Repositioning Zambia to Leverage Energy Transition Minerals for Economic Transformation

A Roadmap

EGPS
EXTRACTIVES GLOBAL PROGRAMMATIC SUPPORT

Resilient and Inclusive Supply Chain Enhancement
RISE

AN INITIATIVE OF
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GOVERNMENT
REPUBLIC OF
ZAMBIA

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ABBREVIATIONS AND ACRONYMS

AfCFTA	African Continental Free Trade Area
AGOA	African Growth and Opportunity Act
AltX	Alternative Exchange
ASM	artisanal and small-scale mining
CAM	cathode active mass
CBAM	carbon border adjustment mechanisms
CEC	Copperbelt Energy Corporation Plc.
CET	Common External Tariff
COMESA	Common Market for Eastern and Southern Africa
DRC	Democratic Republic of Congo
EAPP	Eastern Africa Power Pool
EITI	Extractive Industry Transparency Initiative
E&S	environmental and social
ESG	environmental, social, and governance
ETM	energy transition minerals
GPS	Global Positioning System
GRZ	Government of the Republic of Zambia
HS	Harmonized System
IFMIS	Integrated Financial Management Information System
IRP	Integrated Resource Plan
ITBD	Investment, Trade and Business Development [Act]
JORC	Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves
kV	kilovolt
kWh	kilowatt-hour
LME	London Metal Exchange
LuSE	Lusaka Securities Exchange
MFEZ	multi-facility economic zone
Moses	Mineral Output Statistical Evaluation System
MMMD	Ministry of Mines and Minerals Development
MRC	Minerals Regulation Commission
MSMEs	micro-, small, and medium enterprises
mtpa	million tons per annum
MW	megawatt
NRFA	National Road Fund Agency
OECD	Organisation for Economic Co-operation and Development
PPP	public-private partnership
RISE	Resilient Inclusive Supply Chain Enhancement
SADC	Southern African Development Community
SAMREC	South African Code for Reporting of Mineral Resources and Mineral Reserves

SAPP	Southern African Power Pool
SEZ	special economic zone
TAZAMA	Tanzania Zambia Mafuta [oil pipeline]
TAZARA	Tanzania-Zambia Railway Authority
TEVET	technical education, vocational, and entrepreneurship training
TEVETA	Technical Education, Vocational and Entrepreneurship Training Authority
TRACER	Transport Corridors for Economic Resilience
ZATP-II	Zambia Agribusiness and Trade Project-II
ZCCM-IH	ZCCM Investment Holdings
ZDA	Zambia Development Agency
ZRA	Zambia Revenue Authority
ZEMA	Zambia Environmental Management Agency
ZESCO	Zambia Electricity Supply Corporation Limited
ZQF	Zambia Qualifications Framework
ZRL	Zambia Railways Limited

All dollar amounts are US dollar, unless otherwise indicated, and all tons are metric tons.

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1. CONTEXT AND OPPORTUNITIES

1.1 Objectives of the roadmap

Zambia aspires to be a prosperous middle-income country by 2030. To that end, the Government of the Republic of Zambia (GRZ) has set out an aggressive economic diversification and industrialization agenda driven by the agriculture, mining, manufacturing, and tourism sectors. With regards to mining, Zambia recognizes that it has a unique window of opportunity to leverage its endowments in energy transition minerals (ETM)[1] to transform its economy in an inclusive and sustainable manner. The GRZ has set itself ambitious targets,[2] and is undertaking several actions to realize them. This roadmap, requested by the government and prepared jointly with government counterparts, provides a deliberate, whole-of-government approach and an integrated strategy for leveraging Zambia's ETM resources for economic transformation, focusing on maximizing the generation, sharing, and management of benefits and minimizing risks. The roadmap highlights the primary opportunities and constraints along the main segments of the ETM value chain and provides a menu of policy recommendations to address these challenges, along with proposals for implementing the roadmap.

1.2 Structure of the ETM roadmap

The roadmap is structured into five chapters (Table 1.1):

- *Chapter 1: Scaling ETM production*—assesses the ETM resources potential and how to scale up production with special focus on achieving the Government's ambitious target of tripling copper production within a decade (from about 800,000 kilotons of copper per year in 2021 to about 3 million tons of copper per year by 2031). This section also reviews the mining sector governance and investment climate to promote private sector participation in the sector.
- *Chapter 2: Improving the capture, management, and sharing of benefits*—assesses the government's ambition to maximize the benefits from its ETM resources for Zambians, including revenue collection, employment, community development, the development of local micro-, small, and medium enterprises (MSMEs), and local value addition. The chapter also assesses Zambia's fiscal management to promote broader economic development.
- *Chapter 3: Expanding infrastructure and workforce*—examines the enabling infrastructure (energy, transport, and logistics) and the skilled workforce needed to realize the objectives in Chapters 1 and 2.
- *Chapter 4: Enhancing sustainability*—reviews actions needed to ensure the sustainability of the ETM value chain and its contribution to broader economic diversification and transformation. This includes issues such as environmental and social (E&S) governance, progress towards net zero mining, and institutional capacity and capability to manage resources and enforce regulations.
- *Chapter 5: Operationalizing the Roadmap*—presents priority policy actions, the actors responsible for their delivery, areas of coordination needed, the cost of implementing the roadmap, and alternative financing models.

[1] ETM include minerals such as lithium, copper, manganese, graphite, cobalt, nickel, and rare earth elements.
[2] These include tripling copper production within a decade, from about 800,000 tons in 2021 to 3 million tons per year in 2031; increasing the availability of geological data through mapping the whole country; and maximizing local ETM value addition.

Table 1.1. Summary of ETM development, priority roadmap activities, and expected outcomes

Current context	Roadmap focus areas and key activities		Expected outcomes
• Established mining sector • Untapped mineral resources • Strong investor interest • Higher global demand for ETM • Strong government commitment and reform agenda • New trade and investment partnership opportunities • Massive gap in infrastructure and skilled workforce • Low participation by Zambians in ETM value chain • Misalignment among key policies to realize ETM objectives • Lack of prioritized actions and accountability matrix • Limited finance	Scaling production	• Improve geological knowledge • Scale production • Strengthen sector governance	• Higher employment—up to 500,000 jobs in mining alone, and more jobs with value addition • Increased investment—by upwards of $20 billion in the next decade • Increased exports—six- to tenfold rise over the next decade • Higher fiscal revenue—royalties and corporate income tax rising by $3.4 billion to $6.0 billion by mid-2040s • Increased participation of local firms in ETM value chains • Enhanced workforce skills and firm capabilities • Higher household incomes • More economic opportunities for local communities • Better public financial management • Better ESG risk management • Stronger accountability and coordination framework • Improved financing of the roadmap
	Improving capture, management, and sharing of benefits	• Deepen value addition • Expand Zambian participation • Enhance mobilization of revenues and benefit sharing • Improve public financial management	
	Expanding infrastructure and skilled workforce	• Ramp up energy generation and distribution • Enhance transport and logistics services • Increase employment and upgrade skills	
	Enhancing sustainability	• Manage ESG risks • Promote sustainable and low-carbon mining	

Source: World Bank staff.
Note: ESG = environmental, social, and governance; ETM = energy transition minerals.

1.3 Opportunities for Zambia to tap into rising global demand for ETM

The global energy transition is driving demand for ETM. Aspects of the transition, such as the electrification of transport, the decarbonization of industrial processes, and clean energy technologies for generation, transmission, and storage, require more materials and metals than fossil fuel-based energy technologies (Cust and Zeufack 2023). For example, manufacturing electric vehicles uses more minerals than does manufacturing internal combustion engine vehicles; the same holds for energy production using clean technologies such as solar and wind rather than fossil-based technologies.[3] According to the International Energy Agency's bottom-up assessment of energy policies in place or announced by 2020, the world was on track for a doubling of overall mineral requirements for clean energy technologies by 2040. A faster transition, to achieve net zero emissions globally by 2050, would require six times more mineral inputs in 2040 than in 2020. Such significant growth in the demand for ETM could lead to severe supply shortages (Hund and others 2020), especially since investments in upstream exploration are still limited, and production from new mines has a long lead time.

[3] For example, generating one terawatt-hour of electricity from solar and wind could consume, respectively, 300 and 200 percent more metals than generating it from a gas-fired power plant, on a copper-equivalent basis (Azevedo and others 2022).

The global distribution of ETM production and processing is concentrated. ETM reserves and production are more concentrated than fossil-based energy sources (IEA 2021).[4] Their downstream processing is even more concentrated, with fewer than three countries processing over 50 percent of the global market share of vital ETM. Given the strategic nature of ETM and the risks associated with the resilience of their supply chains, major industrial powers seek to secure their supply of "critical" or "strategic" minerals and diversify the geographical production and beneficiation of materials and components.[5] For example, the United States' Inflation Reduction Act and its Minerals Security Partnership,[6] the European Union's legislation for securing critical minerals, China's "Made in China 2025" industrial policy and "1+N" policy framework for carbon peak and carbon neutrality, and Canada's critical minerals strategy[7] all emphasize the importance of securing critical minerals for the energy transition. These initiatives are changing the patterns of production and trade within global ETM value chains. Downstream players also seek to vertically integrate their supply sources to safeguard against geopolitical uncertainties, and some ETM-rich upstream countries are banning the export of unprocessed raw materials and demanding local value addition with respect to materials and electric vehicle-related components. Such shifts in the production and trade patterns of ETM have important implications for mineral-rich African countries such as Zambia.

Supporting ETM-rich African countries in scaling up sustainable ETM production and value addition locally would have significant global benefits.[8] Under the net zero emissions scenarios, global revenue from key ETM is estimated to reach $16 trillion by 2050, and Africa could capture nearly $2 trillion of this revenue (IEA 2024; Chen and others 2024). With about 30 percent of the world's proven ETM reserves, Africa can contribute significantly to the global energy transition (Chen and others 2024). Despite the continent's substantial mineral reserves, most African countries currently export these minerals in their raw form, thus failing to benefit from the considerable potential for local processing and manufacturing.[9] Helping Africa to scale up the supply and value addition opportunities in ETM would have three global public goods benefits: (a) security of an adequate ETM supply, (b) resilient global ETM supply chains, and (c) inclusive and sustainable development, contributing to regional peace and security. However, seizing these opportunities requires addressing challenges around sustainable mining, infrastructure[10] and skills deficits, and access to finance, along with policies that facilitate investment and minimize fiscal costs and market distortions.

[4] See the executive summary.
[5] There is no universally agreed upon definition of what "critical" or "strategic" means, but the common tread is that they are essential to the economy of a given country and their supply may be disrupted. Criticality changes over time, depending on the needs of society and the availability of supply, and it is country- and context-specific, particularly with respect to mineral endowment, the relative importance of the minerals to industrial and economic development, and a strategic assessment of supply risks and volatility.
[6] For more information, see the US Department of State website, https://www.state.gov/minerals-security-partnership/.
[7] European Union: Economist Intelligence (2023); China: PRC, DREP (2021); Canada: NRCan (2022).
[8] Africa's mineral wealth includes 92 percent of the world's platinum reserves, 56 percent of cobalt reserves, 54 percent of manganese reserves, and 36 percent of chromium reserves. Overall, it is estimated that Africa hosts about 30 percent of the global ETM reserves (Richards and others 2024; ZCA 2024).
[9] The focus on extraction rather than value addition limits potential profits, tax revenues, job creation, and technological advancements, all of which could substantially boost economic development on the continent.
[10] Unreliable and expensive electricity, high transport costs, and shipment delays constrain the development of bulk commodity resources (such as iron, nickel, and copper).

Concerted efforts are needed from key stakeholders to realize these opportunities.

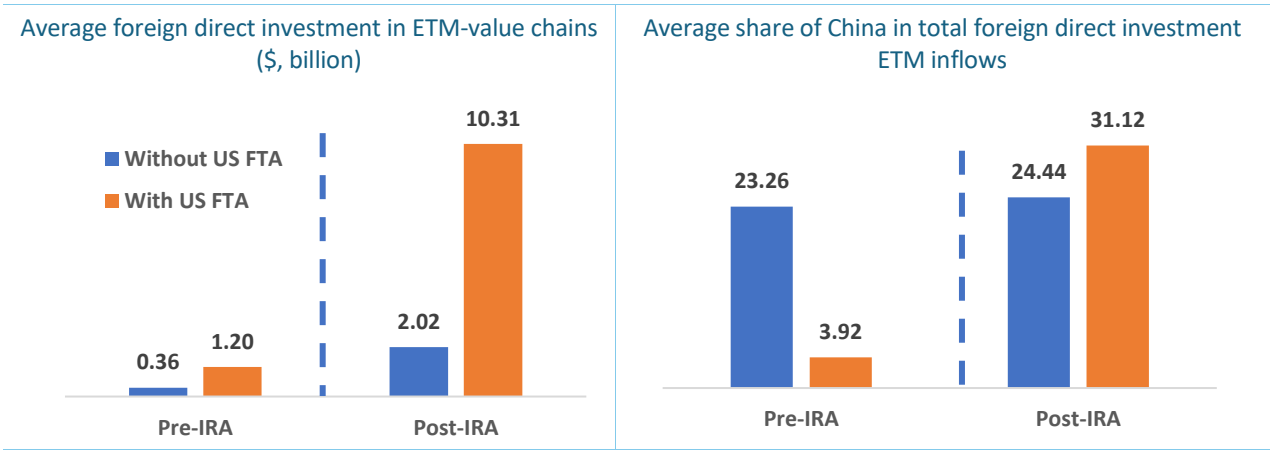
- *ETM-rich countries should create a robust enabling environment for investors to engage in exploration, mining, processing, and downstream value addition*, including working with neighboring countries to achieve scale and create regional value chains. According to the World Bank survey, beyond the distribution of geological potential,[11] investment decisions in the mining and manufacturing sectors are largely driven by six criteria: (a) potential profitability of operations, including ability to repatriate profits; (b) security of tenure; (c) consistency of mineral and tax policy; (d) availability of infrastructure, such as power, roads, and rail; (e) access to markets through trade agreements; and (f) strong institutional governance. This underscores the fact that governments, the quality of their policies, and the core competencies to implement those policies are key determinants of mining investment flows.
- *Developed economies that require significant ETM for their energy transition should encourage ETM-related foreign direct investment in Africa and allow African countries to access their markets.* For example, the G-7 has advocated for a rules-based, open trade system for ETM that benefits all actors, including low- and middle-income countries. Accordingly, the G-7 countries are promoting the green transition and diversification of sourcing through various fiscal and regulatory incentives, including free trade agreements, memoranda of understanding, and cooperation agreements, which can steer investment and trade flows (Figure 1.1).[12] Unfortunately, these incentives tend to benefit countries that have existing free trade agreements with the United States. For most ETM-rich countries in Africa to benefit from these incentives, alternative models should be established, including exploring the possibility of including US-Africa trade in ETM in the ongoing reauthorization process of the African Growth and Opportunity Act (AGOA) before its expiry in 2025 (Usman and Csanadi 2024). It is proposed that the AGOA reauthorization process consider three options: (a) exempt eligible African mineral producers from Inflation Reduction Act restrictions to diversify US supply chains and advance African value addition objectives, (b) reframe the US-Africa trade relationship into a strategic economic partnership for a new era, and (c) negotiate a new critical minerals agreement.
- *Africa's development partners, including the multilateral development banks, should help strengthen the capacity and capability of ETM-rich countries* to better manage their ETM resources and overall economy; address infrastructure and skills deficits; improve their environmental, social, and governance (ESG) frameworks; and facilitate access to affordable finance to support local small and medium enterprises to participate in ETM-related supply chains and value addition.

[11] This stems from both good geological prospectivity and mining history.

[12] Although free trade agreements must comply with World Trade Organization rules to ensure fair treatment and limit distortions to global trade, memoranda of understanding and cooperation agreements generally have terms that are less clear and an ad hoc choice of partner countries.

Figure 1.1. Impact of the US Inflation Reduction Act on foreign direct investment in ETM value chains

Countries with free trade agreements with the USA after the Inflation Reduction Act, 2022 to 2023



Source: World Bank analysis, based on foreign direct investment markets and S&P data, using bilateral foreign direct investment flows in ETM extraction, processing, and battery and storage manufacturing between 2019 and 2023.
Note: IRA = Inflation Reduction Act. The charts present unconditional means of the results of a two-way fixed-effects panel estimation with bilateral foreign direct investment inflows for 2013–23 as the dependent variable and an interaction between free trade agreements with the USA and post-Inflation Reduction Act period (2022–23), controlling for country characteristics and yearly cross-country shocks.

1.4 Zambia's current performance and prospects for ETM development

Mining, especially copper extraction, remains a pillar of Zambia's economy, but it is vulnerable to shocks and employs only a fraction (less than 2 percent) of the labor force (Figure 1.2). In 2022, mining accounted for over 44 percent of government income. Copper contributed 15 percent of the country's gross domestic product and over 70 percent of its exports (AfDB 2022b; IMF 2023) and remains the primary source of foreign currency earnings. However, Zambia's heavy reliance on mining revenues exposes it to metal price volatility, particularly as its foreign currency reserves are relatively low.

Figure 1.2. Employment share by sector, 2001 to 2021

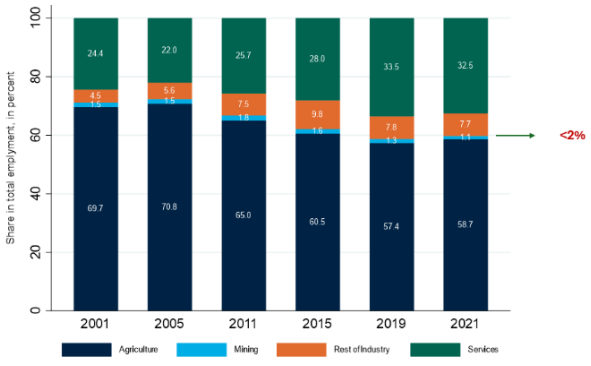
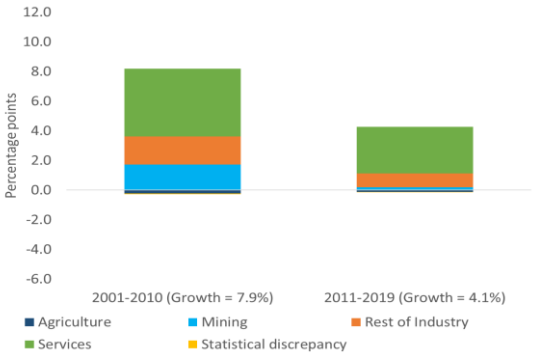


Figure 1.3. Contribution to growth by sector, 2001–10 and 2011–19



Source: World Bank 2024a.

High copper prices drove significant economic growth in the 2000s, but falling prices in the 2010s slowed the country's momentum. From 2001 to 2010, the mining sector saw fivefold growth and accounted for about one-fifth of total value-added growth (Figure 1.3). Copper export volumes nearly tripled from 296,838 tons to 829,750 tons. By 2007, copper prices had quadrupled. Export volumes peaked in 2014, despite the subsequent decline in prices. By 2016, copper prices had dropped by 41.3 percent from their 2011 levels, and mining's contribution to growth fell to less than 5 percent between 2011 and 2019 (World Bank 2024a). Real economic growth decelerated to 4.1 percent and to just 0.9 percent in per capita terms. A mix of domestic and external shocks—including climatic events and significant fiscal and external imbalances—inhibited Zambia's growth prospects throughout the decade.

Zambia's vulnerable macroeconomic position has been exacerbated by the severe drought in the 2023–24 rainy season. Economic growth averaged 5.7 percent between 2021 and 2023, thanks to stronger services and rising copper prices. However, it is expected to slow to 2.3 percent in 2024, largely because of electricity shortages (resulting in daily outages of over 12 hours) and a 53.7 percent drop in maize production. The government declared a state of emergency and revised the 2024 budget in response to this crisis. With the current account in deficit, the currency depreciating, and the food supply falling, inflation soared to 15.4 percent in July 2023, far above the Bank of Zambia's target range of 6–8 percent, despite efforts at fiscal and monetary restraint.

The government's capacity to finance development in the medium term will remain constrained, underscoring the need to attract foreign direct investment and leverage private sector investment. Zambia has been shut out of international capital markets since its Eurobond default in 2020. Despite progress in debt restructuring, including agreements with official creditors and Eurobond holders, and ongoing negotiations with nonbonded creditors, Zambia will face significant fiscal constraints in the medium term because of its enormous financing needs. To realize its ETM potential, Zambia will have to leverage private sector investment, including through public-private-partnerships (PPPs), to upgrade its energy, transport, and water infrastructure to expand the production of copper and other ETM.

Zambia has significant untapped natural resources with potential for value addition. Its extensive deposits of ETM include 2 percent of global copper reserves and some of the highest-grade copper in the world. Zambia is the ninth-largest producer of copper in the world and the second largest in Africa, after the Democratic Republic of Congo (DRC).[13] It also has notable deposits of cobalt, nickel, and manganese. Zambia is strategically positioned to become a regional energy export center through the Southern African Power Pool (SAPP) and the Eastern Africa Power Pool (EAPP). It has abundant renewable energy sources and the capability to diversify its energy mix, particularly through solar and wind energy. There are opportunities for value addition in processing ETM, including upstream and certain downstream electric vehicle components and batteries. Realizing these opportunities could support economic transformation and bring Zambia closer to its goal of becoming a prosperous middle-income industrial nation by 2030, fostering inclusive growth, and improving the well-being of its people.

Zambia has an ambitious goal of increasing copper production from about 800,000 tons in 2021 to 3 million tons per annum (mtpa) by 2031 (Lusaka Times 2022). To this end, the government is undertaking a series of reforms, including changing mining regulations to incentivize foreign investment; removing

[13] SAFE analysis based on data from Zientek and others (2024, 65).

most of the long-term, speculative licenses that prevent new exploration; and resolving issues around the non-deductibility of mineral royalty payments from corporate income taxes (Jalasi and Silwamba 2022). These policy developments have supported investment by private sector companies such as Anglo American, KoBold, and First Quantum Minerals (Box 1.1).

Box 1.1. New investments in Zambia's mining sector

- *Anglo American* made its first investment in Zambia in 20 years by acquiring a majority stake of Arc Minerals, a junior exploration firm with exploration licenses in the copper-rich North-Western Province (Reid 2022).
- *KoBold*, a US company, invested $150 million in copper exploration in the Copperbelt, backed by Breakthrough Energy Ventures (Reuters 2022a).
- *First Quantum Minerals* announced a further $1.25 billion investment in its Kansanshi copper-gold mine, the largest copper-producing mine in Africa, involving an expanded pit and mining fleet. It aims to extend the mine's life to 2040 and boost annual copper production to over 200,000 tons. The expansion is scheduled for completion by mid-2025 (Reuters 2022a).
- *Mopani Copper Mines Plc* secured a new investor, Delta Mining (a subsidiary of Abu Dhabi-based International Resources Holding), in early 2024. It aims to increase copper cathode production to 200,000 tons annually within three years, according to an April 2024 report by Energy Capital and Power.
- The resolution of the ownership dispute at *Konkola Copper Mines* with Vedanta Resources offers potential for increased output.
- Canadian mining giant *Barrick Gold* announced a near $2 billion investment in 2023 to expand its Lumwana mine, targeting an annual copper production of 240,000 tons by 2028.

Sources: Reid 2022; Reuters 2022a, 2022b. For more information, see First Quantum Minerals' "Kansanshi" website at https://www.first-quantum.com/English/our-operations/default.aspx.

2. CHAPTER 1: SCALING ETM PRODUCTION

KEY MESSAGES

- Zambia's potential for producing ETM, especially copper, remains significant, despite a long-run stagnation of production. The World Bank modeled two scenarios, *business as usual* and *unconstrained*, to project Zambia's potential future copper production and consider the impact of infrastructure and skills development on copper output.
- Sustainable and inclusive growth of the sector will be affected by factors within and beyond the control of the government. Factors within government control include a cleanup of noncompliant licenses, regulatory stabilization, enhanced geological information collection and dissemination, efficient permitting, and electricity availability. External factors include copper prices, the quality of the resources, and the like.
- Preliminary projections suggest the target of 3 million tons of copper production per year may realistically be achieved around 2042, under optimal conditions. Zambia has a different timeline for reaching this target because of different assumptions on mine development and improvements in the investment climate. The World Bank is working closely with the Ministry of Mines and Minerals Development to align assumptions and finalize projections.
- Only 55 percent of Zambia is geologically mapped, which poses a barrier to exploration and investment. A comprehensive, nationwide geological campaign is underway to address this, alongside efforts to make data available to potential investors.
- To attract responsible investment, Zambia must refine its regulatory framework, streamline licensing and permitting, and create attractive fiscal terms (including state equity and production sharing) that balance state interests with private sector incentives. Then it needs to refrain from further policy changes. Policies that are anchored in analytics and robust engagement tend to be more stable.
- The establishment of a semi-autonomous Minerals Regulation Commission aims to enhance sector governance and investor confidence by ensuring transparent and accountable management, reducing political interference, and strengthening sector oversight. Its urgent operationalization will be key to better sector oversight and interministerial coordination.
- State-owned enterprise governance and financial management should be reformed to ensure that the country reaps the benefits from its national resources, with ZCCM Investment Holdings as a critical stakeholder. State-owned enterprises must operate effectively and support Zambia's development objectives.
- Local content regulations must have clear targets and enforcement mechanisms to stimulate Zambian participation in mining value chains, recognizing that the practical approach may need to be adopted. Capacity building is essential for ensuring compliance and sustainable growth in local businesses, and a holistic approach is necessary to ensure success—the regulations on their own will not address the multiple challenges facing small businesses.
- Responsible environmental management is crucial for sustainable growth of the ETM sector. This should include, for example, safety standards for tailings management, ensuring the effectiveness of the environmental protection fund, and policies addressing artisanal and small-scale mining.

This chapter outlines strategic policy and regulatory actions to maximize Zambia's potential in ETM, with a primary focus on copper production. It addresses key policy issues related to regulatory stability, fiscal attractiveness, the availability of geological data, and local content in the mining sector. The focus area underscores the importance of an independent regulatory body to foster investor confidence and improve governance, alongside state reforms for better resource management. By addressing these

issues, Zambia seeks to position itself competitively in the global ETM market, balancing state participation with private investment, local development, and environmental stewardship.

2.1 Projections of Zambia's ETM potential

After more than a decade of policy changes (mainly to the fiscal regime), Zambia's mining production has stagnated, but its potential remains significant. The World Bank modeled potential copper production to 2050 to quantify this potential and the degree to which infrastructure or skills availability could become a constraint.

The projections are based on two scenarios modeled by the World Bank: *business as usual* and an *unconstrained* case. Figure 2.1 compares these two scenarios with other forecasts of copper production. Differences between the two World Bank scenarios lie in the assumptions on improvements in the investment climate, energy and transport infrastructure, and mine productivity (through innovation). The projections consider various production sources (Figure 2.2), including:

(a) existing mines as announced or committed to by investors, including extensions of these mines (if economic), based on public information on the remaining undepleted resources

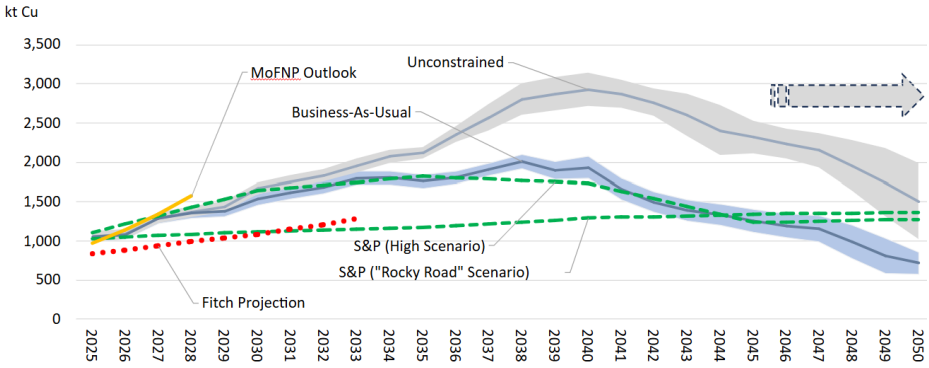
(b) preproduction properties, which include assets at the exploration stages and for which no formal commitment to move to production yet exists

(c) artisanal and small-scale mining (ASM) projections, based on figures from the Ministry of Mines and Minerals Development (MMMD)

(d) minerals remaining in mine wastes, including tailings dumps and slag heaps

(e) undiscovered potential mineral resources (based on the work of the United States Geological Survey) and an "undiscovered plus" category included only in the *unconstrained* case to reflect the limits of the current knowledge of the mineral inventory.[14]

Figure 2.1. Comparison of copper production forecasts, 2024 to 2050

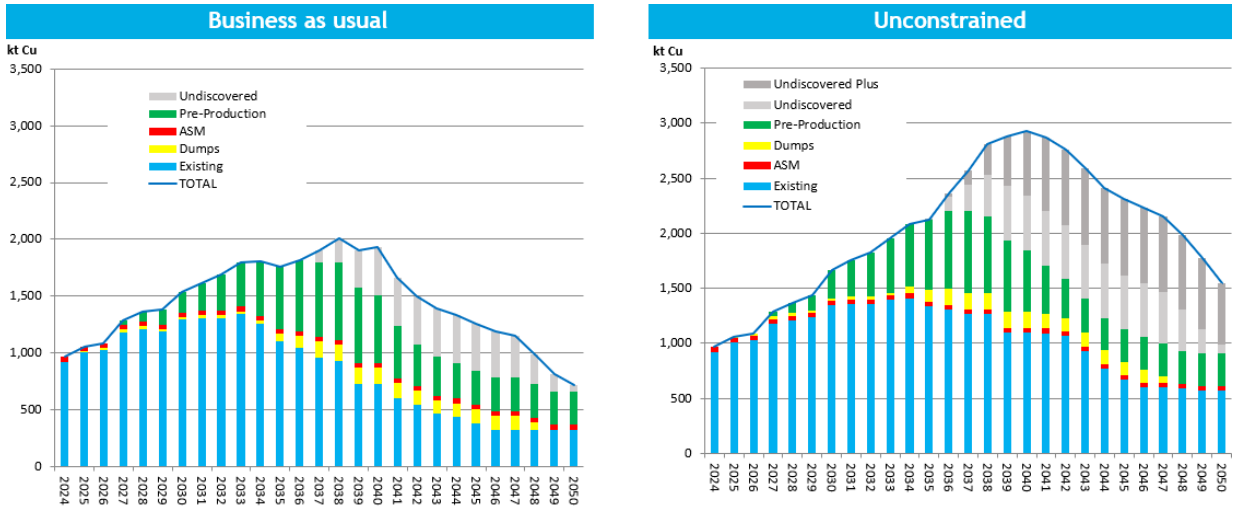


Source: World Bank calculations, Government of Zambia projections, S&P Capital IQ, Fitch ratings.
Note: MoFNP = Ministry of Finance and National Planning; WBG = World Bank Group. Confidence intervals represent two standard deviations around mean from Monte Carlo simulations.

[14] In 2014 the United States Geological Survey estimated that there remained as much undiscovered mineral potential in the Central African Copperbelt as had been discovered. The World Bank engaged the authors to produce a grade-tonnage curve of the undiscovered mineral potential to allow it to model portions that could be economic, given the cost structure of Zambian mines (Zientek and others 2014).

The GRZ target of producing 3 mtpa of copper is a driving ambition, already reflected in significant investment plans. However, it is recognized that there are risks to reaching this target by 2031. The World Bank's estimates suggest another decade would be needed, provided the necessary conditions are in place. In the *business-as-usual* case, production increases to approximately 1.5 mtpa, with some possibility of reaching 2 mtpa under the right conditions. These conditions are not all under the government's control. Conditions within the government's control include: (a) cleaning up noncompliant licenses in the cadaster and making these available to the private sector; (b) stabilizing the regulatory framework to reduce risk perceptions and enhance the investment climate; (c) improving the availability of high-resolution geological information; (d) ensuring efficient, effective, and inclusive permitting and licensing; (e) avoiding lengthy negotiations with the private sector over carried state equity participation and/or a share of production; and (f) ensuring the provision of sufficient, stable, and cost-effective electricity, particularly for value added copper production. Important factors beyond the government's control include: (a) the price of copper; (b) the grades and recoveries of the different mines; and (c) changes in investor risk perception of other copper investment destinations.[15] The World Bank's projections until about 2040 are consistent with those of S&P Mining Intelligence and Fitch but differ significantly from the government's own projections. They also differ from third-party estimates in the 2040s, bringing in new sources of production not considered by others. In the *unconstrained* scenario (Figure 2.2, panel b), preproduction and undiscovered sources comprise a larger share of production to meet the GRZ target.

Figure 2.2. Composition of production projections by production source



Source: World Bank analysis. *Note:* ASM = artisanal and small-scale mining.

The main reasons for the delay in ramping up production between the World Bank's own projections and those of the government are assumptions on the timelines to advance projects through the production stages and the degree to which these can be accelerated by technological innovation and better geological information through the state-financed, nationwide geological campaign. Current data from S&P indicate that timelines from the discovery of a mine to production in Zambia could range from

[15] Mining companies invest globally and position their portfolios based on risk and reward.

14.7 years (when including mines that started production in 2020–23) to 34 years (when including mines that were not already in production in 2023).[16] As the data for Zambia are based on a limited number of mines, the World Bank projections optimistically assumed that it would take 10.75–12.1 years to bring a mine into production from first discovery.[17] The government projections used a period of about 5–6 years, which would normally require a deposit already being in a prefeasibility study stage.

For preproduction properties on which data on exploration and development are available, significant additional production would begin to enter service in the mid-2030s. This horizon for new production is based on a typical (although still ambitious and optimistic) horizon to initial production from the current development stage. Based on the latest reserve/resource estimates for these properties and a generically assumed 25-year mine life, these properties could add copper production of 250,000 tons per year. However, as this comes online after the peak of 1.4 mtpa, the tonnage does not increase; rather, the peak is sustained for longer in the business-as-usual case. The ramp-up is sustained in the unconstrained case, as current mines are extended, more greenfield projects come online, and undiscovered deposits come online sooner. The peak in this scenario is ~3 mtpa of production by about 2042, with a potential significant drop from 2046, if new mines do not come online to replace those that close.[18]

This analysis focuses on copper production in view of the country's copper target. However, Zambia hosts Africa's largest nickel mine, which is ramping up production.[19] It has an active manganese operation, which produces raw ore that is processed elsewhere in the country. Lithium is also to likely come online, but unlike copper, the lead times to production are shorter (5–7 years). All these metals have the potential to add value and increase production, but together they are unlikely to match the copper mining sector.

A comprehensive, integrated approach is required to enable the mining sector and value chains to deliver on their potential. The first broad group of actions ("Enabling the production of ETM") relate directly to enabling the production of ETM. As the sector's growth relies heavily on private sector investment, the second ("Creating an enabling, well-governed investment climate") relates to the enabling environment to attract that investment, but also to ensure that the sector is governed well.

2.2 Enabling the production of ETM

Enabling an increased supply of ETM requires a set of actions with varying impacts and timeframes. Some actions with a significant impact also have a long timeframe, such as investment in the collection of new geological data.

[16] Nickel mines take the longest time and gold mines the least (Manalo 2024).
[17] For example, the recently built Luongo Manganese Open Pit Mine in Chipili District of Luapula Province took 12 years from exploration to reach first production.
[18] The unconstrained scenario shows production dropping significantly from about 2046; however, this does not mean that Zambia's copper potential would be depleted. Rather, it is a limitation of the modeling, which uses existing information. More resources are likely to be identified in future, which could help sustain production.
[19] First Quantum Minerals' Trident (Enterprise) is Zambia's only project with significant planned nickel production. The published 2020 feasibility study for this project suggest maximum output of 280,000 per year of nickel concentrate.

2.2.1 Geological data: Legacy data and new data collection

Zambia's mineral potential is yet to be well researched, and better, publicly disseminated analysis of its mineral resources is a precondition for attracting investment. Work done in the 1960s used old technologies, and much of this valuable information remains in analogue form. Large swathes of the country (about 45 percent of its landmass) have yet to be geologically mapped, including, perhaps surprisingly, in the Copperbelt region. Although a reinterpretation of existing geological information could offer a potentially easy and relatively inexpensive alternative, there is a need to use new technologies and high-resolution sampling to better understand Zambia's geological potential, identify geological hazards and underground water resources, and utilize information for land use planning.[20]

A private mining exploration company (KoBold Metals) has started digitalizing the data from the Geological Survey Department, along with data from ZCCM Investment Holdings (ZCCM-IH). Although KoBold has committed to making the data available to the government, it will likely have exclusive access to the data for some time, as: (a) it will be the first to interpret the data before the handover; and (b) there is no publicly available geological database to disseminate the data, and the government has not yet adopted a data dissemination policy. Most countries that have attracted significant investment in their mining sectors treat geological data as a public good necessary to attract investment and ensure fair and inclusive access to mining opportunities.[21] Leaving the data unpublished might further delay the achievement of the government's 3 mtpa target.

To increase its share of benefits from mining, the government plans to leverage the national geological campaign and the cadaster cleanup. It would reserve some revoked licenses for itself and use the geological information to negotiate a larger share of benefits through a special purpose vehicle (Box 3.1). To achieve maximum value, it would need to make the information collected from the geological campaign exclusively available to an investor; it is therefore not clear if any part of the new geological information would be made publicly available in line with international good practice. Furthermore, based on information obtained on the design of the geological campaign, the World Bank has reservations as to whether the resolution would be sufficiently granular to provide enough commercial value to an investor to give up a production share or equity stake before a potential mineral resource has been identified. The investor would likely still need to take considerable risk in moving an "area of interest" forward to target definition and eventual drilling of the resources and proving an economic reserve (see section 2.2.1). It may be that the government would need to undertake additional work (advanced exploration) before the value of a particular license is known, which would transfer significant risk to the state. Wide application of this approach would likely delay the achievement of its 3 mtpa copper target.

The government has already committed to investing in a broad, nationwide geological campaign. The survey will cost about $70–$90 million and will include the following (Box 2.1):

- An airborne magnetic, spectrometric, and iCORUS-X gravity survey will be flown at a 300-meter line spacing for the whole country, totaling 2.7 million km.

[20] This could include, for example, examining core samples collected in earlier exploration efforts. There has been underinvestment in the country's core repository at Kalalushi and in geological data storage in general.

[21] Chile, Peru, Canada, Australia, the United States and, more recently, Saudi Arabia are among many countries that have adopted open-data policies for geological information. Canada, Australia, and the United States alone attract about half of global investment in exploration.

- An airborne gravity gradiometry survey will be conducted over specific areas of interest, with line spacing depending on the geological complexity, for a total of 250,000 km.
- A frequency-domain transient electromagnetic survey will focus on specific areas of interest for an additional total of 250,000 km.

The survey has already started, and the government and the contracted firm (Xcalibur) believe it could be completed within two years. However, as the government has only allocated $17–$20 million over the last two years, the survey may well take longer. Precipitation and other logistics challenges could also add to delays, as some instruments require both the ground to be dry and visibility to be good to ensure quality measurements.

The new data collection could help Zambia reach its 3 mtpa target. It could assist with the discovery of (potentially significant) new copper deposits and the diversification of the mining sector into minerals such as manganese, nickel, lithium, and gold. However, as previously discussed, it will take time for new deposits to be identified, drilled, and evaluated and for mines to be built. In addition, as discussed above, the value of the data in supporting the 3 mtpa target depends on how the government plans to utilize it to drive private investment.

Box 2.1. Geological surveys: A primer

- *Magnetic survey:* Detects variations in the Earth's magnetic field to map subsurface geological structures and detect minerals with magnetic or magnetically responsive properties, such as iron, nickel, or copper.
- *Spectrometric (spec) survey:* Measures gamma radiation to determine the distribution of certain elements, like potassium, uranium, and thorium.
- *iCORUS-X gravity:* A proprietary instrument used by Xcalibur Geophysics to collect scalar gravity data to identify broad changes in the gravity field, which is useful for locating mineral deposits (manganese) or oil.
- *Airborne gravity gradiometry (AGG) surveys:* A powerful geophysical tool for detecting variations in subsurface density, particularly useful for exploring certain types of mineral deposits (copper, iron, manganese, coal), oil and gas reservoirs, and even some geological structures.
- *Frequency-domain transient electromagnetic (FTEM) surveys:* Highly effective for detecting subsurface features with specific conductive or resistive properties, making them valuable for both mineral exploration (massive sulfide mineral deposits, such as copper, nickel, and zinc), and environmental studies (groundwater resources and saline aquifers).

Source: World Bank.

The resolution of maps from the geological survey will be extremely useful for mining companies to identify areas of interest; however, it is insufficient to identify where to position drills for advanced exploration and delineation of a resource. The line spacing for the survey (300 meters for some aspects) is likely to generate maps of a scale of 1:250,000 to 1:100,000. It is very likely that companies will need to gather additional airborne data to generate maps with a scale of 1:10,000 to 1:5,000 to allow for the positioning of drills and confirmation of a mineral occurrence. The lead times to production discussed previously all assume that a deposit has been confirmed.

Importantly, to fast-track investment and fully leverage the new geological data to grow the sector, the government needs to define its investment promotion strategy now. Competitive and transparent

processes are likely to yield better terms for the government. A model agreement should be defined, with clear, predefined biddable terms, and weightings should be drawn up even before the geodata collection process has been finalized. This preparatory work, ideally with the support of external technical, financial, and legal advisors, will help ensure that the government's goal to negotiate a stake for itself would not cause an unnecessary delay.

2.2.2 Review "stranded assets"

In the nearer term, the government could commission a detailed review of studies submitted by companies for projects that did not go ahead, known as stranded assets. A deposit may not be developed for reasons such as market conditions, the technology available at the time, or a lack of infrastructure. In time, infrastructure may have been provided and processing and evaluation technology evolved, making a deposit viable.

The much-discussed Mingomba copper deposit owned by KoBold is a good example. The deposit, formerly known as the Konkola West Project, was an extension of Konkola Deeps, owned by Konkola Mining Company. KoBold Metals is using advanced techniques to reassess the quality and size of the deposit. Although a definitive feasibility study has not yet been produced, public indications suggest a deposit that could potentially contribute over 300 ktpa of copper per year. However, the deposit is very deep, and any mine would face significant water ingress.[22] Dewatering is highly energy-intensive, and without energy investment, Mingomba could remain a stranded asset.

There may be other deposits like Mingomba, and a comprehensive review could identify potential synergies to unlock their development without the need for public investment. This could provide much-needed infrastructure investments. As the deposits are already well known and have been studied, they would come online relatively sooner than any deposits identified in the geological survey.

2.2.3 Assess and retreat mine waste

Zambia has been mining for over 100 years, during which time very few mining areas have been closed and rehabilitated. It has many mine waste facilities, such as waste rock dumps, tailings (waste from the initial processing of ore into concentrate), and slag heaps (waste from the smelting of concentrate). These facilities may still contain trace amounts of metal that could be economic for extraction, given that technologies for recovering metal from ores have advanced significantly. However, they may also pose environmental and human health concerns, like the lead tailings dams in Kabwe Municipality.[23]

A preliminary inventory of mine waste facilities should be conducted to classify them according to: (a) the potential for economic extraction or alternative safe use for the material; and (b) the potential safety, environmental, and health risks. The facilities should be sampled to assess the metal content to understand the possibility of retreatment and extraction of metals, along with any deleterious elements

[22] Konkola Deep must pump 450,000 m^3 of water every day from its underground mine to keep workings open. Mingomba will experience water ingress equivalent to 180 Olympic-sized pools every day.
[23] The lead tailings in Kabwe, owned by Jubilee Metals, are the principal source of lead pollution and contamination in the Kabwe Municipality.

that could be a danger to the public or the environment if they were reused in a "circular" manner (for example, as building or construction materials). Retreating or reusing these materials would both generate positive economic activity and reduce legacy environmental liabilities. Following this assessment, it is recommended that the government establish an investor promotion strategy to create awareness of the economic opportunities of mining waste.

Waste facilities can also pose environmental, health, and safety risks. Worldwide, many large mining disasters involved the failure of tailings dams. These facilities can contain millions of tons of finely crushed mine waste, which if not managed carefully, can become fluidized and flow out of their design embankments, as happened in the Brazilian Brumadinho dam disaster (BBC 2019; Senra 2019). Mining waste facilities should be evaluated to ensure that they are stable and that their management is in line with the Global Industry Standard on Tailings Management (Global Tailings Review 2020). Furthermore, dust and water quality run-off measurements should be taken to ensure the facilities do not contaminate the air or soil, as in the case of Kabwe. Lastly, should any mine waste facility be found in breach of mining or environmental regulations or standards, a plan must be put in place for the license holder to address deficiencies, and the plan must be enforced.

Mine waste material can be an incremental source of ETM production in the short to medium run, and their retreatment and final disposal and rehabilitation may yield environmental benefits. However, as the metal content in mine wastes is often quite small, they will not contribute significantly to the government's 3 mtpa target. Still, they can come online relatively quickly, as the material is already on the surface. Because there is no need for drilling, blasting, or crushing, mining costs are relatively low.

2.2.4 Maximize the recovery of by-products

The recovery of by-products in base metal deposits has become increasingly important, as they contribute to the profitability of base metal mines and provide critical materials for high-tech applications, including renewable energy technologies and electronics. By-products in base metal deposits, such as those containing copper, lead, or zinc, commonly include elements like cobalt, silver, gold, molybdenum, selenium, and some radioactive minerals. These by-products are typically found in trace amounts within the primary ore minerals or as minor associated minerals. Importantly, once disposed of through tailings or slag, they can be lost forever. Advances in extraction and refining processes, especially in sulfide deposits, have enabled the efficient recovery of these elements from base metal ores, reducing waste and adding strategic economic value to mining operations worldwide. Because mining companies normally focus on the main product, such as copper, they often do not give much attention to by-products. However, as many of these metals are vital for renewable energy technologies, there is increased global attention to the need to ensure an adequate supply.

Recovery of by-product metals can increase profitability. For example, Rio Tinto's Bingham Canyon mine in the United States has been in operation for over 100 years, mining copper but disposing of tellurium, a critical metal for some high-efficiency solar panel technologies. In 2022 Rio Tinto began producing tellurium at this mine at a rate of 20 tons per year, for a total capital cost of $2.9 million. Over the past

year, tellurium prices have soared to over $600/kg, which allowed Rio Tinto to recover its initial investment outlay in just under three months.[24]

Such opportunities may well be present in Zambia, but investors need to be alerted to them. The World Bank recommends that the government initiate a process whereby companies submit economically substantiated justification for why certain by-product minerals cannot be recovered efficiently, either at the mine and concentration stage, or during the smelting processes.

2.2.5 Artisanal and small-scale mining

Although ASM contributes only modestly to overall copper production, it plays a significant role in the economy, providing employment and livelihoods for numerous communities. However, the sector faces several challenges, including informality, limited access to financing, inadequate technology, and insufficient regulatory support. These issues often lead to unsafe mining practices, environmental degradation, and reduced productivity. For instance, the lack of formalization has been linked to increased mining accidents, with fatalities in mining accidents rising from 19 in 2023 to 31 in 2024, largely because of illegal mining operations.

Recognizing these challenges, the government has initiated reforms to integrate ASM into its broader mining strategy. The establishment of the Minerals Regulation Commission aims to enhance regulation and revenue generation within the sector. Additionally, the proposed Geological and Minerals Development Bill seeks to establish an ASM fund to provide financial assistance to small-scale miners. The government has outlined plans to formalize artisanal gold mining and streamline gold trading to address the challenges of informality and illegal activities in the sector. To this end, the MMMD has appointed Zambia Gold Company Limited as a gold aggregator, tasked with purchasing gold from formalized ASM cooperatives. This initiative intends to provide a structured market for artisanal miners, ensuring fair pricing and reducing informal trade.[25]

These strategic initiatives are designed to formalize the ASM sector, improve safety standards, and increase its contribution to Zambia's socioeconomic development. By addressing the existing challenges, the government aims to create a more sustainable and productive mining environment that benefits local communities and the national economy.

The government has also proposed the creation of a new special purpose vehicle for commodity trading. It partnered with Mercuria to set up a "jointly owned metals trading unit" with Zambia's Industrial Development Corporation and has considered production sharing on new greenfield projects (Reuters 2024).[26] It could also explore the possibility of acting as aggregator for artisanal copper production. This could help formalize the sector by providing higher prices to artisanal mining and improve the compliance

[24] For more information see Trade Economics "Tellurium" website at https://tradingeconomics.com/commodity/tellurium.
[25] The government is constructing gold marketing centers in districts with significant gold mining activities, such as Mumbwa and Rufunsa. These centers aim to serve as centralized hubs for gold trading, enhancing transparency and oversight in the sector. The first two centers are expected to be operational by early 2025.
[26] Although experienced in commodity trading, Mercuria has very limited experience in non-oil and gas trading, which heightens the financial risk for the government. For more information, see Mercuria's website at https://mercuria.com.

of micro-smelters, some of which operate illegally. Adopting an incremental strategy that starts with ASM would limit the financial risks to the government.

2.3 Creating an enabling, well-governed investment climate

Strong governance, stability, and predictability are critical for attracting private sector investment to Zambia's mining sector and maximizing its benefits.[27] Governance structures that are clear, transparent, and consistently applied build investor confidence, as mining operations often require substantial upfront capital and have long project timelines. When regulations are transparent and well enforced, investors are more willing to commit to long-term projects, confident in the protection of their investments and in the government's commitment to fair and predictable treatment. Predictable governance frameworks reduce the risks associated with sudden policy shifts, tax changes, or regulatory overhauls, all of which could deter investment or lead to costly renegotiations.

Effective governance is also vital for ensuring that mining benefits are distributed equitably and contribute to sustainable development. With strong governance mechanisms, Zambia can implement policies that promote local value addition, create jobs, and increase tax revenues. This, in turn, would help fund essential public services and infrastructure, providing broad-based benefits to the population. Stable governance creates a favorable environment for enforcing local content requirements, encouraging partnerships with local firms, and investing in community development, which are important for fostering long-term economic links beyond resource extraction.

Furthermore, robust governance and predictability help manage the environmental and social risks associated with mining. Transparent regulations and good intergovernmental coordination and collaboration can facilitate responsible mining practices, including environmental stewardship and community engagement, which minimize the sector's negative impacts on local populations and ecosystems. In the absence of such frameworks, mining activities can result in environmental degradation, displacement, and social unrest, which not only harm communities but also destabilize the investment climate. By creating a predictable and well-regulated environment, Zambia can leverage its mineral wealth in ways that are both economically beneficial and socially responsible, ensuring a more resilient and inclusive economy in the long run.

2.3.1 Mining cadaster

The government has taken steps to modernize its mining cadaster, which is crucial for the effective management of the country's mineral resources. A transparent and accessible cadaster system provides clarity on who owns which mineral rights and helps prevent conflicts over land use, a common issue in resource-rich countries. By streamlining the application and licensing processes, a robust cadaster can accelerate investment and promote fair access to resources, which is essential for attracting private sector investment. Furthermore, an accurate cadaster allows the government to monitor compliance with licensing terms, track revenue, and ensure that operators meet work programs and reporting obligations.

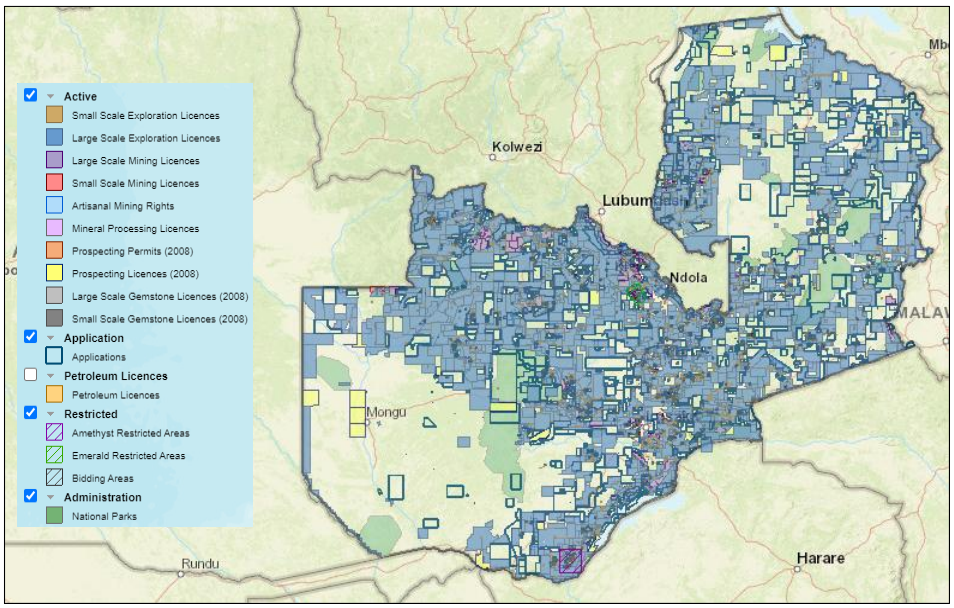
[27] Zambia has averaged one tax change every 18 months since 2001, when major privatizations were concluded.

Zambia's mining cadaster has faced various challenges. An eight-month suspension of the cadaster in 2022 led to a large backlog of license applications. Also, thousands of license holders do not comply with their obligations, be it payments, reporting, or progress on work programs. Many expired licenses are still shown on the cadaster, limiting the opportunity for new investors to undertake exploration work. The current cadaster map is shown in Figure 2.3.

A congested cadaster would delay progress towards achieving the government's 3 mtpa copper production target. Mining companies must pursue opportunities through acquisition rather than through a normal license application, often dealing with unsophisticated license holders with unrealistic expectations of the value of the license. Protracted negotiations are common, and mining companies complain that the process of due diligence on the target company and its license, along with the negotiations, may delay work programs by up to two years.

Most modern licensing processes include specific requirements for applicants to have technical and financial capability. To avoid licenses being held by speculative investors, the government should strengthen these criteria and publicly explain the requirements for demonstrating the ability to finance and move work programs forward. In parallel, it should establish a comprehensive program of support for Zambian entrepreneurs to help them participate in the mining sector as junior exploration companies.

Figure 2.3. Mining cadaster map, October 2024



Source: Zambia, MMMD 2024.

Full digitalization of the mining cadaster should be pursued, including detailed mapping of various workflows, with additional steps such as risk profiling and due diligence on license applicants.[28] Although the government has taken steps to modernize the cadaster, it is not clear what level of

[28] For example, see Votava (2018) and Girones and others (2009).

functionality the future cadaster system will have.[29] Modern mining cadasters are fully digitalized, and workflows are hard coded in accordance with local laws and regulations. Users are given unique logon credentials and user rights according to their roles and seniority, and all actions can be reviewed and audited. Applicants and license holders interact through the system, submit reports online, and receive automatic notifications of the stage of the license application, when reports are due, and the payment of fees. Payments are made online and deposited into a designated account. Such systems can significantly streamline and reduce the work of cadaster officers, improve both oversight of the sector and investor confidence, and provide a robust set of data and analytics that can be used to promote the sector and improve the efficiency of the regulator.

2.3.2 Operationalize the Minerals Regulation Commission

The World Bank has performed a detailed analysis of the Minerals Regulation Commission (MRC) Act and submitted comments to the government when the Act was still a Bill.[30] Although some of the comments have been incorporated, many substantive comments have not (Box 2.2) and should be addressed through the subsequent regulations. For example, the MRC Act could improve the definition of the rights and obligations of license holders, which are not explicitly stated in either the MRC Act or the Geological and Minerals Development Bill and must instead be inferred from the penalty sections. Other key weaknesses relate to significant gaps in the environmental and social provisions.[31] Expert legal support should be sought for preparing the supporting regulations to ensure that the overall legal framework is sound, unambiguous and, hence, stable for the foreseeable future.

The MRC Act preserves many aspects of the 2015 Mines and Minerals Act, but its main objective is the creation of a semi-autonomous mining sector regulator. Several countries have pursued independent regulators for their mining sectors to enhance governance, promote transparency, and improve regulatory enforcement. In many cases, ministries or departments responsible for natural resources face significant capacity constraints, political interference, and operational challenges that undermine effective oversight of the sector. Establishing an independent mining regulator can address these issues by creating a dedicated entity with the autonomy, technical capacity, and authority to oversee mining activities without undue political influence. This structure allows governments to focus on sectoral policy, while the regulator ensures compliance with environmental, safety, and operational standards.

Box 2.2. Minerals Regulation Commission Act, 2024

Although a step in the right direction, the 2024 MRC Act has some gaps:

[29] All payments have been migrated to online payments via the Smart Zambia program/portal. However, the degree of digitalization of the cadaster's other functions is unknown. As of 2024, the World Bank only knows of two firms globally that have the capability to successfully deliver mining cadasters. The global experience with bespoke systems utilizing local firms has often been poor.

[30] Although the MRC Act has been assented to by the President, it will not come into force until a Special Instrument is adopted. The Minister of Mines expects this to take place in 2025.

[31] The World Bank has prepared a comprehensive legal review under the ETM Roadmap, which it shared with the government for its consideration. The review includes suggestions for addressing gaps, using clauses taken from international best practice legislation.

- *Leveraging private investment in geological data collection.* The MRC Act defined various license types and the rules for application. However, neither it nor the GMD Bill require exploration companies to submit the geological information collected to the geological survey department or explain how that information would be managed. This represents a missed opportunity to leverage significant volumes of private data.
- *Formalizing artisanal and small-scale mining.* The National Mineral Resources Development Policy emphasizes the need to formalize ASM by promoting cooperatives and integrating the sector into the formal economy. Although the MRC Act emphasizes regulatory compliance and structured licensing processes, it lacks specific provisions for formalizing ASM. Countries like Tanzania have included specific measures in their mining legislation for the formalization and development of this sector through providing designated areas and cooperative support, some of which is addressed by the Geological and Minerals Development Bill.
- *Goals for local participation.* The National Mineral Resources Development Policy and the National Critical Minerals Strategy aim to enhance local participation in the mining value chain and improve local value addition. The MRC Act does not include such measures, but the GMD Bill does include provisions for the Minister to set local procurement thresholds. The policy framework currently lacks an integrated and holistic approach to address the challenges of SMEs, such as capacity building, access to finance, trade barriers, and competition with firms in the special economic zones (SEZs). This reduces opportunities for broader economic development. In contrast, the South African Mineral and Petroleum Resources Development Act of 2002 mandates the promotion of local beneficiation and value addition through various incentives and regulatory support.
- *Information and communication technology (ICT) reforms for a transparent, efficient licensing process.* The National Mineral Resources Development Policy and the National Critical Minerals Strategy emphasize public-private partnerships and private sector efficiency and innovation. However, the Act does not explicitly mention either digital technologies for application processing and tracking or public access to licensing information. Without these reforms, maintaining investor confidence and ensuring fair play in the sector is challenging. For example, in February 2022, the Ministry of Mines and Minerals Development stopped issuing mining rights to conduct an audit of the mining cadaster department. This highlighted significant issues, such as expired licenses still being active, uncoordinated directives between the department and other regulatory bodies, and unintegrated databases and communication channels, leading to inconsistent regulatory enforcement. In Ghana, the 2015 Mines and Minerals Development (Amendment) Act explicitly addresses using ICT to enhance transparency and efficiency in the mining sector.
- *ICT and remote sensing technologies for enforcement and monitoring.* Neither the MRC Act nor the GMD Bill explicitly incorporates ICT and modern technologies such as satellite imagery, drones, or automated reporting systems, which are critical for effective and efficient monitoring and enforcement activities. Australian mining legislation, particularly the Mining Act 1978 (Western Australia), includes remote sensing technologies and advanced monitoring systems to enhance regulatory oversight and enforcement. The government has stated that although it intends to utilize technology, the "tools" to be used will not be specified in the Act and GMD Bill; rather, the focus is on legal aspects, such as the mandates of government bodies and the obligations and rights of license holders.
- *Capacity building.* The Act lacks detailed strategies for capacity building in environmental regulatory bodies and does not adequately strengthen regulatory frameworks. Although it includes provisions for environmental impact assessments and audits, it lacks specific measures for capacity building and regular updates to environmental standards and guidelines. Brazil's Mining Code includes comprehensive measures for environmental management and capacity building in regulatory agencies to enhance environmental protection.
- *Approval process and decision-making*. The approval process and decision-making in the Act require clarity and sharpening of the centers of responsibility. Before introducing any entity into the sector, it would be advisable, given the complexity of the sector's organizational structure, to conduct a functional review of key agencies and assess business processes to ensure that they fit the objectives of the sector and allow systematic and measurable tracking against clear results. At that point, the mandate and business processes of the new agency

should be reflected in adjusting (dropping or adding to) the mandates and businesses processes of other public agencies in the sector. Any new agency is also expected to avoid many of the administrative bureaucracies around staffing and remuneration. Its financial model should be properly assessed to avoid unfair practices in securing resources. The government's approach is to create the MRC and then let the MRC define its own structure for delivering on its mandate.

Source: World Bank analysis, drawing on Government of Zambia (2022a); Tanzania 2010 Mining Act; Zambia, MMMD (2022, 2024); Zambia, MoFNP (2022).

Independent regulators can also play a crucial role in attracting foreign direct investment by providing greater transparency and consistency in the application of regulations. Mining investments are capital-intensive and entail high risks, especially if the related legislation and supporting regulations are ambiguous. Investors are more likely to commit resources in jurisdictions where there is a reliable regulatory framework that is transparent, predictable, and backed by an impartial authority. An independent regulator can signal to investors that the host country is committed to fair and stable oversight, which can increase competitiveness on a global scale.

To be effective, independent mining regulators should have the following core features:

- *Legal and operational autonomy:* Independence from political and economic pressures is crucial. A regulator must have legal authority to make binding decisions without interference from government ministries or other political entities. In Tanzania, the Mining Commission is headed by a person with over a decade of private sector experience. The same holds for Canada's Alberta Energy Regulator, which governs mining. South Africa's Department of Mineral Resources and Energy has developed a semi-autonomous structure with significant technical and regulatory capacity.[32] Such autonomy is also essential for ensuring impartiality and fairness in regulatory enforcement.
- *Clear mandate and scope of responsibilities:* The regulator's role must be clearly defined, including its authority to grant licenses, inspect and monitor operations, enforce safety and environmental standards, and impose penalties. A clear mandate reduces overlap with other agencies, avoids regulatory conflicts, and helps to ensure that the regulator's role is transparent. In particular, the MRC's role and how it will work with the Zambia Revenue Authority (ZRA) and the Zambia Environmental Protection Agency will be important for coordination and effective implementation of the regulations.
- *Financial independence:* For operational autonomy, the regulator should ideally be self-financed, whether through licensing fees, fines, or a portion of mining royalties. A financially independent regulator is less likely to be swayed by budget constraints, political agendas, or the companies it is supposed to regulate. The World Bank team understands that the Chamber of Mines' constituent companies support the levying of reasonable fees to ensure more even and thorough enforcement of regulations.
- *Transparent and accountable decision-making:* Transparency in operations and accountability to both the public and government institutions build trust in the regulator. This can be achieved through

[32] For more information see the Alberta Energy Regulator "Board of Directors" website at https://www.aer.ca/board-of-directors and the South African Department of Mineral Resources and Energy "Boards" website at https://www.dmre.gov.za/about-us/boards.

annual reports, public consultation mechanisms, processes for appealing regulatory decisions, an updated website hosting useful information for investors and the public, and the integration of a publicly accessible mining cadaster.

- *Data and information management systems:* An effective regulator needs robust systems for collecting, managing, and analyzing data on mineral reserves, production statistics, environmental impacts, and company compliance records. This enables evidence-based decision-making, better resource planning, and public accessibility of data, which enhances transparency.

Much of the details of the MRC's operations will be left to the MRC to define once legally created. Once it comes into force, the MRC Act will repeal the existing Mines and Minerals Act through the enactment of a Statuary Instrument. This leaves a potential governance gap until the MRC is operational. As the Act does not make provision for a transitional period, the existing departments of the MMMD will cease to be legal entities until the MRC has been operationalized. It will be very important to manage this transition carefully, to set up the MRC swiftly, and to time the Special Instrument with the effective transfer of capacity to the MRC.

The World Bank recommends that the current work plan of the MRC project be well resourced and that the team implementing the MRC (presumably the Board, together with the Director General) be made aware of the various good practice options for its broader governance. The government has prepared a budget for the work; however, the team believes more resources will be required.

For the MRC to be effective, a set of clear regulations need to be promulgated to support the MRC Act. It is recommended that the government engage international legal expertise to help prepare a detailed, modern set of regulations to support the implementation of the MRC Act. To benefit from synergies, this expertise should also be leveraged to specify the MRC's operating charter, procedures, and policies.

Finally, the commission will need to be capacitated. From the Board through to its officers and facilities, capacity will be required to effectively undertake the work of the MRC, including training, systems (information management systems, cadastral processes, and the like), and facilities such as laboratories.

2.3.3 Geological Minerals and Development Bill

The 2024 Geological and Minerals Development Bill sets out a framework for managing Zambia's mineral resources. It authorizes the government to undertake geological surveys and mapping of mineral resources, aiming to create a comprehensive geoscientific database. It also grants the Director of Geological Survey the authority to conduct field studies, collect samples, and advise on sustainable land use and mineral exploitation.

The Bill promotes sustainable development in ASM through regulation, technical support, and capacity building. It mandates the formalization of ASM activities and provides guidance on promoting value addition and conservation in mineral extraction from such activities. It also creates a dedicated fund to support ASM development, offering grants, loans, and capacity building resources. Managed by the Ministry of Mines, the fund will be subject to financial oversight and annual audits.

The Bill also contains local content requirements. Mining license holders are required to prioritize Zambian goods, contractors, and the workforce in their operations. Violations can result in fines, with the minister empowered to set local content thresholds. The approach to local content, including draft regulations, is discussed in section 2.3.6.

2.3.4 Reform and professionalization of state-owned enterprises

State-owned enterprises in the mining sector often aim to give governments a direct stake in national mineral wealth, allowing them to capture more value from resource extraction and potentially increase revenue from mineral exports. In Africa, the participation of state-owned enterprises in mining varies, but a common approach includes acquiring equity stakes in mining ventures, often through "free carry" or "noncash" equity, where the state secures a portion of ownership without upfront capital contributions (Box 2.3). Countries like Zambia, Ghana, and Tanzania have all experimented with some form of direct involvement by state-owned enterprises or "free equity" stakes in mining projects, hoping this would bring more economic benefits and greater control over resource extraction.

Box 2.3. State participation in mining

Globally, state participation in mining is common, in three main types:

- *Free equity,* where the state receives an ownership interest at no cost to itself. It is also not obligated to contribute to the costs of the project but receives dividends or a share of profits. This type is common in Sub-Saharan Africa through a small share of equity, as a form of withholding tax on dividends and board participation.
- *Full participation,* where the state purchases equity and contributes to exploration and development costs in proportion to its shareholding, in return for a share of profits or dividends.
- *Free carried interest,* where the initial purchase of the shares by the state is carried by the private investor and repaid by the state from its share of future profits or dividends (GIZ 2023).

In countries such as Sweden and Finland, state ownership is strategic, to boost innovation and secure access to metals for the countries' energy transition. In Japan, state ownership (Japan Oil, Gas and Metals National Corporation) was created to secure a stable supply of minerals for industry. The state has also a stake in mining in Chile (28 percent owned by CODELCO), China, and Vietnam (US ITA 2023). In Africa, since the high metal prices of the 2010s, some countries have passed legislation to increase state participation, mainly by free carry access for the government in all mining ventures.

Sources: World Bank, drawing on GIZ (2023), US ITA (2023).

However, the outcomes have been mixed. For many governments, state ownership in mining has not fully met expectations because of challenges in governance, capital requirements, and operational efficiency. In some cases, governments expected equity stakes to yield significant returns or offer a strategic foothold in the industry. However, the performance of state-owned enterprises is often constrained by underfunding, political interference, or lack of technical expertise, which limits their ability to operate on par with private companies. Also, the need for additional funding to support their participation in the sector can strain public finances, as seen in Zambia's mining sector and elsewhere.

From the private sector's perspective, mandatory ownership by a state-owned enterprise can reduce the attractiveness of an investment. Investors are often wary of state participation, particularly free

carried interest, as it raises concerns about potential future encumbrances on the project's cash flow and operational autonomy. In Africa, foreign investors may also hesitate if state-owned enterprises will benefit from special treatment, such as preferential access to geological information or coveted license areas, which renders the playing field uncompetitive. Despite this, some companies see benefits in partnering with state-owned enterprises, mainly to reduce political risk and enhance community relations. These partnerships generally work best when the state-owned enterprise is financially and technically competent and follows a clear governance framework.

In Zambia's case, using geological data from the national geological campaign as a government contribution could be an innovative approach to leverage state resources while minimizing cash outflows. However, the quality and commercial relevance of the data—such as 1:100,000 scale maps from an airborne geophysical survey—affect the value of this contribution in negotiations with private partners.[33] Investors might question whether this information sufficiently offsets the value of the state's free equity claim, particularly as a deposit of economic interest would not yet have been identified. It is crucial for the government to ensure high-quality data and transparent partnership frameworks to maintain investor confidence and project viability.

Although a new special purpose vehicle is being considered, the ZCCM-IH already plays a central role in the mining sector. It primarily acts as the government's vehicle for sectoral participation, holding a 92.6 percent equity stake through government channels. It also has various other roles, including acting as a revenue collector and agent of economic development. However, the company struggles financially, with most subsidiaries incurring losses in 2023. Despite royalties and dividends allowing the ZCCM-IH to declare a profit of ZMW 4.8 billion, only a small fraction was distributed to shareholders, with the remainder covering debts and new investments—which lack transparent feasibility studies. The company's substantial debt poses a financial risk that limits the potential for additional capital inflows or privatization. To stabilize finances, the government should consider alternative revenue allocations and evaluate the viability of new investments to ensure they are strategically beneficial and sustainable.

Enhanced oversight and professionalization of the ZCCM-IH's management processes could significantly improve its performance. Zambia established the Industrial Development Corporation, a state-owned holding company, to enhance the profitability and accountability of its state-owned enterprises. However, according to the Auditor General's 2022 report (Zambia, OAG 2022), it faces challenges of oversight and enforcement, with weaknesses such as incomplete projects, poor procurement practices, and a lack of feasibility studies across multiple state-owned enterprises. Strengthening the role of the Industrial Development Corporation could involve establishing performance targets, conducting project-level financial assessments, and improving transparency and governance in ZCCM-IH operations. Adopting best practices from successful state-owned holding companies (like Singapore's Temasek Holdings, which prioritizes profitability over the expansion of state ownership) could provide a path forward. By either improving the ZCCM-IH's asset management or considering the divestiture of underperforming assets, Zambia could enhance the sector's efficiency, contributing to broader economic stability and

[33] At this scale of geological information, a deposit of interest would not yet have been confirmed. The investor would need to fund further high-risk exploration to confirm a deposit, and then a mineral resource with potential for economic extraction, and finally a mineral reserve with proven potential for economic extraction.

development. Without such reforms, it is unlikely that the ZCCM-IH or the new special purpose vehicle would meet the government's performance expectations.

2.3.5 Government "free" equity and production sharing

Balancing the objectives of central public authority with private actors is a management challenge. Zambia's legal framework is not clear about the role of the state in the mining sector, and its current role appears inconsistent with the broader policy of attracting mining investment. The Zambia Chamber of Mines believes this carries significant investment risks and contends that establishing a government special purpose vehicle for investment in mining has the hallmarks of free carried interest, where the government or its designated entity retains an ownership stake in a project without contributing proportionally to the initial exploration and development costs. There are also concerns about the 35 percent local content mandate, which lacks clear financing guidelines and could escalate project costs, as companies may need to bear the financing and capacitation costs of these arrangements. Local content is discussed in more detail in section 2.3.6.

Minority state shareholding in operating mines is becoming more common, particularly in Africa where a "free" equity interest is being sought by many governments. Minority state equity in mines is rarer in Asia, North America, and South America—mines are usually either fully owned by the state or by private entities—but it does exist in Myanmar and Papua New Guinea, for example.

However, careful consideration should be given to the factors that affect dividend decisions. Companies can employ various tactics to avoid paying dividends, some of which could diminish the tax base. For example, under free equity requirements, companies would normally finance a mining project with as much debt as possible, often from the parent company. Cash generated from the project would normally be used to service the debt and interest obligations before being considered for dividends. However, should the company need to reinvest in the mine in the foreseeable future, the majority shareholder would often choose to leave the cash in the company to allow it eventually to self-finance any capital outlay. To protect against this possibility, an antidilution provision and a mechanism to receive dividend payments early could be included in shareholder agreements (so-called priority or preferred shares, whereby dividends are based on a percentage of net income, like a profit-based royalty), with proper procedures for applying these mechanisms.[34] Although this would protect the government's dividends, it would also reduce the returns to the private investors and potentially their desire to invest in Zambia.

State equity may be increasingly common, but production sharing is not.[35] In June 2024, the cabinet announced the establishment of a special purpose vehicle to finance production sharing in the copper sector (Mumba 2024). Two months later, the minister specified that the government intends to collect 30 percent of critical mineral production in the form of physical product (Clowes 2024). Most details have

[34] The government could also ensure that the shares are retractable at a given price, allowing it to forego dividends in favor of payouts upon retraction. A retractable preferred shareholder can force the company to buy back retractable preferred shares for cash on a specified date, at a specified price.

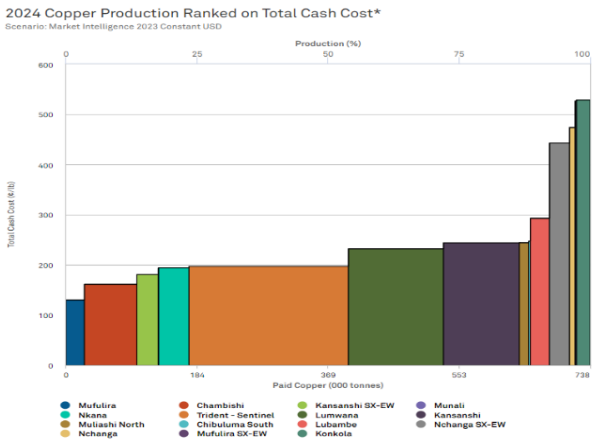
[35] Although common in the oil and gas sector, production sharing contracts are rare in mining. Egypt tried but abandoned production sharing. Azerbaijan, the DRC, and Myanmar have experimented with it, and Burundi, Gabon, Papua New Guinea, the Philippines, Senegal, and Uganda are considering it.

yet to be clarified, such as whether the state would collect 30 percent of concentrates or of the recovered metal constituents.

Compared to traditional fiscal regimes, production sharing replaces one set of risks with another. When the state becomes a mineral commodity marketer, it discovers prices, thereby reducing the risk of abusing transfer pricing on mineral sales figures by investors. But production sharing contracts require the state to become a marketer and manager of physical minerals. This may require transportation, warehousing, and negotiating sales contracts. In many countries where state-owned enterprises manage physical minerals, minerals go missing, storage and management costs are inflated, and sales contracts return below-market prices. The DRC is struggling with these challenges, as its weakly governed Gécamines state-owned enterprise negotiates to sell its 20 percent share of copper from the Tenke Fungurume mine to various global copper traders. Myanmar has tried to address this issue by selling its share of lead, zinc, nickel, and tin back to the operator at market prices less its cost. However, the government's reliance on private sector sales has reintroduced the Base Erosion and Profit Shifting challenges that the contracts were designed to eliminate. The use of a third-party trader could have generated more revenue. The introduction of production sharing contracts in the mineral sector also harmed the investment climate in countries where the details of how the contracts will interact with other elements of the fiscal regime remain unclear. Appendix E provides a summary table of countries that employ production sharing and lists the total share of global exploration investment in the country. Note that the World Bank team is not aware of any country in which a 30 percent free production arrangement would not replace the fiscal regime entirely, as such a loss to a mine's revenues would likely render it uneconomic.

If production sharing to the level being considered by the government were implemented at Zambia's existing mines, no mine would be economic. The returns to mining in Zambia are such that no current (and likely no future) operation could forego 30 percent of revenue while still contributing to taxes and royalties. The World Bank performed a detailed analysis of the impact of free equity and production sharing. The modeling exercise suggests that the 30 percent production share (which acts as a 30 percent royalty) would be more harmful to attracting new investment than the 30 percent free equity share. This is largely because dividends on state equity are only paid once the mine becomes profitable, rather than from the start of production. Private sector operators are also aware that they can delay or reduce dividend payments to minority shareholders. The sensitivity analysis in Figure 2.4 suggests that if both policies were to move ahead, any mines with operational costs above roughly $1,600 per ton (72 cents/lb.) would no longer be profitable enough to warrant private investment.

Figure 2.4. Production costs of Zambian copper mines, 2024



Source: S&P Mining Intelligence.
Note: 2024 cash cost production of Zambian copper mines. The COMEX price of copper was ~$4.20/lb. on November 21, 2024.

Given the cost curve in Zambia, this would cause the closure of all the mines and deter further private investment in the sector.

2.3.6 Local content

The World Bank reviewed the local content regulations and provided comments to the government. The government appears pressed to maintain the current approach to the definition of a reserved amount of local procurement for local enterprises. Significant gaps were identified in the approach to determining the reserved amounts, which was not backed by analysis, and in the implementation arrangements. The World Bank is concerned that implementing the local content regulations in their current form would not achieve the expectations of either the government or local manufacturers.

Local content objectives in mining could support the industry's competitiveness and its growth goals, particularly the government's target of reaching 3 mtpa of copper production per year. A robust and expanding mining sector generates opportunities for local suppliers of products and services that are already competitive. As the industry scales up, it demands more inputs, creating a larger market for local businesses such as suppliers of mining equipment, safety gear, and basic services like transportation and catering. Furthermore, as the mining industry grows, it creates economies of scale for certain products that may have been uneconomic at smaller scales. This scaling effect can support the establishment and growth of local manufacturing and service sectors, enabling them to meet the needs of the mining industry more efficiently and cost-effectively.

To promote local supplier development and the competitiveness of small businesses, several factors are crucial. Local businesses need access to competitive financing to invest in the necessary infrastructure and technology to meet the demands of the mining sector. Financial institutions and government programs can provide favorable loan terms and grants to encourage local participation. Incentives such as tax breaks, subsidies, and technical assistance can help local businesses grow and become more competitive. Trade policies that promote fair competition and protect local industries from unfair foreign competition are also important. Policies should ensure that local suppliers are given fair opportunities to compete for contracts without being undercut by cheaper imports. The competitiveness of local products in multi-facility economic zones (MFEZs) should also be fostered through targeted support measures, ensuring that these zones contribute positively to the broader goal of local content development.

Good international examples of local content policies can serve as valuable models for Zambia. Countries like Norway, Brazil, and Ghana have implemented effective local content requirements that balance the needs of the industry with national development goals (Box 2.4).

Zambia's current draft regulation may yield no extra value addition, as the obligations could be met by "fronting", , that is, when a Zambian-owned company imports a foreign-made product to sell it to the mining industry. The complexity of defining local content makes it challenging to assess the effectiveness of policy measures. Governments often design blanket policies, hoping they will achieve multiple objectives, such as job creation, industrial development, and local ownership. Yet in practice, each of these objectives require tailor-made or sector-specific support.

Shortcomings in local content regulations could negatively affect the competitiveness of firms in ETM value chains. Unlike the 2020 draft regulations, the 2024 draft does not address issues of reporting, monitoring, and enforcement. Furthermore, a reserved amount of local expenditure can be problematic, either if it turns out to be unachievable or if it can be achieved too easily (and is therefore meaningless). Best practice approaches include a company defining a goods and services plan for which targets could be agreed with or set by the government, with the aim of increasing clearly defined local content in a time-bound manner and with a phase-out mechanism. To ensure credibility, a local content plan for ETM should include clear policy targets that align with local capabilities and outline specific actions the company will take to achieve these targets. The plan should also set out how the company will assist suppliers and contractors in building their capacity over time. As targets are achieved, the company would voluntarily update the plan at least every five years, with transparent and monitorable metrics. Potential priority of preference could depend on proximity to the mining operation, degree of local value added in the products, local ownership, and technology transfer potential. The program should be accompanied by an advertising strategy, a timeline for government approval of the local content plan, actions in case of rejection (resubmission/appeal), and commitments from the government to improve factors such as infrastructure and skills in exchange for local content demands. The draft 2024 regulations can be modified to address these shortcomings and to incorporate the best practice approaches.

Box 2.4. Examples of local content regulations

International good practice shows that with the right mix of policies, support mechanisms, and a focus on building local capabilities, substantial local content can be achieved without compromising mining competitiveness and growth:

- *Norway*—the government established clear guidelines and requirements for local content, coupled with strong support for local businesses through education and training, research and development, and infrastructure.
- *Brazil*—has used local content policies to develop a robust local supply chain in its oil and gas sector, ensuring that a significant share of the value created by the industry remains within the country.
- *Ghana*—the government identified 28 items to be manufactured locally. As this was deemed too ambitious, they started with 8 items, which eventually grew to 17. Today more than 50 items are being produced locally.
- *Botswana*—its local content approach includes *supply-side* supplier development programs and *demand-side* preferential treatment requirements, to the "extent possible" given safety, quality, and economic considerations.

Sources: World Bank review.

3. CHAPTER 2: IMPROVING THE CAPTURE, MANAGEMENT, AND SHARING OF BENEFITS

KEY MESSAGES

- Zambia's access to ETM, proximity to regional markets, and opportunities to leverage regional and global trade and investment agreements provide comparative advantages for value addition.
- Declining export performance and value addition can be reversed through policy reforms and infrastructure investments to improve the overall competitiveness of domestic firms.
- Trade policy reforms include addressing tariff and nontariff barriers to provide competitively priced inputs and reduce trade emissions intensity to increase export competitiveness.
- Investment policy reforms include strengthening the capacity of the Zambia Development Agency (ZDA) to design and implement a targeted investment promotion and facilitation program for the ETM value chain, addressing gaps in the regulatory regime, promoting access to competitively priced ETM inputs for domestic firms, leveraging local content policies for more impactful supplier development programs, expanding access to finance for small businesses, and improving the effectiveness of special economic zones (SEZs) to attract ETM investments.
- Expanding the access to finance of small businesses through the effective implementation of the National Financial Inclusion Strategy is critical for expanding the participation of Zambian firms in value addition.
- Development of junior Zambian mining exploration firms requires a targeted program, accompanied by capital market initiatives and incentives.
- Although the government has made progress in formalizing ASM through regulatory reforms and gold aggregation, it should adopt a gradual approach to copper trading by acting as an aggregator for artisanally mined copper, ensuring fair pricing, improving compliance of both ASM and midstream actors, and minimizing the financial risk of commodity trading using a learning-by-doing approach.
- ETM revenue mobilization, allocation, and utilization need to be strengthened with appropriate institutional reforms and proper data collection and reporting mechanisms to improve tracking and monitoring.
- Public financial management for the ETM sector needs to be significantly improved through proper accounting procedures, cost-benefit analysis, and strengthened institutional capacities.

3.1 Expanding Zambian participation in ETM supply chain and value addition[36]

Zambia is well positioned to leverage increased ETM production to expand value addition. Its comparative advantage for processed ETM products is based on: (a) access to critical mineral inputs (primarily copper, and to a lesser extent nickel and manganese) and geographical proximity to other ETM-producing countries, such as the DRC; (b) the potential for lower trade barriers under the African Continental Free Trade Area (AfCFTA), the Common Market for Eastern and Southern Africa (COMESA), and bilateral memoranda of understanding with countries in other regions; and (c) proximity to Sub-Saharan Africa's most developed market for ETM products—South Africa. In the short run, the country can capitalize on its comparative advantage to increase its share of the growing regional market for copper rods, wire, and cables, as well as more sophisticated products such as green wires; medium-, high-, and extra-high-voltage wires; transformers; electric panels; and rewinding motor products driven by the

[36] This section draws on company interviews conducted in the Spring of 2024.

increasing electrification needs. In the medium to longer run, it could participate in the component manufacturing stage of batteries, solar panels, and e-motorcycles for the regional market.[37]

Zambia could be competitive in the medium to long term in positioning itself in a regional battery value chain. Given the right enabling conditions, it could attract investment in the battery value chain to produce precursors and battery components. In an optimistic scenario specifically for the lithium-ion battery value chain, battery grade refining and processing of cobalt sulphates/oxides, manganese sulphates/oxides, and nickel sulphates could be established, based on domestic mineral production and imports from the DRC and South Africa. The next phase could be the production of battery grade cathode active mass (CAM) and electrolytes, as well as components for battery pack and charging infrastructure, such as collector foil, wires, steel cans, and lids. However, this would require Zambia to establish targeted trade and investment partnerships (like the joint special economic zone (SEZ) initiative with the DRC) with countries such as South Africa and Zimbabwe and to become more cost-competitive to attract investments in these components. The potential benefits for Zambia are huge—upwards of $3 billion in annual fiscal revenues and more than 50,000 jobs.

Critical policy and infrastructure reforms are needed for Zambia to capitalize on these opportunities. Without reliable electricity infrastructure, domestic manufacturers struggle to enhance the predictability of output and manage costs, and inefficient trade facilitation and logistics infrastructure undermines timely access to markets. Investments in electricity and logistics infrastructure should be complemented with policies to enhance the competitiveness of ETM value chains. These include: (a) ensuring reliable access to domestic or imported copper through a reference price benchmark; (b) leveraging Zambia's participation in regional economic communities such as the Southern African Development Community (SADC), COMESA, and AfCFTA to discuss a common tariff strategy for ETM goods and complementary investments in infrastructure, particularly in logistics, to make local investments more attractive; (c) revamping the investment strategy to cater to ETM-related investments; (d) upgrading and modernizing the SEZ incentive framework to support ETM value chains; and (e) enabling access to competitive financing for established and new businesses through innovative financial instruments, including equity and blended finance. Estimates suggest that with infrastructure investment and reform, Zambia could grow its export revenues sixfold over the next decade, if it maintains its current copper product mix. Should it diversify into more value-added products, it could potentially grow export revenues tenfold in a decade.

Currently, there is little local supply of goods and services to mines and low levels of value addition in ETM value chains beyond the first stages of mineral refining and smelting. Most ETM exports are in a raw state, except for refined copper products, and most ETM imports are final products (electrical machinery and parts). Zambia's ETM trade flows are highly concentrated in a handful of jurisdictions and products. Taiwan and China are the predominant destinations for its exports (65 percent and 34.6 percent respectively of total ETM exports, as per Figure 3.1), and South Africa and China are the principal suppliers of ETM-related electrical machinery and parts (37 percent and 40 percent of Zambia's total imports of these goods, respectively, as per Figure 3.2).

[37] Based on the Product Complexity Index for these value chains and Zambia's Economic Complexity Outlook Index (Adewumi 2024).

Figure 3.1. Exports of ETM, by export destinations

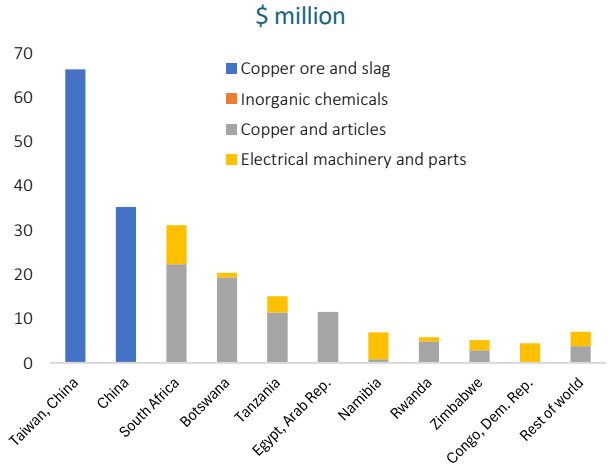
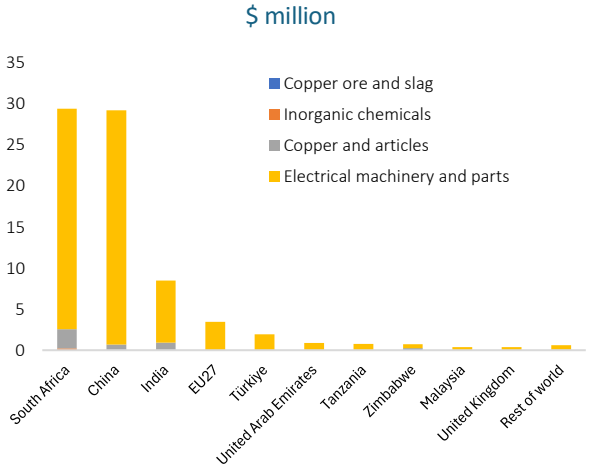


Figure 3.2. Imports of ETM, by import suppliers



Source: WITS Mirror Data 2022, WITS (World Integrated Trade Solutions) (database), Washington, DC. https://wits.worldbank.org/Default.aspx?lang=en. *Note:* ETM = energy transition minerals.

Zambia's exports of copper cathodes, a critical input for copper manufactured products, have declined steadily over the past decade. It exported 371,834 tons of copper cathode in 2023, roughly a third of its 2014 export level of 1.06 million tons. Local cathode consumption remains minimal, at around 15,000–17,000 tons a year. A limited number of producers of semi-fabricated and fabricated copper products (rod, wire, and cable) all operate below capacity (30–50 percent of total capacity). A few Zambian companies have entered regional niche markets, and at least one is planning to expand to another country. There are also a few manufacturers of final products such as transformers, electrical panels, and switchgears, but these are small operations not necessarily connected to the local copper production.

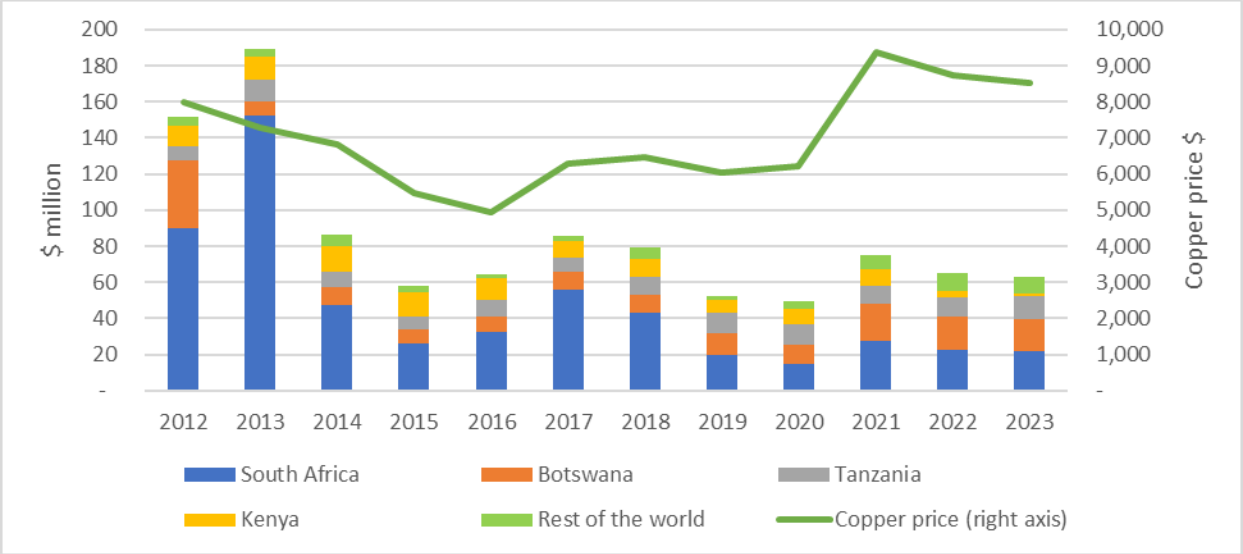
Apart from the price of copper cathode, key competitiveness drivers for copper rod, wires, and cables include plant location, manufacturing efficiency, and access to reliable sources of raw materials. Long-term supply contracts with copper refineries and smelters provide more certainty to those manufacturers, as copper accounts for more than half the total raw material needed for the fabrication of wire.[38] However, fluctuations in copper cathode prices, differences in raw material and final product payment terms, and delays in value added tax refunds create working capital pressures for copper producers (World Bank, 2011). Transportation cost comprises an important share of the total cost of manufacturing copper wire, especially for standard products with low added value. This makes proximity to end consumers and raw materials—as in the case of Zambia—a source of competitive advantage.

The overall decline in both the quantity and value of copper exports and products over the past decade suggests a decline in competitiveness beyond currency depreciation or the fall in international copper prices. Along with the fall in exports of raw and refined copper, exports of copper wire and cable have also declined steadily since 2012 (Figure 3.3). The total value of copper rod, wire, and cable exports in 2013 was over $189.5 million (around 16,741 tons), dropping by more than two-thirds a decade later to $63 million in 2023 (7,143 tons). This decline in exports was partly due to the slowdown in the Southern

[38] Estimate for standard 3 mm wire cable, based on Syndicated Analytics (2024).

African economy over the past decade, which reduced demand (Africa RISE 2024). Zambia's main export destinations for its manufactured copper products are South Africa (35 percent of total exports), Botswana (28 percent), and Tanzania (21 percent). Zambia has not taken advantage of the growing import demand in its main destination markets over the past decade (213 percent on average between 2012 and 2023); on the contrary, it has lost ground to imports from the United Arab Emirates and Russia, which accounted for 70 percent of wire and cable imports into South Africa in 2022.

Figure 3.3. Exports of copper rod, wire, and cable, 2012 to 2023

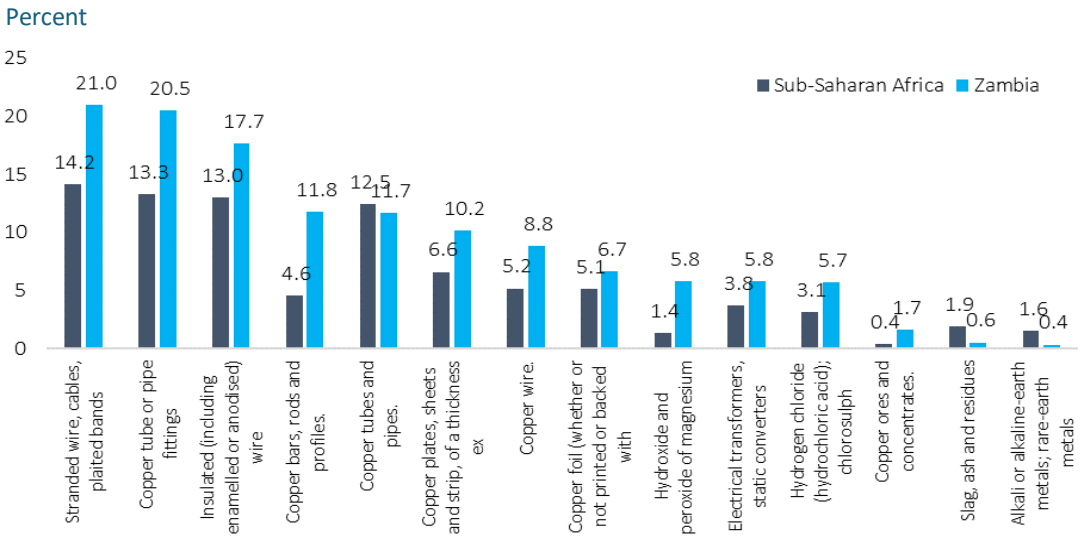


Sources: Trade data, Comtrade Database, UN (United Nations), Washington, DC, https://comtradeplus.un.org/; average annual copper prices from S&P Global Market Intelligence. *Note:* Products include HS codes 740811, 740819, 740822, 740829 and 7407.

Zambia's ETM are subject to relatively higher tariff barriers than the average for Sub-Saharan Africa (Figure 3.4). Tariffs on wire and cables (Harmonized System (HS) code 7413) and copper tube or pipe fittings (HS code 7412) are particularly high, at 21 percent and 20.5 percent, respectively. This tariff structure reduces exposure to international competition for local wire and cable producers, although imports from South Africa, China, and India still serve local demand. Imported inputs for copper wires (such as plastic for bedding and insulation, galvanized steel wire for armoring, or master batch colors for cables) do not generally attract duties. To enhance competitiveness in the ETM value chains, specifically in the sustainable energy supply chain, policy adjustments are required. These adjustments could include eliminating import duties on inputs and progressively reducing import duty protections for final or intermediate ETM-based goods. This could encourage domestic firms to become more competitive in the domestic and export markets.

Further value addition requires establishing a tariff regime that minimizes import costs on essential inputs, including parts and components, capital goods, and other materials critical for the mining and processing of ETM. By implementing a strategic tariff structure within the COMESA Common External Tariff (CET), Zambia can enhance its integration into global ETM value chains, thereby improving its position in the green technology market and contributing to the sector's overall growth. This may also require negotiating tariffs at the regional level.

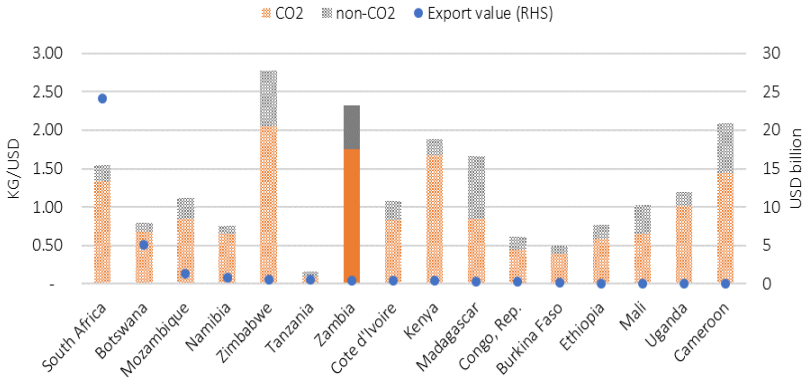
Figure 3.4. Average applied tariffs on ETM-related products in Zambia and Sub-Saharan Africa



Source: World Bank analysis.

High nontariff measures and high trade emissions intensity could undermine export competitiveness in ETM sectors (Figure 3.5). Technical trade barriers and price control measures are the most prominent nontariff measures, with materials that could be used for manufacturing wind turbines facing the largest nontariff measures relative to those for electric vehicles and solar panels. The complexity and pervasiveness of nontariff measures translate into a challenging import regime, significantly raising the rate of border protection. Key regulatory bottlenecks include overlapping regulations, high discretionary power for introducing new regulations without proper impact evaluation, the presence of many border agencies, and a lack of staff with sufficient technical skills to analyze and streamline nontariff measures. Furthermore, Zambia's trade emissions are high relative to its regional peers. The greenhouse gas emissions associated with trade are becoming a critical metric for the competitiveness of exports. To enhance its competitiveness, Zambia needs to actively seek opportunities to reduce the carbon footprint of its ETM value chains. This could involve integrating more sustainable practices and technologies into the production and transportation processes to lower emissions.

Figure 3.5. Emissions intensity of the other extraction metals ores sector



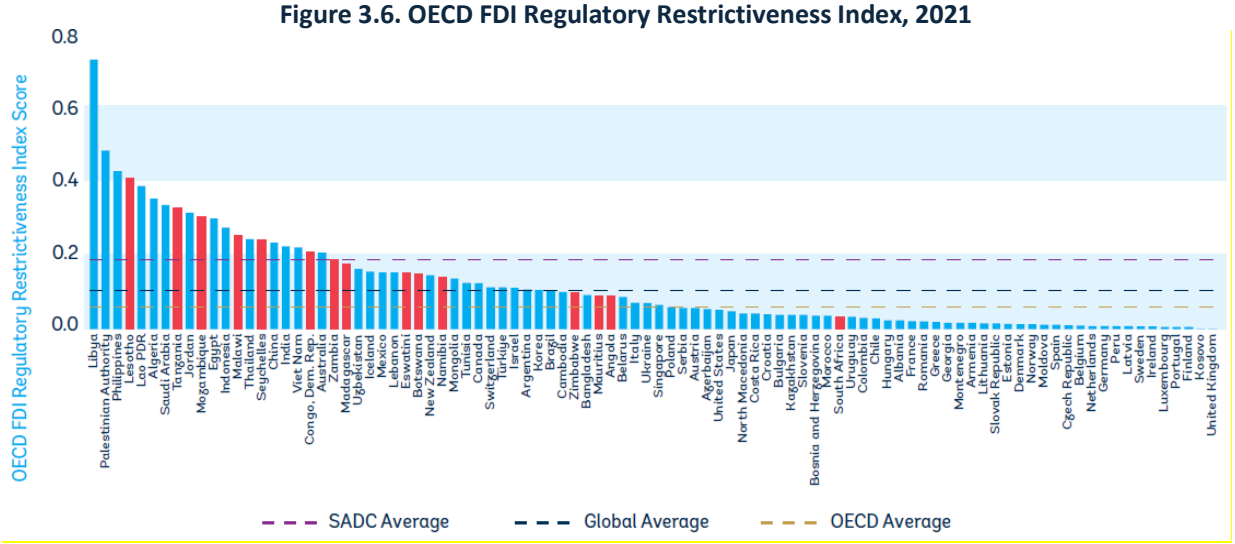
Sources: Chepeliev and Corong 2022; Chepeliev and others 2022. *Note:* RHS = righthand side. Non-CO2 includes CH4, N2O and F-gas.

Targeted investment policy reforms

Targeted reforms are needed to strengthen investment promotion and facilitation and address regulatory hurdles and policy uncertainty. The Zambia Development Agency (ZDA), the government institution that promotes investment, has limited financial and human resources, which restricts its capacity. There is also some confusion about the mandate of the proposed MRC and whether it will promote investment only in mining and primary processing or also in the ETM value chain. The regulatory environment presents another set of challenges. Obtaining the necessary permits and complying with environmental impact assessments can be a protracted and opaque process, adding to the risks and uncertainties for investors. Policy and regulatory instability, such as fluctuating contract terms and tax regulations, further undermine investor confidence. The protection of investor rights and the mechanisms for resolving disputes also need to be strengthened. Another concern is the limited adherence to ESG standards among local businesses, which could hamper their participation in global supply chains.

Zambia has been rationalizing restrictions on foreign investment through the 2022 Investment, Trade and Business Development (ITBD) Act. Efforts have also been made to prepare a negative list (with all sectors not on the list open to foreign investment). Still, some restrictions remain. For example, transport companies with less than 75 percent local shareholding cannot obtain Road Service Licenses (without a ZDA registration). This can affect access to transport services from neighboring countries, which may offer cheaper backhaul and often have lower fuel costs. Zambia's performance on the Organisation for Economic Co-operation and Development's (OECD) Foreign Direct Investment (FDI) Regulatory Restrictiveness Index[39] (which measures the openness of foreign direct investment rules) is the same as the SADC average, about double the global average for non-OECD countries (Figure 3.6). South Africa, Botswana, Namibia, and Zimbabwe all outperform Zambia on the index.

Figure 3.6. OECD FDI Regulatory Restrictiveness Index, 2021



Source: FDI Restrictiveness Index, OECD (Organisation for Economic Co-operation and Development) Index (database), Paris, https://www.oecd.org/en/data/indicators/fdi-restrictiveness.html.
Note: Scoring: 0 = no restrictions and 1 = most restricted. FDI = foreign direct investment.

[39] Until April 14, 2023, the index covered 38 OECD countries, 15 SADC countries, and 26 non-OECD economies including: Albania, Algeria, Angola, Argentina, Armenia, Brazil, Cambodia, Croatia, Egypt, Georgia, Jordan, Kazakhstan, Lao PDR, Lebanon, Libya, Morocco, Namibia, Peru, Romania, Singapore, Thailand, Tunisia, Ukraine, Uruguay, Vietnam, and West Bank and Gaza.

Investments in Zambia are eligible for tax incentives, but there are challenges around transparency and the discretionary nature of such incentives (World Bank 2024a). Tax incentives are provided for in the ZDA Act of 2022 and the ITBD Act of 2022. However, there is lack of clarity on the availability of these incentives, eligibility criteria, and any overlap of incentives across sectors, MFEZs, SEZs, or PPPs. Furthermore, the discretionary nature of provisions allowing for "personalized incentives" for investors that commit to setting up in rural areas or to employ a given number of local people creates uncertainty and, potentially, an uneven playing field. It can also result in inconsistencies and corruption, as there is no single overriding framework for the use of tax incentives. Transparency about which incentives have been offered to which firms is crucial for better policy evaluation and to ensure that incentives are used effectively and equitably, especially in emerging sectors like ETM.

Enhancing manufacturing competitiveness

Zambian copper product manufacturers face significant constraints in accessing copper cathode at competitive prices, despite the country being a major producer. Copper cathodes represent about 85 percent of the operating costs to produce 3 mm copper wire,[40] making their availability and price crucial to the profitability of copper wire manufacturing. Prices follow global trends, and as local manufacturers are generally too small to use financial hedging, they tend to maintain contracts with refiners. The base price formula for international buyers is the reference London Metal Exchange (LME) price + a premium + a shipping cost benchmark (China or Singapore, usually $150–$170 a ton). Although local buyers report getting a discount of $35 on the LME + premium price, they argue that this is too little for them to be competitive. Some refineries reserve part of their production for local buyers (maybe 10–20 percent), but as local demand is low, most of their production is exported. Although some mining and refining companies have already committed their production under long-term contracts or sold it to traders on the global market, one refinery said it would support national regulation on a local pricing scheme for all producers. Local manufacturers advocate for transparent, enforceable medium-term contracts and the opportunity to purchase copper on spot markets. The recently announced cabinet resolution to suspend customs duty and surtax on the importation of copper cathodes aims to make them available to local processors at less than the LME price. This is intended to enable producers to access competitively priced inputs and foster regional integration with neighboring copper-producing countries.

Electricity prices are competitive relative to other copper manufacturing countries, but the instability of the system and frequent power outages increase the overall cost. In December 2023 the electricity price for businesses was $0.033/kWh, significantly below the global average of $0.154/kWh.[41] However, supply disruptions seriously affect production schedules and costs. Zamefa, Neelkanth, and other manufacturing companies have invested in backup generating capacity on site to ensure continuity of operations, with resulting high fuel bills (Africa RISE 2024); according to one manufacturer, the change to 12-hour outages meant 1,000 percent higher energy bills. Local energy prices are also rising because

[40] Estimate based on Syndicated Analytics (2024).
[41] Zambia electricity prices data, Global Petrol Prices (database), Metairie, LA, https://www.globalpetrolprices.com/Zambia/electricity_prices/.

Zambia increasingly relies on more expensive imported energy.[42] Given these challenges, some companies have already preferred to expand operations to supply Africa from other locations.

Companies in the copper product manufacturing sector and those interested in servicing the mining sector report difficulties in accessing financing, along with other external and market constraints. Financial inclusion among micro-, small and medium enterprises (MSMEs) in Zambia remains a significant issue, with only about 7 percent of MSMEs applying for loans between 2017 and 2022. The MSME finance market is characterized by limited diversification of financing sources, with banks and microfinance institutions as the primary formal providers, along with a lack of appropriate instruments for different stages of enterprise development. More broadly, MSMEs face various barriers to accessing credit: (a) high interest rates (commercial banks charge about 25 percent); (b) a lack of collateral; (c) low-income levels; and (d) low awareness of the available financial infrastructure and products for MSMEs (World Bank 2024b). Foreign companies, companies linked to diversified economic groups, and established companies use internal resources and corporate loans at the holding level. Other service and manufacturing companies that are interested in supplying the mining sector cite the high cost of capital, currency depreciation, payment delays, and weak procurement governance of mining companies—including requests for kickbacks—as obstacles to participation in this value chain.

Value addition activities in copper manufacturing require different skill profiles than mining activities, with a greater need for metallurgical and electrical engineers, as well as skilled service professionals such as accountants and lawyers. Access to foreign skills is not restricted if local expertise is unavailable. Although the cost of labor in Zambia is not particularly high, alternative locations like Dubai are still more attractive for manufacturing because of higher labor productivity. Key points regarding skills and labor policies in Zambia's copper manufacturing sector include:

- *Labor productivity:* Zambian firms are less productive than their counterparts elsewhere in the region.
- *Expatriate labor:* Skills that are not available locally, mainly technical and managerial skills, are brought in at high cost. Most of Zambia's competitors do not face the expense of recruiting expatriate skills.
- *Skill development:* Despite the willing workforce, skills development has significant gaps, and some training needs to take place abroad.
- *Contract labor:* The high cost of labor and low productivity of employees contribute to the growing use of contract labor in the mining industry.

Geographical proximity and shorter delivery times give Zambian manufacturers of copper-based products a local and regional competitive edge, but poor trade facilitation and logistics infrastructure hinder their market access. Global Positioning System (GPS) data collected from trucks in June 2024 show that all the transport corridors are inefficient in terms of border crossings and road quality in both Zambia and its neighbors. Further, travel between Lusaka and the Copperbelt (around 300 km) could take a whole day, highlighting the time and cost implications of domestic logistics (Africa RISE 2024). Zambia aims to reform its trade environment to support export-led economic growth, including by amending trade and customs legislation, improving border policies and procedures, establishing coordination structures, and investing in infrastructure (including trade automation). Although some of these activities are being implemented under the Zambia Agribusiness and Trade Project-II (ZATP-II), several others remain either

[42] With load management, companies must pay 18 c/kWh for imported power, which is 50 percent of their needs.

in implementation or at the conceptual stage, and it will be several years before their impact is felt. Rail corridors are also inefficient (see Chapter 3).

Zambia's ambitious plans to expand production would put trade and export infrastructure under pressure. Mineral ores and chemicals are heavy and, therefore, expensive to move; this is compounded by the long distances involved. Trade and logistics capabilities would also need to handle growing traffic in mining equipment and spare parts to support mining and chemical processing. This change will be significant, especially as the copper production and supporting logistics value chain has remained largely the same since Zambia's independence in 1970, when production was reported at 747,500 tons.

Trade stakeholders reported that the journey to port typically takes about 5–10 days,[43] depending on the choice of route. The cost to move copper cathode to port is $180–$200 a ton, depending on the choice of port.[44] The longest routes are from Ndola and Congo to Durban (2 weeks), with Ndola to Walvis Bay (7 days) currently being the preferred and most profitable route. A carrier's costs depend on the size of the consignment, the distance for fuel, the expected travel time, the choice of route (expected wear and tear on the truck), and the availability of backloads (loads to and from the port). In practice, the choice of corridor and port is usually established by the buyer within the sales contract and is influenced by the destination of the consignment and the availability of the ship and port. Operators tend to focus on specific clients, ports, and corridors, with the choice of route to port determined by the operator and the clearing agent. Operators report that ETM exports face two significant challenges: (a) gaining export documentary approval (10–14 days, with Chirundu and Zimbabwe considered the most burdensome), and (b) navigating the logistics of moving the goods through roads and borders to the designated port. As ETM goods are already cleared inland, the border process should be a simple formality of release. However, ETM goods generally require further documentary stops and checks, especially as the Zambia Revenue Authority deem all ETM exports to be high risk.

Several trade bottlenecks and policy, regulatory, and infrastructure gaps have a particularly negative effect on ETM, including (a) slow preclearance inspections on all cargo, including transactional documentary checks to verify ETM export compliance at the border; (b) a lack of coordinated border management with risk management and coordinated inspections; and (c) a lack of fully automated solutions such as the national single window, leading to additional delays. There are also concerns about the evasion of royalties and taxes associated with ETM goods stored in bonded warehouses in Zambia. Although several trade reforms are underway, as mentioned earlier, special regimes for firms in the ETM value chains could be developed to facilitate faster and lower-cost access to markets.

Despite their mixed track record, SEZs could help achieve the government objective of fostering investment in ETM processing.[45] Zambia's SEZ program has several strengths: the eight SEZs established over the last decade are in strategic locations to attract investment, including in ETM processing, although their connectivity and power reliability could be improved. In line with good international practice, most are privately owned and managed. Land in SEZs seems to be allocated at fair cost, following market

[43] World Bank survey of Zambian exporters, 2024.
[44] One operator noted that the logistics price is calculated at $1.5 x load (30 tons) x the distance to the port.
[45] Zambia initially developed zones as "multi-facility economic zones" (MFEZs), a term that is still commonly used. However, recent legislation refers instead to the broader category of SEZ, which also encompasses other zone types, such as industrial parks. "SEZ" is therefore used here as the more generic term, but it is understood as largely interchangeable with "MFEZ".

dynamics, and the government sees SEZs as an important tool to attract investment in ETM processing. SEZs have attracted around $510 million in investment since the SEZ program was established, and they now host around 133 companies that have created 44,000 jobs. However, a lack of detailed data makes it difficult to assess their net economic benefits and additionality (that is, whether the zones enabled investments that would not have materialized otherwise).

However, the SEZ regime has significant shortcomings. Key issues include the lack of a well-defined SEZ strategy and policy on the development and management of zones; weaknesses in the regulatory and institutional framework governing zones; failure to provide better infrastructure than in the rest of the country, and difficulties in connecting to power, water, and transport networks for some zones; limited management of environmental and social performance; and a lack of integration with other policies, leading to missed opportunities for synergy. These elements can undermine the attractiveness of SEZs: companies along the ETM value chain operate mostly outside SEZs, such as manufacturers of copper wires and cables. There is also a need for much stronger monitoring and evaluation systems to enable more evidence-based policy making on zones and determine the program's future direction.

- *Current policies on SEZs lack clarity in several areas***.** The governance of SEZs is now set by the ITBD Act of 2022, which also governs the rules for investors to obtain incentives. However, the ZDA still refers to the previous ZDA Act and its regulations, including for the structure of incentives, creating confusion. A review and update of regulatory and incentives are needed to address these gaps and incorporate recent legal changes. According to the ITBD Act, each new SEZ is established through a statutory instrument issued by the government, which should determine the type of zone, unique regulatory conditions, facilities to be provided, and the obligations of investors. However, in practice, the statutory instruments adopted for the SEZs approved so far provided relatively little detail beyond a standard list of basic infrastructure and services to be provided and a list of sectors for which they should be suitable. The policy and regulatory framework does not set out the management of zones, the responsibilities and prerogatives of their developers and operators, the division of responsibility for infrastructure investment inside and outside the zone area, or the responsibility and resources of the ZDA to manage the zones and conduct cost-benefit analyses.
- *There is scope to improve the institutional framework governing SEZs.* The ZDA currently both regulates zones and promotes their development. Best practice favors separating these functions, and reforms are reportedly being considered that would allow the ZDA to refocus on its investment promotion efforts. Some private zone developers argue that the ZDA gives them little concrete support, for instance failing to consult or inform them about outreach activities to potential investors. They suggest a conflict of interest when the ZDA favors the government-owned Lusaka South MFEZ over private zones. In the ETM space, there is a lack of clarity on the policies and specific instruments to support ETM in SEZs.
- *There is scope for developing the eco-industrial park model in Zambia, especially for ETM.* Regulatory and institutional reforms could be adopted, and technical and financial support mechanisms established to gradually transition SEZs into eco-industrial parks. Given the importance of sustainability and social safeguards for clean energy manufacturing, SEZs supporting these value chains should offer services to boost competitiveness in terms of ESG compliance.

The recommendations for developing the downstream processing of ETM are summarized in Table 3.1.

Table 3.1. Summary recommendations for increasing downstream manufacturing and services

Category	Recommendations
Trade	• Regional coordination to ensure that the CET is not imposing tariffs on inputs and parts for the ETM industry. • Streamline nontariff measures for environmental goods, services, and technologies relevant for ETM. • Formulate an ETM trade and climate strategy to support Nationally Determined Contributions and National Adaptation Plans, mitigate the impact of climate on trade, diversify trade routes, and make logistics more resilient. • Develop and enforce carbon standards and regulations that align with global benchmarks, while enhancing climate emissions measurement and verification systems to close implementation and data gaps. • Establish a specific ETM sector program under the Zambia Revenue Authority within the existing Authorized Operator program • Prioritize risk management capabilities to identify risky trade and fast-track the professional implementation of the existing government reform priorities in digitalization and the coordinated national single window. • Improve controls applied on inbound transit and warehousing to avoid tax revenue losses from the transit of ETM goods from the DRC and reduce the risk of abuse from unlicensed domestic producers. • Extend collaborative bilateral solutions to facilitate cargo trade seamlessly through both sides of the border, along with regional harmonization of end-to-end transit solutions to facilitate consignments to and from the regional ports.
Investment climate	• Establish a clear, uncontested mandate for the ZDA with respect to ETM and bolster it with high-level government support and institutional and financial strengthening and autonomy. • Support the ZDA by staffing it with management and key promotion staff with strong private sector experience to maintain a strong investor-centric service orientation. • Establish a solid national-provincial framework for investment promotion and facilitation, as a single office in Lusaka is unlikely to cover promotion needs across the country. This is key for enhancing responsible, long-term investment from point of interest to establishment and links with domestic industry. • Strengthen investor protection and dispute settlement mechanisms to improve policy and regulatory predictability. • Simplify regulatory requirements, such as obtaining permits and environmental impact assessments. • Raise awareness of ESG standards among local firms and support their compliance efforts. • Streamline investment entry procedures and rationalize incentive frameworks, removing discretionary elements from the review process. • Implement complementary measures to boost the competitiveness of local suppliers; assess their costs and benefits.
Industrial development	• Establish a policy on stable domestic access to refined copper and set a market-based benchmark to define balanced prices in domestic contracts. • Map the electricity needs of industrial zones (including outside SEZs,) and identify gaps in transmission and generation capacity and enabling regulations for private investment to address these gaps. • Review the SEZ framework (public-private coordination, strategy, ITBD Act, SEZ regulations) and for each zone, clarify commitments on infrastructure investments and performance requirements by developers and public authorities. • Review regulatory constraints on SEZs and reform incentives, using SEZs to pilot liberalized regulations. • Ensure that SEZs provide attractive services to investors through effective administrative one-stop shops in all zones, training services in SEZs and links with nearby education institutions, and supplier development and link programs. • Improve monitoring and evaluation of SEZ through collecting data on investment incentives, infrastructure, and environmental and social performance of SEZs, building the monitoring and evaluation capacity of the ZDA and SEZ operators, and conducting solid impact evaluations to assess the effectiveness and value for money of SEZs, accounting for their positive and negative indirect effects.

Category	Recommendations
	• Assess zone developers' financing and business models to identify better solutions to finance zone infrastructure. • Carry out missing public investment to connect the state-owned Lusaka West SEZ to infrastructure networks and consider public-private partnerships. • Develop an eco-industrial park program by including ESG in the SEZ regulatory framework; building institutional capacity at government and zone level; and providing financial and technical support for green investment in zones.
Access to finance	• Implement action plans outlined under the National Financial Inclusion Strategy II (2024–28) to enhance the MSME financing ecosystem, including promoting inclusive green finance to support MSME's green transition. • Foster the development of innovative financing instruments (such as blended finance) by financial service providers to better diversify financing options. • Expand the role of capital markets in MSME financing by establishing key market infrastructure to foster the development of both direct and indirect financing mechanisms, such as equity and debt issuance by specialized MSME lenders.[a] • Enhance climate finance literacy among MSMEs (see the *Carbon Market Guidebook* for Kenyan Enterprises). • Reform national development finance institutions to strengthen their role in catalyzing climate financing, particularly through advisory services that enhance the bankability of MSMEs in green sectors.

Source: World Bank analysis.
Note: CET = common external tariff; DRC = Democratic Republic of Congo; ESG = environmental, social, and governance; ETM = energy transition mineral; ITBD = Investment, Trade and Business Development; SEZ = special economic zone; ZDA = Zambia Development Agency.
a. World Bank (2020).

3.2 A next generation of Zambian "junior" exploration companies

Zambia envisions a mining sector in which its nationals not only contribute as workers but also take ownership as financiers and developers, particularly in the early stages of exploration and the development of small mines. It aims to build a base of local, junior exploration companies that can capitalize on Zambia's mineral wealth, foster economic growth, and ensure that more of the sector's benefits remain within the country. Achieving this requires overcoming a range of structural barriers: the high cost of capital, insufficient expertise among many license holders, the absence of a mineral resource reporting code, and the lack of both government grant funding and equity-based financing. A strategic, multipronged approach is necessary to address these challenges, drawing on successful models from other mineral-rich countries.

Countries like Canada and Australia have established thriving ecosystems for junior mining companies through targeted measures in capital markets, regulatory frameworks, and government incentives. Canada's adoption of the National Instrument 43-101 reporting standard, combined with capital markets designed to support high-risk investments in exploration, has created an environment in which junior companies can access funding and list projects credibly. Australia's Junior Minerals Exploration Incentive provides direct tax offsets for exploration investment, encouraging more local ownership and reducing financial risk for early-stage ventures.

Aligning financial ecosystem development with capacity building and robust regulatory standards can attract investment, build local ownership, and accelerate the growth of the junior mining sector. By following these good practices, Zambia can create a sustainable foundation for its emerging locally owned

junior miners. To this end, a coordinated program of action is needed to implement a range of measures, as set out below: (a) develop the junior miners; (b) develop the financial ecosystem for domestic capital markets; and (c) create an inclusive set of incentives. These actions can also improve the compliance of Zambian license holders with their obligations and accelerate the cleanup of the mining cadaster.

3.2.1 Develop the junior miners

Building a robust base of Zambian-owned junior mining companies requires targeted investment in capacity building to equip these businesses with the necessary skills, knowledge, and resources. Many local license holders face challenges in project development, data collection, and meeting investor expectations to raise financing. By offering comprehensive training in technical project management, financial literacy, and industry compliance, Zambia can empower its entrepreneurs to navigate complex requirements and make informed, strategic decisions. Programs that foster partnerships with established companies and mentorship opportunities will further enhance the capabilities of junior miners, enabling them to actively participate and grow within the mining sector. A comprehensive workstream to achieve these objectives could include:

- *Technical and project management training.* The government and industry should partner with mining schools and industry associations to deliver specialized training in project development, data collection, and compliance with financial reporting standards. The training should equip license holders with skills to advance projects effectively and document findings in formats suitable for investors.
- *Business skills and financial literacy.* Provide workshops and courses on mining finance, business management, and navigating listing requirements. This education could be facilitated by collaboration between government, private sector (mining companies), the banking community, the Lusaka Securities Exchange (LuSE), and international partners.
- *Mentorship and industry partnership programs.* Encourage mentorship partnerships between junior miners and established mining companies. This would help junior miners gain hands-on experience in exploration processes, environmental compliance, and managing stakeholder relationships.
- *Competent persons certification program.* Develop a national program to certify geologists and engineers as "competent persons," ensuring they can conduct geological reporting in compliance with recognized standards. Certification should align with the requirements of a mineral reporting code, such as the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC) or the South African Code for Reporting of Mineral Resources and Mineral Reserves (SAMREC).

3.2.2 Develop the financial ecosystem for capital markets

As early-stage mining exploration is a risky venture with no guarantee of a mineral discovery, junior mining exploration almost always depends exclusively on equity finance.[46] A supportive financial ecosystem is essential for junior miners to raise capital, build credibility, and attract investors. Key to this

[46] Out of every 10,000 identified mineral prospects, only about 10 percent will lead to a drilling program (1 in 10), and just 0.01 percent (1 in 10,000) will lead to a new mine. For more information, see the PDAC (Prospectors & Developers Association of Canada) website at https://pdac.ca/programs-and-advocacy/access-to-capital.

is the adoption of a standardized mineral resource reporting code, which would improve transparency and investor confidence in Zambian projects. Additionally, strengthening the LuSE) and building local capacity in mining financial analysis will create a framework in which junior mining companies can effectively list and trade. Simplifying listing requirements for junior miners and fostering the skills of local financial analysts will make capital markets more accessible, ultimately enabling these companies to secure funding through a credible, well-regulated exchange. The following activities should be considered:

- *Adopt a mineral resource and reserve reporting code.* Implement an internationally recognized reporting code, such as JORC or SAMREC, through the LuSE, to provide standardization and build investor confidence in the exploration data produced by junior miners.
- *Capital markets training for financial analysts.* A qualified set of buy- and sell-side analysts is critical for reviewing companies' underlying assets and the potential value of a company, which ultimately facilitates market liquidity through buy and sell recommendations. Together with the banking community and the LuSE, the government should support the development of specialized training for buy- and sell-side analysts on mining (exploration) project assessment. This could increase the capability of local banks and financial institutions to analyze and promote mining ventures, thus enhancing market liquidity.
- *Simplify listing requirements for junior miners on the LuSE.* Canada, Australia, and the United Kingdom all have a "juniors" board tailored to smaller companies. The LuSE should review its listing procedures to tailor them to the needs of junior mining companies and consider creating a junior mining board suited to smaller, growth-stage companies. This would have positive spillovers to other sectors seeking to access capital.
- *Establish a market liquidity support program.* Market liquidity is important, as mining shares only have value to investors if they can easily sell them at a point in time. The government could consider a government-backed mechanism to enhance liquidity for junior mining stocks, potentially through co-investment or liquidity support funds. This would stimulate trading activity and make the sector more attractive to both local and international investors. In parallel, the LuSE may wish to consider aligning its listing requirements with the Johannesburg Stock Exchange's junior board, Alternative Exchange (AltX), to facilitate access to other pools of capital and provide liquidity.

3.2.3 Create a set of incentives

Although exploration is risky, countries like Australia and Canada continue to support private sector investment in exploration through a range of fiscal incentives because—provided the eventual mines operate responsibly—the returns to the economy justify the support. To encourage Zambian ownership in the mining sector, the government can implement a suite of incentives that reduce the financial barriers to entry for junior miners. Targeted measures such as exploration grants, tax incentives, and subsidized loans (partial guarantees) can mitigate the high capital costs that currently limit local participation. By reducing financial risk and supporting exploration and development activities, these incentives will help attract investment, stimulate project initiation, and increase profitability for Zambian-owned companies. Activities could include:

- *Establish a junior mining grant fund.* Set up a government (or PPP) fund (potentially supported by grants or concessional lending from cooperating partners) to support early-stage exploration activities.

Grants could cover the costs of geological surveys, data collection, and environmental assessments, with priority given to Zambian-owned projects. However, the structure of this fund must ensure that projects are selected based on merit and prospectivity. It will be important to have private sector experience materially included in the decisions about which projects attract government resources. Aside from technical and commercial attractiveness, grant finance would need to be conditional on full compliance of the license holder with their requirements, which in turn could assist with improved ESG performance and the cleanup of the mining cadaster. Beneficiaries from the fund could also be automatically enlisted in the capacity building activities described previously to increase their likelihood of success.[47]

- *Tax incentives for exploration and development expenses.* Canada has successfully utilized tax incentives to mobilize private investment in mineral exploration through its "flow-through shares program."[48] Zambia could similarly provide tax deductions or credits for exploration and development costs to lower the financial burden on junior miners and incentivize private investors to mobilize resources.

3.3 Mobilizing and managing domestic revenue

3.3.1 Revenue mobilization, allocation, and utilization

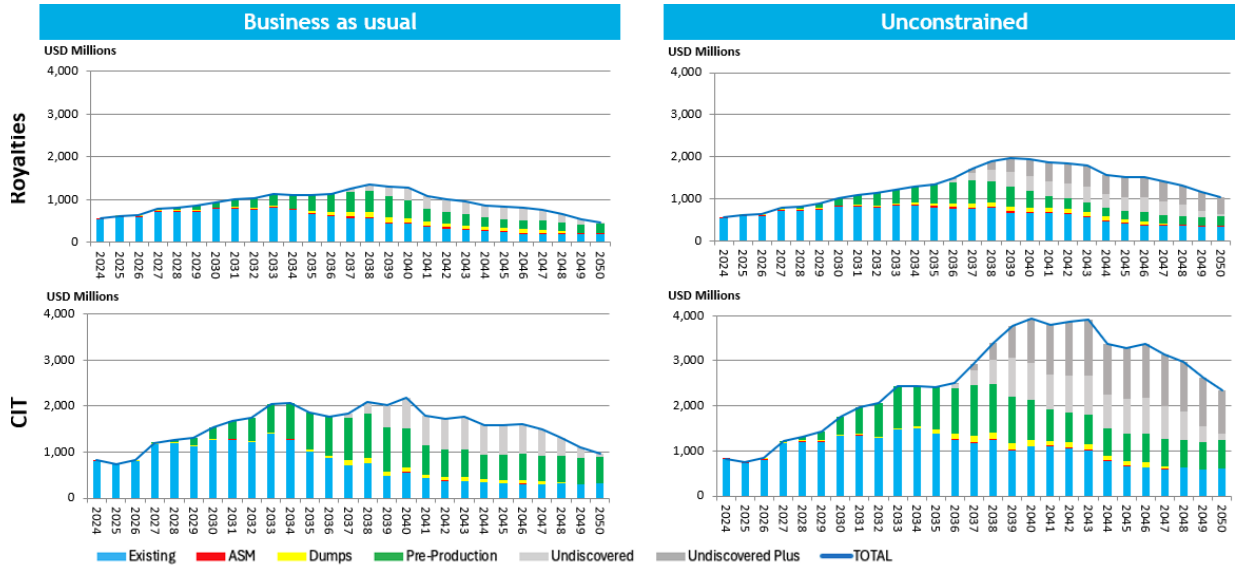
The projected growth in the production and processing of ETM could bring significantly higher revenues for the state. The World Bank modeled only royalties and corporate income tax for this exercise, each of which comprise about 50 percent of projected mining revenues in 2024 (Figure 3.7). Over time, however, the share of corporate income tax in mining revenue increases sharply. The modeling did not consider revenues from state equity; this revenue stream tends to disappoint as mining companies employ various strategies to limit dividends to a free carried interest shareholder. In the *business-as-usual case*, royalties are projected to increase from about $600 million in 2024 to about $1.3 billion by 2040 and corporate income tax from about $800 million to about $2.1 billion. In the *unconstrained case*, royalties and corporate income tax increase from the same starting base to peak at about $2.0 billion and $4.0 billion respectively in the mid-2040s. The growing share of corporate income tax underscores need to build the capacity of the ZRA, invest in facilities to verify production, and improve interministerial coordination around collecting corporate income tax. The lack of a significant contribution for dumps in the aggregate fiscal contribution indicates that the current approach to risk-based auditing should be maintained, with large mines being audited more frequently and in greater depth than some of the smaller operations.

The World Bank also undertook an assessment of the competitiveness of Zambia's fiscal regime. A fiscal regime, while important, is one of many considerations influencing mining investment decisions. The World Bank analysis found that although the design and overall burden of current regime is not out of line with global standards, foreign investors still perceive Zambia as a relatively high-risk destination, albeit on an improving trajectory. This perception could be exacerbated by proposals to introduce free equity

[47] Grant agreements could also include a requirement to fully or partially repay the financing used should a beneficiary mine eventually be developed or a mining company be listed. Such funds could then be used to support future junior miners.
[48] For more information, see the Government of Canada "Flow-Through Shares (FTSs)" website at https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/flow-through-shares-ftss.html.

participation and production sharing, which, though intended to increase government benefits, might heighten perceived risks just when the government seeks to attract investment.

Figure 3.7. Fiscal contribution of Zambian copper mining, 2024 to 2050



Source: World Bank projections. *Note:* CIT = corporate income tax.

To better balance revenue generation and investment needs, the fiscal regime could be made more progressive, enabling the government to capture greater revenues from highly profitable mines while reducing the burden on marginal operations. Initial quick wins could include the introduction of a sliding scale royalty for gold, nickel, and potentially manganese.[49] Longer-term measures that could be explored (if sufficient tax administration exists) include a profit-based royalty as is done in South Africa. Additionally, adjustments to incentivize exploration could help ensure a pipeline of new projects to replace depleting mines.

However, implementing changes now risks reinforcing concerns about policy instability. Any revisions should involve close consultation with the mining industry and include stability assurances. In the medium to long run, the most significant driver of increased government revenue will be enhancing Zambia's reputation as a predictable and low-risk investment destination. Achieving this could lower investors' thresholds for committing capital and increase the scale of their investments, with measures outlined in the forthcoming Energy Transition Minerals Roadmap.

On the administration of the fiscal regime, concerns include revenue leakage and a lack of clarity on revenue sharing between the central and local authorities:

- Zambia faces challenges related to revenue leakage from its ETM *through illicit exports or through under- or misreported production and export figures*.[50] The government needs to improve monitoring and enforcement of regulations around the production and export of ETMs. Actions could include

[49] Zambia currently administers a sliding scale royalty for copper.

[50] Given Zambia's large size and geographically widely distributed mining activities, sizeable ASM presence, and porous borders, it's likely that significant illicit activities could take place, denying the Government appropriate revenue from the sector.

improving the standardization of Zambia's ETM (to differentiate it from those originating in neighboring countries), an information-sharing protocol among relevant agencies (including border control police, customs agents, the ZRA, and the Bureau of Standards), and employing information systems to facilitate processing and live information sharing and investment in a government-run and internationally accredited laboratory to verify the metal content of exports.

- The *revenue records* of the mining sector are limited to those collected centrally by the ZRA and the MMMD. Fees and levies collected locally as own-source revenue are not recorded by either the ZRA or the relevant ministries and are thus not consolidated into the sector revenues. This implies that the mining sector's contribution to revenue is underestimated. The Revenue Unit of the Budget Office does not have procedural guidelines to record or assess own-source revenue from mining.
- The 2022 Auditor General's report on the MMMD highlights various issues, including *under-collection of revenue*, failure to collect outstanding arrear charges, unaccounted-for revenue, loss of revenue from expired licenses, unlicensed mining activities, inadequate funding resulting in delayed implementation of planned programs, and non-submission of production returns. These gaps underscore the need for a more robust and specialized audit framework tailored to the unique challenges of the mining sector.
- There is no *assessment of local revenues* collected by local authorities in their capacity to impose fees, levies, and local taxes on the mining sector. (The Business Regulatory Review Agency, which can conduct regulatory impact assessments when local authorities want to change rates or add new revenue streams, has not published any analysis in this regard.) The ZRA and local authorities collect local taxes and fees separately, doubling the transaction costs for taxpayers.
- *Inconsistent reporting* by mining companies hampers revenue collection management by the ZRA and undermines effective budget planning (ZRA 2023). Such inconsistencies arise from (a) differing reporting standards: mining companies do not use the same standards or formats to report financial and production data, which makes it difficult to aggregate data across the sector; (b) incomplete reporting: some do not fully disclose relevant data, either intentionally or because of weak internal data systems, leaving gaps in the data available to regulators and stakeholders; (c) irregular reporting: companies report at different intervals (monthly, quarterly, or annually), leading to inconsistencies in the data available at any given time; and (d) quality and accuracy issues: company data vary in quality and accuracy because of different measurement techniques, collection methodologies, or reporting errors. Implementing standardized reporting systems would significantly improve financial transparency and planning capabilities and strengthen the ZRA's ability to collect applicable revenues.

On the expenditure side, there is no sector-specific fiscal transfer for districts that host mining areas. No assessments have been conducted to determine fair compensation to such districts to address grievances and redress environmental degradation, health hazards, or other impacts. There is no national fund for these matters, and cases are handled through partial resolutions that are not reflected in the national budget. Moreover, the ministries of Finance and National Planning and of Local Government and Rural Development do not question how the sectoral Intergovernmental Fiscal Architecture transfers are used to manage mining-related risks faced by local communities. There is no comprehensive risk profile of the impact of mining on local communities and no central agency to advise on these matters during the budget exercise. The Integrated Development Plans of mining districts should ideally include a

comprehensive hazard analysis, risk profile, and resilience plan, with regular updating and tracking of implementation and reporting on results.

PPPs involve some level of fiscal risk. Sector strategies and policies rely on PPPs to complement public sources of finance. Yet, the policy of implementing PPPs is unclear, especially around their budgetary impact. The early involvement of the PPP Unit and the Economic Management Department is critical to assess proposed projects to avoid undermining either development in the sector or budget stability.

The MMMD and other key public agencies need adequate budgets to operationalize their national mandates. The ambitious development plan for the mining sector, including its evolving organizational structure, should ideally include a comprehensive budget exercise with quality cost-benefit analysis and better performance indicators to improve budget accountability. Currently, the output-based national budget is not well costed in terms of the efficiency and effectiveness of spending. The program costing exercise is not linked to performance indicators, except the budget burn rate. Linking the budget to outcome performance will inform the budget allocation among regulatory, policy setting, and operations functions. Although those functions are complementary, they compete for the same limited resources. Holding public agencies accountable for results would bring the challenge of balancing the complementarity of functions within the limited budget envelope.

3.3.2 Public financial management for the mining sector

Zambia's planning exercise is incomplete and does not provide structured guidelines for costing public policies. The Eighth National Development Plan does not have a streamlined methodology for costing exercises by sector, which is critical for aligning the plan with the budget. There are no clear ways for the MoFNP to resolve any conflicting demands on the budget stemming from new policies introduced by the National Development Plan, including those of the mining sector.

Sector planning is undermined by the lack of structured guidelines for land management. The three priority sectors (agriculture, mining, and tourism) have a high demand for quality land. However, there is no procedural methodology to advise on managing such conflicts and trade-offs. All decisions are made on the spot, and there is no national body tracking such cases to assess their collective impact.

To inform sector planning, cost-benefit analysis of major policies is needed. Such a costing exercise should involve a comprehensive assessment of the costs and benefits of different policies to ensure completeness, coherence, and consistency of the policy framework. Every policy should be subject to a multilevel regulatory assessment, including business (impact on the corporate sector), financial (impact on the state budget), and strategic (impact on the role of the state). These assessments should not be made in isolation. Box 3.1 provides an example of weak multilevel regulatory assessment.

The need to maximize the value for money from depleting mineral assets is not adequately addressed. Revenues from mining should be handled efficiently to capture the extra price of using depletable resources. However, the current practices do not give due attention to generational accounting. For one, the accounting system does not provide mechanisms to track depletable resources properly. The Chart of Accounts of the Integrated Financial Management Information System (IFMIS) does not clearly distinguish between revenues by type. Moreover, the codification of revenues used by the ZRA does not follow the

Chart of Accounts, and its operations are not integrated into IFMIS. This means that the identification of revenues may be inaccurate under the current provisions. One mechanism that could be considered in the potential establishment of a Sovereign Wealth Fund would be to ring-fence such revenues for quality investments.

Box 3.1. The government special purpose vehicle for investment

An example of policy-making silos is the establishment of a government special purpose vehicle for investment in production-sharing mechanisms, ensuring a 30 percent stake for the government in greenfield projects, promoting local content, and formalizing artisanal and small-scale mining. This approach is intended to streamline investments, safeguard national interests, and promote inclusive growth. However, bureaucratic inefficiency, a lack of informed government involvement, and the risk of overshadowing local private sector roles pose significant challenges. These issues can hinder effective collaboration between the government and the private sector and even undermine business.

Source: World Bank analysis.

Also, current public financial management practices do not support maximizing value for money. Improvements in the quality of budgeting are vital, including:

- *The output-based budget should be leveraged for result-based budgeting* to hold public agencies accountable for results. The medium-term expenditure framework should be made more robust by linking it to policies that have been costed and aligned with outcomes that help to meet the country's development objectives.
- *Strict implementation of the project appraisal guidelines* should be introduced. No unsolicited project should be accepted without being subject to the budget gate process. The MoFNP should produce agile public investment management processes to be used in times of crisis.
- *The medium-term expenditure framework process should maintain a detailed record of the status of all ongoing projects.* Ministries and provincial administrations should be required to justify the funds they allocate to such projects. The MoFNP needs to protect the project portfolio under the budget to avoid new projects crowding out existing ones. Preparing a baseline multiyear and annual budget will help to highlight priority capital spending to protect ongoing projects. Moreover, the appraisal process needs to be strengthened. Using different social discount rates that reflect the true value of different revenue streams may be considered.
- *The current practices of devolution may lead to sectoral and budget fragmentation.* Central agencies should be responsible for integrating the sector portfolio while devolving implementation to the subnational level.
- *The monitoring and evaluation system is weak,* despite the various data platforms established at the Ministry of Finance and other central agencies. Data on most of those platforms are obsolete and seldom updated, and the culture of evidence-based decision-making is weak.

Oversight by the Office of the Auditor General and Parliament is key for the mining sector. Given the sector's importance to the economy, the Auditor General's capacity to provide specialized services to the mining sector needs to be strengthened. Extractive audit is a specialized area of audit that requires particular attention. This includes extending the financial and compliance audit to the performance audit.

Currently, the sector's audit is mainly agency-based, with very little subject-based auditing (Zambia, OAG 2017). The Auditor General does not produce a consolidated audit report on the mining sector's role in generating and using public depleting resources. Another requirement is an implementation plan for audit queries that are repeated frequently, such as a loss of potential revenues, and weak compliance and transparency. In addition, parliamentary oversight and accountability are crucial, possibly through a designated plan for relevant committees to track the performance of the sector, ensuring policy coherence and alignment with national development plans, and mandating structured guidelines for policy costing. Parliament should also promote the role of the Office of the Auditor General and request an implementation plan for audit queries.

4. CHAPTER 3: EXPANDING INFRASTRUCTURE AND THE SKILLED WORKFORCE

KEY MESSAGES

- The lack of adequate infrastructure and a skilled workforce is among the key challenges limiting Zambia's potential to scale up production and processing of ETM. For example, the transport and logistics sector is hampered by inadequate infrastructure, high transport costs, and delays at border points. Likewise in mining, the unreliable power supply undermines investments in the sector, including opportunities for value addition. The limited availability of a skilled workforce is both a challenge and an opportunity, as employment is one of the ways in which Zambians can benefit from the ETM value chain. Various initiatives are underway to address these challenges.
- In transport and logistics, Zambia is connected to regional and global markets through various transport corridors and ports, making it relatively resilient. However, transport and logistics costs are high because the infrastructure is in poor condition and operations are inefficient; this undermines the country's competitiveness. To address these challenges, the GRZ has taken major initiatives to improve key road and rail corridors and border crossings. Several road projects (including the North-South, the Dar es Salaam, Beira, and Nkala-Walvis Bay corridors) are ongoing or planned. In the rail sector, negotiations are ongoing to revamp the Tanzania-Zambia Railway Authority (TAZARA) line through concession agreements. Reform of the rail sector, including the reform of Zambia Railways Limited (ZRL) and recapitalization to rehabilitate its line is also ongoing. Regarding border crossings, several initiatives are underway to install one-stop border facilities to promote easy movement of goods and people.
- Successful implementation of ongoing and planned transport and logistics interventions is likely to address remaining challenges and ensure that transport infrastructure will not become a constraint on ETM development. The three major developments in this respect are the dualling of the Lusaka-Ndola highway, the new TAZARA concession, and the rehabilitation of the Dar es Salaam Road Corridor.
- The energy sector will require massive investment in generation, transmission (both inland and interconnection), and distribution, as well as significant reforms to alleviate the emergency-level power shortage and put the sector on a sustainable trajectory.
- However, the difficult financial and operational state of the Zambia Electricity Supply Corporation Limited (ZESCO) means that it is not a credible off-taker from private power producers. In addition, the country's fiscal situation does not allow it to provide a sovereign guarantee for ZESCO contracts. Although reforming ZESCO (through unbundling and improving its financial and operational efficiency) is important, this will take time, and more urgent solutions are needed to address the country's critical power shortage and diversify its energy sources. As such, actions that promote private sector participation with only a small or no financial guarantee from ZESCO or the state, such as those that allow private power producers to sell directly to private power users, are vital. To that end, investments in transmission and distribution are important, as are reforms that facilitate private sector participation in power generation, such as open access policy, net metering, a cost-reflective tariff, and an independent system operator. Investments in key regional interconnectors will also contribute to energy security and reliability, allowing Zambia to trade with regional power pools.
- The latest Integrated Resource Plan (IRP, 2023–50) provides a menu of reforms and investments needed to meet the country's energy demand. The total investment required to realize the IRP is $11.6 billion by 2030 and $30.97 billion by 2050. Timely implementation of the plan is key to achieving the GRZ's ambitious plan to triple copper production, maximize local value addition, achieve universal access to electricity, and diversify and transform its economy by 2030.
- For workforce development, Zambia builds on a strong foundation, based on more than a century of experience in mining and pockets of excellence in mining and engineering schools. Going forward, it needs to focus on aligning demand and supply, working closely with industry.

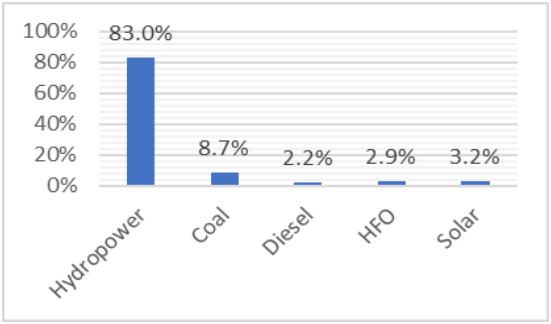
4.1 Providing access to reliable and affordable green electricity

4.1.1 Electricity sector

Zambia's electricity sector is dominated by the state-owned Zambia Electricity Supply Corporation Limited (ZESCO), a vertically integrated utility supplying electricity to household, commercial, and industrial customers. The Ministry of Energy is responsible for policy formulation and implementation, the Energy Regulation Board oversees licensing and regulation, and the Rural Electrification Authority provides electrification infrastructure and services to rural areas.

Heavy reliance on hydropower leaves the energy sector vulnerable to climate shocks. About 83 percent of capacity is hydropower (Figure 4.1), which has been severely affected by variable rainfall. At less than 10 percent of its average level, the Kariba Dam was declared critically low in 2023. The severe, ongoing drought has reduced ZESCO's power generation capacity to 1,019 MW, far below the peak demand of about 2,500 MW, leaving a deficit of about 1,481 MW as of August 2024. ZESCO has been implementing extensive load-shedding, often over 20 hours a day. With frequent power outages, electricity is the second most reported business constraint. In response, the government is prioritizing the diversification of energy sources, particularly solar-based renewable energy and regional power transmission interconnectors to import power from regional power pools.

Figure 4.1. Installed capacity by source



Source: Zambia, MoE 2023.
Note: HFO = heavy fuel oil

Despite substantial hydropower, solar, and wind resources, Zambia's power supply is inadequate. Total installed electricity generation capacity was about 3,811 MW in December 2023,[51] and the peak demand was 2,500 MW. As a result, the electrification rate is low, at about 47.8 percent, with large disparities between urban and rural areas.

The power sector faces severe financial viability constraints, and fiscal deficits prevent it from expanding and delivering reliable electricity. The average tariff of $0.07/kWh is below the average cost-reflective tariff of $0.11.[52] The 2023 Integrated Resource Plan (IRP) estimates that Zambia requires investments of about $8.6 billion by 2030 and $17.18 billion by 2040 to meet its energy demand (Table 4.1).[53] However, ZESCO's serious financial and operational challenges mean that it is unable to invest. Moreover, given the

Table 4.1. Financing requirement in the power sector, 2021 to 2050

IRP Investment Summary	Incremental Investments ($millions)			
Year	2023 to 2026	2027 to 2030	2031 to 2040	2041 to 2050
Generation ($m)	2,943	4,281	7,801	7,805
Transmission ($m) including 66kV	953	457	745	231
Investment in Distribution - 33kv Network ($m)	247	259	364	107
Investment in On-Grid Access ($m)	143	166	235	309
Investment in Off-Grid Access ($m)	698	1,488	749	991
Total IRP Planned Investment ($m)	**4,983**	**6,650**	**9,895**	**9,442**

Source: Zambia, MoE 2023.

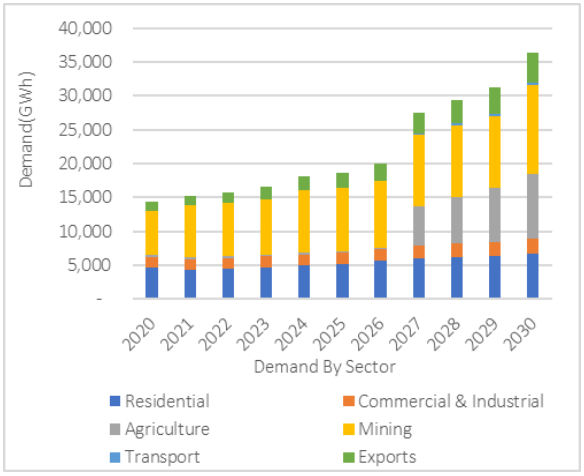
[51] After the commissioning of the Kafue Gorge Lower Hydro Scheme (750 MW) and the Copperbelt Energy Corporation's (CEC) solar photovoltaic power plant (33 MW)
[52] Government of Zambia (2022b).
[53] Zambia is estimated to need investments of about $2.9 billion in electricity access programs by 2030 to achieve universal access.

country's fiscal constraints, the government cannot give ZESCO a sovereign guarantee to enable private sector investment in the sector. Alternative private sector-led solutions must be sought to address the power shortages, which have reached a crisis level.

Electricity demand and supply projections

The mining sector remains the largest consumer of electricity (Figure 4.2). Electricity demand for agriculture is projected to increase significantly, surpassing the demand for residential energy. The IRP projects a peak power demand for 2050 of 11,031 MW, up 349 percent from 2020. The relative shares of peak power demand are expected to shift, with agriculture at 33 percent, followed by mining at 19 percent, and households at 17 percent. Mining energy demand is expected to rise to 10 GWh in 2026 and 13 GWh by 2030, especially from the proposed new mines in the Copperbelt, North-Western, Muchinga, and Eastern Provinces. The expected overall increase in demand between 2020 and 2050 is 132 percent (48 percent in 2020–26, 18 percent by 2030, and 32 percent by 2040).

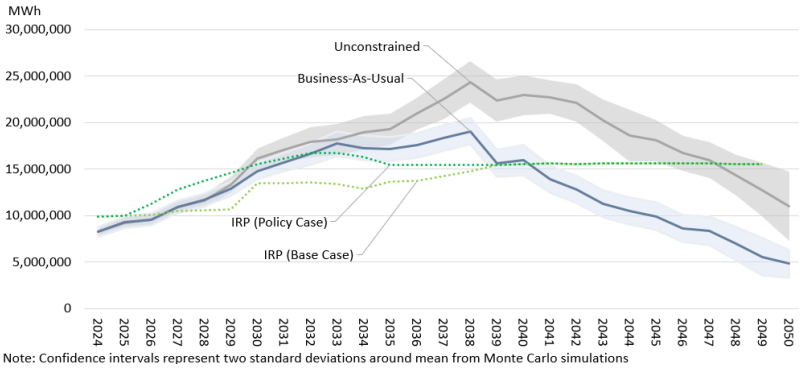
Figure 4.2. Electricity demand by sector, 2020 to 2030



Source: Zambia, MoE 2023.

The IRP base case scenario assumes the government's ambitious target of 3 mtpa of copper production will be achieved by 2040, not by 2031.[54] The World Bank analysis compares energy demand under two scenarios of minerals production—the business-as-usual and unconstrained cases (Figure 4.3). The projections assume a constant energy mix but vary energy intensity based on detailed information at the mine level and distinguishing between lower-intensity open pit mines and higher-intensity underground mines. Changes in the type of mine over time account for the declining trend in energy demand in the business-as-usual case, as the older, underground mines close without enough new, open pit mines being established to meet the growing energy demand.

Figure 4.3. Copper energy demand projections, 2024 to 2050



Note: Confidence intervals represent two standard deviations around mean from Monte Carlo simulations

Sources: World Bank projections, Government of Zambia projections.
Note: IRP = Integrated Resource Plan.

[54] In the base case scenario, producing 3 mtpa of copper is feasible by 2040 in line with the IRP's technical analysis. The policy case is a scenario consistent with the government's policy goal of producing 3 mtpa of copper by 2031. The IRP initially did not assume the 3 mtpa in the analysis, but upon presentation of the analysis to the cabinet, the Ministry of Energy was advised to include this target; hence, it developed the policy case scenario.

The World Bank energy projections under both *business-as-usual* and *unconstrained* scenarios are consistent with the IRP's policy case (a scenario in which the target of 3 mtpa copper is reached in 2031) up to early 2030s but deviates from the IRP's base case. After the mid-2030s, the World Bank projections under both scenarios are consistently higher than those of the IRP. They suggest that more rapid investment in energy generation and transmission infrastructure may be needed to support Zambia's ambitious mining vision without limiting energy availability for other sectors. The key driver for energy demand after 2030s is the operation of Mingomba mine, given the need for significant dewatering.

The IRP's review of potential power generation projects suggests these proposed capacities could be achieved quickly. For example, ZESCO has already signed power purchase agreements to develop over 1,000 MW of solar photovoltaic plants, with a construction period of 18 months. These investments need to be complemented with hydro, biomass, and geothermal projects, along with investment in transmission infrastructure for regional power trade. Hydropower generation projects with a total installed capacity of 525.5 MW are largely ready for implementation, with full feasibility studies, and an additional total installed capacity of 892.6 MW is at the prefeasibility stage (see Appendix A).

Power transmission and distribution

Zambia's transmission and distribution infrastructure is insufficient for providing reliable and cost-competitive access to power. Given the ongoing energy crisis and the time needed to build large hydropower projects, Zambia urgently needs to expand its transmission infrastructure, including regional interconnectors to import cheaper and cleaner power. Without infrastructure to interconnect power grids across the region, it must rely on expensive and unsustainable fossil fuel solutions, even where potential import sources exist. Allowing the private sector to sign power purchase agreements with power producers or utility companies in the region could offer quick and practical solutions.[55]

Figure 4.4. Current and planned transmission lines

Source: Zambia, MoE 2023.

The IRP 2023 transmission plan aims to increase the length of transmission lines by 82 percent, from 12,705 km in 2023 to 17,913 km by 2030 and 23,072 km by 2050 and the aggregated cross-border interconnection capacity from 2,090 MW in 2023 to 4,050 MW by 2030 by implementing seven additional interconnector projects (Figure 4.4 and Table A.2 in Appendix A).[56] One priority is the Zambia-Tanzania Interconnector Project,

[55] Zambia's mining companies are already importing power from neighboring countries (Bloomberg 2024).

[56] There are currently three interconnectors, with Namibia, the DRC, and Zimbabwe, which can transmit 2,090 MW.

which includes a 600 km high-voltage line to increase capacity between the two countries from 17,647 to 588,235 kilovolt-ampere. It is estimated to cost $295 million and will largely be funded by the World Bank ($245 million). The distribution network is also limited, especially in rural areas, where only 5.6 percent of households are connected to the grid. Zambia plans to invest $976 million in distribution assets and grid enhancements by 2050.

4.1.2 Current plans and remaining constraints

Zambia is implementing various energy sector reforms to ensure energy security and reliability, but systematic constraints persist. The country's ambitious reform program to increase non-hydro power supply and incentivize private investment in on-grid distribution includes unbundling ZESCO, an open access policy, net metering, and a single licensing system. Developing regional interconnectors would also diversify energy sources. Key reforms are summarized in Table 4.2 below and Table A.1 in Appendix A.

Table 4.2. Key constraints and government actions

Key constraints	Government actions and opportunities
Monopoly over transmission infrastructure: The electricity market, especially on-grid distribution and transmission, is controlled by ZESCO, which limits private sector engagement.	Zambia has approved an open access policy and is planning to unbundle ZESCO along its generation, transmission, and distribution business areas. More work is required to establish a truly competitive market, such as setting standardized rules for using the national grid, along with a clear transmission pricing methodology, and establishing an independent system operator.
As the primary off-taker, *ZESCO's financial and operational challenges* hamper investment in infrastructure. Private investors are often hesitant to invest in energy projects, given concerns about the bankability of projects and ZESCO's ability to honor long-term contracts.	ZESCO is implementing measures in five areas (customer satisfaction, financial sustainability, infrastructure, maintenance, and human capital) under the 10-year Strategic Plan. The multiyear tariff framework will also contribute to its viability. The World Bank is working with the government to improve ZESCO's financial viability and so increase the sector's sustainability, reliability, and resilience.
Constrained inland and interconnection transmission infrastructure and limited capacity hinder cross-border power trade. Without sufficient regional interconnectors, Zambia cannot import cheaper and cleaner power when needed.	Zambia is developing interconnectors to increase regional power trade, notably the Zambia-Tanzania Interconnector. However, fiscal constrains may make it difficult to use public funds for more interconnectors, and models such as public-private partnerships (PPPs) should be explored.
The lack of a competitive procurement framework for renewable energy creates uncertainty for potential investors, undermining the development of the sector.	Zambia is developing a procurement framework to facilitate priority renewable energy projects in line with the Integrated Resource Plan (IRP). This will help reduce unsolicited proposals, enhance competition, and lower energy costs.
Funding for energy projects is limited because of high interest rates, stringent lending conditions, and the perceived risks of energy investments, including the vulnerability of possible off-takers and electricity tariffs that do not reflect cost.	Zambia is leveraging concessional financing and taking action to address ZESCO's financial and operational challenges to give confidence to commercial lenders. Maintaining fiscal discipline will also help reduce sovereign risks.
Non-cost-reflective tariffs: The average household tariff of $0.07/kWh is below the cost-reflective tariff of $0.11/kWh for residential and small business customers. The average tariff for mining firms is at 9¢/kWh, below the regional trend of 14¢/kWh.	The government approved a multiyear tariff framework to create a predictable tariff path with automatic adjustments. This would allow ZESCO to pass on reasonable costs from currency or fuel price fluctuations. However, this only applies to retail tariffs; tariffs for large consumers, such as mining, are negotiated through PPAs.

Source: World Bank analysis. *Note:* NEAT = National Energy Advancement and Transformation Program; PPA = power purchase agreement; ZESCO = Zambia Electricity Supply Corporation Limited.

As indicated above, Zambia is implementing some priority reforms and investments in generation, transmission, and distribution projects, but they remain critically inadequate. More investments would rapidly be needed to ensure an adequate power supply to support the government's vision. To address these remaining challenges in the energy sector, several actions are needed, as set out in Table 4.3.

Table 4.3. Summary of key challenges and recommendations

Key challenges	Recommendations	Responsible agency
Energy policy is not aligned with GRZ policy on scaling mining and value addition.	• Align the Integrated Resource Plan (IRP) with the overall policy on mining value chain development and update it regularly to reflect new knowledge and technology. • Develop a procurement framework to implement the IRP (including a competitive framework for renewable energy to quickly bring on board much-needed energy). • Strengthen MoE and ZESCO energy planning and procurement to implement IRP.	MoE (ZESCO)
Overdependence on hydropower and ZESCO monopoly led to unreliable power supply.	• Expedite unbundling of ZESCO into generation, transmission, and distribution, and establish an independent system operator. • Adopt net metering to promote renewable (non-hydro) generation at scale. • Strengthen ZESCO and MoE capacity to manage public-private partnership (PPP) contracts for generation and transmission projects. • Implement a multiyear, cost-reflective tariff framework.	MoE ZESCO ERB
ZESCO's performance is weak.	• Accelerate implementation of ongoing World Bank-supported ZESCO reform (focused on customer satisfaction, financial sustainability, infrastructure, maintenance, and human capital) under the 10-year Strategic Plan.	ZESCO
A lack of transmission infrastructure limits private investment and access to power from SAPP and EAPP.	• Implement policies and regulations that allow buyers and sellers to trade freely to make Zambia competitive in the regional power market (develop a transparent and standardized transmission pricing system aligned with regional standards). • Invest (also through PPPs) in key regional interconnectors to facilitate power trading with neighboring countries within the SAPP and EAPP framework.	MoE ZESCO

Source: World Bank analysis. *Note:* EAPP = Eastern Africa Power Pool; ERB = Energy Regulation Board; MoE = Ministry of Energy; SAPP = Southern African Power Pool.

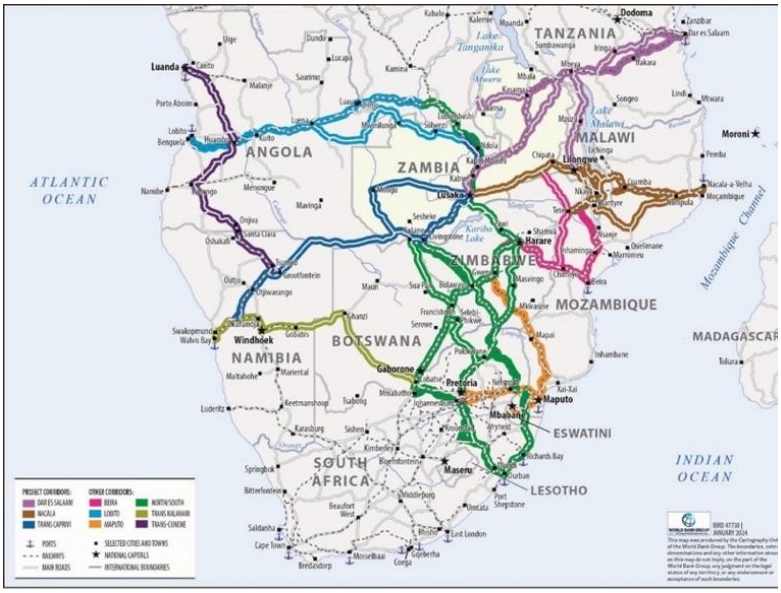
4.2 Enhancing transport and logistics

4.2.1 Zambia's key transport corridors

Zambia relies heavily on key transport corridors for its imports and exports. A landlocked country with a vast land area and widely distributed natural resources, Zambia uses its transport corridors to connect production areas such as the mineral-rich Copperbelt and North-Western provinces with ports in neighboring countries. Of the total rail traffic, 20 percent is domestic, 40 percent is Zambia's imports and exports, and 40 percent is transit international traffic to and from the southern DRC. The main regional transport corridors are (Figure 4.5):

- The *North-South Corridor* connects Zambia and the DRC. Its southern section links to the port of Durban through Zimbabwe and Botswana.
- The *Dar es Salaam Corridor* connects Zambia and the DRC to the port of Dar es Salaam in Tanzania.
- The *Nacala Corridor* connects Lusaka to Malawi and to the Nacala port in Mozambique.
- The *Trans-Caprivi Corridor* (also known as Walvis Bay-Ndola-Lubumbashi) connects Walvis Bay in Namibia with Zambia through Katima Mulilo, and Lusaka to Lubumbashi in the DRC.
- The *Beira Corridor* connects Zambia to the Beira port in Mozambique.

Figure 4.5. Key corridors and the connecting ports



Source: World Bank 2024b.

Table 4.4. Copper and sulfur flows, by port

	Port	Tons ('000)	Share
To[a]	Walvis Bay Corridor	233	11
	Beira	105	5
	Durban	1,018	46
	Dar es Salaam	859	39
Total		**2,215**	**100**
From[b]	Walvis Bay Corridor	0	N/A
	Beira	102	25
	Durban [c]	246	60
	Dar es Salaam	62	15
Total		**410**	**100**

Source: Compiled from information provided by the Zambian government.
Note: a. Includes both copper concentrate and copper products (anodes, cathodes, and blisters). b. Mainly sulfur for refining copper ore. c. Only 16,000 tons head for Zambia; the rest head to the DRC.

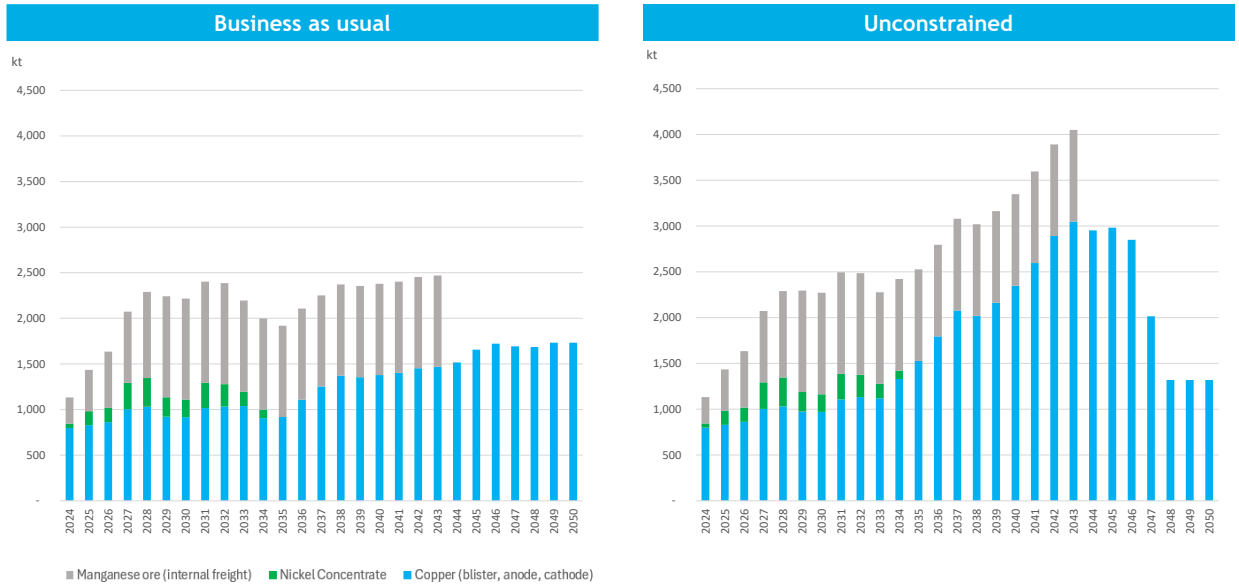
The North-South and Dar es Salaam corridors account for over 65 percent of all freight traffic, including international traffic. The total export volume from the DRC and Zambia (all products and minerals) is estimated at 3.5 million tons.

- The *Dar es Salaam rail-road corridor* is the busiest by traffic volume and the most important by freight value. It carries all of Zambia's and almost 40 percent of the DRC's copper production, as well as fuel imports and agricultural exports. The governments of Zambia and Tanzania have signed agreements to work collectively to develop the corridor and remove any physical and nonphysical barriers.
- The *North-South Corridor*, which extends from the DRC border to Livingstone, is a key route for imports. A vital link for the copper industry, it brings sulfur into Zambia and the DRC (Table 4.4). Most traffic uses the road corridor, and the rail corridor underperforms (see below).

Following government's ambitious plans to scale up ETM production and processing, freight demand is expected to increase significantly. Figure 4.6 shows total projected freight volumes of copper, nickel, and manganese production from 2024 to 2050 under two production scenarios. Copper is assumed to be entirely transported in either cathode, anode, or blister form (which has a Cu content of over 98 percent). However, nickel produced in Zambia will be exported as a concentrate, as the scale of production does not allow for the construction of a smelter. Manganese ore is transported internally as raw ore, which adds significantly to internal freight volumes, and is then processed at small, independent processing plants for final domestic use or export. In the *business-as-usual case*, demand grows from the current 1 mtpa to a peak of nearly 2.5 mtpa by about 2030, driven mainly by a modest increase in copper and nickel concentrate freight and a significant increase in internal demand from manganese ore transporters. In the *unconstrained scenario*, demand grows much faster, with copper freight driving the total to about 4 mtpa by 2043. The projections suggest that demand drops off rapidly thereafter, simply because the model assumes that no new copper will be discovered after 2030 (see footnote 18). Zambia has several

planned or ongoing transport and logistics infrastructure projects; if these key nearer-term projects are delivered successfully, freight is unlikely to be a binding constraint on the sector's growth.

Figure 4.6. Projections of copper, nickel, and manganese freight demand, 2024 to 2050



Source: World Bank projections.

4.2.2 The road network

The road network carries over 80 percent of copper exports from the DRC and Zambia, about 1.8 million tons per year. Table 4.5 shows the road corridors and routes for copper exports. The T3 road carries the largest share of copper exports, as all traffic heading to Dar es Salaam, Beira, and Durban must pass along it; the traffic then splits at Kapiri and Lusaka (Table 4.6). The destination and export routes of copper vary slightly from one year to another. In 2023 the major export destinations were Switzerland, China, and other Asian countries. In 2022 the target destinations included Namibia, South Africa, the Middle East, and China and other Asian countries.

Table 4.5. Road and rail modal split for copper exports

Destination port	Total KT	Rail		Road	
		KT	Share	KT	Share
Durban	1,018	200	20%	818	80%
Dar es Salaam	859	215	25%	644	75%
Walvis Bay	233	-	-	233	100%
Beira	105	-	-	105	100%
Total	**2,215**	**415**	**19%**	**1,800**	**81%**

Source: World Bank calculations. *Note:* KT = kilotons.

Table 4.6. Road corridors for exporting copper, 2023

Road section	Copper freight (KT)	Heading to
T3 (Ndola to Kapiri)	1,567	Dar es Salaam, Beira, Durban
T2 (Kapiri to Lusaka)	923	Beira, Durban
T2/T1 (Lusaka to Livingstone)	818	Durban
T5/other roads (Copperbelt to Katima Mulilo) [a]	233	Walvis Bay

Source: World Bank calculations.
Note: KT = kilotons. a. From the Copperbelt region through T5 to M8 to D181 to D301 to M9 to M10 and then to Katima Mulilo.

The road network faces various barriers and challenges:

- *Long stretches of road are in poor condition,* which contributes to low speeds, travel delays, and accidents. Poor road conditions along the Dar es Salaam, North-South, and Trans-Caprivi corridors result from inadequate maintenance, overloading, and more extreme weather events.
- *Traffic queues key facilities and nodes reduce the efficiency of the corridors.* Police checkpoints, toll plazas, weighing stations, and border crossings cause delays that range from a few minutes at check points to several days at border crossings (see the logistics section below).
- *Insufficient funding hampers rehabilitation and maintenance efforts.* Despite initiatives such as the dedicated National Road Fund Agency (NRFA), toll collection, and higher levies, the available resources are still insufficient. The NRFA collects only 20 percent of the estimated resources required every year, leaving it exposed to variations in central government funding.
- *Asset management systems remain weak*, despite efforts to improve planning and prioritization of maintenance, implementation modalities, monitoring systems, and preventive approaches.
- *Climate change poses a major risk to road connectivity.* Heavy rainfall, floods, erosion, and extreme temperatures damage roads and disrupt the transport of key supplies. Climate events increase the need for maintenance and rehabilitation and require the development of rapid response capacity. Only 25 percent of the core road network is paved, and it receives less than $2,000/km for maintenance per year—less than a third of the recommended level.

Road development plans

Zambia is implementing various initiatives and programs to restore and upgrade the key road corridors and enhance their sustainability and efficiency. These initiatives should contribute to a sustainable increase in road capacity, particularly on the key corridors. They include:

- *Rehabilitating the Dar es Salaam Road Corridor.* Zambia has secured funding from the World Bank, the European Union, the European Investment Bank, and the African Development Bank to rehabilitate the 610 km route from Serenje to Nakonde (Tanzanian borders). This will increase the structural capacity of the corridor (in line with estimates of traffic growth over the next 20 years), allow higher regulated speeds, and reduce delays along the corridor.
- *Developing the Tanzania Zambia Mafuta (TAZAMA) oil pipeline.* This 1,710 km pipeline runs from Dar es Salaam to Ndola in Zambia. Under government plans to improve economic efficiency, it was converted from carrying crude oil into a refined oil pipeline with a capacity of 800,000 tons per year. Trucks carrying diesel comprised 50 percent of fuel trucks on the Dar es Salaam Road Corridor; this will now be transported through the pipeline, reducing traffic on the road and extending its life.
- *Introducing weigh-in-motion systems and streamlining axle load control procedures.* Weigh-in-motion systems are being introduced along key regional corridors, in line with SADC recommendations. They increase efficiency by reducing truck queues at the main weighbridge stations. Zambia also aims to introduce e-tolling to reduce delays at toll plazas.
- *Upgrading and rehabilitating the North-South Road Corridor*. In 2023 the government signed a 25-year concession agreement with the MOIC-LN consortium to: (a) upgrade the 327 km highway between Lusaka and Ndola from a single to a dual carriageway, (b) construct a bypass road connecting Luanshya to Masangano (45 km) with bypasses at Kabwe and Kapiri, and (c) operate and maintain the highway.

The development will double the capacity of the highway by 2027 and improve its efficiency, not least by reducing delays caused by slow-moving trucks. Other features include the construction of weigh-in-motion systems at Kapiri Mposhi and Kafulafuta and new toll technology at the toll plazas. The PPP will allow quick completion of the works and ensure maintenance over the lifetime of the concession.

Potential developments in other road corridors include:

- *Trans-Caprivi Corridor.* One potential corridor for exporting copper from the North-Western Province to Walvis Bay in Namibia is the T5 road connection to Kaoma to Mongu Road (M9) and then to the Trans-Caprivi Corridor at Katima Mulilo. Its worst section stretches from Kazungula to Katima Mulilo (138 km). The World Bank is assisting the government in financing a feasibility study and design of the section from Livingstone to Katima Mulilo. First Quantum Minerals and BHL have been conducting maintenance works on the gravel section from Kaoma to Kasempa (D301) to facilitate the movement of copper exports. Zambia is using a PPP approach to upgrade the section from the T5 Road to Kaoma.
- *Kasomeno to Mwenda Toll Road.* In 2016 the government signed a PPP concession agreement with GED Africa Projects to develop and operate this project, which includes the construction of 85 km of the road, a 345 m bridge over the border at the Luapula River, a one-stop border post between the DRC and Zambia, and warehousing and parking facilities. The aim is to provide shorter, more direct links from DRC copper mines towards Dar es Salaam through the Dar es Salaam Corridor and Nakonde.
- *Nacala Corridor (access route for Beira).* The section of the corridor from Luangwa to Mwami Border (T4) was successfully rehabilitated in 2019. A new one-stop border post at Mwami was commissioned in 2022. Development of the section between Lusaka and Luangwa (220 km) is also being planned.
- *Beira Corridor.* Zambia is using a PPP to rehabilitate a 55 km section from Katete to Chanida (Mozambique) and construct a one-stop border post at Chanida. Road construction started in 2024.

4.2.3 The railway system

Railway development is essential for sustainably maximizing the potential of ETM, given rail's comparative advantage in transporting bulk goods over long distances. But inadequate railway infrastructure and rolling stock mean that copper is almost exclusively transported by road, and increased copper mining to meet the government's 3 mtpa target would burden the already fragile roads.

Zambia's two railway networks carry about 18 percent of its freight, and they also serve the DRC. The Lusaka-Dar es Salaam network, operated by the Tanzania-Zambia Railway Authority (TAZARA), connects Zambia with Tanzania. The North-South railway network, running from the DRC to Zimbabwe through Lusaka, is operated by Zambia Railways Limited (ZRL). In 2023 both rail networks sustained losses.

- *TAZARA* was constructed in the early 1970s. Because of inadequate maintenance, transported freight dropped from a design capacity of 5.0 million tons to a record low of 130,000 tons in 2015 (only 5 percent of its capacity). After the introduction of an open access regime, TAZARA increased its total annual tonnage to 360,000 tons in 2018 and about 500,000 tons in 2023, through the engagement of a private sector operator.
- The *North-South Rail Corridor*, operated by the state-owned ZRL, has a design capacity of 6.0 million tons. Without adequate maintenance and investment, the speed and reliability of the system fell, and

it now carries only 880,000 tons per year (15 percent of its capacity). The ZRL estimated its *immediate* recapitalization needs at $250 million to reinstate part of the design capacity.

The rail network faces several constraints:

- *Strong competition from the road sector.* For long-haul international traffic, rail services are both more expensive and slower than road transport. Railway networks are in poor condition and inadequate, and regional interline agreements with neighboring networks, which all face significant efficiency and competitiveness challenges, are similarly inadequate.
- *Slow reform and limited institutional capacity.* Despite being one of the oldest railway systems in Africa, Zambia's railway system and sector need revitalization to improve operational efficiency, the approach to commercialization, and institutional arrangements. The sector has failed to maintain the national and global competitiveness and capacity of the railways.
- *Budget constraints.* The operation and maintenance cost of the large railway system is high relative to the transported tonnage. This, together with weak management practices, has resulted in operational deficits and losses. Years of underinvestment have further undermined system capacity.
- *Climate change* can cause major disruptions. For example, in August 2024 landslides put TAZARA's passenger services on hold for weeks. As with roads, weather events increase the need for and cost of maintenance and rehabilitation and require the development of rapid response capacities.

Rail sector development plans

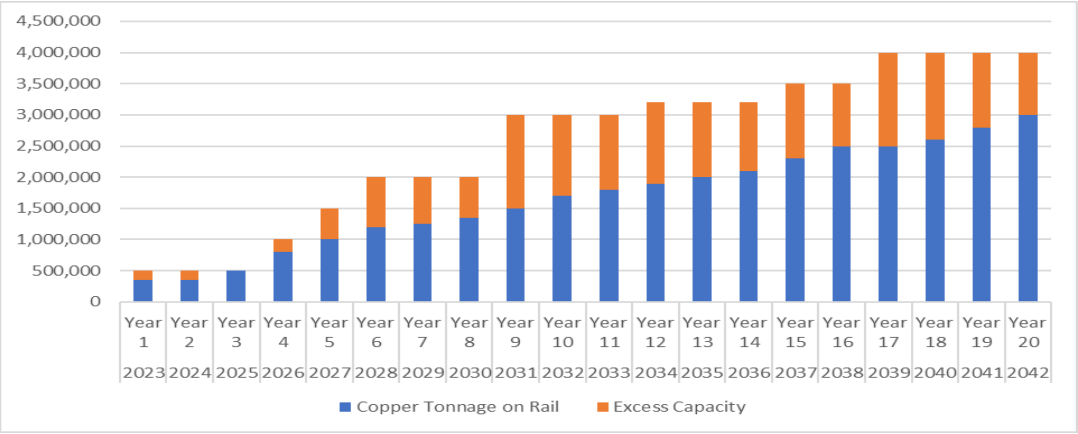
TAZARA development concession. Zambia and the People's Republic of China signed a memorandum of understanding to revive the TAZARA line. TAZARA is negotiating a concession with China Civil Engineering and Construction Corporation to rehabilitate and operate the line. The negotiations remain confidential, but it is believed that a 30-year concession will gradually raise the line's capacity to 2.4 million tons or even higher. Open access will be offered as part of the concession. In the absence of public information, the following assumptions were made about the use of the TAZARA line:

- The concession will be successfully concluded in 2025 and remain in place till 2050.
- A target of 2.0 million tons will be transported in 2028, rising to 3.0 million tons in 2031, assuming a progressive and gradual increase in capacity from 2026 until 2031. Although the target is 3.0 million tons, the rehabilitation and upgrade measures will restore a good share of the rail design capacity beyond this target, possibly as much as 4.0 mtpa by 2039 and close to its design capacity of 5.0 mtpa.
- The open access arrangement will remain in place (based on feedback from TAZARA management).

Based on these assumptions, Figure 4.7 reflects the *estimated volumes of copper* to be transported using TAZARA and the *excess capacit*y of the TAZARA rail system. Any excess capacity would be available for carrying other minerals and cargo (such as agricultural and manufactured products).

Rehabilitating 120 km along the Kapiri to Ndola railway. The government is negotiating, with the same concessionaire as for TAZARA, the possibility of rehabilitating the 120 km between Ndola and Kapiri. This section is important for the success of the TAZARA line, linking it with the Copperbelt region, where over 1.5 million tons move along this section, on both road and rail.

Figure 4.7. TAZARA: Estimated copper volumes and excess capacity, 2023 to 2042



Source: World Bank estimates.

Reforming and recapitalizing the ZRL. The Ministry of Transport and Logistics is leading efforts to reform the railway sector to raise capacity, enhance efficiency, and advance commercialization, starting with the ZRL. The World Bank is financing the preparatory works for the reforms, with the aim of improving performance through better institutional, operational, and commercial models for the ZRL. The government plans to follow the reforms with a program of gradual investment in the ZRL system, starting with a recapitalization of about $250 million. With a well-structured program, these investments could enable the ZRL to gradually reinstate the system to its design capacity of 6.0 million tons per year.

The Lobito Corridor development. This 1,300 km line links the port of Lobito on Angola's Atlantic coast to the town of Luau on its northeastern border with the DRC, near Zambia's North-Western Province. The railway line extends a further 400 km into the DRC to the mining town of Kolwezi. The DRC and Angola have recently concessioned the corridor to a consortium to upgrade the line and operate it. The concessionaire expects to capture more than 40 percent of the import and export cargo flows to and from the DRC's Katanga region, ramping up over 5–10 years. There is a proposal to extend the Lobito Corridor into Zambia for about 800 km, connecting Luau in Angola to Solwezi in Zambia. The Africa Finance Cooperation has commissioned a feasibility study on connecting the North-Western Province to this corridor, with funding from the United States and the European Union. Although the feasibility study has been completed, it has not yet been released to the public. The World Bank estimates the cost of the project to be roughly in the range of $3–$5 billion.

4.2.4 Border crossings and logistics

With eight neighbors, Zambia has many border crossing points. Table 4.7 shows the most relevant crossings for the copper trade. The country has modernized several crossings, converting some into one-stop border posts, and enhanced trade facilitation regimes across the borders and along the key corridors. This has led to notable improvements at the crossing points, but challenges remain in clearance procedures and implementation, where processes are lengthy, and many simplification measures are yet to be applied:

- *Inadequate logistics services industry.* The logistics sector is vital for trade in landlocked Zambia, but the sector is hampered by inadequate infrastructure, high transport costs, and delays at border points. Zambia has not been part of the Logistics Performance Index recently, but its last rating of 2.3 out of 5 (in 2018) highlights the need for improvements in areas such as customs, infrastructure, international shipments, logistics competence, tracking and tracing, and timeliness.

Table 4.7. Border crossings for the copper trade

Border crossing	Country
Nakonde/Tunduma	Tanzania
Kasumbalesa, Mokambo, and Sakania	DRC
Chirundu	Zimbabwe
Chipata	Malawi
Kazangula	Botswana
Katima Mulilo	Namibia

Source: World Bank staff.
Note: DRC = Democratic Republic of Congo.

- *Cross-border inefficiencies.* Cumbersome processes and inadequate facilities at the border crossings hamper transport connectivity. Border clearance documentation and procedures are largely manual (beyond customs), duplicative, and cumbersome, with little coordination among agencies. Zambia does not have a system connecting all relevant border agencies, resulting in long delays. For example, trucks may wait four days at the Nakonde border crossing and even longer at others.
- *The variable quality of border facilities with the DRC results in unbalanced demand and long queues.* The Kasumbalesa border crossing is currently under the Zambia Revenue Authority, but it used to be run as a PPP, and its services were relatively better. Road users strongly preferred this facility, causing long queues. This, coupled with poor road conditions and prolonged clearance procedures in the DRC, meant queues could last for days. Processing a single truck could take as long as a day.

Zambia is implementing several development plans for logistics and other facilities:

- *Nakonde One-Stop Border Post.* Zambia is working with Tanzania to develop this border post and reduce crossing times. Measures include harmonizing border processes to simplify trade procedures. The aim is to replicate these improvements in the other crossings.
- *Solwezi to Kipushi and Border Project.* The development of the border crossing and road rehabilitation are being combined under a single, 25-year concession of about $136 million, which is expected to start in early 2025. Trucks will be distributed by type of freight to smooth demand across the different border facilities. For example, the Solwezi to Kipushi crossing will offer an alternative to Kasumbalesa for copper and other minerals.
- *Ndola-Sakanya-Mufulira concession (border and road):* Another alternative to Kasumbalesa is the Ndola-Sakanya concession with Jaswin Ports Limited Consortium, which includes developing 61 km of the Mufulira-Sakanya-Ndola Road and upgrading the border facility. The total concession amount is $76.13 million, for a period of 22 years, including three years for construction.
- *Lumwana to Kambimba and Border Facilities.* This road connects the North-Western Province to Kolwezi in the DRC, about 145 km, of which 85 km is in Zambia. The new route will avoid Katanga and potentially connect to the ports of Walvis Bay (through the Walvis Bay Corridor), Durban (North-South Corridor), and Dar es Salaam (Dar es Salaam Corridor) via the Nakonde Border Post in Zambia.

4.2.5 Sector-wide conclusion

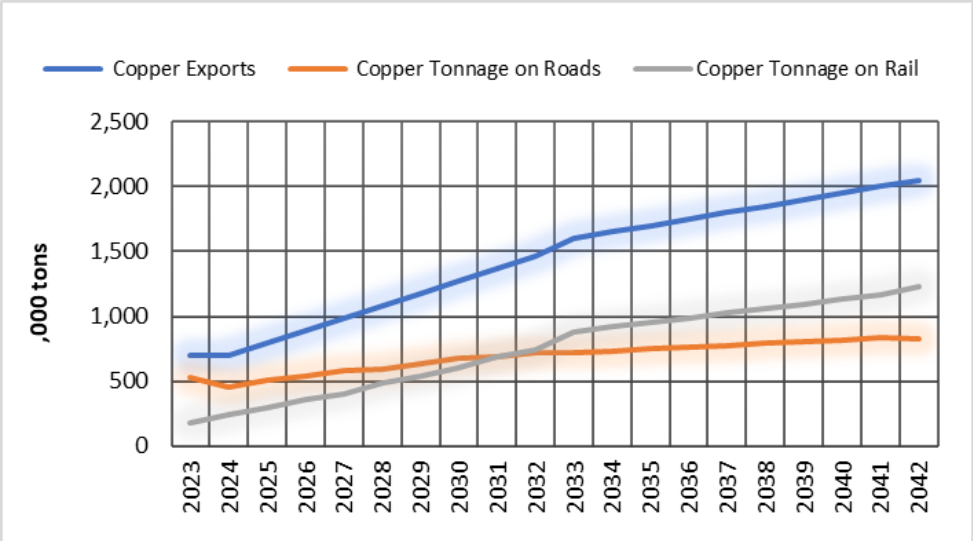
Transport will not be a constraint for moving ETM. Zambia is well connected to several ports, and its transport network is fairly resilient, given the number and geographical divergence of the existing corridors. Although the quality of transport infrastructure and services needs significant improvement, the current capacity and planned additions can handle the projected increase in copper mining, with sufficient spare capacity for transporting other minerals and goods.

However, transport inefficiencies may reduce the competitiveness of the mineral sector by increasing costs. As transport is a significant part of the cost of minerals, this could affect the competitiveness of mineral production in certain areas.

Road infrastructure is likely to remain a key mode of transportation for copper exports for years to come. The growth in freight transport will be absorbed through: (a) higher road capacity, through several ongoing and planned projects; (b) a modal shift of 50 percent of fuel truck traffic from the Dar es Salaam Road Corridor to the TAZAMA pipeline; and (c) better maintenance and damage prevention regimes.

The modal split will change in favor of railways over the next decade. This will primarily be fueled by the new TAZARA concession and improvements to the ZRL link between Ndola and Kapiri, which will significantly increase its operational capacity. Improvements to the TAZARA line will lower the cost of transport, making it more competitive than roads and increasing the modal share of railways (Figure 4.8).

Figure 4.8. Copper exports by road and rail, 2023 to 2042



Source: World Bank analysis.

To optimize the performance of the transport sector, several cross-cutting issues need to be addressed, as per Table 4.8.

Table 4.8. Transport and logistics: Key challenges and recommendations

Key challenges	Recommendations (short, medium, and long term)	Responsible agency
Transport planning and prioritization is weak; rail sector underperforms significantly; key road networks are in poor condition or missing sections; and logistics is costly, hampering competitiveness.	• Develop a planning and prioritization framework to optimize investment in the large and poorly resourced road and rail sectors.	MTL, RDA, TAZARA
	• Accelerate the conclusion of the TAZARA concession agreement and expedite ongoing reform of the rail sector.	MoFNP, MTL, ZRL
	• Develop the enabling environment for PPPs to attract private sector investment in infrastructure at scale.	RDA, MTL
	• Accelerate implementation of key ongoing PPP concessions for major road infrastructure (such as dualling of the Ndola-Lusaka highway and the Dar es Salaam Road corridor) and the TAZAMA pipeline reconfiguration.	PPP units of MoFNP, RDA
	• Harmonize regulations and standards among countries and implement one-stop border posts at key border crossings to harmonize border processes and simplify trade procedures.	MCTI

Source: World Bank analysis. *Note:* MCTI = Ministry of Commerce, Trade and Industry; MoFNP = Ministry of Finance and National Planning; MTL = Ministry of Transport and Logistics; PPP = public-private partnership; RDA = Road Development Agency; TAZAMA = Tanzania Zambia Mafuta oil pipeline; TAZARA = Tanzania-Zambia Railway Authority; ZRL = Zambia Railways Limited.

4.3 Expanding the skilled workforce and seizing employment opportunities

Zambia needs enough workers with the right skills if it is to realize its ETM potential. Although unemployment and underemployment are high,[57] the availability of skilled labor is limited, which could constrain the growth of the mining sector and its benefits to Zambians. Expanding ETM production and processing and, in time, downstream manufacturing and services will create new opportunities for skilled workers. The number and nature of these jobs, and the resulting demand for skills, depend on factors such as the volume of and speed at which production is expanded, its technology and labor intensity, and the scope and nature of the downstream activities.

Although mining is relatively capital-intensive, meeting the GRZ's target for copper production could still see a fourfold increase in mining employment, from 56,000 to 200,000 employees and a further 300,000 indirect and induced jobs.[58] In the *unconstrained* scenario, employment could increase from about 56,000 direct employees and contractors in 2022 to over 200,000. In the *business-as-usual* scenario, the numbers would be 106,000 direct employees and contractors. These numbers exclude indirect and induced jobs.[59] Estimates of job multipliers vary significantly but are generally positive, assuming trade openness and the availability of relevant skills, infrastructure, and other resources (Lopes and others 2023). Using a modest multiplier of 1.5, the economic spillover could result in an additional 160,000 jobs

[57] People are underemployed when they are in low-skill, low-paying jobs, not by choice, or work only part-time because they cannot get full-time jobs that use their skills.

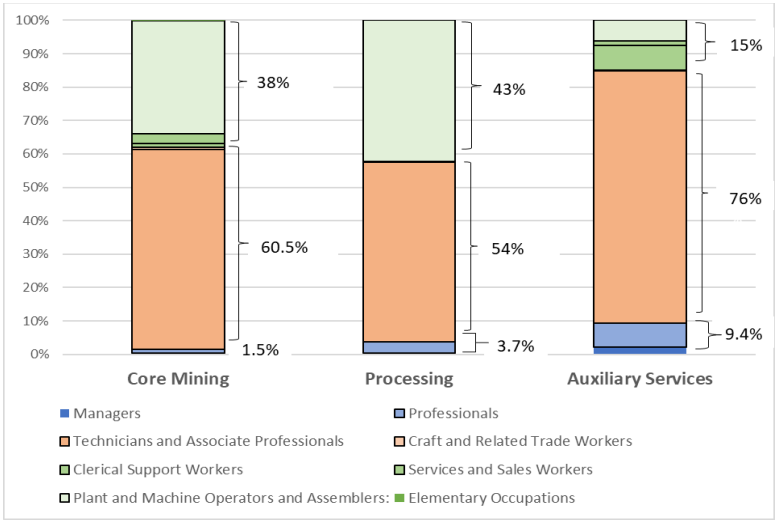
[58] Mining jobs are mostly in core mining activities, with smaller shares working in processing (smeltering) and auxiliary services. Employment data from a large mine in Zambia shows that two thirds of their workers perform core mining activities, which includes among others mining engineering, operations and maintenance, site services, and ensuring health and safety. Around a quarter of workers are active in processing, and the remaining 12 percent perform auxiliary activities in areas such as corporate and commercial affairs, financial and human resource management, and business development.

[59] *Indirect* jobs are generated by companies supporting copper mining and production off-site (such as transport and logistics) or further upstream or downstream from the main projects. *Induced* jobs are created, for example, when people in direct and indirect jobs spend their income on services such as food and housing.

in the *business-as-usual* scenario and 300,000 jobs in the *unconstrained* scenario. Additional jobs could be created through midstream processing and downstream value addition, for which more sophisticated training and skills development support are needed to meet the shortage of skilled people.[60]

Workers in the mining sector are relatively well educated and often employed in occupations that require high or medium skill levels (Figure 4.9). Most workers in core mining (60 percent), processing (54 percent), and auxiliary services (76 percent) are technicians, associate professionals, and crafts or trades workers (orange bars in the figure). They are considered highly skilled, with diplomas (from universities) or advanced certificates (from technical and vocational education and training—TEVET colleges), the equivalent of levels 6 and 5 on the Zambia Qualifications Framework (ZQF) (Table C.1 in Appendix C).

Figure 4.9. Share of workers by category in core mining, processing, and auxiliary services



Source: World Bank analysis based on data from a large mining company in Zambia

Skills development in mining includes firm-specific training on the job and formal qualifications under the ZQF through the universities or the TEVET system. Universities are generally considered to provide a solid foundation of mining and engineering skills, although there are some concerns about quality, and the enrollment of women is low. The Copperbelt University (CBU) and the University of Zambia (UNZA) are deemed to provide graduates with a solid foundation in mining and engineering-related skills, although the recent rapid growth in enrollment may adversely affect the quality of training.[61] Challenges have also been identified at universities in terms of keeping up with the industry's fast-changing technological developments. In contrast, only few of the Zambia's over 300 TEVET institutions are deemed by mining firms to deliver graduates with sufficient skills.[62] Apart from the relatively small number of TEVET graduates focused on mining and the poor quality of training in several public TEVET institutions, an important challenge facing the TEVET system is the small number of graduates with higher-level

[60] For example, in the full battery value chain development (battery cell manufacturing and EV production), a total of 59,000 direct and indirect jobs could be created. Studies by the International Council on Mining and Metals also show that for every $1 generated by mining, at least an additional $3 is generated elsewhere in the local economy, and that for every direct mining employee, as many as 15 more jobs are created elsewhere in that economy. Source: https://www.icmm.com/en-gb/stories/2017/minings-social-economic-contribution.

[61] Enrollment at the CBU schools of engineering and mining rose from about 310 in 2019 to 760 in 2021, and then jumped to 2,400 in 2023, after a policy change that delinked the number of placements from the number of government scholarships; admission criteria have also been relaxed.

[62] An estimated 6,400 students were enrolled in TEVET programs related to mining in 2023, but only about 3,800 were in institutions "preferred" by mining companies. These training providers tend to be in urban areas or relatively close to the mining hubs (Copperbelt and Solwezi) and tend to offer courses that are more specific to mining, such as process instrumentation and plant fitting.

qualifications (ZQF levels 4–6). In addition, several studies have documented the poor quality of training in some public TEVET institutions: curricula are not aligned with industry needs; instructors lack up-to-date theoretical knowledge and practical skills; students have limited opportunities to benefit from work-based learning; and equipment and learning materials are insufficient and outdated. Overall, collaboration between TEVET providers and mining firms seems limited.

Table 4.9 outlines key challenges and recommendations related to employment and skills development.

Table 4.9. Employment and skills: Key challenges and recommendations

Key challenge	Recommendation	Responsible agency
Policy making undermined by weak data on mining-related jobs and skill requirements	• Adopt a workforce development strategy for the ETM agenda, including a detailed implementation plan, budget, and M&E framework. As developing a skilled workforce takes time, this process should start immediately. • Develop a TEVET management information system to allow policy makers and training providers to plan effectively. • Improve data on skills demand and supply to inform well-targeted interventions.	TEVETA HEA MOTS
Insufficient opportunities for high quality technician and artisan training (ZQF levels 4–6)	• Offer incentives for industry-provider collaboration to close critical gaps in technician and artisan training, including providing public financing (direct or vouchers) for industry-led training to expand access. • Concentrate the delivery of high-quality, relevant programs in one or more centers of excellence operation by or with industry. • Introduce opportunities during the school term for a cohort of students to benefit from work-based learning (co-op programs) between semesters. • Support the establishment of a joint training center or joint training programs involving both government and multiple mining companies.	MLSS TEVETA
Quality and relevance gaps in university education for mining and engineering	• Urgently address any quality gaps arising from the rapid increase in enrollment in mining and engineering programs at UNZA and CBU. • Focus on modernizing mining and engineering programs to include the use of new technologies in mining. • Offer new courses for professionals who can contribute to the technological transformation of the mining industry, such as automation engineers, robotics technicians, data analysts, artificial intelligence specialists, maintenance technicians, and cybersecurity experts.	MLSS MOTS HEA
Insufficient local Zambians with the required skills in mining/engineering	• Several highly skilled Zambians work in mining companies globally. The growth of the local mining industry offers an opportunity for these Zambians to return to their country, provided the pay and benefits are competitive. • The government could consider incentives such as lower income taxes for highly skilled Zambian workers for 7–8 years, as some countries in Europe offer.	MLSS Foreign Affairs
Limited participation of women and young people in the mining industry	• Increase awareness among young people and women about mechanization and automation in mining, which both improve safety and reduce physical workloads. • Work with mining companies to improve social responsibility to workers and communities and ensure access to psychosocial support if needed. • Improve gender equality and hire more women in managerial and professional roles to help attract more women to the profession.	MLSS

Source: World Bank analysis. *Note:* CBU = Copperbelt University; ETM = energy transition minerals; HEA = Higher Education Authority; M&E = monitoring and evaluation; MLSS = Ministry of Labour and Social Security; MOTS = Ministry of Technology and Science; R&D = research and development; TEVETA = Technical Education, Vocational and Entrepreneurship Training Authority Zambia; TEVET = technical and vocational education and training; UNZA = University of Zambia.

5. CHAPTER 4: ADDRESSING ENVIRONMENTAL AND SOCIAL RISKS AND ENHANCING SUSTAINABILITY

KEY MESSAGES

- Despite its long mining experience, Zambia's environmental and social governance are weak. The Zambia Environmental Management Authority (ZEMA) faces significant capacity constraints (such as staffing, institutional capacity, regional presence, and laboratory equipment).
- The government's ambitious vision of scaling up mining and value addition would leave ZEMA even more constrained. Urgent actions are needed to capacitate it. In addition, coordination between ZEMA and the Mine Safety Department (MSD) at the Ministry of Mines and Minerals Development is important to ensure alignment and collective enforcement of regulations. Coordination with the MRC, once operational, will also be required to facilitate permitting and licensing.
- Zambia's copper production currently has low carbon footprint and is seen as a market of choice. With the new government ambition in mining, the projection is that Zambia's ETM production will increasingly become more carbon intensive. Significant increases in expected emissions will undermine Zambia's ability to remain a competitive market of choice.
- Zambia needs to adopt an emissions reduction strategy for the mining sector and mainstream its implementation. A combination of regulatory measures and incentive mechanisms could be used to promote implementation.
- In terms of institutional governance, it is important for various policies, laws and regulations pertaining to land use, water, environment, and human health and safety to be well aligned and their implementation fully coordinated. Moreover, alignment between national and local policies and regulations, public financial management, and intergovernmental fiscal transfers is important to ensure that local authorities and communities are the center of their socioeconomic development planning and realization.

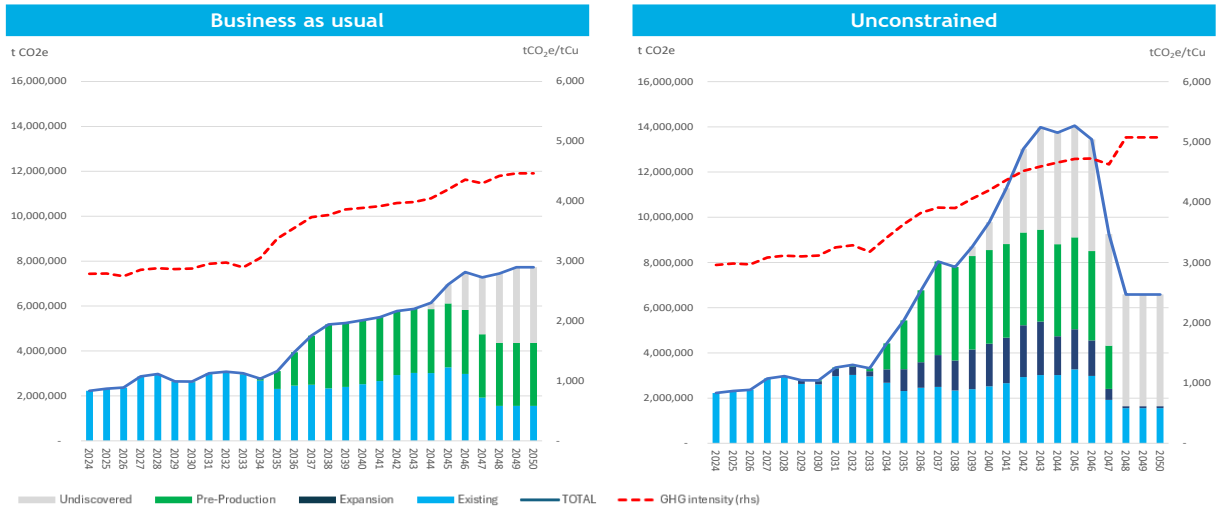
5.1 Towards net-zero mining and a supplier of choice

Rising energy demand is likely to be accompanied by rising greenhouse gas (GHG) emissions and the declining carbon-competitiveness of Zambia's mining sector. Both the World Bank's business-as-usual and the unconstrained scenarios assume an unchanged energy mix. Total sector greenhouse gas emissions would quadruple in the business-as-usual case and increase by seven times in the unconstrained case (Figure 5.1) from a combination of higher electricity use and the liquid fuels used to power mining fleets. The growing carbon footprint of mining will make it more difficult for Zambia to achieve its Nationally Determined Contribution under the Paris Agreement.

Zambia does not currently have a carbon emissions strategy for the mining sector. Companies are not required to introduce shadow prices for carbon emissions in their feasibility studies nor are they required to provide greenhouse gas projections in the environmental and social impact assessments or to explore the best available technologies to avoid emissions. The significant increase in expected emissions will undermine Zambia's ability to remain competitive and be a market of choice (Figure 5.2). With carbon border adjustment mechanisms (CBAM) becoming more common, higher emissions jeopardize the

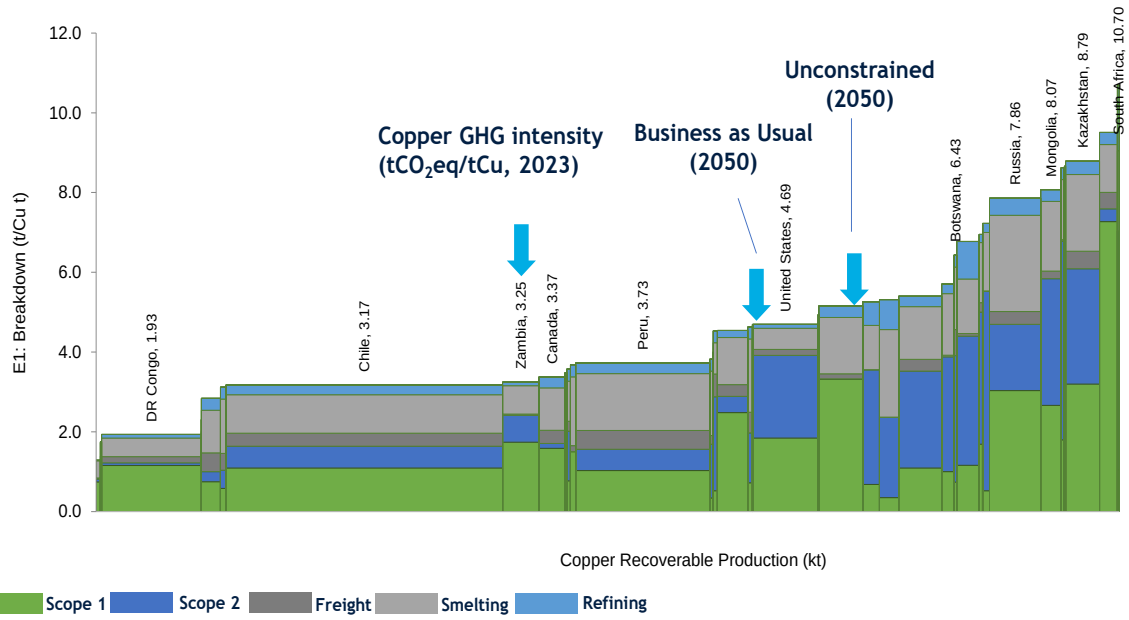
attractiveness of Zambia's copper.[63] To mitigate this, the government should focus on decarbonizing the sector, with a back-up plan of levying a local carbon tax equivalent to the carbon price in the CBAM. These strategies should be implemented in parallel to benefit from synergies.

Figure 5.1. Greenhouse gas emissions from mining under different scenarios, 2024 to 2050



Source: World Bank projections. *Note:* GHG = greenhouse gas.

Figure 5.2. Carbon competitiveness of Zambian copper production, 2023 and 2050



Note: ^ From 2021 to 2023, Zambian copper's carbon competitiveness has shifted from 1st quartile, to 2nd quartile as Chilean producers have taken more "climate action". This is despite minor improvements in its emissions intensity. Source: Skarn (2023)

Source: World Bank projections. *Note:* GHG = greenhouse gas.

[63] Companies selling products made with Zambian copper will need to pay the CBAM in the final importing countries. Ultimately this will result in a lower price offered for Zambian copper. As the tax paid in the final importing country is not refunded to the copper-producing country, it effectively transfers Zambia's mineral wealth to the importing country.

5.2 Environmental, social, and governance risks

The global energy transition offers Zambia a unique opportunity to leverage its rich ETM resources for broader socioeconomic development, but it will be crucial to ensure that the extraction of ETM follows sustainable development principles that safeguard the environment, local communities, and the safety of workers. Box 5.1 summarizes some of the environmental, social, and governance (ESG) risks associated with ETM extraction and processing.

Box 5.1. Environmental, social, and governance risks associated with ETM extraction and processing

Mining activities, if not done correctly, could lead to heavy environmental and social impacts.

- *Dispossession, exclusion, and conflict* often result from mining activities without appropriate *social license to operate* from local communities and stakeholders. Adopting appropriate community development agreements that are based on an inclusive, transparent, and fair share of benefits (including land compensation) are key to successful mining operations.
- High *water consumption* in mining contributes to water stress and affects local ecosystems and communities. Advanced technologies, like water recycling and closed-loop systems, should be prioritized to reduce pressure on local water resources.
- *Deforestation* because of land clearing for mining leads to biodiversity loss and habitat disruption, as happened in areas like Kitwe and Mufulira.
- Mining activities could lead to heavy water and soil pollution. Effective *waste management* is essential to prevent land and water pollution, which affects both ecosystems and communities.
- Mining operations contribute to high *greenhouse gas emissions*, both directly and indirectly through nonrenewable energy sources. Decarbonizing the mining sector by integrating renewable energy sources can help reduce its carbon footprint.
- The *supply chain risks* associated with the production of energy transition minerals (ETM), from extraction to transportation, and present environmental and social challenges. Supply chain transparency, using blockchain and other digital solutions, could help mitigate these risks.
- The mining industry is vulnerable to *climate change* impacts, such as extreme weather events and changes in water availability. In towns in the Copperbelt, like Kitwe, extreme weather combined with weak infrastructure could lead to flooding and water pollution from tailings. Climate-resilient infrastructure and operations, including water management systems that account for rainfall variability and drought, are essential.
- In terms of *governance*, both sectoral (such as mining-related *policies, regulations and institutional framework*, Chapter 1) and broad economy-wide issues, such as appropriate mining *revenue collection and its management* will have significant implications for the social, economic, and environmental well-being of Zambia. For example, public procurement and financial management will dictate how mining revenue is collected and utilized in the broader economy, affecting how communities and citizens benefit (or not) from the nation's ETM resources, leading in some cases to disharmony and conflict between communities and environmental damage from investments supported by revenues generated from mining.

Sources: AfDB 2022a; Copperbelt University 2020; IEA 2021; IISD 2021; IRENA 2020; ZCM 2021; Zambia, MWDS 2021; Zambia, MMMD 2023; ZEITI 2023; ZEMA 2019.

Without appropriate ESG risk mitigation measures, the net benefits from mining investments could be significantly undermined. Compliance with ESG matters can also affect a company's ability to obtain operating permits, raise capital, attract talent, and work with host communities and regulators. For example, legacy mining operations in Zambia have created severe environmental and health risks (CBU

2020; see also Box 5.2). In municipalities like Kitwe, Mufulira, Chingola, and Kabwe, pollution from smelters, tailings dumps, and mining waste contributed to air and water pollution, affecting soil, crop yields, and water quality (ZCM 2021). Kabwe is a cautionary example of unchecked mining, with dangerous levels of lead and zinc still affecting local populations. Tailings dumps in these areas continue to contribute to heavy metal contamination. In the Copperbelt province, copper and cobalt concentrations in soil and water far exceed acceptable levels, posing serious risks to local communities.[64]

Box 5.2. Cleanup costs related to mining contamination

The cost of environmental cleanup in developed regions, such as the USA and Europe, is significantly higher than in developing countries, because of more stringent environmental regulations, the use of advanced cleanup technologies (including bioremediation and soil washing), and higher labor and operational costs.

- The *2015 Gold King Mine spill in Colorado, USA*, released 3 million gallons of toxic waste into the Animas River, polluting water bodies with heavy metals and acid mine drainage. The total cleanup cost reached $44 million, and over 10,000 residents were affected.[a]
- *Germany's brown coal (lignite) mining* has led to deforestation and water table disruption, affecting local ecosystems and communities. The cost of reforestation and water table restoration is estimated at $500 million. Additionally, the loss of biodiversity and ecosystem services has had long-term economic and environmental impacts. Over 50,000 residents face water shortages and ecological degradation because of mining activities.
- *Zambia's Copperbelt Province* has experienced severe contamination from decades of copper and cobalt mining. Tailings and smelting operations have led to heavy metal pollution in soil, water, and air, affecting over 300,000 residents along with local ecosystems. The estimated cleanup cost is $100 million, with an additional $200 million in health and social costs. The contamination has led to health issues such as respiratory illnesses and skin diseases, as well as long-term environmental degradation. Children are particularly vulnerable, experiencing high levels of lead poisoning.
- *Artisanal gold mining in Tanzania* has led to mercury contamination (miners use mercury to extract gold) in water bodies, contaminating drinking water and aquatic ecosystems and causing neurological disorders and developmental issues. Cleanup efforts are estimated at $50 million, with economic losses of $20 million because of the loss of aquatic biodiversity and damage to fisheries. Over 1 million residents are exposed to mercury contamination, making this a critical public health issue.
- *Uganda's Albertine Graben oil exploration* caused extensive deforestation and water contamination, disrupting ecosystems and local agriculture and contaminating water sources. The environmental damage has affected local communities that rely on these resources for agriculture and fishing. Restoration and compensation costs are estimated at $150 million, with over 500,000 residents affected; many lost their livelihoods.
- In *Kenya's Mui Basin*, coal mining has resulted in air pollution and soil erosion, severely affecting agricultural productivity. Coal dust and emissions from mining operations have contributed to respiratory illnesses in local communities. The cost of rehabilitation efforts for degraded land and addressing health impacts is estimated at $30 million, and economic losses from reduced crop yields amount to $10 million. Over 200,000 residents in the Mui Basin suffer from respiratory diseases because of coal dust exposure ().

Sources: Kenya, Departmental Committee on Energy 2019; Kinyondo and Huggins 2021; Ogwang and others 2018; OHCHR 2021; World Bank 2020. *Note:* a. For more information, see the EPA (United States Environmental Protection Agency) website "Emergency Response to August 2015 Release from Gold King Mine" at https://www.epa.gov/goldkingmine.

[64] The production of copper creates large quantities of mine waste; for instance, in Zambia producing one ton of copper generates 20–140 tons of waste, possibly even more, depending on the copper content in the ore. Large areas of land are affected by mining waste, with an estimated 10,000 hectares covered with about 791 million tons of tailings material. About 388 hectares contain about 77 million tons of waste rock, and 279 hectares are covered by around 40 million tons of slag. About 20,646 hectares of land in the Copperbelt Province alone hold about 1,899 million tons of mining waste (Lindahl 2014).

5.2.1 Institutional governance and regulatory challenges

Zambia's regulatory framework for E&S management, although extensive, faces significant implementation challenges. Gaps between regulatory frameworks and enforcement hinder the effective management of these impacts (ZCM 2021). Zambia has a robust legal framework to govern E&S impacts, with legislation such as the 2011 Environmental Management Act and the 2008 Mines and Minerals Development Act setting out environmental obligations for mining companies. However, monitoring and enforcement remain weak because of insufficient financial and human resources.

The Zambia Environmental Management Agency (ZEMA) is the primary body responsible for monitoring compliance with these regulations, particularly through environmental impact assessments, but it struggles to conduct regular inspections and ensure that environmental management plans are followed. A lack of timely intervention, inconsistent enforcement, and administrative inefficiencies contribute to environmental degradation and social conflict (ZCM 2021).

Increased mining activity without corresponding regulatory oversight risks creating new environmental hazards (UNDP 2020). Local communities report that enforcement tends to be inconsistent, and in some cases, operations can bypass regulations through corruption or because of administrative bottlenecks. Without stronger enforcement, Zambia risks severe environmental degradation and social harm as the mining sector expands. Corruption and regulatory capture also undermine its ability to fully realize the benefits of its mineral wealth (TI-Z 2022). Zambia must take urgent action to avoid the E&S impacts of mining overwhelming the regulatory framework (AfDB 2022a). Steps include:

- *Strengthening ZEMA and other regulatory bodies* with more funding, staffing, laboratory equipment, and technical training to better monitor and enforce compliance with environmental regulations and enhancing their coordination.
- Closely *engaging local communities* in decision-making processes, strengthening mechanisms for addressing grievances, and ensuring fair compensation to help avoid conflict.
- Focusing on *corporate social responsibility* and ensuring the equitable distribution of mining benefits to reduce tensions between local communities and mining companies (UNDP 2020).

5.2.2 Environmental and social legislation in the mining sector

Although Zambia has a structured framework for E&S regulation in mining, this could be strengthened and better aligned with international good practices (Table 5.1).[65] For instance, international good practice emphasizes the need for stringent and regularly updated regulations to address emerging concerns, along with robust enforcement mechanisms, better coordination among regulatory agencies.

[65] This section draws on the Zambia Mining Environmental and Rehabilitation Improvement Project (ZMERIP), the World Bank's assessment of Zambia's environmental and social legislation (Zambia, MMMD 2021).

Table 5.1. Regulatory misalignment and constraints in ETM mining

Constraint	Description
Environmental impact management	The current Environmental Management Act and its related framework is better suited to traditional mining and lacks detailed technical guidance on issues such as mine closure and rehabilitation.
Water stress	Expanding mining activity is likely to worsen water stress in the Copperbelt and North-Western provinces, which already face high water consumption from existing mines.
Waste management and GHG emissions	The legal framework lacks clear, specific targets and enforcement mechanisms aligned with global standards in areas such as the disposal of hazardous materials, managing industrial waste, and the adoption of cleaner technologies to lower GHG emissions.
Policy and regulatory gaps	ETM extraction involves distinct challenges such as extracting minerals from more dispersed deposits, using complex chemical processes like acid leaching, and having higher energy demands. Without clear regulations tailored to ETM—such as managing toxic waste, minimizing water use, and reducing the carbon footprint—Zambia may face intensified E&S challenges. Related regulatory uncertainties could delay investment and reduce operational efficiency.
Regulatory and bureaucratic delays	Delays in processing permits and approvals significantly affect investment in mining and could lead to operational inefficiencies and missed economic opportunities, as shown by the delay in passing the new Mines and Minerals Development Bill, which includes better regulation of ETM.
Enforcement challenges	Resource and capacity constraints in the regulatory agencies hinder the effective enforcement of environmental regulations. ZEMA and other overseeing agencies have limited staff numbers, and their personnel often lack the specialized training needed, especially for ETM. ZEMA also faces infrastructural and technological challenges, as regional offices and laboratories lack well-equipped laboratories and specialized equipment for testing hazardous materials, such as heavy metals in tailings dams and the toxic components in mine waste. The widespread deposition of mine waste across the Copperbelt region complicates monitoring, leading to some inspections being postponed or cancelled. This means noncompliant mining operations may continue without facing immediate repercussions, leading to long-term environmental damage.
Alignment with international standards	Relative to other countries, Zambia's frameworks often fall short in addressing emerging environmental concerns and social impacts. Advanced mining processes, such as acid leaching, pose substantial risks of water contamination that threaten both ecosystems and community water sources. Habitat destruction from mining and agricultural expansion leads to biodiversity loss, necessitating enhanced protective measures. Social impacts, such as the displacement of communities from large-scale infrastructure and mining projects, call for more robust resettlement and compensation frameworks. Regulations also fall short of international good practices in areas such as the emerging health risks from exposure to hazardous material and the need for transparent supply chains to ensure ethical sourcing of minerals.
Environmental and social compliance	There is a significant gap in compliance with environmental and social regulations, particularly in waste management, air emissions, and water pollution. Outdated infrastructure may exacerbate mining companies' noncompliance with environmental and mining legislation, which increases the risks to the environment and the health of surrounding communities.

Source: World Bank analysis, drawing on AfDB 2022a; Copperbelt University 2020; IEA 2021; World Bank 2021; Zambia, MMMD 2023; ZCM 2021; ZEMA 2019, 2021.
Note: E&S = environmental and social; ETM = energy transition minerals; GHG = greenhouse gas; ZEMA = Zambia Environmental Management Agency.

5.2.3 Governance risks

Sectoral governance risks (such as mining policies, regulations, and institutional frameworks) are discussed in Chapter 1; this section focuses on governance risks in the broader economy stemming from any misalignment between mining policies and other policies or any mismanagement of mining revenues.

Zambia has three main guiding frameworks for mining sector management: (a) an overarching national *policy* framework to promote mining's contribution to national development objectives;[66] (b) a *legal* framework that tasks agencies with mandates to perform the duly divided roles and responsibilities; and (c) the *sector* organizational structure. Although the frameworks appear sound, the cascading from the three levels (policy-legal-organization) has several gaps and carries many risks that undermine the sustainability of the sector and its role in the economy.

Complex legal frameworks and overlapping jurisdictions

Overlapping legal frameworks create a complex regulatory environment, which leads to inconsistencies in land use decisions and enforcement.

- The 1995 Lands Act requires presidential consent for land transactions, which can cause delays in land allocation and management. The Kitwe City Council, for example, faces delays in obtaining presidential consent for land allocation, which hinders local development projects.
- The 2019 Local Government Act decentralizes land use authority to local governments.
- The 2015 Mines and Minerals Development Act regulates mining rights and operations, requiring mining companies to obtain surface rights from landowners or lawful occupiers and consent from local authorities for mining on customary land.

Complex land and mineral rights in the mining sector present significant challenges for local authorities, mining companies, and communities. The centralized authority under the Lands Act often clashes with the decentralized, locally responsive mechanisms outlined in the Local Government Act and the mining rights regulated by the Mines and Minerals Development Act. Local councils have limited control over land occupied by mining operations, given the overriding powers granted to mining companies under the Mines and Minerals Development Act. For example, in Mufulira, mining operations occupy 16 percent of the district's land area, and in Chingola, they occupy 21 percent. As mining companies hold both surface and underground rights, such significant land occupation undermines local authorities' ability to manage land use. It restricts urban development and limits the availability of land for housing, infrastructure projects, and other community needs, potentially stifling the growth and development of mining towns. It also undermines the ability of local authorities to address E&S concerns associated with mining operations. Land degradation, pollution, and community displacement may not be effectively managed without adequate oversight and coordination.

The overlapping jurisdictions of the MMMD and ZEMA contribute to inconsistent enforcement of mining regulations and conflicting directives, which reduce regulatory efficiency and compliance. The legacy of lead contamination in Kabwe is a clear example of regulatory overlap and miscommunication. The MMMD is responsible for granting mining licenses, and ZEMA oversees environmental regulations. However, inadequate coordination between them has allowed mining activities to continue without comprehensive environmental impact assessments, exacerbating lead pollution and posing severe health risks to local communities. Their conflicting requirements and procedures also result in project delays. The process of obtaining an environmental impact assessment involves both the MMMD and ZEMA. For

[66] See Government of Zambia (2006); Zambia, MMMD (2022, 2024); Zambia, MoFNP (2022).

instance, while the MMMD may approve a mining license, ZEMA may still be conducting an environmental impact assessment, leading to delays for stakeholders or even contradictory decisions.

Balancing mining and community interests

The frameworks do not provide guidance on resolving the main conflicts facing the sector, the first of which is *balancing the mining sector's objectives and business models with community interests*. One of the principles for mining is developing local communities in mining areas by prioritizing their needs, health, and safety. However,

- *Zambia has neither strict requirements for supporting sustainable local development nor a body responsible for tracking the realization of such objectives.* Complaints of local communities are handled in part, with no clear mechanism to escalate them.
- *Community participation in decision-making processes is limited*, with a lack of genuine involvement. For example, in Solwezi, insufficient engagement has left a significant gap between mining operations and community benefits, which caused dissatisfaction and mistrust. Genuine involvement requires mining companies and authorities to actively seek and incorporate community input into their planning and operational decisions.
- *Many local authorities lack effective mechanisms for consultation.* Some simply disseminate information without gathering feedback, leading to disenfranchisement and mistrust. Robust, two-way consultation mechanisms are essential for addressing community concerns and giving them a meaningful role in decision-making. The multi-stakeholder group approach of the Extractive Industry Transparency Initiative (EITI) provides a platform for open dialogue involving communities, governments, and mining companies.
- *Communication barriers between mining companies, local authorities, and communities are significant.* For instance, the community may not understand technical mining terms, which hinders effective engagement. There are often no platforms where communities can easily communicate with authorities and companies. Overcoming these barriers requires simplifying communication, using local languages, and creating accessible and inclusive platforms for dialogue.
- *Fragmented on-the-ground sector management erodes benefits for local communities.* Many actors engage with mining companies separately, but their internal collaboration is weak, and their actions not coordinated. No agency takes responsibility for the integrated picture.

Mining companies do promote local community development through corporate social responsibility initiatives. For instance, in 2014–19 First Quantum Minerals, one of the top 10 copper-producing companies globally, invested $3.2 million in West Lunga, under a memorandum of understanding with the Department of National Parks and Wildlife. This covered recruitment, training, equipment, and pay for wildlife rangers; vehicle maintenance and transport; infrastructure development; and conservation-related livelihood programs in surrounding communities. As of 2019 First Quantum Minerals, through a public-private community partnership, has been working to restore West Lunga to a complete, functioning ecosystem to boost ecotourism and provide sustainable livelihoods for local communities. It also introduced electrical trolley assist technology that lowered diesel consumption, saved on maintenance, increased productivity, and reduced carbon dioxide emissions (Chipangamate and others 2023).

Balancing state and private sector objectives

Zambia's strategic documents indicate that private companies should be client-centered, which would entail a new business model; however, public agencies continue the legacy management model. The legal framework clearly spells out the rights and obligations of mining and non-mining rights holders, how information should be handled, and the modernization of business processes. But although the framework looks consistent, the approval process for key decisions is highly diluted, with no clear responsibility or accountability; this creates loopholes for corruption.

There is limited appreciation of the role of business enablers. Overlapping responsibilities among regulatory bodies can hinder the effective implementation of standardized processes. Challenges include (a) redundant processes, with multiple agencies requiring similar documentation; (b) overlapping jurisdictional responsibilities, for instance between the Mine Safety Department (MSD) of the MMMD and ZEMA; and (c) inconsistent enforcement, because agencies differ in their interpretation of regulations.

Data and information weaknesses

Limited data and information create a risk to good management of the mining sector. The establishment of comprehensive information platforms faces constraints such as limited appreciation of information in the public sector, fragmented reporting practices, the need to review business processes, and a lack of investment in technology in the sector. This undermines effective monitoring and evaluation.

Although the legal framework requires detailed data from mining companies,[67] **data disclosure in the sector is weak.** Despite Zambia's commendable achievements in EITI compliance, and the good work of the Mineral Output Statistical Evaluation System (Moses) project, disclosure around stakeholder engagement, reporting, beneficial ownership, revenue management, and environmental and social impact assessments could be strengthened.

Data and information processing should be managed systematically through (a) advanced data analysis; (b) reporting on performance metrics, disseminated to stakeholders in an accessible format; and (c) mainstreaming sector strategic objectives into national systems. However, achieving the objectives of the National Critical Minerals Strategy will require substantial investment in technology, professional development and training, infrastructure, and human capital development, along with consistent funding and strategic oversight for research and development. Given the country's constrained fiscal position, exploring alternative funding mechanisms, such as international grants, loans, or development aid for green energy and sustainable mining practices, is imperative.

Underutilization of oversight systems

Implementation challenges undermine the role of the Business Regulatory Review Agency. The agency is mandated by the 2014 Business Regulatory Act to conduct regulatory impact assessments on proposed and existing acts and regulations to evaluate their impact on the business environment. This mandate ensures that all such rules are aligned with national goals and do not impose unnecessary burdens.

[67] Companies need to submit annual financial reports, semi-annual progress reports on reconnaissance, rehabilitation and mine closure annual reports, employment and training annual reports, procurement plans and local content reports, for example.

Despite this clear mandate, many ministries and agencies do not consistently submit proposed regulations and acts to the agency, leading to the implementation of regulations that may not have been thoroughly evaluated. The MRC Bill is a good example of the need for a thorough impact assessment (Box 3.8). The bill was not subject to a regulatory impact assessment before adoption. Moreover, in addition to revenue leakages discussed previously, the Auditor General's 2017 compliance audit on contract granting in the mining sector found inconsistencies in the process of awarding mining rights and noted the destruction of the environment by the illegal miners.

Table 5.2 summarizes key challenges and recommendations related to E&S risks and sustainability.

Table 5.2. E&S: Key challenges and recommendations

Key challenges	Recommendations	Responsible agency
ZEMA is poorly equipped to manage environmental and social risks, and coordination with local government and communities is weak or nonexistent; overlapping jurisdictions between ZEMA and others lead to inconsistent enforcement of regulations.	• Capacitate ZEMA through staffing, further training, regional offices, and a well-equipped laboratory. • Ensure ZEMA works closely with local government, communities, and law enforcement agencies in monitoring and enforcing regulations. • Provide clear and consistent roles and responsibilities for ZEMA, the MSD, the MRC, and the RPA in regulations to operationalize the Environmental Management Act and the MRC Act.	ZEMA MGEE, local governments, communities MMMD (MSD, MRC), RPA
Legacy mines remain open and are not safely rehabilitated.	• Develop and adopt a national mine closure and rehabilitation plan; operationalize the Environmental Protection Fund and link compliance with the transfer of mining licenses.	ZEMA MMMD (MSD, MRC)
Zambia lacks a carbon emissions strategy for the mining sector.	• Develop a carbon emissions strategy for the mining sector. • Mainstream decarbonization in mining development plans (including feasibility studies and environmental and social impact assessments).	ZEMA MRC MMMD
Overlapping jurisdictions between ZEMA and MMMD lead to inconsistent enforcement of regulations, reducing regulatory efficiency and compliance.	• Provide clear and consistent roles and responsibilities for ZEMA, the MSD, and the MRC in regulations to operationalize the Environmental Management Act and MRC Bill. • Ensure ZEMA coordinates closely with the MSD and the MRC (once operational).	ZEMA MMMD (MSD, MRC)
Oversight systems are underutilized.	• Strictly enforce the 2014 Business Regulatory Act to conduct regulatory impact assessments. • Enforce implementation of findings by the Auditor General.	BRRA OAG
Overlapping legal frameworks (between the lands, local development, and mining acts, for example) create a complex regulatory environment.	• Clarify application and superiority of key legal frameworks that have overlapping applications.	MLNR, MLGRD

Source: World Bank analysis.
Note: BRRA = Business Regulatory Review Agency; MGEE = Ministry of Green Economy and Environment; MLGRD = Ministry of Local Government and Rural Development; MLNR = Ministry of Lands and Natural Resources; MMMD = Ministry of Mines and Minerals Development; MRC = Minerals Regulation Commission; MSD = Mine Safety Department; OAG = Office of the Auditor General; RPA = Radiation Protection Authority; ZEMA = Zambia Environmental Management Authority.

6. CHAPTER 5: ROADMAP IMPLEMENTATION

This section focuses on a priority set of actions needed to operationalize the roadmap, along with a clear accountability framework. It quantifies the financial resources needed to implement the roadmap and identifies alternative financing options. It also highlights the collaboration needed at regional level to benefit from scale and regional value chains.

6.1 Priority actions needed to operationalize the roadmap

Whereas previous chapters provided key recommendations that need to be implemented to achieve Zambia's ETM vision, this chapter focuses on priority recommendations that must be implemented immediately (within a year), in the short term (1–2 years), and in the medium-term (3–5 years). These priority recommendations, summarized in Table 6.1, are identified based on importance, urgency, and ease of implementation. Some actions must be taken before others can start; this is considered in the identification of these priority list.

6.2 Fit-for-purpose institutional framework for implementation

Successful implementation of the roadmap requires a whole-of-government approach with clear roles and responsibilities and a defined coordination framework and accountability matrix. Although individual ministries and agencies will remain responsible for implementing recommendations that fall within their respective mandates,[68] they would require significant additional resources to enhance their implementation capacity and capability.[69] Table 6.2 identifies relevant ministries or agencies that should take the lead in operationalizing the priority recommendations. More importantly, an overall coordination mechanism and accountability matrix should be established to ensure timebound actions are taken to avoid delayed decisions and uncoordinated actions.

The Ministry of Finance and National Planning, the Presidential Delivery Unit (PDU), and the Cabinet Office have overarching responsibilities and could be empowered to perform coordination roles to ensure that all actions are implemented as planned, with a framework to monitor progress and correct course when needed. For example, the PDU could be supported to develop a monitoring and evaluation framework and provide regular updates on progress, whereas the Cabinet Office and the MoFNP could be empowered to perform the coordination role. The Public-Private Dialogue Forum (PPDF) is another important multistakeholder platform to provide structured, participatory, and inclusive public-private engagement on policy matters to address market failures hindering the private sector.

[68] For example, the MMMD for actions related to mines; the ZRA for minerals revenue management; and the ministries of transport and energy for transport and logistics and energy, respectively.

[69] For instance, the mining sector must be ready and open for business to attract private capital to enable the scaling up of copper production to 3 mtpa; the power sector should provide cost-competitive and reliable power in a timely manner; and the transport and logistics sector must provide adequate freight capacity to move goods around competitively. The education and skills development sector should provide enough skilled people to meet demand; and ZEMA and MSD should offer adequate and timely services to ensure environmental, social, safety, and health issues are addressed. The financial sector must match demand and make affordable finance available to MSMEs. The ZRA must be equipped to set standards and guidelines and manage revenue collection to maximize benefits for Zambia.

Table 6.1. Summary of high-impact recommendations and responsible agencies

Focus area	Subtheme	Recommendation	Responsible agency
Scaling production	Improve geological data	Digitalize existing geodata.	MMMD
		Expedite ongoing national geological campaign.	MMMD
		Disseminate historical and new geodata online.	MMMD
		Investment promotion campaign (definition of strategy and execution).	MMMD
	Reform mining cadaster	Clean up mining cadaster.	MMMD
		Fully digitalize mining cadaster (mapping and codification of workflows, online interface, online payments).	MMMD
	Mining policy development	Prepare regulations for the MRC Act and the Geological and Minerals Development Bill.	MMMD
	Operationalize the MRC	Set up MRC governance, including legal and operational autonomy; mandate and scope of responsibilities; and operations and composition of the board.	MoFNP & MMMD co-lead with members incl. MoJ, PDU, ZRA, Chamber of Mines
		Ensure the provision of facilities, staffing, capacity building, equipment, and data and information management systems for the MRC.	MoFNP & MMMD
		Strengthen institutional coordination to avoid duplication and delay in processing permits and approvals (with ZEMA, the MSD, local government, communities, and people affected by projects).	MoFNP & MMMD co-leads with members incl. ZEMA, MSD, MoLGRD
	Local content	Finalize local content regulations, supported by analytics, and define local content to focus on value addition or on limited product lists based on feasible domestic capacity, as well as comprehensive support to create local capability.	MMMD, MSMED
	Government “free” equity and production sharing	Reorient production sharing strategy (drop free equity in favor of production purchase rights and purchase artisanal and small-scale mining (ASM) production).	MMMD
	Review stranded assets	Conduct review of stranded mining assets.	MMMD
Expanding infrastructure and the skilled workforce	Diversify energy mix and create competitive electricity market	Diversify the energy supply by adopting net metering, developing a model independent power producer (IPP) procurement framework, and implementing an open access policy.	MoE
		Support expansion and new transmission capacity (national and regional).	MoE, ZESCO
		Establish an independent system operator.	MoE
		Operationalize a multiyear, cost-reflective tariff framework.	ERB
		Update the Integrated Resource Plan (IRP) to align with the vision of scaling up ETM production and processing; develop IRP procurement framework.	MoE
	Reform ZESCO	Improve ZESCO’s financial and operational viability.	ZESCO
		Unbundle ZESCO into generation, transmission, and distribution units.	ZESCO
	Improve climate for private investment in infrastructure	Develop the PPP enabling environment by enhancing capacity of relevant entities and regulatory aspects.	MTL
		Develop a planning and prioritization framework for transport infrastructure investment.	MTL, RDA
	Expanding railway system	Accelerate conclusion of the TAZARA concession agreement and the ZRL segment between Kapiri and Ndola.	TAZARA

Focus area	Subtheme	Recommendation	Responsible agency
		Reform the rail sector, recapitalizing the ZRL to gradually reinstate the system to its design capacity.	ZRL
	Improving key road corridors	Expedite implementation of ongoing investment in the road corridors.	RDA
	Improve border crossings	Accelerate implementation of one-stop border posts at key border crossings.	MCTI
		Harmonize rules, regulations, and standards behind the border among corridor countries.	MCTI
	Increase skilled workforce	Prepare and operationalize a well-consulted ETM workforce development plan.	MLSS
		Incentivize industry to build workforce skills, including partnering with the public sector to align supply and demand.	TEVETA
Maximizing generation, management, and sharing of benefits	Attractive investment policies	Designate the ZDA as the agency responsible for ETM investment promotion and facilitation and enhance its operational capabilities, footprint, and resources.	ZDA
		Establish a policy on stable domestic access to refined copper.	MCTI
	Maximize revenue capture	Reduce leakage of revenues by strengthening monitoring and enforcement at border crossings and airports.	ZRA
		Strengthen coordination among control agents (police, customs, ZRA, Bureau of Standards) using ICT and interagency information-sharing protocol.	ZRA
	Competitive special economic zone (SEZ) regime	Assess gaps in energy and infrastructure for SEZs and establish enabling regulations for private investment.	ZDA
		Review the SEZ legal framework to provide a more competitive business environment for private participation; support eco-industrial zones.	ZDA
	Increase SME finance	Implement action plans on SME and green finance of the National Financial Inclusion Strategy II (2024–28).	MSMED
	Ensure competitive trade policies	Strengthen regional collaboration at COMESA on CET to eliminate tariffs on inputs for ETM processing.	COMESA
		Streamline nontariff measures for goods and services for ETM processing.	MCTI
		Fast-track implementation of the digitalization reform priorities and the coordinated national single window.	MCTI
	Improve public financial management and procurement	Enhance the capacity of the Office of the Auditor General to provide stronger oversight.	MoFNP
		Stabilize budgeting, avoiding boom and bust following commodity price cycles.	MoFNP
		Improve data collection and reporting systems on revenue sharing.	MoFNP
		Strengthen public financial management and procurement to maximize value for money and optimize budget allocation.	MoFNP
Enhancing sustainability	Enhance environmental and social risk management	Strengthen ZEMA capacity (staffing, capacity building, regional offices, laboratory, and equipment).	ZEMA
		Operationalize the EPF for mine closure and prevent license transfer without EPF compliance.	ZEMA

Source: World Bank analysis.

Note: EPF = Environmental Protection Fund; ERA = Energy Regulation Board; ETM = energy transition minerals; ICT = information and communication technology; MCTI = Ministry of Commerce, Trade and Industry; MLGRD = Ministry of Local Government and Rural Development; MLSS = Ministry of Labor and Social Security; MMMD = Ministry of Mines and Minerals Development; MoE = Ministry of Energy; MoFNP = Ministry of Finance and National Planning; MoJ = Ministry of Justice; MRC = Minerals Regulation Commission; MSD = Mine Safety Department; MTL = Ministry of Transport and Logistics; PPP = public-private partnership; RDA = Road Development Agency; SMEs = small and medium enterprises; TAZARA = Tanzania-Zambia Railway Authority; TEVETA = Technical Education, Vocational and Entrepreneurship Training Authority Zambia; ZDA = Zambia Development Agency; ZEMA = Zambia Environmental Management Authority; ZRA = Zambia Revenue Authority.

The GRZ has established a coordination framework to operationalize the MRC. It is chaired by the Cabinet Office, with the MMMD as the Secretariat; several working groups have been set up to lead individual workstreams. However, there is no clear institutional framework for implementing the roadmap. It is recommended that a cabinet steering committee be established, chaired by the minister of the MoFNP and co-chaired by the minister of the MMMD. It should include a limited number of key ministries and agencies and be supported by strong secretariat to facilitate coordination and overall implementation of the roadmap.

Regional cooperation and coordination are also needed for Zambia to benefit fully from scale and regional value chains. As Zambia's mineral resources, market access, and technical capacity and capability are limited, it needs to work with its neighbors to access more competitive markets and reliable energy and benefit from regional supply chains and value addition opportunities related to ETM. Trade and investment more broadly are facilitated by various international bodies (including the World Trade Organization and the United Nations), along with continental bodies (such as the African Union) and subregional bodies, including SADC, COMESA, SAPP, and the EAPP. But no agency has the specific mandate to promote coordination between Zambia and its neighbors in ETM value chains. Zambia has signed bilateral and multilateral memoranda of understanding with various governments and entities, some of which involve collaboration among countries. These are helpful initiatives, but they need to be implemented. Zambia is advised to follow up on key memoranda of understanding and agree on specific and time-bound actions to be undertaken to realize them. Without clear implementation plans, the memoranda of understanding remain frustrating, empty promises.

Zambia, as an important player in the global ETM value chain, could benefit significantly from championing regional cooperation with its neighbors and promoting FDI and regional value chain development. For example, to attract credible FDI in ETM value chain development and negotiate better prices for their minerals and metals, the countries of the region must work together to benefit from economies of scale and ensure global competitiveness. Bilateral memoranda of understanding signed between Zambia and the DRC on developing the value chain for electric vehicle batteries, Zambia's membership of the SAPP and EAPP power pools, and its shared ownership of TAZARA with Tanzania are good examples that could be strengthened and expanded. With over 100 years of mining experience and relatively strong skills, Zambia has comparative advantages in the region to lead midstream processing of ETM value chains. Its strong mining and engineering schools can also serve as centers of excellence to produce skilled geologists and engineers for the broader region.

6.3 Financing the roadmap

Implementing the roadmap is estimated to cost about $14 billion by 2030 and about $32 billion by 2040 (Table 6.2)[70]. Most of the financing is expected to come from the private sector. This requires a stable and competitive investment climate that attracts private capital at scale. It also requires deploying innovative financing models to leverage limited public and concessional finances to mobilize private capital at scale.

[70] Although significantly larger investments are needed to provide energy and transport for sectors such as agriculture and manufacturing, the estimates given here are those related to ETM roadmap implementation.

Table 6.2. Options for financing the roadmap

Project type	Estimated cost ($, billion)	
	By 2030	By 2040
Electricity (generation, transmission, distribution)	2.74 (82%)	5.40
Transport and logistics (rail, road, logistics and border facilities)	4.10[a] (90%)	7.05
Scaling up mining (mapping, exploration, mining, and processing)[b]	7.12 (98%)	19.63
Workforce and skills development	0.05 (20%)	0.09
Safeguarding the environment (staffing, laboratory and lab equipment)	0.05 (1%)	0.11
Total	**14.06 (89%)**	**32.28**

Source: World Bank estimates.
Note: a. Includes the Kapiri to Ndola Railway link ($75 million); b. Public investment ranges from $120 to $200 million; the remainder is to come from private sector investment in mine development. Estimates of private sector investment in mine development are derived from the detailed modeling exercise performed by the World Bank.

Various financing options could be considered to implement the roadmap. Project finance is a vital method for funding capital-intensive infrastructure projects that require substantial investment, such as energy, transportation, and large construction undertakings. Unlike corporate finance, which relies on a company's balance sheet, project finance involves securing the necessary funds for a standalone economic unit, where the financial viability of the project is the primary concern. As such, it is important for Zambia to adopt a competitive investment climate for the ETM value chain, a robust and transparent project appraisal framework, and strong capacity and capability for implementation.

The array of funding sources in project finance is diverse. Equity contributions from project sponsors provide the necessary investment without collateral, reflecting their commitment and confidence in the project's profitability. Debt funding takes various forms, from bank loans and bonds to export credit agencies and development finance institutions. Asset-based financing, including lease arrangements and factoring, can also be crucial for funding specific asset purchases or operations. Structuring these financial components to mitigate risks while maximizing returns requires in-depth analysis and strategic planning.

Identifying and selecting the appropriate mix of financial options is critical for ensuring the success and sustainability of a project. This mix might include a balanced allocation of debt and equity, in line with the risk profile and projected cash flows of the project. However, for such projects to be financed (fully or partially) by a private sector, the enabling environment should be in place, including sector-specific regulations, such as a cost-reflective tariff, security of tenure, and the ability to repatriate revenues. For projects jointly involving the public and private sectors, a robust PPP framework should be in place to attract credible private capital and expertise in a competitive environment.

Concessional financing, such as grants and credits, and low-interest climate and sustainability loans, could also be mobilized to support key development projects and programs. Given the limited availability of such concessional financing, its strategic utilization is key to leverage more private capital by derisking private investment across the ETM value chains and supporting infrastructure. Given its sizeable role in the global energy transition, Zambia could negotiate better access to concessional financing. The Resilient Inclusive Supply Chain Enhancement (RISE) initiative, climate-resilient mining, and several memoranda of understanding signed between Zambia and various countries and agencies could

be good sources of such financing. Zambia would need to prepare and position itself appropriately to maximize the benefits from these arrangements.

Some innovative financing models can address specific needs and challenges within the mining sector:

- *Green bonds*, successfully used in countries like Sweden and Germany, raise capital for large-scale projects, including climate resilience and rehabilitation, by attracting investors interested in sustainable outcomes.
- *Blended finance.* In Kenya, blended finance structures have been used to attract private sector investment for renewable energy projects, combining donor funds with private capital to lower investment risks. Similarly, Indonesia has leveraged blended finance to improve infrastructure and environmental management, showing how this model can address high-impact projects and infrastructure needs.
- *Impact investment funds* have been used in regions such as Latin America and Southeast Asia to support community engagement and capacity building. For instance, in Latin America, impact funds have supported indigenous communities affected by mining operations, enhancing their ability to participate in decision-making processes and benefit-sharing programs. This highlights the potential of impact funds to generate positive social and environmental outcomes while providing financial returns.
- *Concessional loans* have funded regulatory reforms and large-scale infrastructure projects. Ghana's use of concessional loans for improving mining sector regulations and Morocco's investment in mining infrastructure with concessional support show the benefits of these loans for policy development and strategic reforms.
- *Grants and technical assistance*. In Peru, grants from international development agencies supported technical assistance for environmental management, and Mongolia used donor funding for policy development and capacity building.

APPENDIXES

Appendix A. The energy sector

Table A.1. Energy sector reforms

Initiative	Outline
National Energy Policy 2019[a]	This comprehensive policy aims to optimize the use of energy resources to meet domestic and international needs. It emphasizes diversifying the energy mix by promoting renewable energy sources alongside traditional sources like hydropower to enhance energy security. The policy focuses on increasing access to reliable energy in both urban and rural areas and incorporates measures to ensure the sustainable development of the sector, including climate change mitigation and adaptation. It encourages private investment in the energy sector through cost-reflective tariffs and an open access regime. It calls for strengthening institutional capacities and coordination among stakeholders.
Integrated Resource Plan (IRP) 2023	This 30-year roadmap for the electricity sector promotes a balanced approach, incorporating renewable energy alongside traditional resources. It aims for a reliable, sustainable power supply through resource development and optimized infrastructure investment. The IRP supports increased mining production, industrial development, agricultural transformation, and universal electricity access by 2030.
Zambia Power Development Framework (ZPDF) 2021[b]	This strategic document guides the development and operation of the power sector. It sets out detailed processes for government- and private sector-initiated projects, from site identification and feasibility studies to project commissioning and operations. The ZPDF encourages private sector involvement in the power sector, detailing the legal framework and procedures for private investments.
Electricity Act and Energy Regulation Act, 2019	The Act regulates the generation, transmission, distribution, and supply of electricity, focusing on the licensing and regulation of enterprises in the sector. It aims to create a more robust and transparent energy sector, encourage investment, and ensure a reliable supply.
Open Access Policy, June 2024	The policy aims to transform the electricity sector by allowing third-party users, such as independent power producers (IPPs) and large consumers, to access the electricity transmission and distribution networks owned by ZESCO. It enables IPPs to generate and sell electricity directly to consumers to increase competition and improve efficiency in the electricity market. By opening the market, the policy aims to attract private investment, address the electricity deficit, and promote growth. The policy is anchored in the Electricity Act and includes detailed implementation guidelines.
Net Metering Regulations, August 2024	Governed by the Energy Regulation Act and the Zambian Distribution Grid Code, the regulations encourage the integration of renewable energy sources into the national grid. They aim to promote sustainable energy practices and reduce the carbon footprint by promoting renewable energy. Retail consumers can generate electricity from renewable sources for their own use and supply any surplus to the grid, for which they are compensated (typically through credits on their electricity bill).

Source: World Bank analysis.
Note: a. Zambia, MoE 2019; b. Zambia, MoE 2021.

Table A.2. Transmission priority projects

S/N	Project Name	Cost Estimate (USD'm)	COD
TRN0001	Copperbelt Provine Reinforcement Project	700	2026
TRN0002	a) LTDRP (Chilanga – Lusaka West 132 kV line Project)	14.2	2025
	b) LTDRP (Roma– UNZA 132kV Line and UNZA 132/33/11kV Substation)	22.1	2025
TRN0003	Eastern Province Reinforcement Project	72	2026
TRN0004	Reinforcement of power supply to Mkushi and Kapiri Mposhi	120	2026
TRN0005	Southern Province 132kV Network Reinforcement	350	2026
TRN0006	Pensulo – Mansa Transmission Project	208	2026
TRN0007	Reinforcement of power supply to Kariba Lakeshore areas	41	2026
TRN0008	Central Transmission corridor	73	2026
TRN0009	Kalumbila and Luano DVSD	56	2026
TRN0010	Reinforcement of power supply to Western Province Project	250	2030
TRN0011	Reinforcement of power supply to Livingstone[1]	8.52	2030
TRN0012	Sustainable Electricity Supply Southern Division (SESSD) Project	87	2026
TRN0013	Kabwe Pensulo line 2 Transmission Line Project[2]	134	2024
TRN0014	Zambia – Tanzania Kenya Interconnector Project	270	2030
TRN0015	Luano – Kansanshi – Lumwana – Kalumbila 330kV Transmission Project	260	2030
TRN0016	Solwezi – Kolwezi Interconnector Project	104.3	2030
TRN0017	Zambia-Mozambique 400kV Interconnector	41.2	2035
TRN0018	Zimbabwe-Zambia-Botswana-Namibia Interconnector (ZIZABONA)	150	2035
TRN0019	Zambia – Malawi interconnector	TBD (feasibility study not yet done)	2035
TRN0020	Zambia – Angola	TBD (feasibility study not yet done)	2035
TRN0021	Kafue West — Muzuma – Mukuni 330kV Transmission Lines	150	2035
TRN0022	Kasama Mporokoso Transmission Line	100	2027
[1] Project funded by the EIB			
[2] Project under execution without long term funding			

Source: Zambia, MoE 2023.

Table A.3. Priority generation projects to support the energy transition roadmap

Project name	Technology	Completion date	Capacity (MW)
Lusiwasi Lower	Hydro	2027	86
Chishimba Falls	Hydro	2027	15
Kalungwishi	Hydro	2030	247
Ngonye Falls	Hydro	2028	180
Devils Gorge	Hydro	2030	500
Luapula Hydro	Hydro	2030	789
Namundela	Hydro	2030	4.8
Kalapela	Hydro	2030	4
Kakonko Falls	Hydro	2030	8
Mwasha Falls	Hydro	2030	5
West Lunga II	Hydro	2030	44.6
Batoka Gorge	Hydro	2032	1,200
Kariba	Solar	2030	200
New Solar Central Province	Solar	2033	500
New Solar Copperbelt Province	Solar	2033	500
New Solar Muchinga Province	Solar	2034	500

Project name	Technology	Completion date	Capacity (MW)
New Solar Southern Province	Solar	2035	500
New Solar Lusaka Province	Solar	2037	500
New Wind Projects	Wind	2037	400
Shangombro	Solar/Diesel	2030	1
Maamba II	Coal	2030	600

Source: Zambia, MoE 2023.

Table A.4. Power generation energy sources

Licensee	Power Plant Name	Technology	Installed Capacity 2024
ZESCO Limited	Kafue Gorge Upper	Hydro	990
	Kariba North Bank	Hydro	720
	Kafue Gorge Lower	Hydro	750
	Kariba North Bank Extension	Hydro	360
	Victoria Falls	Hydro	108
	Lunzua River	Hydro	360
	Lusiwasi Lower	Hydro	12
	Lusiwasi Upper	Hydro	15
	Chishimba Falls	Hydro	5
	Musonda Falls	Hydro	10
	Shinwang'andu	Hydro	1
	Lunzua River	Hydro	14.8
Itezhi-Tezhi Power Corporation	Itezhi-Tezhi	Hydro	120
Lusemfwa Hydro Power Company	Mulungushi	Hydro	32
	Lunsemfwa	Hydro	24
Total hydropower			**3,521.80**
ZESCO Limited	Kabompo	Diesel	2
	Zambezi	Diesel	1.36
	Mufumbwe	Diesel	0.8
	Luangwa	Diesel	2.6
	Lukulu	Diesel	0.32
	Chavuma	Diesel	0.8
	Shango'mbo	Diesel	1
Copperbelt Energy Cooperation	Bancroft	Diesel	20
	Luano	Diesel	40
	Luanshya	Diesel	10
	Mufulira	Diesel	10
Ndola Energy Generation Plants	Ndola	Heavy Fuel Oil	110
Total heavy fuel oil and diesel			**296**
Maamba Collieries Ltd	Maamba Power Plant	Coal	300
Dangote Coal Plant	Dangote	Coal	30
Total IPP coal			**330**
Copperbelt Energy Corporation	Kitwe	Solar	94
Neon	Bangweulu	Solar	54
Enel Green Power	Ngonye	Solar	34
Total IPP solar photovoltaic			**182**

Source: Zambia, MoE 2023.
Note: IPP = independent power producers.

Table A.5. Mining energy demand, 2021 to 2050

Mine	Data source	Electricity demand (GWh)		
		2021	2035	2050
Konkola Copper Mines Plc	CEC	1,490	2,293	2,293
Mopani Copper Mines Plc	CEC	944	962	962
Luanshya Copper Mines	CEC	301	306	306
NFC Africa Mining Plc (Chisenga)	CEC	158	158	158
NFC Luela	CEC	54	54	54
Lubambe Copper Mine Ltd	CEC	135	149	149
Chambishi Metals Plc	CEC	4	4	4
Cosak	CEC	2	2	2
China Copper Mines Ltd	CEC	13	13	13
Chibuluma Mines Plc	CEC	5	5	5
China Civil Engineering	CEC	0	0	0
SinoHydro	CEC	0	0	0
Yong Jia	CEC	0	0	0
Mwekera Copper Mine	CEC	0	23	23
Zhonghui Mining Group	CEC	0	0	0
Kalumbila Minerals Limited (100%)	COM	1,438	0	0
Kansanshi Mining Plc (100%)	COM	1,840	2,409	2,409
Lumwana Mining Co. Limited (100%)	COM	394	455	262
Projected mining projects (new)	**Data Source**	**2021**	**2035**	**2050**
Chambishi Copper Smelter	COM	600	600	600
Manganese sector Luapula	COM	100	200	300
Manganese sector Central	COM	100	200	300
New smelters SXEW	COM	600	1,200	1,200
NW Open pit mine 1	COM	0	1,400	1,400
NW Open pit mine 2	COM	0	1,400	1,400
CB development	COM	0	400	400
NW Open pit mine 3	COM	0	1,400	1,400
Central open mine	COM	0	0	150
Western open mine 1	COM	0	0	150
Northern open mine	COM	0	0	150
Luapula open mine	COM	0	0	150
Eastern open mine	COM	0	0	150
Muchinga open mine	COM	0	0	150
Mabiza open mine	COM	0	0	150
Kitumba open mine	COM	0	0	150
Kangaluwi open mine	COM	0	0	150
Dunrobin open mine	COM	0	0	150
Sasare open mine	COM	0	0	150
Western open mine 2	COM	0	0	150

Source: Zambia, MoE 2023.
Note: CEC = Copperbelt Energy Corporation; COM = Chamber of Mines; NW = North-Western.

Table A.6. Planned coal, solar photovoltaic, wind, geothermal, and biomass projects

S/N	Project name	Technology	District	Province	Installed capacity (MW)	Annual energy (GWh)
1	Chanka Project/ZESCO-Masen	Wind	Isoka	Muchinga	150.00	457.00
2	ZESCO/Masen Kanona Solar PV	Solar PV	Chitambo	Central	100.00	270.09
3	Chongo Geothermal	Geothermal	Mpika	Muchinga		
4	ZESCO/Masen Muzuma Solar PV	Solar PV	Choma	Southern	75.00	206.14
5	Shang'ombo Solar/Diesel Hybrid	Hybrid	Shang'ombo	Western	0.58	2.00
6	Unika I Wind Energy Project	Wind	Katete	Eastern	201.60	675.00
7	Pensulo Wind Power (130 MW)	Wind	Serenje	Central	130.00	394.00
8	Lubungu Geothermal	Geothermal	Mumbwa	Central		
9	Bulemu West	Solar PV	Kabwe	Central	20.00	63.00
10	Bulemu East	Solar PV	Kabwe	Central	20.00	63.00
11	Aurora Solar 1	Solar PV	Kafue	Lusaka	20.00	60.00
12	Aurora Solar 2	Solar PV	Kafue	Lusaka	20.00	60.00
13	Garneton North Solar	Solar PV	Kitwe	Copperbelt	20.00	56.50
14	Garneton South Solar	Solar PV	Kitwe	Copperbelt	20.00	56.50
15	Green Field	Solar PV	Lusaka	Lusaka	50.00	
16	Globeleq Project	Solar PV	Lusaka	Lusaka	100.00	
17	MGC Project	Solar PV	Mumbwa	Central	100.00	
18	Hive Project	Solar PV	Siavonga	Southern	20.00	
19	Sesheke Solar PV	Solar PV	Sesheke	Western	50.00	108.13
20	Mongu Solar PV	Solar PV	Mongu	Western	50.00	108.55
21	Mozambique Coal Fired Phase I	Coal Fired	Tete	Mozambique	700.00	4,550.00
22	Mozambique Coal Fired Phase II	Coal Fired	Tete	Mozambique	700.00	4,550.00
23	Maamba Coal Fired Phase II	Coal Fired	Sinazongwe	Southern	300.00	
24	Afri Energy Biomass Power Project	Biomass	Samfya	Luapula	100.00	
25	Emco Coal Fired Power Project	Coal Fired	Sinazongwe	Southern	340.00	100.00
26	Kalahari Geothermal Project	Geothermal	Monze	Southern	20.00	
27	Kanzinze Coal Fired Project	Coal Fired	Sinazongwe	Southern	300.00	
28	Geomin Coal Fired Project	Coal Fired	Gwembe	Southern	270.00	
29	MGC Coal Fired Project	Coal Fired	Sinazongwe	Southern	700.00	
30	Texxon Energies Coal Fired Project	Coal Fired	Sinazongwe	Southern	300.00	
31	Black Rhino Coal Fired Project	Coal Fired	Chipata	Eastern	300.00	
32	Coal Fired Power Plant	Coal Fired	Ndola	Copperbelt	100.00	

Source: Zambia, MoE 2023.
Note: PV = photovoltaic.

Appendix B. Pipeline projects and estimated costs

Table B.1. Pipeline infrastructure investments

No.	Section of the corridor	Length (km)	Financier/ lender	Cost ($ million)	Target commencement
1	Chinsali to Nakonde	210	AfDB	243.00	Completed
2	Lusaka to Ndola *(NS Corridor)*	372[a]	PPP	650.00[b]	Ongoing
3	Mpika to Chinsali	161	EU/EIB	198.00[c]	Q1, 2025
4	Serenje to Mpika[d]	203	WB	150.00	Q1, 2025
5	TAZARA Railways Concession	1,860	PPP	1,000.00	Q4 2025
6	Lumwana to Kambimba Border	85	PPP[e]	160.00	Q2, 2025
7	Solwezi to Kipushi and Border Project	110	PPP[f]	136.00	Q3, 2025
8	Mutanda to Kaoma Road	366	PPP	150.00	Q2, 2025
9	Chongwe to Luangwa *(Nacala Corridor)*	175	WB/PPP	130.00	Q2, 2026
10	Livingstone to Katima Mulilo *(Walvis Bay Corridor)*	212	WB	160.00	Q2, 2026
11	Lusaka to Chongwe *(Nacala Corridor)*	45	PPP	38.25	Q2, 2026
12	Kapiri to Ndola Railway link	120	PPP	750.00	N/A
13	Katete to Chanida	55	PPP	79.00	Ongoing
14	Ndola to Mufulira via Sakanya	42	PPP	76.00	Ongoing
15	Mufulira to Mokambo	26	PPP	TBD	Q4, 2024
16	Mokambo to Mansa via Pedicle & Border	170	PPP	143.00	Q2, 2026
	Total excluding Lobito Corridor			**4,105.00**	
17	Lobito Greenfield Link	800	PPP	4,000.00–6,000.00	N/A
	Total including Lobito Corridor			**8,105.00–10,105.00**	

Source: World Bank.
Note: AfDB = African Development Bank; EIB = European Investment Bank; EU = European Union; NS = North-South; PPP = public-private partnership; Q = quarter; TAZARA = Tanzania-Zambia Railway Authority; WB = World Bank.
a. Lusaka-Ndola (327 km) + Luanshya-Masangano (45 km).
b. Road construction cost is $577 million; the difference relates to transaction costs.
c. Original loan and grant amount is €182.75 million. Conversion €1 = $1.083 (2 August 2024)
d. Under the TRACER project. Project includes the development of a one-stop border post at Nakonde, co-funded with TradeMark Africa and the UK Foreign and Commonwealth Development Office.
e. DRC 60 km. Border agreement yet to be signed between the DRC and Zambia.
f. Unsolicited bid proposal. An interministerial committee is negotiating the concession agreement.

Table B.2. Targeted investment by corridor, unconstrained, 2024 to 2027

Project	Cost ($ million)	Percentage share
Beira	79	4%
Dar es Salaam	528	25%
Dar es Salaam/North South	76	4%
Nacala	168	8%
North-South	650	31%
Walvis Bay	470	22%
Walvis Bay/Dar es Salaam/North South	136	6%
Total	**2,107**	

Source: Government data shared with the World Bank.

Appendix C. The Zambia Qualifications Framework

Table C.1. Zambia Qualifications Framework

ZQF level	General education	TEVET	Higher education
10			Doctorate Degree
9			Master's Degree
8			Post-Graduate Diploma
7			Bachelor's Degree
6		Diploma (Technologist)	
5		Advanced Certificate (Technician)	
4		Craft Certificate (Artisan)	
3		Trade Test Certificate (Level 1)	
2	Senior secondary education certificate (Grade 12) Junior secondary education certificate (Grade 9)		
1	Primary education certificate (Grade 7)		

Source: Adapted from Zambia Qualifications Authority 2023.
Note: TEVET = technical education, vocational, and entrepreneurship training; ZQF = Zambia Qualifications Framework

Table C.2. TEVET programs not incorporated in the ZQF

Type	Description
Trade Test Certificates – Levels 2 and 3	Trade Tests exist at levels 1, 2, and 3, with level 1 being the highest and level 3 the lowest. The ZQF only incorporates Trade Test Level 1 (at ZQF level 3), until such time as it is amended to also incorporate lower qualifications.
Secondary School TEVET (SSVET)	SSVET is intended to be offered at Trade Levels 1–3. However, since its introduction in 2014, training and assessments have only been conducted for level 3 (at junior secondary schools), mostly because of a lack of equipment and instructors in secondary schools.
Skills Awards	These short modular programs in micro-credentials are not incorporated in the ZQF. The amended Zambia Qualifications Authority (ZAQA) Act 2024 does allow their incorporation in the ZQF.

Source: Consultations with TEVETA, September 2024.
Note: ZQF = Zambia Qualifications Framework.

Table C.3. Examples of specific jobs by job category and activity

Category	Core mining	Processing	Auxiliary
Manager	Engineering	Metallurgy	Group Manager
	Mine Geology	Process Plant	Manager, Finance
	Mining Maintenance		Manager, Mining
Professional	Geologist, Mine	Chemist	Accountant
	Senior Specialist, Mining Maintenance	Specialist, Process	Head Chef
	Specialist, Electrical and Instrumentation	Specialist, Smelter Plant	Specialist, ICT
Technician and Associate Professionals	Mechanic, Site Maintenance	Assistant or Technician or Controller, Process Plant	Assistant, Procurement
	Supervisor, Site Services	Assistant or Technician or Controller, Smelter Plant	Foreman, Warehouse
	Officer, Health and Safety	Technician or Supervisor, Electrical and Instrumentation	Officer, Logistics and Materials
	Assistant Mining	Mech, Mechanical	Officer, Community Relations
	Superintendent Mining	Assistant, Refractory	Clerk, Accounting
	Supervisor, Mining	Metallurgist	Engineer, ICT
Artisan and other Trades	Artisan, Site Maintenance	Artisan, Acid Plant	Artisan, Construction
	Artisan, Electrical and Instrumentation	Artisan, Process Plant	Artisan, Electrical and Instrumentation
	Artisan, Fleet Maintenance	Artisan, Smelter Plant	Artisan, Maintenance
	Artisan, Mine Geology	Artisan, Laboratory	Artisan, Mechanical
	Artisan, Surveying		
Plant and Machine Operators	Operator, Roads	Operator, Laboratory	Operator, Housing
	Operator, Fleet Maintenance	Operator, Process Plant	Operator, Maintenance
	Operator, Mining	Operator, Smelter Plant	
	Operator, Site Services	Operator, Oxygen Plant	

Source: World Bank staff summary.
Note: ICT = information and communication technology.

Appendix D. Environmental and social governance

Table D.1. Recommendations: Environmental and social governance

Recommendation	Description	Responsible ministry/agency	Key stakeholders	Prerequisite actions	Proposed timeline	Urgency	Challenges	Development impact	Estimated budget
Immediate (within a year)									
Strengthening institutional capacity	Provide technical assistance to ZEMA and Mines Safety Department to enhance monitoring and enforcement of environmental and social legislation on ETMs.	Ministry of Mines and Mineral Development, Mines Safety Department	ZEMA, Mines Safety Department, international partners	Assess current institutional capacity, coordinate with partners	6–12 months	High	Securing technical assistance and resources	Improved regulatory enforcement, better environmental outcomes, and increased investor confidence.	500,000
Policy development for ETMs	Develop and implement specific policies and guidelines[a] for the extraction and processing of ETMs.	Ministry of Mines and Mineral Development	Mining companies, environmental NGOs, local communities	Draft policies, consult with stakeholders, implement guidelines	6–12 months	High	Aligning policies with international standards, gaining stakeholder consensus	Clear guidelines for sustainable ETM development, aligning with global standards.	500,000
Performance rating system for environmental and social compliance	Introduce a rating system for mining companies based on their environmental and social performance, with penalties or degradation of operating licenses for poor ratings.	Ministry of Mines and Mineral Development, ZEMA	Mining companies, investors, environmental NGOs, local communities	Develop rating criteria, establish enforcement mechanisms, consult with industry stakeholders	6–12 months	High	Securing mining company cooperation; establishing fair and transparent rating systems	Improved environmental and social governance in mining, encouraging sustainable practices and responsible investment in ETMs.	300,000
Enhanced environmental monitoring and compliance	Strengthen monitoring systems and enforce compliance with rehabilitation and restoration requirements.	ZEMA	Mining companies, environmental NGOs	Develop monitoring frameworks, enhance enforcement mechanisms	Immediate to short term	High	Securing resources, enhancing monitoring capabilities	Reduced environmental degradation, increased effectiveness of environmental regulations.	400,000

Recommendation	Description	Responsible ministry/agency	Key stakeholders	Prerequisite actions	Proposed timeline	Urgency	Challenges	Development impact	Estimated budget
Short term (1–2 years)									
Community engagement and benefit sharing	Develop programs to ensure local communities benefit from mining activities through job creation, infrastructure development, and community investment initiatives.	Ministry of Mines and Mineral Development, local governments	Mining companies, local communities	Develop community engagement plans, secure funding	Short to medium term	Medium	Ensuring effective community engagement, balancing interests	Improved local community relations, enhanced social stability, and economic benefits for affected communities.	1,000,000
Improvement and enhancement of a national mine closure plan	Formulate and implement a national strategy for the closure of mining operations, including guidelines for decommissioning, progressive rehabilitation, and environmental restoration.	Ministry of Mines and Mineral Development, ZEMA	Mining companies, environmental NGOs	Develop closure strategies, secure funding	Medium term	Medium	Developing comprehensive guidelines, ensuring compliance	Systematic and effective closure of mining sites, reducing long-term environmental liabilities.	800,000
Medium term (up to five years)									
Climate resilience in mining operations	Implement programs to improve climate resilience of mining operations, including water management and energy efficiency measures and emission reduction initiatives.	Ministry of Mines and Mineral Development, Ministry of Environment	Mining companies, environmental NGOs, local communities	Develop resilience programs, secure funding, implement measures	2–5 years	Medium	High investment requirements, ensuring program effectiveness	Mitigated impact of climate change on mining operations, ensuring sustainability.	2,500,000
Cleaner production initiatives	Promote cleaner production techniques to ensure efficient use of resources, reduction in waste generation, and minimization of environmental impacts during ETM extraction and processing.	Ministry of Mines and Mineral Development, Ministry of Environment	Mining companies, ZEMA, environmental NGOs	Develop guidelines, incentivize cleaner production technologies, conduct capacity building	2–5 years	Medium	High initial costs for cleaner production technologies, securing stakeholder buy-in	Reduced environmental impact, improved resource efficiency, decreased waste generation, contributing to circular economy goals.	3,000,000

Recommendation	Description	Responsible ministry/agency	Key stakeholders	Prerequisite actions	Proposed timeline	Urgency	Challenges	Development impact	Estimated budget
Rehabilitation of mining sites	Implement environmental restoration and rehabilitation projects for decommissioned and legacy mining sites.	Ministry of Mines and Mineral Development, ZEMA	Mining companies, environmental NGOs, local communities	Conduct site assessments, develop rehabilitation plans	3–5 years	Medium	Securing funding, coordinating rehabilitation efforts	Improved environmental conditions at former mining sites, reduced long-term environmental impact.	5,000,000
Capacity building for environmental rehabilitation	Provide training and resources for mining companies and local authorities on best practices for environmental rehabilitation and sustainable mining.	Ministry of Mines and Mineral Development, ZEMA	Mining companies, environmental NGOs	Develop training programs, allocate resources	Medium term	Medium	Ensuring widespread adoption of best practices	Improved rehabilitation outcomes, enhanced skills and knowledge for sustainable mining practices.	1,000,000

Source: World Bank analysis.
Note: ETM = energy transition mineral; NGO = nongovernmental organization; ZEMA = Zambia Environmental Management Agency.
a. Review and update environmental impact assessment regulations, and where possible, the national environmental policy, to include the environmental and social aspects of ETM; water management and pollution control; waste management guidelines; biodiversity conservation measures; health and safety protocols; community engagement and resettlement; supply chain transparency and ethical sourcing; and climate change adaptation strategies.

Appendix E. Global comparison of state participation and production sharing in mining

Table E.1. State participation and production sharing in mining

Country	Mining state-owned enterprises	Major minerals produced	Statutory right of the state to minority equity in mines	Production sharing	Comments	Relevant law on state equity	Share of global exploration expenditure (2023)[a]
Angola	Endiama (diamonds)	Diamonds	10% (terms unclear)	No (Diamonds purchased by SODIAM where agreed.)	The Mining Code allows the government to choose between the 10% free equity or equivalent production sharing.	Mining Code (2011)	0.19% $24.9 million
Benin	*None*	Gold	10% free equity (non-dilutable and no financial obligations)	No		Mining Code (2006)	~0% Not covered.
Botswana	Debswana (50-50 joint venture with De Beers)	Diamonds	Right to purchase up to 15% equity in any mine with financial obligations covering exploration, development and production costs[b]	No	Diamonds are subject to a different fiscal regime than other minerals	Mines and Minerals Act (1999)	0.37% $48.2 million
Burkina Faso	*None*	Gold	10% free equity with antidilution provision and no financial obligation plus a priority dividend (undefined)	No		Mining Code (2015)	0.41% $52.7 million
Cameroon	Société nationale des mines (SNM)	Gold	10% free equity without obligations and antidilution provision, plus up to 25% more paid equity at same terms as other minority shareholders	No		Mining Code (2016)	0.03% $3.6 million
Chile	Codelco	Copper	*None*	No	Codelco is the sole owner and operator of seven mines and minority shareholder in five large-scale operating mines, mostly retained from asset sales		6.45% $832.7 million

Country	Mining state-owned enterprises	Major minerals produced	Statutory right of the state to minority equity in mines	Production sharing	Comments	Relevant law on state equity	Share of global exploration expenditure (2023)[a]
DR Congo	Gécamines, MIBA, SODIMICO	Copper, cobalt	10% free equity without obligations and antidilution provision; increase by 5% after each mining permit renewal	Yes (two contracts require that Gécamines collect its share as physical product)		Mining Code (2018)	1.04% $133.8 million
Gabon	Société équatoriale des mines (SEM)	Manganese	10% free equity (non-dilutable; no obligations; can be converted to other revenue streams); and right to 25% paid equity	Yes (found in contract)		Mining Regulation (2019)	0.07% $9.2 million
Ghana	Sankofa	Gold	10% free carried interest (undefined)	No		Minerals and Mining Act (2006)	0.77% $99.7 million
Kazakhstan	Tau-Ken Samruk National Mining Company, Kazatomprom	Gold, copper, uranium	*None*	No			0.61% $78.3 million
Kenya	National Mining Corporation (NMC)	Titanium, gold	10% free carried interest in large-scale and strategic mines (undefined; to be detailed in future regulation)	No		Mining Act (2016)	0.10% $13 million
Mongolia	Erdenes Mongol	Coal, copper	Free shares equal to up to 34% of invested capital in "strategic mineral deposits", where the private sector bore all exploration costs; up to 50% free equity where the state partially funded exploration; state equity can be converted to royalty payments	No		Minerals Law (2006) (amended in 2024)	0.23% $29.9 million
Namibia	Namdeb (50-50 joint venture with De Beers)	Diamonds, gold	*None*	No			0.56% $72.9 million

Country	Mining state-owned enterprises	Major minerals produced	Statutory right of the state to minority equity in mines	Production sharing	Comments	Relevant law on state equity	Share of global exploration expenditure (2023)[a]
Peru	*None*	Copper, gold, iron, zinc	*None*	No	The only state-owned enterprise in the mining sector is AMSAC, which specializes in the remediation of mining environmental liabilities.		3.80% $490.5 million
Tanzania	Stamico	Gold, copper	16% free carried interest, non-dilutable; up to 34% more paid equity	No		Written Laws Act (2017)	1.03% $133.2 million
South Africa	AEMFC	Gold, platinum, diamonds, coal, iron	*None*	No			0.91% $117.4 million

Source: World Bank analysis.
Note: a. For reference, in 2023 Zambia attracted $79.6 million in private investment in mineral exploration, amounting to 0.62 percent of total global expenditure.
b. Revisions to the Mining Act are being contemplated to allow the following: if the government chooses not to exercise its option to acquire the shareholding, the mining companies will reportedly be required to use their "best endeavors" to dispose of 24 percent to citizens or citizen-owned companies.

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