



2013 Minerals Yearbook

ZAMBIA

THE MINERAL INDUSTRY OF ZAMBIA

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Copper and cobalt mining and refining were the dominant components of Zambia's mineral industry. In 2013, Zambia was estimated to rank eighth in the world in the production of copper ore and sixth in the production of cobalt ore. Zambia also was an internationally significant producer of semiprecious gemstones (Brininstool, 2015; Shedd, 2015).

Minerals in the National Economy

In 2013, Zambia's gross domestic product (GDP) (at constant 1994 prices) increased by 6.5% compared with 7.3% in 2012. The construction sector accounted for 13.4% of Zambia's real GDP compared with 12.7% in 2012. The value of the mining and quarrying sector, which accounted for 7.8% of the GDP in 2013 compared with a revised 8.0% in 2012, increased by 4.1% compared with a decrease of 2.7% in 2012. The Bank of Zambia attributed the mining and quarrying sector's expansion to an increase in existing mine production, new mine production, and the continued increase of construction activities (Bank of Zambia, 2014, p. 31–36).

Government Policies and Programs

The mining sector is regulated primarily by Act No. 7 of 2008 (the Mines and Mineral Development Act of 2008). Uranium exploration and mining are regulated by the Mines and Minerals Development (Prospecting, Mining and Milling of Uranium Ores and Other Radioactive Mineral Ores) Regulations of 2008.

The Income Tax Act (Chapter 323 of the Laws of Zambia), the Income Tax (Amendment) Act of 2008, the Income Tax (Amendment) Act No. 27 of 2009, the Mines and Minerals Development Act of 2008, and the Mines and Minerals Development (Amendment) Act of 2013, address capital allowances, mineral royalties, mining development agreements, the variable profits tax, and the windfall tax. 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 Protection and Pollution Control Act of 1990, and its 1999 amendment, address environmental issues, including those associated with the mining industry. Petroleum exploration and production are regulated by Act No. 10 of 2008 [the Petroleum (Exploration and Production) Act of 2008].

In February 2013, the Government issued increased fees for mining licenses and permits. The Minerals Development Commission was formed in May 2013 for the purpose of verifying production figures submitted by companies. The Environmental Management (Licensing) Regulations of 2013, passed in November, provided criteria, limits, guidelines, and license requirements for emissions and effluents. In December,

the Government ordered emerald producers to submit mineral reports for tax purposes (Nyaungwa, 2013; Thomson Reuters, 2013; *Zambian Economist*, 2013; Chama, 2014).

Production

Data on estimated mineral production are in table 1. Notable increases in production were estimated for beryl, cobalt contained in concentrate, copper recovered and refined by electrowinning, emerald, and iron and steel. Notable decreases in production were estimated for refined cobalt. Cobalt and copper metal production data published by the Bank of Zambia were significantly higher than production estimates published by the Cobalt Development Institute and the International Copper Study Group (Bank of Zambia, 2014, p. 144; Cobalt Development Institute, 2014, p. 3; International Copper Study Group, 2014, p. 12).

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, which was owned by the Zambian Energy Corporation Ltd. of Ireland (52% equity interest) and ZCCM-IH (20%). Copperbelt Energy purchased the majority of its power from ZESCO Ltd., which was a Government parastatal company, but also had 80 megawatts (MW) of gas-turbine-powered generating capacity. ZESCO's 1,948.5 MW of generating capacity was powered by hydroelectric facilities. ZESCO also operated several small isolated diesel-fueled power stations (Liu, Masera, and Esser, 2013, p. 59; Copperbelt Energy Corporation PLC., 2014, p. 45).

In the past few years, domestic electric power demand has exceeded domestic supply, which adversely affected several proposed high-energy-demand mineral-processing projects in Zambia. In late 2013, electrical shortages were mitigated as Ndola Energy Company Ltd. commissioned a 50-MW heavy-fuel-oil plant and ZESCO commissioned a 150-MW hydroelectric generator, which was part of the Kariba North Bank Extension project that was expected to add 360 MW upon completion. An additional 1,150 MW of hydroelectric

generating capacity was expected by 2018. In July, the Government approved plans to sell a 49% interest in the Indeni Oil Refinery. In August, the Government approved feasibility studies of the proposed Bwana Mukubwa oil refinery and pipeline. The Government also commissioned a 160-million-barrel fuel storage facility in Lusaka in the first phase of a construction program to build four fuel depots in the next year to address challenges in the energy sector owing to inadequate storage infrastructure (Bariyo, 2013; Greve, 2013; Sakala, 2013; Copperbelt Energy Corporation PLC, 2014, p. 13–14; Mutumweno, 2014).

In February, the Government released \$120 million to Zambia Railway Ltd. (ZRL) for a 3-year rehabilitation program of freight and railways. ZRL planned to reestablish an inter-mine railway network and increase freight capacity. In December, the Tanzania-Zambia Railway Authority (TAZARA) planned to spend \$177 million over 5 years to increase capacity. The railway linked Zambia's Copperbelt Province with the Tanzanian port of Dar es Salaam (Hill, 2013; Tanzania Daily News, 2013).

Mineral Trade

In 2013, the preliminary value of exports and imports was estimated to be about \$10 billion and \$9 billion, respectively. Exports increased by about \$1 billion owing to an increase in metal exports to China, India, Japan, Switzerland, and the United Arab Emirates. The value of copper exports was estimated to be about \$7 billion in 2013, when copper exports accounted for an estimated 68% of Zambia's merchandise exports. The value of exports of cobalt was estimated to be \$138 million (1.3% of the preliminary value of Zambia's exports in 2013). Imports increased by about \$1 billion owing to an increase in copper ore imports from the Democratic Republic of the Congo [Congo (Kinshasa)] and manufactured goods from South Africa. The value of imports of petroleum was estimated to be about \$1.1 billion in 2013, when oil accounted for about 12% of Zambia's imports. The preliminary 2013 value of imports of fertilizer increased to \$383 million from \$304 million in 2012 (Bank of Zambia, 2014, p. 23).

Commodity Review

Metals

Cobalt and Copper.—Lubambe Copper Mine Ltd.'s rampup of the Lubambe copper mine (formerly the Konkola North Mine) continued as a shaft ore-handling system was commissioned in late 2013. The concentrator plant produced copper concentrate to be toll smelted and refined in Zambia by a third party. Production was expected to reach 45,000 metric tons per year (t/yr) of copper contained in concentrate by mid-2015, when the plant was expected to be processing 2.5 million metric tons per year (Mt/yr) of ore with an average grade of 2.3% copper. Feasibility work continued on the Lubambe extension area south of the present mine development. ZCCM-IH exercised its right to acquire up to 20% interest in the mining operation, of which 5% was free-carried interest. The joint venture of African Rainbow Minerals Ltd. of South Africa

and Vale S.A. of Brazil held the remaining 80% interest in the Lubambe copper mine (African Rainbow Minerals Ltd., 2013, p. 12, 204; 2014, p. 71–72).

Four direct (or indirect) subsidiaries of China Nonferrous Mining Corporation Ltd. (CNMC) operated copper facilities in Zambia, including Chambishi Copper Smelter Co., Ltd., CNMC Luanshya Copper Mines PLC, NFC Africa Mining PLC, and Sino-Metals Leach Zambia Ltd. In 2013, NFC Africa produced 28,069 metric tons (t) of copper in concentrate from the Chambishi Main and the Chambishi West Mines and continued the development of the southeast Chambishi ore body. The southeast ore body project, which was expected to be completed in 2016, was designed to produce 63,000 t/yr of copper in concentrate. CNMC Luanshya's Baluba Center Mine produced 16,184 t of copper contained in concentrate and the Muliashi project produced 21,551 t of copper cathode. The Muliashi heap-leaching system began initial production with an output of 2,561 t by yearend. The agitation-leach and heap-leach facilities were designed to produce 40,000 t/yr of copper cathode at full capacity. In October, the company started construction of the slag copper recovery project, which was expected to begin production in late 2014 (China Nonferrous Mining Corporation Ltd., 2014, p. 27–30, 34–35).

At yearend 2013, Chambishi Copper increased the production capacity of the Chambishi copper smelter to 250,000 t/yr of blister copper through the completion of the second phase expansion. Chambishi Copper produced 201,123 t of anode (blister copper) in 2013. Sister company Sino-Metals Leach Zambia Ltd. produced 4,002 t of copper cathode at the Chambishi leach plant in 2013. Production at the Chambishi leach plant was suspended in January as the plant's electrolytic cells were overhauled. Sino-Metals Leach's Chambishi processing plant produced 195 t of copper in concentrate in 2013. The West Mine of NFC Africa halted the supply of ores in June (China Nonferrous Mining Corporation Ltd., 2014, p. 30–31, 33).

Kansanshi Mining PLC, which was a subsidiary of First Quantum Minerals Ltd. of Canada, mined 36.3 million metric tons (Mt) of ore and milled 11.1 Mt of sulfide ore, 7.68 Mt of mixed ore, and 6.66 Mt of oxide ore in 2013 compared with milling 9.25 Mt of sulfide ore, 8.56 Mt of mixed ore, and 6.21 Mt of oxide ore in 2012. The output from the Kansanshi facility in 2013 also included 106,214 t of copper contained in concentrate compared with 92,149 t of copper contained in concentrate in 2012 (First Quantum Minerals Ltd., 2014, p. 55).

In 2013, First Quantum continued work to expand the Kansanshi facility's total copper production capacity to 400,000 t/yr by 2015. First Quantum started construction of a smelter designed to process 1.2 Mt/yr of copper concentrate and to produce 300,000 t/yr of copper cathode. The increase in total copper output would include both copper cathode and copper in concentrate. The company continued exploration drilling programs at Kansanshi and completed the infill drilling program at the Sentinel project (First Quantum Minerals Ltd., 2013; 2014, p. 43–44).

In 2013, Konkola Copper Mines plc (KCM), which was a subsidiary of Vedanta Resources plc, produced 200,000 t of copper cathode compared with 209,000 t in 2012. Mining

operations were affected by the temporary suspension at the Chingola open pit mine in January and by the temporary closure of shafts, the unavailability of equipment, and power interruptions at the Konkola Mine. In April, furnace leakage at the Nchanga smelter temporarily halted production until late May. The Konkola Deep Mine Project continued as KCM planned underground expansion after sinking a shaft (Vedanta Resources plc, 2013a, p. 5; 2013b, p. 4, 8; 2014a, p. 5; 2014b, p. 36).

Lumwana Mining Company Ltd., which was owned by Barrick Gold Corp. of Canada, operated the Lumwana copper mine. In 2013, production from Lumwana Mining's Chimiwungo open pit accounted for about 77% of the 24.2 Mt of ore that was milled and processed at the Lumwana Mine to produce about 118,000 t of copper contained in concentrate; the remainder of the ore mined came from the Malundwe pit. The ore contained cobalt, copper, gold, and uranium mineralization. Uranium in the concentrate was controlled by blending the ore to comply with agreed-to content limits for copper contained in concentrate sold to smelters. The Chimiwungo pit was scheduled to provide about 70% of the mill feed in 2014. After an exploration and delineation drilling program at Chimiwungo and Malundwe, Barrick updated the life-of-mine plan, which resulted in decreased stripping (Barrick Gold Corp., 2014, p. 18, 75, 77–79).

In 2013, Mopani Copper Mines plc produced 112,000 t of copper (which included blister copper and copper contained in concentrate) compared with 99,000 t of copper and about 100 t of cobalt (contained in concentrate and hydroxide) in 2012. Mopani also produced an additional 100,000 t of blister copper from ore obtained from other companies and traders in 2013. Decreased cobalt production was attributed to the suspension of operations at the Nkana cobalt plant. The Nkana cobalt plant upgrades were expected to increase capacity to 7,000 t/yr from 2,800 t/yr. The plant was placed on care-and-maintenance status in July 2012 owing to the lack of suitable feed and decreased world cobalt prices. The plant was expected to be operational in June 2014 (MetalBulletin, 2013; Glencore Xstrata plc, 2014, p. 14).

In 2013, Mopani continued the sinking of the 1,277-meter (m)-deep Synclinorium shaft at the Nkana Mine. Shaft completion and the initial hoisting of ore from the Nkana Synclinorium deposit was expected to begin by mid-2015. Mopani continued the refurbishment of the Mufulira smelter. More than 97% of the smelter's sulfur dioxide emissions were expected to be captured after the renovation compared with about 50% of the smelter's sulfur dioxide emissions prior to the investment (Glencore Xstrata plc, 2013; Murray & Roberts Cementation Zambia Ltd., 2013).

A number of cobalt and copper development and exploration projects in Zambia were ongoing. Enviro Processing Ltd., a wholly owned subsidiary of Berkeley Mineral Resources Plc (BMR) of the United Kingdom, continued the development of the Kabwe Lead-Zinc Recovery and Copper Processing project. The company acquired a copper cementation plant in June. The plant had a 29,200-t/yr copper-ore-processing capacity and was operational in December. The plant was expected to process concentrates and tailings to produce intermediate copper products to be sold to electrowinning plants. In October, the

company submitted an Environmental Impact Assessment (EIA) for approval (Berkeley Mineral Resources Plc, 2013; 2014, p. 1, 5, 8).

In 2013, Ndola Mineral Resources Ltd., owned by a joint venture of BMR (75% interest) and Phoenix Materials Ltd. (25% free-carried interest), entered into an agreement with Phoenix to acquire stockpiles held at Ndola. The stockpiles of copper ore and tailings material were planned to be delivered to Enviro Processing's processing plant at Kabwe. In March, BMR entered into a joint-venture agreement with Bwana Mkubwa Consortium to acquire a small-scale mining license for the Bwana Mkubwa Mine site. The site hosts stockpiles estimated to contain 2 Mt of copper ore and tailings (Berkeley Mineral Resources Plc, 2014, p. 5).

In 2013, First Quantum released a mineral resource estimate of 1.03 billion metric tons at a grade of 0.51% copper for the Sentinel project. Kalumbila Minerals Ltd., which was a subsidiary of First Quantum, continued construction of the \$2 billion Sentinel Mine, which was expected to be completed in late 2014. The Sentinel Mine was designed to mill and process 55 Mt/yr of ore and was expected to produce about 270,000 t/yr of copper in concentrate (First Quantum Minerals Ltd., 2014, p. 18, 44).

Blackthorn Resources Ltd. of Australia continued the development of the Kitumba prospect, part of the Mumbwa project. In April, Blackthorn announced an updated mineral resource estimate (indicated and inferred) of 108.9 Mt with a grade of 1.09% copper (0.5% copper cutoff grade) for the Kitumba prospect. In September, a prefeasibility study for the development of the prospect recommended an underground operation with a flotation and solvent extraction and electrowinning plant (Blackthorn Resources Ltd., 2013, p. 1, 6).

In 2013, Caledonia Mining Corp. of Canada searched for other parties in Zambia to operate the Nama cobalt-copper prospect. A preliminary technical study found that the surface leaching of copper would require the additional stripping of waste rock. The company awaited the approval of an EIA (Caledonia Mining Corp., 2014, p. 17).

Mwombezhi Resources Ltd. of Zambia, in which Argonaut Resources NL of Australia's subsidiary Lumwana West Resources Ltd. was earning interest, continued to explore for copper in Northwestern Province. After completing a 23-hole, 2,838-m drilling program on the Nyungu copper prospect in 2012, Mwombezhi planned to begin three drilling programs in May 2014. The company planned a 9-hole, 3,000-m drilling program on the Nyungu Central, North, and South prospects; an 8-hole, 2,400-m drilling program on the Kavipopo prospect; and a 10-hole, 2,500-m drilling program at the West Mwombezhi prospect (Argonaut Resources NL, 2014, p. 1–3).

Other copper sector activity included that of Superleg Zambia Ltd., which planned to build a copper processing and refining plant to process waste from tailing dumps. In November, Jinchuan Group International Resources Co. Ltd. of the Cayman Islands acquired Metorex Group of South Africa. Metorex operated the Chibuluma South Mine and planned to develop the Chifupu deposit, which was expected to extend mine life by 7 years (Mulikelela, 2013a; Jinchuan Group International Resources Co. Ltd., 2014, p. 7, 21).

Gold.—Gold recovery by Kansanshi Mining from the residue of the high-pressure leach circuit had increased in recent years. New gravity concentrators were installed in 2010. In 2013, output from the Kansanshi facility was more than the 4,200 kilograms of gold produced in 2012 (First Quantum Minerals Ltd., 2013, p. 29, 55).

In 2013, Luri Gold Ltd. of Australia continued the development of the Luri Hill Gold project. In October, the company received EIA approval for its proposed open pit mine and processing plant at the Dunrobin prospect. The company completed a feasibility study of the Dunrobin prospect and began development late in December. The company also completed a scoping study for the development of the Matala prospect. In December 2013, Luri Gold sold 75% interest in the Luri Hill gold project to Bamboo Rock Ltd. of South Africa. In 2012, Luri Gold announced an initial measured resource estimate for the Dunrobin prospect of 978,000 t at a grade of 2.6 grams per metric ton (g/t) gold and indicated and inferred resources of 1.8 Mt at a grade of 1.9 g/t gold (using a cutoff grade of 1 g/t gold) (Luri Gold Ltd., 2014, p. 4–5).

Lead and Zinc.—In 2013, Enviro Processing Ltd. continued the development of the Kabwe Lead-Zinc Recovery and Copper Processing project tailings project after acquiring area surface and underground assets in 2012. A feasibility study released in August estimated the combined surface assets to contain 6.4 Mt of 5.50% zinc and 5.48% lead, which included a 2.6-Mt central leachplant stockpile estimated to contain 8.71% lead and 3.88% zinc; a 573,000-t washplant stockpile estimated to contain 10.66% zinc and 7.21% lead; Imperial smelter slag and Waelz furnace slag stockpiles; pyrite tailings; and mixed leachplant stockpiles. The company planned to use a mobile gravity separation and leachplant to begin processing the washplant tailings stockpile. Development was halted until the company's EIA was approved. The Kabwe site also hosted ore bodies that contain an estimated 51 Mt of ore at a combined grade of 4.01% lead and zinc. In 2012, BMR and Yunnan Xiangyun Feilong Nonferrous Metal Co. of China signed a memorandum of agreement to form a joint venture to recover lead and zinc from the Kabwe stockpiles (Ascot Group Ltd., 2013, p. 7–8, 16; Berkeley Mineral Resources Plc, 2014, p. 1, 3–4, 6).

Manganese.—Manganese ore was produced primarily by small-scale operations near Mansa in Luapula Province and Mkushi in Central Province. In 2013, Kaboko Mining Ltd. of Australia began mining operations at the Mansa project and continued the exploration and development of the Emmanuel project. After acquiring a processing plant in April, Kaboko completed its scoping study of the Mansa project in May. Production of ore at Mansa began in June. The project was expected to reach production of 120,000 t/yr of manganese ore by early 2014. In January, Kaboko reached an agreement to supply ore to Noble Resources International Pte. Ltd., a wholly owned subsidiary of Noble Group Ltd. By yearend, Kaboko had supplied 2,000 t of manganese ore to Noble. Kaboko continued exploration at the Emmanuel project (which included the Brunelli prospect, the Chowa Mine prospect, and the Kapumba prospect), the Kanona project, and the Northern Manganese

project (formerly the Peco project) near Mansa (Kaboko Mining Ltd., 2013a, p. 2–4, 7–11; 2013b).

Zamanco Minerals Ltd. of Australia (formerly Atticus Resources Ltd.) continued to develop the Serenje manganese project, which was a 56,000-t/yr manganese smelter. Zamanco had completed a scoping study and awaited EIA approval. In 2013, Zamanco continued exploration work on the Nkundalia and Chinali prospect (Zamanco Minerals Ltd., 2013).

Nickel.—First Quantum continued exploration of the Trident project, which included the Enterprise nickel sulfide prospect and the Sentinel copper prospect. First Quantum planned to develop a 4-Mt/yr-capacity ore-processing facility at the Sentinel copper plant to process nickel ore from the Enterprise Mine, which initially was expected to produce 38,000 t/yr of nickel in concentrate. First Quantum released a mineral resource estimate of 40.1 Mt at a grade of 1.07% nickel for the Sentinel project. The processing plant was designed to process copper ore and nickel ore from the Sentinel Mine (First Quantum Minerals Ltd., 2014, p. 44).

In May, Albidon Ltd. was acquired by Jin Tuo Investments Ltd., which was a subsidiary of the Jinchuan Group Resources Holding Ltd. of China, which itself was a subsidiary of Jinchuan Group International Resources Co. Ltd. Albidon Ltd. had owned the Munali nickel mine, which had been placed on care-and-maintenance status (Zambia Consolidated Copper Mines Investments Holdings Plc, 2013, p. 21; 2014, p. 5).

Industrial Minerals

Cement.—In 2013, Dangote Cement Plc of Nigeria continued the construction of the 1.5-Mt/yr Ndola cement plant, which is located in the Masaiti District near Ndola. The company planned to construct another 1.5-Mt/yr plant in Lusaka after the completion of the Ndola plant. By yearend, the Ndola plant was under construction (Kalia, 2013).

Gemstones.—Kagem Mining Ltd., which was a joint venture of Hagura Mining Ltd. (75%) and the Government of Zambia (25%), operated the Kagem open pit emerald mine, and continued an underground emerald trial mining program. Kariba Minerals Ltd., which was owned by Gemfields PLC of the United Kingdom (50% interest) and ZCCM-IH, reported recapitalization efforts at the Kariba amethyst mine. The company installed a washplant, two excavators, and a photovoltaic powerplant (Gemfields PLC, 2014).

Rare Earths.—In 2013, Fisherman Mining Ltd., which was a subsidiary of African Consolidated Resources plc of the United Kingdom, continued the development of the Nkombwa Hill project. In January 2013, Zambia's Ministry of Mines and Mineral Development confirmed Fisherman Mining Ltd. as the sole holder of the disputed Nkombwa project license. Galileo Resources Plc of the United Kingdom elected not to pursue an option to acquire Rare Earth International Ltd.'s (REI's) interest in the joint-venture project to explore the Nkombwa Hill carbonatite for rare earths (African Consolidated Resources plc, 2013a, p. 6; 2013b; Galileo Resources Plc, 2014, p. 44).

Sulfur.—In 2013, Chambishi Copper completed the second phase expansion of the Chambishi copper smelter, which increased the smelter's sulfuric acid production capacity to

600,000 t/yr. The smelter was expected to be completed by yearend 2014. Also in 2013, First Quantum completed the expansion of the 14.5-Mt/yr oxide circuit at the Kansanshi Mine. The company deferred the completion of a 25-Mt/yr sulfide ore treatment plant until 2017 (First Quantum Minerals Ltd., 2013; 2014, p. 43–44; China Nonferrous Mining Corporation Ltd., 2014, p. 33).

Mineral Fuels and Related Materials

Coal.—In February 2013, the Government canceled Collum Coal Mining Industries Ltd.’s three mining licenses owing to safety and environmental concerns. In May, the mining licenses were issued to ZCCM-IH, which incorporated the wholly owned subsidiary Nkandabwe Coal Mine Ltd. to operate the mine. In late 2013, ZCCM-IH sought the transfer of Collum’s mine assets. The Nkandabwe Mine had been placed on care-and-maintenance status (Mulikelela, 2013b; Zambia Consolidated Copper Mines Investments Holdings Plc, 2014, p. 51).

Maamba Collieries Ltd., which was owned by a consortium of Nava Bharat Proprietary Ltd. of Singapore (a subsidiary of Nava Bharat Ventures Ltd. of India) and ZCCM-IH, produced coal in 2013 and continued construction of its onsite powerplant. Rehabilitation of Maamba’s facilities began in 2010 (Zambia Consolidated Copper Mines Investments Holdings Plc, 2013, p. 12–13).

Uranium.—Denison Mines Zambia Ltd., which was a subsidiary of Denison Mines Corp. of Canada, continued to explore the Mutanga project, which included the Dibwe North, the Dibwe-Mutanga corridor, and the Mutanga East deposits. In 2013, technical analysis of the Mutanga project estimated a combined measured and indicated mineral resource estimate of 10.3 Mt at a grade of 345 parts per million U_3O_8 equivalent (Denison Mines Corp., 2014, p. 11).

Outlook

Historically, Zambia’s mineral industry has been dominated by the copper sector, although Zambia has many deposits and occurrences of other metals and industrial minerals, such as barite, feldspar, graphite, iron ore, kaolin, lead, silica sand, talc, and zinc. Landlocked Zambia faces several internal and external obstacles to successful diversification of its mineral production, which includes the availability of electrical energy and fuel supplies, cyclical world commodity prices, and high transportation costs.

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TABLE 1
ZAMBIA: ESTIMATED PRODUCTION OF MINERAL COMMODITIES^{1,2}

(Metric tons unless otherwise specified)

Commodity ³	2009	2010	2011	2012	2013
METALS					
Cobalt:					
Mine output, Co content	4,900	6,200	5,400	4,200 ^r	5,200
Metal ⁴	1,506	5,026	5,746	5,665	5,000
Copper:⁵					
Mine output, Cu content:					
Concentration or cementation	496,000 ^r	527,000 ^r	521,000 ^r	517,000 ^r	559,000
Leaching, electrowon	141,000	145,000 ^r	142,000 ^r	178,000 ^r	201,000
Total	637,000 ^r	672,000 ^r	663,000 ^r	695,000 ^r	760,000
Metal, smelter, primary, includes low-grade electrowon	402,000 ^r	535,000 ^r	520,000 ^r	519,000 ^r	520,000
Refinery, primary:					
Electrowon	146,000 ^r	158,000 ^r	147,000 ^r	186,000 ^r	241,000
Other	294,000 ^r	370,000	370,000	344,000 ^r	327,000
Total	440,000 ^r	528,000 ^r	517,000 ^r	530,000	568,000
Gold kilograms	3,300	3,600	3,800	4,500	4,500
Iron and steel, crude steel	10,000	40,000	50,000	50,000	55,000
Manganese:					
Gross weight	40,000	120,000	120,000	120,000	120,000
Mn content	13,000	40,000	40,000	40,000	40,000
Nickel, Ni content of concentrates	280	2,482 ⁴	2,724 ⁴	-- ⁴	--
Silver kilograms	6,000	6,500	6,500	6,400	6,400
INDUSTRIAL MINERALS					
Cement	880,000	1,126,728 ⁴	1,200,000	1,200,000	1,200,000
Gemstones:					
Amethyst kilograms	1,400,000	1,300,000	1,000,000	1,050,000	1,150,000
Beryl million carats	6	13	7	10	11
Emerald do.	11	20	14	17	19
Tourmaline kilograms	21,000	20,000	20,000	21,000	20,000
Lime, calcined thousand metric tons	130	140	50	200	200
Limestone:					
For cement and lime do.	2,000	2,500	2,400	2,600	2,700
Crushed aggregate do.	750	800	1,000	1,000	1,050
Sand and gravel, construction do.	320	350	360	360	370
Sulfur:					
Gross weight:					
Pyrite concentrate	100,000	--	--	--	--
Sulfuric acid ⁶	600,000	990,000	800,000	950,000	910,000
Sulfur content:					
Pyrite concentrate (42% S)	42,000	--	--	--	--
Sulfuric acid (32.6% S)	200,000	300,000	240,000	310,000	290,000
Total, S content	242,000 ^r	300,000	240,000	310,000	290,000
MINERAL FUELS AND RELATED MATERIALS					
Coal, bituminous	200,000	200,000	220,000	200,000	200,000
Petroleum, refinery products ⁷ thousand 42-gallon barrels	3,700 ^r	3,800 ^r	4,700 ^r	-- ^r	--

^rRevised. do. Ditto. -- Zero.

¹Estimated data are rounded to no more than three significant digits; may not add to totals shown.

²Table includes data available through February 25, 2014.

³In addition to the commodities listed, bismuth, clays, lead, palladium, platinum, and selenium may be produced, but available information is inadequate to make reliable estimates of output.

⁴Reported figure.

⁵Terms used are as defined by the International Copper Study Group.

⁶From the Chambishi and the Nkana acid recovery plants.

⁷From the U.S. Energy Information Administration.

TABLE 2
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2013

(Metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Bismuth	Chambishi Copper Smelter Company, Ltd. [China Nonferrous Metal Mining (Group) Company 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%)	Ndola, Copperbelt	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	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	330,000.
Coal, bituminous	Maamba Collieries Ltd. [Nava Bharat consortium, 65%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM-IH), 35%]	350 kilometers south of Lusaka in the Kanzie and the Izuma Basins	400,000.
Do.	Nkandabwe Coal Mine Ltd. [Zambia Consolidated Copper Mine Investments Holdings Plc (ZCCM-IH), 100%]	Kandabwe Mine, ² near Sinazongwe	240,000.
Copper and cobalt:			
Ore and concentrate	Lubambe Copper Mine Ltd. [Joint venture of 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 joint products.
Do.	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 18,000 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	1,500,000 ore.
Do.	do.	Luanshya North Mine, Luanshya	4,500,000 ore.
Do.	Kansanshi Mining plc [Kansanshi Holdings Ltd., ⁴ 80%, 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 [Vedanta Resources Finance Ltd., 79.4%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM-IH), 20.6%]	Chingola open pit A and Nchanga open pit, Chingola	4,500,000 ore.
Do.	do.	Nchanga underground mine, 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.

See footnotes at end of table.

TABLE 2—Continued
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2013

(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	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) Company 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; 3,400 cobalt metal.
Do.	Chambishi Copper Smelter Co., Ltd. [China Nonferrous Metal Mining (Group) Company Ltd., 60%, and Yunnan Copper Industry (Group) Co. Ltd., 40%]	Chambishi copper smelter, 75 kilometers northwest of Ndola	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 80%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM-IH), 20%]	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, Chingola	80,000 copper cathode.
Do.	do.	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 International plc, 100%)	Sable copper leach and electrowinning plant, Kabwe	14,000 copper cathode; 600 cobalt carbonate.
Do.	Sino-Metals Leach Zambia Ltd. [China Nonferrous Metals Mining (Group) Company Ltd., Sino-Africa Mining Investments Ltd., NFC Africa Mining plc, and China Hainan Construction Co. Ltd.]	Chambishi	8,000 copper cathode.

See footnotes at end of table.

TABLE 2—Continued
ZAMBIA: STRUCTURE OF THE MINERAL INDUSTRY IN 2013

(Metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Gemstones:				
Amethyst		Kariba Minerals Ltd. [Gemfields PLC, 50% and Zambia Consolidated Mines Investments Holdings Plc (ZCCM-IH), 50%]	Kariba Mine, Mapatizya area, Kolomo District, Southern Province	1,100.
Beryl and emerald	kilograms	Kagem Mining Ltd. (Hagura Mining Ltd., 75%, and Government of Zambia, 25%)	Kagem Mine, Ndola District, Copperbelt Province	6,600.
Tourmaline		Artisanal miners	Various locations	NA.
Gold, Au content of ore	kilograms	Kansanshi Mining plc [Kansanshi Holdings Ltd., ⁴ 80%, and Zambia Consolidated Copper Mines Investments Holdings Plc (ZCCM-IH), 20%]	Kansanshi Mine, north of Solwezi	4,800.
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 (ZCCM-IH), 100%]	Ndola	300,000. ⁶
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 about 60 kilometers south of Lusaka	10,500.
Petroleum, refined	42-gallon barrels	Indeni Petroleum Refinery Ltd. (Government, 100%)	Indeni refinery, 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) Company 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.	Bwana Mkubwa acid plant, near Ndola	350,000.

Do., do. Ditto. NA Not available.

¹Subsidiary of Lafarge S.A.

²Operations suspended. Facility on care-and-maintenance status.

³Subsidiary of Jinchuan Group International Resources Co. Ltd.

⁴Subsidiary of First Quantum Minerals Ltd.

⁵A joint venture of Glencore International plc, 81.2%, and First Quantum Minerals Ltd., 18.8%.

⁶Plant has the capacity to produce up to 5,000 metric tons of hydrated lime (slaked) from quicklime.