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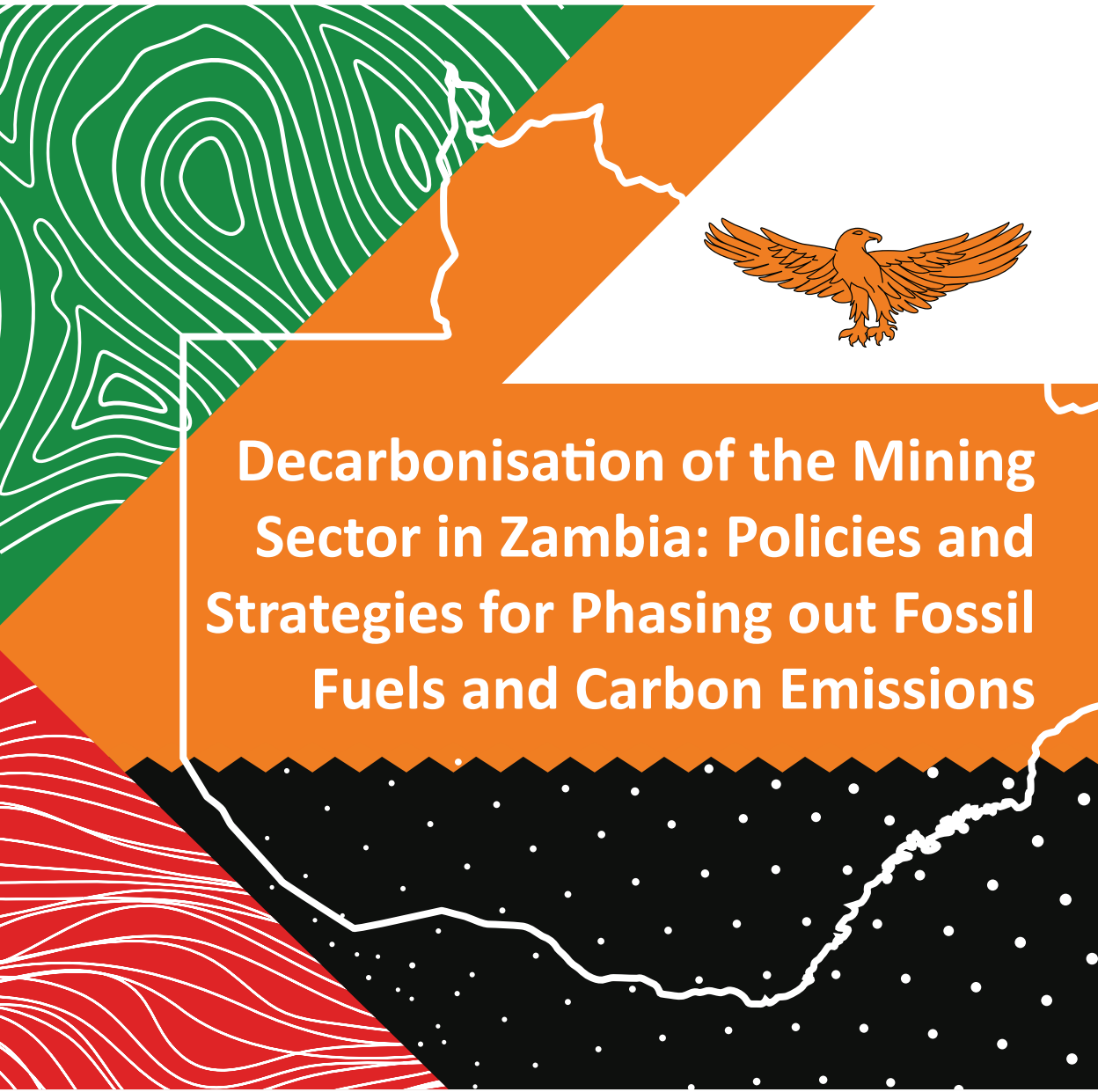

Decarbonisation of the Mining Sector in Zambia: Policies and Strategies for Phasing out Fossil Fuels and Carbon Emissions

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Southern Africa Resource Watch

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Introduction

Zambia has a long mining history and a large known resource base of copper, emeralds, and other deposits. Given the high degree of mineral prospecting, the country has good potential for further discoveries.

According to the Central Statistics Office, the mining sector's contribution to the national economy in Zambia increased to ZMW3682.50 million in the fourth quarter of 2021, up from ZMW3561.70 million in the third quarter of 2021. According to the 2020 Extractive Industry Transparency Initiative (EITI) report, the contribution of the extractive sector to gross domestic product (GDP) stood at 11.1 per cent, exports at 79.5 percent, domestic revenue at 31.4 per cent, and employment at 2 per cent.[1] The mining sector is a major contributor to foreign direct investment, and mining tax revenues contribute a significant portion of total government revenue. As a mature mining economy, the sector is also a significant source of formal employment – both directly and indirectly. However, with the mechanisation of the sector, employment levels are dwindling.

The need to decarbonise the mines is informed by the risk of carbon emissions per tonne of coal mined, mainly driven by fugitive methane from coal layers. Mining is vital in providing materials for a net zero carbon emission world. To achieve this, the extractive industry must expand and decarbonise at the same time. Decarbonisation involves reducing the amount of carbon dioxide from fossil fuels by replacing fossil fuels with other forms of renewable energy that make mining greener.

This policy paper discusses the decarbonisation of the mining sector in Zambia and analyses the available policies and strategies for phasing out fossil fuels in mining operations. It analyses the government policies and legislation on the decarbonisation of mining activities in Zambia. It has also attempted to look at the role of the private sector in contributing to the decarbonisation process through different interventions and activities.

[1] https://eiti.org/countries/zambia

The study's objectives include evaluating national policy and strategies for phasing out fossil fuels in the mining sector and modelling the institutional framework for mining decarbonisation in Zambia. Furthermore, the study sought to review mining policy to offer a range of policy tools and options for decarbonisation measures and compliance mechanisms. It also sought to inspect the availability of carbon-relevant industrial policies and standards for decarbonising mining operation systems in selected companies.

Overview of the Zambian mining sector

Zambia possesses one of the world's highest-grade deposits of copper and is ranked the seventh-largest copper producer globally. In addition, Zambia is home to small, exploitable deposits of cobalt, nickel, and manganese. The mining sector is vital in fostering economic development in the country. The sector contributes significantly to Zambia's socio-economic development, including net export earnings and employment opportunities to the people of Zambia. The mining sector accounts for up to 12 per cent of the GDP and 70 per cent of export earnings.[2]

The mining landscape in Zambia covers the production of multiple minerals, including copper, cobalt, gold, nickel, manganese, emeralds, beryllium, myriad gemstones, sulphur, zinc, coal, iron ore, steel, limestone, uranium and other platinum-group metals.

The geology and mineral resource distribution covers a large portion of Zambia's area, stretching across all ten provinces.

Mining comes with several impacts. Negative impacts of mining on host communities include water pollution (surface and underground), land degradation, air pollution, and displacement of people. Despite all this, mining activities do also have positive impacts. Mining activities may bring about technology which promotes rural-urban connections, employment opportunities for the host community, and improvements in education facilities, among other things. For example, Konkola Copper Mines[3] has been known to be a perpetual water polluter, and Mopani Copper Mines has contributed to the deterioration of air quality through the emission of oxide in the atmosphere.[4] The primary sources of these pollutants were flue gasses from smelter operations and dust within the mines. Dust and gasses are blown from the operational and abandoned waste rock, and from tailings dump sites.

The identified occupational diseases for miners in Zambia, especially in the copperbelt, have been silicosis and tuberculosis. In the hotspot townships of airborne exposure from smelter emissions in Mufulira, ambient air SO2 levels exceeded

[2] National Mineral Resources Development Policy Implementation Plan 2022 - 2027
[3] https://www.lusakatimes.com/2017/03/28/kcm-polluting-environment-10-times-statuary-limit/
[4] https://copperbelt.history.ox.ac.uk/2019/12/18/from-senta-to-acid-fumes-mufulira-mopani-copper-mines-and-environmental-pollution-chibamba-jennifer-chansa/

the 'safe' limits set by international and national standards. Moreover, the topsoil has turned acidic and has become laden with heavy metals (Pb, Zn, Cu, Co and Fe). These metals were also found in the dust deposited on the leaves of crops. There were visual signs of impaired vegetation cover and corroded housing infrastructure in the affected areas. Near the abandoned Pb–Zn mine in Kabwe, the soils have been contaminated by heavy metals, resulting in pathological lead poisoning among children.[5]

Government policy on the decarbonisation of the mining sector

The process of reducing 'carbon intensity' and lowering the amount of greenhouse gas emissions produced by the burning of fossil fuels is referred to as decarbonisation. Generally, this involves decreasing CO_2 output per unit of electricity generated. Reducing the amount of carbon dioxide occurring because of transport and power generation is essential to meet global temperature standards set by the Paris Agreement.

In Zambia, mining operations contribute to greenhouse gas (GHG) emissions through downstream processes, including most emissions-intensive activities such as steel, aluminium and cement manufacturing.[6] Mining is an energy-intensive industry that has social, and economic risks with a number of implications for the natural environmental. Firstly, mining requires a massive and continuous supply of energy, usually from fossil fuels which are the largest contributor to GHG emissions. The Intergovernmental Panel on Climate Change (IPCC) estimates that primary minerals and metal production were responsible for approximately 10 per cent of global energy-related GHG emissions in 2018.

Secondly, direct carbon emissions from mining operations are primarily generated through the increased use of diesel, petrol, acetylene, coal, coke, liquefied petroleum gas (LPG), propane, and heavy fuel oil (HFO). These forms of fuels produce greenhouse gas emissions. Mining companies have long used energy from carbon-intensive energy sources in their operations.

[5] Mwaanga, P., Silondwa, M., Kasali, G. and Banda, P.M., 2019. Preliminary review of mine air pollution in Zambia. Heliyon, 5(9), p.e02485.
[6] Climate risk and decarbonization: What every mining CEO needs to know January 28, 2020

Thirdly, Indirect GHG emissions are generated through electricity use and in the later stages of the value chain, with the scope of emissions gaining increasing attention. Other negative impacts are attributed to land and forest clearance and removing carbon sinks, such as forest cover, on site. Decarbonisation may refer to the dramatic reduction in carbon dioxide (CO_2) emissions from fossil fuel combustion, the primary global challenge in reducing GHG emissions. Zambia's primary fossil energy sources include coal, oil, petroleum, and natural gas.

The proven coal reserves in Zambia are estimated to be over 30 million tonnes, mainly consumed by mining, electricity, and commercial industries.

The generation capacity from coal accounts for 10 per cent of the total installed capacity. This means more exploration work is required for the country to ascertain the quality and extent of coal production from the deposit for electricity generation. Coal reserves alone have the potential to provide sustainable power and improve the security of electricity supply to the mining sector. However electricity production from coal is considered unclean or dirty energy.

Zambia is party to the United Nation Climate Change Conferences (UNCCC) and is committed to implementing the Paris Agreement. Together with the rest of the world, the state has promised a net zero-carbon world by 2050. This means greenhouse gas emissions are to be reduced by at least 25 per cent by 2023 against the 2010 base year from a business-as-usual scenario with limited international support, and up to 47 per cent GHG reduction with enhanced international support. This entails aggressive carbon abatement measures from 91.36 million tonnes to 67.22 million tonnes of greenhouse gas CO2 equivalent (GgCO2eq) in all climate-sensitive sectors, including the mining sector, translating into massive decarbonisation in all sectors of the Zambian economy. Zambia's nationally determined contribution (NDC) aims to reduce total emissions by 38 000 GgCO2eq by implementing three programmes driven by Zambia's Climate Response Strategy in sustainable forest management, sustainable agriculture and renewable energy, and energy efficiency.[7] Zambia's updated and revised nationally determined contribution represents a progression beyond its previously communicated nationally determined contribution, as it broadens the scope of sectors under mitigation

[7] Murungu, R.J., Bankole-Bolawole, O., Otieno, C. and Mwangi, C., 2022. Policy Brief on Inclusion of Water, Sanitation and Hygiene in Zambias Nationally Determined Contributions. Sustainable Development Research, 4(1), pp.p37-p37.

by adding transport, liquid waste, and coal (production, transportation, and consumption), and elaborates the adaptation component of the NDC by developing indicators that will enable the country to track progress on building resilience in both the human and physical systems.[8]

Appropriate legal and regulatory analysis for decarbonising the mining sector in Zambia

Zambia needs a specific and direct provision of policy for decarbonisation. This includes case law that may have, in one way or another, compelled any mining company in Zambia to decarbonise their extraction and mining operations. That being the case, decarbonisation in the mining sector can only be attributed by stretching the interpretation of mine safety, based on the current understanding of mine safety.[9]

The Constitution of Zambia

The constitution, as amended by Act 2 of 2016, is the supreme law, and "if any other law is inconsistent with it, that other law shall, to the extent of the inconsistency, be void" (Zambia, 2016a, Article 1(1)). The state is required, under the constitution, to put in place mechanisms aimed at reducing waste, promoting relevant environmental management systems and tools, and ensuring that the environmental standards that are enforced in the country essentially benefit the citizens (Zambia, 2016a, Article 257(b)(c)(f)). The constitution has established certain principles that must govern the development and administration of the environment and its natural resources (Zambia, 2016a, Article 255). Although it does not explicitly mention decarbonisation, it has strong environmental and sustainable development provisions. It calls for establishing policies, legislation and institutions that directly and indirectly affect the environment and climate change.

[8] Nationally Determined Contribution (NDC) of Zambia for the timeframe 2015-2030 -Updated as of 30th July 2021.

[9] Mine safety refers to all matters pertaining to safety and health of persons employed in Exploration, Mining and Mineral processing operations in line with the provisions of the Mines Minerals Development Act. Within safety definition is the use of both mechanical and electrical equipment, that demands inspections, mining safety audits and risk assessments targeted towards large and small mines to enforce Mining and Explosive Regulations.

Mines and Minerals Development Act 11 of 2015

Zambia's mining industry is principally regulated by the Mines and Minerals Development Act No. 11 of 2015 (the Mines Act) and the regulations issued thereunder. Section 4 recognises the principle of sustainable development by calling for the use and development of mineral resources in a manner that considers the needs of present and future generations (Zambia, 2015, Section 4(a)). This section further provides that the exploitation of minerals shall ensure safety, health, and environmental protection (Zambia, 2015, Section 4(c)).

The more instructive provisions relating to mine closure are found in sections 81, 82, 83 and 86 of the Mines Act. First, Section 81 provides that the conditions subject to which a mining right is granted or renewed shall include certain conditions prescribed by the Minister of Mines. The conditions may be about rehabilitation, levelling, re-grassing, reforesting, or contouring of the part of the land over which the right or licence has effect as may have been damaged or adversely affected by exploration operations, mining operations or mineral-processing operations and the filling-in, sealing or fencing of excavations, shafts and tunnels (Zambia, 2015, Section 81(1) (c), (d)). This includes a further requirement imposed on an applicant for the grant or renewal of a licence or the holder of a licence to lodge one or more cash deposits for securing the performance of the conditions by the applicant or licence holder.

Section 82 of the Mines Act instructs the holder of a mining or mineral-processing right to clear away all mining and mineral processing plants on land that ceases to be subject to a mining right or mineral processing licence. This must be done within a period of six months following cessation of the mining right or mineral-processing licence or within a period specified by the Director of Mines Safety (Zambia, 2015, Section 82(1), (2), (3)). Where any mining or mineral-processing plant still needs to be removed, section 83 prescribes how the state will dispose of it and how the sale proceeds will be apportioned.

Section 86 establishes the Environmental Protection Fund and briefly describes how the money contributed to the fund is applied. One progressive provision in the new Mines Act is that it expressly grants the minister the power to make regulations that should specifically deal with the decommissioning and closure of mines (Zambia, 2015, Section 119(2)(d)).

One critical component for mine safety includes decarbonisation as the responsibility of the mine owner or operator to achieve sustainable exploration and mining of mineral resources.

Section 87(1) applies specifically to a holder (a person in whose name a mining right or non-mining right is registered).
Section 87 of the Mines and Minerals Act No. 11 of 2015 places liability on a mine for damage caused to a person or environment under this Act. The mine shall be strictly liable for any harm or damage caused by mining operations or mineral processing operations and shall compensate any person to whom the harm or damage is caused. Subsection (2), states that liability shall attach to the person who directly contributes to the act or omission which results in the harm or damage. Subsection (4) states that, where any harm or damage is caused to the environment or biological diversity, compensation shall include the cost of reinstatement, rehabilitation or clean-up measures which are incurred and, where applicable, the costs of preventive measures.

Environmental Management Act No. 12 of 2011

This Act is the principal law that captures all aspects of protecting the environment against harm from human activities. Section 5, for instance, stipulates that every person must safeguard and enhance the environment. Section 6 then goes on to stipulate various principles of environmental management upon which mine closure is premised. These include the 'polluter pays' principle, the people's right to participate in the development of policies, plans and programmes for environmental management, long-term integrated planning against adverse environmental impacts, and sustainable development (Zambia, 2011, Section 6(d), (f), (b), (j)).

Section 29 of the Act is the most relevant provision concerning mine closure. This section prohibits persons from undertaking any project that may harm the environment without the written approval of the Zambia Environmental Management Agency (ZEMA). This approval is essentially granted upon ZEMA's consideration of an environmental impact statement (EIS). Further, there is a prohibition on other appropriate authorities from granting licences for the execution of projects likely to harm the environment without the project's approval from ZEMA (Zambia, 2011, Section 29(2)). The Act also provides for integrated environmental

management through the protection and conservation of the environment and the sustainable management of natural resources, including all mandates relating to preventing and controlling pollution and environmental degradation. The Act also promotes public awareness, information-sharing and education on climate change impacts and effects, and seeks to control and manage emissions from the industry.

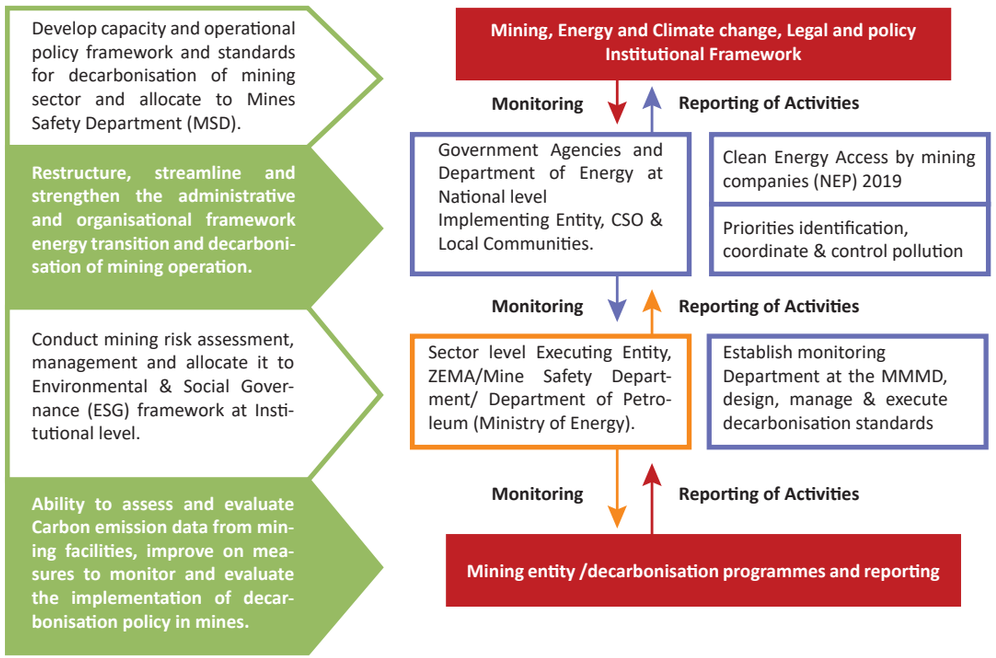
Energy Regulations Act No. 23 of 2003

This Act regulates energy and how efficiently it is used. In one of the key provisions (162), it promotes the scaling-up of alternative energy sources such as solar, wind and geothermal, as well as energy efficiency and conservation. It also seeks to provide electricity supply to rural areas to enable more people to access it, anticipating that it will reduce the demand for wood energy. The Act makes provision for the upgrade of petroleum by blending oil and fuel to reduce carbon emissions. There is an urgent need to change the processes used in the extractive industry, which is highly energy-intensive, if Zambia is to achieve the objectives of the Energy Regulations Act.

The Institutional Framework for Decarbonisation in the Mining Sector

The government's position and strategies for transitioning from fossil fuels to green energy is based on strategic analysis of mining, environment, energy and green growth. Zambia has strategic choices to make about the resource intensity of its economy. There is a need to analyse the long-term and short-term implications for energy costs and competitiveness, bearing in mind the relative infancy of the country's economy and the nascent energy and industrial infrastructure. The government should play a key role by supporting renewable energy development in the extractive sector and by setting a clear and strategic policy framework that creates a stable business environment for renewable energy investment. This can range from command-and-control regulations, such as a mandate for a certain percentage of electricity from on-site renewable energy generation to market.
To effectively implement the mining decarbonisation model in Zambia, there is a need first to restructure the Ministry of Mines and Mineral Development, the Ministry of Energy and the Ministry of Green Economy and Environment to coordinate measures in monitoring mining decarbonisation activities through established carbon monitoring reporting.

Figure 1: Institutional Arrangement Decarbonising Mining Operations capacities in Zambia.



Many of the environmental impacts are associated with the use of energy in various processes. Greenhouse gas emissions in the mining value chain are typically associated with fuel consumption in mining and material transport, processing, and indirect emissions from electrical energy use, land clearing and beneficiation processes. Decarbonisation is better analysed nationally by reviewing a public policy instrument covering sector standards, institutional-level effort, and legal and policy analysis. The starting point in the decarbonisation framework involves allocating responsibility through the standard setting to various institutions to decarbonise their operations and report on compliance to the appropriate executing entity for the approval process. Each actor has roles and responsibilities to comply with the set standards in line with legal, legislative and policy provisions.

The transition to a low-carbon economy will create opportunities for increased demand for metals and minerals required for transforming the global energy system. With the broader considerations in the region to decarbonise mining invest-

ment, mining companies in Zambia are required to lower their GHG emissions and carbon footprint, thereby contributing to sustainable mining critical for the transition to a green economy. This policy paper develops a model of problem causation in the mining and mineral processing industry: greenhouse gases from energy consumption, climate change impacts, negative environmental externalities and increased uptake of fossil fuel use in the mining industry and operation structures.

Two levels of decarbonisation in Zambia

The analysis is essential for policymakers, investors, various stakeholders, and the mining industry. Decarbonisation in the mining sector can be demonstrated twofold: firstly, reducing carbon emissions in the existing mining operational system, and secondly, the transit from fossil fuel to green energy through solar, wind, and electric vehicles. This requires a transformative approach to drive a new strategic corporate investment decision that shifts the company to a low-carbon development pathway. It further means emission reduction in the existing physical and material infrastructure across the mining value chain. Decarbonisation requires relatively rapid deployment of clean technologies, consistent with a decarbonisation pathway,[10] and a corporate responsibility framework such as Environmental Social Governance (ESG) that incentivises adopting cleaner production technologies. There needs to be more than public policy to drive the adoption of decarbonisation technologies.

Reduction of carbon emissions

Heavy-duty mining vehicles and carbon footprint: Mining companies in Zambia use heavy-duty vehicles in their underground and open-cast mining operations. This means more carbon emissions and extends the operational carbon footprint. Decarbonising in this area requires substantial changes in the primary means of moving cargo from trucking to rail transport. This transition will require a significant infrastructural shift for bulk and ore transportation, necessitating foreign and local financial investments. Changes in regulatory models will also encourage optimal private-sector infrastructure investments and streamline licensing and other barriers. Decarbonising mining haulage could significantly reduce emissions in the mining industry.

[10] pathway is a transformational process that delivers long-term emissions reductions and sustainable development in collaboration with local communities,

Transportation of ore and associated carbon emissions: From underground mining operations to mineral processing centres and refineries or smelters involves heavy-duty vehicles that depend on fossil fuel as the principal energy source. Supply chains in the mining sector primarily rely on complex, specialised networks of the production process located in different sites or towns or even countries. This system of value chains leads to the build-up of greenhouse gas emissions from haulage and bulk transportation. In Zambia, there needs to be a clear policy that is easy to enforce, ensuring that the action is controlled systematically.

Transitioning from fossil fuels to green energy

Zambia has produced coal since 1967. Most of the coal is from the country's largest coal production site, the Maamba coal mine. The country is estimated to have between 10 megatons (Mt) and 30 Mt in coal reserves. In 2021, the primary coal consumption for Zambia was 1 210 thousand short tons. Although Zambian coal primary consumption fluctuated substantially in recent years, it tended to increase from 2002 - 2021, ending at 1 210 thousand short tons in 2021.[11] Copper and cement processing along the rail line in Zambia's Copperbelt still relies on coal. The government has no clear policy to phase out coal as it relies on the following instruments, strategies and policies: environmental impact assessments (EIAs), risk assessments, performance targets and indicators, ISO-45001 quality standards, emission reports to ZEMA, GHG Accounting Protocol, environmental policy, decarbonisation policy, Standards ISO 14001 certified, cleaner production strategy, multi-stakeholder dialogue, environmental lawsuits and case law, environmental audits, and deforestation plans. Generally, the results display a picture of mixed compliance by the mining companies mainly because some standards are not obligatory. Understanding procedural compliance by mining companies is critical for measuring substantive compliance promulgated in government policies and regulatory requirements to reduce the mining sector's carbon emissions.

Mineral extraction and greenhouse gases: This stage of mining is characterised by energy-intensive processes with greenhouse gas (GHG) emissions from large volumes of fuels used in extracting ores. Material transport is where large quan-

[11] https://knoema.com/atlas/Zambia/topics/Energy/Coal/Coal-primary-consumption

tities of waste rock from the operation are transported using diesel haulage, blasting, grinding, crushing, and loading. The energy consumption in mineral extraction is dominated mainly by value addition due to high energy demand requirements for crushing and grinding ore. In the mining process, energy is required in loading, hauling, blasting, and in ventilation. These processes are an energy-intensive stage of the entire mining value chain. Hauling and loading account for high energy consumption due to heavy reliance on diesel-operated vehicles. The indirect emissions are mainly from electrical energy use and land clearing (for open pit mines).

Mining releases greenhouse gases into the atmosphere through mineral processing, hauling, supply chains, electricity supply, transportation, and diesel trucks. Mining decarbonisation is a policy that propels transformation in mining governance from a limited incremental emission reduction strategy to a complete transformative energy and mineral production system. The value of shifting to a decarbonised mining system will bring about mining reform towards net zero emissions. Therefore, reducing the use of diesel, gas, and coal becomes critical to the new shift to the decarbonisation of the mining sector and the long-term goal of transitioning to a green economy in mining.

Understanding mining decarbonisation requires critically examining mining operations through an analytical process driven by public policy objectives in mining and mineral development policy. Without explicit mineral policy provision, decarbonisation is motivated by comprehensive decisions of greening mining investments and harnessing green infrastructure within the mining value chain. However, efforts and time must be invested in decarbonising existing mining infrastructure and processing plants through emission reduction strategies and low-carbon development pathways. This way, the net zero carbon economy will continue to positively affect the national economy and society by promoting equality and social justice.

The results present governments' position through green growth strategy, policies, and strategies in the short, medium, and long term to transit from fossil fuels to green energy.

Table 1: Environmental standards and emission reporting protocols in four mining companies

ENVIRONMENTAL & MINERAL PRODUCTION	MOPANI COPPER MINE	NFCAFRICA PLC	KONKOLA. COPPER MINE	ZCCM IH
EIA	✓	✓	✓	X
Risk assessment	✓	✓	✓	X
Performance targets & Indicators	X	✓	X	✓
ISO-45001 Quality standard	X	X	X	✓
Emission Report to ZEMA	✓	✓	✓	X
GHG Accounting Protocol	X	X	X	X
Environmental policy	✓	✓	✓	✓
Decarbonisation policy	X	X	X	X
Standards ISO 14001 certified	✓	✓	✓	✓
Cleaner production Strategy	✓	✓	✓	X
Multi stakeholder Dialogue	✓	X	✓	✓
Environmental Lawsuit/ case law	✓	✓	✓	X
Environmental Audit	X	X	✓	X
Deforestation plan	X	X	X	X
Overall Records (Yes) ✓	8	8	9	5

Source: Field Data 2022

Key: ✓ means the policy availability X means policy unavailability

The table above presents procedural compliance that establishes whether the mining companies generally complied with government policy requirements for addressing decarbonisation and the environmental impact of the mining industry.

Analysis of Mopani greenhouse accounting and reporting system

This set greenhouse accounting system is voluntary and reports on carbon emissions and fossil fuels as part of the decarbonisation strategy by the mining company to reduce carbon footprint. Old mines with obsolete infrastructure must replace the machinery with better technology through recapitalisation. The idea is to reduce coal consumption in major operational areas, including the smelter and processing plants. The company has no stand-alone policy on decarbonisation but relies on its decarbonisation strategy.

Table 2: Detailed analysis of Mopani Copper mine fossil fuel monthly use in the mining operation

Item No	Description	Typical monthly consumptions	Commentary
1	Hydro electricity grid	150MW demand 90GW h Energy	The main source of power used throughout the mine's underground and surface operations. Hydro includes minor combination of fossil fuel and the solar electricity generated and fed.
2	Diesel	1 600 000 litres	Used in mobile and fixed equipment on the surface and underground, includes the smelter furnaces.
3	Petrol	2 300 litres	Mainly used in transportation vehicles. The bulk of the mine fleet uses diesel engines.
4	Acetylene	Less than 100 tonnes	Mainly used for metal welding.
5	Coal	200 tonnes	Used at the smelter furnaces.
6	Coke	300 tonnes	Used at the smelter furnaces.
7	Liquefie petroleum gas (LPG)	Less than 1 tonne	Used at the smelter acid plant, preheater.
8	Heavy fuel oil (HFO)	647 tons	Used at the smelter furnaces.
9	Propane	Less than 10 tonnes	Used in metallurgical analytical laboratories process.

Source: Field Data; 2022

Decarbonisation energy needs in the mining sector

Energy efficiency is one key strategy for decarbonising the mining sector. This voluntary measure includes the promotion of efficient utilisation of energy services and switching to clean energy alternative sources and technologies. Some mining companies have started deploying energy performance standards, such as lighting and solar water heater initiatives within the mining sector.

Diversification of electricity sources is another decarbonisation measure employed by a few mining companies, including Mopani Copper Mine. This includes the promotion of energy-efficient technologies and initiatives within the mining operation.

Zambia's electricity installed generation capacity stands at 2 976.3 MW, comprising 80.8 per cent of hydro, 10 per cent of coal, 3.5 per cent of heavy fuel oil, and 2.7 per cent of diesel. The mining sector is the largest electricity consumer in Zambia, consuming an estimated 51.1 per cent.

Decarbonisation presents both opportunities and challenges for the mining and energy sectors. Regarding energy, mining can be analysed in terms of the energy vision "Universal access to clean, reliable and affordable energy at the lowest total economic, financial, social and environmental cost consistent with national development goals by 2030" contained in the National Energy Policy 2019. This is also illustrated in the Mines and Mineral Resources Development Policy, which provides for mining and processing minerals in compliance with safety, health and environmental regulations, including emission reduction initiatives. The policy encourages mining companies to utilise appropriate, affordable, and safe emission reduction technology within the mining operations.

Mining companies' policies and interventions to decarbonise their operation

The policy paper analyses mining companies' efforts through policies and the application of new technologies to reduce emissions from their operations. The International Council on Mining and Metals (ICMM), through its Climate Change

Statement[12] has committed its members to a goal of net zero Scope 1 and 2 greenhouse gas (GHG) emissions by 2050 or sooner in line with the ambitions of the Paris Agreement. Although companies have individual decarbonisation targets which in some cases go beyond the collective commitment, this represents a joint ambition from companies that make up one-third of the global mining and metals industry. It is hoped that suppliers and customers will be encouraged to decarbonise the value chains.

Analytical works examine whether the mining companies have institutional policies addressing decarbonisation measures. This entails the level of compliance by targeted mining companies to international carbon standards for self-regulation aimed at reducing the impact of carbon emissions from mining operations.

Table 3: Assessment of mining companies' decarbonisation policies and standards in target mines

CORPORATE RESPONSIBILITY	MOPANI COPPER MINE	NFC AFRICA PLC	KONKOLA COPPER MINE	ZCCM IH
Carbon Policy	X	X	X	X
Decarbonisation strategy	✓	X	X	X
Sustainability Reporting	X	✓	X	✓
Carbon Risk Assessment Strategy	X	X	X	✓
Performance Targets & Indicators	X	✓	X	X
Public disclosure of policies/practices	✓	✓	X	X
Community participation policy	✓	✓	✓	✓
ESG strategy	✓	X	X	✓
Renewable Energy Policy	X	X	X	X
Multi Stakeholder Dialogue	✓	X	✓	✓

Source: Field Data 2022

Key: ✓ means the policy availability X means policy unavailability

a) Mopani Copper Mine: the company has only five (5) out of ten (10) decarbonisation policies and standards in place. The company still needs to implement the following: carbon policy, sustainability reporting, carbon risk assessment, performance targets and indicators, and renewable energy policy.

[12] https://www.icmm.com/website/publications/pdfs/mining-principles/net-zero-by-2050_en-gb.pdf

b) NFCA PLC: 4 out of 10; the following policies and standards are absent: carbon policy, decarbonisation strategy, carbon risk assessment strategy, ESG strategy, renewable energy policy, and multi-stakeholder dialogue

c) Konkola Copper Mine: 2 out of 10; the following policies and standards are absent: carbon policy, decarbonisation strategy, sustainability reporting, carbon risk assessment strategy, performance targets and indicators, public disclosure of policies/ practices, renewable energy policy, and multi-stakeholder dialogue.

ZCCM-IH cannot be assessed separately because it is part of the other three companies and has 50 per cent of the policy and standards used in this analysis.

Of the above companies, only Mopani Copper Mine has a deliberate policy on decarbonisation, while the rest still need to make any steps.

Conclusion and recommendations

This study concludes that no specific and direct legal provision speaks to decarbonisation in Zambia. Mine safety includes all matters about the safety and health of persons employed in exploration, mining and mineral processing operations. However, within the safety definition, mechanical and electrical equipment use demands inspections and mine safety audits and risk assessments may include carbon risks analysis targeted at large and small mines.

The government's position on fossil fuel deployment in the mining sector must be clear. However, it encourages mining companies to utilise appropriate, affordable, and safe emission reduction technology within the mining operations. Transportation is the leading source of carbon emission in Zambia's mining companies. Mining companies in Zambia use a lot of heavy-duty vehicles (HDVs) in their mining operations, both in underground and open-cast mining. Decarbonising mining requires more than policies; it needs a mind shift or transformative change that adopts net zero targets modelled to be financially attractive to mining companies. Finally, Zambia does not have a specific carbon reduction strategy for the mines in all its national policies, including the Nationally Determined Contribution (NDC) 2030.

The study further established that decarbonisation policy would require changes in behaviour (adapted energy and climate targets embedded into mine processes and strategic goals). Involvement of stakeholders mining DNA, building net zero carbon, building social license with decarbonisation goals, technological uptake in mining companies, increased rail use and increased use of public transport and incentivising emissions reductions) could significantly reduce the burden of carbon in mining economy-dependent countries like Zambia.

Recommendations to the mining companies on phasing out fossil fuels and decarbonising the mining sector

- Mining companies must work on decarbonising mobility, such as fleet diesel displacement, electrification and zero emission mining equipment as a better road map towards net zero mining by 2030.
- The institutional policies in most mining companies should foster climate resilience in mining operations and reduce carbon footprint.
- Mining companies must use, test, and evaluate specific strategies for reducing carbon emissions from motor vehicles focused on increasing motor vehicle efficiency, improving vehicle fleet, and reducing carbon emissions from the operation of existing motor vehicles and other forms of transportation.
- There is a need to restructure, streamline and strengthen the administrative and institutional framework through ESG to promote decarbonisation in the mining sector.

Recommendations to the government on decarbonising the mining sector in Zambia

- There is a need to put in place a deliberate policy that can compel mining companies to contribute towards a low-carbon economy actively.
- The government should develop a National Greenhouse Gas Emissions and Reporting Policy for mining companies.
- Air quality law must be developed by the government, and the law must outline the emission standards that facilitate fuel efficiency improvements and conversion to zero (or near-zero) emission technologies such as electric drive train technology, hydrogen, and synthetic gas. All this will be necessary to reduce GHG emissions by 2030.
- The government must develop capacities and operational adequacies of the Geological Survey, Mineral Development and Mines Safety Department.
- The government should establish a research and monitoring department in the Ministry of Mines and Mineral Development to monitor and evaluate decarbonisation in mining companies.
- The government must encourage mining companies to conduct energy switch to sustainable and renewable energy targets. Transitioning to renewable solutions will increase economic sustainability, helping mines maintain their social licence.

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SARW
Southern Africa Resource Watch

SARW Objectives

Monitor corporate and state conduct in the extraction and beneficiation of natural resources in Southern Africa, and assess to what extent these activities uplift the economic conditions of the region's communities.

- Generate and consolidate research and advocacy on natural resource extraction in Southern Africa.
- Create informed awareness of the specific dynamics of natural resources in Southern Africa, building a distinctive understanding of the regional geo-political dynamics of resource economics.
- Provide a platform of action, coordination and organisation for communities, activists, researchers, policy-makers, corporations, regional and global governing bodies in the watching and strengthening of corporate and state accountability in extractive industries.
- Engage with and support government on building accountable and transparent management of extractive resources.
- Build capacity for communities, civil society, parliaments, and media to hold governments and corporations to account, and to participate in decisions about resource management.
- Advocate and promote human rights and environmental protection in resource extraction activities.
- Support efforts to legislate mandatory public disclosure of and access to financial, social, environmental and regulatory compliance information in the extractives industry.
- Promote extractive industries that create wealth for local communities.

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