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The Mineral Industry of South Africa

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The Republic of South Africa remained one of the world's leading mining and mineral-processing countries. In 2015, South Africa's estimated share of world mined platinum production was 74%; refined rhodium, 59%; refined platinum, 56%; kyanite and related minerals, 49%; chromite, 46%; vermiculite, 39%; mined palladium, 38%; ferrochromium, 35%; manganese, 34%; refined palladium, 28%; zircon, 25%; ilmenite, 21%; refined gold, 9%; diamond and mined gold, 5% each; coal, 4%; iron ore and stainless steel, 3% each; mined cobalt, fluorspar, and nickel, 2% each; ferrosilicon and silicon metal combined, primary aluminum, bentonite, refined cobalt, and silica sand, 1% each. South Africa also played a globally significant role in the production of rutile and vanadium (Anglo American Platinum Ltd., 2016b, p. 25; BP p.l.c., 2016, p. 32; Cobalt Development Institute, 2016; Merafe Resources Ltd., 2016, p. 10–11; World Gold Council, 2016, p. 20; Bedinger, 2017a, b; Bray, 2017; Corathers, 2017; Dolley, 2017; Flanagan, 2017; George, 2017; Kuck, 2017; Loferski, 2017; McRae, 2017; Olson, 2017a, b; Papp, 2017; Polyak, 2017; Schnebele, 2017; Shedd, 2017; Tanner, 2017a, b; Tuck, 2017).

In 2015, South Africa's estimated share of the world's coal consumption was 2.2%, and petroleum products, 0.7%. The country also accounted for 88% of Africa's total coal consumption and 17% of Africa's total petroleum products consumption in 2015 (BP p.l.c., 2016, p. 9, 33).

Minerals in the National Economy

The mineral industry accounted for 7.7% of the gross domestic product (GDP) in 2015 compared with 7.6% in 2014 and 9.8% in 2006. Coal mining accounted for 23% of the mining industry's contribution to the GDP; platinum-group metal (PGM) mining, 22%; gold mining, 11%; the mining of other metal ores, 31%; and other mining, 13%. In recent years, the mineral industry has been limited by increasing costs for labor and power and decreasing prices for mineral commodities on world markets (Chamber of Mines of South Africa, 2016, p. 25–26).

Employment in the mineral industry was 481,521 workers in 2015 compared with a revised 492,936 in 2014 and 444,132 in 2005. The mineral industry accounted for about 3% of employment in South Africa. In 2015, PGM mining accounted for 39% of the mineral industry's employment; gold, 23.9%; coal, 16.2%; iron ore, 4.3%; chromite, 3.8%; diamond, 3.6%; manganese, 1.8%; and other minerals, 7.4%. In 2005, gold mining accounted for 36.2% of the mineral industry's employment; PGMs, 34.9%; coal, 12.9%; diamond, 5%; and chromite, iron ore, and manganese combined, a total of 4.2% (Chamber of Mines of South Africa, 2015, p. 14; 2017, p. 6; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., December 9, 2016).

Government Policies and Programs

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

Under the Amended Mining Charter of 2010, the Government's Black Economic Empowerment (BEE) program requires that mining companies have at least 26% black ownership. Companies are allowed to use the value of their domestic beneficiation activities as credit for up to 11% of their black ownership requirements. Companies are required to purchase 70% of their services, 50% of their consumable goods, and 40% of their capital goods from BEE entities. Companies are also required to report progress annually on the development of near-mine communities, the sustainability of growth and development, and mineral beneficiation. In early 2015, the Chamber of Mines was engaged in a dispute with the Government regarding the interpretation of the black ownership requirement (Creamer, 2010, 2015b).

In the Witwatersrand basin, acid mine drainage from gold mining operations threatened to contaminate water supplies in Gauteng Province with increased levels of toxic heavy metals and radioactive particles. The acid mine drainage was the result of leaching from tailings piles and from abandoned deep underground mines that filled with water that became acidic. South Africa had about 6,000 abandoned mines and numerous tailings piles in the Witwatersrand basin that contained about 6 billion metric tons of pyrite. The oxidation of pyrite led to acid mine drainage. The tailings piles also contained an estimated 600,000 metric tons (t) of uranium. Remediation costs for the abandoned mines were estimated to be $2.7 billion (Crowley, 2014).

Production

In 2015, fire clay production increased by 213%; mined ruthenium, by 52%; mined platinum, by 48%; mined iridium, by 47%; mined rhodium, by 45%; mined palladium, by 42%; refined platinum, by 39%; other refined PGMs, by 36%; refined palladium, by 34%; refined rhodium, by 31%; feldspar, by 27%; natural gas, by 24%; refined nickel, by 23%; mined lead, by 18%; granite and norite, by 15%; manganese ore, by 14%; chromite, by 12%; mined zinc, by 11%; and andalusite, by an estimated 10%. Plastic clay production also increased sharply. In 2015, mica production decreased by 65%; antimony, by an estimated 51%; gypsum, by 38%; direct-reduced iron, by 29%; fluorspar, by an estimated 27%; flint clay, kaolin, and sodium sulfate, by 26% each; pyrophyllite, by 25%; ferromanganese, by 23%; ferrovanadium and uranium, by 21% each; vanadium, by 18%; slate, by 16%; rutile and zirconium, by an estimated

15% each; silica sand and titaniferous slag, by 13% each; mined copper, by 12%; and lime, by 11% (table 1; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016).

Structure of the Mineral Industry

Most of the South African mineral industry was privately owned; Government-owned PetroSA operated a gas-to-liquids plant and produced crude petroleum and natural gas in recent years. The production of diamond and gold, which were produced mostly by artisanal miners in many African countries, was dominated by large-scale producers in South Africa. The leading producer's share of total output varied sharply by commodity; the leading producer of iron ore accounted for about 62% of national production; that of andalusite, 61%; diamond, 57%; ferrochromium, 48%; nickel, 39%; gold, 33%; and coal, 20%. Antimony, fluorspar, mined lead, phosphate rock, vermiculite, and mined zinc were produced by only one domestic company each (table 2).

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

Mineral Trade

Crude and processed mineral products accounted for more than 40% of the value of total exports in 2015. About 69% of crude mineral products and 83% of processed mineral products, by value, were exported in 2015. South Africa's exports of gold amounted to $4.16 billion in 2015; platinum, $4.14 billion; coal, $3.58 billion; iron ore; $2.59 billion; palladium, $1.44 billion; manganese ore, $953 million; chromite, $610 million; nickel, $530 million; rhodium, $506 million; diamond, $438 million; iridium, $127 million; ruthenium, $27 million; and other crude mineral products, which included ilmenite, rutile, and zircon, $1.03 billion. Exports of ferrochromium amounted to $2.28 billion; manganese alloys, $358 million; vanadium alloys and other vanadium products and silicon metal and alloys, $160 million each; and other processed mineral products, which included aluminum, antimony trioxide, phosphoric acid, and titanium slag, $1.55 billion (Chamber of Mines of South Africa, 2016, p. 23; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016).

In 2015, the United States reported imports of $1.56 billion in precious metals from South Africa; steelmaking materials, $663 million; diamond, $634 million; bauxite and aluminum, $153 million; and other nonferrous metals, $384 million. In 2015, the United States reported exports of $260 million of mineral fuels and $73 million of chemical fertilizers to South Africa (U.S. Census Bureau, 2017a, b).

The percentage of domestic consumption of mineral commodities produced in South Africa varied sharply by commodity. In 2015, manganese alloy exports, by volume, amounted to 93% of total sales; iron ore, 90%; PGMs, 89%; gold, 88%; ferrochromium and nickel, 84% each; silicon alloys, 62%; diamond, 60%; copper, 50%; granite, 41%; chromite, 33%; coal, 30%; flint clay, 6%; and lime and silica, less than 1% each. Between October 2014 and March 2015, vermiculite exports, by volume, accounted for 93% of total sales; andalusite, 57%; and phosphate rock, 26% (Motsie, 2015; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016).

Commodity Review

Metals

Aluminum.—South Africa produced primary aluminum from alumina imported from Guinea. BHP Billiton Ltd. of Australia was the only producer and operated the Hillside and Bayside primary aluminum smelters at Richards Bay. Total aluminum production decreased to 695,000 t in 2015 from 745,000 t in 2014. Production at Hillside decreased to 695,000 t in 2015 from 704,000 t in 2014; the Bayside smelter produced 41,000 t in the first half of 2014 before shutting down. In 2015, BHP Billiton spun off its South African assets into a new company called South32 Ltd. of Australia (BHP Billiton Ltd., 2015, p. 15; South32 Ltd., 2016).

Antimony.—The Cons Murch Mine was South Africa's only antimony mine in 2015. In 2014, production declined sharply because of aging equipment and under-capitalization of the operations. The mine was in provisional liquidation in early 2015; Stibium Mining (Pty) Ltd. of Australia and its joint-venture partners purchased the mine and restarted production in September 2015 (Ramane, 2016).

Chromium.—Most South African chromite production was metallurgical grade. In 2015, chromite production was about 15.66 million metric tons (Mt) compared with 14.04 Mt in 2014 and 7.35 Mt in 2005. Increased production was partially attributable to PGM mining companies producing chromite as a coproduct. From 2005 to 2015, employment in chromite mining increased to 18,470 workers from 7,893 (table 1; Chamber of Mines of South Africa, 2015, p. 14, 17; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016; December 9, 2016).

Glencore plc of Switzerland (formerly Glencore Xstrata plc) and its joint-venture partner Merafe Resources Ltd. operated the Boshoek, the Helena, the Kroondal, the Magareng, the Thorncliffe, and the Waterval Mines. Glencore and Merafe produced about 2.75 Mt of chromite in 2015 compared with 3.05 Mt in 2014 (Merafe Resources Ltd., 2015, p. 17; 2016, p. 17).

Glencore and Merafe operated the Boshoek, the Lion, the Lydernburg, the Rustenburg, and the Wonderkop ferrochromium plants, which had a total capacity of 2.34 million metric tons per year (Mt/yr). The companies produced 1.56 Mt of ferrochromium in 2014; output increased by nearly 13% in 2015.

Increased production was attributable to an expansion of the Lion plant's capacity to 720,000 metric tons per year (t/yr) from 360,000 t/yr in 2013; output at the other plants remained nearly unchanged (Merafe Resources Ltd., 2016, p. 17).

Samancor Chrome (Pty) Ltd. (International Mineral Resources BV of the Netherlands, 70%) produced chromite at the Eastern Chrome Mines in Mpumalanga Province and the Western Chrome Mines in North West Province. The company mined about 2 Mt/yr of chromite at the Eastern Chrome Mines and 1.5 Mt/yr at the Western Chrome Mines (Khaile, 2016).

Samancor Chrome operated the Ferrometals plant in Witbank, the Middelburg plant in Middelburg, and the Tubatse plant in Steelpoort; the plants had a combined capacity of more than 1.2 Mt/yr of ferrochromium (table 2). In the first half of 2015, the company was producing at the rate of more than 1.1 Mt/yr of ferrochromium, which was nearly unchanged from that of 2014 (Matlala and Bisessor, 2015a, p. 29; 2015b, p. 27).

Assmang (Pty) Ltd. [African Rainbow Minerals Ltd. (ARM), 50%, and Assore Ltd., 50%] operated the Dwarsrivier Mine in Mpumalanga. In 2015, production increased to 1.13 Mt from about 1.03 Mt in 2014. Chromite sales were expected to increase to about 1.2 Mt in 2016 and 1.4 Mt in 2018 (African Rainbow Minerals Ltd., 2015a, p. 91, 97; 2015b, p. 51; 2016, p. 9).

Assmang's ferrochromium production at the Machadodorp plant decreased to 21,000 t in 2015 from 22,000 t in 2014. The company converted its remaining ferrochromium furnaces at Machadodorp to ferromanganese in mid-2013. Ferrochromium continued to be produced from stockpiles of slag at Machadodorp's metal recovery plant until the fourth quarter of 2015, when the plant was placed on care-and-maintenance status (African Rainbow Minerals Ltd., 2015a, p. 97; 2015b, p. 51, 53; 2016, p. 9; Markram, 2016).

ARM and its joint-venture partner MMC Norilsk Nickel of Russia operated the Nkomati chromite mine. Chromite sales from Nkomati decreased to 385,000 t in 2015 from 413,000 t in 2014. Chromite sales from the Two Rivers Mine increased to 270,177 t in 2015 from 228,268 t in 2014; ARM planned to increase total chromite sales at Nkomati Chrome and Two Rivers to more than 700,000 t/yr by 2017 (African Rainbow Minerals Ltd., 2015a, p. 75, 77, 83; 2015b, p. 57–58; 2016, p. 16–17).

Hernic Ferrochrome (Pty) Ltd. (a subsidiary of Mitsubishi Corp. of Japan) operated the Bokone Mines, which had a capacity of 1.5 Mt/yr, and a ferrochromium plant with a capacity of 420,000 t/yr (table 2). In the first half of 2015, Hernic was producing ferrochromium at the rate of between 300,000 t/yr and 350,000 t/yr compared with about 350,000 t/yr in 2014 (Markram, 2014b; Matlala and Bisessor, 2015a, p. 29; 2015b, p. 27).

ASA Metals (Pty) Ltd. (Sinosteel Corp. of China, 60%, and Limpopo Economic Development Enterprise, 40%) operated the Dilokong chromite mine near Burgersfort and a ferrochromium plant near Pietersburg with capacities of 800,000 t/yr and 400,000 t/yr, respectively. In the first half of 2015, the company was producing ferrochromium at the rate of between 200,000 and 250,000 t/yr compared with about 250,000 t/yr in 2014 (Matlala and Bisessor, 2015a, p. 29; 2015b, p. 27).

International Ferro Metals Ltd. of Australia (IFM) operated the Buffelsfontein ferrochromium plant in North West Province. The company produced 209,807 t of ferrochromium in 2014; planned production for 2015 was between 202,000 and 205,000 t. In the first half of 2015, output was 100,015 t of ferrochromium. IFM also produced 109,117 t of chromite at the Lesedi Underground and the Rooderand in the first half of 2015. At yearend, the company was in bankruptcy proceedings, which may be attributable to low ferrochromium prices on world markets and power supply interruptions (International Ferro Metals Ltd., 2015a, p. 2, 5–6; 2015b; Markram, 2016).

In fiscal year 2015 (which ran from October 1, 2014, to September 30, 2015), Tharisa Minerals (Pty) Ltd. of Cyprus produced about 1.12 Mt of chromite at the Tharisa Mine compared with 1.09 Mt in fiscal year 2014. The company planned to reach steady-state production of 1.5 Mt/yr in fiscal year 2016. The remaining life of the open pit was estimated to be 20 years, which was expected to be followed by an underground mine with a life of 40 years (Tharisa Minerals (Pty) Ltd., 2015, p. 2, 7, 16).

Afarak Group Oyj of Finland operated the Mecklenburg, the Stellite, and the Vlakpoort Mines and the Mogale Alloys plant. In 2015, Afarak produced 412,629 t of chromite compared with 268,351 t in 2014; output was limited in 2014 by the closure of the Mecklenburg Mine for 7 months. Ferroalloy production also increased in 2015 (Afarak Group Oyj, 2016, p. 24).

Tata Steel (KZN) (Pty) Ltd. operated a ferrochromium plant with a capacity of 150,000 t/yr; the company was operating at between 80% and 90% of capacity in the first half of 2015. In July, the company started bankruptcy proceedings (Matlala and Bisessor, 2015a, p. 29; 2015b, p. 27; Markram, 2016).

PGM producers also mined chromite as a coproduct of mining of Upper Group 2 (UG2) ore in the Bushveld Complex. Production of chromite from UG2 ore had increased in recent years because of the declining profitability of PGM mining. UG2 ore had a much lower production cost than the Lower Group 6 (LG6) chromite ore mined by ferrochromium producers. Technological advances have allowed ferrochromium producers to use UG2 ore, which had a grade of about 10% Cr_2O_3 and was much lower than the grades in LG6 ore (Ryan's Notes, 2012).

In the first half of 2014, a labor dispute that lasted for 5 months had resulted in total UG2 production losses from the three leading PGM producers of about 1.4 Mt, although production rebounded in 2015. Lonmin plc of the United Kingdom's sales of chromite from UG2 ore were 1.51 Mt in 2015 compared with 727,000 t in 2014. In 2015, Anglo American Platinum Ltd. (Amplats) produced 566,500 t of chromite from UG2 ore compared with 289,200 t in 2014. Amplats operated the Waterval and the Masa treatment plants with capacities of 350,000 t/yr and 330,000 t/yr, respectively. In 2015, the company approved the development of a new plant at the Amandelbult Mine with a capacity of 600,000 t/yr. Production could start at the new plant in 2017 (Barradas, 2014a; Lonmin plc, 2015, p. 189; 2016; Anglo American Platinum Ltd., 2016a, p. 24; 2016b, p. 40).

Siyanda Chrome Smelting Co. was considering the development of a new plant that would process UG2 ore to

produce more than 150,000 t/yr of ferrochromium. Depending on the results of a feasibility study, production could start by 2018 (Davies, 2015b).

Cobalt.—Refined cobalt production was an estimated 1,300 t in 2015, which was nearly unchanged from that of 2014. Most of South Africa's refined cobalt production was attributable to domestic PGM mining operations. ARM and Norilsk also produced 1,112 t of mined cobalt at the Nkomati Mine in 2015 compared with 1,096 t in 2014 (African Rainbow Minerals Ltd., 2015a, p. 83; 2015b, p. 58; 2016, p. 17; Cobalt Development Institute, 2016).

Copper.—Palabora Mining Co. Ltd. operated the Palabora Mine, which accounted for most of South Africa's mined and refined copper production. In 2015, Palabora Mining approved plans to proceed with the Lift II project, which would extend the life of the Palabora Mine through 2033 by opening a new underground mine. Production was expected to start at Lift II by late 2017 (Crankshaw, 2016; Louw, 2016).

Amplats produced 16,800 t of refined copper in 2015 compared with 12,500 t in 2014; the company's copper production in matte decreased to 300 t from 6,200 t. About 12,800 t of copper was mined at the company's South African PGM mining operations in 2015 compared with 13,100 t in 2014 (Anglo American Platinum Ltd., 2016a, p. 24, 28–36).

Gold.—The long-term decline in the country's gold output continued in 2015, with national gold mine production decreasing to 144,504 kilograms (kg) from a revised 151,622 kg in 2014 and about 297,000 kg in 2005. During the same period, South Africa's share of world gold production decreased to about 5% from 12%. Decreased production was primarily attributable to mines operating at depths of as great as 4 kilometers, which led to difficult mining conditions, high ore haulage and refrigeration costs, and low labor productivity. From 2005 to 2015, employment in gold mining decreased to 115,055 workers from 160,634 (table 1; du Venage, 2013; Chamber of Mines of South Africa, 2015, p. 14, 28; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016, and December 9, 2016).

Sibanye Gold Ltd. mined gold at the Beatrix, the Driefontein, and the Kloof Mines, which were underground mines. Production at Driefontein decreased to 17,350 kg in 2015 from 17,735 kg in 2014; at Kloof, to 14,068 kg from 17,038 kg; and at Beatrix, to 10,105 kg from 10,354 kg. The Cooke Operations produced at the rate of nearly 6,900 kilograms per year (kg/yr) in 2014 after being acquired by Sibanye; output was 6,252 kg in 2015 (Sibanye Gold Ltd., 2016b, p. 41).

In Sibanye's mining plan, total production at Beatrix, Cooke, Driefontein, and Kloof was expected to decrease to about 37,000 kg/yr by 2023, 19,000 kg/yr by 2027, and 4,000 kg/yr by 2031. Reserves at all mines were expected to be depleted by 2033 without the development of new projects (Sibanye Gold Ltd., 2016a, p. 17).

In 2015, Sibanye approved the reopening of the Burnstone Mine. Development was likely to start in 2016, and mining, in 2018. Planned steady-state production at Burnstone was between 3,100 and 4,000 kg/yr of gold. Sibanye completed a feasibility study with favorable results on the development of the West Rand Tailings Retreatment Project (WRTRP) in 2015. Production could start at the WRTRP in 2018; Sibanye planned steady-state production of 3,400 kg/yr. The company also completed feasibility studies with favorable results on extending the lives of the Driefontein and the Kloof Mines. The life of the Driefontein Mine would be extended from 2028 to 2042, and the Kloof Mine, from 2030 to 2033. Additional production from the Driefontein Mine was expected to be an average of 3,000 kg/yr between 2021 and 2042, and from the Kloof Mine, an average of 1,200 kg/yr between 2021 and 2033 (Sibanye Gold Ltd., 2016a, p. 17; 2016b, p. 49–50).

Other projects under consideration by Sibanye included the Beisa and the De Bron Merrispruit, which could start in 2019 and 2024, respectively. If all projects proceeded according to plan, Sibanye could maintain production at nearly 44,000 kg/yr through 2025, 25,000 kg/yr through 2029, and 12,000 kg/yr through 2035 (Sibanye Gold Ltd., 2016a, p. 17; 2016b, p. 51).

AngloGold Ashanti Ltd. operated mines in the Vaal River area near Klerksdorp and the West Wits area near Carletonville. The company's gold production decreased to about 31,200 kg in 2015 from 37,900 kg in 2014. Production at the Moab Khotsong Mine was 7,900 kg in 2015; the Mponeng Mine, 6,800 kg; the Tau Tona Mine, 6,500 kg; the surface mining operations in the Vaal River and West Wits areas and Mine Waste Solutions, 6,400 kg; and the Great Noligwa and Kopanang Mine, a total of 3,600 kg. The decrease in production was broadly based in 2015, with reduced output at every operation except for Mponeng. In 2015, ore grades decreased at every operation except for Tau Tona (AngloGold Ashanti Ltd., 2016, p. 98).

Harmony Gold Mining Company Ltd. produced a total of 30,995 kg of gold from its South African operations in 2015 compared with 31,933 kg in 2014. The Tshepong Mine produced 4,515 kg in 2015; the Target 1 Mine, 3,860 kg; the Kusasalethu Mine, 3,833 kg; the Phakisa Mine, 3,516 kg; the Bambanani Mine, 3,313 kg; surface mining operations, 2,899 kg; the Doornkop Mine, 2,691 kg; the Masimong Mine, 2,394 kg; the Joel Mine, 2,288 kg; and the Unisel Mine, 1,686 kg. The Target 3 Mine was placed on care-and-maintenance status in 2014 and production decreased at the Kusasalethu and the Masimong Mines in 2015 (Harmony Gold Mining Company Ltd., 2014; 2015a, p. 126–149; 2015b, p. 7–8; 2016, p. 5–6).

For fiscal year 2016, Harmony's planned production at Kusasalethu was about 5,300 kg; Tshepong; about 4,400 kg; Target 1, about 4,000 kg; Phakisa, about 3,400 kg; Bambanani, about 3,100 kg; surface mining operations, about 2,800 kg; Doornkop, about 2,600 kg; Masimong; about 2,500 kg; Joel, about 2,300 kg; and at Unisel, 1,700 kg. The estimated remaining life of the Masimong Mine was 3 years (Harmony Gold Mining Company Ltd., 2015a, p. 123).

Gold Fields Ltd. produced 6,200 kg of gold at the South Deep Mine in 2015, which was nearly unchanged from that of 2014. The company planned to produce about 8,000 kg in 2016. Gold Fields had planned to increase output at South Deep to between 20,200 and 21,700 kg/yr by the end of 2017; a revised long-term production plan was expected to be completed in 2017 (Projects in Progress, 2014a; Gold Fields Ltd., 2016, p. 21–22).

In its 2015 fiscal year (which ended on June 30, 2015), Pan African Resources plc produced 5,470 kg of gold compared

with 5,853 kg in fiscal year 2014. Production at the Barberton Mine was 2,535 kg in fiscal year 2015; the Evander Mine, 1,977 kg; the Barberton Tailings Retreatment Project (BRTP), 755 kg; and the Evander Tailings Retreatment Project (ERTP), 203 kg. The ERTP started operations in fiscal year 2015. Pan African planned to produce about 3,000 kg/yr each at Barberton and Evander, 620 kg/yr at BRTP, and 300 kg/yr at ERTP. The estimated remaining life of the Barberton Mine was 20 years; the Evander Mine and the ERTP, 16 years each, and the BRTP, 15 years (Pan African Resources plc, 2015, p. 8, 10–11, 47–48).

DRDGold Ltd. produced 4,652 kg of gold in 2015 compared with 4,270 kg in 2014 at the Ergo tailings retreatment operations, which are located near Johannesburg. In 2014, the company's production was limited by heavy rainfall in late February and early March and problems with integrating its new processing plants and its older processing plants (Ryan, 2014; DRDGold Ltd., 2016a, b).

In 2015, Gold One International Ltd. produced nearly 4,000 kg of gold at the Modder East Mine, which was a record level of production for the company. The estimated remaining life of the mine at production rates of 4,000 kg/yr was 9 years. Gold One was considering an expansion of its processing plant. Depending on company board approval, the 18-month construction phase could start in 2016. Gold One hoped to maintain production of 6,200 kg/yr for more than 25 years by mining from its licenses near Modder East (Cornish, 2016b).

Gold was also produced at PGM mining operations, which accounted for at most 5% of South Africa's gold production. Amplats produced about 2,800 kg of gold from its South African PGM mining operations in 2015 compared with 2,100 kg in 2014 (Anglo American Platinum Ltd., 2016a, p. 24, 28–36).

Rand Refinery Ltd. (AngloGold Ashanti, 53%; Gold Fields, 33%; DRDGold, 10%; and Avgold Ltd. and Western Areas Ltd., 2% each) refined most of the newly mined gold in South Africa. The company produced at the rate of about 400,000 kg/yr. Rand Refinery sourced the majority of its gold from foreign gold producers (Clark, 2013).

Iron Ore and Iron and Steel.—In 2015, iron ore production was about 72.8 Mt compared with 80.8 Mt in 2014 and 39.5 Mt in 2005. The long-term increase was attributable to increased production from the Palabora and the Sishen Mines and the opening of the Khumani and the Kolomela Mines. From 2005 to 2015, employment in iron ore mining increased to 20,761 workers from 7,493. Iron ore was exported to China (Chamber of Mines of South Africa, 2015, p. 14, 18; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016; December 9, 2016).

Kumba Iron Ore Ltd.'s iron ore production decreased to 44.9 Mt in 2015 from 48.2 Mt in 2014. In 2015, production at the Sishen Mine decreased to 31.4 Mt from 35.5 Mt. At the Kolomela Mine, output increased to 12.1 Mt from 11.6 Mt, and the Thabazimbi Mine, to 1.4 Mt from 1.1 Mt (Kumba Iron Ore Ltd., 2016, p. 2).

Kumba planned to produce 27 Mt/yr at Sishen between 2016 and 2020. The company planned to increase production at Kolomela to 13 Mt/yr by 2017. The Thabazimbi Mine was scheduled for closure in mid-2016. Kolomela had an estimated remaining life of 21 years, and Sishen, 15 years (Kumba Iron Ore Ltd., 2016, p. 13, 66, 70).

Assmang produced iron ore at the Beeshoek and the Khumani Mines. In 2015, production at Beeshoek and Khumani increased to 16.7 Mt from 16.4 Mt in 2014. The company was engaged in an expansion of Khumani's capacity to 13.9 Mt/yr from 13 Mt/yr. Assmang planned to start production at the Village Pit at Beeshoek in April 2016, which would extend the life of the mine to 2025 from 2017 and maintain production at 3 Mt/yr (African Rainbow Minerals Ltd., 2015a, p. 86, 95, 2015b, p. 51; 2016, p. 9, 11).

Foskor (Pty) Ltd. sold magnetite, which was a byproduct of its phosphate rock mining process. Magnetite was sold from the company's stockpile and was not produced in 2015. In its 2015 fiscal year (which ended on March 31, 2015), Foskor sold 5.25 Mt of magnetite compared with 6.17 Mt in fiscal year 2014. The sales target for fiscal year 2015 was 6.6 Mt. The company put its plans to beneficiate magnetite on hold because of decreased magnetite prices on world markets (Foskor (Pty) Ltd., 2015, p. 26, 57).

Evraz Highveld Steel and Vanadium Corp. Ltd. (Evraz plc of the United Kingdom, 85.11%) mined 2.31 Mt of magnetite from the Mapochs Mine in 2014 compared with 2.08 Mt in 2013. Lumpy iron ore from Mapochs was consumed in Highveld's steel mill at Witbank. Highveld's production of pig iron increased to 666,000 t in 2014 from 639,000 t in 2013; crude steel production decreased to 621,000 t from 642,000 t. In the first quarter of 2015, the company's production of iron ore was 425,000 t; pig iron, 151,000 t; and crude steel, 149,000 t. Highveld entered into bankruptcy proceedings in April (Evraz plc, 2015a, b).

In early 2015, Ferrum Crescent Ltd. of Australia was considering the development of a new mine at its Moonlight magnetite deposit. The company planned to raise between $10 million and $12 million to complete its feasibility study. Depending on the results of the study, production at Moonlight was expected to be 6 Mt/yr of iron ore pellets. Mining could start in 2019 (Andrews, 2015a).

In September 2014, Government-owned Industrial Development Corp. (IDC) signed an agreement with Hebei Iron & Steel Group of China for the development of a new steel mill in Limpopo Province. Hebei and IDC planned to complete a feasibility study of the plant by the first quarter of 2015. Depending on the results of the study, the companies could complete construction of the first phase of the project by 2017, and the second phase, by 2020. Production was likely to be 3 Mt/yr of steel in the first phase of the project and 5 Mt/yr in the second phase. The estimated capital cost of the first phase was $2.8 billion, and the second phase, an additional $1.7 billion. The plant would use magnetite tailings in the Palabora area as raw material. By October 2015, the opening of the plant had been delayed until 2020 (Barradas, 2014b; Wild, 2015).

Lead and Zinc.—The Black Mountain Mine, which was operated by Vedanta Resources plc of the United Kingdom, produced copper, lead, silver, and zinc. Lead mine production increased to 34,573 t in 2015 from 29,348 t in 2014, and zinc mine production, to 29,040 t from 26,141 t

(Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016).

In 2015, Vedanta started construction on the Gamsberg Mine. The company planned to produce 250,000 t/yr of zinc in concentrate in the first phase of mining, which had an estimated life of 13 years. Mining was expected to start in 2018. Vedanta planned to export about 150,000 t/yr of zinc in concentrate to its refinery in Namibia and about 100,000 t/yr to international customers. Resources at Gamsberg were estimated to be 214 Mt at a grade of about 6.5% zinc (Tredway, 2014, 2015).

Manganese.—In 2015, manganese ore production was about 15.95 Mt compared with 14.05 Mt in 2014 and 4.61 Mt in 2005 because of increased production from the Mamatwan, the Nchwaning, and the Wessels Mines and the opening of the Kalahari, the Kudumane, and the Tshipi Borwa Mines. From 2005 to 2015, employment in manganese mining increased to 8,657 workers from 3,336 (Chamber of Mines of South Africa, 2015, p. 14, 19; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016, and December 9, 2016).

Assmang produced manganese ore at the Black Rock Mine (formerly the Gloria and the Nchwaning Mines). Output at Black Rock remained nearly unchanged at about 3.13 Mt in 2015. Assmang was engaged in an expansion of Black Rock's capacity to 4.6 Mt/yr, which was about 50% completed in late 2015. The company planned to complete the expansion by the end of 2018 (African Rainbow Minerals Ltd., 2015a, p. 96; 2015b, p. 51; 2016, p. 9; Cornish, 2015a).

In 2015, Assmang decreased production to 259,000 t of ferromanganese at its Cato Ridge and Machadodorp plants from 342,000 t in 2014. The company placed its ferromanganese furnaces at Machadodorp on care-and-maintenance status in April; only three out of six furnaces were operating at Cato Ridge by the end of June (African Rainbow Minerals Ltd., 2015a, p. 89; 96, 2015b, p. 51; 2016, p. 9).

Samancor Manganese (Pty) Ltd. (South32 Ltd., 60%) operated the Mamatwan open pit mine and the Wessels underground mine near Hotazel in Northern Cape Province. In 2015, Samancor Manganese's production of manganese ore decreased to 3 Mt from 3.77 Mt in 2014. The company started a temporary shutdown of its mining operations in November. Samancor Manganese was engaged in an expansion of Wessels' capacity to 1.5 Mt/yr from 1 Mt/yr, which was 44% completed in mid-2015. The expansion was planned to be completed by the third quarter of 2016. In 2015, BHP Billiton spun off its South African manganese assets into South32 (BHP Billiton Ltd., 2015, p. 15; South32 Ltd., 2015, p. 24; 2016).

In 2015, Samancor Manganese produced 253,000 t of manganese alloys at its Meyerton plant compared with 430,000 t in 2014. The company shut down production at three of its four high-carbon ferromanganese furnaces in May because of oversupply on world steel markets (BHP Billiton Ltd., 2015, p. 15; South32 Ltd., 2016).

In late 2015, United Manganese of Kalahari (Pty) Ltd. (UMK) (Majestic Silver Trading 40 (Pty) Ltd., 51%, and Renova Group of Russia, 49%) were exporting manganese ore at the rate of between 1.92 Mt/yr and 2.88 Mt/yr. UMK announced plans to cut exports by about 50% for December 2015 and to suspend sales for January 2016 (Davies, 2015c).

Manganese from the Kalahari deposit was consumed by Transalloys (Pty) Ltd. (a subsidiary of Renova) in the production of silicomanganese. Transalloys had a capacity of 180,000 t/yr. In December 2015, Renova and Majestic announced plans to reduce production by as much as 80% in 2016 because of low prices on world markets for silicomanganese (Metal Bulletin, 2015).

BEE company Ntsimbitntle Mining (Pty) Ltd. held a 50.1% share in Tshipi e Ntle Manganese Mining (Pty) Ltd., and Jupiter Mines Ltd. of Australia, a 49.9% share. In the fiscal year that ended on February 28, 2015, Jupiter and Ntsimbitntle produced more than 2 Mt of manganese ore at a grade of 36.5% manganese from the Tshipi Borwa Mine, which was adjacent to the Mamatwan Mine. The mine had a capacity of 3.6 Mt/yr and an estimated life of more than 60 years. The companies initially planned to produce more than 2 Mt in the subsequent fiscal year. In December, Jupiter and Ntsimbitntle announced plans to reduce exports of medium-grade manganese ore by 35% in the first 3 months of 2016 and 30% for the entire year (Greve, 2015; Kotze, 2015e).

Kalagadi Manganese (Pty) Ltd. (ArcelorMittal of Luxembourg, 50%; Kalahari Resources (Pty) Ltd., 40%; and IDC, 10%) planned to start production at a new underground mine at Hotazel in early 2015. Output was expected to be 3 Mt/yr of manganese ore at a grade of 38%; Kalagadi completed a plant to beneficiate the mine's output into 2.4 Mt/yr of sintered ore in 2013. The sintering plant, which had a capacity of 3.7 Mt/yr, was processing manganese ore from other South African producers at the rate of 730,000 t/yr in September 2014. As of the end of 2015, mining had not yet started (Green, 2014; Projects in Progress, 2014c; ArcelorMittal S.A., 2016, p. 85, 148).

About 1.7 Mt/yr of the mine's sintered output was likely to be exported. Kalagadi also planned to build a new ferromanganese plant at Coega with a capacity of 320,000 t/yr by the first quarter of 2015; the plant was expected to consume about 700,000 t/yr of the mine's sintered output. As of yearend, production had not started (Projects in Progress, 2014b; ArcelorMittal S.A., 2016, p. 85, 148).

Asia Minerals Ltd. (AML) of Hong Kong was producing manganese ore from its Kudumane Mine at the rate of between 1.5 and 1.6 Mt/yr in May 2015. By November, AML had reduced its output to about 780,000 t/yr because of world market conditions (Davies, 2015a).

In mid-2012, Lehating Mining (Pty) Ltd. completed a feasibility study on its new Lehating Mine with favorable results. Lehating Mining's environmental impact assessment was approved by the Government in December 2014, and its mining license, in October 2015. Mining could start in 2017 depending on the company successfully obtaining financing; output was planned to be 600,000 t/yr of ore at a grade of more than 44% manganese during the estimated 14-year life of the mine (Cornish, 2013; Lehating Mining (Pty) Ltd., undated).

Nickel.—The majority of South Africa's nickel mine production was a coproduct of PGM mining. Amplats produced

25,400 t of refined nickel in 2015 compared with 20,500 t in 2014; the company's nickel production in matte decreased to 400 t from 7,700 t. About 20,200 t of nickel was mined at the company's South African PGM mining operations in 2015 compared with 22,200 t in 2014. Impala Platinum Holdings Ltd. (Implats) produced 16,600 t of refined nickel in 2015, of which about 4,300 t was attributable to the company's South African PGM mining operations (Impala Platinum Holdings Ltd., 2015, p. 44, 57, 67; 2016; Anglo American Platinum Ltd., 2016a, p. 24, 28–36).

ARM and Norilsk produced 22,265 t of nickel at the Nkomati Mine in 2015 compared with 21,602 t in 2014. The company planned to maintain production at more than 20,000 t/yr at least through mid-2018 (African Rainbow Minerals Ltd., 2015a, p. 77, 83; 2015b, p. 58; 2016, p. 17).

Platinum-Group Metals.—In 2015, platinum-group metal (PGM) mine production was 275,515 kg compared with 188,444 kg in 2014 and about 303,000 kg in 2005. From 2005 to 2015, the share of platinum in PGM production by volume decreased to 50% from 54%. During the same period, employment in PGM mining increased to 187,757 workers from 155,034 (table 1; Chamber of Mines of South Africa, 2015, p. 14, 34; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016, and December 9, 2016).

In 2015, Amplats produced about 151,400 kg of refined PGMs compared with 116,200 kg in 2014. The company's production of refined platinum was 76,477 kg in 2015; refined palladium, 49,607 kg; refined rhodium, 9,493 kg; and other PGMs, about 15,800 kg. About 110,000 kg was attributable to South African mining operations of Amplats and its joint-venture partners in 2015, of which platinum accounted for 54,975 kg; palladium, 36,758 kg; rhodium, 6,837 kg; and other PGMs, about 11,400 kg. Attributable South Africa production of PGMs increased by 40.2% in 2015; output was limited in 2014 by a labor dispute during most of the first half of the year (Anglo American Platinum Ltd., 2016a, p. 24, 28–36).

In 2015, PGM production at Amplats' Mogalakwena Mine amounted to 29,278 kg; the Rustenburg Mine 29,194 kg; the Amandelbult Mine, 25,744 kg; the Kroondal Platinum Mine, 17,315 kg; the Union Mine, 8,892 kg; the Modikwa Platinum Mine, 8,423 kg; the Mototolo Platinum Mine, 7,919 kg; and the Twickenham Mine, 1,008 kg. Production increased at Amandelbult by 83% in 2015; Rustenburg, by 59%; Union, by 45%; Mogalakwena, by 20%; Twickenham, by 19%; Kroondal, by 15%; Modikwa, by 14%; and Mototolo, by 2%. In 2014, output was limited by a labor dispute during most of the first half of the year. The Dishaba and the Tumela Mines were consolidated to form Amandelbult in 2015, and the Batholope, the Siphumelele, and the Thembelani Mines, and the Western Limb Tailings Retreatment project were consolidated to form the Rustenburg Mine (Anglo American Platinum Ltd., 2016a, p. 14, 28–29, 31–36; 2016b, p. 2).

In 2016, Amplats planned to increase its production at the Amandelbult, the Modikwa, the Rustenburg, and the Union Mines. Amplats agreed to sell the Rustenburg Mine to Sibanye in September 2015; the companies planned to complete the sale by the end of 2016 (Anglo American Platinum Ltd., 2016b, p. 2, 7, 50, 54, 59–60).

In 2015, Atlatsa Resources Corp. and joint-venture partner Amplats produced 5,933 kg of PGMs (not including ruthenium or iridium) at the Bokoni Mine compared with 6,035 kg in 2014. The companies planned to increase production to about 7,800 kg/yr of PGM by 2020. The remaining estimated life of the Bokoni Mine was 37 years (Staff, 2015; Atlatsa Resources Corp., 2016, p. 10).

Royal Bafokeng Platinum Ltd. (RBPlat) operated the Bafokeng-Rasimone Platinum Mine. Production of PGMs (not including ruthenium or iridium) was 8,647 kg in 2015, of which about 5,600 kg was platinum. Output of PGMs (not including ruthenium or iridium) was likely to decrease to 5,000 kg/yr by 2020 (Royal Bafokeng Platinum Ltd., 2016, p. 74).

RBPlat was building a new mine at the Styldrift project; the company had planned to start mining in the third quarter of 2015 and to ramp up to full capacity by the second quarter of 2018. Development of the mine was delayed, with the rampup to full capacity starting in 2016 and completing in 2020. Production of PGMs and gold (not including ruthenium or iridium) at Styldrift was likely to be about 10,000 kg/yr, of which platinum would account for 69%, and palladium, rhodium, and gold, a total of 31%. The remaining life of RBPlat's operations was estimated to be about 60 years (Projects in Progress, 2012; Royal Bafokeng Platinum Ltd., 2016, p. 51).

In 2015, Implats produced 83,342 kg of refined PGMs compared with 66,648 kg in 2014. About 46,500 kg was attributable to Implats' mining operations, of which platinum accounted for about 22,600 kg; palladium, 12,200 kg; rhodium, 3,400 kg; and other PGMs, about 8,300 kg. The remainder was attributable to the Two Rivers joint venture with ARM, company operations in Zimbabwe, recycling, and toll refining (Impala Platinum Holdings Ltd., 2015, p. 44, 57, 66–67; 2016).

The Impala Mines near Rustenburg in North West Province produced about 40,000 kg of PGMs in 2015, of which about 20,200 kg was platinum, 9,700 kg was palladium, and 2,800 kg was rhodium. PGM production increased by 144% in 2015; mining was limited in 2014 by a labor dispute that affected operations for 5 months in the first half of the year. In 2015, platinum output at Marula was about 2,400 kg; palladium, about 2,500 kg; and rhodium, about 510 kg. Implats planned to increase platinum production at the Impala Mines to about 25,500 kg/yr by 2020 by sinking new mine shafts. The company also planned to increase platinum production at Marula to 2,800 kg/yr (Impala Platinum Holdings Ltd., 2015, p. 14, 19, 44, 57; 2016).

ARM and Implats operated the Two Rivers Mine; output increased to 11,924 kg of PGMs in 2015 from 11,460 kg in 2014. Platinum accounted for about 47% of Two Rivers' PGM output; palladium, 27%; ruthenium, 14%; rhodium 8%; iridium, 3%; and gold, 1%. Production was expected to be about 11,500 kg of PGMs in 2016 (African Rainbow Minerals Ltd., 2015a, p. 74, 81; 2015b, p. 57; 2016, p. 64).

In 2015, Lonmin produced 46,517 kg of refined PGMs compared with 23,459 kg in 2014. Lonmin's mining operations produced 41,457 kg of PGMs in 2015, of which platinum accounted for 21,813 kg; palladium, 10,196 kg; ruthenium,

5,234 kg; rhodium, 3,191 kg; and iridium, 1,023 kg. Most of the mine production was attributable to the Marikana Mine. In 2014, production from mining operations was reduced by a labor dispute that lasted for most of the first half of the year. Lonmin planned to reduce platinum production to about 20,200 kg/yr in 2017 and 2018 (Lonmin plc, 2015, p. 26, 188–189; 2016).

Northam Platinum Ltd. operated the Booysendal and the Zondereinde Mines. In 2015, Booysendal and Zondereinde produced a total of about 7,700 kg of platinum, 3,700 kg of palladium, and 1,200 kg of rhodium compared with about 5,600 kg of platinum, 3,100 kg of palladium, and 1,000 kg of rhodium in 2014 because of the rampup of Booysendaal towards full capacity. In 2016, Northam was expected to produce 7,700 kg of platinum, 4,000 kg of palladium, and 1,000 kg of rhodium (CPM Group, 2016, p. 13, 112, 184).

In February 2015, Northam announced the purchase of the Everest Mine (adjacent to the Booysendal Mine) from Aquarius Platinum Ltd. of Bermuda. Northam planned to reopen Everest, which was on care-and-maintenance status. Everest was expected to increase Northam's PGM production by 50% by early 2019 (Ryan, 2015).

ARM and Norilsk produced PGMs at the Nkomati nickel mine. Output decreased to 5,074 kg of PGM in 2015 from 5,535 kg in 2014 (African Rainbow Minerals Ltd., 2015a, p. 77, 83; 2015b, p. 58; 2016, p. 17).

Sedibelo Platinum Mines Ltd. (formerly Platmin Ltd. of Canada) produced about 3,400 kg of platinum, 1,700 kg of palladium, and 340 kg of rhodium at Pilanesberg in 2015 compared with about 2,900 kg of platinum, 1,400 kg of palladium, and 390 kg of rhodium in 2014. The company's platinum and palladium production were expected to remain unchanged in 2016; rhodium production could increase to 450 kg (CPM Group, 2016, p. 13, 112, 184).

In fiscal year 2015, Tharisa produced nearly 3,700 kg of PGMs compared with about 2,400 kg in fiscal year 2014. Platinum accounted for 56.2% of production by volume in fiscal year 2015; palladium, 16.2%; ruthenium, 13.7%; rhodium, 9.3%; and iridium, 4.4%. The company planned to reach steady-state production of 4,500 kg/yr in fiscal year 2016. Sylvania Platinum Ltd. produced about 1,000 kg of platinum, 470 kg of palladium, and 260 kg of rhodium from its chromite tailings retreatment plants in 2015 compared with 960 kg of platinum, 470 kg of palladium, and 280 kg of rhodium in 2014 (CPM Group, 2016, p. 13, 112, 184; Tharisa Minerals (Pty) Ltd., 2015, p. 2, 7, 12).

Glencore operated the Eland Mine, which produced about 1,150 kg of PGM (not including ruthenium or iridium) in 2015. In October, the company placed Eland on care-and-maintenance status because of low platinum prices and operational problems (Glencore plc, 2016a, p. 55).

Platinum Group Metals Ltd. of Canada was engaged in the development of the Western Bushveld Joint Venture (WBJV) project; the company planned to start mining by the fourth quarter of 2015. By the fourth quarter of 2017, production was expected to reach the full capacity of nearly 8,600 kg/yr of PGMs and gold (not including ruthenium or iridium), of which platinum would account for 64%; palladium, 27%; rhodium, 5%; and gold, 4%. The estimated life of the mine was more than 20 years. As of yearend, production had not started (Platinum Group Metals Ltd., 2015, p. 13–14).

In February 2014, Platinum Group Metals completed a preliminary economic assessment of a new mine at the Waterberg project in the Northern Limb of the Bushveld Complex. The company subsequently started a prefeasibility study and planned to complete a feasibility study by early 2016. Depending on the results of the studies, mining could start by 2018 with full capacity reached by 2021. Planned production was 20,400 kg/yr of PGMs and gold (not including ruthenium or iridium), of which palladium would account for 60%; platinum, 30%; gold, 9%; and rhodium, 1%. Mining was likely to be maintained at full capacity for 13 years. As of yearend 2015, the prefeasibility study was not completed (Cornish, 2014a; Platinum Group Metals Ltd., 2015, p. 25, 31, 34).

In 2015, Wesizwe Platinum Ltd. was engaged in the development of the Bakukung Mine. Wesizwe planned to start mining in the fourth quarter of 2018 and reach the full capacity of 13,000 kg/yr of PGMs and gold (not including ruthenium or iridium) in 2020. Platinum was expected to account for 62.4% of PGM and gold production; palladium, 28%; rhodium, 7.4%; and gold, 2.2%. The estimated life of the mine was 30 years (Engineering & Mining Journal, 2015c).

In January 2015, Ivanhoe Mines Ltd. of Canada completed a prefeasibility study of a new mine at its Platreef project. Depending on the results of a feasibility study, mining could start at Platreef, which is located in the northern limb of the Bushveld Complex, in 2019. In the first phase of mining, Ivanhoe would mine about 4 Mt/yr of ore. Production was likely to be 8,600 t/yr of nickel, 5,400 t/yr of copper, and 13,500 kg/yr of PGMs (not including ruthenium or iridium), In the second phase, ore production would increase to 8 Mt/yr, and in the third phase, to 12 Mt/yr (Engineering & Mining Journal, 2015a).

Selenium and Tellurium.—Implats and its partners produced about 9,000 kg of selenium and 4,000 kg of tellurium from their PGM mining operations in 2013. It is likely that Implats' selenium and tellurium production increased substantially in 2015 after decreasing because of the labor dispute in the first half of 2014. Selenium and tellurium were also contained in anode slimes from Palabora Mining's copper operations (Paul Finney, Group Executive—Refining, Impala Platinum Ltd., written commun., March 8, 2013).

Silicon, Titanium, and Zirconium.—Grupo Ferroatlantica was South Africa's only producer of silicon metal; the company also produced ferrosilicon. In early 2015, Globe Speciality Metals Inc. of the United States had reactivated both of the ferrosilicon furnaces at Silicon Technology Ltd. (Siltech). Globe planned to produce between 40,000 and 45,000 t/yr of ferrosilicon when the plant reached full capacity. By the end of August, Globe had shut down production at Siltech because of low prices on world markets for ferrosilicon and high power costs. By yearend, Globe and Grupo Ferroatlantica merged to form Ferroglobe plc of the United Kingdom (Ryan's Notes, 2015a, b).

Richards Bay Minerals (RBM) (Rio Tinto plc, 74%; Blue Horizon Investments, 24%; and RBM permanent employees, 2%) of the United Kingdom was South Africa's leading producer of ilmenite, rutile, and zircon; the company also produced

pig iron and processed ilmenite to titanium slag. About 95% of RBM's total pig iron, rutile, titanium slag, and zircon output was exported (Rio Tinto plc, 2016, p. 8).

RBM mined nearly 1.8 Mt of ilmenite in 2013. The company had planned to produce at about the same level in 2014 and to increase output to between 2 Mt and 2.1 Mt in 2015, of which between 1.5 Mt and 1.6 Mt would be attributable to the Zulti North deposit. By 2015, actual production was estimated to have decreased by more than 10% from that of 2013 because of reduced demand on world markets (Rio Tinto plc, 2014, p. 28; 2016, p. 9).

Production at Zulti North was expected to decrease after 2015; RBM was engaged in the development of the Zulti South deposit in 2015. The company planned to start mining at Zulti South in 2017. RBM's total ilmenite production could increase to more than 2.2 Mt/yr starting in 2018. The opening of Zulti South was postponed until 2019 because of delays in obtaining permits. Zulti North and Zulti South were expected to be depleted in 2036 and 2041, respectively (Rio Tinto plc, 2014, p. 28; 2015, p. 6, 10).

Titanium slag production by RBM was about 880,000 t in 2012. In 2014, production was at more than 90% of 2012 levels. In 2015, production was estimated to have decreased by more than 25% from that of 2014 because of reduced demand on world markets (Rio Tinto plc, 2013, p. 10; 2015, p. 10; 2016, p. 9).

Zircon production by RBM was about 264,000 t in 2012, and rutile production, about 97,000 t. In 2014, rutile and zircon production were at about the same levels as in 2012. In 2015, rutile and zircon production were estimated to have decreased by more than 25% each from that of 2014 because of reduced demand on world markets. Rutile and zircon production could increase with the development of Zulti South starting in 2019 (Rio Tinto plc, 2013, p. 10; 2015, p. 10; 2016, p. 9).

Tronox Ltd. of the United States (Exxaro Resources Ltd., 44.65%) produced 115,000 t of zircon at the Namakwa Sands project in 2015 compared with 114,000 t in 2014; rutile production increased to 28,000 t from 26,000 t in 2014. Titanium slag production decreased to 155,000 t in 2015 from 161,000 t in 2014. The company's ilmenite production was 625,000 t in 2014 (Tronox Ltd., 2015, p. 32; 2016, p. 32).

In early 2014, Tronox shut down its KZN Sands project as reserves were depleted at the Hillendale Mine. The company planned to start production at the Fairbreeze Mine, which would replace Hillendale, by early 2016. Mining started at Fairbreeze in the fourth quarter of 2015. Tronox planned to produce 450,000 t/yr of ilmenite, 55,000 t/yr of zircon, and 25,000 t/yr of leucoxene and rutile during Fairbreeze's estimated 12-year life (Mineral Sands Report, 2016).

Mineral Commodities Ltd. (MCL) of Australia operated the Tormin Mine in Western Cape Province. In 2015, production was 109,959 t of ilmenite, 32,424 t of zircon, and 5,979 t of rutile. In 2014, production was 100,437 t of ilmenite, 32,812 t of zircon, and 3,789 t of rutile. MCL planned to complete a new garnet stripping plant that would increase zircon recovery rates and the grades of ilmenite, rutile, and zircon in concentrate by the second quarter of 2016 (Mineral Commodities Ltd., 2016).

Most of the titanium slag produced in South Africa was exported before additional processing. Huntsman International LLC of the United States operated a titanium dioxide (TiO_2) pigment plant at Umbogintwini with a capacity of 25,000 t/yr. In 2015, Nyanza Light Metals Ltd. (Arkein Group of Companies, 80%, and Highveld, 20%) was engaged in a feasibility study on a new TiO_2 pigment plant in the Richards Bay Industrial Development Zone. Depending on the results of the study, the company could produce 50,000 t/yr of TiO_2 pigment starting in 2017. Pigment would be produced using 200,000 t/yr of titanium-rich wastes from Highveld's iron ore and vanadium mining operations (Hughes and Ollett, 2013; Arkein Group of Companies, 2015).

In 2013, the Council for Scientific and Industrial Research (CSIR) started producing titanium metal powder at a pilot plant using an experimental production process. CSIR was engaged in a feasibility study of a new plant in 2015. Depending on the results of the study, the plant could start production of 500 t/yr of titanium metal powder in 2016. Depending on the success of the new plant, a large-scale plant with a capacity of 20,000 t/yr could be opened by 2020 (van Vuuren and Greyling, 2015, p. 6).

Vanadium.—Evraz produced vanadium from titaniferous magnetite at the Mapochs and the Vametco Vanadium Mines, which were operated by Highveld and Vametco Minerals Corp., respectively. Highveld produced vanadium slag from the lumpy iron ore at Mapochs; the slag was sold to Germany for processing into ferrovanadium and to Vametco for processing into other products. In 2014, the content of vanadium in vanadium slag was 7,127 t at Mapochs compared with 6,675 t in 2013. In the first quarter of 2015, the content of vanadium in vanadium slag was nearly 1,800 t. Highveld entered bankruptcy proceedings in April (Evraz plc, 2015a, b).

Vanchem Vanadium Products (Pty) Ltd. (a subsidiary of Duferco) purchased fine iron ore from the Mapochs Mine for processing into ferrovanadium and other products. In fiscal year 2014 (October 1, 2013, to September 30, 2014), Vanchem's output of contained vanadium was 4,166 t, which was an increase of 6% compared with that of fiscal year 2013. In the first quarter of 2015, the Mapochs Mine was producing fine ore at the rate of 600,000 t/yr compared with more than 720,000 t/yr in 2014. In November, Vanchem entered bankruptcy proceedings because of the closure of Mapochs and its inability to purchase remaining stockpiles of the mine's ore (Duferco Group, 2014, p. 35; Evraz plc, 2015a, b; Hack, 2015).

Glencore produced vanadium pentoxide (V_2O_5) and ferrovanadium at the Rhovan Mine and smelter in Brits. In 2015, the production of V_2O_5 at Rhovan was nearly 9,500 t, which was nearly unchanged from that of 2014 (Glencore plc, 2016a, p. 190).

In 2014, Ironveld plc of the United Kingdom completed a feasibility study with favorable results on its Ironveld Pig Iron project, which is located on the Northern Limb of the Bushveld Complex. Ironveld planned to mine magnetite, which would be processed at the company's new smelters into 46,000 t/yr of pig iron, nearly 8,300 t/yr of titanium in slag, and 381 t/yr of vanadium in slag. Construction of the smelter was expected to start in the second quarter of 2016, and production, in the second quarter of 2017 (Ironveld plc, 2016).

In July 2014, Bushveld Minerals Ltd. of the United Kingdom completed a scoping study with favorable results on a new mine at its Bushveld Vanadium project. Depending on the results of prefeasibility and feasibility studies, the company could produce nearly 10,400 t/yr of V_2O_5 from 1 Mt/yr of titaniferous magnetite ore. Mining could start in 2018 or 2019. The company also was considering the production of pig iron from iron-rich calcine dumps resulting from vanadium production. The estimated life of the mine was 30 years. At the end of 2015, Bushveld Minerals was engaged in a prefeasibility study (Bushveld Minerals Ltd., 2014; 2016, p. 27).

Industrial Minerals

Cement.—At the end of 2015, South Africa had at least five cement producers with a total capacity of at least 20.1 Mt/yr. Pretoria Portland Cement Co. (Pty) Ltd.'s plants had a combined capacity of 7 Mt/yr; AfriSam Consortium (Pty) Ltd., 4.6 Mt/yr; and Natal Portland Cement Co. (Pty) Ltd., 1.8 Mt/yr. In 2015, South Africa's limestone sales were nearly 19.3 Mt, of which nearly 14.5 Mt were to cement producers (Edwin and Fourie, 2014; International Cement Review, 2017; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016).

In 2014, Sephaku Cement (Pty) Ltd. (Dangote Industries Ltd. of Nigeria, 64%) completed its clinker grinding plant near Delmas in Mpumalanga Province and its Aganang integrated cement plant in Lichtenburg in North West Province. The total cement capacity at Aganang and Delmas was 3.3 Mt/yr. Total sales from the plants increased to about 2.1 Mt in 2015 from 0.8 Mt in 2014 as Sephaku Cement had its first full year of production. In November 2015, the company changed its name to Dangote Cement South Africa (Pty) Ltd.(Dangote Cement plc, 2016, p. 5, 38, 69–70).

Mamba Cement Company (Pty) Ltd. (Jidong Development Group of China, 51%; Continental Cement (Pty) Ltd., 25.1%; and Women Investment Portfolio Holdings Group, 23.9%) planned to build a new cement plant in Limpopo Province by the third quarter of 2016. The capacity of the plant was expected to be 1 Mt/yr (International Cement Review, 2015).

Osho Ventures Group of the United Arab Emirates had planned to start construction on two new clinker grinding plants near Port Elizabeth and Richards Bay in February 2014. The plants would have a capacity of 600,000 t/yr each of cement; completion was scheduled for the end of 2014. The planned completion of the plants subsequently was delayed until June 2015. At yearend 2015, it was unclear whether the plants had been completed (International Cement Review, 2013; Government Gazette, 2014).

Diamond.—In 2015, diamond production was 8.23 million carats compared with 8.06 million carats in 2014 and 15.78 million carats in 2005 because of decreased production at the Cullian, the Finsch, and the Venetia Mines. From 2005 to 2015, employment in diamond mining decreased to 17,481 workers from 22,033 (table 1; Chamber of Mines of South Africa, 2015, p. 14, 26; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016, and December 9, 2016).

De Beers Group of Companies accounted for the majority of South Africa's rough diamond production. In 2015, the company's total output increased to 4.67 million carats from 4.63 million carats in 2014. The Venetia Mine produced 3.13 million carats in 2015; the Kimberley Surface Mining Operations, 837,000 carats; and the Voorspoed Mine, 704,000 carats. Reserves near the surface at Venetia were likely to be depleted by 2021; De Beers planned to build an underground mine at Venetia that would extend the life of the project until 2043. Planned production from the underground mine was 4.4 million carats per year (Anglo American plc, 2016, p. 13; Cornish, 2016a).

In 2015, diamond production at the Finsch Mine by Petra Diamonds Ltd. amounted to 2.15 million carats; the Cullinan Mine, about 660,000 carats; the Kimberley Underground Mine, about 150,000 carats; and the Koffiefontein Mine, about 57,000 carats. Petra planned to ramp up production at the Cullinan Mine to 2.2 million carats per year by mid-2018, and at the Koffiefontein Mine, to 100,000 carats per year by mid-2016. The company also planned to maintain production at the Finsch and the Kimberley Underground Mines at 2 million carats per year and 170,000 carats per year, respectively (Petra Diamonds Ltd., 2015; 2016, p. 11–16).

Jagersfontein Developments (Pty) Ltd. mined diamond at the rate of about 250,000 carats per year in Free State Province. In the last nine months of 2015, Batla Minerals SA of France produced 87,686 carats at the Superkolong Diamond operations compared with 74,005 carats during the same period in 2014. Alexkor Ltd. and ASA Resources Group plc produced more than 50,000 carats per year each at the Alexkor and Klipspringer Mines, respectively (Batla Minerals SA, 2015, 2016; Moumakwa, 2016, p. 19–20).

Trans Hex Group produced at the rate of about 53,000 carats per year, most of which was attributable to the Baken Mine (accounted for 43,534 carats). In October 2014, Trans Hex purchased the Namaqualand Mine, which was on care-and-maintenance status, from De Beers. The company started production at Namaqualand in December 2015. Reserves were estimated to be between 1.6 million and 1.9 million carats that could be mined during a 14-year period (Creamer, 2014a; Moumakwa, 2016, p. 23; Trans Hex Group, 2016, p. 20, 26).

DiamondCorp plc of the United Kingdom recovered small amounts of diamond at the Lace Mine in 2015; production was likely to reach commercial levels in the first half of 2016. The company's planned peak output was 500,000 carats per year, which could be increased to more than 700,000 carats per year with the installation of a high-volume waste sorter. The estimated life of the Lace Mine was 25 years (Kotze, 2015a).

The South African diamond-cutting industry specialized in diamonds larger than one carat because of the labor-intensive processes involved in cutting smaller diamonds. The State Diamond Trader (SDT) was allowed to purchase as much as 10% of South Africa's diamond production by volume and value for domestic beneficiation. In its 2015 fiscal year, the SDT purchased about 1% of national diamond production by volume and 3% by value. The decrease in the SDT's sales in

fiscal year 2015 was 63% by volume and 29% by value. The domestic diamond-cutting industry faced problems including 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).

Employment in the South African diamond-cutting industry decreased to about 1,000 workers in 2013 from 1,800 workers in 2008. During the same period, production costs increased to between $130 and $150 per carat from between $60 and $100 per carat. In 2013, production costs in Namibia were between $60 and $140 per carat; in Botswana, between $60 and $120 per carat; and in India, between $10 and $50 per carat. By 2015, employment decreased to about 200 workers (De Beers Group, 2014, p. 37; Kotze, 2015c).

Fluorspar.—In 2015, South Africa's production of fluorspar decreased to an estimated 120,000 t from 164,054 t in 2014. Between October 2014 and March 2015, sales of fluorspar were at the rate of 162,000 t/yr. More than 90% of sales were exports and nearly 10% was consumed domestically by Pelchem SOC (a subsidiary of South African Nuclear Energy Corp.) A majority of Pelchem's consumption was attributable to hydrofluoric acid production (Modiselle, 2015b; Motsie, 2015).

Minerales Y Productos Derivados SA of Spain held an 85% share in the Vergenoeg Mine, which was South Africa's only active fluorspar mine at the end of 2015. Vergenoeg's capacity of acid-grade fluorspar was 250,000 t/yr, and its capacity of metal-grade fluorspar powder and briquette, 30,000 t/yr. Production was limited by a labor dispute that started in mid-February 2015, reduced fluorspar demand in world markets, and uneconomic mining conditions (Modiselle, 2015a, b).

Sephaku Fluoride Ltd. (SepFluor) had planned to start production at the Nokeng fluorspar project by the fourth quarter of 2014; the company subsequently delayed the startup until 2017. In the first 9 years of the project, SepFluor planned to produce 185,000 t/yr of acid-grade fluorspar from the Plattekop deposit. Production was expected to decrease subsequently to 130,000 t/yr as mining shifted to the Outwash Fan deposit. SepFluor also planned to build a new processing plant that would consume 130,000 t/yr of fluorspar and 156,000 t/yr of sulfuric acid in the production of 60,000 t/yr of hydrogen fluoride (HF). About 42,600 t/yr of HF was expected to be consumed in the production of 60,000 t/yr of aluminum fluoride (AlF_3). National consumption of AlF_3 was estimated to be about 28,000 t/yr, all of which was imported (Sephaku Fluoride Ltd., 2013, p. 4, 18, 21; Modiselle, 2015a).

Kyanite and Related Minerals.—South Africa was the world's leading producer of andalusite. In 2015, national production increased to an estimated 190,000 t from 172,657 t in 2014. Production was limited between February and March 2014 by heavy rains. Between October 2014 and March 2015, export sales of andalusite were at the rate of 114,000 t/yr, and domestic sales, 86,000 t/yr. Andalusite was consumed by the domestic steel industry for use in refractories (Lismore-Scott, 2015; Motsie, 2015; Singo, 2015).

Imerys South Africa (Pty) Ltd. (a subsidiary of Imerys Group of France) operated the Annesley, the Segorong, and the Thabazimbi (Rhino) Mines, which accounted for about 61% of South Africa's andalusite production in 2015. Andalusite Resources (Pty) Ltd. operated the Maroeloesfontein Mine, which accounted for about 39% of production in 2015. Exports to Japan accounted for between 35% and 45% of the company's production; exports to European countries, between 30% and 40%; and domestic sales, about 25%. In April 2015, the Government's Competition Committee blocked a proposed merger between Imerys and Andalusite Resources. The companies planned to appeal the decision (Lismore-Scott, 2015; Patel, 2015; Singo, 2015).

Phosphate Rock.—Foskor was South Africa's only producer of phosphate rock. In 2015, phosphate rock production decreased to 1.85 Mt from 2.01 Mt in 2014. Between October 2014 and March 2015, domestic sales of phosphate rock were at the rate of 1.46 Mt/yr, and export sales, about 510,000 t/yr (Motsie, 2015).

Foskor consumed phosphate rock in the production of phosphoric acid and fertilizers, including monoammonium phosphate and diammonium phosphate, at its plant in Richards Bay. In its 2015 fiscal year, the company produced 393,000 t of phosphoric acid compared with 510,000 t in fiscal year 2014. Fertilizer production decreased to 297,000 t from 307,000 t. Decreased production was attributable in part to equipment problems and power and water shortages. By fiscal year 2017, Foskor planned to increase its phosphate rock production to 2.4 Mt/yr; phosphoric acid, to 700,000 t/yr; and fertilizers, to 450,000 t/yr (Foskor (Pty) Ltd., 2015, p. 1, 28).

In 2012, Montero Mining & Exploration Ltd. of Canada completed a preliminary economic assessment on a new mine at its Duyker Eiland project located near Saldanha Bay. Depending on the results of prefeasibility and feasibility studies, Montero could produce 490,000 t/yr of phosphate rock at Duyker Eiland, which would be processed to fertilizer at a nearby processing plant. The company hoped to identify sufficient resources for a mine life of 50 years. In early 2015, Montero was engaged in a prefeasibility study on Duyker Eiland (Montero Mining & Exploration Ltd., 2015).

In January 2015, Galileo Resources plc of the United Kingdom signed an agreement to sell its share in the Glenover Phosphate Rare-Earth project to Fer-Min-Ore (Pty) Ltd. Galileo's previous plans were to consume 400,000 t/yr of ore in the production of 310,000 t/yr of granular nitrophosphate fertilizer and 190,000 t/yr of calcium nitrate fertilizer at Glenover, depending on the results of prefeasibility and feasibility studies. The company agreed to sell its share in Glenover because of low prices for rare earths on world markets. At yearend, the sale had not been completed (Galileo Resources plc, 2014; 2015, p. 3, 10; 2016).

Rare-Earth Elements and Thorium.—In May 2014, Great Western Minerals Group Ltd. (GWMG) of Canada completed a feasibility study on reopening the Steenkampskraal Mine in Western Cape Province. GWMG planned to produce about 1,650 t/yr of rare-earth oxides that it deemed to be the most marketable; the company also planned to produce and stockpile cerium and lanthanum until market conditions became more favorable. In October 2015, GWMG sold its 74% share in Steenkampskraal to the Thorium Foundation of Norway after initiating bankruptcy provisions.

The Thorium Foundation was considering the possibility of mining thorium at Steenkampskraal; resources at the mine were estimated to be 11,700 t of contained thorium (Sidler, 2014; Steenkampskraal Thorium Ltd., 2016, p. 2, 5).

Frontier Rare Earths Ltd. of Luxembourg and Korea Resources Group (Kores) completed a prefeasibility study on a new mine at the Zandkopsdrift rare-earths project with favorable results in June 2015. In the first four years of mining, production would be 8,000 t/yr of rare-earth oxides and 48,000 t/yr of manganese sulfate. Production would increase to 16,000 t/yr of rare-earth oxides and 86,000 t/yr of manganese sulfate in the second phase. The estimated life of the mine was 45 years. The costs of the first phase of mining and a rare-earths separation plant at Saldhanha Bay were estimated to be $809 million. In late 2015, the companies had difficulty obtaining financing because of low prices for rare earths on world markets (Cornish and Kotze, 2015; Engineering & Mining Journal, 2015b).

In 2014, Galileo Resources was considering the production of about 5,500 t/yr of rare-earth oxides at its Glenover project in Limpopo Province. In January 2015, the company signed an agreement to sell its share in Glenover. At yearend, the sale had not been completed (Galileo Resources plc, 2014; 2015, p. 3, 10; 2016).

Vermiculite.—South Africa was the world's leading producer of vermiculite. In 2015, Palabora Mining's production at the Palabora Mine decreased to 138,290 t from 143,007 t in 2014. Output decreased in the first quarter of 2015 because of reduced demand on global markets for vermiculite. Palabora Mining had planned to increase production to 150,000 t/yr by the end of 2015 and subsequently to reach its full capacity of 200,000 t/yr. Between October 2014 and March 2015, export sales of vermiculite were at the rate of 140,000 t/yr, and domestic sales, 10,000 t/yr (Motsie, 2015; Muravha, 2015).

Mineral Fuels and Related Materials

Coal.—In 2015, coal production was about 252.2 Mt compared with a revised 261.9 Mt in 2014 and 245 Mt in 2005. From 2005 to 2015, employment in coal mining increased to 77,773 workers from 56,971. Coal was shipped by rail to the Richards Bay Coal Terminal for export; South Africa's exports were 75.4 Mt in 2015 compared with 75.8 Mt in 2014 and 71.4 Mt in 2005 (table 1; Chamber of Mines of South Africa, 2015, p. 14, 20; Martin Kohler, Deputy Director of Statistics, Department of Minerals and Energy of the Republic of South Africa, written commun., November 4, 2016, and December 9, 2016).

Anglo American's coal production was 50.3 Mt in 2015 compared with 55.8 Mt in 2014. The New Vaal Mine produced 14.1 Mt in 2015; the Kriel Mine, 6.16 Mt; the Zibulo Mine, 5.57 Mt; the Isibonelo Mine, 4.53 Mt; the Goedehoop Mine, 4.29 Mt; the Landau Mine, 4.27 Mt; the Greenside Mine, 3.88 Mt; the Kleinkopje Mine, 3.15 Mt; the New Denmark Mine, 2.83 Mt; and the Mafube Mine, 1.44 Mt. Output decreased at New Denmark by 25%; Kleinkopje, by 19%; New Vaal, by 15%; Isibonelo, by 14%; and at Goedehoop, by 10% (Anglo American plc, 2016, p. 10).

In 2015, Exxaro's coal production was about 41.8 Mt compared with 39.1 Mt in 2014. Output at the Grootegeluk Mine was 23.5 Mt in 2015; the Matla Mine, 7.86 Mt; the Leeuwpan Mine, 3.78 Mt; the North Block Complex, 2.87 Mt; the Arnot Mine, 1.4 Mt; and the Inyanda Mine, 1.04 Mt. At Grootegeluk, production increased by 25% because of the expansion of the mine's capacity by 14.6 Mt/yr. Production decreased at Matla by 24% in 2015. The Arnot and the Inyanda Mines were shut down in 2015, and the North Block Complex was scheduled to be shut down in 2017 (Exxaro Resources Ltd., 2016, p. 6, 48; Tex Report, The, 2016).

Total Coal South Africa (Pty) Ltd. (TCSA) (Total S.A. of France, 100%) operated the Dorstfontein and the Forzando Mines. Exxaro purchased TCSA's assets from Total in 2015; the mines were producing at the rate of about 4.1 Mt/yr (Exxaro Resources Ltd., 2016, p. 43, Tex Report, The, 2016).

Exxaro started mining at the Grootegeluk Medupi expansion project in 2014, which would supply coal to the new Medupi power station operated by Government-owned utility Eskom. The company planned to ramp up production to full capacity by 2019. Exxaro received the mining right for the Belfast project, which was located in Mpumalanga Province, in the first quarter of 2015. Mining was likely to start at Belfast by the third quarter of 2018; planned production was 2.7 Mt/yr. Exxaro also planned to start the first phase of mining at the Thabametsi project by 2020; production was expected to be 4 Mt/yr (Exxaro Resources Ltd., 2016, p. 7, 65).

In fiscal year 2015 (which ended on June 30, 2015), Sasol Ltd.'s salable coal production decreased to 39.2 Mt from 39.7 Mt in fiscal year 2014. Total production was 41.2 Mt, of which the Syferfontein Mine accounted for 10.6 Mt; the Twistdraai Mine, 7.5 Mt; the Bosjesspruit Mine, 7.3 Mt; the Brandspruit Mine, 7 Mt; the Middelbult Mine, 6.9 Mt; and the Sigma Mine, 1.9 Mt. Sasol planned to complete the new Impumelelo Mine to replace the Brandspruit Mine in late 2015 (Sasol Ltd., 2015, p. 39, 41).

BHP Billiton Energy Coal South Africa Ltd. (BESCA) produced coal at the Khutala, the Klipspruit, the Middelburg, and the Wolverkrans Mines in Mpumalanga Province. In 2015, BESCA's output increased to 34.1 Mt from 31.9 Mt in 2014. BHP Billiton spun off its South African coal assets into South32 in 2015 (BHP Billiton Ltd., 2015, p. 15; South32 Ltd., 2016).

Glencore and ARM operated the Goedgevonden Complex, the Impunzi Complex, the South Stock operations, and the Tweefontein Complex. Output at Goedgevonden decreased to 7.27 Mt in 2015 from 7.92 Mt in 2014 and increased to a total of 14 Mt from 12.5 Mt at Impunzi, South Stock, and Tweefontein. In 2015, Glencore and ARM completed an expansion of Tweefontein's capacity. The companies planned to increase total production at Impunzi, South Stock, and Tweefontein to more than 16 Mt/yr by mid-2018 (African Rainbow Minerals, 2015a, p. 101–102, 104–105; 2015b, p. 61–62; 2016, p. 20–22).

In 2015, Glencore and ARM were engaged in a feasibility study on the Goedgevonden Expansion project. Depending on the results of the study, production could increase by 8 Mt/yr at Goedgevonden. Mining could start by 2020. Glencore also planned to start mining at Zonnebloem in 2015; production at full capacity was expected to be 10 Mt/yr of run-of-mine coal. The company also was considering the development of the Paardekop project, which could produce 8 Mt/yr starting in 2021. At yearend, Paardekop and Zonnebloem were awaiting

environmental permits (Inside Mining, 2014; African Rainbow Minerals, 2015a, p. 100; Glencore plc, 2016b, p. 57).

Optimum Coal Holdings (Pty) Ltd. (Glencore, 67.6%) operated the Optimum Complex and the Koornfontein Complex, which were producing 9.8 Mt/yr and 1.8 Mt/yr in the first half of 2014, respectively. Glencore placed Optimum Coal's mining operations into bankruptcy proceedings in August 2015; the operations were sold in December. Production was likely to shut down in 2016. Before 2015, Glencore was considering the development of the Koornfontein OC and the Schoonoord projects, which had proposed production rates of 3.3 Mt/yr of run-of-mine coal and 1.6 Mt/yr of run-of-mine, respectively (Glencore plc, 2014, p. 19; 2016a, p. 39; Inside Mining, 2014).

Umcebo Mining Ltd. (Glencore, 48.7%) operated the Kleinfontein, the Middelkraal, and the Wonderfontein Mines, which were producing at the rate of 7.2 Mt/yr in the first half of 2014. Kleinfontein and Middelkraal produced a total of less than 2 Mt in 2015 before reserves were depleted. Umcebo produced at about 75% of Wonderfontein's capacity of 2 Mt/yr of salable coal in 2015. The company's joint-venture Wildfontein Mine produced salable coal at the rate of 1.5 Mt/yr (Glencore plc, 2014, p. 19; 2016b, p. 55, 57–58; 2016c, p. 111; Inside Mining, 2014).

Shanduka Coal (Pty) Ltd. (Shanduka Group, 50.01%, and Glencore, 49.99%) was producing salable coal at the rate of 5.6 Mt/yr in the first half of 2014. The company operated the Graspan and the Springlake Mines. In 2015, salable coal production at Graspan and Springlake was less than 5 Mt. Shanduka Coal was considering the development of the Argent and the Springboklaagte projects, which could produce 2.4 Mt/yr of run-of-mine coal each. At yearend, the projects were awaiting mining licenses and environmental permits (Glencore plc, 2014, p. 19; 2016b, p. 57; Inside Mining, 2014).

Vunene Mining (Pty) Ltd. (Ichor Coal N.V. of the Netherlands, 74%) operated the Usutu Mine, which produced 1.85 Mt of coal in 2014 compared with 900,000 t in 2013. Ichor planned to maintain production at 1.8 Mt/yr. Mbuyelo Coal (Pty) Ltd. (Mbuyelo Group, 49%, and Ichor, 45%) started production at the Mbuyelo and the Welgemeend Mines in 2015. Initial planned production at Mbuyelo and Welgemeend was 1.6 Mt/yr and 1.2 Mt/yr, respectively. The company could increase production at Manungu and Welgemeend to 3 Mt/yr and 2.2 Mt/yr, respectively, of salable coal by 2017 or 2018. Mbuyelo also planned to start mining at Welstand in early 2017; output was expected to be nearly 3 Mt/yr of salable coal. Mbuyelo Group also operated the Rirhandzu Mine, which produced 1.2 Mt/yr of coal for sale to Eskom (Ichor Coal N.V., 2015, p. 1, 7, 9, 13, Solomons, 2016).

Kangra Group (Pty) Ltd. (Shanduka Resources (Pty) Ltd., 30%) produced about 5 Mt/yr of run-of-mine coal from the Savmore Mine, of which about 3 Mt/yr was salable coal. The Savmore Mine had an estimated remaining life of between 3 and 5 years. The company was considering the development of the Kusipongo project to extend Savmore's life by between 10 and 20 years. Kusipongo could produce between 3.6 and 3.8 Mt/yr of run-of-mine coal (Environmental Resources Management Southern Africa (Pty) Ltd., 2015, p. 1.1, 3.6).

In its fiscal year ending in March 2015, Keaton Energy Holdings Ltd. produced about 2.3 Mt of salable thermal coal at its Vanggatfontein Mine compared with 2.2 Mt in fiscal year 2014. Keaton was producing at the rate of 2.5 Mt/yr between April and June 2015. The company also produced modest amounts of anthracite coal at its Vaalkranz Mine. Keaton was considering the development of the Moabsvelden project, which could produce 1.7 Mt/yr of salable thermal coal for use by Eskom. The estimated life of the Moabsvelden project was 16 years. The Braakfontein project, which could produce 1.6 Mt/yr of run-of-mine thermal coal, was on hold because of low coal prices (Kotze, 2015b).

Wescoal Holdings Ltd. operated the Intibane and the Khanyisa Mines, which produced about 1 Mt/yr of coal each. As of early 2015, Intibane's remaining life was between 24 and 36 months, and Khanyisa's between 12 and 24 months. Wescoal started mining at the new Elandspruit Mine in April; the company planned to ramp up production to the full capacity of 2 Mt/yr by early 2016 (Cornish, 2014c; Wescoal Holdings Ltd., 2015, p. 3–4, 8, 23).

In late 2014, Universal Coal plc of the United Kingdom was producing at its planned capacity of 1.8 Mt/yr of salable coal at its new Kangala Mine, of which 1.7 Mt/yr was supplied to Eskom and 100,000 t/yr was exported. The company was producing above its planned capacity in late 2015. Universal received approval for its purchase of the New Clydesdale Colliery (NCC) from Exxaro in July 2015; production could restart at NCC's processing plant within 4 months of signing a coal supply agreement with Eskom. The company planned to supply NCC's plant with 1.74 Mt/yr of thermal coal from the new Roodekop Mine initially and to produce an additional 400,000 t/yr for export subsequently (Cornish, 2014b, 2015b).

Coal of Africa Ltd. was engaged in the construction of a new coal-washing plant at the Vele Mine. The company planned to restart mining at Vele after the new plant was reopened in mid-2015 and to produce 1.1 Mt/yr of salable coal. At yearend, it was unclear when production would restart. Coal of Africa also planned to start construction of the Makhado project at the Southpansberg coalfield in Limpopo Province in 2016; production was expected to start in 2018 or 2019. The company planned to produce 3.2 Mt/yr of thermal coal and 2.3 Mt/yr of coking coal during the estimated 16-year life of the mine (Tex Report, The, 2014; Creamer, 2015a).

Firestone Energy Ltd. of Australia and Sekoko Coal (Pty) Ltd. planned to start production at a new mine in the Waterberg coalfield by the end of 2015. The companies planned to produce 10 Mt/yr for consumption by Eskom during the first 30 years of the project. The life of the mine was estimated to be about 100 years. Mining had not started at yearend; Firestone and Sekoko were engaged in a project optimization study (Projects in Progress, 2014d).

Resource Generation Ltd. (Resgen) of Australia was engaged in the construction of its new Boikarabelo Mine in 2014. The company planned to start mining in the first half of 2016. In the first stage of the project, production was likely to be 6 Mt/yr of thermal coal, of which about 3 Mt/yr would be consumed domestically and 3 Mt/yr would be exported. Resgen planned to start the second phase of the project by 2020; production

was expected to increase to 20 Mt/yr of thermal coal. Estimated reserves at Boikarabelo were 745 Mt. The company was seeking financing for the project at the end of 2015; it was unclear when production would start (Projects in Progress, 2014c; Resource Generation Ltd., 2016).

Natural Gas and Petroleum.—PetroSA produced natural gas; the company planned to start production at the offshore F-O field in June 2015. Reserves at the F-O field were estimated to be sufficient to supply PetroSA's gas-to-liquids refinery until 2020. The refinery had a capacity of 45,000 barrels per day (bbl/d) oil equivalent. PetroSA had revised its estimates of reserves by mid-2015; the refinery was expected to shut down by 2017 as reserves were depleted (PetroSA, 2015, p. 56; Ramane, 2015).

South Africa had four petroleum refineries with a combined capacity of about 508,000 bbl/d. PetroSA was considering the development of a new refinery at Coega with a capacity of 300,000 bbl/d. The company was planning to conduct a feasibility study on the refinery as of early 2015; production could start by 2021, depending on the results of the study (Ramane, 2015).

Uranium.—AngloGold Ashanti mined uranium as a coproduct of gold. The company's production of uranium oxide (U_3O_8) from its Kopanang and surface mining operations was about 590 t in 2014; output decreased by about 31% in 2015. The uranium circuit at the MWS processing plant was shut down temporarily in the second half of 2015 because of unexpectedly low efficiency. Uranium was exported to France and the United States (AngloGold Ashanti Ltd., 2016, p. 67).

In 2015 Sibanye produced 55 t of U_3O_8 from the Cooke Operations compared with about 76 t in 2014. Sibanye planned to increase production at the Cooke Operations to more than 110 t in 2016. The company also completed a feasibility study of the WRTRP in December 2015 with favorable results. In the first phase of the project, Sibanye's production from retreating tailings could be about 1,000 t/yr of U_3O_8. Production could start in 2018 (Sibanye Gold Ltd., 2016b, p. 27, 50–51).

Shiva Uranium (a subsidiary of Oakbay Resources & Energy) produced between 420 and 480 kg/yr of gold and small amounts of uranium at its mine in North West Province in 2015. The company planned to complete a feasibility study on restarting large-scale underground mining by early 2016. Depending on the results of the study, Shiva could produce between 1,100 and 1,300 t/yr of U_3O_8 starting in May 2017. Resources were 89,000 t of contained U_3O_8 and 162 t of gold (Kotze, 2015d).

In 2013, Peninsula Energy Ltd. of Australia completed a scoping study of a new mine at its Karoo project. Planned production in the study was nearly 1,400 t/yr of U_3O_8. In 2014, Peninsula started a prefeasibility study of the mine, which was planned to be completed in 2015. The company also planned to complete a feasibility study in mid- or late 2016. Depending on the results of the studies, Peninsula could start mining at Karoo in 2017 or 2018. Contained resources at Karoo were estimated to be 25,800 t of U_3O_8. At the end of 2015, the prefeasibility study had not been completed (Andrews, 2015b).

Reserves and Resources

South Africa's estimated share of world reserves of PGMs amounted to 95%; chromite ore, 42%; manganese, 32%; vanadium, 23%; zirconium, 18%; fluorspar, 16%; rutile, 15%; gold, 11%; and ilmenite, 9%. The country also had substantial reserves of andalusite, antimony, coal, copper, iron ore, lead, nickel, phosphate rock, uranium, vermiculite, and zinc (table 3; Bedinger, 2016a, b; Corathers, 2016; George, 2016; Loferski, 2016; McRae, 2016; Papp, 2016; Polyak, 2016).

Outlook

Numerous producers are planning new mines and plants and capacity expansions of existing operations for cement, chromite, coal, copper, diamond, ferrochromium, ferromanganese, ferrovanadium, fluorspar, gold, ilmenite, iron ore, manganese ore, nickel, pig iron, PGMs, phosphate fertilizers, phosphate rock, rutile, tin, titanium metal, uranium, vanadium, zinc, and zircon. Power shortages could constrain mining and mineral processing expansions until Eskom's new coal-fired Kusile and Medupi power stations are completed, particularly in power-intensive industries, such as ferrochromium. Load-shedding was forecasted to continue through at least late 2019. Between 2008 and 2014, power costs increased by an average of 19.4% per year (Markram, 2014a; Chamber of Mines of South Africa, 2016b, p. 26).

Increases in coal, iron ore, and manganese exports depend upon increased rail network capacity. Transnet planned to increase its railway capacity dedicated to coal exports in increments to 97.5 Mt/yr in 2021 or 2022 from 81 Mt/yr. During the same period, Transnet planned to increase the capacity of the iron ore railways to 71 Mt/yr from about 60 Mt/yr, and railways for transporting manganese ore, to 16 Mt/yr from 5.5 Mt/yr (Jones, 2016, p. 5–6, 21).

Increased coal production also depended on the construction of new mines in the Waterberg coal field. Development of new mines could be constrained by the lack of infrastructure and water, the complex geology of the Waterberg coal deposits, and the relatively low quality of the coal. Less than 50% of run-of-mine coal was estimated to be salable, which could result in higher processing costs and render unprofitable plans by smaller mining companies to build from low levels of production (McCloskey Coal Report, 2014).

The long-term future of the domestic gold mining subsector depended upon new mining technologies. Contained gold resources in the Witwatersrand basin were estimated to be 40,000 t, of which 34,000 t were likely to be subeconomic because of factors including depth and low ore grades (Creamer, 2014b).

In the PGMs mining subsector, production is expected to continue to shift away from platinum and towards other PGMs. Many PGM mining companies are producing less ore from the platinum-rich Merensky layer and more from the UG2 layer, which is rich in other PGMs (CPM Group, 2016, p. 183).

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TABLE 1
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		2011	2012	2013	2014	2015
METALS						
Aluminum metal, primary		809,000	665,000	822,000	745,000	695,000
Antimony concentrate, Sb content		3,175	3,066	2,405	815	400
Chromium, gross weight:						
44% to 48% chromic oxide	thousand metric tons	1,070	1,073	1,608	2,043	2,128
Less than 44% chromic oxide	do.	10,795	10,244	12,082	11,995	13,528
Total	do.	11,865	11,317	13,690	14,038	15,656
Cobalt:						
Mine output, Co content[e]		1,600	2,500	2,800	2,800	2,900
Refinery output		862	1,102	1,294	1,332	1,300 [e]
Copper:						
Mine output, Cu content		96,600	81,000	76,500	87,600	77,400
Metal:						
Smelter		82,400	62,300	69,700	71,700	71,800
Refined, primary		86,166	66,416	80,821	78,697	77,360
Gold:						
Mine output	kilograms	180,293	155,286	160,016	151,622	144,504
Refined[e, 2]	do.	476,229 [3]	440,000	400,000	400,000	400,000
Iron and steel:						
Iron ore, ore and concentrate:						
Gross weight	thousand metric tons	58,057	67,100	71,645	80,759	72,806
Fe content[e]	do.	36,500	42,000	45,000	51,000	47,000
Metal:						
Direct-reduced iron	do.	1,414	1,493	1,295 [r]	1,560 [r]	1,100 [e]
Pig iron	do.	4,604	4,599	4,928 [r]	4,690 [r]	4,464
Ferroalloys, electric arc furnace:						
Chromium ferroalloys	do.	3,426	3,063	3,219	3,719	3,685
Ferromanganese	do.	714	706	702	772	595
Ferrosilicon	do.	126	83	78	89 [r, e]	91 [e]
Ferrovanadium[e]	do.	19	18	18	19	15
Silicomanganese[4]	do.	314	149	134	228	210
Silicon metal	do.	59	53	34	56 [e]	57 [e]
Total[e]	do.	4,660	4,070	4,190	4,880	4,650
Steel:						
Crude	do.	7,546	6,938	7,162 [r]	6,550 [r]	6,400 [e]
Stainless		444	505	493	473	515
Lead:						
Concentrate, Pb content		54,460	52,489	41,848	29,348	34,573
Refined, secondary		56,000	54,000	52,000	52,000	52,000 [e]
Manganese:						
Ore and concentrate, gross weight:						
Metallurgical:						
More than 48% manganese	thousand metric tons	128	200	--	--	--
45% to 48% manganese	do.	2,742	2,711	3,057	2,572	1,194
40% to 45% manganese	do.	1,181	1,187	1,319	1,703	2,499
30% to 40% manganese	do.	4,584	4,833	6,581	9,776	12,259
Total	do.	8,636	8,931	10,957	14,051	15,952
Chemical, 35% to 65% manganese dioxide	do.	16	12	1	--	--
Grand total	do.	8,652	8,943	10,958	14,051	15,952
Metal, electrolytic[e]	do.	29 [3]	30 [3]	30	30	30
Nickel:						
Mine output, concentrate, Ni content		43,321	45,945	51,208	54,956	56,689
Metal, electrolytic		35,900	32,900	33,200	34,100	42,000

See footnotes at end of table.

TABLE 1—Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		2011	2012	2013	2014	2015
METALS—Continued						
Platinum-group metals:						
Mine output:						
Iridium	kilograms	6,813	5,665	5,680	4,231	6,230
Platinum	do.	148,008	128,590	137,024	93,991	139,125
Palladium	do.	82,731	74,738	76,008	58,410	82,691
Rhodium	do.	20,332	17,810	18,129	12,916	18,722
Ruthenium	do.	30,966	27,535	27,347	18,896	28,747
Total	do.	288,850	254,338	264,188	188,444	275,515
Refined:						
Platinum	do.	155,900	141,700	144,700	102,400	142,700
Palladium	do.	89,640	84,800	82,300	64,100	85,900
Rhodium	do.	21,300	19,300	18,600	13,900	18,200
Other[5]	do.	36,400	32,400	32,100	22,800	30,900
Total	do.	303,200	278,200	277,700	203,200	277,700
Selenium, Se content of anode slimes[e]	do.	18,000	14,000	15,000	14,000 [r]	14,000
Silver, mine output	do.	73,180	67,304	68,777	49,220 [r]	51,861
Tellurium, Te content of anode slimes[e]	do.	8,500	6,400	7,200	6,700 [r]	6,800
Titanium:						
Ilmenite concentrate[e]	thousand metric tons	2,750	2,650	2,530	2,280 [r]	2,300
Rutile concentrate[e]	do.	149 [3]	150	70	130 [r]	110 [e]
Total	do.	2,896	2,801	2,604	2,406	2,400
Titaniferous slag[e]	do.	1,367 [3]	1,300	1,170 [r]	1,090 [r]	950
Uranium, mine output, U_3O_8 content		656	551	626	668	528
Vanadium, vanadium metal content		21,652	19,957	21,397	21,582	17,788
Zinc:						
Concentrate, Zn content		36,629	37,034	30,145	26,141	29,040
Metal, smelter, primary		73,000	--	--	--	--
Zirconium mineral concentrate (baddeleyite and zircon)		432,282	367,190	224,446	390,000 [r, e]	330,000 [e]
INDUSTRIAL MINERALS						
Andalusite		186,242	163,801	175,328	172,657	190,000 [e]
Cementitious products:						
Cement, finished product, sales	thousand metric tons	11,234	11,560	12,168 [r]	12,068 [r]	13,000
Granulated slag, fly ash, and others, sales[e]	do.	1,200	1,200	1,300	1,300	1,300
Total[e]	do.	12,400	12,800	13,500	13,400	13,400
Clay:						
Attapulgite		14,448	15,019	21,233	17,668 [r]	17,627
Bentonite		120,417	120,592	177,187	171,119 [r]	165,535
Brick clay, local sales	thousand metric tons	7,658	7,227	6,897	6,687 [r]	7,056
Fire clay		785,641	643,285	506,019	239,906	751,711
Flint clay, raw and calcined		29,968	21,065	22,984	26,891	19,785
Kaolin		15,220	20,791	22,295	27,258	20,150
Plastic clay		NA	NA	1,328	268	4,554
Diamond, natural:						
Gem[e]	thousand carats	2,800	2,900	3,300	3,300	3,400
Industrial[e]	do.	4,300	4,400	4,800	4,800	4,800
Total	do.	7,112	7,250	8,129	8,059 [r]	8,233
Feldspar		101,559	94,458	191,443	102,541	130,184
Fluorspar:						
Acid-grade[e]		180,000	160,000	150,000	150,000	110,000
Metallurgical-grade[e]		15,000	10,000	8,000	14,000	10,000
Total		195,502	170,338	157,776	164,054	120,000
Gypsum, crude		476,118	558,242	559,443	376,223	231,688
Industrial or glass sand (silica)	thousand metric tons	2,722	2,155	2,296	2,605 [r]	2,271
Lime	do.	1,539	1,209	1,187	1,255	1,115
Magnesite, crude		31,900	12,878	8,219	12,335	12,000 [e]

See footnotes at end of table.

TABLE 1—Continued
SOUTH AFRICA: PRODUCTION OF MINERAL COMMODITIES[1]

(Metric tons unless otherwise specified)

Commodity		2011	2012	2013	2014	2015
INDUSTRIAL MINERALS—Continued						
Mica, scrap and ground		633	400	309	83	29 e
Nitrogen, N content of ammonia[e]		620,000	620,000	620,000	620,000	620,000
Perlite		NA	NA	1,078	1,100 e	1,100
Phosphate rock:						
Gross weight	thousand metric tons	2,565	2,242	2,132	2,011	1,852
Phosphorus pentoxide content	do.	962	829	788	743	685
Pigments, mineral, natural oxides[e]		266 [3]	-- [3]	--	--	--
Salt		381,177	399,135	479,024	493,798 r	517,159
Sodium sulfate, natural		38,290	36,435	41,428	51,751	38,374
Stone, n.e.s.:[6]						
Dimension:						e
Granite and norite		227,154	187,475	236,231	139,577 r	160,818
Slate		53,643	23,938	19,266	19,051	--
Crushed and broken:						
Limestone and dolomite	thousand metric tons	16,980	17,269	21,966	21,776	22,905
Shale:						
For cement	do.	404	423	464	404	354
Other	do.	655	547	830	785 r	872
Total	do.	1,059	970	1,294	1,189 r	1,226
Aggregate and sand, n.e.s.[6]	do.	52,286	54,649	61,414	62,192 r	63,801 e
Sulfur, byproduct:						e
Metallurgy	do.	174	103	111 r	110 e	110
Petroleum	do.	163	154	159 r	160 e	170
Total	do.	336	257	270	277	284
Talc and related materials:						
Talc		4,453	4,765	4,924	4,827	4,497
Pyrophyllite (wonderstone)		121,368	18,734	17,336	22,500 r	16,801
Vermiculite		170,571	132,886	127,658	143,007	138,290
Wollastonite		2,400	2,400	2,400	2,400	2,400
MINERAL FUELS AND RELATED MATERIALS						
Coal (salable product):						
Anthracite	thousand metric tons	2,554	3,005	3,621	3,517	3,395
Bituminous	do.	248,153	256,007	252,942	258,432 r	248,781
Total	do.	250,707	259,012	256,563	261,949 r	252,176
Natural gas	million cubic meters	1,516	1,313	927	1,194	1,476
Petroleum:[7]						
Crude	thousand 42-gallon barrels	591	343	139	--	-- e
Refinery products:						e
Liquefied petroleum gases	do.	3,666	3,422	3,387	2,494 r	2,500 e
Natural gas liquids	do.	1,456	1,019	1,529	1,529 r	1,500 e
Gasoline	do.	53,236	53,295	58,976	49,227 r	49,000 e
Jet fuel	do.	12,410	9,445	13,077	12,434 r	12,000 e
Kerosene	do.	2,806	2,729	3,278	3,448 r	3,500 e
Distillate fuel oil	do.	56,450	57,494	58,442	52,220 r	52,000
Residual fuel oil	do.	14,399	19,021	22,344	20,806 r	21,000
Other, includes lubricants and greases[e]	do.	17,000	17,000	19,000	17,000 r	17,000
Total[e, 8]	do.	161,000 r	163,000	180,000	159,000 r	159,000

[e]Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. [r]Revised. do. Ditto. NA Not available. -- Zero.

[1]Table includes data available through December 9, 2016.

[2]Data are for the Rand Refinery (Pty) Ltd. fiscal year ending September 30 of the year listed.

[3]Reported figure.

[4]Reported by the International Manganese Institute.

[5]May include small amounts of gold.

[6]Not elsewhere specified.

[7]In addition, Sasol Ltd. produced about 67 million barrels per year of synthetic liquid petroleum fuels from coal.

[8]Excludes refinery fuel and losses.

TABLE 2
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	South32 Ltd.	Hillside smelter at Richards Bay	726.
Do.	do.	Bayside smelter at Richards Bay[1]	97.
Andalusite	Imerys South Africa (Pty) Ltd. (subsidiary of Imerys Group)	Annesley and Segorong Mines at Penge, and Thabazimbi Mine near Thabazimbi	250.[e]
Do.	Andalusite Resources (Pty) Ltd. [African Mineral Trading and Exploration (Pty) Ltd.]	Maroeloesfontein, near Thabazimbi, Northern Province	70.
Antimony metric tons	Stibium Mining (Pty) Ltd.	Cons Murch Mine near Gravelotte	7,000 antimony in concentrate.
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 South Africa Ltd. (Lafarge S.A.)	Lichtenburg plant in North West Province	3,400.
Do.	Sephaku Cement (Pty) Ltd. (Dangote Industries Ltd., 64%)	Plants near Delmas in Mpumalanga Province and at Lichtenburg	3,300.
Do.	Natal Portland Cement Co. (Pty) Ltd. (Cimentos de Portugal SGPS, S.A., 98%)	Simumu plant	1,800.
Chromite	Glencore plc, 79.5%, and Merafe Resources Ltd., 20.5%	Thorncliffe Mine at Steelpoort	995.
Do.	do.	Kroondal Mine at Rustenburg	850.
Do.	do.	Helena Mine at Steelpoort	825.
Do.	do.	Waterval Mine	650.
Do.	do.	Boshoek and Helena Mines	NA.
Do.	do.	Magareng Mine in Mpumalanga Province	1,200.
Do.	Samancor Chrome (Pty) Ltd. (International Mineral Resources BV, 70%)	Eastern Chrome Mines in Steelpoort Valley, Mpumalanga Province	2,000.
Do.	do.	Western Chrome Mines in North West Province	1,500.
Do.	Tharisa Minerals (Pty) Ltd.	Tharisa Mine	1,920.
Do.	Hernic Ferrochrome (Pty) Ltd. (Mitsubishi Corp., 51%)	Bokone Mines	1,500.
Do.	Assmang (Pty) Ltd. (African Rainbow Minerals Ltd., 50%, and Assore Ltd., 50%)	Dwarsrivier Mine in Mpumalanga Province	1,400.
Do.	International Ferro Metals Ltd.	Sky Chrome Mine[1]	840 run-of-mine.
Do.	do.	Lesedi Underground and Rooderand Mines[1]	NA.
Do.	Lonmin plc	Marikana Mines (Eastern Platinum, Karee, and Western Platinum) and Pandora Mine	1,500.[e]
Do.	Nkomati Joint Venture (African Rainbow Minerals Ltd., 50%, and MMC Norilsk Nickel, 50%)	Nkomati Chrome Mine in Mpumalanga Province	1,000.
Do.	Dilokong Chrome Mine (Pty) Ltd. [ASA Metals (Pty) Ltd., 100%]	Dilokong Mine, near Burgersfort in Mpumalanga Province	800.
Do.	Eastern Platinum Ltd. (Eastplats)	Crocodile River Mine at Arbourfell[1]	520.[e]
Do.	Afarak Group Oyj	Mecklenburg, Stellite, and Vlakpoort Mines	500.[e]
Do.	Bayer (Pty) Ltd.	Rustenburg chrome mine	450.
Do.	Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 74.1%)	Waterval plant near Rustenburg	350.
Do.	Anglo American Platinum Ltd. (Amplats) and Siyanda Resources	Masa plant at Union Mine	330.
Coal	Anglo Coal Ltd. (Anglo American plc, 100%)	New Vaal Mine	18,000.
Do.	Anglo Coal Ltd., 73%	Kriel Mine	10,000.
Do.	do.	Zibulo Mine	8,000.
Do.	Anglo Coal Ltd.	Goedehoop Mine	7,500.
Do.	do.	Isibonelo Mine	5,000.
Do.	do.	New Denmark Mine	5,000.
Do.	do.	Kleinkopje Mine	4,500.
Do.	do.	Landau Mine	4,200.
Do.	do.	Greenside Mine	3,100.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Coal—Continued	Exxaro Resources Ltd. (BEE Holdco, 52.3%)	Grootegeluk Mine in Limpopo Province	33,400.
Do.	do.	Matla Mine in Mpumalanga Province	14,000.
Do.	do.	Arnot Mine in Mpumalanga Province[1]	5,000.
Do.	do.	Dorstfontein, Forzando, and Tumelo Mines	4,500.[e]
Do.	do.	Leeuwpan Mine in Mpumalanga Province	4,200.[e]
Do.	do.	North Block Mine in Mpumalanga Province	3,300.
Do.	do.	New Clydesdale Mine in Mpumalanga Province[1]	1,400.
Do.	do.	Inyanda Mine[1]	1,100.[e]
Do.	Exxaro Resources Ltd., 50%, and Anglo American plc, 50%	Mafube Mine	4,200.
Do.	Sasol Ltd.	Syferfontein Mine	9,500.
Do.	do.	Bosjesspruit Mine	7,900.
Do.	do.	Middelbult Mine	7,400.
Do.	do.	Brandspruit Mine	6,900.
Do.	do.	Twistdraai Mine	6,900.
Do.	do.	Sigma Mine	1,900.
Do.	South32 Ltd.	Middelburg and Wolverkrans Mines	17,000.
Do.	do.	Khutala underground mine	12,000.
Do.	do.	Klipspruit Mine	7,000.
Do.	Glencore plc, 74%	Goedgevonden Complex at Witbank	7,700.
Do.	Glencore plc, 79.8%	Tweefontein Complex at Witbank	7,200.
Do.	do.	Impunzi Complex at Witbank	6,700.
Do.	Tegeta Exploration and Resources (Pty) Ltd.	Optimum Complex	11,000.
Do.	do.	Koornfontein Complex	2,800.
Do.	Umcebo Mining Ltd. (Glencore plc, 48.7%)	Kleinfontein,[2] Middelkraal,[2] and Wonderfontein Mines	4,000.[e]
Do.	do.	Wildfontein Mine	1,500.
Do.	Shanduka Coal (Pty) Ltd. (Shanduka Resources (Pty) Ltd., 50.01%, and Glencore plc, 49.99%)	Graspan and Springlake Mines	4,500.[e]
Do.	Wescoal Holdings Ltd.	Elandspruit Mine	2,000.
Do.	do.	Khanyisa Mine	1,000.
Do.	do.	Intibane Mine	1,000.
Do.	Kangra Group Pty. Ltd. (Shanduka Resources (Pty) Ltd., 30%)	Savmore Mine	3,000.
Do.	Keaton Energy Holdings Ltd.	Vanggatfontein Mine	2,640.
Do.	do.	Vaalkranz Mine	360.
Do.	Imbawula Group	Mpumalanga Division (Spitzkop and Tselentis Mines) at Breyten and Ermelo	2,800.
Do.	Mbuyelo Coal (Pty) Ltd.	Mbuyelo and Welgemeend Mines	2,800.[e]
Do.	Universal Coal	Kangala Mine	2,100.[e]
Do.	Kuyasa Mining (Pty) Ltd.	Delmas Mine	2,000.
Do.	Vunene Mining (Pty) Ltd.	Usutu Mine	1,900.[e]
Do.	Coal of Africa Ltd.	Vele Mine[1]	1,000.
Cobalt, mine	Nkomati Joint Venture	Nkomati Mine in Mpumalanga Province	1,200.[e]
Copper:			
Mine	Palabora Mining Co. Ltd.	Palabora Mine at Phalaborwa	65.[2]
Do.	Anglo American Platinum Ltd. (Amplats) (Anglo American plc, 78%)	Amandelbult, Mogalakwena, Rustenburg, and Union Mines, and other mines	13.[2]
Do.	Nkomati Joint Venture	Nkomati Mine in Mpumalanga Province	10.
Do.	Impala Platinum Ltd. (Implats)	Impala Mines	7.[2]
Do.	Black Mountain Mineral Development Co. (Pty) Ltd. (Vedanta Resources plc, 74%)	Black Mountain Mine near Aggeneys in Northern Cape Province	6.[2]
Smelter	Palabora Mining Co. Ltd.	Smelter at Phalaborwa	110.[2]
Do.	Anglo American Platinum Ltd. (Amplats)	Rustenburg Smelter	11.[2]
Do.	Impala Platinum Ltd. (Implats)	Smelter near Phokeng	7.[2]

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper, refined		Palabora Mining Co. Ltd.	Refinery at Phalaborwa	140.[2]
Do.		Anglo American Platinum Ltd. (Amplats)	Rustenburg Base Metal Refiners	13.[2]
Do.		Lonmin plc	Base Metals Refinery and scrap plant	9.[2]
Do.		Impala Platinum Ltd. (Implats)	Base Metals Refinery	7.[2]
Diamond	thousand carats	De Beers Consolidated Mines Ltd. (Anglo American plc, 85%)	Venetia Mine in Northern Province	7,500.
Do.	do.	do.	Kimberley surface mines, Kimberley	1,500.
Do.	do.	do.	Voorspoed Mine	800.
Do.	do.	Petra Diamonds Ltd.	Finsch Mine, 100 kilometers west of Kimberley	2,000.
Do.	do.	do.	Cullinan Mine	950.[e]
Do.	do.	do.	Kimberley underground mines, Kimberley	170.
Do.	do.	do.	Koffiefontein Mine in Free State Province	60.[e]
Do.	do.	DiamondCorp Ltd.	Lace Mine	500.
Do.	do.	Jagersfontein Developments (Pty) Ltd.	Jagersfontein Mine in Free State Province	250.[e]
Do.	do.	Trans Hex Group	Namaqualand Mine	130.[e]
Do.	do.	do.	Baken and other mines	60.[e]
Do.	do.	Batla Minerals SA	Superkolong Diamond operations	130.[e]
Fluorspar		Vergenoeg Mining Corp. (Pty) Ltd. [Minerales Y Productos Derivados SA , 85%]	Vergenoeg Mine at Rust de Winter	250.
Gold:				
Mine	kilograms	Sibanye Gold Ltd.	Driefontein Mine	17,000.[e]
Do.	do.	do.	Kloof Mine	14,000.[e]
Do.	do.	do.	Beatrix Mine	10,000.[e]
Do.	do.	do.	Cooke Operations	7,500.[e]
Do.	do.	do.	Burnstone Mine[1]	3,100.
Do.	do.	AngloGold Ashanti Ltd. (Anglo American plc, 41.8%)	Moab Khotsong Mine	13,000.
Do.	do.	do.	Mponeng Mine	10,000.
Do.	do.	do.	Great Noligwa and Kopanang Mine	9,000.
Do.	do.	do.	Tau Tona Mine	8,100.
Do.	do.	do.	Mine Waste Solutions (MWS) project	5,700.
Do.	do.	Harmony Gold Mining Co. Ltd.	Kusasalethu Mine	8,900.
Do.	do.	do.	Doornkop Mine	6,100.
Do.	do.	do.	Target 1 and Target 3[1] Mines	5,800.[e]
Do.	do.	do.	Tshepong Mine	4,500.
Do.	do.	do.	Masimong Mine	3,900.
Do.	do.	do.	Phakisa Mine	3,200.[e]
Do.	do.	do.	Bambanani Mine	3,000.
Do.	do.	do.	Surface operations	3,000.
Do.	do.	do.	Joel Mine	2,600.
Do.	do.	do.	Unisel Mine	1,900.
Do.	do.	Gold Fields Ltd.	South Deep Mine	9,200.
Do.	do.	Pan African Resources plc	Barberton Mine	3,000.
Do.	do.	do.	Evander Mine	3,000.
Do.	do.	do.	Barberton tailings retreatment project	800.
Do.	do.	Gold One International Ltd.	Modder East Mine	4,700.
Do.	do.	DRDGold Ltd.	Ergo operations near Johannesburg	4,500.[e]
Do.	do.	Village Main Reef Ltd.	Tau Lekoa Mine	3,200.[e]
Do.	do.	Anglo American Platinum Ltd. (Amplats)	Amandelbult, Mogalakwena, Rustenburg, and Union Mines, and other mines	3,000.[e]
Refined	metric tons	Rand Refinery Ltd. (AngloGold Ashanti Ltd., 53%, and Gold Fields Ltd., 33%)	Germiston, Gauteng Province	1,000.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(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	11,000.
Do.		do.	Thabazimbi Mine at Thabazimbi	2,700.
Do.		Assmang (Pty) Ltd.	Khumani Mine	16,000.
Do.		do.	Beeshoek Mine near Postmasburg	4,000.
Do.		Palabora Mining Co. Ltd.	Palabora Mines at Phalaborwa	9,000.
Do.		Evraz Highveld Steel and Vanadium Corp. Ltd. (Ervaz Group S.A., 79%)	Mapochs Mine at Roossenekal[1]	2,700.
Do.		Vametco Minerals Corp. (Ervaz Group S.A., 81%)	Vametco vanadium mine and plant near Brits[1]	1,100
Do.		Glencore plc	Rhovan Mine at Brits	400.
Ferroalloys		Glencore plc, 79.5%, and Merafe Resources Ltd., 20.5%	Lion plant at Steelpoort	720 ferrochromium.
Do.		do.	Wonderkop plant at Marikana	553 ferrochromium.
Do.		do.	Rustenburg plant at Rustenburg	430 ferrochromium.
Do.		Glencore plc, 69.6%, and Merafe Resources Ltd., 30.4%	Lydenburg plant at Lydenburg	396 ferrochromium.
Do.		Glencore plc, 79.5%, and Merafe Resources Ltd., 20.5%	Boshoek plant at Boshoek	240 ferrochromium.
Do.		Samancor Chrome (Pty) Ltd.	Plants at Middelburg, Steelpoort, and Witbank	1,200 ferrochromium.
Do.		Hernic Ferrochrome (Pty) Ltd.	Plant at Brits	420 ferrochromium.
Do.		ASA Metals (Pty) Ltd. (Sinosteel, 60%, and Limpopo Economic Development Enterprise, 40%)	Plant near Pietersburg, Northern Province	400 ferrochromium.
Do.		International Ferro Metals Ltd.	Buffelsfontein plant in North West Province[1]	267 ferrochromium.
Do.		Tata Steel (KZN) (Pty) Ltd.	Plant at Richards Bay[1]	150 ferrochromium.
Do.		Assmang (Pty) Ltd.	Cato Ridge plant in KwaZulu Natal Province	300 ferromanganese.
Do.		do.	Machadodorp plant in Mpumalanga Province[1]	290 ferromanganese
Do.		Samancor Manganese (Pty) Ltd. (BHP Billiton Ltd., 60%, and Anglo American plc, 40%)	Plant at Meyerton	500 ferromanganese.
Do.		Assmang (Pty) Ltd.	Cato Ridge plant in KwaZulu Natal Province	300 ferromanganese.
Do.		Transalloys (Pty) Ltd. (subsidiary of Renova Group)	Plant at Witbank	50 ferromanganese;[1] 170 silicomanganese.
Do.		Globe Speciality Metals Inc.	New Castle plant at Ballengeich	45 ferrosilicon.
Do.		Grupo Ferroatlantica	Rand Carbide plant	40 ferrosilicon.
Do.	metric tons	Vanchem Vanadium Products (Pty) Ltd. (subsidiary of Duferco Group)	Plant at Witbank[1]	12,500 ferrovanadium.
Do.	do.	Glencore plc	Rhovan plant at Brits	6,000 ferrovanadium.
Do.	do.	Vametco Minerals Corp.	Smelter near Brits[1]	4,800 ferrovanadium.
Do.		Afarak Group Oyj	Mogale plant	110 ferroalloys.
Steel		ArcelorMittal South Africa Ltd.	Vanderbijlpark plant	4,500 crude steel.
Do.		do.	Newcastle and Vereeniging plants	2,300 crude steel.
Do.		do.	Saldanha plant	1,200 crude steel.
Do.		Evraz Highveld Steel and Vanadium Ltd.	Witbank	815 crude steel.
Do.		Columbus Stainless (Pty) Ltd. (Acerinox SA, 76%)	Stainless steel plant at Middelburg	750 crude steel.
Do.		Scaw Metals Group	Germiston plant, Johannesburg	600 crude steel.
Do.		Davsteel Division (Cape Gate Pty. Ltd.)	Vanderbijlpark plant, Gauteng	485 crude steel; 460 rolled steel.
Do.		Cape Town Iron & Steel Works (Pty) Ltd. (Cisco)	Kuilsrivier plant, Cape Town	300 crude steel; 300 billet.
Do.		Duferco Steel Processing Ltd.	Cold-rolled slab steel plant at Saldanha Bay	240 rolled steel.
Lead, mine		Vedanta Resources plc	Black Mountain Mine near Aggeneys in Northern Cape Province	55.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Lime		PPC Lime Ltd. (subsidiary of Pretoria Portland Cement Company Ltd.)	Plant at Lime Acres	1,200.
Do.		Idwala Lime (Idwala Industrial Holdings)	Plant at Daniëlskuil	1,000.
Do.		Inca Lime (Pty) Ltd. [subsidiary of Inca Mining (Pty) Ltd.]	Plant at Immerpan, Limpopo Province	100.
Manganese		Hotazel Manganese Mines (Pty) Ltd. (BHP Billiton, 44.4%; Anglo American plc, 29.6%)	Mamatwan Mine near Hotazel	3,500 ore.
Do.		do.	Wessels Mine near Hotazel	1,000 ore.
Do.		United Manganese of Kalahari (Pty) Ltd. (UMK) [Majestic Silver Trading 40 (Pty) Ltd., 51%, and Renova Group, 49%]	Kalahari Mine	4,000 ore.
Do.		Assmang (Pty) Ltd.	Nchwaning Mine near Black Rock	3,200 ore.
Do.		do.	Gloria Mine near Black Rock	600 ore.
Do.		Tshipi e Ntle Manganese Mining (Pty) Ltd. [Ntsimbitntle Mining (Pty) Ltd., 50.1%, and Jupiter Mines Ltd., 49.9%]	Tshipi Borwa Mine	3,600 ore.
Do.		Asia Minerals Ltd. (AML)	Kudumane Mine	1,500 ore.
Do.		Manganese Metal Co. Pty. Ltd. [Samancor Manganese (Pty) Ltd., 51%]	Electrolytic plant at Nelspruit	30 manganese metal.
Nickel		Anglo American Platinum Ltd. (Amplats)	Amandelbult, Mogalakwena, Rustenburg, and Union Mines, and other mines	33 mine.[e]
Do.		do.	Rustenburg Base Metal Refiners	33 refined.
Do.		Nkomati Joint Venture	Nkomati Mine in Mpumalanga Province	21 mine.
Do.		Impala Platinum Ltd. (Implats)	Impala Mines	6 mine.[e]
Do.		do.	Base Metals Refinery	16 refined.[e]
Do.		Lonmin plc	Marikana and Pandora Mines	4 mine.[e]
Do.		do.	Base Metals Refinery	5 sulfate.[e]
Nitrogen, ammonia		Sasol Ltd.	Plants at Sasolburg and Secunda	660.
Petroleum:				
Crude	thousand 42-gallon barrels	Petroleum Oil and Gas Corporation of South Africa	Oribi and Oryx fields[1]	730.
Refined	do.	South African Petroleum Refineries (Shell SA Energy, 50%, and BP Southern Africa, 50%)	Sapref refinery in Durban	65,700.
Do.	do.	Engen Ltd., 62%	Enref refinery in Durban	43,800.
Do.	do.	National Petroleum Refiners of South Africa Pty. Ltd. (Sasol Ltd., 63.6%)	Natref refinery in Sasolburg	39,400.
Do.	do.	Caltex Oil SA (Pty) Ltd.	Chevref refinery in Cape Town	36,500.
Phosphate rock		Phosphate Development Corp. Ltd. [Foskor (Pty) Ltd.]	Foskor Mine and plant at Phalaborwa	2,800 phosphate rock.
Phosphoric acid		Farmers World Limpopo (Pty) Ltd.	Plant at Phalaborwa	325.
Platinum-group metals	kilograms	Anglo American Platinum Ltd. (Amplats)	Rustenburg Mine	24,000 platinum; 11,900 palladium; 3,100 rhodium; 5,500 iridium and ruthenium.
Do.	do.	do.	Amandelbult Mine	16,000 platinum; 7,300 palladium; 2,400 rhodium; 4,200 iridium and ruthenium.
Do.	do.	Anglo American Platinum Ltd. (Amplats), 85%	Union Mine at Swartklip	10,700 platinum; 4,600 palladium; 1,800 rhodium; 3,100 iridium and ruthenium.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Platinum-group metals—Continued	kilograms	Bafokeng Rasimone Platinum Mine [Royal Bafokeng Nation, 67%, and Anglo American Platinum Ltd. (Amplats), 33%]	Bafokeng Rasimone Platinum Mine at Rasimone	5,900 platinum; 2,400 palladium; 790 ruthenium; 460 rhodium; 150 iridium.
Do.	do.	Kroondal Platinum Mines [Anglo American Platinum Ltd. (Amplats), 50%, and Aquarius Platinum Ltd., 50%]	Kroondal Mine	7,800 platinum; 3,800 palladium; 2,300 ruthenium; 1,500 rhodium; 550 iridium.
Do.	do.	Modikwa Platinum Mine [Anglo American Platinum Ltd.. (Amplats), 50%, and African Rainbow Minerals (ARM), 50%]	Modikwa Mine at Makgemeng	4,200 platinum; 4,000 palladium; 1,200 ruthenium; 820 rhodium; 310 iridium.
Do.	do.	Anglo American Platinum Ltd. (Amplats)	Mogalakwena Mine at Ga-Masenya	10,600 platinum; 10,900 palladium; 700 rhodium; 760 iridium and ruthernium.
Do.	do.	Anglo American Platinum Ltd., 50%, and XK Platinum Partnership, 50%	Mototolo Mine at Steelpoort	4,100 platinum; 2,400 palladium; 630 rhodium; 1,300 iridium and ruthernium.
Do.	do.	Anglo American Platinum Ltd. (Amplats)	Polokwane smelter at Polokwane, Mortimer smelter at Swartklip, and Waterval smelter	85,000 platinum; 48,000 palladium; 12,000 rhodium.
Do.	do.	do.	Precious Metals Refinery	81,000 platinum; 45,700 palladium; 10,800 rhodium; 18,800 iridium and ruthenium.
Do.	do.	Impala Platinum Holdings Ltd.	Impala Mines, near Phokeng in North West Province	29,500 platinum; 16,000 palladium; 6,600 ruthenium; 4,000 rhodium; 1,600 iridium.
Do.	do.	do.	Marula Mine at Bothashoek	2,200 platinum; 2,300 palladium; 630 ruthenium; 460 rhodium; 180 iridium.
Do.	do.	do.	Smelter near Phokeng	81,000 platinum; 52,600 palladium; 11,600 rhodium; 17,000 gold, iridium, and ruthenium.
Do.	do.	do.	Precious metals refinery, near Springs in Guateng Province	71,500 platinum metal; 46,400 palladium metal; 10,200 rhodium metal; 15,000 gold, iridium, and ruthenium.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Platinum-group metals—Continued	kilograms	Lonmin plc	Marikana and Pandora Mines	24,900 platinum; 11,600 palladium; 5,300 ruthenium; 3,400 rhodium; 1,100 iridium.
Do.	do.	do.	Precious Metals Refinery at Western Platinum	31,000 platinum metal; 14,600 palladium metal; 7,000 ruthenium metal; 4,300 rhodium metal; 1,400 iridium metal.
Do.	do.	Northam Platinum Ltd. [Anglo American Platinum Ltd. (Amplats), 22.5%, and Mvelaphanda Resources Ltd., 21.9%]	Zondereinde Mine near Northam	9,400 platinum; 4,600 palladium; 1,100 rhodium.
Do.	do.	do.	Booysendal Mine	2,900 platinum; 1,600 palladium; 470 rhodium.
Do.	do.	Marikana Platinum Mine [Anglo American Platinum Ltd. (Amplats), 50%, and Aquarius Platinum Ltd., 50%]	Marikana Mine	2,700 platinum; 1,300 palladium; 760 ruthenium; 480 rhodium; 210 iridium.
Do.	do.	Sedibelo Platinum Mines Ltd.	Pilanesberg Mine	5,400 platinum; 1,700 palladium; 490 rhodium.
Do.	do.	Glencore plc, 74%	Eland Mine at Brits[1]	7,500 platinum-group metals.
Do.	do.	Atlatsa Resource Corp., 51%, and Anglo American Platinum Ltd. (Amplats), 49%	Bokoni Mine at Sefateng	4,100 platinum; 2,700 palladium; 470 rhodium.
Do.	do.	Two Rivers Platinum Mine (Pty) Ltd. [African Rainbow Minerals Ltd., 55%, and Impala Platinum Holdings Ltd., 45%]	Two Rivers Platinum Mine near Steelpoort	5,100 platinum; 2,900 palladium; 1,500 ruthenium; 870 rhodium; 330 iridium.
Do.	do.	Eastern Platinum Ltd. (Eastplats)	Crocodile River Mine at Arbourfell[1]	3,100 platinum; 1,300 palladium; 950 ruthenium; 520 rhodium; 220 iridium.
Do.	do.	Tharisa Minerals (Pty) Ltd.	Tharisa Mine	2,700 platinum; 710 palladium; 530 ruthenium; 360 rhodium; 170 iridium.
Do.	do.	Nkomati Joint Venture	Nkomati Mine in Mpumalanga Province	4,300 platinum-group metals.
Do.	do.	Platinum Australia Pty Ltd. (PLA)	Smokey Hills Mine[1]	3,000 platinum-group metals.
Do.	do.	Sylvania Platinum Ltd.	Sylvania Dump Operations	1,100[e] platinum; 520[e] palladium; 290[e] rhodium.
Pyrophyllite		Idwala Industrial Minerals (Benoni)	Ottsdal Mine in North West Province	15.
Do.		Wonderstone Ltd. (The Associated Ore & Metals Corp. Ltd.)	Pyrophyllite (wonderstone) mine, North West Province	NA.
Do.		G&W Base and Industrial Minerals Pty. Ltd.	Piet Retief Mine	NA.

See footnotes at end of table.

TABLE 2—Continued
SOUTH AFRICA: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Selenium kilograms	Impala Platinum Ltd. (Implats)	Impala and Marula Mines	12,000.[e]
Do. do.	Palabora Mining Co. Ltd.	Palabora Mine and plant at Phalaborwa	10,000.[e]
Silicon	Grupo Ferroatlantica	Polokwane plant, near Pietersburg	55 silicon metal.
Do.	do.	Rand Carbide plant	12 silicon metal.
Silver:			
Mine metric tons	Vedanta Resources plc	Black Mountain Mine	50 mined silver.
Refined do.	Rand Refinery Ltd.	Germiston, Gauteng Province	200 refined silver.
Sulfur	Sasol Synthetic Fuels (Pty) Ltd.	Plant at Secunda	180.
Do.	South African Petroleum Refineries	Plant at Durban	63.
Do.	Engen Petroleum Ltd.	do.	47.
Do.	National Petroleum Refiners of South Africa (Pty) Ltd.	Plant at Sasolburg	44.
Do.	Caltex Oil SA (Pty) Ltd.	Plant at Cape Town	30.
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 Ltd. (Implats)	Impala and Marula Mines	5,000.[e]
Do. do.	Palabora Mining Co. Ltd.	Palabora Mine and plant at Phalaborwa	5,300.[e]
Titanium:			
Titanium mineral concentrates	Richards Bay Minerals (RBM) (Rio Tinto plc, 74%, and Horizon Investments, 24%)	Open cast operations, near Richards Bay	2,000 ilmenite;[e] 100 rutile.[e]
Do.	Tronox Ltd., 74% (Exxaro Resources Ltd., 44.65%)	Namakwa Mine near Brand-se-Baai and mineral separation plant at Koekenaap	540 ilmenite; 31 rutile.
Do.	do.	Fairbreeze Mine in KwaZulu Natal Province	450 ilmenite; 25 rutile.
Do.	Mineral Commodities Ltd. (MCL)	Tormin Mine in Western Cape Province	100 ilmenite; 5.5 rutile.
Titanium slag	Richards Bay Minerals (RBM)	Smelter at Richards Bay	1,050.
Do.	Tronox Ltd., 74%	Empangeni smelter near Richards Bay	220.
Do.	do.	Smelter at Vredenberg, Saldanha Bay area	190.
Uranium, U_3O_8 content metric tons	AngloGold Ashanti Ltd.	Kopanang and Moab Khotsong Mines and Mine Waste Solutions (MWS) project	650.[e]
Do. do.	Sibanye Gold Ltd.	Cooke Opeations	120.[e]
Vanadium, V_2O_5 content do.	Evraz Highveld Steel and Vanadium Ltd. (Ervaz Group S.A., 79%)	Mapochs Mine near Lydenburg[1]	17,500.
Do. do.	do.	Plant at Witbank	10,800.
Do. do.	Glencore plc, 74%	Rhovan Mine at Brits	10,000.
Do.	Vanchem Vanadium Products (Pty) Ltd. (a subsidiary of Duferco Group)	Plant at Witbank[1]	5,000.[e]
Do. do.	Vametco Minerals Corp.	Vametco Mine and plant near Brits[1]	3,800.
Vermiculite	Palabora Mining Co. Ltd.	Palabora Mine and plant at Phalaborwa	200.
Wollastonite metric tons	Namaqua Wollastonite (Pty) Ltd.	Magata Mine	2,400.[e]
Zinc, mine	Black Mountain Mineral Development Co. (Pty) Ltd.	Black Mountain Mine near Aggeneys in Northern Cape Province	40.
Zirconium and concentrates	Richards Bay Minerals (RBM)	Open cast mines near Richards Bay	300 zircon in concentrate.
Do.	Tronox Ltd., 74%	Namakwa Mine near Brand-se-Baai and mineral separation plant at Koekenaap	135 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 2015.

[2]Data are from the International Copper Study Group.

TABLE 3
SOUTH AFRICA: RESERVE BASE OF MAJOR MINERALS IN 2015[1]

(Million metric tons unless otherwise specified)

Commodity		Reserves
Andalusite[2]		51
Antimony	thousand metric tons	27
Coal, recoverable		30,156
Copper		11
Fluorspar		41
Gold	thousand metric tons	6
Iron ore		650
Manganese, ore		150
Nickel	thousand metric tons	3,700
Phosphate rock		1,500
Platinum-group metals	thousand metric tons	63
Titanium minerals		71
Vanadium	thousand metric tons	3,500
Vermiculite		14
Zinc		15
Zirconium minerals		14

[1]Metallic minerals are metallic elemental content.
[2]Includes aluminosilicate and sillimanite.

Source: Mwape, P., Mnguni, M., Jali, N., and Menoe, K., 2015, General review, *in* South Africa's mineral industry 2013/2014: Pretoria, South Africa, Department of Mineral Resources of the Republic of South Africa, p. 1–40.