



# Zambia 2023 Mining Report

November 2023

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# Foreword



**Andrew Chibuye**  
Country Senior Partner  
PwC Zambia

Investment in Zambia's mining sector tripled in 2022 thanks largely to the introduction of various tax incentives in the new Government's first budget and the apparent commitment to maintaining a stable mining tax policy. This is good news and is much needed if Zambia is to meet the ambitious Government target to produce three million tonnes of copper per year by 2032.

Despite the increase in investment, copper production fell in 2022 to 763,550 metric tonnes. While this was in part due to ongoing issues at two of the country's largest mines, it is clear that Zambia has much work to do if it is to realise its three million tonne target in the next eight years. Furthermore, while the mining sector is the largest contributor to tax revenue in Zambia, there is growing public expectation to see these incentives translate into even greater tax revenue and development.

In the first edition of our mining report, we focused on how Zambia's mining sector can rebuild trust among stakeholders. In this, our second edition, we have engaged directly with the mining companies to broaden the discussion around mining as well as draw on available information about the sector.

By presenting all this information in one place, we hope to help stakeholders better understand the industry and encourage greater participation in the sector's development.

I would like to take this opportunity to acknowledge and thank the following for their input:

- Survey respondents
- The Ministry of Mines and Minerals Development
- The Ministry of Finance and National Planning
- The Zambia Revenue Authority
- The Zambia Development Agency
- The Zambia Statistics Agency
- The Bank of Zambia
- The Zambia Extractive Industries Transparency Initiative
- The Zambia Chamber of Mines
- Mr Kurt House, Chief Executive Officer of Kobold Metals

I would also like to acknowledge the members of staff at PwC Zambia that have contributed to the preparation of this publication.

We look forward to receiving your feedback.



# Introduction

Mining continues to form the backbone of economic growth in Zambia. Increased global demand for commodities driven by the shift from fossil fuels to renewable energies has created an opportunity for Zambia to grow the sector and meet this demand. Minerals such as copper are crucial in the global energy sector's goal to achieve net zero carbon dioxide emissions by 2050. The sector's importance to Zambia's economic development has also been underscored by the United Party for National Development (UPND) Government's plans to increase copper production to three million tonnes per annum by 2032.

This report builds on our first mining sector report, which looked at building trust and securing the future of Zambia's mining sector. In this, our second mining sector report, we broaden the conversation to include discussion around some of the wider issues affecting the sector.

We obtained data for this report through research, surveys and interviews with key industry stakeholders, most notably, some of the mining companies. The profile and geographical of our survey respondents is as follows:

Location	Life of Mine	2022 Emerald Production
Copperbelt - 4 North-Western - 3 Central - 1	0 -10 years : 2 10 - 20 years : 2 20 - 30 years : 2 >30 years : 1	37,241,282 CT
Nature	Employees	2022 Copper Production
Open Pit - 5 Underground - 1 Combined - 2	>10,000 : 1 5,000 - 10,000 : 1 2,500 - 5,000 : 2 <2,500 : 4	542,676MT (71%)

The mining companies that responded to our survey together represent 71% of Zambia's total annual copper production in 2022. In addition, we spoke to companies that are engaged in exploration as this is a strategically important area that will need to grow considerably if Zambia is to reach its three million tonne target by 2032.

Some of the broader issues we discuss in this report include:

- The three million metric tonne annual copper production target
- Exploration
- Mineral diversification
- Local participation
- Artisanal/small-scale mining
- Improving oversight and compliance
- Environmental, social and governance (ESG) aspects of mining



# Mining sector facts and figures

## Overview of the mining sector in Zambia

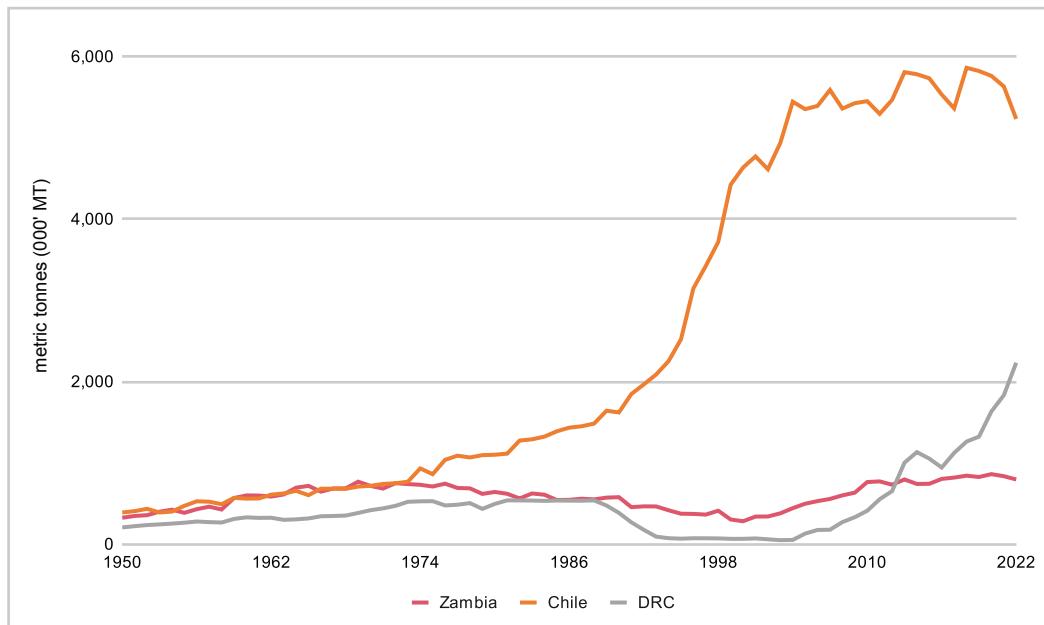
In this section of the report, we analyse the sector's performance in terms of production, export earnings, contribution to employment, taxes, investments, and dividends paid. Where possible, we compare Zambia's mining sector to other mining-dependent countries. Over the years, Zambia's mining sector has been recognised globally for its copper and emerald production. However, the sector produces other valuable minerals, such as gold, manganese, nickel, coal and precious stones, among others, which will become increasingly important as Zambia looks to diversify its mineral exports.

### I. Mining production output

In 2022, Zambia and Chile both experienced a decrease in copper production compared to 2021. While Zambia's production fell from 803,747 metric tonnes in 2021 to 763,550 tonnes in 2022, Chile's production fell from 5.6 million to 5.2 million tonnes. In contrast, the Democratic Republic of Congo ("DRC") continued its upward production trend, with copper production increasing from 1.8 million to 2.2 million tonnes in 2022. This is largely due to production increasing at the Kamoza Kakula Copper Mine.



**Figure 1: Annual copper output for Zambia, Chile and the DRC**



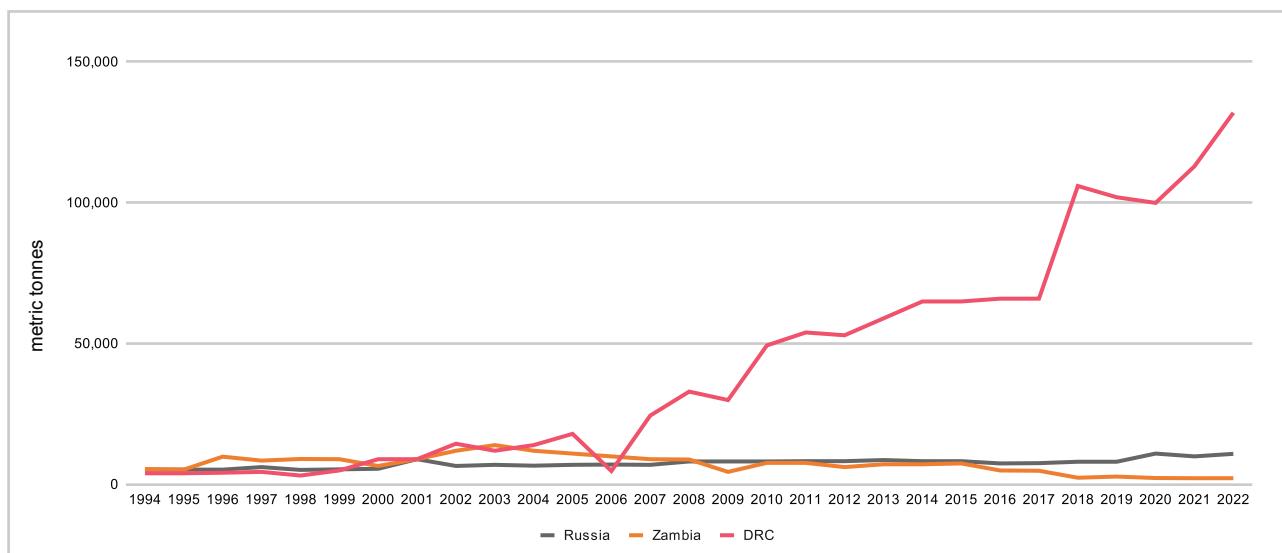
Source: US Geological Mineral Commodity Summaries

## Cobalt

During the period under review, Zambia's peak cobalt production was between 2002 and 2005, averaging 10,250 metric tonnes. Between 1994 and 1998, Zambia was uninterruptedly Africa's leading cobalt producer; since 2007, the DRC has significantly overtaken Zambia to become Africa's leading cobalt producer. In 2022, DRC's production increased to 130,000 metric tonnes from 111,000 metric tonnes produced in 2021. Russia's Cobalt production has been fairly consistent over the years, increasing from 8,000 metric tonnes in 2021 to 8,900 metric tonnes in 2022.<sup>1</sup>

It is sufficient to note that, despite Zambia's intention of leading global cobalt output alongside the DRC, production levels since 2017 have fallen significantly short of the ideal range. Zambia's production increased marginally from 251 to 247 metric tonnes in 2021.<sup>2</sup> Determining the mineral's production potential is further challenged by the insufficiency of current information relating to Zambia's cobalt reserves.

**Figure 2: Annual cobalt output for Zambia, Russia and the DRC**



Source: US Geological Mineral Commodity Summaries

1 Mineral Commodity Summaries 1950-2023 <https://www.usgs.gov/centers/national-minerals-information-center/mineral-commodity-summaries>

2 2022 Annual Economic Report [https://www.mofnp.gov.zm/?wpdm\\_pro=2022-annual-economic-report](https://www.mofnp.gov.zm/?wpdm_pro=2022-annual-economic-report)



The table below shows copper and cobalt trends in Zambia.

**Table 1: Copper and cobalt production summary**

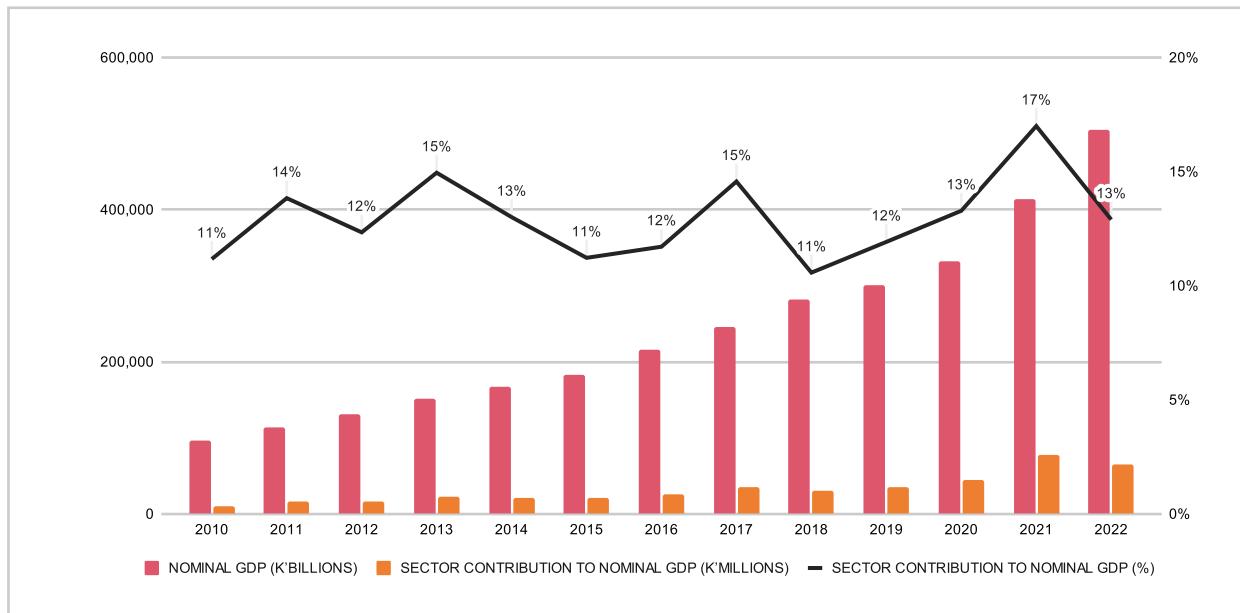
Statistic	Copper	Cobalt
29-year production peak	2020	2003
Amount produced during peak production (MT) year	869,000	12,000
29-year production low	1999	2021
Amount produced during lowest production (MT) year	271,000	241

Source: US Geological Mineral Commodity Summaries

## II. Contribution to GDP

Mining's contribution as a percentage of Zambia's GDP has broadly increased since 2010, rising from 11% in 2010 to 17% in 2021. However, in 2022, the sector's contribution to GDP fell from 17% to 13%.<sup>3</sup> Domestic GDP growth is projected to be 2.7% in 2023, a reduction from 5.2 % in 2022. The slowdown in GDP is attributed to lower mineral production due to operational challenges and flooding in some of the major mines and lower copper ore grades, in particular the copper mines.

**Figure 3: Mining sector contribution to GDP**



Source: Ministry of Finance and National Planning

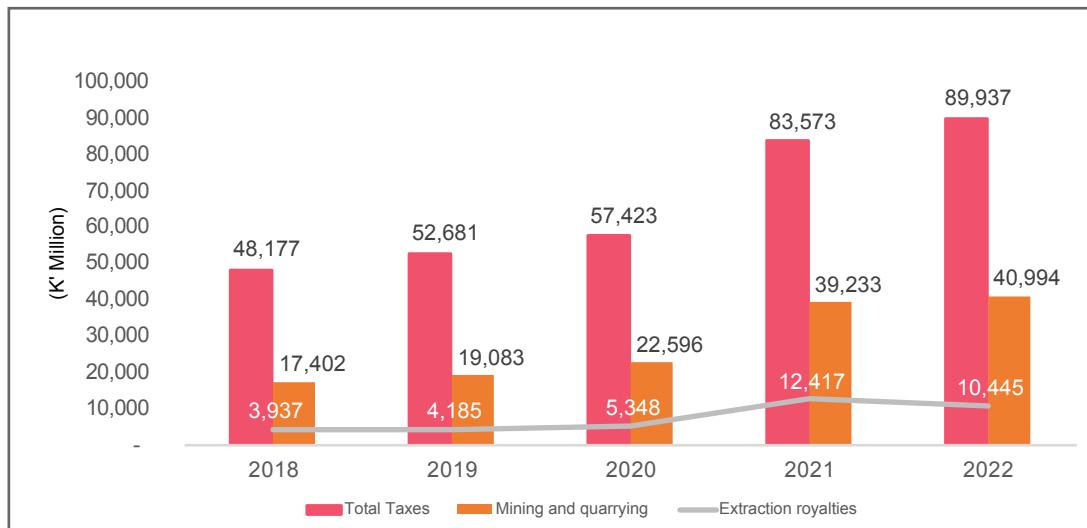
## Mining and quarrying's contribution to tax revenues

A critical measure of the sector's contribution to the economy is the percentage of domestic taxes collected that are generated by mining. Figures published by the Zambia Revenue Authority (ZRA) show that mining is the largest contributor to the treasury.

The proportion of tax revenue to GDP decreased from 18.8% in 2021 to 17.8% in 2022. This was mainly due to lower mining tax collections and the suspension of VAT, customs and excise duties on fuel. Mineral royalty and mining company income tax were below the set collection targets, while other tax types were above collection targets.

3 2022 Ministry of Finance Annual Economic Report [https://www.mofnp.gov.zm/?wpdm\\_pro=2022-annual-economic-report](https://www.mofnp.gov.zm/?wpdm_pro=2022-annual-economic-report)

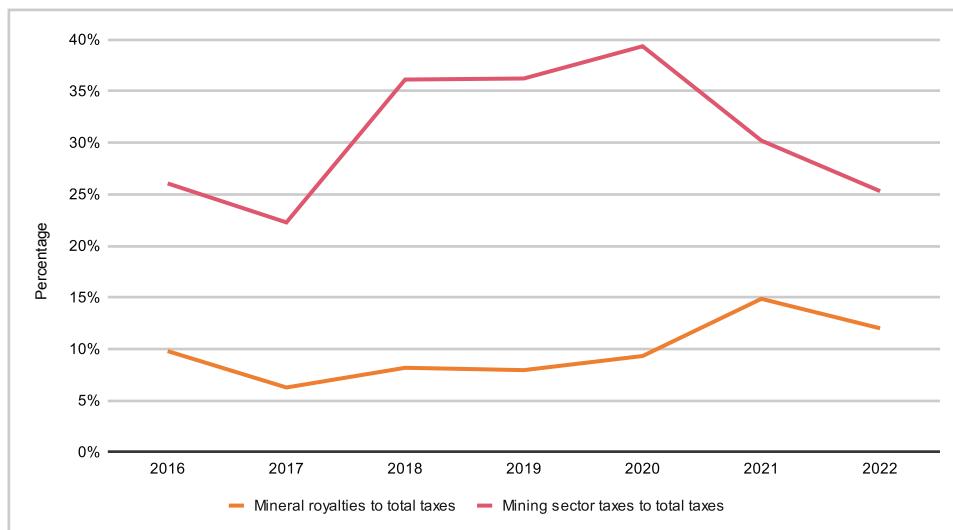
**Figure 4: Mining and quarrying contribution to taxes**



Source: Zambia Revenue Authority

In 2022, core mining taxes, which include mining company tax, mineral royalties and export duty on mineral concentrates, accounted for 25.3% of total tax revenue. This compares to 30.2% in 2021. Mineral royalties as a percentage of total taxes reduced from 15% in 2021 to 12% in 2022. The drop in tax revenue from the mining sector was attributed to reduced copper production at certain mines, low grade ore, capital constraints, a fall in international copper prices, and the appreciation of the Kwacha against the US dollar for much of the year.<sup>4</sup>

**Figure 5: Mining tax revenue as a percentage of total taxes**



Source: Ministry of Finance and National Planning & Zambia Revenue Authority

4 Zambia Revenue Authority 2022 Annual Report <https://www.zra.org.zm/wp-content/uploads/2023/05/ZRA-Annual-Report-2022-compressed.pdf>

## VAT refunds

The number of VAT refund claims in 2022 reduced by 2.8% to 13,730 from 14,119 in 2021. A total of K16,146.2 million was paid out in VAT refunds in 2022, an increase on the K12,238.4 million paid out in 2021. Mining accounted for K11,064.4 million of the K16,146.2 million of total VAT refunds in 2022, the equivalent of 68% of all VAT refunds. This is a reduction from 2021 when mining VAT refunds represented 74% of total VAT refunds.<sup>5</sup>

Meanwhile, K0.7 million was paid in mineral royalty refunds to the mining companies in 2022.

Table 2 : VAT refunds by economic sector 2020-2022 (K' million)

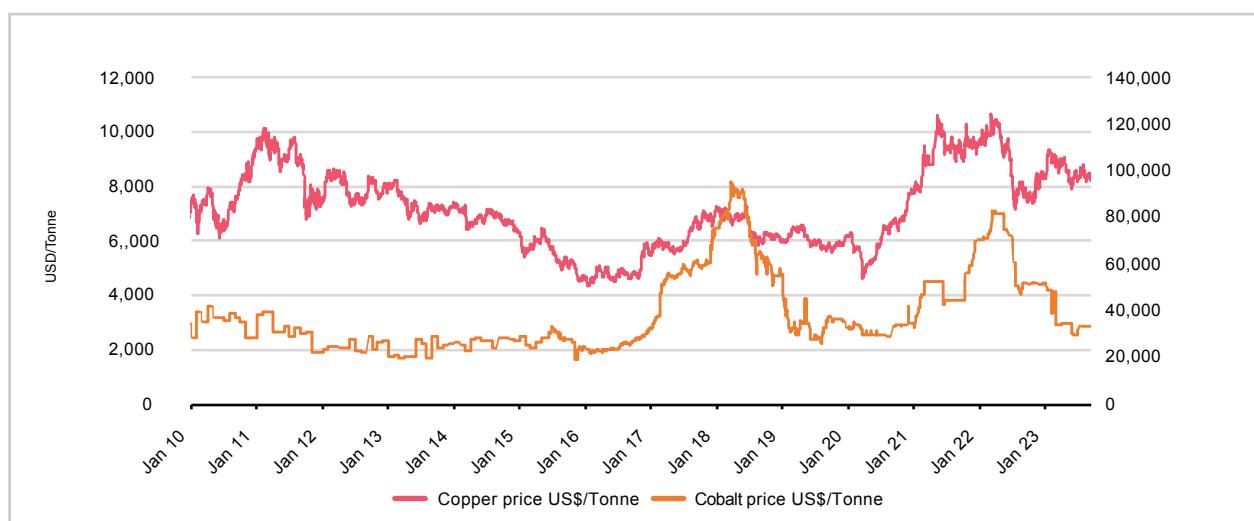
Return Period	Mining	Non-Mining	Total
2020	9,608.4	3,034.2	12,642.6
2021	9,056.4	3,182.0	12,238.4
2022	11,064.40	5,081.8	16,146.2

Source: Zambia Revenue Authority

## III. Commodity prices

Prevailing commodity prices have a big impact on the mining sector's performance. The graph below shows copper and cobalt prices since 2010. As we can see from this chart, copper and cobalt prices have fallen significantly since the beginning of 2022, although the copper price has recovered somewhat in 2023. This, coupled with the issues already mentioned, has contributed to the sector's lower tax contributions. Analysis of annual average cobalt prices shows that since 2020 prices have rebounded in the last few years. Cobalt prices rose by 26% from USD50,595 in 2021 to USD63,560 per metric tonne in 2022. However, in 2022, annual average copper prices fell by 6% from USD9,288 per metric tonne in 2021 to USD8,777 per tonne.

Figure 6: Annual average cobalt and copper prices



Source: Bank of Zambia | Commodity price highlights

5 Zambia Revenue Authority 2022 Tax Statistics <https://www.zra.org.zm/wp-content/uploads/2023/08/2022-Tax-Statistics.pdf>

**Table 3: Summary of copper and cobalt prices**

Statistic	Copper	Cobalt
Price (US\$/MT): 6 October 2023	8,046	3,340
Price (US\$/MT): 21-year high (2001 to September 2023)	10,674	120,393
Date: 21-year high (2001 to July 2022)	4-Mar-22	23-Jul-07
Highest 21-year annual average – Year	2021	2018
Highest 21-year annual average – Price (US\$/MT)	9,288	72,935
Lowest 21-year annual average – Year	2001	2002
Lowest 21-year annual average – Price (US\$/MT)	1,578	15,634

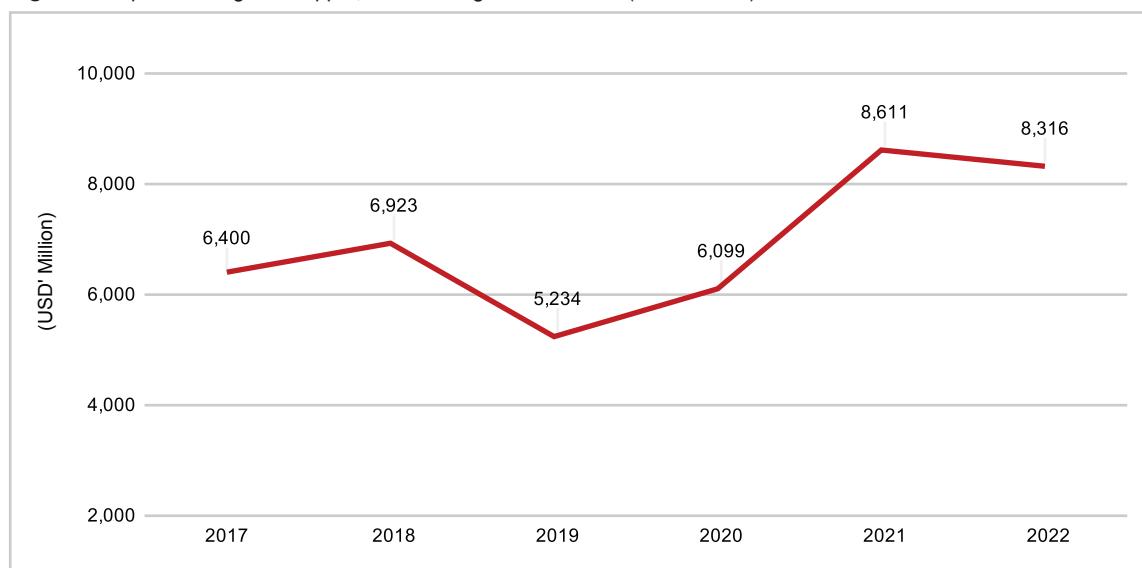
Source : Bank of Zambia



## IV. Mineral export earnings

Copper export earnings for 2022 fell by 3.2% from USD8,397 million in 2021 to USD8,129 million largely due to lower export volumes. The reduction in export volumes was underpinned by a decline in copper output because of low ore grades, operational challenges and routine closures for maintenance at some mines. Gold export earnings fell from USD209.2 million to USD187 million in the same period due to lower commodity prices and export volumes. Cobalt earnings also continued to fall as Zambia's main cobalt producer (Chambishi Metals) remained on care and maintenance.<sup>6</sup>

**Figure 7: Export earnings for copper, cobalt and gold 2017-2022 (USD' Million)**



Source: Ministry of Finance and National Planning

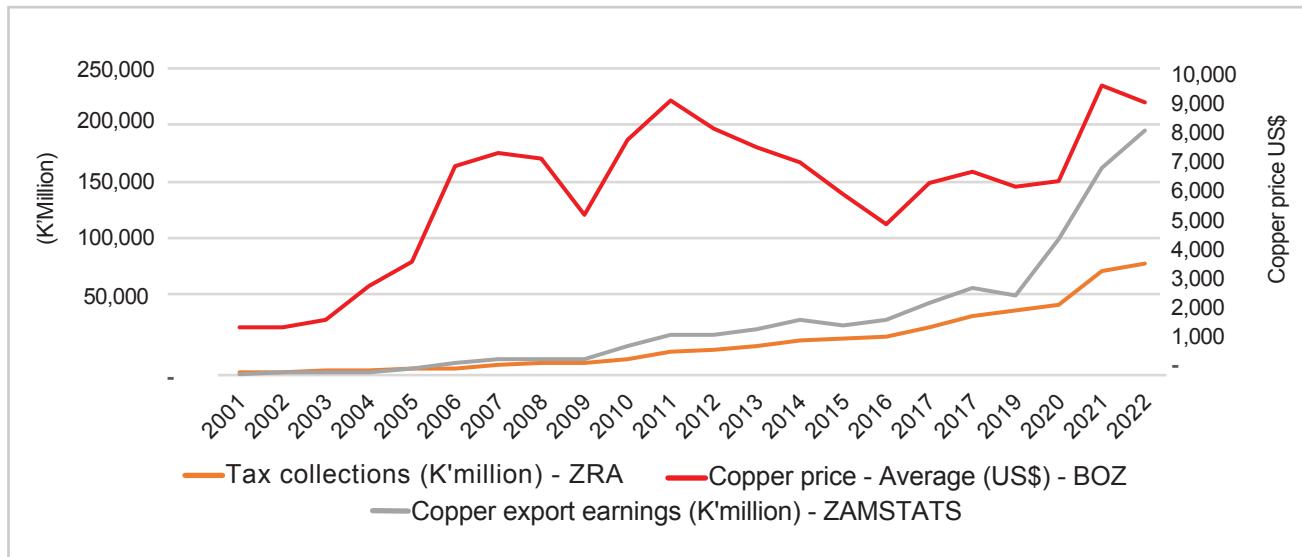
<sup>6</sup> 2022 Annual Economic Report [https://www.mofnp.gov.zm/?wpdm\\_pro=2022-annual-economic-report](https://www.mofnp.gov.zm/?wpdm_pro=2022-annual-economic-report)



## Copper's Contribution to Export Earnings

Mining was the biggest contributor as a sector to total tax revenue. Furthermore, copper accounts for the most foreign exchange earnings per mineral.

Figure 8: Tax collections, copper earnings and copper price from 2001-2022

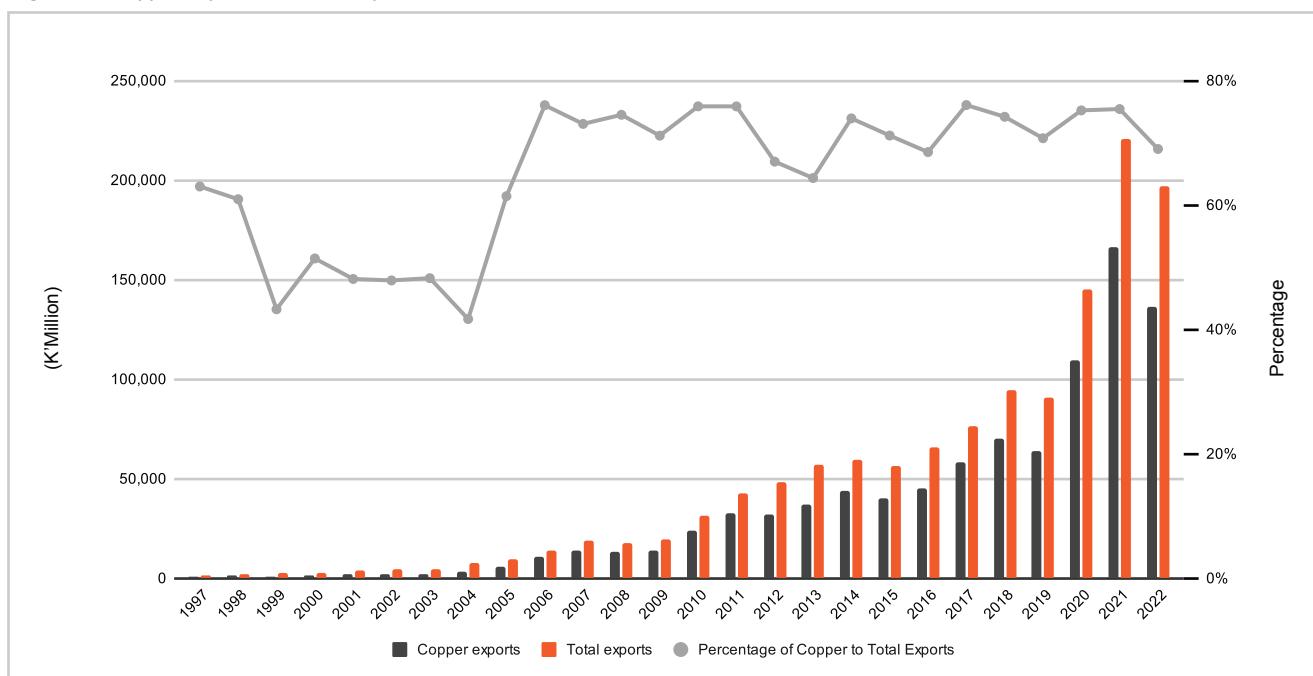


Source: Zambia Revenue Authority | Bank of Zambia | Zambia Statistics Agency

## Copper exports as a share of total exports

Between 1997 and 2022, both total exports and copper exports increased, albeit with some volatility, with copper exports peaking in 2021. However, in 2022 lower total exports and copper exports were recorded, on account of the reasons already discussed. Copper exports as a percentage of total exports fell by 5% from 74% in 2021 to 69% in 2022.

Figure 9: Copper exports and total exports 1997-2022



Source: Ministry of Mines and Mineral Development | Central Statistics Office

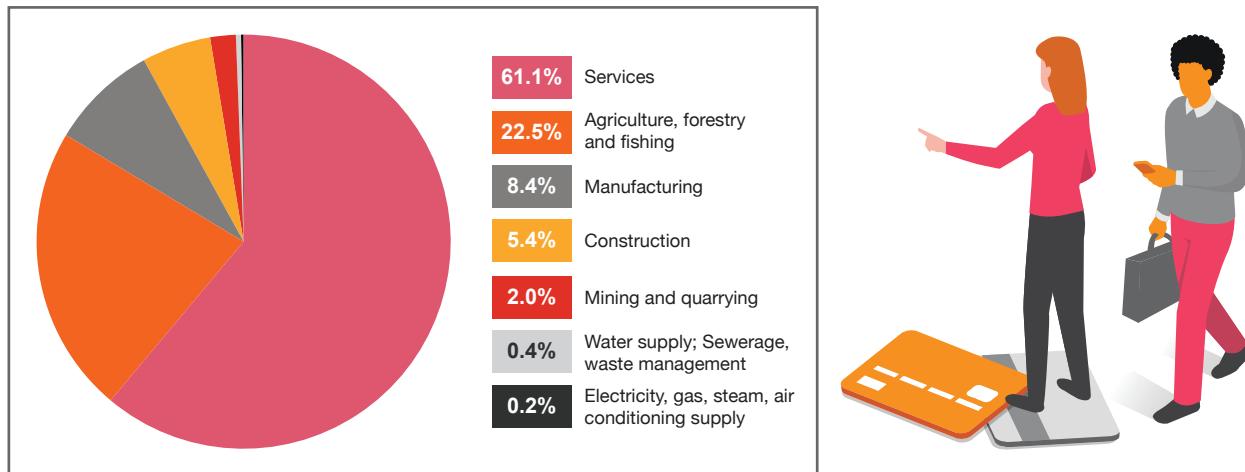


## V. Mining sector employment

As of 2022, the mining sector was accountable for 2% of total employees in Zambia, according to the Labour Force Survey. This is a marginal decrease on the 2.1% recorded in 2021. Mechanisation of the industry and the use of technology means the mining sector is more efficient than many other sectors in terms of productivity, which is why employment in the sector is relatively low.

The North-Western Province had the highest earnings of all the provinces, with an average monthly salary of K6,849, according to the 2022 Labour Force Survey.<sup>7</sup> This is because the top three mines in terms of production in 2022 all operate in North-Western Province. Mining and quarrying was ranked sixth for most income by sector, accounting for an average monthly pay of K9,086.

Figure 10 : Zambia Statistics Agency 2022 Labour Force Survey

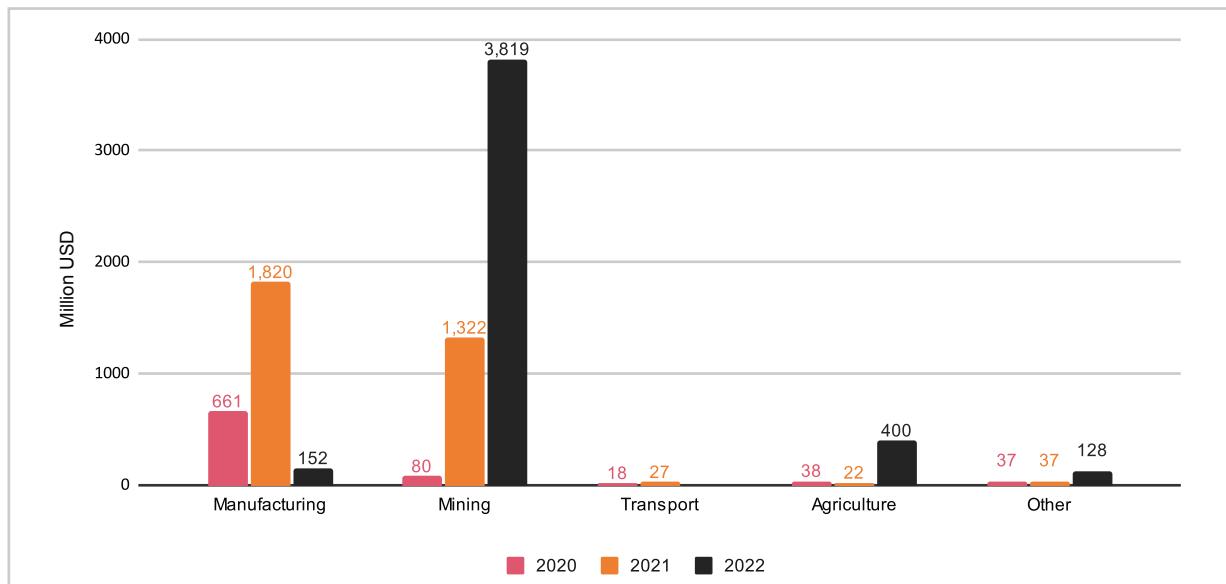


Source: Ministry of Labour and Social Security

## VI. Share of investment

Investment in Zambia's mining sector almost tripled in 2022, according to figures from the Zambia Development Agency (ZDA), with investment increasing from USD1.32 billion in 2021 to USD3.82 billion in 2022. In 2021 and 2020, the mining sector received the second largest share of investment after manufacturing.

Figure 11: Annual investment (million USD)



Source: Zambia Development Agency

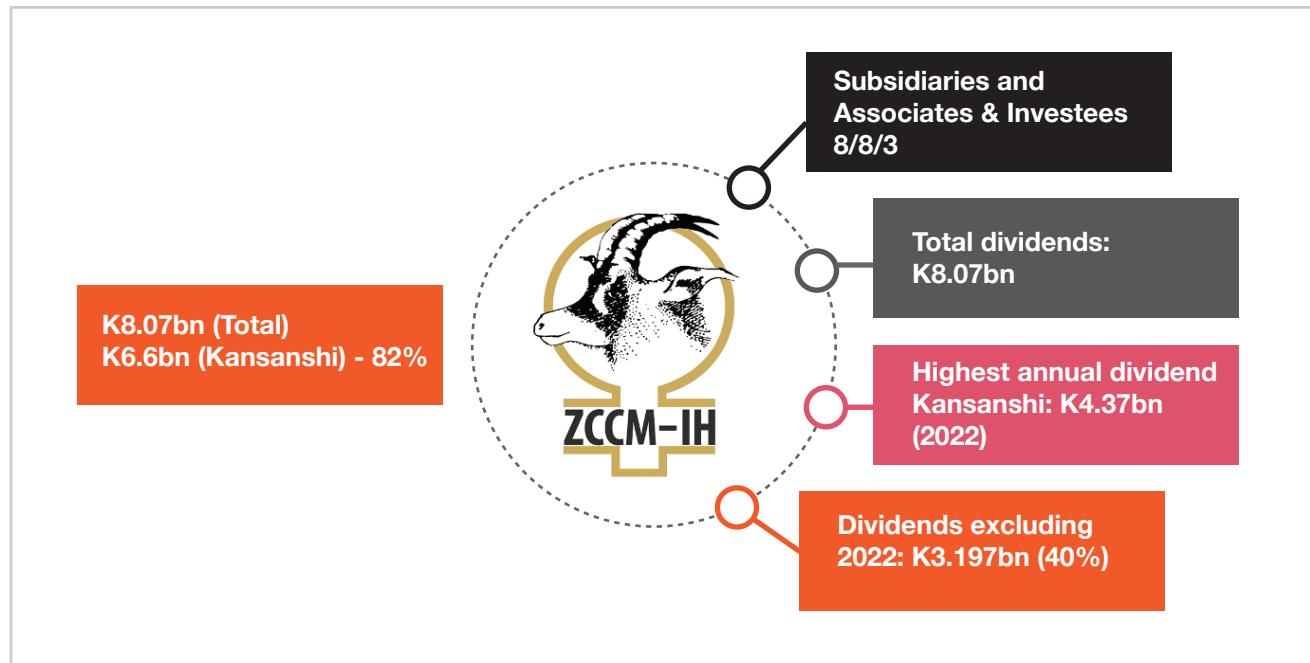
7 Launch and Dissemination of the 2022 Labour Force Survey Report <https://www.mlass.gov.zm/?p=3165>



## VII. Mining sector dividends

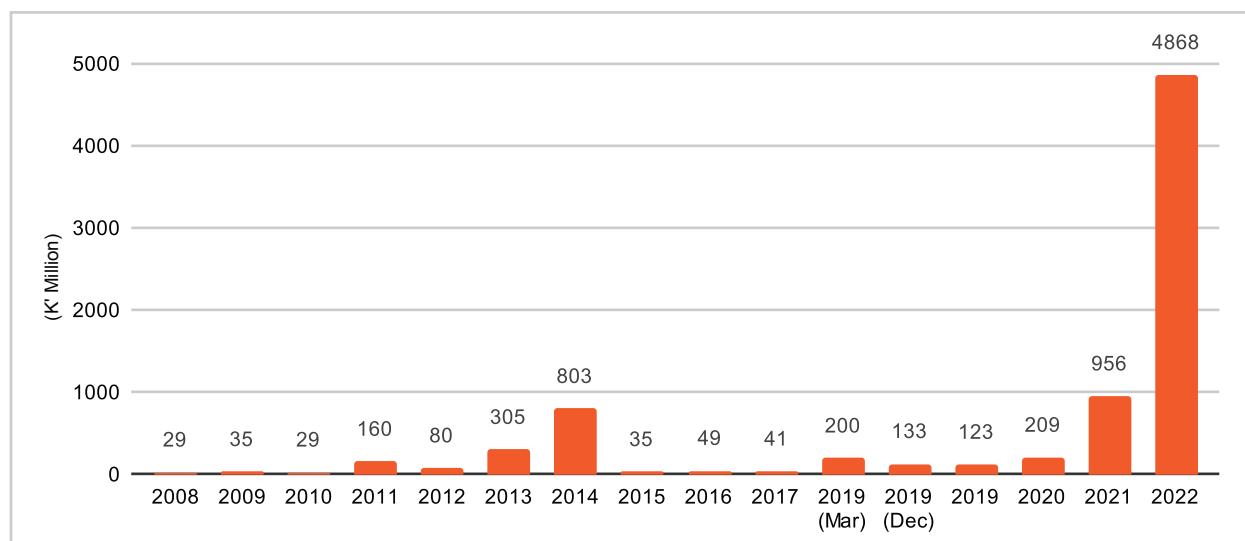
The sector has continued to see an increase in mining company dividends received by ZCCM-IH<sup>8</sup>, with Kansanshi mine continuing to be the highest payer of dividends. Our analysis of the published ZCCM IH annual reports from 2008 to 2022 shows the following:

Figure 12: ZCCM-IH Dividend Returns 2008-2022



Source: ZCCM IH annual reports

Figure 13: Dividends received



Source: PwC analysis

<sup>8</sup> ZCCM Investments Holdings Plc (ZCCM-IH) is an investment holdings company with significant investments in Zambia's mining industry.



## Understanding the sector's current performance and economic contribution

### a) Incentives given: the effectiveness of recent changes to mining tax policy

The Government has introduced various tax incentives to encourage investment in the mining sector since coming into Government in 2021. In his maiden budget speech, the Minister of Finance and National Planning, the Honourable Dr Situmbeko Musokotwane, reintroduced the deductibility of mineral royalty tax<sup>9</sup> for corporate income tax assessment purposes to maintain compliance with best practices around the world<sup>10</sup>. In the 2023 budget, the minister proposed restructuring the mineral royalty tax regime to lower the effective rate payable. The tax now applies to incremental value in each adjusted price band as opposed to aggregate value when the price crosses the respective threshold.<sup>11</sup>

The measure was intended to eventually increase the overall tax collection as a function of total copper earnings achieved on account of higher investment than production. The results of these measures are yet to be seen as tax collections from the sector are yet to grow to the desired level.

<sup>9</sup> Mineral Royalty Payable to be paid is deductible when computing company Income tax when arriving at gains and profits of a person carrying on mining operations.

<sup>10</sup> 2022 Budget Address [https://www.parliament.gov.zm/sites/default/files/images/publication\\_docs/BUDGET%20SPEECH%20\\_2022.pdf](https://www.parliament.gov.zm/sites/default/files/images/publication_docs/BUDGET%20SPEECH%20_2022.pdf)

<sup>11</sup> 2023 Budget analysis <https://www.parliament.gov.zm/sites/default/files/2023%20Budget%20Analysis.pdf>



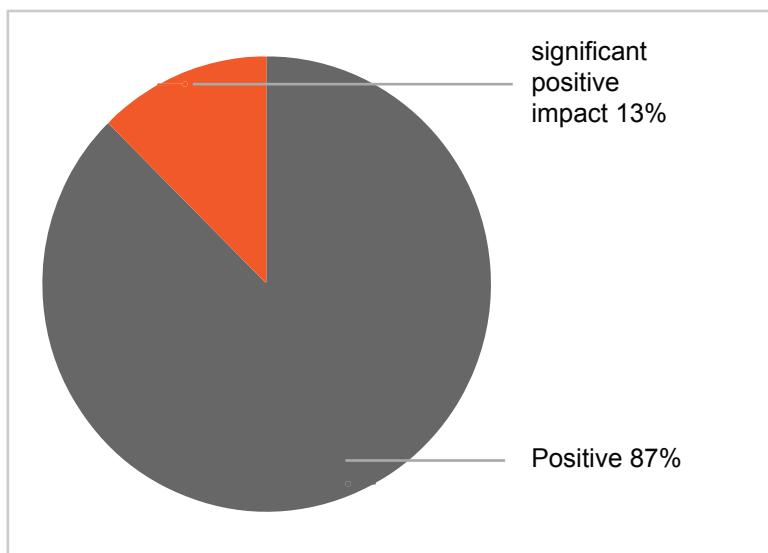
**Table 4:** Mining tax regime 2022 and 2023

2022 regime		2023 regime	
Price range per tonne US\$	Rate (%) on the full amount	Price range per tonne US\$	Rate (%) on the incremental price
< 4,500	5.5	< 4,000	4
4,501 - 6,000	6.5	4,001 - 5,000	6.5
6,001 - 7,500	7.5	5,001 - 7,000	8.5
7,501 - 9,000	8.5	> 7,001	10
> 9001	10%		

Source: PwC analysis

In our survey, mining companies were asked about the impact on operations from changes to the mineral royalty regime. Of those that responded, 87% said it had a positive impact, while 13% said it had a significant positive impact. The respondents indicated that changes to the mineral royalty regime had enabled mining companies to free up financial resources, allowing them to redeploy these resources to other areas such as exploration, expansion projects and corporate social responsibility.

**Figure 14:** Impact of the changes in tax policy



Source: PwC analysis

## Tax performance

- In the first half of 2023, mineral royalty tax collections totalled K3.7 billion, representing 6% of total national copper export earnings, which amounted to USD3.4 billion (approximately K64.8 million). This compares to the first half of 2022, when mineral royalty tax collections totalled K6.2 billion, representing 8% of total national copper export earnings of USD4.4 billion (approximately K76.8 billion).<sup>12</sup> This represents a 2% drop in mineral royalty tax collection caused mainly by a lower average copper price between the two periods and a drop in production. The average copper price fell 11.3% between January and June 2023 compared to the same period in 2022, from USD9,754 to USD8,648 per tonne.

12 Ministry of Finance and National Planning : 2023 Midyear economic review <https://www.mofnp.gov.zm/?wpdmpro=2023-mid-year-economic-review>

- The Zambian Government plans to maintain a steady mining policy to create a consistent environment for investment. These efforts are intended to align Zambia's tax system with global best standards. Given tax reforms are forward looking and have a lagged effect, the impact of changes in mining tax policy on revenue will not reflect immediately.

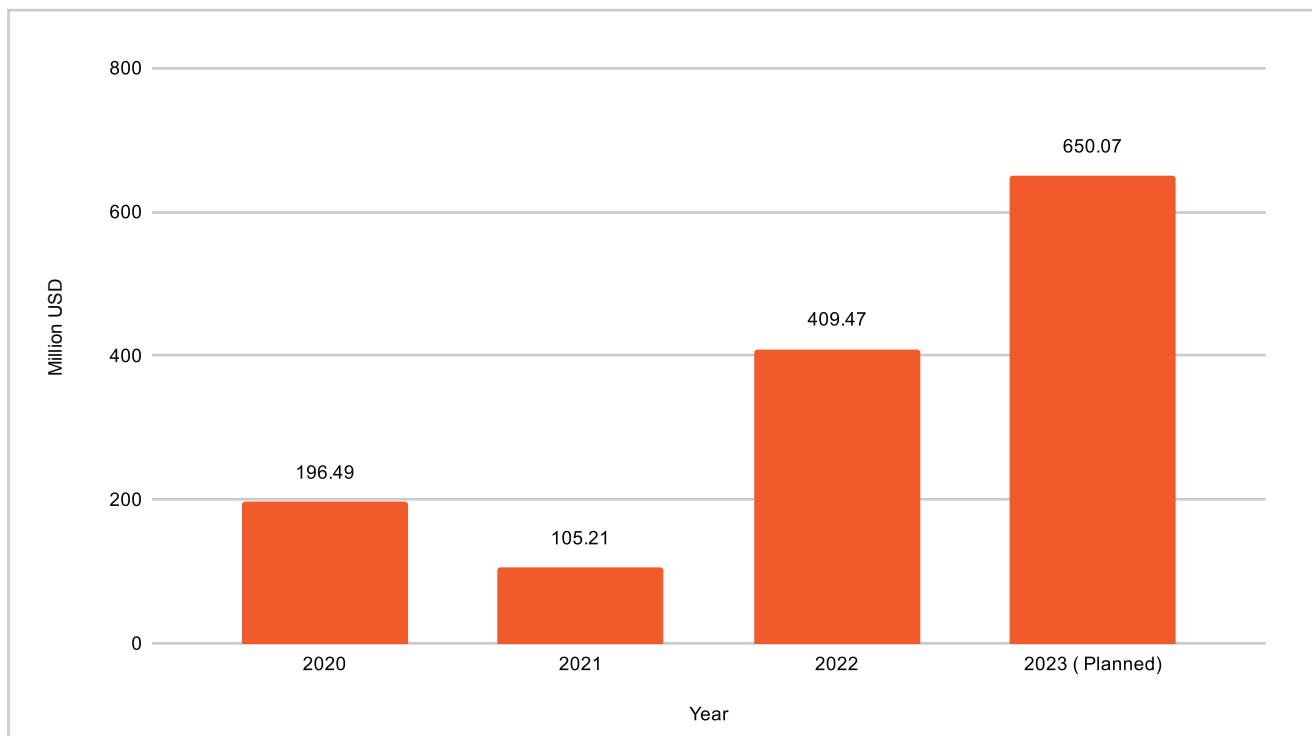
In the section below, we look at some of the responses to the incentives given to the mining sector.

### a. Capital expenditure

Although the new tax incentives have not yet yielded results in terms of increased tax collection, the mining sector has seen an increase in capital expenditure by companies due to the cash flow freed up by the tax policy changes. This freed capital is being reinvested into mining operations. Collective expenditure across 20 tracked mining companies increased by 12.8% in 2022 due to delays in delivery of purchased inputs, favourable foreign exchange rates and deferrals.

An assessment of capital spending was carried out among our respondents. The survey revealed that capital expenditure increased by 75% in 2022 compared to 2021. Planned capital spending for 2023 totals USD650 million and is 59% more than USD409 million spent in the preceding year.

**Figure 15: Mining capital expenditure**



Source: PwC analysis



## b) Significant investment announcements

Since the Government started to reform the tax measures in 2022, a number of mining companies have made investment announcements regarding expansions and new projects. The table below highlights some of these key announcements:

**Table 5:** Investment announcements

Company	Investment and project details
First Quantum	Kansanshi S3 expansion at USD1.25 billion and USD100 million. The Enterprise Nickel project is expected to produce its first nickel in 2023. Both projects are located in North-Western Province. Once completed, the S3 expansion project is expected to increase to approximately 250,000 tonnes per annum (2022 production was 146,282 tonnes). <sup>13</sup>
Moxico Resources	USD180 million cumulative. Located in rural North-Western Province, Mimbula Copper Project is poised to leverage the anticipated increase in demand for copper due to the global shift to renewable energy.
Lumwana Copper Mining	USD2 billion in an expansion project designed to increase Lumwana's annual production to an estimated 240,000 tonnes of copper from a 50 million tonne per annum process plant over a 36-year life of mine. Expected duration 2024-2028. <sup>14</sup>
KoBold Metals	USD150 million towards the Mingomba project and plans to commence copper and cobalt mining Zambia. <sup>15</sup> The company estimates production will commence within 10 years.
China's Nonferrous Mining Metal Mining (CNMC)	Has pledged to invest USD1.3 billion by the end of 2025. This will be distributed as follows: Chambishi copper mine USD450 million; Luanshya copper mine USD600 million; and Sino Metals and warehouse project USD200 million. <sup>16</sup>
Arc Minerals	USD90 million joint exploration project with Anglo American Exploration. <sup>17</sup>

Source: PwC analysis

The investments above, totalling just USD 5 billion, will be made over a period of time but are expected to significantly improve Zambia's mining sector production outlook.

13 <https://www.miningweekly.com/article/fqms-kansanshi-s3-mine-expansion-back-on-track-2023-10-19>

14 <https://www.barrick.com/English/news/news-details/2023/barrick-strengthens-zambia-partnership-invests-in-major-expansion-of-lumwana-mine/default.aspx>

15 <https://trendsnafrica.com/kobold-metals-to-invest-us-150-million-in-zambia-anticipates-production-of-copper-and-cobalt-within-a-decade/>

16 <http://mines.org.zm/cnmc-to-invest-us1-3bn/>

17 <https://www.miningweekly.com/article/anglo-arc-agree-90m-zambia-exploration-joint-venture-2023-10-27>





## Growing the mining sector

The increase in global demand for commodities creates an opportunity for mining companies in Zambia to increase mineral production to meet this demand. Growing the mining sector is critical to broader economic growth and social development in Zambia. A thriving mining sector has the potential to improve the country's prospects not just through greater tax revenue and associated social spending, but also through job creation.

### a) Increasing copper production to three million tonnes per annum within 10 years

#### Global production

Since 2013, Zambia's share of global copper production has fallen. According to the Battery Metals Report 2023, global copper demand is expected to rise from the current 21 million tonnes of copper per year to 25 million tonnes in 2030 and 28 million tonnes by 2035. Mines already in operation will need to ensure they maximise their current production or expand operations to meet this growing demand.

While Zambia's share of global copper production and that of other big copper producers like Chile has fallen over the last decade, other countries, such as the DRC and Peru, have increased their share. In 2013, Zambia produced 830,000 metric tonnes of copper, representing 4.6% of global copper production that year. In 2022, that share had fallen to 3.5% of global production, with Zambia producing 763,000 tonnes of copper.



Table 6: 2013 vs 2022 country share of global copper mining production

Country	2013 Production 000 <sup>1</sup> metric tonnes	2022 Production 000 <sup>1</sup> metric tonnes	2013 ranking	2022 ranking
Zambia	830 (4.6%)	763 (3.5%)	8th	9th
Chile	5,700 (31.9%)	5,200 (23.7%)	1st	1st
DRC	900 (5%)	2,200 (10%)	7th	2nd
Peru	1,300 (7.3%)	2,200 (10%)	3rd	2nd
Canada	630 (3.5%)	530 (2.4%)	9th	11th
China	1,650 (9.2%)	1,900 (8.7%)	2nd	3rd
Russia	930 (5.2%)	1,000 (4.6%)	6th	5th
United States	1,220 (6.8%)	1,300 (5.9%)	4th	4th
Australia	990 (5.5%)	830 (3.8%)	5th	8th
World Total	17,900	22,000	-	-

Source: US Geological Mineral Commodity Summaries

## Zambia

The Zambian Government announced a target to increase copper production from the current 763,000 tonnes per annum to three million tonnes per annum by 2032. According to the draft strategy, this target will be achieved through new discoveries supported by expanded exploration and increasing the output from current mining assets. In light of this, the Government has been pushing to reach resolutions on the matters affecting two of the country's largest mines, Mopani Copper Mine ("Mopani") and Konkola Copper Mine ("KCM"). An agreement was reached with KCM in September with the signing of the agreement in November this year officially handing over the copper asset to the principal investor, Vedanta Resources to resume control of its mines and smelter, and invest an additional USD1.2 billion into operations. Government hopes to announce a new investor for Mopani imminently.

Despite the Government's ambitious target, copper production fell by 11.9% in the first half of 2023 compared to the same period in 2022, with production falling from 365,042 metric tonnes in the first six months of 2022 to 321,778 metric tonnes in the same period in 2023.<sup>18</sup> Except for April 2023, monthly production in 2022 outperformed 2023. This underlines how productivity will need to improve considerably if production targets set for the sector are to be achieved.

## Productivity: mines' operational performance

The ore grade is the relative quantity or percentage of mineral content in an ore body. Africa's copper resources are not as abundant in terms of ore tonnage as, for example, Central and South America, but its ore is richer, averaging 2.38% copper compared to 0.91% in Central and South America.<sup>19</sup> The minimum grade that can be mined profitably from a deposit is called the cut-off grade. When estimating ore reserves and mining profitability important considerations include:

1. The yield.
2. The tonnage of ore above the cut-off grade.

<sup>18</sup> Ministry of Mines and Mineral Resources, <https://www.mmmr.gov.zm/?p=2587>

<sup>19</sup> <https://www.princeton.edu/~ota/disk2/1988/8808/880807.PDF>



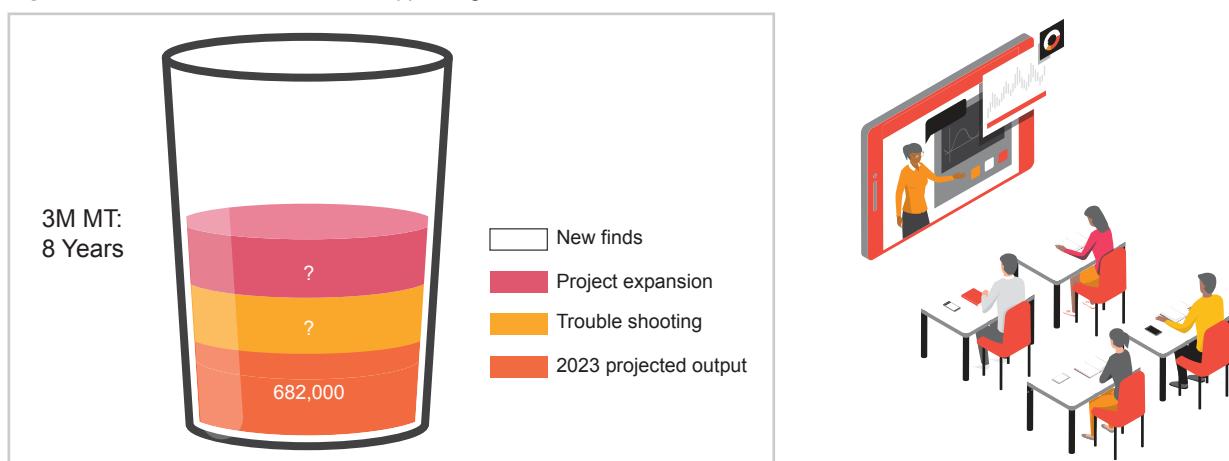
Ore grade and mineralisation play an essential role in determining the competitiveness of a mining operation. A mine with an ore grade of 0.5% must extract 200 tonnes of ore to produce one tonne of metal, but an ore content of 2% copper only requires 50 tonnes to produce one tonne of metal.<sup>20</sup> The ore grade of copper resources varies from country to country from a low of about 0.64%<sup>21</sup> in Azerbaijan to a high of around 2.77% in DRC. Mine plans are designed so they can be adjusted to take advantage of lower-grade areas when prices are high and higher grades when prices are low.<sup>22</sup>

In Zambia, the top three copper producers in 2022 accounted for 45% of the country's total copper production. The top three mines were Lumwana, Kansanshi and FQM Trident.<sup>23</sup>

The latest forecast from the Ministry of Mines and Minerals Development indicates that copper production in 2023 will be 682,000 metric tonnes, which is lower than the 763,000 tonnes recorded in 2022.

However, with more investment expected to flow into Zambia's mining sector due to greater stability and more predictable policy, copper output should recover and increase going forwards.<sup>24</sup>

**Figure 16:** A closer look at the 3m MT copper target



Source: PwC Analysis

To deliver the target, we start by considering the projected outturn for 2023 of 682,000 MT. Resolving the issues that have plagued mines like Mopani, KCM and other troubled assets should also contribute to the target although it is not clear by how much and by when.

Production enhancement projects at existing mines should also contribute to the overall results in the near term. This also needs to be quantified. Beyond the above, is the gap that will need to be filled through new discoveries. This will require a significant ramp up in successful exploration very soon.

The ultimate question is whether all of this will add up to 3 million MT by 2032. It's certainly an ambitious target, and rightly so, but its achievement hinges on making significant discoveries soon.

The reality that mines often require several years before they are fully operational further complicates the ability of the country to deliver on the target set.

## Production at Konkola Copper Mines and Mopani Copper Mines

Due to the vast ore body and good ore quality at Mopani and KCM, the two companies are expected to make a vital contribution to the three million tonne target. However, figures indicate that production at the two Copperbelt mining giants has been falling since 2018, as shown in the table below. Since 2018, KCM has contributed an annual average of 7% and Mopani 5% of Zambia's total annual production.

20 Princeton University: World Copper Resources <https://www.princeton.edu/~ota/disk2/1988/8808/880807.PDF>

21 Anglo Asia sharpens focus on copper <https://www.miningweekly.com/article/anglo-asian-sharpens-focus-on-copper-2021-09-29>

22 Democratic republic of copper <https://www.miningweekly.com/article/democratic-republic-of-copper-2021-10-08>

23 PwC analysis on Zambia Chamber of Mines data

24 Zambia's Copper Fantasy <https://www.theafricareport.com/318857/zambias-copper-fantasy/>

Table 7: Five-year overview of Mopani and KCM production levels metric tonnes

Year	2018	2019	2020	2021	2022
Mopani	62,191	30,078	34,480	45,313	41,685
KCM	96,769	61,943	64,035	58,948	55,810

Source: Ministry of Mines and Mineral Development

- Vedanta Resources, which owns 80% of KCM, reached an agreement with the Government and reclaimed control of KCM in September 2023, which they deconsolidated back in 2019. Vedanta plans to invest USD1 billion in investment and development, pay USD250 million to local creditors, invest USD20 million in corporate social responsibility, and raise employee salaries by 20%.<sup>25</sup>
- Glencore completed the sale of its stake in Mopani to ZCCM-IH in March 2021 and retained offtake rights on operations at Mopani.<sup>26</sup> Progress has been made in the bidding process and completed its final stages in July 2023. The Government plans to reach a full agreement with a new investor soon.<sup>27</sup>

## Enabling Zambia's Copper Mining

### a) Zambia's mineral production outlook

In our survey, we asked mining companies to identify key areas they believe will be significant in influencing the general outlook for favourable production in their respective mines in the next 10 years. Below is a summary of their responses:

1. **More exploration.** In order to replenish stagnant and diminishing production, greater exploration activity is needed. Key brownfield and greenfield exploration projects are currently ongoing.
2. **Stable mining policy.** Mining companies expect the Government to design mining policies and initiatives that will address the specific obstacles that the sector is currently facing.
3. **Technology integration into production.** With digital technology constantly changing, miners said it was important to stay abreast of digital developments that support greater production.
4. **Commodity market price.** Copper prices are a reflection of demand and supply, hence an increase in the prices stimulates production as mining companies' sentiments are towards favourable and stable prices

25 Zambia agrees to hand disputed Copper asset back to Indias Vedanta <https://www.reuters.com/markets/commodities/zambia-agrees-hand-disputed-copper-assets-back-indias-vedanta-2023-09-05/>

26 Completion of sale of underlying-73-stake in Mopani <https://www.glencore.com/media-and-insights/news/completion-of-sale-of-underlying-73-stake-in-mopani>

27 Ministry of Mines and Mineral Development <https://www.mmmmd.gov.zm/?p=2587>



## Supporting infrastructure

Ensuring mining companies have access to infrastructure such as energy and transport is essential if the Government is to meet its three million tonne copper target.

### • Power generation and supply

The mining sector consumed 48% of the total electricity produced in Zambia in 2022. State-owned power utility ZESCO has embarked on the path to financial sustainability through a multi-year tariff restructure, which covers the period 2023-2027.

At the 2023 Africa Energy forum, ZESCO reinstated various incoming reforms intended to reduce the institution's dominance. This included the establishment of an independent system operator to encourage private sector participation in the energy sector.<sup>28</sup>

Southern Africa continues to face seasonal power shortages due to lower water levels at Kariba dam. The most recent example of this in Zambia was between December 2022 and January 2023. This has prompted the region to explore alternative sources of power and find long-term solutions.<sup>29</sup>

Zambia's 2022 Renewable Energy Strategy and Action Plan hopes to add 2,015 MW of grid-connected renewable energy capacity by 2030. Current generation produces 2,981 MW of electricity. The strategic plan further identifies financing as a major limiting factor to both investment in supply and uptake of renewable energy.<sup>30</sup>

**Table 8:** Zambia's current generation mix in megawatts

Current generation mix		
Hydro	80%	2,386
Coal	10%	298
Diesel	3%	89
Solar	3%	89
Heavy fuel oil	4%	119
Total	100%	2,981

28 Zambia's MD says electricity sector now open to business <https://www.zesco.co.zm/news/126>

29 Juggling the act needed to end power crisis <https://mg.co.za/thoughtleader/opinion/2022-09-16-juggling-act-needed-to-end-power-crisis/>

30 Renewable Energy Strategic Plan [https://www.moe.gov.zm/wp-content/uploads/2022/08/Renewable-Energy\\_final-file\\_for-web.pdf](https://www.moe.gov.zm/wp-content/uploads/2022/08/Renewable-Energy_final-file_for-web.pdf)



Table 9: Targeted renewable energy additional production by 2030 in megawatts

Targeted renewable energy production		
Technology	Total capacity	Percentage (%)
Hydro	1,383	69%
Solar	500	25%
Wind	130	6%
Geothermal	2	0%
<b>Total</b>	<b>2,015</b>	<b>100%</b>

Source: Ministry of Energy

- **Railway revamping**

**New Zambia-Lobito rail line:** In September 2023, the European Union and the US Government said they will support the launch of a pre-feasibility study as part of plans to modernise the Lobito Atlantic<sup>31</sup> railway.<sup>32</sup>

In October 2023, Zambia, DRC and Angola signed a Memorandum of Understanding to develop the Lobito Corridor and the new Zambia-Lobito rail line. This comes after the three Governments entered an agreement to develop the Zambia-Lobito greenfield rail line in January 2023. Once complete, the railway will offer cost-efficient transport connections by opening up rail access from the Atlantic to the Indian Ocean. The African Development Bank and Africa Finance Corporation will support the project.<sup>33</sup>

**Tazara railway:** Zambia and Tanzania, with the support of Chinese investors, announced a joint plan to renovate and recapitalise the Tazara railway in August 2022. Further meetings are expected after position papers and recommendations by the two countries are reviewed by respective committees. Engagement with investors will follow thereafter.<sup>34</sup> It is hoped that once the renovations are complete, Tazara will offer a more efficient mode of transport for mining equipment and supplies.



<sup>31</sup> Lobito Atlantic Railway currently manages the rail infrastructure for the transport of goods for the 1,300 km connecting Lobito Port in Angola to Luau on the border of the DRC. Lobito Atlantic Railway is a joint venture consortium formed by Trafigura Pte Ltd, Mota-Engil Engenharia e Construção África SA and Belgian rail operator Vecturis SA.

<sup>32</sup> Angola Railway study backed by EU and USA <https://www.railwaygazette.com/infrastructure/zambia-dr-congo-angola-railway-study-backed-by-eu-and-usa/64901.article>

<sup>33</sup> Signing of The memorandum of Understanding on Development of the Lobito-corridor and the Zambia lobito rail line <https://www.state.gov/signing-of-the-memorandum-of-understanding-on-the-development-of-the-lobito-corridor-and-the-zambia-lobito-rail-line/>

<sup>34</sup> <https://tazarasite.com/communique-occasion-119th-meeting-tazara-board-directors>

## b) Exploration

Exploration is a critical stage in the mining life cycle because it identifies the next generation of mines and ensures there is a pipeline of new resources coming online. Mineral exploration is mostly conducted by the private sector, or, in some cases, the Government to identify economically viable mineral deposits.

The Government has allocated K160 million to geological mapping in the 2024 national budget in an effort to boost the sector by supporting exploration and investment. In 2024, the Government is set to carry out aerial surveys in the Copperbelt, Lusaka, North-Western and Western Provinces.<sup>35</sup> With reference to geological surveys, 61% of the country has at one time experienced geophysical<sup>36</sup> or geochemical<sup>37</sup> mapping as of 2015. The remaining 39% of the unmapped portion of the country is located in the North-Western and Western provinces. This is because mapping in the west of Zambia requires geophysical methods as this part of the country is covered in thick layers of Kalahari sand.<sup>38</sup> In the 2023 budget, the Government reduced property transfer tax from 10% to 7.5% on mining rights held by exploration companies to encourage mining exploration.

According to the Mines and Mineral Development Act No 11 of 2015, an exploration licence in Zambia is valid for an initial period of four years, and can be renewed for two periods, although it cannot exceed 10 years from when it was initially granted.<sup>39</sup>

**Table 10:** Investment announcements

Stage	Process	Desired outcome
Ground selection	Selection of area within the region to assess for different minerals. Publicly available information integrated.	Identify regions worthy to proceed to the next stage.
Target generation	As the explorer learns more about the geology, focus narrows to smaller or targeted areas within the licence boundary that have the highest potential. More specific methods are employed, including prospecting, mapping, remote sensing surveys, geochemical surveys, geophysical surveys, or even drilling for geological information.	Target areas identified are tested by sampling.
Target testing or investigation	The target is sampled and measured for its size, quality and the identification of features associated with the potential deposit, often considered essential according to the deposit model under consideration. Sampling may take the form of taking samples from the surface or underground, trenching or drilling	Mineralisation identified in sufficient quality and quantity that gives permission for further evaluation.
Deposit delineation	Quantifying the amount (tonnage or volume) of mineral present within and the quality (usually grade) of a mineral deposit. This involves extensive and intensive sampling of the deposit, and assay or analysis of those samples so that a mineral reserve can be calculated. Such sampling may be carried out on the surface or underground, but commonly involves much drilling.	A mineral deposit with a well-founded calculation of the quantity and quality of the minerals in the deposit compliant with a recognised code or standard.

Source: Mineral Intelligence Capacity Analysis and PwC analysis

<sup>35</sup> [https://www.parliament.gov.zm/sites/default/files/images/publication\\_docs/2024%20BUDGET%20SPEECH\\_230929\\_174057.pdf](https://www.parliament.gov.zm/sites/default/files/images/publication_docs/2024%20BUDGET%20SPEECH_230929_174057.pdf)

<sup>36</sup> Geophysical surveys are surveys of the physical characteristics of mineral deposits to measure physical differences between rock types or physical discontinuities in geological formations. These surveys include, among other things, magnetic and electromagnetic surveys, gravity surveys, seismic surveys, and multispectral surveys. A geophysical survey provides an accurate result of the types of hydrocarbons and minerals present underground without tunnelling or digging.

<sup>37</sup> Geochemical surveys are surveys of the chemistry of mineral deposits. They are done by, among other things, sampling soils, waters and bedrock to identify areas of anomalous mineral values and quantities that may in turn identify mineral deposits.

<sup>38</sup> Ministry of Mines and Mineral Development <https://www.cgs.gov.cn/ddztt/kydh/2016kydh/gjhzcgxz/201609/P020160924530230536301.pdf>

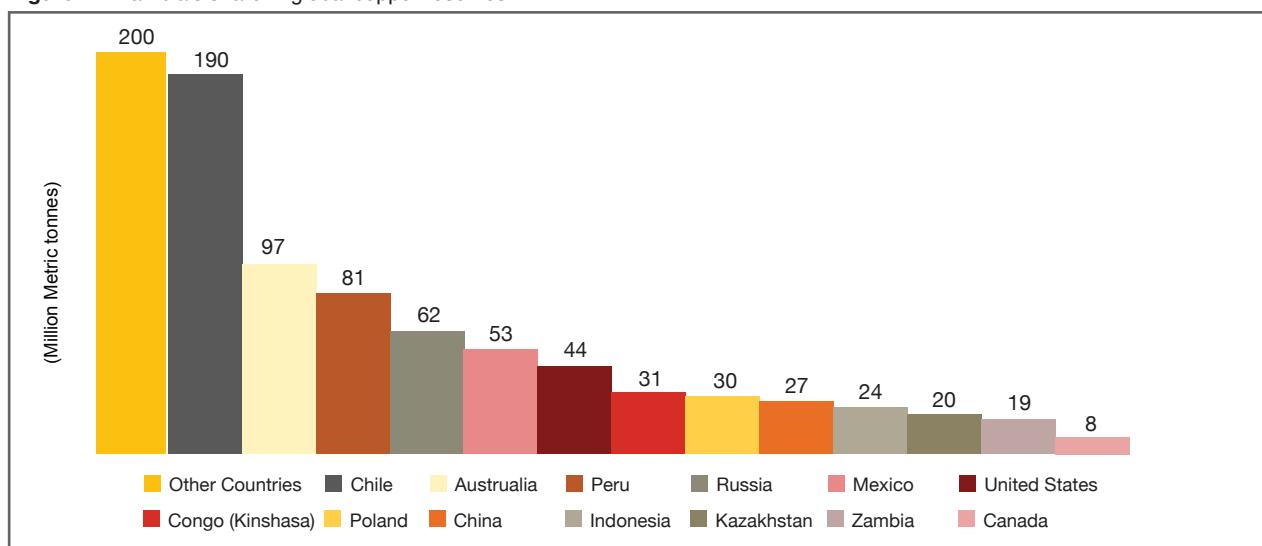


Exploration may or may not complete all stages, and may end at the end of or within a particular stage. If the out-turn is sufficiently positive in all processes, then the next activity is actual mining or mineral extraction. In assessing the potential of a country in meeting mineral production targets, it is worth noting the approximation of minerals that lie in its reserves. Data on mineral reserves<sup>40</sup> is dynamic, increasing as new deposits are discovered or known deposits are fully explored, and decreasing when the ore is mined or the feasibility diminishes. For instance, in 1970, there were 1.6 billion tonnes of undiscovered copper and 280 million tonnes of reserves worldwide. In 2022, global reserves were 890 billion tonnes, with 3.5 billion tonnes of undiscovered copper.<sup>41</sup>

Chile holds the largest percentage of global copper reserves, with 21% of reserves found there, while Australia holds 11% and Peru 9%. Russia and Mexico are also in the top five, with 7% and 6% respectively.

Zambia's copper reserves of 19 million metric tonnes accounted for 2% of global copper reserves in 2022, a 9.5% reduction from 21 million in 2021.<sup>42</sup> The DRC holds 31 million metric tonnes, which is 3% of global reserves. If this is combined with Zambia's 2%, it brings the reserves held by Africa's two largest copper producing countries to 5%.<sup>43</sup> Among the top global copper producers with the least share of global reserves is Canada, which accounts for 1% of global copper reserves.

**Figure 17: Zambia's share in global copper reserves**



Source: US Geological Survey 2023 US Geological Survey 2023 Mineral Commodity Summaries

Note: Other countries include countries with minimal shares that have been bundled up

40 Reserve Base: That part of identified resource that meets specified minimum physical and chemical criteria related to current mining production practices including those grade, quality, thickness and depth.

41 <https://pubs.usgs.gov/periodicals/mcs2023/mcs2023.pdf>

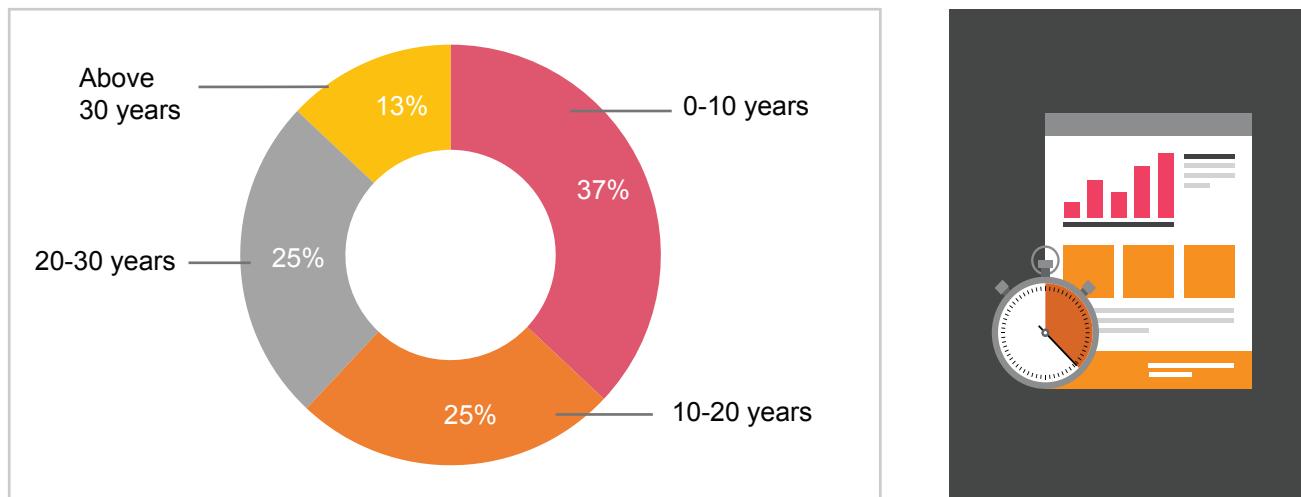
42 US Geological Survey 2023 <https://www.usgs.gov/centers/national-minerals-information-center/mineral-commodity-summaries>

43 5% of Africa's Copper reserve holding only accounts for leading copper producers Zambia and Congo, not the total African shareholding in copper reserves.

In June 2023, the Zambian Government announced the development of a draft strategy to provide direction towards meeting the three million tonne copper target in nine years. The first step is to prioritise investments in geological mapping and mineral exploration. Government has allocated K160 million towards geological mapping and has assured support for exploration projects that will enhance the success of existing and new copper projects, both brownfield and greenfield.<sup>44</sup>

Survey respondents were asked how much mine life is remaining in their current mining operations. Among the companies that replied, 37% said their mine's life ranged from 0-10 years, 25% said it ranged from 10-20 years, another 25% said their mine had a life of 20-30 years and 13% said their mine had above 30 years.

**Figure 18: Current life of Zambian mines**



Source: PwC analysis

## Efforts to make exploration more effective in Zambia

On the exploration side, we acknowledge Anglo American Plc and Kobold Metals for their insights regarding concerns pertaining to exploration in Zambia.

Current exploration projects are west of North-Western province as well as the Copperbelt Province, which lies close to the Katanga basin, an area which possesses potentially rich copper deposits. Factors that will enhance exploration include:

- Timely issuance of prospecting licences. Which could allow mining companies to retain ground rather than drop or abandon after the exploration period elapses.
- Since exploration costs are high, a mineral exploration environment with reduced taxation to relieve overall spending thereby releasing funds that can encourage more exploration activity.
- Attracting specialised services into the country through Government partnerships to enable exploration companies to focus on mineral exploration.
- De-risking the exploration process. Mineral exploration brings in millions of USD in funding, but the financial services sector is usually unable to provide attractive interest rates for the funds kept in banks.
- Improving rural infrastructure (i.e roads, bridges, electricity) as the areas of interest are mostly located in rural areas. Weather patterns in the North-Western province, which often result in flooding and high rainfall, create challenges as drill rigs cannot easily be moved to the area of interest.

<sup>44</sup> Ministry of Mines and Mineral Development <https://www.mmmmd.gov.zm/?p=2587>

## Artificial intelligence and machine learning: the future of mineral exploration

In the past, mineral exploration has been an activity of perception, persistence and sometimes luck using existing methodologies. This has sometimes led to abandoned prospective sites due to inadequate feasible resources.<sup>45</sup> In today's robust technological age, companies are poised to leverage artificial intelligence (AI) and incorporate it into current geological processes to help them assess risk and maximise profits through cost reduction and improved operational safety, among other things.<sup>46</sup>

Miners have realised the importance of incorporating data science into their operations. The need for efficient data on drilling, blasting, equipment management, mine safety and mine hazard assessment has paved the way for the development of AI advanced data analytics as well as machine learning specific to mining.<sup>47</sup> Autonomous technologies have the potential to improve mineral exploration by addressing many procedural challenges, thereby enhancing efficiency and success rates. This enables the extraction of valuable minerals in a way that significantly promotes environmental sustainability as well as mitigating the negative impacts of extraction.

Challenges are inevitable in the adoption of new technology in the industry, however, and a lack of skills to support the transition in the introductory stages may be an issue in some regions of the world, especially the developing world.<sup>48</sup>



45 Smart Stones: AI in Mineral Exploration <https://k-mine.com/articles/smart-stones-ai-in-mineral-exploration/#:~:text=Artificial%20Intelligence%2C%20a%20buzzword%20that,invisible%20to%20the%20 human%20eye>.

46 Smart Stones: AI in Mineral Exploration <https://k-mine.com/articles/smart-stones-ai-in-mineral-exploration/#:~:text=Artificial%20Intelligence%2C%20a%20buzzword%20that,invisible%20to%20the%20 human%20eye>.

47 Systematic Review of Machine Learning Applications in Mining <https://www.mdpi.com/2075-163X/11/2/148>

48 Barriers and Enablers of technology adoption in the Mining Industry <https://www.sciencedirect.com/science/article/abs/pii/S0301420721002026>

# A first-hand perspective on exploration

By Kurt House,  
KoBold Metals Global CEO



Without mineral exploration, humans will not discover new deposits to mine, and without new deposits, our economies will become raw material limited as mineral exploration is essential to increasing prosperity. Further, transitioning society completely off fossil fuels requires finding and mining over 1000 new deposits of the critical metals: copper, lithium, nickel, and cobalt.

The principal methods of exploration have not changed for decades. Conventional explorers synthesise geological, geochemical, and geophysical information in their brains, and, from that synthesis, they contrive exploration hypothesis that inform methodologies such as soil surveys, and drilling programs with the hope of finding mineable deposits.

KoBold Metals is different. We combine the best conventional explorers - professionals who have discovered great deposits with companies such as Ivanhoe, Newmont, Barrick, Vale, Rio Tinto, BHP, etc - with world-class data scientists and software engineers hailing from the world's leading technology companies such as Google, Apple and Lyft. Together, the KoBold team has invented, and is continuing to develop, our AI-driven exploration system. This system combines all manner of information about the physics and chemistry of the earth's crust, with AI algorithms to predict, with statistical rigor, where we are most likely to discover new critical metal deposits. KoBold is turning the heuristic, judgement-laden process of conventional exploration into rigorous science. Our technology enables us to maximise uncertainty reduction per dollar of exploration expenditure, thereby, increasing our knowledge of mineral systems systematically.

Zambia is among KoBold's highest priority jurisdictions, and Mingomba, our flagship project in Zambia, will be the best new mine in more than a generation.

There are many exploration challenges, the most significant of which is figuring out where to invest exploration capital. Exploration programs are not cheap. Preliminary efforts frequently cost a few million US dollars and are very risky, with less than 1 in 200 exploration efforts turning into an operating mine. As such, exploration companies must:

- (a) have access to meaningful quantities of risk capital and
- (b) move quickly from project to project since most early-stage exploration efforts will fail.

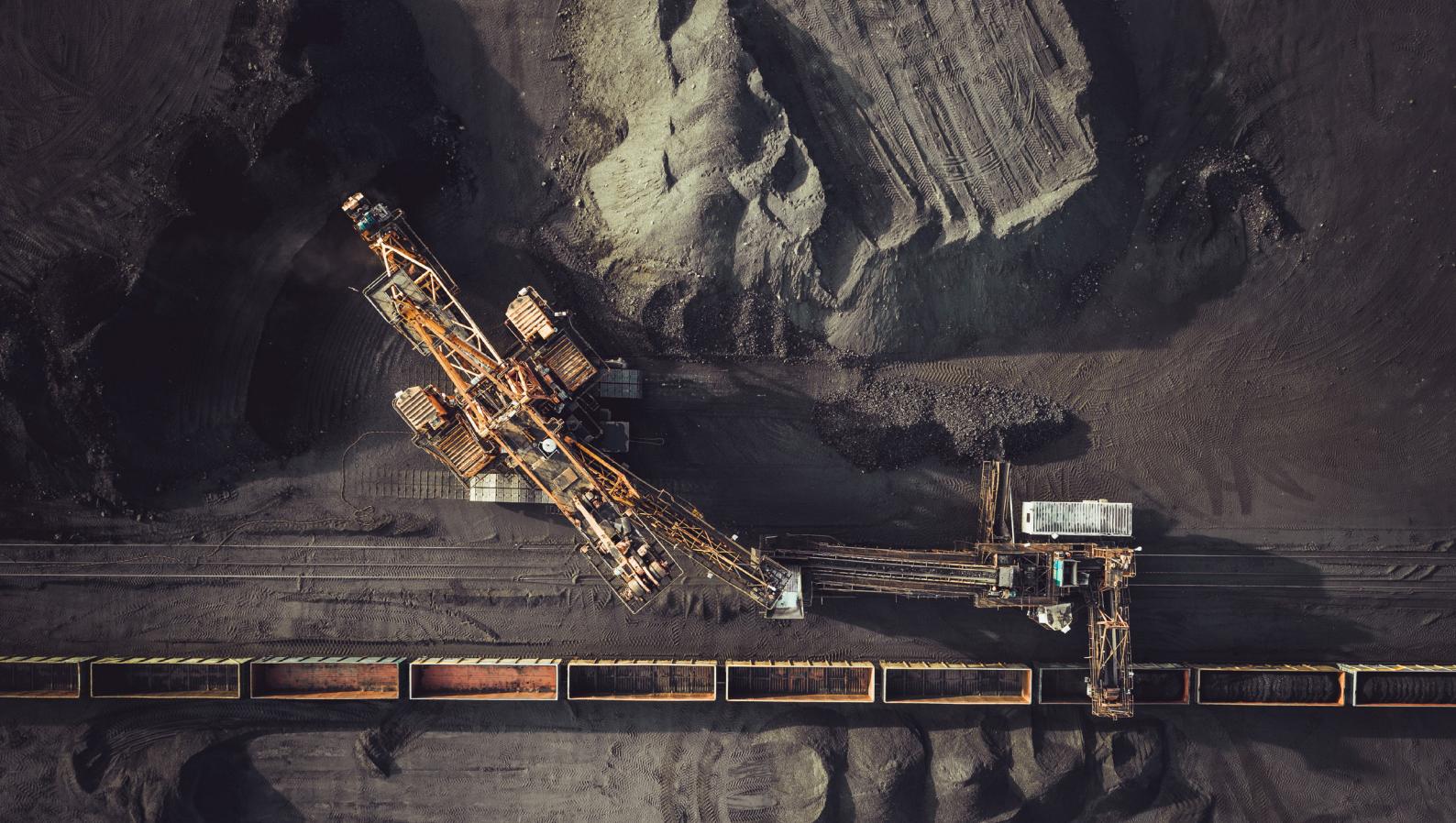


Exploration companies must experiment on many, many different prospects. In many jurisdictions, including Zambia, most exploration licenses are controlled by individuals with no intention of investing in their property. Rather, their objective is to bring in an exploration company that provides both the capital and operating expertise to explore the property.

That's not obviously bad, except that transaction friction necessarily reduces experimentation and exploration investment. The combination of high-friction transactions and high-risk exploration programs is bad. Companies often have to negotiate for more than one year just to be able to invest into a project that has a less than 1% chance of being successful. All jurisdictions can accelerate exploration investment by increasing the cost to maintain licenses such that firms can't hold them for long periods without investing.

KoBold's mission is to make exploration more efficient and more effective, and we're investing heavily in research and development to achieve that mission. To compliment our AI software, we're developing new sensors for measuring novel properties and phenomena. Indeed, KoBold has the largest exploration R&D budget of any mining company.





The Zambian Government is planning to conduct airborne geophysical surveys — which KoBold anticipates partially sponsoring with other industry stakeholders. The collection of modern magnetic, gravitational, electromagnetic, and spectral data will be a boon for foreign direct investment into Zambian exploration as that geophysical data may provide crucial, if indirect, hints about where the next discovery is to be made.

With regards to fiscal incentives, private capital will get the job done, provided the land is available to explore. There are some elegant fiscal ideas to stimulate more exploration investments. For instance, the government could create a tradable tax credit for exploration. For example, for every US\$1 invested in exploration, the exploring company could sell that credit to an operating mine that the mine could use to reduce its tax liability.

Overall, exploration is a costly and high risk venture that requires patient capital and the benefit of today's technological advances if it is to deliver quicker. It must be supported by the right policies that ensure that licences are owned by the right people and that focussed incentives are given to those who are ready to invest in much needed ventures.



## c) Mineral diversification

Zambia's vision of a diversified mining sector incorporates both high-value metals and lower-value industrial minerals at commercial and small-scale levels. In 2023, the Zambian Government announced plans to develop a strategy based on the potential exploration and mining of lithium and other critical minerals. In the 2024 national budget, the Government declared all minerals as strategic for economic growth, and the Government intends to enhance exploration and exploitation of these minerals. The overall goal is to diversify the mining sector and secure consistent mineral production.

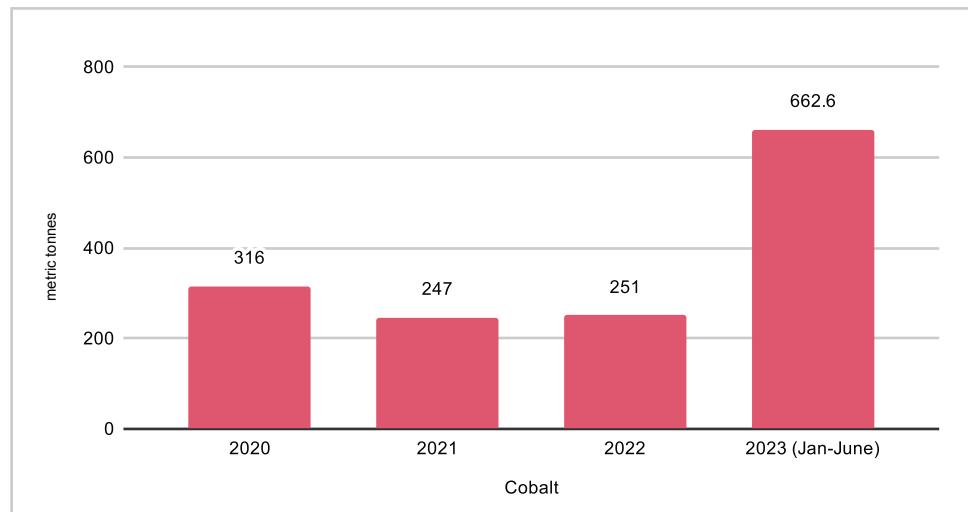
The transition to renewable energy is playing an instrumental role in facilitating a global shift towards a more diversified mining sector. The strategic mindset among mining companies will play a greater role in diversification among the top global miners as they opt to mine different commodities and position themselves at new points in the value chain.<sup>49</sup> Many mining companies, including those with operations in Zambia such as Glencore, Moxico Resources, First Quantum Minerals and Gemfields, instil this in their strategies. The common theme among these miners is their focus on identifying resources and production of commodities that are deemed critical to a more sustainable future.

### Cobalt

Cobalt is mined as a by-product in copper mines in Zambia, unlike in the DRC, where Glencore runs the world's largest cobalt mine, Mutanda. Zambia's last significant production of cobalt was 2,900 metric tonnes in 2017. Since then, production has fallen to 814 metric tonnes in 2022. One of the main reasons for the decline in cobalt production is the geological out-turn as cobalt content diminishes from the mined copper ore as mining goes deeper.

Global cobalt production is currently 190 million metric tonnes, with DRC, the world's largest producer, producing 130,000 metric tonnes of this. Zambia's production increased marginally by 1.6% between 2021 and 2022 on account of the increase in cobalt content in the copper ore.

**Figure 19:** Zambia's cobalt production



Source: Ministry of Mines and Mineral Development

49 Mine 2022: A Critical Transition [https://www.pwc.com/cl/es/publicaciones/Global\\_Mine\\_2022.pdf](https://www.pwc.com/cl/es/publicaciones/Global_Mine_2022.pdf)

In 2019, cobalt prices fell 60% due to weaker demand amid investor uncertainty. Many cobalt operations were regarded as economically unviable thanks to lower prices and rising input costs. Cobalt mining was halted at some mines so they could focus on more economically viable copper. In 2022, cobalt was produced alongside the copper ores at KCM, but the mine was reluctant to process the ore due to the falling prices driven by oversupply (since most cobalt produced by mines in the DRC is processed in China) coupled with investor uncertainty.<sup>50</sup>

Going forward, the cobalt price is expected to recover on the back of an anticipated increase in demand due to its use in electric vehicles.<sup>51</sup>

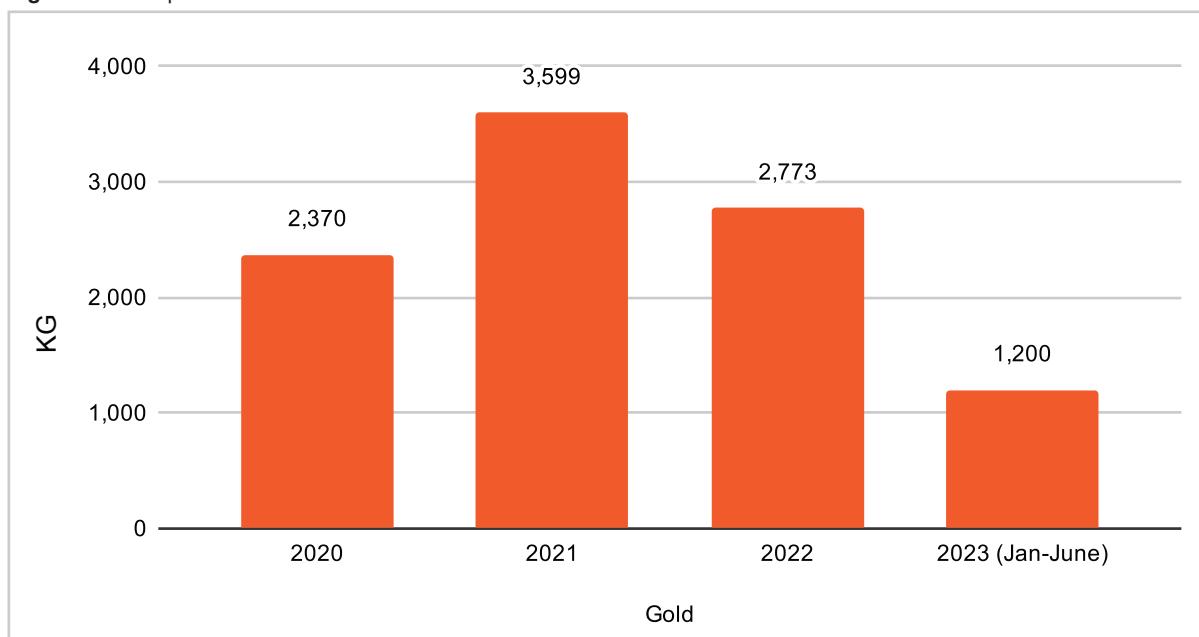


## Gold

Global gold production was 3,100 tonnes in 2022, with China, the world's largest producer, accounting for 330 tonnes or 10.64% of total production.

Zambia's gold production decreased from 3,599 kg to 2,773 kg by 32% in 2022 due to low grade ore and the suspension of operations at some mines.

Figure 20: Gold production



Source: Ministry of Mines and Mineral Development

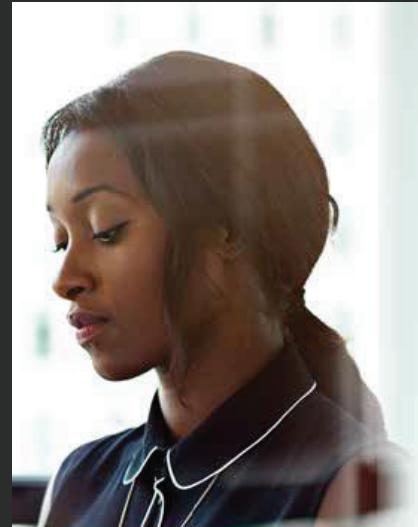
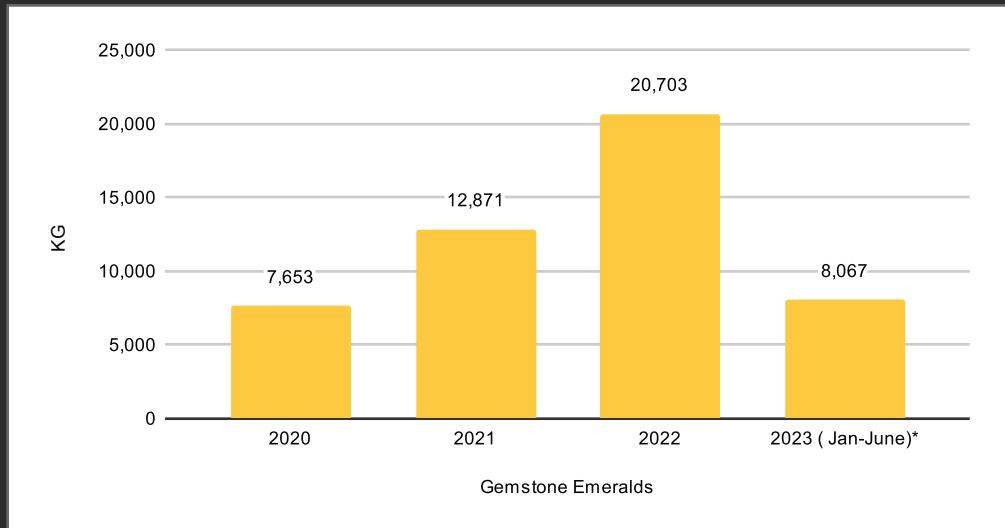
50 Zambia's Mopani Plans to resume cobalt mining <https://www.reuters.com/world/africa/zambias-mopani-plans-resume-cobalt-production-prices-rise-2022-05-24/>

51 What's causing the market damaging cobalt slump in 2019? <https://www.nsenergybusiness.com/features/cobalt-2019-price-drop/>

## Emeralds

Zambia's total annual emerald output for 2022 increased by 61% due to a rebound in production at the mines following the lifting of operational restrictions brought about by COVID-19 and a new mine coming online.

Figure 21: Gemstone production



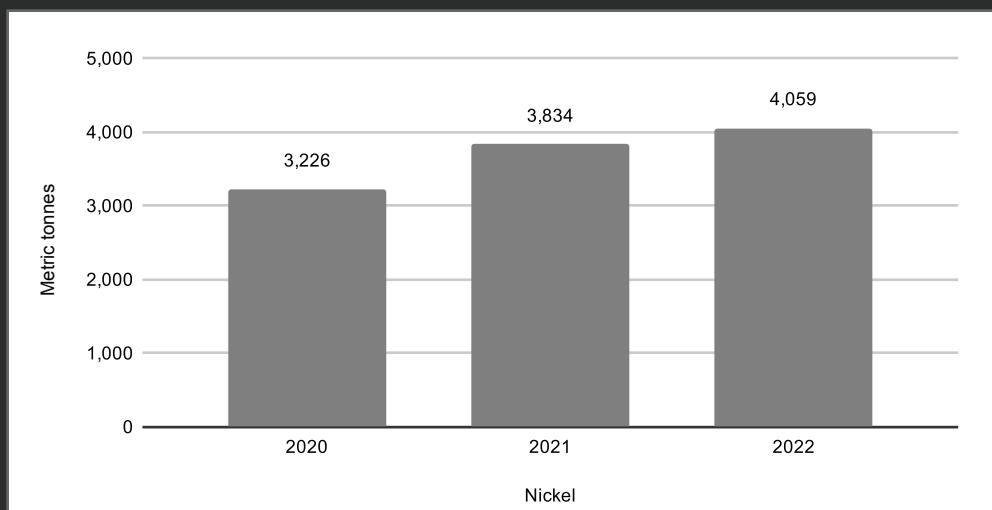
Source: Ministry of Mines and Mineral Development

## Nickel

In 2022 Global nickel production in total was 3,300,000, metric tonnes, with almost all of the increased production attributed to top global producer Indonesia, producing 1,600,000 metric tonnes.

Nickel production in Zambia increased by 5.9% in 2022 compared to the previous year. The increase was attributed to increased production on account of higher nickel prices. The commencement of nickel production at Enterprise Nickel Project in Kalumbila District, with an estimated mine production of approximately 35,000 metric tonnes per annum, is expected to significantly increase current production going forward.<sup>52</sup>

Figure 22: Nickel production



Source: Ministry of Mines and Mineral Development

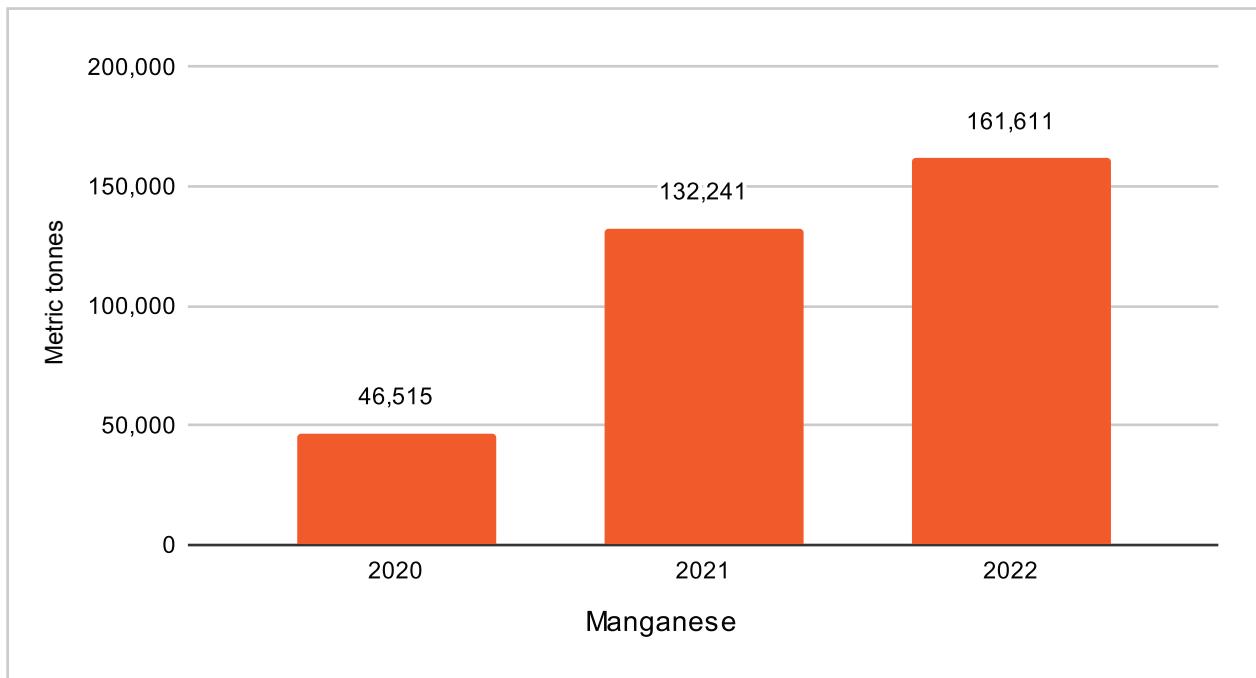
52 First Quantum Minerals commissions Nickel mine <http://mines.org.zm/fqm-commissions-nickel-concentrator-diversifies-zambias-mineral-portfolio/>

## Manganese

As of 2022, South Africa leads global production of manganese, producing 7,200 metric tonnes. Globally manganese production for 2022 was 20,000 metric tonnes.

Zambia's production of manganese increased by 22% in 2022 compared to 2021 due to new processing plants which opened in 2022.

Figure 23: Manganese production



Source: Ministry of Mines and Mineral Development

## Emerging minerals

**Sugilite:** this mineral was recently discovered in the Muombe area of the Chembe District in Zambia.<sup>53</sup> A preliminary geological survey in Chembe in Luapula Province was unable to establish the full extent of the resource. The Ministry of Mines and Minerals Development has confirmed the presence of sugilite within the licence area of Bayan Construction Limited.<sup>54</sup>

**Lithium:** preliminary geology has been undertaken in Mapatizya, Southern Province. More analysis is required to identify the materiality and confirm its presence by the Ministry of Mines and Minerals Development. At the global level, lithium mining currently comprises notable operations in Australia, Chile and Zimbabwe. Established significant lithium operations around the world have increased, while some are in the process of increasing production capacity on the back of the rapid increase in demand and prices of lithium in 2022.

**Uranium:** Goviex announced a resource increase from 29% to 74% in July 2023. The drilling campaigns in 2021 and 2022 successfully led to a significant update in the Muntanga Project mineral resource estimate. Currently, the Muntanga Project consists of three mining permits that cover approximately 720 kilometre squared, and contains five deposits: Dibbwi, Dibbwi East, Muntanga, Gwabi and Njame. There exists additional potential for further upgrading of resources following the positive out-turn of feasibility studies.<sup>55</sup>

53 Sugilite a captivating gemstone with unique properties <https://copperbeltkatangamining.com/sugilite-a-captivating-gemstone-with-unique-properties/>

54 Ministry of Minees and Mineral Developmet [https://www.parliament.gov.zm/sites/default/files/images/publication\\_docs/Ministerial%20Statement%20-%20On%20illegal%20Mining%20of%20Sugilite.pdf](https://www.parliament.gov.zm/sites/default/files/images/publication_docs/Ministerial%20Statement%20-%20On%20illegal%20Mining%20of%20Sugilite.pdf)

55 Goviex announcement [https://goviex.com/site/assets/files/4654/2i\\_muntangaresourceupdate\\_170723\\_final.pdf](https://goviex.com/site/assets/files/4654/2i_muntangaresourceupdate_170723_final.pdf)

## d) Increasing local ownership and participation in the mining value chain

Local ownership and participation of locals in the mining sector's value chain is one area that needs to be improved in order to spur economic activity in the sector and create employment opportunities for Zambians. According to the 2022 Least Developed Countries Report, some 95% of metals extracted in least developed countries serve final consumption in other countries. Additionally, developing countries have a high export dependence, with 70% of primary energy extracted in least developed countries serving final consumption in non-least developed countries.<sup>56</sup> With Europe planning to become carbon-free and climate neutral by 2050, certain minerals have been identified as essential to this drive, some of which are found in Africa.<sup>57</sup> Africa in turn has identified this as an opportunity to capitalise on prospective demand and rising metal prices. With regards to the value chain, mining nations intend to ensure they reassign themselves new value positions in supply of the much-needed minerals, while local shares in the sector have an active trickle-down effect.

Policies regarding local content for extractive industries have grown in significance as local content requirements are incorporated in legislation and contracts.<sup>58</sup> Given Africa houses about 60% of the world's poor population, local content<sup>59</sup> policies and practices are intended to promote sustainable development by contributing to the fight against poverty. Zambia's Medium Term Budget Plan 2023-2025 seeks to develop local content regulations that enhance the participation of Zambians through the development of real partnerships with investors.<sup>60</sup> In the 2023 national budget, there was a reduction of income tax rate for the lapidary<sup>61</sup> and jewellery facilities in the gemstone industry from 30% to 25% to promote value addition and attract more investment.<sup>62</sup> This is a sector dominated by small-scale and artisanal miners.

From the survey, it was revealed that 97% of mine workers were indigenous citizens, with only 3% being expatriates. With regards to gender distribution, 91% of miners are male and 9% are female.

Table 11: Local content metrics

	Number	Percentage
Total employees	22,620	100%
Expatriates	557	3%
Zambian employees	22,058	97%
Male	20,549	91%
Female	2,071	9%

Source: PwC analysis



56 Least Developed Countries Report [https://unctad.org/system/files/official-document/lcd2022\\_en.pdf](https://unctad.org/system/files/official-document/lcd2022_en.pdf)

57 Fit for 55 plan for a green Transition <https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/>

58 <https://academic.oup.com/book/27405/chapter/197234198>

59 Local Content: Means the extent of utilisation of local inputs and/or products in the production and provision of goods and services throughout the economy. To this effect, Government policy requires a minimum of 35% utilisation of local inputs and/or products in the production and provision of goods and services throughout the economy

60 2023-2025 Medium Term Budget Plan <https://www.mofnp.gov.zm/wp-content/uploads/2022/08/Presentation-of-the-2023-2025-Medium-Term-Budget-Plan.pdf>

61 Lapidary (from the Latin *lapidarius*) is the practice of shaping stone, minerals, or gemstones into decorative items such as cabochons, engraved gems (including cameos), and faceted designs.

62 2023 National Budget Address <https://www.parliament.gov.zm/sites/default/files/documents/articles/2023%20Budget%20Speech.pdf>

## d. Enhancing local participation in the mining value chain

Zambia's current Vision 2030 identifies the mining sector as one of the key pillars to facilitate the creation of downstream value-added products and the capacity to localise upstream inputs.<sup>63</sup> The African Mining Vision of 2009 and the Southern African Development Community Regional Mining Vision (SADC-RMV) of 2019 both emphasise the importance of realising the mineral extraction and processing linkages, and in particular the mining supply chain linkages, by increasing local content.

As local ownership develops, so does local participation in the mining value chain. The benefit of this is that the industry expands by attracting new local players or allows existing local firms to increase their current share. The value chains in the mining industry are as complex and interconnected as those in any other sector in Zambia that relies on exports.<sup>64</sup>

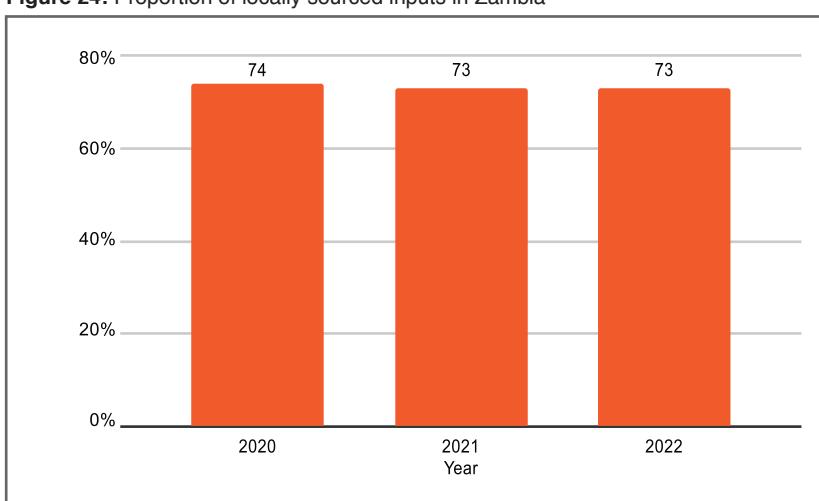


Zambia signed a memorandum of understanding with the US and the DRC to jointly develop a supply chain for electric vehicle batteries on December 13, 2022. The memorandum of understanding, which was signed during the African Leaders Summit, aims to establish a value chain from mining to assembly and encourage private sector participation in all stages of the supply chain. Both copper and cobalt are used in electric car battery production.<sup>65</sup>

Resource rich-countries have developed a strong interest in the area of local procurement over the past decade.<sup>66</sup> As a result, the role of law in the mining value chain has been more pronounced than ever. This role of law establishes the frameworks for the industry, ownership of mineral resources, and economic relationships between companies and host countries.

Respondents to our survey were asked what proportion of inputs they source locally. Their replies indicate that the average percentage of inputs procured by mining companies from Zambian-registered entities was 73% in both 2021 and 2022.

Figure 24: Proportion of locally sourced inputs in Zambia



Source: PwC Analysis

63 Vision 2030 Zambia. [https://www.nor.gov.zm/?wpfb\\_dl=44](https://www.nor.gov.zm/?wpfb_dl=44)

64 <https://blogs.worldbank.org/governance/innovative-solutions-resource-mobilization-zambia#:~:text=The%20Zambia%20mineral%20value%20chain,export%20permits%20and%20finally%20exports.>

65 <https://www.zccm-ih.com.zm/2023/01/20/us-signs-mou-with-drc-and-zambia-for-cobalt-and-copper-mining-and-processing-for-electric-vehicle-batteries/>

66 [http://www.scielo.org.za/scielo.php?script=sci\\_arttext&pid=S2225-62532022000200005](http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S2225-62532022000200005)

- **Restructuring in response to an evolving value chain for minerals:** mining companies see that diversification has been prompted by demand for essential metals and minerals for sustainable energy solutions. Emerging minerals provide industry players with a chance to restructure the value chain in a way that benefits locals more than before.
- **Institutions, policies, logistics, and the repatriation of minerals:** current areas that have active local player participation in the industry are significant as they are key contact areas in implementing frameworks that foster vital value addition in the sector.
- **Addressing the financial challenge:** access to cheaper finance continues to be a challenge for most local and potential local players in the sector. Therefore, closing the finance gap is essential if the mining sector is to attract more local players and improve the level of local participation in the mining value chain. This would enhance local performance in the sector by enabling improved equipment, efficiency and productivity, which would have a beneficial impact on local participation.



## e) Promoting and supporting artisanal mining

Artisanal and small-scale miners,<sup>67</sup> which in Zambia are mainly women and youths, mine high-value minerals such as cobalt, copper, gold, manganese and precious metals. While it is estimated that more than 40 million people work in the sector globally, it remains largely unregulated, resulting in limited information on production, revenues, employment and operations.<sup>68</sup>

Different countries have different approaches to artisanal mining. For example, Botswana's Department of Mines does not recognise informal artisanal mining as all small-scale mining is licensed.<sup>69</sup> Therefore, Botswana does not appear to have an illegal artisanal/small-scale mining sector like many other mineral rich countries do, especially in developing countries. However, in Zambia the sector is recognised and is currently undergoing licensing. The Zambian Mines and Minerals Act of 2015 Section 29 [2] limits artisanal mining licensing to citizens or cooperatives owned by citizens.<sup>70</sup>

The Government increased support for small-scale and artisanal mining in 2023 from K460,000 to K52,140,997. The increase aims to enhance operations in the sector, such as site inspections, technical support services and enhanced compliance, through sensitisation and inspections.<sup>71</sup>

Copper production by small-scale miners increased by 18.7% from 26,610 tonnes in 2021 to 31,591 tonnes in 2022. This was underpinned by increased production activities at mine tailing dumps.<sup>72</sup>

**Table 12:** National budget allocations for artisanal and small-scale mining

2021(K)	2022(K)	2023(K)
497,928	460,000	52,141,000

Source: Ministry of Finance and National Planning<sup>73</sup>

## Newly introduced artisanal and small-scale tax

The ZRA has set up the artisanal and small-scale mining unit, which intends to optimise and increase accessibility, compliance and the tax base. Six months after its creation, the unit is still in its primary stages of raising awareness of miners' tax obligations and is yet to take effect. This amendment introduces a presumptive tax rate based on gross turnover less the mineral royalty paid for income from artisanal and small-scale mining. Despite their turnover, corporate income tax is currently applicable to all mining firms. The artisanal and small-scale mining sector will not be subject to the K12,000 annual income level taxed at 0% that is applicable to the general turnover tax.<sup>74</sup>

**Table 13:** Presumptive tax artisanal and small-scale mining

Tax Rate	Taxbase
4%	On gross turnover less mineral royalty paid

Source: Zambia Revenue Authority

<sup>67</sup> Artisanal and small-scale mining, or ASM, is a largely informal economic sector that includes workers around the world who use basic tools to extract from the earth everything from gold and gemstones to vital metals such as cobalt, tin, tungsten and tantalum.

<sup>68</sup> <https://eiti.org/artisanal-and-small-scale-mining>

<sup>69</sup> <https://documents1.worldbank.org/curated/en/104891476786294215/pdf/109316-REVISED-PUBLIC-Botswana-MInGov-2017.pdf>

<sup>70</sup> The Mines and Minerals Act 2015 <https://www.parliament.gov.zm/sites/default/files/documents/acts/The%20Mines%20and%20Minerals%20Act%202015.pdf>

<sup>71</sup> Estimates of Revenue and Expenditure [https://www.parliament.gov.zm/sites/default/files/images/publication\\_docs/07%20Main%20Report%20Budget%202023%20%282%29.pdf](https://www.parliament.gov.zm/sites/default/files/images/publication_docs/07%20Main%20Report%20Budget%202023%20%282%29.pdf)

<sup>72</sup> 2022 Annual Economic Report <https://www.mofnp.gov.zm/?wpdmpro=2022-annual-economic-report>

<sup>73</sup> Estimates of Revenue and Expenditure <https://www.parliament.gov.zm/publications/yellow-book>

<sup>74</sup> Zambia Revenue Authority Practice-Notes <https://www.zra.org.zm/wp-content/uploads/2023/02/Practice-Notes-2023.pdf>



## Enhancing artisanal mining

The following areas should be considered when addressing the concerns of artisanal and small-scale miners in Zambia:

### 1. Formalisation

- High costs/charges incurred to formalise the miners, which on average range from K50,000 to K80,000. Miners reported the delay in acquiring the Environmental Project Brief (EPB).<sup>75</sup>
- This is a significant barrier that further prevents artisanal miners from formal access to financial markets, thereby limiting their access to capital.

### 2. High finance costs

- Small-scale miners identified high finance costs as a hindrance to accessing capital, consequently lowering their productivity capacity.
- At the same time, banks revealed many small-scale mining sector operations do not meet the requirements for financing support given the nature of their operations. These risks include uncertainty of lifespan of minerals, shifts into new mining locations, and irregular production boom/slump cycles.
- Financial risk is matched to levels of uncertainty. Therefore, more financial risk is associated with artisanal mining as finance providers face challenges in qualifying collateral for artisanal mining.

As of June 2023, 52 mining cooperatives have been registered with the collaboration of various ministries, such as small and medium enterprises, trade, commerce, and industry, among others. Partnerships with small and medium enterprise projects have so far been taken on in Muchinga Province, North-Western Province, Central Province and Eastern Province, where artisanal miners form cooperatives and operations are formalised to leverage opportunities.

Gradual steps towards formalisation and capacity building in the artisanal mining sector should be made as these small-scale businesses are essential to the economy in the long run. As previously mentioned, the ZRA recently established the artisanal and small-scale mining tax unit as well as the mining regulation commission, although these organisations are not yet fully operational. Formalising the sector playing a critical role to facilitate the implementation for future implementation.

Although opportunities for small-scale miners exist, most are unable to leverage them because their operations run outside the legal framework. These are all Government efforts aimed at countering high finance and formalisation costs for the small-scale miners.

Formalisation of the sector would enhance transparency and provide significant information and insights, which would provide the basis for the design of appropriate financial products for the sector.

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75 Association of Small-Scale Mining Meeting



## Artisanal mining financing projects within Africa

The United Nations Development Programme (UNDP) supports small-scale mining. The UNDP's mining projects in Botswana are run through the Artisa Supplier Development Programme, which focuses on enhancing market footprints for artisanal and small-scale miners.<sup>76</sup> In West Africa, the UNDP offered small grants to artisanal projects and small-scale mining in Cameroon.<sup>77</sup>



## f) Improving oversight and compliance

### Minerals Regulatory Commission

The Minister of Finance announced in his 2024 budget speech in September that the Government will establish a new Minerals Regulatory Commission to enhance oversight of the mining sector. Increased production targets require increased mining activity, and the commission will be tasked with ensuring companies comply with regulations. The draft legal framework has been finalised and was handed to the Ministry of Justice in readiness to be passed onto Cabinet.

The Ministry of Mines has focused on periodic assessments regarding the legality of mining licence holders. In June 2023, a total of 130 licences were revoked, while in July, 1,217 new licences were awarded for different types of mining activities.<sup>78</sup> Private and foreign players depend on Government oversight and policies for their projects.

- Zambia currently has emerging minerals such as gold, manganese, sugilite and lithium in the activities stage. Potential challenges which may emerge are mixed operations where non full-scale mining operations occur alongside mineral production and trading, such as the sugilite incident in Luapula.<sup>79</sup> There is a need for an assessment to address the vulnerabilities that exist during the prospective mining period.
- The Zambia Revenue Authority(ZRA) intends to increase physical presence in mining locations by appointing withholding agents for the collection of mineral royalty, turnover tax and rental income tax.
- The ZRA's new Mineral Value Chain Data Analytics Unit has been introduced to support mining tax audits, while other electronic tools have been introduced to achieve compliance.

<sup>76</sup> <https://www.atisa.org.bw/about-us/>

<sup>77</sup> UNDP Cameroon Small Grants for Artisan projects and Small scale mining <https://www.advance-africa.com/UNDP-Cameroon-Small-Grants-for-Artisan-Projects-and-Small-Scale-Mining.html>

<sup>78</sup> Ministry of Mines and Mineral Development <https://www.mmmmd.gov.zm/?p=2587>

<sup>79</sup> Ministry of Mines and Mineral Development Ministerial Statement [https://www.parliament.gov.zm/sites/default/files/images/publication\\_docs/Ministerial%20Statement%20-%20On%20illegal%20Mining%20of%20Sugilite.pdf](https://www.parliament.gov.zm/sites/default/files/images/publication_docs/Ministerial%20Statement%20-%20On%20illegal%20Mining%20of%20Sugilite.pdf)





## ESG

Mining companies have grappled with environmental sustainability issues for a long time due to their impact on the environment. Despite this, mining has a crucial role to play in delivering the minerals required to foster environmental sustainability.<sup>80</sup> Driven by investor demand and the changing global economy, ESG is now identified as a crucial component in mining company strategy and policy, and is vital in the assessment of a company's morality, competitiveness and culture. ESG presents environmental, social and governance themes in a comprehensive framework in order to ensure a balance of beneficial effects exists between the three Ps: planet, people and profits.

When compliant with ESG, mining companies have the ability to add value, improve reputation and attract investment.<sup>81</sup> On the contrary, a lack of concern for ESG is a perceived risk that could threaten the continuity of a business operation. Overlooking ESG protocols could make a mining company vulnerable by negatively affecting its ability to raise capital, acquire work permits, and engage with various players (regulators, suppliers, clients, community etc). In contrast, adopting ESG principles can improve asset management (reduce operating costs and financial performance), reduce energy, water bills, and reduce carbon emissions among others.

80 Environment: biodiversity, ecosystem services, water management, mine waste / tailings, air, noise, energy, climate change (carbon footprint, greenhouse gas), hazardous substances, mine closure. Social: human rights, land use, resettlement, vulnerable people, gender, labour practices, worker/community health & safety, security, artisanal miners, mine closure / after use. Governance : Legal compliance , ethics, anti-bribery and corruption (ABC), transparency

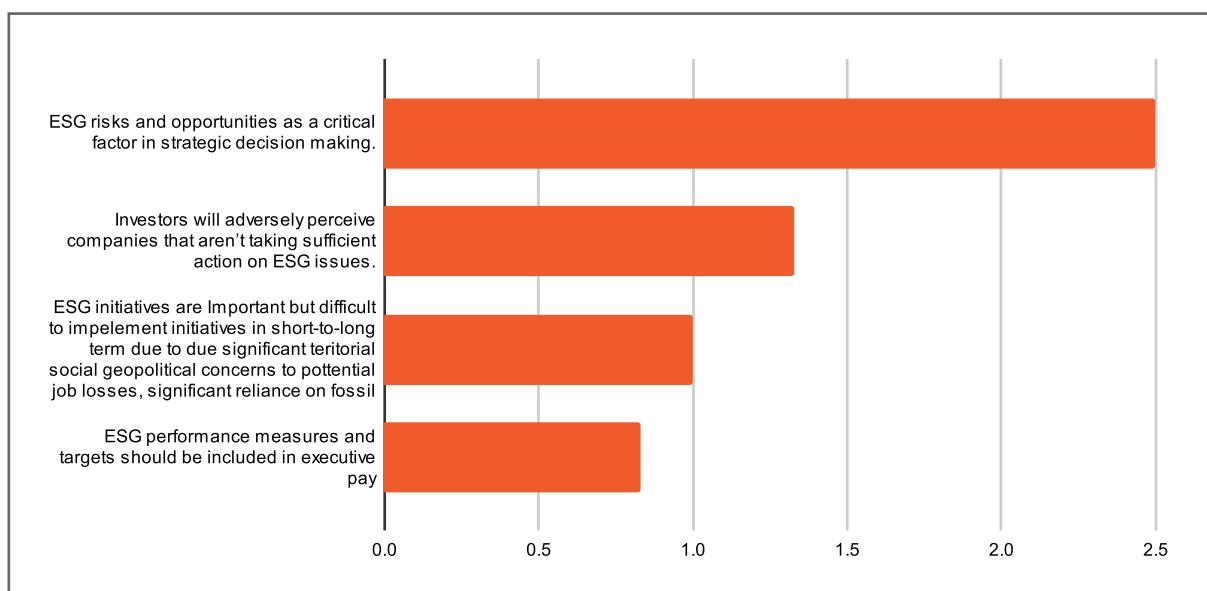
81 Environmental Social and Governance <https://www.sciencedirect.com/science/article/pii/S2666789421000076>

Among mining companies operating in Zambia, our survey reveals that 88% reported to have integrated sustainable investment criteria into their decision-making process, while 12% have not but are considering it. The main incentives for mining companies adopting ESG strategies are as follows:

1. It is part of group requirements from companies operating as part of a group, which are driven by shareholder demand.
2. It improves a mine's corporate social responsibility, and its standing in society and the community, making its business more sustainable.
3. It preempts regulatory rules requiring mines to 'green up' operations.

Various steps have been taken to ensure mining firms adhere to ESG values and practices. Mining companies have also embedded ESG in their short and long-term corporate plans. Integrating ESG risks and opportunities in strategic decision-making has become an essential part of creating a sustainable business.

**Figure 25: Drivers for incorporating ESG into a mining company's corporate plan**



Source: PwC analysis

## ESG and small-scale mining

Various organisations have stepped forward to offer training in sustainable mining practices for small-scale miners and artisanal miners. The lack of support in the provision of the correct equipment remains a challenge.

## Sustainability reporting

Businesses are now more aware that to run an efficient operation they need to take into account not just financial capital but other forms of capital too, including social, intellectual and environmental. ESG is the input, while sustainability is the outcome. In this regard, financial markets have responded rapidly to investor, customer and society's demands for a more transparent reporting mechanism.

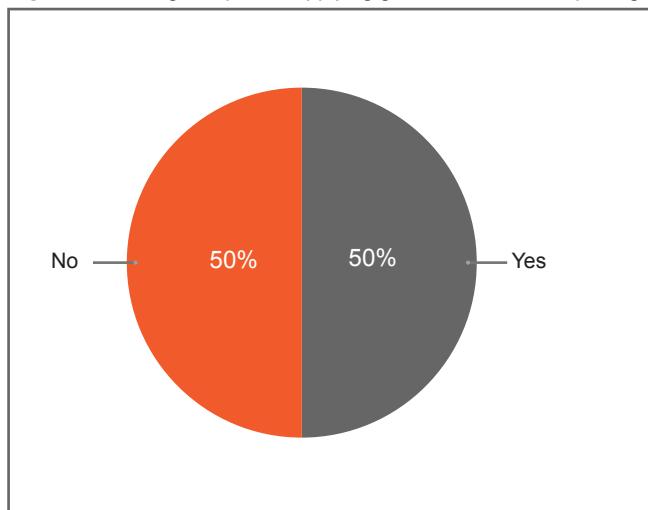
Using a voluntary ESG framework for guidance can help determine which issues to disclose and the form that those disclosures take, and may facilitate the verification of information contained in a company or client's report.<sup>82</sup> Therefore, sustainability reporting can be broken down into two parts:

1. It gives clarity to external stakeholders on how a company measures success by communicating both financial and non-financial efforts and priorities.
2. It can help an organisation internally by enabling it to define its purpose and guide how resources are allocated.



According to our survey, half of the mining companies that responded said they applied global sustainable reporting standards/ framework when preparing nonfinancial information in the annual report, while the other half said they did not.

**Figure 26: Mining companies applying global sustainable reporting**



Source: PwC Analysis

Some of the sustainability reporting frameworks used by the mining firms consist of the following<sup>83</sup>

- Global Reporting Initiative: an international standards organisation that aids businesses, Governments and organisations in understanding and communicating their impacts on climate change, human rights and corruption.
- Sustainability Accounting Standards Board: the framework is a sector-specific guidance tool designed to assist publicly traded companies in determining the financial materiality of sustainability-related information for the SEC and public disclosure.
- Task Force on Climate-Related Financial Disclosures: the voluntary framework provides recommendations for organisations to prepare consistent and comparable climate-related financial disclosures across various sectors and jurisdictions.

With the view of enhancing disclosures in entities' and bring harmonisation to sustainability reports, the International Sustainability Standards Board (ISSB) on 26 June 2023 issued its inaugural standards—IFRS S1 and IFRS S2—ushering in a new era of sustainability-related disclosures in capital markets worldwide. The Standards are aimed to improve trust and confidence in company disclosures about sustainability to inform investment decisions. And for the first time, the Standards create a common language for disclosing the effect of climate-related risks and opportunities on a company's prospects.

The ISSB developed IFRS S1 and IFRS S2 with the benefit of extensive market feedback and in response to calls from the G20, the Financial Stability Board and the International Organization of Securities Commissions (IOSCO), as well as leaders in the business and investor community.

The Zambian Government in 2015 initiated a plan with support from the World Bank for a project called the Zambia Mining and Environmental Remediation and Improvement Project (ZMERIP). The aim was to strengthen capacity when dealing with pollution and other environmental issues at national and state levels by improving enforcement of pollution prevention and addressing the environmental needs associated with poor mining practices. In 2020, the World Bank disbursed USD65.5 million with the purpose of reducing environmental health risks in critically polluted mining areas. The project was designed to improve living conditions among the poor and vulnerable in affected communities such as those living in Chingola, Kitwe and Mufulira, as well as those in Kabwe who have been exposed to lead. The ZMERIP project builds on the previous Copperbelt Environment Project, which closed in 2011 with a total cost of USD53.5 million.

<sup>83</sup> Comparison of ESG reporting Frameworks <https://pro.bloomberg.com/brief/comparison-of-esg-reporting-frameworks/>



# Conclusion

The transition to renewable energy has created a huge opportunity for Zambia's mining sector to grow as global demand for minerals such as copper and cobalt increases. However, the sector can only realise to its full potential if appropriate support infrastructure is developed.

Other parts of the mining value chain also need investment if Zambia is to get close to its three million tonnes of copper per annum target by 2032. These include encouraging more exploration, improving mining's processing capacity and ensuring existing and new mines have a reliable energy supply.

Finally, the Government should intensify efforts to extend mineral geological mapping to more than 80% of the country (as at the end of December 2021 only 55% of the country was mapped) by putting in place targeted investor incentives for exploration activities and publicly sharing the results. Key to this would include making public the exploration data that has underpinned Government's three million tonne target. Given it takes on average 14 years from exploration and discovery to production, this geological mapping will need to be undertaken to assess whether this target will be met.

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# Contributors



Andrew Chibuye  
Country Senior Partner  
Assurance  
[andrew.chibuye@pwc.com](mailto:andrew.chibuye@pwc.com)



Malcolm Jhala  
Partner  
Tax  
[malcolm.jhala@pwc.com](mailto:malcolm.jhala@pwc.com)



Nsansa Mkonda  
Associate Director  
Assurance  
[nsansa.n.mkonda@pwc.com](mailto:nsansa.n.mkonda@pwc.com)



Nyambe Mbanga  
Manager  
Assurance  
[nyambe.mbanga@pwc.com](mailto:nyambe.mbanga@pwc.com)



Evelyn Tembo  
Manager  
Clients Market Development  
[evelyn.tembo@pwc.com](mailto:evelyn.tembo@pwc.com)



Kasongo Lufuma  
Senior Associate  
Clients Market Development  
[kasongo.lufuma@pwc.com](mailto:kasongo.lufuma@pwc.com)



Chansa Musonda  
Associate  
Advisory  
[chansa.musonda@pwc.com](mailto:chansa.musonda@pwc.com)



Kurt House  
Global CEO  
KoBold Metals  
Guest Contributor



[www.pwc.com/zm](http://www.pwc.com/zm)

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