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The Mineral Industry of Zambia

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Zambia's mining sector was dominated by cobalt and copper production. In 2015, the country accounted for more than 4% of world mined cobalt and copper production. The country also produced bismuth, crude steel, semiprecious gemstones, and gold (Brininstool, 2017; Shedd, 2017).

Minerals in the National Economy

In 2015, Zambia's real gross domestic product (GDP) increased by 3.2% compared with a revised 5.0% in 2014. The value of the mining and quarrying sector accounted for 10.8% of real GDP; the sector increased by 0.3% compared with a revised decrease of 2.2% in 2014. The value of the construction sector accounted for 11.4% of Zambia's real GDP; the sector increased by 18.9% in 2015 compared with an 8.9% increase in 2014. Growth in the construction sector was attributed to an increase in the number of public infrastructure and residential construction projects. The value of the manufacturing sector accounted for 8.6% of real GDP; the sector grew by 4.4% compared with a revised 4.0% in the previous year (Bank of Zambia, 2016, p. 29–31, 143).

Government Policies and Programs

The mining sector is regulated by Act No. 11 of 2015 (the Mines and Mineral Development Act of 2015). In July, the Government adopted the Mines and Mineral Development Act of 2015, which replaced Act No. 7 of 2008 (the Mines and Mineral Development Act of 2008). The Mines and Mineral Development Act of 2015 established guidelines for: exploration and large- and small-scale-mining licenses; import and export permits; mining rights; safety, health, and environmental protections; and mineral trading permits. The Act reduced the mineral royalty rate for opencast and underground operations to 6% and 9%, respectively, from 8% and 20%, respectively. The Act also established a Mining Appeals Tribunal with the purpose of resolving disputes brought against regulatory bodies and established regulations for the analysis and mining licensing of radioactive minerals. The Ministry of Mines and Minerals Development was responsible for implementing the law (International Comparative Legal Guides, 2017).

The Income Tax Act (Chapter 323 of the Laws of Zambia) and the Income Tax (Amendment) Act No. 7 of 2014 address capital allowances, mineral royalties, mining development agreements, and variable profit taxes. Investment in most types of mineral operations are covered by the Zambia Development Agency Act of 2006, although minerals produced for the construction industry, such as clay, sand, and most types of stone, are excluded. The Engineering Institution of Zambia Act of 2010 requires that the Engineering Institution of Zambia register and regulate the conduct of professional engineers. The Environmental Management Act addresses environmental regulations associated with the mining industry. The environmental laws are administered by the Zambian Environmental Management Agency (ZEMA). Petroleum exploration and production are regulated by Act No. 10 of 2008 [the Petroleum (Exploration and Production) Act of 2008].

Production

Data on estimated mineral production are in table 1. Notable increases in production included sulfuric acid (67.0%), copper metal (23.4%), and emerald (22%). Notable decreases in production included bismuth (-78%), refined cobalt (-30.6%), refinery electrowon copper (-13.8%), gold (-11.7%), and amethyst (-13.7%). Increased production of copper metal was owing to the startup of the Kansanshi smelter. Decreased refined copper metal production was owing to inadequate electricity supply (table 1).

Structure of the Mineral Industry

Many of the country's large copper-mining and -processing operations are located in Copperbelt Province in north-central Zambia. The Government retains minority interest in most of the large copper projects through its holding company, Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM-IH). The mining sector is administered by the Geological Survey Department, the Mines Development Department, and the Mines Safety Department of the Ministry of Mines and Minerals Development. The Ministry of Commerce, Trade and Industry oversees the industrial manufacturing sector. Data on the capacity and ownership of selected mineral operations are in table 2.

Much of the mineral industry's electrical power was distributed by Copperbelt Energy Corporation Plc (CEC), which was owned by the Zambian Energy Corporation Ltd. of Ireland (52% equity) and ZCCM I-IH (20%). CEC purchased the majority of its power from ZESCO Ltd., which was a Government parastatal company. ZESCO's 2,337 megawatts (MW) of generating capacity was powered dominantly by hydroelectric facilities and several small isolated diesel-fueled power stations (ZESCO Ltd., 2015; Copperbelt Energy Corp. PLC., 2016, p. 11).

In 2015, shortfalls in electricity supplies resulted from decreased hydroelectric generation owing to lower rainfalls and reservoir levels. In July 2015, ZESCO requested that the mining sector reduce demand load by 30% from September to December. The CEC imported 30% of its supply from the South African Power Pool to make up for the domestic supply deficit. The Energy Regulation Board of Zambia reported that the mining sector's consumption of electricity increased by 6.4% to 6,245.6 gigawatthours (GWh) in 2015 from 5,871.3 GWh in 2014. Maamba Collieries Limited (MCL), a subsidiary of Nava Bharat Ventures Ltd. (65%) of Singapore and ZCCM-IH (35%), completed construction of a 300-MW coal powerplant, which was expected to be commissioned in August 2016. By yearend

2015, the first phase of the 120-MW Itezhi-Tezhi hydropower project had been commissioned, and the second phase was expected to be commissioned in 2016. The Government and ZESCO continued plans to develop the 750-MW Kafue Gorge Lower Hydropower project; in 2015, the engineering, procurement, and construction contract was obtained. The Solwezi fuel storage depots were completed by yearend. The Mongu fuel storage depot was expected to be completed in 2016 (Bank of Zambia, 2016, p. 32; Copperbelt Energy Corp. PLC, 2016, p. 11; Energy Regulation Board, 2016, p. 1, 17; Nava Bharat Ventures Ltd., 2016, p. 16).

Mineral Trade

In 2015, the preliminary values of exports and imports were estimated to be about $7.36 billion and $7.44 billion, respectively. The total value of exports decreased by about $2.86 billion, or by about 28%, as exports of cobalt, copper, gemstones, and gold declined. The value of copper exports decreased by 31.3% to about $5.23 billion compared with $7.62 billion in 2014. Exported volumes of copper decreased by 11.3% to 1.02 million metric tons (Mt) from 1.15 Mt in 2014, reflecting drawdowns in inventories. Copper exports accounted for 71% of Zambia's total export value in 2015. The value of cobalt exports decreased by 42.9% to $70.7 million from $124 million in 2014 and accounted for about 1.0% of Zambia's total export value in 2015. Exported volumes of cobalt decreased by 34.7% to 2,980 metric tons (t) from 4,560 t in 2014. The value of gemstones exports decreased by 28.8% to $111 million from $156 million in 2014. Gold export values decreased slightly by 0.3% to $152 million as export volumes decreased by 1.8% to 4,360 kilograms (kg) from 4,440 kg in 2015 (Bank of Zambia, 2016, p. 21–23).

Commodity Review

Metals

Cobalt and Copper.—Lumwana Mining Company Ltd., which was owned by Barrick Gold Corp. of Canada, operated the Lumwana copper mine. In 2015, production at the Lumwana Mine increased to 130,200 t of copper contained in concentrate from 97,000 t in 2014. The 34% production increase was the result of the return to a normal year of operation after a conveyor collapse halted production at the mill and processing plant during the second quarter of 2014. Lumwana sold 133,800 t of copper concentrate from Zambian smelters in 2015 (Barrick Gold Corp., 2016a, p. 16, 47; 2016b, p. 26, 51).

Kansanshi Mining PLC, a subsidiary of First Quantum Minerals Ltd., operated the Kansanshi mining complex, the Kansanshi smelter, and the Sentinel Mine. In 2015, the company mined and processed 34.1 Mt of ore compared with 26.9 Mt in 2014. Output from the Kansanshi facility included 160,384 t of copper contained in concentrate and 66,290 t of copper cathode compared with 157,365 t and 102,362 t, respectively, in 2014. Smelter constraints resulted in increased copper concentrate inventory. The company did not produce toll-refined copper cathode for third parties in 2015, although it produced 2,560 t of toll-refined copper cathode in 2014 and 64,675 t in 2013. Total copper production decreased by 14% to 226,674 t from 262,287 t in 2014 owing to lower ore grades and recoveries, lower oxide and sulfide ore throughput limited by acid production, and reductions in energy supplied by ZESCO through CEC. In July 2015, Kansanshi began commercial production at the Kansanshi smelter. By yearend, the smelter had processed 709,188 t of concentrate to produce 150,292 t of copper anode. The smelter is designed to process 1.2 million metric tons per year (Mt/yr) of copper concentrate to produce 300,000 metric tons per year (t/yr) of copper metal. In 2015, the company began production rampup at the Sentinel Mine. In January 2015, the mine began to produce copper concentrate; by yearend, 32,971 t of copper contained in concentrate had been produced from the mine. Restricted electricity supply delayed production-rampup activities. Sentinel was expected to begin commercial production levels in the third quarter of 2016 (First Quantum Minerals Ltd., 2016a, p. 12, 19; 2016b, p. 6, 29, 32).

In 2015, Lubambe Copper Mine Ltd. produced 24,990 t of copper contained in concentrate compared with 25,790 t in 2014. The company postponed the planned mine rampup to 45,000 t/yr to mid-2018. African Rainbow Minerals Ltd. of South Africa and Vale S.A. of Brazil, partners in the joint venture, each held a 40% interest in the Lubambe copper mine, with ZCCM-IH holding the remaining 20% (African Rainbow Minerals, 2015a, p. 64–65; 2015b, p. 41, 63; 2016, p. 23).

In 2015, Chambishi Metals plc, a subsidiary of Eurasian Natural Resources Corp. plc. of the United Kingdom, operated the Chambishi cobalt plant, located 75 kilometers (km) northwest of Ndola. In 2015, the company produced 2,997 t of cobalt metal compared with 4,317 t in 2014. Decreased production was attributed to a suspension of plant operations in June and July owing to challenges in obtaining cobalt concentrate from the Democratic Republic of the Congo [Congo (Kinshasa)] (table 2; Bank of Zambia, 2016, p. 21; Cobalt Development Institute, 2016, p. 3).

Four direct (or indirect) subsidiaries of China Nonferrous Metal Mining Corp. Ltd. (CNMC) operated copper facilities in Zambia, including Chambishi Copper Smelter Ltd., CNMC Luanshya Copper Mines PLC, NFC Africa Mining PLC, and Sino-Metals Leach Zambia Ltd. In 2015, mines and facilities in Zambia operated by the subsidiaries of CNMC produced 185,698 t of blister copper, 37,876 t of copper contained in concentrate, and 37,418 t of copper cathode compared with 222,224 t of blister copper, 45,951 t of copper contained in concentrate, and 33,104 t of copper cathode in 2014. The decrease in production was attributed to insufficient energy supplies. The Baluba Center Mine and the Slag Copper Recovery project, operated by Luanshya, were not operating as of yearend as operations were suspended in early September owing to the reduction in energy supplied by ZESCO through CEC (China Nonferrous Metal Mining (Group) Corp. Ltd., 2015a, p. 30–31; 2016, p. 20, 29–31).

In 2015, NFC Africa continued exploration and development of the southeast Chambishi Mine. The mine, which was expected to be completed in the third quarter of 2018, was designed to produce 63,000 t/yr of copper in concentrate. Sino-Metals Leach Zambia Ltd. continued the development of the Mwambashi Strip Mine project, which was expected to

produce 600,000 t/yr of ore. The project included a 700,000-t/yr processing plant. The Mwambashi Mine was expected to be in full operation in June 2016. In January, Chambishi Copper announced plans to develop the Cobalt Converter Slag Recycling project. The $40.8 million project consisted of the Converter Slag Reduction Furnace (CSRF) project and the High-Grade Cobalt Matte Metallurgy (HGCMM) project. The CSRF project was expected to process 100,000 t/yr of slag to produce 10,350 t/yr of copper-cobalt alloy containing 9.3% cobalt and 23.1% copper. By yearend 2015, the project was in a trial phase. The HGCMM plant was expected to process 50,000 t/yr of cobalt matte to produce 34,650 t/yr of copper concentrate containing 39.1% copper. By yearend, the main structure of the plant was completed and the majority of the equipment was installed. The project was expected to be completed in April 2016. Luanshya completed the Muliashi South Strip Mine mining project in September 2015, and by yearend the project was operational. The project had the capacity to produce 500,000 t/yr of ore (China Nonferrous Metal Mining (Group) Corp. Ltd., 2015b; 2016, p. 35–36).

In 2015, Konkola Copper Mines plc (KCM), a subsidiary of Vedanta Resources plc of the United Kingdom, produced a combined 183,000 t of copper cathode at the Nkana refinery and the Nchanga tailings leach plant compared with 191,000 t in 2014. Increased production of copper cathodes was attributed to greater equipment availability at the Nchanga tailings leach plant. KCM produced 122,000 t of copper contained in mined ore in 2015 compared with 115,000 t in 2014. By yearend 2015, the Nchanga underground mine remained on care-and-maintenance status. Operations at the upper ore body at the Nchanga underground mine had been suspended since November 2014. Mined metal output increased owing to higher copper grades and equipment availability at the Konkola underground mine. At the Konkola Mine, shaft 1 resumed operation in March and shaft 4 was expected to resume operation in the first quarter of 2016. In September, ZEMA ordered KCM to cease processing copper concentrate imported from Chile owing to high levels of arsenic (Jamasmie, 2015; Vedanta Resources plc., 2015a, p. 27–28; 2015b, p. 5; 2016, p. 8).

In 2015, Mopani Copper Mines plc produced 92,100 t of copper metal compared with 109,900 t in 2014, a 16% decrease. Mopani also produced an additional 92,700 t of blister copper from ore obtained from other companies and traders in 2015. Decreased production of copper metal was attributed to the smelter's partial suspension. From September to yearend, the smelter operated at reduced capacity resulting from the continued construction of three mining shafts: the Mindolo Deeps shaft, the Mufulira haft, and the Synclinorium shaft. The nameplate capacity of the projects, which were expected to be completed in December 2016, was 2.0 Mt/yr. Cobalt metal was not produced in 2015 at the Nkana cobalt plant as operations continued to be suspended (ZCCM Investments Holdings Plc, 2015, p. 20; Glencore plc, 2016, p. 54, 185).

In 2015, Intrepid Mines Ltd. of Australia continued the development of the Kitumba deposit (part of the Mumbwa project). The company had been granted a large-scale-mining license for a 25-year period for the Kitumba deposit in 2014. In October, Intrepid announced an agreement to access the mining rights, held by African Deposits Ltd. (ADL) of Zambia, to 4 square kilometers adjacent to the Kitumba deposit for a period of 1 year. Intrepid updated the estimated mineral reserves of the Kitumba deposit to 21.9 Mt grading 2.2% copper at a 1% copper cutoff grade (Intrepid Mines Ltd., 2016, p. 7, 11–12, 19).

Gold.—In 2015, gold output from the Kansanshi Mine and smelter, operated by First Quantum, decreased to about 4,240 kg from the 4,800 kg produced in 2014, owing to lower concentrate production and head grades. The Kansanshi Mine was the sole source of gold production in the country. In November 2015, Alecto Minerals Plc of the United Kingdom acquired 100% interest in the Dunrobin and the Matala gold deposits, located 120 km west of Lusaka, through the acquisition of Luiri Ltd. of Australia. Alecto Minerals held a 25-year renewable mining license and environmental permit. The company planned to develop a strip mine with a gravity and cyanidation process with an estimated 10-year life. By yearend, the company had entered into an engineering, procurement, and construction contract with PenMin Ltd. of South Africa (Alecto Minerals plc, 2016, p. 4, 7; First Quantum Minerals Ltd., 2016a, p. 19; 2016b, p. 29).

Lead and Zinc.—In 2015, BMR Mining plc of the United Kingdom continued with the development of the Kabwe Lead-Zinc Recovery project. In December, the company submitted an Environmental Social Impact Assessment for the construction of a pilot processing plant at the Kabwe lead and zinc mine. The company planned to commission the pilot plant in the third quarter of 2017. The pilot plant was expected to process about 44,000 t/yr of tailings to produce lead sponge and zinc cathode, as well as byproducts. The Kabwe lead and zinc mine was not operating but hosted tailings and slag stockpiles that contained germanium, lead, silver, vanadium, and zinc. Total non-Joint Ore Reserves Committee (JORC) compliant stockpile resources were estimated to contain 357,000 t of zinc and 352,000 t of lead. In 2016, the company planned to continue metallurgical tests for byproduct production (BMR Group plc, 2016, p. 4, 6; 2017).

Nickel.—In 2015, First Quantum continued with development of the Enterprise nickel sulfide mine, which is located about 12 km northwest of the Sentinel Mine. The company reported that process plant construction was advanced, and expected to begin commissioning project areas that could be incorporated with the Sentinel Mine in the first quarter of 2016. The Enterprise processing facility, a 4-Mt/yr-capacity ore-processing plant, was expected to produce 38,000 t/yr of nickel contained in concentrate from ore mined at the Enterprise Mine. First Quantum reported that the processing plant, which was designed to process copper and nickel ore, would initially process copper ore from the Sentinel Mine (First Quantum Minerals Ltd., 2014, p. 44; 2016c, p. 24).

In 2015, Mabiza Resources Ltd. [a wholly owned subsidiary of Consolidated Nickel Mines Ltd. (CNM) of the United Kingdom] continued with the development of the Munali nickel mine, which is located in the Mazabuka District 75 km south of Lusaka. In March, the company completed a feasibility study and reported that key infrastructure and operation permits were in place for the mine restart. CNM reported that mining operations would restart within 3 months of favorable nickel market conditions. The mine was expected

to process 80,000 t/yr of ore to produce about 4,500 t/yr of nickel concentrate containing 10% to 12% nickel over 7 years. CNM leased the mine through a lease and royalty agreement with Jin Tuo Investments Ltd., a subsidiary of Jinchuan Group Resources Holding Ltd. of China. The Munali nickel mine had last operated in 2011 (Consolidated Nickel Mines Ltd., 2017; Mabiza Resources Ltd., 2017).

Industrial Minerals

Cement.—Cement production continued to increase in 2015 owing to increased consumption from construction sector expansion attributed to public infrastructure development projects, including the construction of hydroelectric dams, and an increase in residential housing construction. Dangote Cement Plc of Nigeria commissioned the 1.5-Mt/yr Ndola cement plant, located in the Masaiti District near Ndola, in the second quarter of 2015. Dangote expected the plant to supply the Copperbelt region and to export cement to the DRC. The company planned further capacity increases in the country through another line at the Ndola plant or a 1.5-Mt/yr plant in Lusaka (Bank of Zambia, 2016, p. 31; Dangote Cement plc., 2016, p. 42, 70).

In 2015, Scirocco Enterprises Ltd. of Zambia announced plans to construct a 900,000-t/yr cement plant in Lusaka. Scirocco entered into an agreement with international investors to construct and operate the $200 million plant under a consortium, Amaka Cement Industries Ltd. The company was working to complete a feasibility study and expected to begin construction in September (Global Cement staff, 2015).

Sulfur.—In early July, First Quantum began commercial production at the Kansanshi smelter. The smelter produced 645,000 t of sulfuric acid in 2015 compared with 201,300 t in 2014, which accounted for the majority of the country's overall increase of 680,000 t of sulfuric acid production. The smelter was designed to produce 1 Mt/yr of sulfuric acid as a byproduct of copper metal production (First Quantum Minerals Ltd., 2016a, p. 19).

Outlook

The country's mineral and metal-processing industry continues to be under pressure from internal and external challenges. Internal challenges to the successful diversification and growth of the mineral sector included unstable policy environments, electricity shortages, and high fuel prices owing to the depreciation of the Kwacha. External challenges included low copper prices resulting in decreased export earnings and constrained Government budgets. The landlocked country's ability to renew foreign direct investment in the mining sector hinges on developing a stable policy and monetary environment, as well as the diversification and expansion of the electricity sector.

References Cited

African Rainbow Minerals Ltd., 2015a, Interim results for the six months ended 31 December 2014: African Rainbow Minerals Ltd., 92 p. (Accessed December 12, 2016, at http://www.arm.co.za/im/files/results/interim_31dec14.pdf.)

African Rainbow Minerals Ltd., 2015b, Provisional results for the year ended 30 June 2015: African Rainbow Minerals Ltd., 87 p. (Accessed December 12, 2016, at http://www.arm.co.za/im/files/results/prelim_30jun15.pdf.)

African Rainbow Minerals Ltd., 2016, Interim results for the six months ended 31 December 2015: African Rainbow Minerals Ltd., 48 p. (Accessed December 12, 2016, at http://www.arm.co.za/im/files/results/interim_31dec15.pdf.)

Alecto Minerals plc, 2016, Annual report and financial statement for the year ended 31 December 2015: London, United Kingdom, Alecto Minerals plc, 50 p. (Accessed December 19, 2016, at http://www.alectominerals.com/investors/documents/Alecto%20Minerals%20Plc%20Accounts%202015.pdf.)

Bank of Zambia, 2016, Annual report 2015: Lusaka, Zambia, Bank of Zambia, 139 p. (Accessed December 5, 2016, at http://www.boz.zm/BOZANNUALREPORT2015.pdf.)

Barrick Gold Corp., 2016a, Form–40–F—2015: U.S. Securities and Exchange Commission, 166 p. (Accessed December 27, 2016, at http://d1lge852tjjqow.cloudfront.net/CIK-0000756894/a891767d-57d0-4684-bacd-fdf3d2b9ab5c.pdf.)

Barrick Gold Corp., 2016b, Management's discussion and analysis: U.S. Securities and Exchange Commission, 79 p. (Accessed December 27, 2016, at http://d1lge852tjjqow.cloudfront.net/CIK-0000756894/a891767d-57d0-4684-bacd-fdf3d2b9ab5c.pdf.)

BMR Group plc, 2016, Annual report 30 June 2016: BMR Group plc, December 29, 66 p. (Accessed January 5, 2017, at http://www.bmrplc.com/documents/168542%20BMR%20Mining%20plc%20Annual%20Report%20(AS%20PRINTED).pdf.)

BMR Group plc, 2017, BMR lead and zinc: BMR Group plc. (Accessed January 5, 2017, at http://www.bmrplc.com/index.php.)

Brininstool, Mark, 2017, Copper: U.S. Geological Survey Mineral Commodity Summaries 2017, p. 54–55.

China Nonferrous Metal Mining (Group) Corp. Ltd., 2015a, Announcement of annual results for the year ended 31 December 2014: Beijing, China, China Nonferrous Metal Mining Corp. Ltd., 52 p. (Accessed December 5, 2016, at http://www.hkexnews.hk/listedco/listconews/SEHK/2015/0326/LTN20150326139.pdf.)

China Nonferrous Metal Mining (Group) Corp.Ltd., 2015b, Voluntary announcement of CCS to invest in cobalt converter slag recycling project: Beijing, China, China Nonferrous Metal Mining Corp. Ltd., 2 p. (Accessed December 5, 2016, at http://www.hkexnews.hk/listedco/listconews/sehk/2015/0119/LTN201501191004.pdf.)

China Nonferrous Metal Mining (Group) Corp. Ltd., 2016, Announcement of annual results for the year ended 31 December 2015: Beijing, China, China Nonferrous Metal Mining Corp. Ltd., 49 p. (Accessed December 5, 2016, at http://www.hkexnews.hk/listedco/listconews/SEHK/2016/0328/LTN20160328453.pdf.)

Cobalt Development Institute, 2016, 2015 production statistics: Cobalt News, no. 2, April, p. 13. (Accessed January 24, 2017, at http://www.thecdi.com/cdi/images/news_pdf/16-2_cobalt_news.pdf.)

Consolidated Nickel Mines Ltd., 2017, The Munali nickel mine: London, United Kingdom, Consolidated Nickel Mines Ltd. (Accessed January 17, 2017, at http://www.cnmplc.co.uk/the-munali-nickel-mine/.)

Copperbelt Energy Corp. PLC, 2016, 2015 annual report: Lusaka, Zambia, Copperbelt Energy Corp. PLC, March 29, 105 p. (Accessed December 9, 2016, at https://cecinvestor.com/cec-release-of-2015-annual-report/.)

Dangote Cement Plc., 2016, Annual report 2015: Lagos, Nigeria, Dangote Cement Plc., February 29, 213 p. (Accessed January 17, 2017, at http://www.dangotecement.com/wp-content/uploads/reports/2015/Dangote%20Cement-2015%20Annual%20Report.pdf.)

Energy Regulation Board, 2016, Energy sector report 2015, Lusaka, Zambia, Energy Regulation Board, 68 p. (Accessed January 24, 2017, at http://www.erb.org.zm/reports/ESR2015.pdf.)

First Quantum Minerals Ltd., 2014, 2013 annual report: Vancouver, British Columbia, Canada, First Quantum Minerals Ltd., 138 p.

First Quantum Minerals Ltd., 2016a, Annual report 2015: Vancouver, British Columbia, Canada, First Quantum Minerals Ltd., March 30, 94 p.

First Quantum Minerals Ltd., 2016b, Management's discussion and analysis for second quarter ended June 30, 2016: Vancouver, British Columbia, Canada, First Quantum Minerals Ltd., July 28, 43 p.

First Quantum Minerals Ltd., 2016c, Management's discussion and analysis for the year ended December 31, 2015: Vancouver, British Columbia, Canada, First Quantum Minerals Ltd., February 19, 48 p.

Glencore plc, 2016, Annual report 2015: Baarermattstrasse, Switzerland, Glencore plc, 202 p. (Accessed December 5, 2016, at http://www.glencore.com/assets/investors/doc/reports_and_results/2015/GLEN-2015-Annual-Report.pdf.)

Global Cement staff, 2015, Amaka cement industries plant on the cards: Pro Global Media Ltd., February 5. (Accessed January 18, 2017, at

http://www.globalcement.com/news/item/3284-amaka-cement-industries-plant-on-the-cards.)
International Comparative Legal Guides, 2017, Zambia: Global Legal Group, September 25. (Accessed February 12, 2018, at https://iclg.com/practice-areas/mining-laws-and-regulations/zambia.)
Intrepid Mines Ltd., 2016, Annual report 2016: Intrepid Mines Ltd., Sydney, New South Wales, Australia, March, 90 p. (Accessed January 5, 2017, at http://www.annualreports.com/HostedData/AnnualReports/PDF/TSX_IAU.t_2015.pdf.)
Jamasmie, Cecilia, 2015, Zambia orders Vedanta unit to get rid of Chilean copper: Mining.com, September 14. (Accessed December 9, 2016, at http://www.mining.com/zambia-orders-vedanta-unit-to-get-rid-of-chilean-copper/.)
Mabiza Resources Ltd., 2017, Overview: Lusaka, Zambia, Mabiza Resources Ltd. (Accessed January 17, 2017, at http://www.mabiza.co.zm/index.php/mine/overview/.)
Nava Bharat Ventures Ltd., 2016, 44th annual report 2015–16: Hyderabad, India, Nava Bharat Ventures Ltd., June 22, 176 p. (Accessed December 9, 2016, at http://www.nbventures.com/pdf/annual_reports/2015-16/pdf_2015-16_Annual_Report.pdf.)
Shedd, K.B., 2017, Cobalt: U.S. Geological Survey Mineral Commodity Summaries 2017, p. 52–53.
Vedanta Resources plc, 2015a, Interim results for the six months ended 31 September 2015: London, United Kingdom, Vedanta Resources plc, November 7, 62 p.
Vedanta Resources plc, 2015b, Production results for first quarter and full year ended 31 March 2015: London, United Kingdom, Vedanta Resources plc, April 10, 11 p.
Vedanta Resources plc, 2016, Production results for third quarter ended 31 December 2015: London, United Kingdom, Vedanta Resources plc, January 29, 19 p.
ZCCM Investments Holdings Plc, 2015, Annual report 2015: Lusaka, Zambia, ZCCM Investments Holdings Plc, 121 p.
ZESCO Ltd., 2015, Generation projects: ZESCO Ltd. (Accessed December 9, 2016, at http://www.zesco.co.zm/projects/generation.)

TABLE 1
ZAMBIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1, 2]

(Metric tons unless otherwise specified)

Commodity[3]		2011	2012	2013	2014	2015
METALS						
Bismuth[4]		--	--	--	180 [r]	40
Cobalt:						
Mine output, Co content[4]		7,702	5,435	5,919	4,600 [r, e]	4,600 [e]
Metal[4]		5,749 [r]	5,669 [r]	5,000	4,317	2,997
Copper:[5]						
Mine output, Cu content:						
By concentration or cementation		521,000	517,000	559,000	520,000	550,000
Leaching, electrowon		142,000	178,000	201,000	188,000	162,000
Total		663,000	695,000	760,000	708,000	712,000
Metal, smelter, primary, includes low-grade electrowon[4]		520,000	519,000	520,000	526,000	649,000
Refinery, primary:						
Electrowon		147,000	186,000	241,000	188,000 [r]	162,000
Other		369,000	344,000	327,000	295,000 [r]	309,500
Total		516,000	530,000	568,000	483,000 [r]	471,500
Gold[4]	kilograms	3,490	4,230	5,210	4,800	4,240
Iron and steel, crude steel		54,500 [r, 4]	76,400 [r, 4]	90,650 [r, 4]	91,000 [r]	91,000
Manganese ore:						
Gross weight		120,000	120,000	120,000	130,000	130,000
Mn content		40,000	40,000	40,000	45,000	45,000
Nickel, Ni content of concentrates[4]		2,724	--	--	--	--
Silver	kilograms	6,500	6,400	6,400	5,900	5,700
INDUSTRIAL MINERALS						
Cement		1,230,000 [4]	1,580,000 [4]	1,810,000 [4]	2,190,000 [4]	2,390,000 [e]
Gemstones:						
Amethyst	kilograms	1,000,000	1,050,000	1,150,000	1,150,000 [r]	992,000
Beryl	million carats	7	10	9	11	12
Emerald	do.	14	17	17	18	22
Tourmaline	kilograms	20,000	21,000	20,000	19,000	18,000
Lime, calcined	thousand metric tons	50	250	280	300	310
Limestone:						
For cement and lime	do.	2,400	2,600	2,700	2,900	3,000
Crushed aggregate	do.	1,000	1,000	1,050	1,175 [r]	1,250
Sand and gravel, construction	do.	360	360	370	375	400
Sulfur, gross weight:						
Sulfuric acid[6]		800,000	950,000	975,000	1,015,000	1,695,000
S content, 32.6% S		240,000	310,000	320,000	330,000	550,000

See footnotes at end of table.

TABLE 1—Continued
ZAMBIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES[1, 2]

(Metric tons unless otherwise specified)

Commodity[3]		2011	2012	2013	2014	2015
MINERAL FUELS AND RELATED MATERIALS						
Coal, bituminous		90,000 [7]	90,000 [r]	149,000 [7]	159,000	150,000
Petroleum, refinery products:[8]	thousand 42-gallon barrels					
Liquefied petroleum gas	do.	104	116	104	128 [r]	130 [e]
Gasoline	do.	665	759	725	810 [r]	800 [e]
Gas oil[9]	do.	2,265	2,573	2,460	2,753 [r]	2,800 [e]
Kerosene	do.	224	255	240	271 [r]	270 [e]
Jet kerosene	do.	230	262	246	278 [r]	280 [e]
Residential fuel oil	do.	480	546	526	586 [r]	590 [e]
Total	do.	3,968	4,511	4,301	4,825 [r]	4,870 [e]

[e]Estimated. [r]Revised. do. Ditto. -- Zero.
[1]Estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]Table includes data available through December 31, 2016.
[3]In addition to the commodities listed, clays, lead, palladium, platinum, and selenium may have been produced, but information was inadequate to make reliable estimates of output.
[4]Reported figure.
[5]Terms used are as defined by the International Copper Study Group.
[6]From the Chambishi, Kansanshi, and Nchanga acid recovery plants.
[7]Secondary sources reported a production difference of 250,000 metric tons; unable to confirm owing to inadequate information.
[8]Source: International Energy Agency
[9]Diesel fuel containing more than 0.001% sulfur.

TABLE 2
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2015

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Bismuth	Chambishi Copper Smelter, Ltd. [China Nonferrous Metal Mining (Group) Co. Ltd., 60%, and Yunnan Copper Industry (Group) Co. Ltd., 40%]	Chambishi copper smelter, 75 kilometers northwest of Ndola	NA.
Cement	Dangote Industries (Zambia) Ltd. (Dangote Cement Plc, 100%)	Plant in Ndola, Copperbelt Province	1,500,000.
Do.	Lafarge Cement Zambia plc (Pan African Cement Ltd.,[1] 50%, and Financiere Lafarge S.A.,[1] 34%)	Chilanga II plant, about 15 kilometers south of Lusaka	830,000.
Do.	do.	Ndola, Copperbelt Province	450,000.
Do.	do.	Chilanga I plant, about 15 kilometers south of Lusaka	200,000.
Do.	Scirocco Enterprises Ltd.	About 18 kilometers southwest of Lusaka	100,000.
Do.	Zambezi Portland Cement Ltd.	Ndola, Copperbelt Province	510,000.
Coal, bituminous	Maamba Collieries Ltd. [Nava Bharat consortium, 65%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 35%]	Siankondobo coalfield, 350 kilometers south of Lusaka, Sinazongwe District	400,000.
Do.	Nkandabwe Coal Mine Ltd. [Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 100%]	Kandabwe Mine,[2] near Sinazongwe	240,000.
Copper and cobalt:			
Ore and concentrate	Lubambe Copper Mine Ltd. [African Rainbow Minerals Ltd., 40%; Vale S.A., 40%; Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 20%]	Lubambe Copper Mine, near Chililabombwe	2,500,000 ore, which yields about 45,000 copper in concentrate.
Do.	Jin Tuo Investments Ltd. (Jinchuan Group International Resources Co. Ltd., 100%)	Munali nickel mine,[2] about 60 kilometers south of Lusaka	1,200,000 ore, which yields about 1,700 copper and 500 cobalt coproduct.

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper and cobalt—Continued:			
Ore and concentrate—Continued	Chibuluma Mines plc [Metorex Ltd.,[3] 85%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 15%]	Chibuluma South Mine, about 12 kilometers west of Kitwe	600,000 ore, which yields about 19,000 copper in concentrate.
Do.	CNMC Luanshya Copper Mines PLC. [NFC Africa Mining plc, 80%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 20%]	Baluba Center underground mine[2]	1,500,000 ore.
Do.	do.	Luanshya North Mine, Luanshya	4,500,000 ore.
Do.	do.	Luanshya slag recovery, Luanshya	500,000 slag, which yeilds 3,500 copper in concentrate.
Do.	Kansanshi Mining plc [Kansanshi Holdings Ltd.,[4] 80.0%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 20%]	Kansanshi Mine, north of Solwezi	12,000,000 sulfide ore, 8,800,000 oxide ore, 8,600,000 mixed ore.
Do.	Konkola Copper Mines plc (KCM) [Vedanta Resources plc., 80%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 20%]	Chingola open pit A and Nchanga open pit, Chingola	4,500,000 ore.
Do.	do.	Nchanga underground mine,[2] Chingola	2,800,000 ore.
Do.	do.	Konkola Mine, Chililabombwe	2,400,000 ore.
Do.	do.	Fitwaola open pit, Chingola	NA.
Do.	do.	Reprocessing material from the TD3a, the TD3b, the TD5, and the TD7 tailings dams, Chingola	NA.
Do.	Lumwana Mining Company Ltd. (Barrick Gold Corp., 100%)	Lumwana Mine (Chimiwungo and Malundwe pits), 20 kilometers west of Chingola	21,000,000 ore.
Do.	Mkushi Copper Joint Venture Ltd. (Seringa Mining Ltd., 51%, and Katanga Resources Ltd., 49%)	Mkushi heap leach	NA.
Do.	Mopani Copper Mines plc [Carlisa Investments Corp.,[5] 90%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM-IH), 10%]	Nkana Mine, includes the Central, the Mindola North, the Mindola Sub-Vertical, and the South Ore Body shafts for underground operations, and the Area A, the Area E, and the Mindola open pits, Southwest of Kitwe	5,500,000 ore.
Do.	do.	Mufulira Mine	2,500,000 ore.
Do.	NFC Africa Mining plc [China Nonferrous Metal Mining (Group) Co. Ltd., 85%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 15%]	Chambishi Main Mine, 75 kilometers northwest of Ndola	2,145,000 ore, which yields about 50,000 copper in concentrate.
Do.	do.	Chambishi West Mine, 75 kilometers northwest of Ndola	990,000 ore.
Metal	Chambishi Metals plc [Eurasian Natural Resources Corporation PLC (ENRC), 90%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 10%]	Chambishi cobalt plant, 75 kilometers northwest of Ndola	27,000 copper cathode, 5,500 cobalt metal.
Do.	Chambishi Copper Smelter Company, Ltd. [China Nonferrous Metal Mining (Group) Co. Ltd., 60%, and Yunnan Copper Industry (Group) Co. Ltd., 40%]	Chambishi copper smelter	250,000 copper anode (blister copper).
Do.	CNMC Luanshya Copper Mines PLC. (NFC Africa Mining plc, 100%)	Muliashi leach plant, Luanshya	40,000 copper cathode.
Do.	First Quantum Mining and Operations Ltd. (First Quantum Minerals Ltd., 100%)	Bwana Mkubwa solvent extraction-electrowinning plant	52,000 copper cathode.
Do.	Kansanshi Mining plc [Kansanshi Holdings Ltd.,[4] 79.4%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 20.6%]	Kansanshi high-pressure leach and solvent extraction-electrowinning plant	250,000 copper cathode.
Do.	Konkola Copper Mines plc [Vedanta Resources Finance Ltd., 79.4%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 20.6%]	Tailings leach plant at Chingola	80,000 copper cathode.

See footnotes at end of table.

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

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Copper and cobalt:—Continued				
Metal—Continued		Konkola Copper Mines plc [Vedanta Resources Finance Ltd., 79.4%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 20.6%]	Nchanga copper smelter, Chingola	311,000 copper anode (blister copper), 3,000 copper-cobalt alloy.
Do.		do.	Nkana copper refinery, Kitwe	300,000 copper cathode.
Do.		Mopani Copper Mines plc [Carlisa Investments Corp.,[5] 90%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 10%]	Mufulira West heap-leach facility	NA.
Do.		do.	Mufulira (ISASMELT) smelter	200,000 copper anode.
Do.		do.	Mufulira refinery	275,000 copper cathode.
Do.		do.	Nkana solvent extraction plant, southwest of Kitwe	15,000 copper cathode.
Do.		do.	Nkana cobalt plant,[2] southwest of Kitwe	2,800 cobalt metal.
Do.		Sable Zinc Kabwe Ltd. (Glencore plc, 100%)	Sable copper leach and electrowinning plant at Kabwe	14,000 copper cathode, 600 cobalt carbonate.
Do.		Sino-Metals Leach Zambia Ltd. [China Nonferrous Metals Mining (Group) Co. Ltd., Sino-Africa Mining Investments Ltd., NFC Africa Mining plc, and China Hainan Construction Co. Ltd.]	Chambishi	8,000 copper cathode.
Gemstones:				
Amethyst	kilograms	Kariba Minerals Ltd. (Gemfields PLC, 50%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 50%)	Kariba Mine, Mapatizya area, Kolomo District, Southern Province	1,100.
Beryl and emerald	do.	Kagem Mining Ltd. (Hagura Mining Ltd.,[6] 75%, and Government of Zambia, 25%)	Kagem Mine,[8] Ndola District, Copperbelt Province	6,600.
Tourmaline	do.	Artisanal miners	Various locations	NA.
Gold, Au content of ore	do.	Kansanshi Mining plc [Kansanshi Holdings Ltd., 80%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 20%]	Kansanshi Mine, north of Solwezi	5,300.
Iron and steel, crude steel		Universal Mining and Chemical Industries Ltd. (Trade Kings Group)	Kafue	100,000.
Lead, metal, secondary		Pagrik Zambia Ltd.	Lusaka	1,000.
Lime, quicklime		Ndola Lime Company Ltd. [Zambia Consolidated Copper Mines Investments Holdings Plc Holdings Plc (ZCCM–IH), 100%]	Ndola	300,000.[7]
Do.		Neelkanth Lime Ltd.	do.	144,000.[8]
Manganese		Kaboko Mining Ltd.	Mansa area, Luapula Province	120,000.
Do.		Primarily small-scale miners	Mansa area, Luapula Province and Mkushi area, Central Province	120,000.
Nickel, Ni content of ore		Jin Tuo Investments Ltd (Jinchuan Group International Resources Co. Ltd., 100%)	Munali Mine,[2, 9] about 60 kilometers south of Lusaka	10,500.
Petroleum, refined	42-gallon barrels	Indeni Petroleum Refinery Ltd. (Government, 100%)	Indeni refinery at Ndola	10,000,000.
Sulfur:				
Pyrite ore, gross weight		Konkola Copper Mines plc [Vedanta Resources Finance Ltd., 79.4%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM–IH), 20.6%]	Nampundwe Mine,[2] 48 kilometers west of Lusaka	300,000.
Sulfuric acid		do.	Nchanga acid plant	675,000.
Do.		Chambishi Copper Smelter Company, Ltd. [China Nonferrous Metal Mining (Group) Co. Ltd., 60%, and Yunnan Copper Industry (Group) Co. Ltd., 40%]	Chambishi copper smelter, 75 kilometers northwest of Ndola	600,000.
Do.		First Quantum Minerals Ltd.	Kansanshi smelter, north of Solwezi	1,000,000.

See footnotes at end of table.

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

Do., do. Ditto. NA Not available.
[1]Subsidiary of Lafarge S.A.
[2]Operations suspended. Facility on care-and-maintenance status.
[3]Subsidiary of Jinchuan Group International Resources Co. Ltd.
[4]Subsidiary of First Quantum Minerals Ltd.
[5]A joint venture of Glencore plc, 81.2%, and First Quantum Minerals Ltd., 18.8%.
[6]Subsidiary of Gemfields PLC.
[7]Plant has the capacity to produce up to 5,000 metric tons of hydrated lime (slaked) from quicklime.
[8]Plant has the capacity to produce up to 27,000 metric tons of hydrated lime from quicklime.
[9]Operated by Mabiza Resources Ltd. (Consolidated Nickel Mines Ltd., 100%) through a lease agreement with listed owners.