In collaboration with Development Bank of Southern Africa and McKinsey and Company

WORLD ECONOMIC FORUM

Securing Minerals for the Energy Transition: Finance for Southern Africa

WHITE PAPER

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Contents

Foreword

Boitumelo Mosako
Chief Executive Officer, Development
Bank of Southern Africa (DBSA)

At the Development Bank of Southern Africa (DBSA), our mission has always extended beyond infrastructure financing. It is about enabling inclusive growth, alleviating poverty and deepening development impact across the continent. As we confront the major transitions of our time that include climate change-induced challenges, cyclical economic headwinds and technological disruption, Africa must be an active participant in shaping its own development path.

The transition to a low-carbon future brings with it opportunities driven by the global agenda of suppressing the pace of climate change, since Africa is abundant in the minerals needed to drive clean energy technologies. However, if extraction continues in the same manner as historical practice, which is characterized by the export of raw materials, limited local beneficiation and inadequate community impact, the continent will once again miss the opportunity to convert its mineral wealth into structural socio-economic transformation.

DBSA partnered with the World Economic Forum to produce this paper, a playbook of solutions that reframes the critical minerals landscape to prioritize long-term economic transformation and diversification across the region. DBSA sees a unique role for development finance in ensuring that value is created and retained locally, that communities are meaningfully included, and that economic participation becomes more equitable.

This paper outlines practical solutions to accelerate investment in Southern Africa's clean energy and critical minerals value chains. Furthermore, it identifies the regulatory, institutional and policy enablers that will de-risk the sector and encourage private capital participation by providing a toolbox for governments, development finance institutions and industry partners to work collectively to close investment gaps.

As we look ahead, our commitment is to drive and support solutions that build industrial resilience through enabling infrastructure, unlock the regional opportunity and broaden economic participation.

Executive summary

This paper unlocks solutions to finance and scale critical mineral value chains across Southern Africa.

Critical minerals are essential to the energy transition, forming the foundation of low-carbon technologies such as electric vehicles (EVs), energy storage systems and photovoltaic cells. The International Energy Agency (IEA) classifies them as vital yet vulnerable to supply disruptions. This report focuses on critical minerals found in the Southern African Region (SAR) – including copper, cobalt, graphite, lithium, manganese, chromium, platinum group metals (PGMs) and vanadium – and analyses their value chains across 10 SAR countries: Angola, Botswana, Democratic Republic of the Congo (DRC), Madagascar, Mozambique, Namibia, South Africa, Tanzania, Zambia and Zimbabwe.

Many SAR countries have higher reserves-to-production ratios than global peers, allowing longer production at current rates and underscoring their role in global supply. Despite these large reserves, exploration is underfinanced in SAR countries, attracting less than 15% of total global spending.

Despite SAR's mineral wealth, financing challenges hinder the development of its value chains. From January to June 2025, the World Economic Forum's Centre for Energy and Materials and the Development Bank of Southern Africa (DBSA) organized consultations and workshops to discuss the financing challenges with key regional stakeholders.

Financing challenges were grouped into eight themes: policy uncertainty, investment risks, energy access, transportation barriers, innovation lag, pace of industrialization, skill gaps and demand volatility. Workshop participants proposed proven and innovative solutions like designing de-risking finance structures, upgrading infrastructure networks, adopting advanced technologies and leveraging offtake agreements to ensure predictable revenues.

This paper outlines the solutions that emerged, illustrating each with a case study that offers a replicable model for SAR countries. Some span multiple countries, like the Lobito Corridor in Angola, DRC and Zambia, while others highlight national efforts, like Namibia's "green iron" project with the European Union (EU). The inclusion of innovation piloted in Chile reflects how solutions from outside the region can also be adapted and scaled to enhance mining operations in Southern Africa.

Introduction

Surging demand for critical minerals offers an opportunity to expand and diversify global supply chains.

The energy transition and critical minerals

Critical mineral demand is set to grow four-fold by 2040.

Rising carbon emissions have driven global warming and more extreme weather, making the shift to low-carbon technologies essential. The energy transition, from fossil fuels to renewables like solar, wind, hydro and geothermal, also requires decarbonizing key sectors such as transport.

The transportation sector accounts for 37% of global emissions and has grown at an average annual rate of 1.7% over the past 30 years, faster than any other sector.[1] Decarbonizing transportation will hinge on various enablers, including faster adoption of EVs as a sustainable alternative to internal-combustion engine (ICE) vehicles.

Renewable energy and electric vehicle (EV) development rely on technologies like battery storage, solar panels, wind turbines and advanced grids. Key minerals such as lithium, cobalt, nickel and graphite are critical for lithium-ion batteries, while rare earth elements are used in magnets for wind turbines and EV motors. Copper is essential for wiring and PGMs support fuel cells and electrolysers.[2]

These minerals and others are collectively referred to as "critical minerals", which the International Energy Agency (IEA) classifies as minerals vital for the energy transition but vulnerable to supply disruptions.[3] Most of the countries and multilateral organizations involved in the IEA also define a list of critical minerals based on their strategic needs.

The African Union's Green Mineral Strategy defines "green minerals" as "minerals that are used in clean energy technologies and green industries, that can maximize the benefits of Africa's mineral endowment and those that are feedstocks for resource-based industrialization of clean energy industries."[4] This contrasts with approaches like the United States (US) Energy Act of 2020, which lists 50 critical minerals based on economic and national security needs, reflecting a focus on supply security rather than production.[5]

Under IEA's net-zero scenario, demand for critical minerals is expected to quadruple by 2040, driven by clean energy technologies.[6] However, reserves and production are highly concentrated, risking supply disruptions amid growing demand.[7] For example, the DRC holds 55% of global cobalt reserves and produces 74% of global cobalt supply. China produces 69% of the world's rare earth elements and holds 40% of global reserves. Indonesia accounts for 50% of nickel production and 42% of reserves.

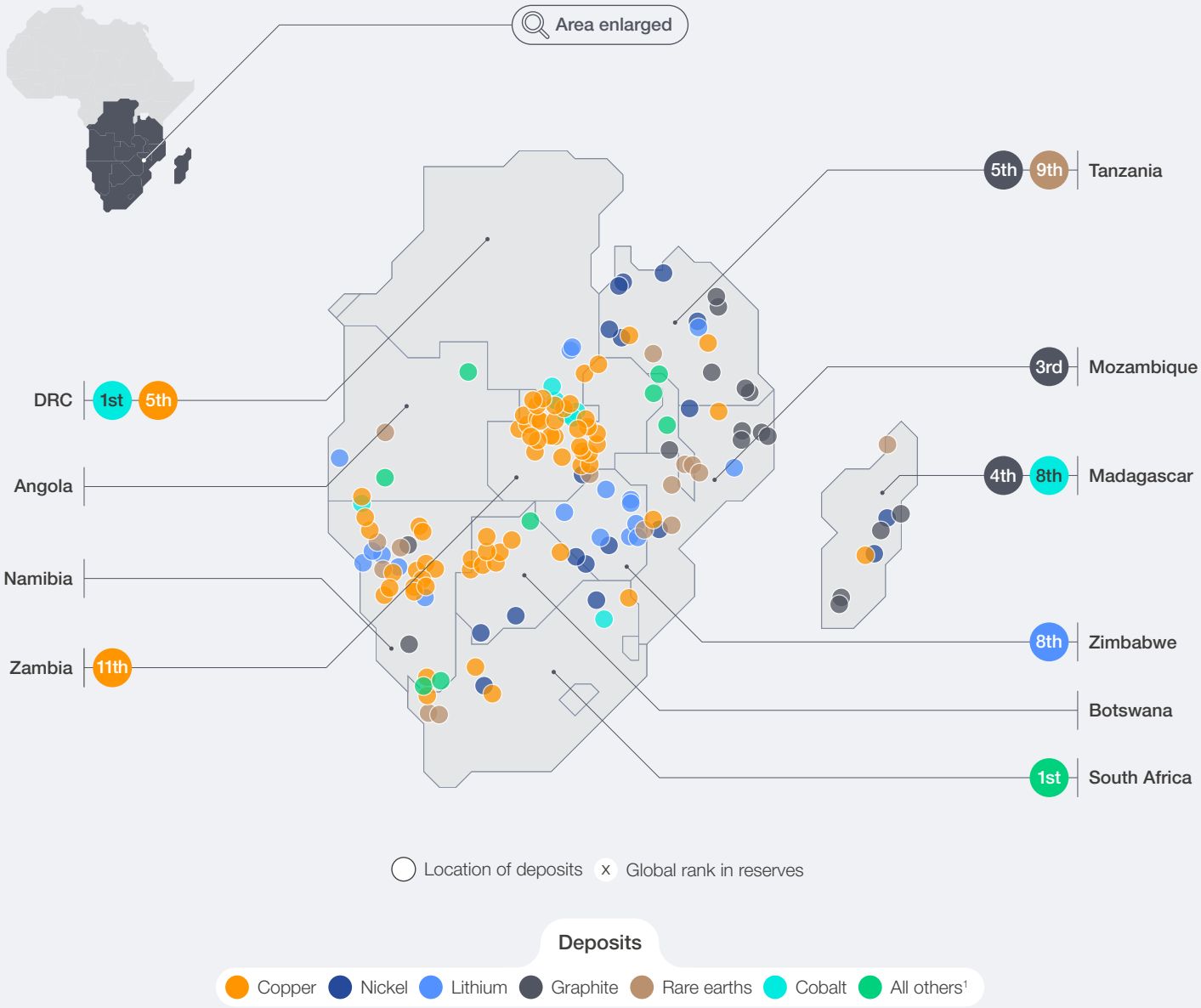
The Southern African Region's role in critical minerals

The Southern African Region (SAR), which includes Angola, Botswana, Democratic Republic of the Congo (DRC), Madagascar, Mozambique, Namibia, South Africa, Tanzania, Zambia and Zimbabwe, is expected to play a crucial role in the energy transition. Nearly 30% of the world's proven critical mineral reserves are found in the region, which also includes approximately 50% of the world's cobalt reserves, 20% of the world's graphite reserves and 10% of the world's copper reserves.[8]

Critical minerals found in SAR countries can be leveraged to support the region's economic and social development. However, Africa's exploration spending in 2024 was $1.3 billion, only 10.4% of the total global spending,[9] while SAR countries' percentage share was even smaller. In comparison, Australia and Canada attracted $2 billion and $2.5 billion, respectively, 16% and 20% of global exploration spending in 2024, largely driven by private sector investment.

Compared to global peers, SAR countries have higher reserves-to-production ratios for most minerals (except lithium), suggesting greater extraction potential.

FIGURE 1 **Critical mineral deposits in the Southern Africa Region**



Note: 1. Includes platinum group metals, manganese, chromium and diamond.

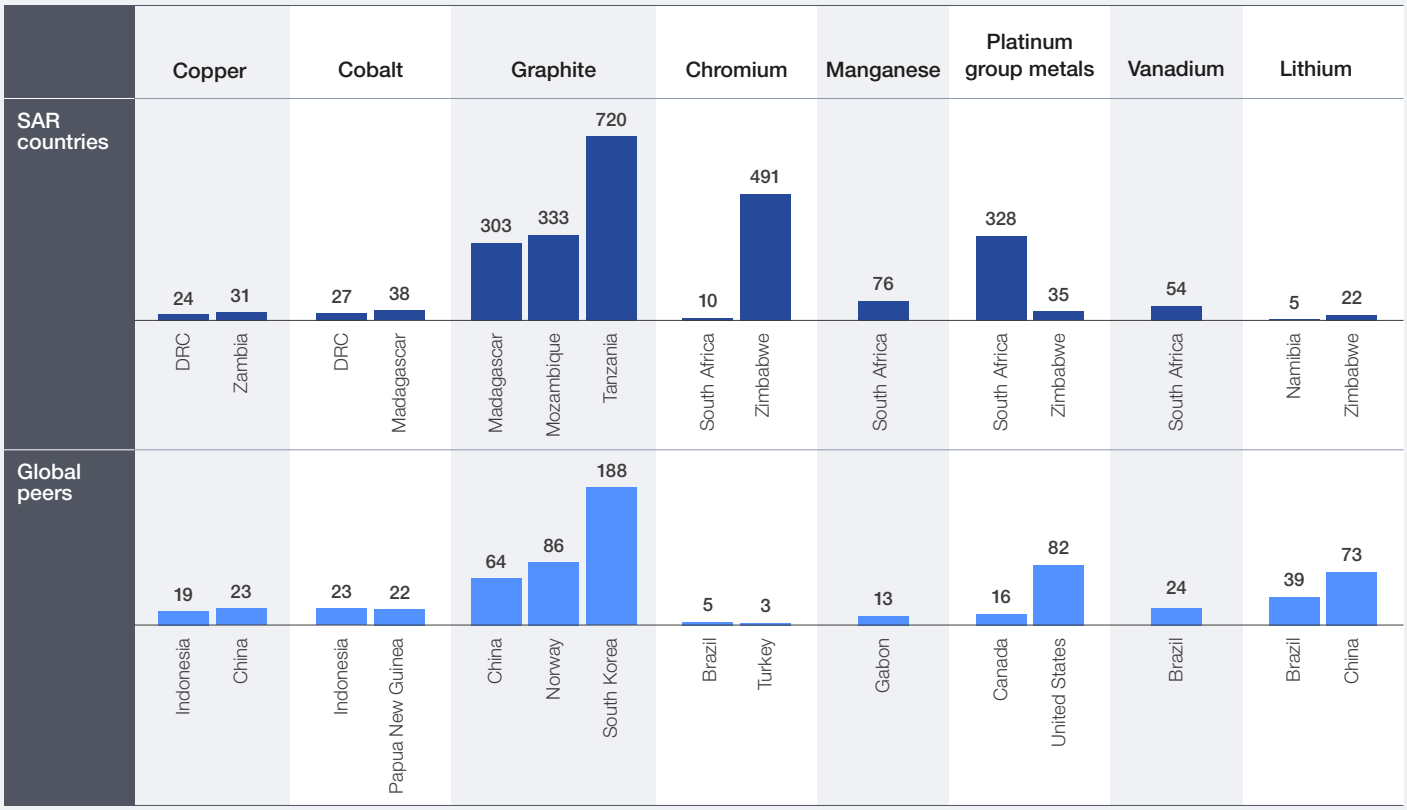
Source: SNL metals and mining intelligence, United States Geological Survey.

FIGURE 2 | **Reserves-to-production ratio in Southern African Region countries**

At 2024 production rates, SAR can produce critical minerals for longer than other countries, highlighting the importance of its reserves to global supply chains

Reserves-to-production ratio[1]

Non-exhaustive



Note: 1. An indication of the number of years of potential production at 2024 production rates.

Source: US Geological Survey.

SAR country profiles

An overview of SAR's critical minerals sector highlights current strategies and reveals opportunities to grow the value chain from exploration to processing.

Despite holding around 30% of global critical mineral reserves,[10] Southern Africa attracts less than 10% of global mining exploration spending, highlighting the region's financing gap and untapped potential.[11]

To respond to the challenge of underfinancing, SAR countries have taken several policy actions recently, such as amendments to mining regulations, local value addition requirements and export bans.[12]

TABLE 1 | **Examples of publicly announced policy actions**

Non-exhaustive

Country	Overview of critical minerals sector	Recent policy actions
 **Angola**	Focusing on increasing production of critical minerals such as lithium and rare earth elements (REE)	Fundo Soberano de Angola (sovereign wealth fund) invested an additional **$9 million in Pensana's Longonjo rare earths project**. The United States International Development Finance Corporation backed a **feasibility study for rare earths processing** in 2024.
 **Botswana**	Emerging copper producer, particularly in the Kalahari Copper Belt, saw a five-fold increase in production from 12 kilotonnes (kt) in 2021 to 55 kt in 2023.	**An amendment to the existing Mines and Minerals Act** increased local ownership in mining projects. **Diversified exploration spending** increased the share of non-diamond minerals (copper and nickel) from 24% in 2006 to 70% in 2024.
 **DRC**	Making heavy investment in exploration; 67% of total exploration investment is in copper, ensuring that the Kamoa-Kakula Complex produces the world's highest copper ore grade. Has a 74% share of global cobalt production, refining activity remains low. Aiming to enhance cobalt refining capabilities.	Temporarily **banned cobalt exports in early 2025** to curb oversupply, stabilize global prices and **enhance domestic processing capabilities**. Exerting pressure on the International Conference of the Great Lakes Region to enforce stricter mineral tracing standards.
 **Madagascar**	Has a 6% share in global graphite production, 1% in global nickel production. Creating infrastructure in areas with mines, which are located in remote locations.	**Recently published Mining Code** incorporates provisions to attract investment, including **enhanced mining sector governance** and assurance of fair distribution of mining benefits.
 **Mozambique**	Comprises 6% of global graphite production. Security challenges have caused exploration spending to drop from $25.5 million in 2014 to just $1.4 million in 2024.	Mozambique Mining Exploration Company, a state-owned company, is working to further **increase graphite extraction**.
 **Namibia**	Critical minerals such as REE and lithium are in development/early production stage.	**Banned export of unprocessed critical minerals** in 2023, including lithium and REE. **Signed an EU-Namibia strategic partnership** on sustainable raw materials value chains and renewable hydrogen.
 **South Africa**	Provides 40% of global manganese supply (2024). Is the leading producer of platinum group metals and chromium.	**Published a minerals exploration strategy**, including a critical minerals list. Announced a **ZAR500 million (~$27 million) critical minerals fund** to support exploration activities.
 **Tanzania**	Is building graphite and rare earth reserves. Doubled exploration spending from 2021 to 2022; is redirecting more exploration investment towards nickel and copper.	**Is developing a Critical and Strategic Minerals Strategy** (at consultation stage). **Is undertaking legal reforms** (Mining Act CAP 123) to attract investments.
 **Zambia**	Has a 3% share of global copper production. Targets 3 million tonnes of copper output by 2032. Increased exploration investment 89% year-on-year in 2022, from $42.1 million in 2021 to $79.6 million.	**Has drafted a local content policy** to increase the participation of domestic businesses in the nation's mining industry. **Launched the Integrated Mining Information System (ZIMIS)** to ensure transparency in managing mining licenses.
 **Zimbabwe**	Lithium production has increased eight-fold from 417 kt in 2020 to 3,400 kt in 2023; the current share is at 2% of global lithium production.	**Introduction of the Base Minerals Export Control Order** in 2022 is set to boost processing and local value addition. **Amendments to the tax regime** and expansion of the definition of "beneficial owner" and "controller" deter corruption.

Source: Press search, literature review, CSIS, Global Critical Minerals Outlook 2025.

1 Context setting

A regional effort can mobilize investment and accelerate the development of critical minerals in Southern Africa.

1.1 Methodology

In 2024, the World Economic Forum convened a public-private community of 50 experts that surfaced key investment barriers and proposed solutions to accelerate the development of clean energy capital in South Africa. This work was expanded upon in 2025 to look at the broader SAR and facilitate solutions that could accelerate financing for critical minerals.

This regional deep dive is part of the Securing Minerals for the Energy Transition (SMET) initiative launched by the World Economic Forum, with McKinsey & Company as a knowledge partner and in collaboration with the DBSA.

Over six months, public and private stakeholders engaged in consultations and dialogue to identify financing gaps, policy needs and opportunities for local value addition to boost inclusive growth. This report provides guidance for solutions that enhance local impact and global supply resilience, as well as real case studies that serve as examples to inspire SAR countries.

1.2 Problem definition

The SMET initiative brings together key stakeholders to address financing barriers and unlock the critical minerals value chain in the region. Developing this value chain in SAR could improve mining revenues and lead to economic growth and socio-economic development.[13]

The following core problems emerged from stakeholder discussions:

- SAR attracts a low share of global exploration financing despite high reserves-to-production ratios.
- This underfinancing leads to reserves not being leveraged to their full potential.

FIGURE 3 | **Key challenges and potential "unlocks" identified through multistakeholder consultations**

Challenges	Effect on financing	Potential "unlock"	Solution theme
Policy uncertainty	Ambiguity in regulations decreases investor confidence	Laying out stable, clear and consistent regulations	Policy measures
Investment risks	Directly affects project stability and can make it unattractive for investments	Innovative financing structures and partnerships for de-risking	Investment de-risking
Energy access	Destabilizes mining operations and reduces project viability	Strategic investments to enable stable power for mining operations	Energy strategy
Transportation barriers	Constrains procurement and logistics, leads to sub-optimal mining operations	Building new transportation networks and upgrade existing ones	Transportation infrastructure
Innovation lag	Lag in adopting latest technologies leads to operational inefficiency	Implementing latest technologies for enhancing operational efficiency	Innovation promotion
Pace of industrialization	Slow industrialization and focus on only raw material exports lowers value-add	Developing industries for local value-add and beneficiation	Industrial cluster development
Skill deficit	Unskilled workforce leads to inefficient operations, lowers project attractiveness	Preparing local workforce with market-ready skills to boost operational efficiency	Human capital development
Demand volatility	Affects revenue stream predictability and lowers project attractiveness	Ensuring predictable revenue streams for the mining project	Demand certainty

Source: Consultations and workshops conducted with stakeholders.

1.3 Key challenges

Consultations and workshop sessions focused on financing challenges and the missed opportunity from limited local beneficiation, as most processing occurs outside the region. Developing downstream capabilities could better integrate SAR into global low-carbon value chains, supporting local decarbonization, energy security and industrial growth.

The challenges surfaced by the community have been classified into the following eight themes:

1 Policy uncertainty

While policies are often designed to advance national priorities, inconsistencies and governance uncertainty could still undermine investor confidence.

BOX 1 **Illustration of policy uncertainty**

Zimbabwe imposed a special capital gains tax of 20% on the proceeds of transferring a mining title, which mining companies operating in the country have deemed high and detrimental to their operations.[14]

Policy and regulatory factors	Key challenges
Trade and tax policy	– Tariffs, export bans and inconsistent regulations can hinder exports – Uncertain tax regimes and volatile, highly complex and subjective tax legislation can directly impact mining activities through ambiguous royalty rates
Local content requirements and benefit mandates	– Regulatory barriers to beneficiation can discourage local value addition and refinement, leading to the export of raw materials instead of processed goods
State capacity to enforce policies	– Delays in government approvals and lack of consistency in regulatory frameworks can hinder project timelines. Similarly, lack of capacity to structure and de-risk deals and policy inconsistency can lead to legal disputes and governance uncertainty in the form of regulatory changes, which can in turn deter investments

2 Investment risks

Mining is an inherently risky activity, which can be compounded by other potential risks in SAR.

BOX 2 **Illustration of a consequence of investment risk**

According to a partner at the Critical Minerals Fund, around $17 billion of specialist mining capital is held by private equity funds globally, with only 2.8% focused on Africa.[15]

Investment risk category	Key challenges
Securing early-stage investments	– Limited access to diverse funding options during development often forces companies to give up significant equity – Early-stage financing for large-scale projects in high-risk regions remains a key challenge – Financial institutions may face mandate restrictions and short tenures, limiting their ability to support critical minerals investment
Sector constraints	– Mining critical minerals is highly capital-intensive, and the lack of local expertise in advanced processing further deters investment – The competitiveness of local processing and refining is often hindered by market dominance and state subsidies provided in markets outside the region
Sector-specific risks and barriers	– Investors are often wary of unstable economic conditions in some SAR countries, leading to reluctance when committing to financing projects in the region – The lack of quality geological data and issues around bankability barriers can make it challenging to secure investment for extraction in the region

3 Energy access

Without access to reliable energy, the viability of projects remains questionable and can deter investors. ESG standards play a key role in promoting responsible development, and in some cases, specific criteria – such as emissions thresholds or supply chain traceability – may influence the availability or structure of financing.

BOX 3 Illustration of energy access challenges

Power outages in Zimbabwe, which can last up to 18 hours at a stretch, have severely affected the mining sector.[16] Some renewable energy projects, such as the Gwanda solar project in Zimbabwe, have stalled for 10 years.[17]

Category	Key challenges
Power generation, transmission and distribution	– Bankrupt utilities can cause frequent power outages – Insufficient tariffs can hinder utilities' abilities to cover costs, invest in generation and maintain infrastructure – Cross-border grid limitations can make it difficult to share excess power – Lack of transmission lines makes it difficult to carry power from generation sites to mines, smelters and processing facilities
Fuel mix (percentage share of renewables)	– Heavy reliance on coal persists despite major untapped solar and wind potential – Remote mineral deposits and unreliable power grids drive reliance on diesel generators and hydropower, limiting renewable integration
Just transition and ESG opportunity	– Focusing on ESG compliance can help ensure local jobs, community benefits and ESG safeguards, which can de-risk projects from a reputational standpoint – Lack of net-zero strategies in most SAR countries makes ESG enforcement difficult – Underdevelopment of renewable energy sources hampers decarbonization, affecting alignment with ESG-focused trade partners – Rising compliance costs must be factored into early project planning (e.g. Environmental Impact Assessments,[18] emissions controls, waste management and water treatment)

4 Transportation barriers

Without a well-developed transportation system, mining project logistics are likely to suffer. This could increase project costs and make financing unattractive.

BOX 4 **Illustration of a transportation barrier**

Disruptions in port operations at Maputo, Beira and Nacala ports in Mozambique.[19]

Type of transportation	Key challenges
Port authorities and shipping services	– Port congestion often arises from infrastructural limitations, slow processing times, use of outdated equipment and inefficient customs procedures[20] – Some ports in SAR countries have seen disruptions in operations and delays in cargo processing and vessel handling, stemming from political unrest and volatility[21] – Some SAR countries, such as Botswana, Zambia and Zimbabwe, are landlocked and therefore rely on their neighbours for shipping services
Railway systems and containers	– The region suffers from poor maintenance of rail and poor coordination between intra-region rail operators – Theft and vandalism on rail networks, particularly those transporting mineral ores, has been reported in railway systems servicing cross-border trade[22] – Some railway systems transporting key critical minerals are struggling with debt and a lack of capital required for repairing infrastructure
Road transportation and trucking	– Over 1,000 trucks per day are used in place of rail infrastructure, leading to 100-kilometre truck queues at borders and delays of up to two weeks – Delays in securing project approvals from key stakeholders are frequent – Outbound minerals exceed inbound cargo (mostly fuel), causing transportation inefficiencies and empty legs – The safety of truck drivers is a concern; approximately 5,000 truck hijackings occurred in South Africa from 2018 to 2021[23]

5 Innovation lag

Limited venture capital, slow tech adoption and weak intellectual property (IP) protection reduce project appeal for investors.

BOX 5 **Illustration of an innovation lag challenge**

The African Private Equity and Venture Capital Association (AVCA) notes that materials made up less than 1% of total private equity and venture capital investments in 2021-22.[24]

Type of innovation lag	Key challenges
Venture capital financing	– A lack of venture capital to support innovation is a global challenge that adversely affects SAR countries – Promising projects remain underfunded or stalled because of financial constraints
Adoption of cutting-edge mining technologies	– A lack of collaboration between universities, research institutions and the private sector means fewer homegrown innovations and trained specialists – There is also insufficient mentorship for junior miners
Intellectual property policy	– Most SAR countries, except South Africa, lack IP protection policies – Concentration of IP in just a few countries makes it difficult to develop local expertise and downstream processing capabilities in the region

6 Pace of industrialization

Most of the critical minerals in SAR countries are exported as raw materials, with limited local value addition. Development of downstream capabilities and industrialization has been slow, except in the case of copper concentrates, which are almost fully refined onshore in SAR and exported as a cathode or blister. Such activities help boost investor confidence.

BOX 6 **Illustration of an industrialization challenge**

Africa retains only 4-20% of the total value of unprocessed minerals extracted due to minimal local processing and limited downstream development.[25]

Industrialization category	Key challenges
Beneficiation cluster development	– Lack of infrastructure for mineral beneficiation, including processing plants and transport networks – Dependency on funding and technological support from foreign players limits local control of value chains
Cross-border collaboration for industrial activity	– Lack of harmonization of mining regulations and tax policies can complicate cross-border collaboration – Governance and security issues can include corruption and lack of transparency, among others
Downstream processing hubs	– Cross-cutting challenges include frequent power outages, inadequate transportation infrastructure and human capital

7 Skill gap

A lack of skilled workforce can hinder mining and deter investors. Reducing gender gaps is also key as many international financial institutions require gender impact assessments in their due diligence processes.[26]

BOX 7 **Illustration of a skill gap challenge**

The Mining Qualifications Authority (MQA) in South Africa finds that only 14% of employees in the mining sector possess a post-matriculation qualification (beyond Grade 12).[27]

Workforce category	Key challenges
Local workforce development	– Limited investment in mining-focused technical education and underfunded apprenticeship programmes, often urban-based and focused on non-critical minerals, hinder local skill development and increase reliance on foreign expertise[28] – Weak enforcement of local hiring and training laws further limits workforce development, despite existing quotas – Rural mine locations with poor infrastructure make it hard to attract and retain skilled workers – Gender disparities persist, and while inclusion initiatives exist, progress remains uneven[29]
Overall skills landscape	– There is a shortage of skilled technicians, operators and process control experts – University programmes are often misaligned with industry needs – There are limited public-private partnerships for skill development
Expatriate talent attraction	– Strict visa rules and security concerns limit expatriate hiring and relocation to some SAR countries

8 Demand volatility

Supply shocks can cause unexpected changes in price levels, increasing demand volatility and rendering some projects unviable by affecting their financing.

BOX 8 **Illustration of a real-world demand challenge**

Lithium prices are declining due to rising supply – in January 2025, exports from Chile increased 23% month-on-month) – and weaker demand. In February 2025, the Lithium Carbonate CIF North Asia price dropped by 4.5% to $9,550/t – the lowest since 2021. Further production cuts are expected in 2025 to balance the market.[30]

Demand category	Key challenges
Global trends	– Low critical mineral prices, largely shaped by China's dominant role in processing, can make certain projects economically unviable, particularly in higher-cost regions[31] – The critical minerals supply chain is fragmented, with sourcing varying across regions, leading to inefficiencies and limiting transparency
Securing potential buyers through offtake agreements or partnerships	– Pre-production projects often struggle to meet end-user standards and timelines – Demand for traceability is high, but buyers rarely pay a premium, limiting adoption – Beneficiation is often hindered by difficulty securing stable pricing through offtake deals – Low initial demand complicates inventory buildup and risks mineral degradation – Extensive testing and pilot plants are needed to prove quality and secure offtake agreements

2 Solution case studies

SAR could benefit from adapting these eight solution tracks.

During the workshops, regional stakeholders co-developed solutions to key challenges, grouped into eight themes and each illustrated by a case study.

These case studies aim to inspire SAR countries to adapt them to local needs. Some span multiple themes but are grouped by primary impact.

2.1 Policy measures

To tackle these challenges, stakeholders could prioritize clear, stable regulations to boost investor confidence, prevent disputes and foster community trust.

One role that governments could play is to reduce fragmentation by applying cross-sector best practices that promote regional coordination, like the SADC Mining Protocol, which aligns policies across SADC member states through information exchange, promotion of private sector participation, environmental protection and occupational health and safety. Such frameworks could help reduce fragmentation and serve as references for future regional harmonization efforts.[32]

CASE STUDY 1

Zambia's policy reforms to promote investment in mining[33]

Zambia, a major producer of copper and cobalt, accounted for ~3% of global copper output in 2023. Recent reforms, including a new mining law, aim to streamline regulation and boost local participation in critical mineral production.

Impact of Zambia's policy reforms[34]

Zambia has set an ambitious goal of producing 3 million tonnes of copper by 2032.

Although this is a stretch from current production levels of 700,000 tonnes, ongoing reforms are expected to drive significant benefits, with investment inflows potentially increasing output to 1 million tonnes by 2026.

Challenge

Uncertain policy regime: Zambia's mining sector faced a volatile tax regime, complex laws and frequent policy shifts tied to copper prices. Sudden hikes in royalty rates, double taxation and a 5% import duty on copper concentrates discouraged investment.

Macroeconomic conditions: Zambia defaulted on its external debt post-COVID, with a debt-GDP ratio of 115%. Heavy reliance on copper and lack of economic diversification exposed the country to fiscal and trade imbalances due to price volatility.

Underinvestment in exploration and mapping: About 45% of Zambia's land remains unmapped, and 55% was mapped 25 years ago. Macroeconomic challenges have deterred private exploration, leaving much of the country's mineral potential untapped.

Low value addition: Reliance on exports of unprocessed minerals has led to limited value-adding downstream processing activities. This has prompted resource nationalist policies, like import duties on concentrates, to drive local beneficiation and retain more value.

Solution

National Mineral Resources Development Policy 2022: Addresses policy challenges by promoting licensing transparency, stable taxation, exploration incentives, artisanal mining formalization, local ownership and value addition.

Zambia's budget of 2023: Introduces tax reforms, reduces mineral rights transfer tax (10% to 7.5%), allows royalty tax deductions and applies presumptive tax to artisanal miners.

Minerals Regulation Commission Act 2024: Centralizes regulation, streamlines licensing, enforces compliance, curbs speculative licenses, expands local mining rights and introduces a transfer tax to stabilize revenues.

Impact

Production targets: According to Zambia's finance minister, copper output could increase from 700,000 tonnes in 2022 to 1 million tonnes by 2026, driven largely by investments in expanding mining production.[35]

Licensing: Information and communication technology can be further integrated and stakeholder collaboration can be increased, leading to enhanced transparency, efficiency and accountability in licence management.

Taxation: A stable tax regime can help create consistency for investors and revised property transfer tax rates can increase the government's share of revenues.

Partnerships: Mercuria Energy Group, a commodity house, has provided financing and is teaming up with Zambia on a metals trading venture to secure access to key resources.[36]

2.2 Investment de-risking

As demand for critical minerals grows, bankable, ESG-aligned projects in frontier markets are essential for the energy transition. De-risking tools, like blended finance and local bank syndication, can help close the funding gap. In SAR, perceived risks make it difficult to secure capital, underscoring the need for strong technical studies and investment de-risking to attract financing.

CASE STUDY 2

Rawbank-led financing for the Kamoa-Kakula copper project

Local banks can structure complex transactions and drive development in high-stakes mining projects. Rawbank's leadership underscores the importance of empowering local financial institutions, not only as financiers but also as architects of sustainable development.

By aligning with global ESG standards, such as the International Finance Corporation (IFC), International Council on Mining and Metals (ICMM) and Global Industry Standard on Tailings Management (GISTM), and integrating local content requirements, Rawbank set a precedent for structuring deals that meet both investor expectations and domestic development goals.

Impact of Rawbank's investment de-risking

Rawbank played a leading role in financing the Kamoa-Kakula copper project in the DRC, helping arrange a $400 million syndicated loan with partners ABSA, Africa Finance Corporation (AFC) and First Bank DRC.[37]

The deal met international standards while embedding ESG and local content requirements, including repatriation of 60% of revenues to the DRC.[38]

Challenge[39]

High capital requirements: Large-scale projects require significant upfront capital and local financial institutions in SAR countries usually do not have the required capital to enable this.

Complex regulations: Mining is a highly regulated industry and arranging financing requires managing legal and operational complexities, which can deter many financiers, particularly those from outside the region.

Risk perception: Factors such as political instability, infrastructural challenges, regulatory uncertainties and price volatility of critical minerals, all increase the inherent risks in such projects.

Lack of precedent: There are few examples of syndicated loans led by local banks, and this deal required innovative structuring and collaboration between diverse stakeholders.

Solution

Leadership in the syndicated loan: Rawbank pioneered the structuring of the syndicated loan, bringing other banks such as FirstBank DRC and ABSA Bank on board to mobilize blended capital.[40]

ESG considerations: Rawbank ensured that financing aligned with international standards on ESG, such as those of the IFC, ICMM and GISTM, as well as sustainable mining practices and compliance with DRC's mining laws.[41]

Renewable source of energy: The project reduced its carbon emissions by arranging 150 megawatts (MW) of clean hydroelectric power from Mwadingusha and Inga II.[42]

Localization of content: Rawbank took the initiative to bring local suppliers such as Pacific Logistics into the project, which helped ensure compliance with Article 108 of DRC's mining code, which mandates in-country processing of minerals, requires partial Congolese ownership of processing firms and restricts mining subcontracting to Congolese companies.[43]

Innovative financing tools: Platforms such as Rawbank online and SIOP were used to automate transactions and provide tailored solutions for working capital, equipment finance and trade finance.[44]

Impact[45]

Copper production: The funds raised by Rawbank for the expansion of the Kamoa-Kakula copper project make it the third largest copper mine in the world, with a 600,000-tonne annual capacity (they produced 437,000 tonnes in 2024),[46] approximately 20% of the DRC's 3.3 million tonnes produced.

Renewable energy installation: The integration of renewable power into the project is a key example of how mineral development can serve as a platform for broader energy transition goals. The project installed 178 MW of hydroelectric power capacity connected to the national grid, helping advance the energy transition.

Flagship case: Moving forward, this deal helps set a precedent for other financial institutions in Africa, as other local banks can also lead complex syndicated structures, helping to ensure greater availability of funds to the mining sector.

2.3 Energy strategy

The mining sector's energy needs require reliable, low-carbon power to unlock critical mineral production. With rising ESG demands, governments and the private sector can both help reduce the industry's carbon emissions. The region's abundant but underused solar, hydro and wind resources offer a key opportunity to power sustainable mining and meet ESG goals.

CASE STUDY 3

Namibia's green iron breakthrough[47]

Namibia launched the Oshivela plant in April 2025 – the first industrial-scale green iron facility in Africa, powered entirely by renewables. Developed by a German-Namibian consortium, it operates off-grid using a 25-megawatt (MW) solar photovoltaic (PV) system, 13.4 MW battery storage[48] and SAR's largest electrolyser to produce green hydrogen, enabling zero-emissions iron production.

Impact of Namibia's renewable energy push

Hylron's Oshivela plant in Namibia is aligned with the EU-Namibia Strategic Partnership on Green Hydrogen and could benefit from its framework as it expands. It has an initial annual capacity of 15,000 tonnes with plans to scale up to 2 million tonnes annually by 2030.

Challenge

High carbon emissions: The use of fossil fuel sources in mining, such as coal, has led to high global carbon emissions.

Energy dependency: The mining sector's reliance on fossil fuels also results in higher operational costs and environmental damage.

Structural issues in the Namibian economy: The country depends on raw materials exports without in-country value addition, high youth unemployment and restrictions faced by carbon-intensive products in global trade.

Solution

Integration of renewable energy: The off-grid facility runs on a 25 MW solar PV system and 13.4 MW battery storage, enabling fully emissions-free iron production.

Green hydrogen: The plant has the largest hydrolyser in SAR, with 12 MW of power, developed to produce green hydrogen for use in the reduction process, as an alternative to coal and natural gas.

Scalability of technology: The plant's modular setup supports rapid expansion, with plans to reach 1 million tonnes of iron output by 2030.

Impact

Emissions reduction: The plant is projected to cut 27,000 tonnes of carbon dioxide (CO_2) emissions in its first phase, with potential to scale to 1.8 million tonnes annually.[49]

Leadership in decarbonization: Success could position Namibia as a pioneer in green industrialization globally.

Economic growth: By adopting this model of industrial development, Namibia could also move up the value chain in critical minerals processing, enhance its industrial base and improve its performance in global trade.

Offtake agreement: Hylron has signed a deal with German metals firm Benteler for 200,000 tonnes of hydrogen-based iron annually.

2.4 Transportation infrastructure

Infrastructure accounts for a major share of mining capex, as projects often require on-site power and transport. Shared infrastructure could help reduce costs, enable market access and connect landlocked mineral-rich areas to export hubs, in turn boosting local economies.

CASE STUDY 4

Lobito Corridor Railway transportation infrastructure upgrade

Landlocked countries such as the DRC and Zambia have vast reserves of critical minerals, but face difficulties in transporting them due to lack of infrastructure. The Lobito Atlantic Railway is a strategic transportation route connecting the Atlantic coast of Angola to the DRC. In 2022, the Angolan government granted a concession to a European consortium of companies to upgrade and rehabilitate the existing railway and associated infrastructure in Angola. The consortium is also working on rehabilitating the state-owned railway line in the DRC that connects the Lobito Atlantic Railway to the DRC copper belt mining area.

A second, separate phase of the project envisages construction of a new 800-kilometre railway line to connect the Lobito Atlantic Railway to Zambia (the Zambia-Lobito Rail Project). This greenfield project is currently being assessed by a public-private consortium comprising, inter alia, the governments of Angola, DRC, Zambia, Italy, the EU, the US, the Africa Finance Corporation and African Development Bank.

These investments could play an important role in regional economic integration and development. The Lobito Atlantic Railway is controlled by a European group consisting of Trafigura, Mota-Engil and Vecturis. The DBSA has played a pivotal role in co-arranging funds for this project, by approving a $200 million funding alongside the US International Development Finance Corporation (DFC).

Impact of Lobito Atlantic Railway[50]

The Lobito Atlantic Railway is a contemporary example of a major infrastructure initiative in SAR led by the EU and the US.

DBSA played a pivotal role in arranging funds for this project, approving $200 million in funding alongside the DFC.

Challenge[51]

Ageing and inefficient railway networks: The existing railway network in SAR required investment and upgrading. Furthermore, conflicts in the region, such as the Angolan Civil War, caused damage to the railways.

High costs of transportation: Lack of investment in upgrading railway networks has led to an inefficient and fragmented transportation system, which creates higher costs of transportation.

Lack of regional integration: There has been limited development of cross-border infrastructure. Regulatory frameworks around cross-border trade are also underdeveloped.

Landlocked mines: Most critical mineral deposits in SAR are in landlocked countries such as DRC and Zambia. Exporting to global markets by using the Durban and Dar es Salaam ports requires taking longer routes, which can lead to delays and logistical difficulties.

Solution

Efficient transport corridor: Linking the Atlantic coast at the Port of Lobito in Angola to the mineral deposits of DRC provides open access to a fast, cost-effective route for transporting critical minerals to global markets, which could boost value chains and ensure mineral availability.

Tapping into a wider resource pool: The savings in transportation, logistics and working capital costs for mining companies from the Lobito Atlantic Railway are expected to be significant, helping support the economic viability of Africa's copper belt mines.

Regional integration: This project is expected to help support value addition locally as well as industrial development and downstream beneficiation, which could in turn ensure regional economic integration between multiple SAR countries.

Role of global partnerships: The Lobito Atlantic Railway and the Zambia-Lobito Rail Project represent two significant international public-private partnerships engaging with Africa in infrastructure in recent years. They seek to engage in a collaborative manner with equitable partnerships and promote ethical sourcing, transparency and sustainability in critical mineral value chains.

Impact

Transportation efficiency: By providing logistics and transportation on an open-access basis, at cost-effective rates compared to alternatives, the Lobito Atlantic Railway can help seamlessly transport critical minerals to global markets.

Economic development: The Lobito Atlantic Railway helps facilitate local value addition and downstream processing, thereby supporting local industries and generating employment.

Energy transition: By making critical minerals such as cobalt and copper available at faster and more cost-effective rates compared with global markets, the Lobito Corridor can help drive down the costs of renewable energy technologies, thereby helping accelerate the energy transition.

2.5 Innovation promotion

To boost exploration, extraction and processing, SAR countries must embrace continuous innovation by adopting advanced mining technologies, digital tools, venture capital financing and IP protection. Strong IP rights will be crucial to advance and safeguard these innovations.

CASE STUDY 5

Hydraulic Dewatered Stacking in Chile[52]

Innovative tailings management solutions are helping address water scarcity and stability risks. One example is Anglo American's Hydraulic Dewatered Stacking (HDS) technology, piloted in Chile. While HDS is proprietary, it illustrates how companies are rethinking legacy waste practices to enable safer, more sustainable mine closure and land use.

Impact of hydraulic dewatered stacking

- High levels of water recovery – in some instances, more than 80% of tailings can be recycled back to the mine.
- Piloted at the Mogalakwena Platinum Mine in South Africa, which will be the first brownfield application.[53]

Challenge[54]

Tailings stability: Traditional storage facilities created for wet tailings can cause risks to surrounding communities and environments and even potentially lead to failures or mudslides.

Impact on the environment: Tailings dam spills can contaminate soil and water with hazardous waste, harming ecosystems. Remediation is possible but often costly.[55]

Regulatory compliance: The Global Industry Standard on Tailings Management (GISTM) mandates strict compliance, pushing mines to ensure long-term stability and safety of tailings facilities.

Economic viability: Mining projects are generally capital-intensive. In the absence of financing, it is important for companies to innovate cost-effective solutions to ensure economic viability, particularly for managing tailings.

Solution[56]

Innovative technology: Coarse particle recovery creates fines-free sand that forms a drainage network, enabling fast dewatering and consolidation.

Enhanced stability: HDS improves tailings facility safety by reducing water content and eliminating surface ponds, lowering mudslide risk.

Cost-effective implementation: HDS is a lower-cost alternative to other tailings technologies, requiring less capital investment.

Progressive closure: Cell-based deposition supports phased closure and reclamation, with reduced long-term monitoring due to free-draining tailings.

Impact

Water conservation: HDS enables over 80% tailings water recovery, cutting demand for fresh water.

Potential transferability: After success in Chile, HDS is now piloted at South Africa's Mogalakwena mine, its first brownfield use, potentially leading to the first large-scale facility.

Improved safety: HDS enhances tailings stability and reduces failure and mudslide risks.

2.6 Industrial cluster development

By localizing critical minerals value chains through industrial clusters and green technology manufacturing, SAR countries can move from raw exports to value-added production – driving growth, job creation and clean energy leadership.

With around 700 clusters, South Africa can unlock economies of scale, attract investment and scale green technology manufacturing for the energy transition.

CASE STUDY 6

Richard's Bay IDZ

One illustrative example of industrial clustering is the Richards Bay IDZ, a state-owned industrial development company located in the KwaZulu-Natal province of South Africa. This industrial cluster consists of small, downstream manufacturing businesses located together with provisions for world-class infrastructure, competitive input costs and tax incentives. Major industries such as energy and agricultural processing are co-located along with mineral beneficiation.[57]

Impact of Richard's Bay IDZ cluster

Supports the co-location of multiple downstream industries with shared infrastructure, including mineral beneficiation.

South32, an Australian company, operates the largest aluminium smelter, Hillside Aluminium Smelter, within the cluster.[58]

Challenge

Infrastructure deficits: Lack of adequate transportation, energy and water infrastructure has negatively affected the development of industrial projects and efficient processing of minerals.

Regulatory hurdles: Complex regulations and administrative clearances can create difficulties in running downstream processing businesses.

Underinvestment: Limited access to capital for developing downstream beneficiation facilities and industrial operations has stunted industrial growth.

Solution[59]

Tax incentives: Tax incentives offered to downstream facilities can help reduce the cost of operations and make zones more investor friendly.

Shared infrastructure: Transportation, utilities and waste management facilities are all provided in a consolidated manner to support efficient industrial operations.

Simplified administrative processes: The regulatory regime can be streamlined and customs-controlled areas (CCAs) established.

Cluster development: Clusters for smaller, downstream manufacturing businesses can be formed around existing industries to promote synergies.

Impact[60]

Investment attraction: Richards Bay IDZ has drawn major investments, including the $4.5 billion Nyanza Light Metals plant backed by Africa Finance Corporation, the African Export-Import Bank, the Industrial Development Corporation and the Department of Trade, Industry and Competition of South Africa.

Employment generation: The KwaZulu Natal Titanium Beneficiation Complex is expected to create over 3,000 jobs.

Export competitiveness: Beneficiation of raw materials facilitated by Richards Bay IDZ is expected to produce 80,000 tonnes of titanium dioxide annually, 85% for export and 15% for local use.

Economic diversification: The development of Richards Bay IDZ has also helped diversify the local economy beyond raw mineral exports.[61]

⚠ **Note from designer:**
As previously mentioned we cannot add an image to the case study on Energy Strategy: Namibia green Iron breakthrough. This would disrupt the flow of the report - we simply dont have enough space for images for every case study without splitting most of them across multiple pages which would be hard to read.

We only put this image here as a response to the following feedback in the last round: '*If it ruins the layout for more than 1-2 case studies, in the sense that they would need to be split on multiple pages, please use the image instead of the one on page 23'.*

We can easily swap this image for something else but please provide a suggestion, thankyou.

2.7 Human capital development

SAR's population is expected to grow by 6 million by 2030[62] and increase 1.3-fold by 2050. With unemployment at 10-20%, developing local mineral value chains could contribute to job creation.[63]

Although expatriate expertise can provide short-term support, long-term success depends on investing in local talent through targeted training and capacity building.

CASE STUDY 7

Mandela Mining Precinct[64]

The Mandela Mining Precinct (MMP) is a public-private partnership, launched in 2018, between the Department of Science, Technology and Innovation (DSTI) and the Minerals Council South Africa. The MMP is co-hosted by the Council of Scientific and Industrial Research (CSIR) on behalf of the DSTI and by the Minerals Council on behalf of the mining industry. The MMP aims to develop technologies that improve mine safety, productivity and lifespan, while revitalizing mining research and development (R&D) and supporting skills development.

The MMP aims to develop technological solutions that will increase mine safety, productivity and lifespan while reducing costs. It also seeks to revitalize the Mining Research, Development and Innovation (RD&I) capability in the country; and support skills development in the mining sector. MMP focuses on modernization of mining operations, extension of the life of current mines, safety improvement, and, through their relationship with the Mining Manufacturers of South Africa (MEMSA), support the promotion of local manufacturing capabilities.

Impact of Mandela Mining Precinct

- Technologies like real-time monitoring and collision prevention systems have extended the life of ageing mines and reduced safety incidents.
- Partnerships with academic institutions have cut reliance on imports and helped train a new generation of mining professionals.

Challenge

The MMP was formed to facilitate RDI into many of the challenges faced by South Africa's mining sector:

Declining contribution of mining to GDP: The share of mining to the GDP in South Africa declined from 21% in 1980 to 8.2% in 2020.[65]

Ageing mines: Mines faced challenges such as resource depletion and outdated technologies, which led to cost-ineffective and unsafe mining conditions.

Skill gap: Lack of skilled professionals in the mining sector in South Africa, particularly in research and development, led to a loss of institutional knowledge and capacity to innovate.[66]

Reliance on imports: Heavy dependence on imports from foreign original equipment manufacturers (OEMs) limited local value addition and led to rising costs.

Solution

Research and development: The MMP was formed to support the implementation of the South African Minerals Extraction Research, Development and Innovation (SAMERDI) strategy. Their core research focuses on mine longevity, orebody knowledge, real-time data systems, mechanized mining and the application of technology centred around people.

Industry partnerships: Through collaboration with MEMSA and other sector bodies such as the Mining Qualifications Authority and Mine Health and Safety Council, the MMP supports local manufacturing and reduces reliance on imported mining equipment.

Technology modernization: Various initiatives on modernizing technology, such as the development of a "digital twin for trackless mobile machinery" and "collision prevention systems" have been undertaken.

Capacity building: Collaborations with academia and research institutions help in skill development and developing capacity for people in the mining sector.

Impact

The MMP has had a significant impact on South Africa's mining sector:[67]

Extended life of mines: MMP's Longevity of Current Mines (LoCM) programme develops technologies to extend production from ageing mines.

Improved safety: Real-time monitoring and collision prevention technologies aim to reduce accidents and improve safety – a core focus of all MMP initiatives.

Comprehensive industry-wide approach: Initiatives to understand job impacts of modernization, build capacity of mining professionals and address environmental and social issues have all contributed to the advancement of the mining industry.

2.8 Demand certainty

The energy transition and EV growth have sharply increased demand for critical minerals, though this demand remains volatile, illustrated by recent lithium price swings. Offtake agreements that lock-in prices early could provide demand certainty, improve market visibility and support more stable investment.

CASE STUDY 8

Offtake agreement between POSCO and Black Rock Mining[68]

POSCO International, South Korea's largest trading company and a key player in the global battery materials supply chain, signed a binding agreement in September 2024 to invest $40 million in equity in Black Rock Mining, an Australian-listed developer of the Mahenge Graphite Project in Tanzania, coupled with $10 million prepayment to Faru Graphite, the Tanzanian joint venture operating entity. The agreement strengthens a long-standing strategic alliance between the two firms and secures POSCO's long-term offtake of high-purity graphite fines from Mahenge's Module 2 as well as marketing rights for large flake graphite outside China.

Black Rock Mining, through its Tanzanian subsidiary Faru Graphite Corporation, holds one of the world's largest graphite reserves and is positioned to become a major global supplier of natural graphite – a critical input for lithium-ion battery anodes used in EVs and energy storage systems.

Impact of the offtake agreement

It enables Black Rock to reach production by combining equity investment with long-term offtake, helping to reduce financing and commercial risk.

It also strengthens POSCO's battery materials supply chain by securing stable access to high-purity graphite through a strategic upstream partnership.

Challenge

Financing hurdles: High capital expenditures are required for mine development, which often leads to reliance on external funding.

Market access: Limited downstream partnerships and offtake agreements can make it harder to secure revenue.

Demand concentration: Global graphite supply is dominated by a few players, with downstream capacity largely concentrated in China.

Commercial risk: Without long-term offtake agreements, smaller firms face difficulty attracting institutional or development finance.

Intellectual property: IP is a key barrier to entry in the critical minerals sector. Building out from an established participant can minimize competitive risks during the critical business establishment phase.

Solution

Equity injection: POSCO's $40 million investment will be made in two tranches, supporting development of Mahenge Module 1.

Long-term offtake: There is also a binding agreement for 100% of graphite fines from Module 2 over 12 years, with options to extend up to 22 years.

Marketing rights: POSCO gains non-exclusive rights to market large flake graphite globally (excluding China), with incentives for offtake.

Strategic alignment: POSCO is deepening vertical integration across its battery materials business and securing feedstock critical for its growth.

Scale: From day one this investment helps secure commercial scale for the supply chain.

Impact

De-risked financing: The equity stake and offtake support help reduce financing risk and improve Black Rock's ability to reach production.

Supply chain resilience: POSCO can secure a diversified source of high-purity graphite, strengthening its strategy to source from places other than China.

Project momentum: Enables development of Module 1 and future scaling, with planned production of 30,000 tonnes per annum of fines from Module 2.

Economic uplift: The Mahenge project could generate jobs and economic activity in Tanzania, supporting regional development goals and providing revenue for parastatals in the power supply and transport sectors.

Conclusion

The IEA predicts that the supply-demand gap for critical minerals will quadruple by 2040, challenging global supply chains and the energy transition. While SAR countries hold vast reserves, mining remains underexplored and underfinanced. **Unlocking investment is crucial not only for the global transition but also to drive local economic value** through job creation, infrastructure development and revenue retention, powering a sustainable future and inclusive growth.

Innovative financing tools, like de-risking structures, guarantees and blended finance, can help unlock funding for critical minerals. However, it is equally vital for governments, mining companies, financiers and international partners to ensure these investments also support broader development and better living conditions.

Public-private partnerships like the Lobito Corridor can help drive national growth and benefit local communities. International partners also have a role to play, such as the EU in Namibia's renewables-powered iron production. This shows how renewables-focused energy strategies can strengthen the ESG case for investment.

Stakeholder engagement and community participation are essential to ensure local populations benefit from investments. Through human capital and local skilled workforce development, SAR countries can support citizens through employment, training, enterprise development and community ownership.

Developing industrial clusters and promoting local beneficiation could help SAR countries move down the value chain, industrialize and grow their economies. By localizing critical minerals value chains through clean hydrogen and green tech manufacturing, they could boost economic growth, create quality jobs and support inclusive development. This could also position the region as a leader in clean energy technology, driving industrial decarbonization and enhancing energy security.

Contributors

World Economic Forum

Marina Colombo
Lead, Materials Systems

Jörgen Sandström
Head, Transforming Industrial Ecosystems, Energy and Materials

Development Bank of Southern Africa

Mpho Mokwele
Group Executive, Transacting

Mahlatsi Molokomme
Principal Investment Officer

McKinsey and Company

Patricia Bingoto
Senior Expert Global Materials Practice

Karel Eloot
Senior Partner

Lynn Kappes
Project Fellow, Securing Minerals for the Energy Transition

Alex Kazaglis
Partner

Agesan Rajagopaul
Partner

Tanay Shankar
Associate

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Laurence Denmark
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World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744
contact@weforum.org
www.weforum.org