Mt; and for synthetic fuel production, 41 Mt (table 1; Prevost, 2017; Galane, 2021; Steyn, 2021; Minergy Ltd., 2023, p. 7; Bulelwa Satsha, Administrative Officer, Department of Mineral Resources and Energy of the Republic of South Africa, written commun., July 27, 2023).

About 60% of South Africa's anthracite production was exported, and 40% was used in sintering and the production of electrode paste and ferroalloys. Total coal exports decreased to about 50 Mt in 2022 from 68 Mt in 2012. In 2022, Asian countries accounted for 31.7 Mt of coal exports from Richards Bay, of which 15.5 Mt were attributable to India. Asian countries accounted for 50.7 Mt in 2021, of which 24.1 Mt were attributable to India. European countries accounted for 14.3 Mt in 2022 compared with 2.3 Mt in 2021. Exports to Europe increased as buyers substituted Russian coal and natural gas for South African coal because of the Russia-Ukraine conflict (Holman, 2013; Creamer, 2022a; Reid and Banya, 2023).

Seriti Coal (Pty) Ltd. (the leading producer of coal in South Africa) produced nearly 52 Mt/yr of coal at its mines. All of the company's mines are located in Mpumalanga Province except for the New Vaal Mine, which is in Gauteng Province. The mines produced the following amounts of coal in 2022: New Vaal, 16 Mt/yr; Middelburg South, 9 Mt/yr; Klipspruit, nearly 7.9 Mt/yr; Middelburg North, 6.5 Mt/yr; Khutala, 5.5 Mt/yr; Kriel, 4 Mt/yr; and New Denmark, 3 Mt/yr. About 37.4 Mt/yr of Seriti's production was supplied to domestic power stations, and 14.1 Mt/yr was exported. Seriti expected to continue production at Klipspruit until 2048, at New Denmark and New Vaal until 2039, at Kriel until 2035, at Middelburg North and Middleburg South until 2034, and at Khutala until 2033 [Seriti Coal (Pty) Ltd., 2023a–e, g].

Seriti was engaged in the development of several small mining operations at the New Largo project in Mpumalanga Province. The company was negotiating 10-year supply agreements with Eskom. Full production at a large-scale mine at New Largo was estimated to be 12 Mt/yr of thermal coal, which would be supplied to Eskom's Kusile power station. The estimated mine life was at least 50 years [Seriti Coal (Pty) Ltd., 2023f].

Exxaro Resources Ltd. produced 45 Mt of coal at its mines in 2022 compared with 44.1 Mt in 2021. Output at the Grootegeluk Mine in the Waterberg Coalfield in Limpopo Province increased to 29.8 Mt in 2022 from 27.3 Mt in 2021. Metallurgical coal output at the mine increased to 2 Mt from 1.9 Mt. Exxaro completed an expansion of Grootegeluk's capacity by 1.7 Mt/yr in 2021. The company's production at the following mines increased: the Matla Mine, to 6.2 Mt in 2022 from 5.9 Mt in 2021; the Mafube Mine, 3.9 Mt from 3.2 Mt; and the Leeuwpan Mine, 2.6 Mt from 2.4 Mt. At the Belfast Mine, production decreased to 2.4 Mt in 2022 from 2.5 Mt in 2021 (Exxaro Resources Ltd., 2023, p. 89; Tex Report, The, 2023a; Thungela Resources Ltd., 2023, p. 77).

Exxaro planned to produce 32 Mt of coal at Grootegeluk in 2023, of which 3.2 Mt would be metallurgical. The company's planned production from its mines in 2023 was as follows: Matla, 5.8 Mt; Leeuwpan, 3.9 Mt; Mafube, 3.8 Mt; and Belfast, 2.8 Mt. Exxaro planned to complete the expansion of Matla's capacity to 10 Mt/y by 2025. The estimated remaining life of Mafube was at least 21 years; Grootegeluk, at least 19 years; Belfast, 11 years; and Leeuwpan, 7 years (Exxaro Resources Ltd., 2023, p. 8, 89; Tex Report, The, 2023b).

In fiscal year 2022 (July 1, 2021, through June 30, 2022), Sasol Ltd.'s coal production decreased to 33.6 Mt from 36.7 Mt in fiscal year 2021. The company's mines produced the following amounts of coal in fiscal year 2022: the Syferfontein Mine, 8.5 Mt; the Twistdraai Thubelisha Mine, 7.3 Mt; the Shondoni Mine, 6.4 Mt; the Impumelelo Mine, 5.3 Mt; the Bosjesspruit Mine, 5 Mt; and the Sigma Mine, 1.1 Mt. Most of Sasol's coal production was used in the company's synthetic fuel operations (Sasol Ltd., 2022, p. 55).

Glencore and ARM operated the Goedgevonden Complex, the Impunzi Complex, and the Tweefontein Complex. Production at Goedgevonden increased to 6.57 Mt in 2022 from 5.79 Mt in 2021 and remained nearly unchanged at a total of 10.3 Mt at Impunzi and Tweefontein. Exports accounted for about 79% of sales in 2022. Glencore and ARM planned to increase total sales from Goedgevonden, Impunzi, and Tweefontein to about 20 Mt/yr by mid-2024. The estimated remaining life of Goedgevonden was 24 years, and Impunzi and Tweefontein, 12 years each (African Rainbow Minerals Ltd., 2022a, p. 5, 88–89; 2022b, p. 19–20; 2023, p. 16–17).

Izimbiwa Coal (Pty) Ltd. (Phembani Group, 50.01%, and Glencore, 49.99%) operated the Middelburg Complex; salable coal production was about 2.4 Mt in 2021. Glencore sold its share in Izimbiwa Coal in 2022. Umcebo Mining Ltd. operated the Wonderfontein Mine; production at Wonderfontein was about 2.7 Mt in 2022. The estimated remaining life of Wonderfontein was 8 years (Glencore plc, 2022, p. 43; 2023, p. 38–39).

Thungela Resources Ltd. produced 16.1 Mt in 2022 at the Goedehoop, Greenside, Isibonelo, Khwezela, and Zibulo Mines compared with 21.7 Mt in 2021. Production at the mines decreased as follows: at Zibulo, to 4.48 Mt in 2022 from 5.55 Mt in 2021; at Goedehoop, 3.22 Mt from 5.28 Mt; at Isibonelo, 3.67 Mt from 4.15 Mt; at Greenside, 2.59 Mt from 3.45 Mt; and at Khwezela, 2.15 Mt from 3.21 Mt. Decreased production was attributable to such factors as increased rainfall, lower domestic demand, and Transnet's reduced rail capacity. About 90% of the company's sales were exports in 2022 (Thungela Resources Ltd., 2023, p. 76–77).

Terracom Ltd. of Australia operated the Kangala Colliery, the North Block Complex (NBC), the New Clydesdale Colliery (NCC), and the Ubuntu Colliery in Mpumalanga Province. In the second half of 2022, Terracom was producing coal at a rate of 6.83 Mt/yr, which was nearly unchanged from the second half of 2021. NBC's production increased to 3.25 Mt/yr in the second half of 2022 from 3.14 Mt/yr in the second half of 2021, and Ubuntu's to 1.09 Mt/yr from 930,000 t/yr. NCC's production decreased to 2.49 Mt/yr in 2022 from 2.75 Mt/yr in 2021. As of the end of 2022, Kangala was shut down because its reserves were depleted. Terracom was considering restarting production at Kangala by mining an undeveloped coal deposit nearby (Tex Report, The, 2022b, c; 2023d).

Salungano Group (formerly Wescoal Holdings Ltd.) operated the Elandspruit, Khanyisa, Moabsvelden, and Vanggatfontein Mines in Mpumlanga Province. Total sales from the company's operations were about 7.1 Mt in fiscal year 2022 (April 1, 2021, through March 31, 2022) compared with 7.2 Mt in fiscal year 2021. Vanggatfontein was placed on care-and-maintenance status in March. Moabsvelden had an estimated remaining life of 9 years; Vanggatfontein, 6 years; Elandspruit, 3 years; and Khanyisa, 1 year (Salungano Group, 2022, p. 13–16, 46, 52).

As of April 2021, Overlooked Colliery (Pty) Ltd. was producing coal at a rate of 2.4 Mt/yr from its mines in Mpumalanga Province. The company planned to increase production to 4.8 Mt/yr in 2022. As of the end of 2022, it was unclear whether Overlooked's production had increased. The company purchased the Exxaro Coal Central (ECC) operations from Exxaro in September 2021, which subsequently were renamed the Katlego Operations. In the first 8 months of 2021, ECC produced at a rate of 3.7 Mt/yr (Arnoldi, 2021; Exxaro Resources Ltd., 2023, p. 3; Tex Report, The, 2023a).

Menar Holding (Pty) Ltd. of Luxembourg held controlling interests in Canyon Coal (Pty) Ltd., Kangra Coal (Pty) Ltd., and Zululand Anthracite Colliery (Pty) Ltd. (ZAC). Canyon Coal produced nearly 2.6 Mt/yr of saleable coal at the Khanye and the Phalanndwa Mines, of which about 70% was exported. Kangra produced about 1.6 Mt/yr of saleable coal from the Savmore Mine in Mpumalanga Province for export; small amounts of coal were produced for the domestic market. In September 2022, ZAC was producing anthracite at a rate of about 600,000 t/yr [Moodley, 2021; Creamer, 2022a; Kangra Coal (Pty) Ltd., undated].

Menar planned to increase its total production by about 170%. The company planned to start production at new projects including Gugulethu (formerly De Wittekrans) in 2023; Bekezela (formerly Palmietkuilen) and Thuso (formerly Witfontein) in 2024; Gila (formerly Koppie), Sukuma (formerly Springfield), Ukuduma (formerly Aasvoëlkrans), and Umzila (formerly Birmingham) in 2025. The estimated life of Sukuma was 30 years; Gugulethu, more than 20 years; Gila and Umzila, about 20 years each; Thuso, 11 years; and Ukuduma, 4 years (McKay, 2022b; Barradas, 2023a).

Eyethu Coal (Pty) Ltd. (Beryl Group, 100%) operated six mines in Mpumalanga Province. The company produced more than 4 Mt/yr of coal (table 2; Slater, 2021).

HCI Coal (Pty) Ltd. operated the Palesa Mine in Mpumalanga Province. In fiscal year 2022 (April 1, 2021, through March 31, 2022), the company produced 2.58 Mt of coal compared with 2.29 Mt in fiscal year 2021 (Hosken Consolidated Investments Ltd., 2022, p. 24).

Kuyasa Mining (Pty) Ltd. operated the Delmas Mine in Mpumalanga Province. The company produced about 2 Mt/yr of coal, all of which was for domestic consumption [Kuyasa Mining (Pty) Ltd., undated].

In 2022, MC Mining Ltd. of Australia completed a feasibility study on a new mine at the Makhado project at the Southpansberg Coalfield in Limpopo Province. The company planned to start construction in early 2023. MC Mining planned to produce 1.1 Mt/yr of saleable coal in the first phase of mining and between 1.6 and 1.8 Mt/yr in the second phase (Bulbulia, 2022; MC Mining Ltd., undated).

Eskom's power-generating capacity was about 45,000 MW; the company accounted for about 80% of the power produced in South Africa. The coal-fired power stations operated by Eskom were inefficient and prone to mechanical breakdowns owing to a lack of prior maintenance work. Theft also was a significant problem. Eskom had planned to reach full capacity at its Kusile and Medupi coal-fired power stations in 2015; however, the stations were still operating below capacity in 2022. South Africa's power demand exceeded supply by between 4,000 and 6,000 MW, and, as a result, led to significant power cuts. Eskom planned to decommission half of its capacity by 2035 to meet South Africa's greenhouse gas-emission-reduction goals (Burkhardt and Cohen, 2019; Mkhize, 2022; du Venage, 2023a).

**Petroleum.**—In 2022, South Africa's total production of refined petroleum products decreased to an estimated 42 million barrels (Mbbl) from 84 Mbbl in 2021 and 147 Mbbl in 2019. Glencore's refinery in Cape Town, which had a capacity of 100,000 barrels per day (bbl/d), closed in mid-2020 after a fire. The refinery remained closed at the end of 2022. Engen Ltd.'s refinery in Durban (which had a capacity of 120,000 bbl/d) shut down in December 2020 after an explosion. The company subsequently announced plans to convert its refinery to a fuel import terminal. At the end of March 2022, BP Southern Africa and Shell SA Energy closed their refinery in Durban indefinitely because of factors including aging equipment (table 1; Parker, 2022; Roelf, 2023).

## Outlook

Numerous companies are planning new mines, plants, and capacity expansions of existing operations for coal, copper, ferrovanadium, gold, ilmenite, industrial garnet, iron ore, manganese ore, nickel, PGMs, phosphate rock, rare earths, rutile, vanadium, zinc, and zircon between 2023 and 2027. Challenges to the industry included aging mines, community unrest, decreasing ore grades, increasing costs, labor disputes, low levels of exploration activity (which were partially attributable to inadequate geoscientific data), and power outages (Louw, 2017; Tex Report, The, 2019a, b; Sguazzin, 2022).

The production of chromite, coal, iron ore, and manganese for export markets could be limited by Transnet's reduced rail capacity because of aging locomotives, lack of spare parts, and problems with theft. Increased production of chromite, iron ore, and manganese for domestic markets would require a stable power supply; power-intensive downstream-processing operations were constrained by high power costs and power outages. Domestic coal demand is expected to decrease as Eskom decommissions coal-fired power stations.

Low levels of investment in infrastructure are likely to constrain the production of brick clay, cement, limestone, sand for construction, and shale. Cement production is also expected to be limited by factors including import competition and high import costs; limestone and shale production is also expected to be limited as a result.

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).

Production of ilmenite, rutile, titanium slag, and zircon is likely to remain below 2012 levels until RBM completes its new solar-power station. Silica sand production is expected to decrease as glass recycling rates increase. Increases in ferrovanadium production depended on the relative prices of ferroniobium and ferrovanadium; relatively higher ferrovanadium prices could result in substitution of ferroniobium for ferrovanadium (Khaile, 2019).

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TABLE 1

SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise specified)

| Commodity | | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| METALS | | | | | | |
| Aluminum, metal, primary | | 714,000 | 717,000 | 717,000 | 714,000 | 718,000 |
| Chromium, mine, chromite: | | | | | | |
| 44% to 48% $Cr_2O_3$ | thousand metric tons | 1,133 | 1,428 | 1,156 | 1,792 r | 2,316 |
| Less than 44% $Cr_2O_3$ | do. | 16,718 | 16,227 | 12,041 | 16,589 r | 16,789 |
| Total | | 17,900 | 17,700 | 13,200 | 18,400 r | 19,100 |
| Cobalt, Co content: | | | | | | |
| Mine[e] | | 1,007 | 1,027 | 897 | 355 | 250 |
| Refinery, metal powder and sulfate[e] | | 600 r | 500 r | 450 r | 500 r | 500 |
| Copper, Cu content: | | | | | | |
| Mine, concentrates | | 46,900 | 52,501 r | 38,334 r | 51,138 r | 49,194 |
| Smelter, primary[e] | | 45,000 r | 48,000 r | 35,000 r | 51,000 r | 51,000 |
| Refinery, primary | | 43,900 | 47,000 r, e | 34,000 r, e | 49,000 r, e | 49,000 e |
| Ferroalloys: | | | | | | |
| Ferrochromium | thousand metric tons | 3,516 | 3,248 | 2,404 | 3,700 e | 3,900 e |
| Ferromanganese | do. | 236 | 232 | 122 | 103 r | 89 |
| Ferrosilicon | do. | 98 e | 90 | 51 e | 55 e | 60 e |
| Ferrovanadium[e] | do. | 7 | 7 | 7 | 7 | 7 |
| Silicomanganese[2] | do. | 164 | 172 | 109 r | 151 | 134 |
| Gold: | | | | | | |
| Mine, Au content | kilograms | 117,144 | 105,185 | 95,781 r | 107,890 r | 92,573 |
| Refinery[e, 3, 4] | do. | 370,000 | 330,000 | 260,000 | 330,000 | 310,000 |
| Iron ore, mine: | | | | | | |
| Gross weight | thousand metric tons | 74,273 | 72,407 | 55,635 | 72,980 r | 63,714 |
| Fe content | do. | 47,200 | 46,100 | 35,400 | 46,500 | 40,500 |
| Iron and steel: | | | | | | |
| Direct-reduced iron | do. | 835 | 661 | 176 | 196 | 200 |
| Pig iron | do. | 4,611 | 3,791 | 2,103 | 2,917 | 2,400 |
| Steel: | | | | | | |
| Raw steel | do. | 6,327 | 6,152 | 3,877 | 5,020 | 4,403 |
| Products: | | | | | | |
| Hot-rolled[e] | do. | 5,650 | 4,000 | 3,480 r | 4,540 r | 4,000 |
| Stainless steel | do. | 550 | 469 | 453 | 576 | 523 |
| Lead: | | | | | | |
| Mine, concentrate, Pb content | | 35,118 | 42,936 | 28,048 | 31,224 | 39,974 |
| Refinery, secondary | | 56,000 e | 56,000 e | 55,000 e | 56,000 | 58,000 |
| Manganese: | | | | | | |
| Mine, metallurgical: | | | | | | |
| Gross weight: | | | | | | |
| 30% to 40% Mn | thousand metric tons | 10,512 | 11,718 | 12,435 | 14,920 r | 14,682 |
| 40% to 45% Mn | do. | 2,189 | 2,786 | 2,002 | 2,168 | 2,279 |
| 45% to 48% Mn | do. | 2,219 | 2,226 | 1,558 | 1,863 | 1,935 |
| More than 48% Mn | do. | -- | 272 | 204 | 112 | 71 |
| Total | do. | 14,900 | 17,000 | 16,200 | 19,100 r | 19,000 |
| Mn content[e] | do. | 5,800 | 6,600 | 6,200 | 7,300 | 7,300 |
| Refinery, metal, electrolytic[e] | do. | 30 | 30 | 27 r | 30 | 28 |
| Nickel, Ni content: | | | | | | |
| Mine, sulfide ore, concentrate | | 43,236 | 43,443 | 34,908 | 31,848 r | 29,033 |
| Smelter, matte[e] | | 35,000 | 35,000 | 25,000 | 33,000 | 33,000 |
| Products, chemicals | | 5,281 | 4,431 r | 3,940 r | 4,748 r | 4,419 |
| Refinery, metal, electrolytic | | 39,500 | 39,137 | 29,007 r | 38,000 r | 37,500 |
| Platinum-group metals: | | | | | | |
| Mine, elemental content: | | | | | | |
| Iridium | kilograms | 6,357 | 6,464 | 6,186 | 7,007 r | 6,160 |
| Palladium | do. | 80,629 | 80,684 | 66,264 | 84,334 r | 73,104 |

See footnotes at end of table.

TABLE 1—Continued

SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise specified)

| Commodity | | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| METALS—Continued | | | | | | |
| Platinum-group metals:—Continued | | | | | | |
| Mine, elemental content:—Continued | | | | | | |
| Platinum | do. | 137,053 | 132,989 | 111,993 | 141,625 r | 124,401 |
| Rhodium | do. | 18,608 | 19,545 | 16,972 | 20,875 | 18,687 |
| Ruthenium | do. | 27,999 | 28,386 | 25,053 r | 31,152 r | 27,894 |
| Total | do. | 271,000 | 268,000 | 226,000 | 285,000 | 250,000 |
| Refinery: | | | | | | |
| Palladium | do. | 89,500 r | 89,800 r | 75,300 r | 108,200 r | 90,200 |
| Platinum | do. | 156,300 r | 146,300 r | 117,500 r | 163,400 r | 139,800 |
| Rhodium | do. | 18,600 r | 18,300 r | 14,800 r | 20,700 r | 16,800 |
| Other[5] | do. | 31,800 | 34,800 r, e | 26,000 e | 40,000 r, e | 32,500 e |
| Total | | 296,000 r | 289,000 r | 234,000 r | 332,000 r | 279,000 |
| Selenium, anode slimes, Se content[e] | do. | 9,300 | 8,600 r | 9,000 r | 10,000 r | 9,000 |
| Silicon, metal[e] | thousand metric tons | 51 | 33 | -- | -- | 2 |
| Silver, mine, Ag content | kilograms | 46,467 | 55,903 | 38,118 | 37,146 r | 45,724 |
| Tellurium, refinery, anode slimes, Te content [e] | do. | 4,200 | 3,900 | 3,800 r | 4,500 r | 4,100 |
| Titanium: | | | | | | |
| Mineral concentrates: | | | | | | |
| Ilmenite and leucoxene[e] | thousand metric tons | 1,900 | 1,800 | 1,600 r | 1,500 | 1,800 |
| Rutile | do. | 110 e | 105 | 100 r, e | 89 r, e | 100 e |
| Total | do. | 2,010 | 1,910 | 1,700 r | 1,590 | 1,900 |
| Titaniferous slag | do. | 950 e | 903 | 790 r, e | 740 r, e | 910 e |
| Vanadium, V content | | 7,700 | 8,030 | 8,584 | 8,799 | 8,871 |
| Zinc, mine, concentrate, Zn content | | 28,129 | 125,157 | 160,816 | 193,785 | 224,356 |
| Zirconium, baddeleyite and zircon | | 341,308 | 324,000 | 290,000 r, e | 280,000 r, e | 300,000 e |
| INDUSTRIAL MINERALS | | | | | | |
| Cement, hydraulic, sales[6] | thousand metric tons | 13,680 | 12,726 | 10,800 r | 12,500 e | 12,000 e |
| Clay: | | | | | | |
| Bentonite | | 173,486 | 105,084 | 85,558 | 98,606 | 97,019 |
| Brick[6] | thousand metric tons | 5,588 | 4,706 | 3,774 | 5,532 | 4,885 |
| Fire clay | | 525,853 | 751,238 | 657,266 | 598,974 | 567,726 |
| Flint, raw and calcined | | 4,421 | 5,390 | 2,164 | 52,429 | 41,473 |
| Fullers earth, attapulgite | | 17,246 | 11,090 | 12,496 | 13,189 | 9,004 |
| Kaolin | | 23,724 | 27,827 | 20,639 | 29,168 | 10,553 |
| Plastic clay | | 2,092 | 12,604 | -- | -- | 24,135 |
| Diamond, gem and industrial | thousand carats | 9,912 | 7,181 | 8,476 r | 9,726 r | 9,680 |
| Feldspar | | 76,803 | 76,255 | 48,427 | 67,113 r | 75,382 |
| Fertilizers, phosphate fertilizer[7, 8] | thousand metric tons | 357 | 266 | 238 | 264 | 197 |
| Fluorspar:[e] | | | | | | |
| Acid grade | | 198,000 | 236,000 | 240,000 | 360,000 | 360,000 |
| Metallurgical grade | | 14,000 | 17,000 | 47,000 | 41,000 r | 46,000 |
| Total | | 212,000 | 253,000 | 287,000 | 401,000 r | 406,000 |
| Garnet, industrial | | 278,205 | 179,057 | 153,743 | 144,874 | 178,766 |
| Gemstones: | | | | | | |
| Amethyst | kilograms | 500 | 500 | 450 e | 500 e | 500 e |
| Emerald | do. | 2 | 2 | -- | -- e | -- e |
| Gypsum, mine | | 321,988 | 277,102 | 205,542 | 277,376 r | 243,052 |
| Kyanite and related materials, andalusite[e] | | 200,000 | 180,000 | 160,000 | 160,000 | 160,000 |
| Lime[6] | thousand metric tons | 1,332 | 1,239 | 1,004 | 1,146 r | 1,073 |
| Magnesite, crude[e] | | 90,000 | 99,000 | 90,000 | 99,000 | 99,000 |
| Mica, ground and scrap | | 32 | 9 | 194 | 630 | 392 |
| Nitrogen, ammonia, N content | | 470,000 | 460,000 | 450,000 | 430,000 | 410,000 |
| Perlite[e] | | 11,000 r | 11,000 r | 10,000 r | 11,000 r | 11,000 |

See footnotes at end of table.

TABLE 1—Continued

SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons, gross weight, unless otherwise specified)

| Commodity | | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|
| INDUSTRIAL MINERALS—Continued | | | | | | |
| Phosphate rock: | | | | | | |
| Compounds, phosphoric acid, $P_2O_5$ content | thousand metric tons | 453 | 382 | 287 | 301 | 294 |
| Gross weight | do. | 2,058 | 1,826 | 1,807 [r] | 1,726 [r] | 1,985 |
| $P_2O_5$ content | do. | 761 | 676 | 669 [r] | 630 [r] | 725 |
| Phosphoric acid[7, 8] | | 452,526 | 382,035 | 287,000 | 301,000 | 294,000 |
| Salt | | 478,285 | 510,012 | 538,355 | 545,942 [r] | 570,012 |
| Sand and gravel, industrial, unspecified | thousand metric tons | 2,288 | 2,269 | 2,116 | 2,074 [r] | 1,860 |
| Sodium, compounds, sodium sulfate, natural | | 44,008 | 42,581 | 32,114 | 35,674 | 38,169 |
| Stone, sand, and gravel, construction: | | | | | | |
| Sand and gravel:[6] | | | | | | |
| Aggregate | thousand metric tons | 48,223 | 47,172 | 38,972 [r] | 42,851 [r] | 44,753 |
| Sand | do. | 13,707 | 11,778 | 10,071 [r] | 12,139 [r] | 11,566 |
| Stone: | | | | | | |
| Crushed: | | | | | | |
| Limestone, including dolomite | do. | 22,746 | 22,275 | 20,288 | 23,962 [r] | 22,266 |
| Shale:[6] | | | | | | |
| For brickmaking | do. | 1,043 | 1,035 | 595 [r] | 802 [r] | 1,148 |
| For cement | do. | 305 | 252 | 220 | 248 | 197 |
| Dimension: | | | | | | |
| Granite, including norite[6] | | 387,397 | 384,019 | 371,547 [r] | 485,596 [r] | 392,740 |
| Slate[e] | | 2,000 | 2,000 | 2,000 | 6,000 | 5,000 |
| Sulfur: | | | | | | |
| Compounds, sulfuric acid: | | | | | | |
| Gross weight | | 1,378,000 | 1,359,789 | 1,201,214 | 1,300,000 [e] | 1,200,000 [e] |
| S content | | 450,000 | 445,000 | 392,000 | 420,000 [e] | 390,000 [e] |
| Byproduct, S content: | | | | | | |
| Metallurgy | | 44,279 | 720,000 [e] | 405,000 [e] | 105,924 [r] | 70,640 |
| Petroleum | | 195,348 | 180,000 [e] | 170,000 [e] | -- | -- |
| Total | | 240,000 | 900,000 [e] | 575,000 [e] | 106,000 [r] | 70,600 |
| Talc and pyrophyllite: | | | | | | |
| Pyrophyllite, wonderstone | | 98,245 | 134,451 | 92,318 | 270,944 | 438,698 |
| Talc | | 3,897 | 979 | -- | -- | -- |
| Vermiculite | | 141,346 | 158,013 | 118,223 | 150,104 | 171,898 |
| Wollastonite[e] | | 1,100 | 1,200 | 1,200 | 1,300 [r] | 1,300 |
| MINERAL FUELS AND RELATED MATERIALS | | | | | | |
| Coal, marketable: | | | | | | |
| Anthracite | thousand metric tons | 3,317 | 3,808 | 4,301 | 4,111 [r] | 3,279 |
| Bituminous[e] | do. | 246,000 | 251,000 | 240,000 | 226,000 [r] | 222,000 |
| Metallurgical[e] | do. | 3,900 | 4,000 | 3,800 | 3,900 [r] | 3,500 |
| Coke, metallurgical, marketable[e] | do. | 1,900 | 1,900 | 1,800 | 1,900 | 1,900 |
| Natural gas | million cubic meters | 685 | 734 | 618 | 49 | 5 |
| Petroleum: | | | | | | |
| Natural gas liquids, refinery | thousand 42-gallon barrels | 250 | 312 | 335 | 163 [r] | 51 |
| Refinery, total | do. | 134,000 | 147,000 [r] | 89,200 [r] | 84,300 [r, e] | 42,100 [e] |
| Uranium, mine, U content | | 196 | 138 | 112 | 138 [r] | 159 |

[e]Estimated. [r]Revised. do. Ditto. -- Zero.

[1]Table includes data available through January 31, 2024. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Reported by the International Manganese Institute.

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

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

[5]May include small amounts of gold.

[6]Sales.

[7]Data are for Foskor (Pty) Ltd.

[8]Production 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 2022

(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.[e] |
| Do. | | Pretoria Portland Cement Co. (Pty) Ltd. (Barloworld Trust Co. Ltd., 68%) | Mines at Francistown, Kgale, Laezonia, 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.[e] |
| Do. | | ARM Andalusite (Pty) Ltd. | Maroeloesfontein Mine, near Thabazimbi, Northern Province | 72. |
| 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.[e] |
| 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. | Boshoek Mine in North West Province | NA. |
| Do. | | Assore Ltd. | Dwarsrivier Mine in Mpumalanga Province | 2,400.[e] |
| Do. | | Sibanye-Stillwater Ltd. | Marikana Mines (Eastern Platinum, Karee, and Western Platinum) and Pandora Mine | 1,700.[e] |
| Do. | | do. | Waterval Plant near Rustenburg Mine | 830.[e] |
| Do. | | Tharisa Minerals (Pty) Ltd. | Tharisa Mine in North West Province | 1,920. |
| 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.[e] |
| Do. | | Eastern Platinum Ltd. (Eastplats) | Crocodile River Mine in North West Province | 1,000.[e] |
| Do. | | Northam Platinum Ltd. [Zambezi Platinum (RF) Ltd., 31.37%, and Coronation Asset Management (Pty) Ltd., 27.71%] | Booysendal Mine near Roossenekal, Eland Mine near Brits, and Zondereinde Mine near Northam | 1,000.[e] |
| Do. | | Nkomati Joint Venture (African Rainbow Minerals Ltd., 50%, and MMC Norilsk Nickel, 50%) | Nkomati Mine in Mpumalanga Province[1] | 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.[e] |
| Do. | | Siyanda Resources (Pty) Ltd. | Masa Plant at Union Mine near Northam | 330. |
| Do. | | Two Rivers Platinum Mine (Pty) Ltd. (African Rainbow Minerals Ltd., 55%, and Impala Platinum Holdings Ltd., 45%) | Two Rivers Platinum Mine near Steelpoort | 320.[e] |

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2022

(Thousand metric tons unless otherwise specified)

| Commodity | Major operating companies and major equity owners | Location of main facilities | Annual capacity |
|---|---|---|---|
| Chromium:—Continued | | | |
| 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[1] | 396. |
| Do. | do. | Boshoek plant at Boshoek | 240. |
| Do. | Traxys Group | Plant at Richards Bay[1] | 150. |
| Do. | Afarak Group Oyj | Mogale plant in Gauteng Province[1] | 110. |
| 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.[e] |
| Do. | Brikor Ltd. | Ilangabi Mine in Gauteng Province | 800. |
| Fire clay | Ceramic Industries Ltd. | Quarries at Pretoria, Vereeniging, and Waterberg | 530.[e] |
| Coal | Exxaro Resources Ltd. (BEE Holdco, 52.3%) | Grootegeluk Mine in Limpopo Province | 33,400. |
| Do. | do. | Matla Mine in Mpumalanga Province | 8,500.[e] |
| Do. | do. | Leeuwpan Mine in Mpumalanga Province | 7,000.[e] |
| Do. | Exxaro Resources Ltd., 50%, and Salungano Group, 50% | Arnot Mine in Mpumalanga Province[1] | 5,000. |
| Do. | Exxaro Resources Ltd., 50%, and Thungela 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[e]. |
| Do. | do. | Forzando Complex in Mpumalanga Province | 2,000[e]. |
| Do. | Seriti Coal (Pty) Ltd. | New Vaal Mine near Vanderbijlpark | 18,000. |
| Do. | do. | Khutala Mine in Mpumalanga Province | 12,000. |
| Do. | do. | Kriel Mine in Mpumalanga Province | 10,000. |
| Do. | do. | Middelburg South Mine in Mpumalanga Province | 9,000. |
| Do. | do. | Klipspruit Mine in Mpumalanga Province | 7,000. |
| Do. | do. | Middelburg North Mine in Mpumalanga Province | 6,500. |
| Do. | do. | New Denmark Mine in Mpumalanga Province | 5,000. |
| Do. | Sasol Ltd. | Syferfontein Mine near Secunda | 11,000. |
| Do. | do. | Twistdraai Thubelisha Mine near Secunda | 9,700. |
| Do. | do. | Shondoni 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. | Thungela Resources Ltd. | 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.[e] |
| Do. | Glencore plc, 79.8%, and African Rainbow Minerals Ltd., 20.2% | Impunzi Complex and Tweefontein Complex at Witbank | 18,000.[e] |
| Do. | do. | Goedgevonden Complex at Witbank | 7,700. |
| Do. | Glencore plc | Zonnebloem Mine in Mpumalanga Province | 3,300.[e] |
| Do. | Salungano Group | 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. |

See footnotes at end of table.

TABLE 2—Continued

SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2022

(Thousand metric tons unless otherwise specified)

| Commodity | | Major operating companies and major equity owners | Location of main facilities | Annual capacity |
|---|---|---|---|---|
| Coal—Continued | | Terracom Ltd. | New Clydesdale Colliery in Mpumalanga Province | 3,000. |
| Do. | | Mbuyelo Coal (Pty) Ltd. (Mbuyelo Group, 49%, and IchorCoal N.V., 45%) | Manungu, Vlakvarkfontein, and Welgemeend Mines in Mpumalanga Province | 8,000.[e] |
| Do. | | do. | North Block Complex in Mpumalanga Province | 2,600. |
| Do. | | do. | Kangala Mine in Mpumalanga Province | 2,400. |
| Do. | | Overlooked Colliery (Pty) Ltd. | Katlego Operations in Mpumalanga Province | 4,000.[e] |
| Do. | | do. | Three mines in Mpumalanga Province | 2,700.[e] |
| Do. | | Canyon Coal (Pty) Ltd. [Menar Holding (Pty) Ltd.] | Hakhano[1], Khanye, Phalanndwa and Singani Mines in Mpumalanga Province | 3,700.[e] |
| Do. | | Menar Holding (Pty) Ltd. | Savmore Mine in Mpumalanga Province | 2,000.[e] |
| Do. | | Zululand Anthracite Colliery (Pty) Ltd. [Menar Holding (Pty) Ltd., 76%] | Mine near Emakhalathini | 870.[e] |
| Do. | | Iyanga Mining (Pty) Ltd. | Klipfontein, Leeuwpoort, and Welgelegen Mines in Mpumalanga Province | 6,000.[e] |
| Do. | | HCI Coal (Pty) Ltd. | Palesa Mine in Mpumalanga Province | 3,300.[e] |
| Do. | | Izimbiwa Coal (Pty) Ltd. (Phembani Group, 50.01%, and Glencore plc, 49.99%) | Middelburg Complex | 3,800.[e] |
| Do. | | Umcebo Mining Ltd. (Glencore plc, 48.7%) | Wonderfontein Mine near Belfast | 3,700.[e] |
| Do. | | Vunene Mining (Pty) Ltd. (IchorCoal N.V., 76%) | Vunene Mine in Mpumalanga Province | 2,100.[e] |
| Do. | | do. | Mbali Mine in Mpumalanga Province | 1,600. |
| Do. | | Eyethu Coal (Pty) Ltd. | Beryl, Klipfontein, Leeuwpoort, Nooitgedacht, Welgelegen, and Witbank Mines in Mpumalanga Province | 4,500.[e] |
| 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] | 1,200.[e] |
| Do. | do. | Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats) | Amandelbult, Kroondal, Modikwa, Mogalakwena, and Mototolo Mines in Bushveld Complex | 500.[e] |
| Refinery | do. | Impala Platinum Holdings Ltd. (Implats) | Base metals refinery | 900.[e] |
| Copper: | | | | |
| Mine | | Palabora Mining Co. Ltd. | Palabora Mine at Phalaborwa | 65.[3] |
| Do. | | Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats) | 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. | | 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. (Anglo American plc, 78%) (Amplats) | Rustenburg smelter near Rustenburg | 11.[3] |
| Do. | | Impala Platinum Holdings Ltd. (Implats) | Smelter near Phokeng | 7.[3] |
| Refinery | | Palabora Mining Co. Ltd. | Refinery at Phalaborwa | 140.[3] |
| Do. | | Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats) | Refinery near Rustenburg | 13.[3] |
| Do. | | Sibanye-Stillwater Ltd. | Base metals 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. | 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[1] | 85. |

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2022

(Thousand metric tons unless otherwise specified)

| Commodity | | Major operating companies and major equity owners | Location of main facilities | Annual capacity |
|---|---|---|---|---|
| Diamond—Continued | thousand carats | Ekapa Mining (Pty) Ltd. | Kimberley Mine in Northern Cape Province | 800. |
| Do. | do. | DiamondCorp plc | Lace Mine[1] near Kroonstad | 500. |
| Do. | do. | Jagersfontein Developments (Pty) Ltd. | Jagersfontein Mine in Free State Province | 250.[e] |
| Do. | do. | West Coast Resources (Pty) Ltd. (Trans Hex Group, 67.2%) | Namaqualand operations | 130.[e] |
| 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.[e] |
| 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. | Kalgold, Phoenix, and other surface operations | 8,000.[e] |
| Do. | do. | do. | Moab Khotsong Mine in Free State Province | 7,700. |
| Do. | do. | do. | Mponeng Mine in Gauteng Province | 6,700. |
| Do. | do. | do. | Kusasalethu Mine in Gauteng Province | 5,300. |
| Do. | do. | do. | Doornkop Mine in Gauteng Province | 3,900. |
| Do. | do. | do. | Target 1 Mine in Free State Province | 2,600. |
| Do. | do. | do. | Bambanani Mine in Free State Province[1] | 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. | Sibanye-Stillwater Ltd. | Kloof Mine in Gauteng Province | 17,000.[e] |
| Do. | do. | do. | Beatrix Mine in Free State Province | 6,800.[e] |
| Do. | do. | do. | Driefontein Mine in Gauteng Province | 5,800.[e] |
| Do. | do. | do. | Burnstone Mine[1] in Mpumalanga Province | 3,900. |
| Do. | do. | do. | Cooke Operations in Gauteng Province | 1,600.[e] |
| Do. | do. | Gold Fields Ltd. | South Deep Mine in Gauteng Province | 12,000. |
| 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., 50.1%) | Ergo and Far West Gold Recovery Operations in Gauteng Province | 6,200.[e] |
| Do. | do. | Village Main Reef Ltd. (Heaven-Sent Capital Group) | Kopanang Mine in Free State Province | 2,900.[e] |
| Do. | do. | do. | Tau Lekoa Mine in North West Province | 2,500.[e] |
| Do. | do. | Gold One International Ltd. | Modder East Mine in Gauteng Province | 4,700. |
| Do. | do. | Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats) | Amandelbult, Kroondal, Modikwa, Mogalakwena, and Mototolo Mines in Bushveld Complex | 3,000.[e] |
| Do. | do. | Blyvoor Gold (Pty) Ltd. | Blyvoor Mine in Gauteng Province | 1,200. |
| 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. |

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2022

(Thousand metric tons unless otherwise specified)

| Commodity | Major operating companies and major equity owners | Location of main facilities | Annual capacity |
|---|---|---|---|
| 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%] | Sedibeng Mine at Postmasburg in Northern Cape Province | 3,000. |
| Do. | Foskor (Pty) Ltd. | Foskor Mine and plant at Phalaborwa | 1,400. |
| Do. | Afrimat Ltd. | Demaneng Mine in Northern Cape Province | 1,000. |
| Do. | do. | Jenkins Mine in Northern Cape Province | 300. |
| 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[e]. |
| Do. | Duferco Steel Processing Ltd. | Cold-rolled slab steel plant at Saldanha Bay | 240. |
| Lead, mine | 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 Danielskuil | 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[e]. |
| Manganese: | | | |
| Mine | Tshipi e Ntle Manganese Mining (Pty) Ltd. [Jupiter Mines Ltd., 49.9%, and Ntsimbitntle Mining (Pty) Ltd., 37%] | Tshipi Borwa Mine in Northern Cape Province | 5,000 ore. |
| Do. | 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. | Kalagadi Manganese (Pty) Ltd. [Kalagadi Alloys (Pty) Ltd., 44%; Kalahari Resources (Pty) Ltd., 36%; and Industrial Development Corp., 20%] | Mine at Hotazel in Northern Cape Province | 3,000 ore; 2,400 sinter. |
| Do. | Asia Minerals Ltd. (AML) | Kudumane Mine at Farm York | 1,900 ore. |
| Do. | Glencore plc and Ntsimbitntle Mining (Pty) Ltd. | Mokala Mine in Northern Cape Province | 1,600 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. | Samancor Manganese (Pty) Ltd. (South32 Ltd., 60%) | Plant at Meyerton[1] | 500. |
| Silicomanganese | Transalloys (Pty) Ltd. (Renova Group, 23.78%) | Plant at Witbank | 180. |
| Do. | Afarak Group Oyj | Mogale plant | 55.[e] |

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2022

(Thousand metric tons unless otherwise specified)

| Commodity | | Major operating companies and major equity owners | Location of main facilities | Annual capacity |
|---|---|---|---|---|
| Manganese:—Continued | | | | |
| Refinery, metal, electrolytic | | 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. (Anglo American plc, 78%) (Amplats) | 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[1] | 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. | Base metals refinery at Brakpan | 4.[e] |
| Refinery | | Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats) | 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[1] | 65,700. |
| Do. | do. | Engen Ltd., 62% | Enref refinery in Durban[1] | 43,800. |
| Do. | do. | National Petroleum Refiners of South Africa (Pty) Ltd. (Sasol Ltd., 63.6%) | Natref refinery in Sasolburg | 39,400. |
| Do. | do. | Astron Energy (Pty) Ltd. (Glencore plc) | Chevref refinery in Cape Town[1] | 36,500. |
| Phosphate rock | | Foskor (Pty) Ltd. | Foskor Mine and plant at Phalaborwa | 2,800. |
| Do. | | Kropz Elandsfontein (Pty) Ltd. | Elandsfontein Mine in Western Cape Province | 1,000. |
| Phosphoric acid | | do. | Plant at Richards Bay | 720. |
| Platinum-group metals: | | | | |
| Mine | kilograms | Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats) | Mogalakwena Mine at Ga-Masenya | 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., 50%, and Sibanye-Stillwater Ltd., 50%) | Kroondal Mine near Rustenburg | 11,000 platinum; 6,000 palladium; 3,500 ruthenium; 2,200 rhodium; 800 iridium. |
| Do. | do. | Modikwa Platinum Mine (African Rainbow Minerals Ltd., 50%, and Anglo American Platinum Ltd., 50%) | Modikwa Mine at Makgemeng | 4,200 platinum; 4,000 palladium; 1,200 ruthenium; 820 rhodium; 310 iridium. |
| Do. | do. | Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats) | 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; |

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2022

(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 | Sibanye-Stillwater Ltd. | 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 Management (Pty) Ltd., 27.71%] | Booysendal 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. |
| Do. | do. | do. | 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 in Limpopo Province | 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[1] | 2,900[e] palladium; 1,200[e] platinum; 200[e] rhodium. |
| Do. | do. | Sedibelo Resources Ltd | Pilanesberg Mine in North West Province | 5,400 platinum; 1,700 palladium; 490 rhodium. |
| Do. | do. | African Rainbow Minerals Ltd. | Bokoni Mine at Sefateng[1] | 4,100 platinum; 2,700 palladium; 470 rhodium. |

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2022

(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 | 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[e] platinum; 520[e] palladium; 290[e] rhodium. |
| Smelter | do. | Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats) | 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. |
| Refinery | do. | Anglo American Platinum Ltd. (Anglo American plc, 78%) (Amplats) | 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[e] platinum metal; 10,000[e] palladium metal. |
| Pyrophyllite | | Idwala Industrial Holdings (Pty) Ltd. | Ottsdal Mine in North West Province | 15. |
| Do. | | Sino Rock (Pty) Ltd. | Mine in North West Province | NA. |
| Do. | | Wonderstone Ltd. (The Associated Ore & Metals Corp. Ltd.) | Pyrophyllite (wonderstone) mine, North West Province | 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.[e] |
| Do. | | Maxima Silica (Pty) Ltd. (Incubex Minerals (Pty) Ltd., 100%) | Mine near Boshoek | 72. |
| Selenium | kilograms | Impala Platinum Holdings Ltd. (Implats) | Impala and Marula Mines | 12,000.[e] |
| Do. | do. | Palabora Mining Co. Ltd. | Palabora Mine and plant at Phalaborwa | 2,700.[e] |
| Silicon: | | | | |
| Ferrosilicon | | do. | New Castle plant at Ballengeich | 45. |
| Do. | | do. | eMalahleni plant | 40. |
| Metal | | Ferroglobe plc | Polokwane plant, near Pietersburg | 55. |
| Do. | | do. | eMalahleni plant | 12. |
| 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. |

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2022

(Thousand metric tons unless otherwise specified)

| Commodity | | Major operating companies and major equity owners | Location of main facilities | Annual capacity |
|---|---|---|---|---|
| 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 in 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.[1] | 47. |
| Do. | | National Petroleum Refiners of South Africa (Pty) Ltd. (Sasol Ltd., 63.6%) | Plant at Sasolburg | 44. |
| Do. | | Astron Energy (Pty) Ltd. (Glencore plc) | Plant at Cape Town[1] | 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.[e] |
| Do. | do. | Palabora Mining Co. Ltd. | Palabora Mine and plant at Phalaborwa | 2,200.[e] |
| Titanium: | | | | |
| Mineral concentrates | | Richards Bay Minerals (RBM) (Rio Tinto plc, 74%, and Blue Horizon Investments, 24%) | Zulti North Mine near Richards Bay | 2,000 ilmenite;[e] 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[e] ilmenite; 5.5 rutile. |
| Titaniferous 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. |
| Uranium oxide | metric tons | Harmony Gold Ltd. | Surface Operations in North West Province | 180.[e] |
| Do. | do. | Sibanye-Stillwater Ltd. | Cooke Operations in Gauteng Province | 120.[e] |
| 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 (Pty) Ltd. | Mine near Garies | 1,800. |
| Zinc, mine | | Vedanta Resources Ltd., 69.6% | Gamsberg Mine in Northern Cape Province | 250. |
| Do. | | do. | Black Mountain Mine near Aggeneys in Northern Cape Province | 40. |
| Zirconium | | Richards Bay Minerals (RBM) (Rio Tinto plc, 74%, and Blue Horizon Investments, 24%) | Zulti North Mine 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. |

[e]Estimated. Do., do. Ditto. NA Not available.
[1]Not operating at the end of 2022.
[2]Joint venture with Sinosteel Corp.
[3]Data from International Copper Study Group.
[4]Unlicensed artisanal miners also produced diamond near the Kimberley Mine in Northern Cape Province.
[5]Artisanal miners also produced gold from abandoned large-scale gold mining operations.

TABLE 3

SOUTH AFRICA: RESERVE BASE OF MAJOR MINERALS IN 2022[1]

(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 | 5 |
| Iron ore | | 670 |
| Lead | thousand metric tons | 300 |
| Manganese ore | | 640 |
| Nickel | thousand metric tons | 3,700 |
| Phosphate rock | | 1,600 |
| Platinum-group metals | thousand metric tons | 63 |
| Titanium minerals | | 37 |
| Uranium | thousand metric tons | 322 |
| Vanadium | do. | 3,500 |
| Vermiculite | | 14 |
| Zinc | | 15 |
| Zirconium | thousand metric tons | 6 |

[1]Metallic minerals are contained metal, except for titanium, which is titanium dioxide content, and zirconium, which is zirconium dioxide content; metallic ore reserves are in gross weight.

[2]Includes aluminosilicate and sillimanite.