

Definition and Exploration of Critical Energy Transition Minerals Value Addition by Commodity Chains



ABSTRACT

(SADC) region holds significant deposits of Critical Energy Transition Minerals (CETMs; hereinafter critical minerals), including graphite, chrome, manganese, cobalt, copper, rare earth elements (REEs), platinum group metals (PGMs), and lithium. Despite their growing importance in global markets, particularly for electric vehicles (EVs) and renewable energy technologies, these critical raw materials (CRM) are largely exported in raw or minimally processed forms, limiting their economic impact within the region. This policy brief examines the history and status of these mineral value chains, identifying key barriers to downstream beneficiation, such as infrastructure deficits, high energy costs, regulatory challenges, and limited investment in processing facilities. It presents targeted policy recommendations to strengthen local value addition through refining and processing, promote AI-driven innovation along the value chain, invest in research and development for dry processing to reduce water reliance, establish regional processing hubs or special economic zones, and develop renewable and reliable energy sources for mining and processing activities.

1. INTRODUCTION

The SADC region hosts abundant mineral resources of critical minerals, such as graphite, chrome, manganese, cobalt, copper, and REEs. Despite these minerals being integral to the global demand, particularly with the growth in EVs, renewable energy, and electronics, the potential economic benefits of these resources are often under-realised due to limited local value addition. By processing and refining minerals locally, countries can retain more value within the region, create jobs, and drive industrial development. This policy brief explores the respective value chains in the SADC region, including their historical context, the extent of downstream value addition, if any, and makes specific policy recommendations.

2. COMMODITY CHAIN MAPPING

Framework for CRM Commodity Chains

A commodity chain is a series of steps involved in producing a product, from extraction through processing to final use and recycling. These key stages are highlighted in (Figure 1).

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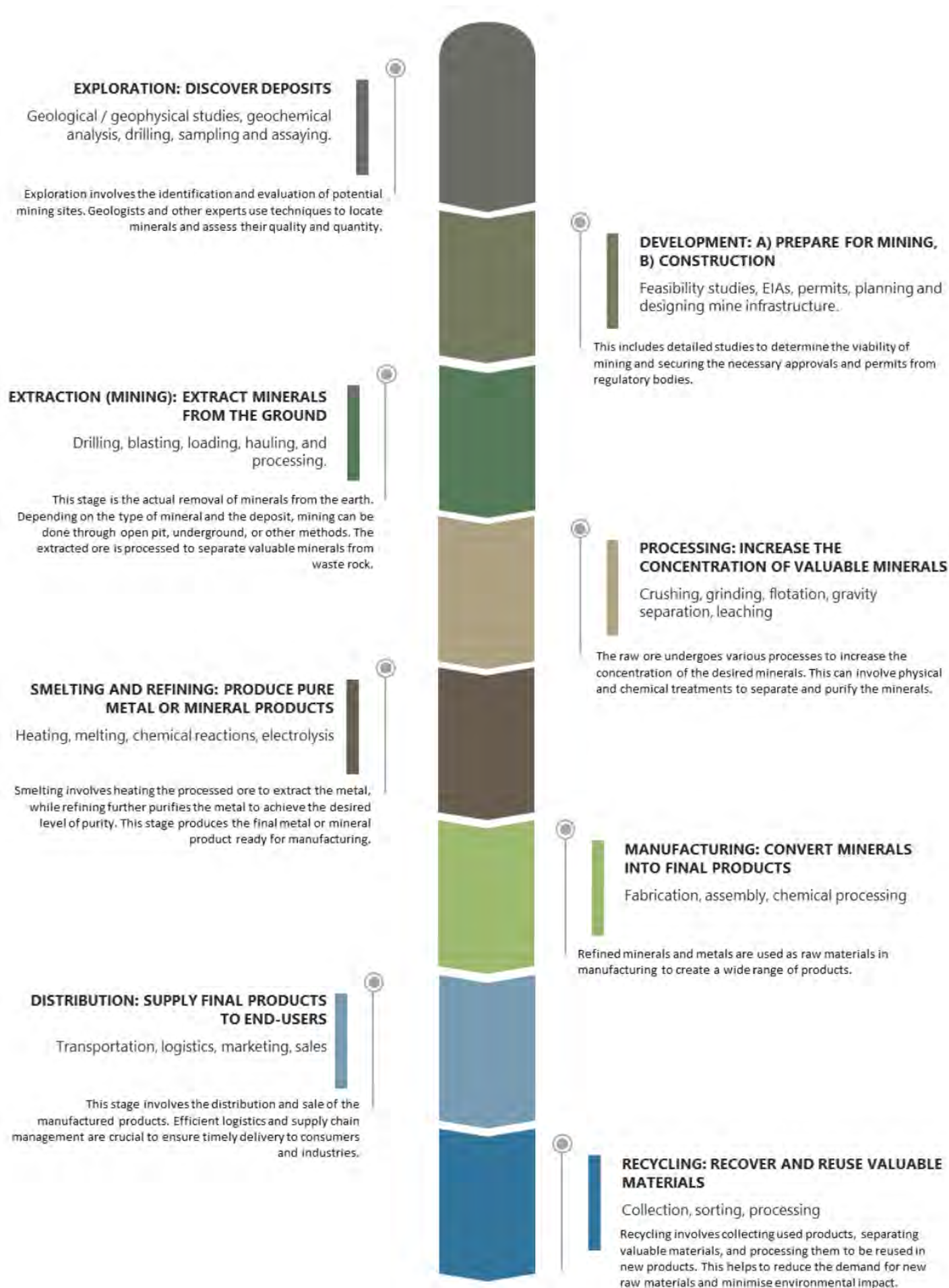
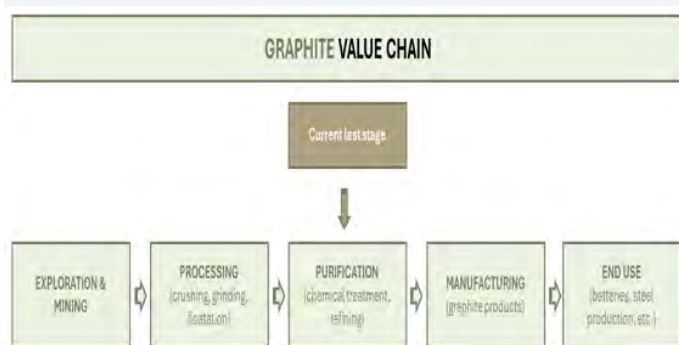


Figure 1: Generic Mineral Value Chain.

Graphite



Historical and Current Position

Significant graphite resources exist in Madagascar, Mozambique, Namibia and Tanzania.

Export of raw graphite concentrate has been the dominant practice.

The region historically lacked infrastructure and processing facilities to add value beyond extraction.

Limited local purification and processing capacity with most operations focused on mining and flotation.

Global demand for battery-grade graphite is a recent development, driving the need for downstream processing.

Graphite concentrate production is the primary output, with 90–96% carbon content, for export.

Mozambique's Balama Graphite Mine sends concentrate for offshore beneficiation in the United States for America (USA).

Madagascar produces purified graphite for niche markets.

Tanzania hosts high-grade graphite projects like Mozambi Resources.

Namibia's Okanjande Mine has dormant potential for downstream processing revival.

Limited progress in developing facilities for

battery anode material (BAM) production -- only early-stage investments in purification.

Policy Recommendations for Downstream Growth

Introduce local beneficiation policies:

Tanzania and Mozambique have started introducing incentives for local processing to encourage value addition.

Invest in purification facilities: Establish plants that refine graphite to 99.95% purity for battery-grade use.

Address infrastructure deficits: Improve energy supply and transportation networks to support graphite value chain growth.

Attract investment and technology partnerships: Focus on high capital-intensive areas like purification and BAM production to close financing gaps and compete or collaborate with market leaders like China.

Chrome

Historical and Current Position

Pre-2000s: South Africa mostly exported raw chromite ore to China and Europe, with little local processing.

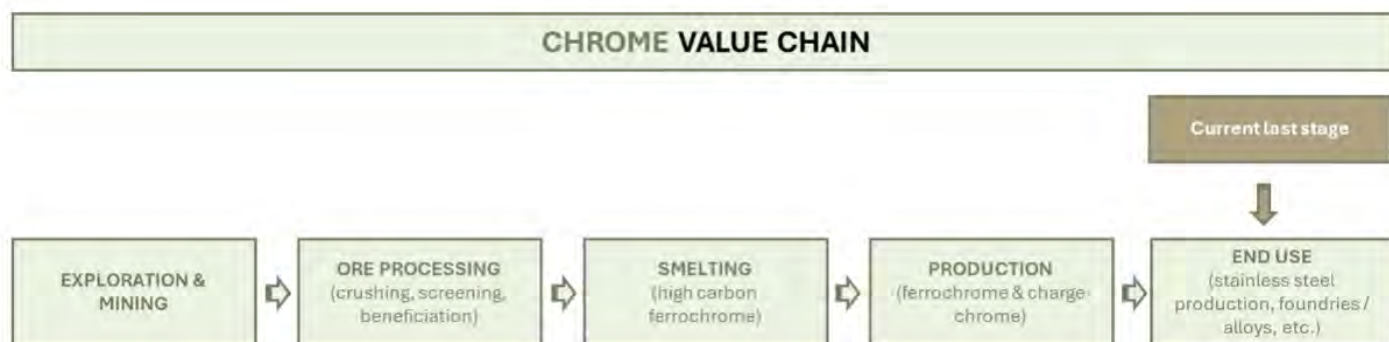
Early 2000s: Ferrochrome smelting grew, and local processing facilities were developed.

Limited beneficiation: High energy costs, outdated technology, and policy gaps slowed value addition.

Smelting development: South Africa expanded its local smelting capacity.

Export reliance: Despite increased smelting, the industry still relied on raw ore exports due to ongoing energy and policy issues.

Increased ferrochrome smelting: South Africa and Zimbabwe are expanding ferrochrome production, led by companies like



Glencore-Merafe, Samancor, and Zimasco.

Regulatory developments: Zimbabwe banned raw chrome exports, and South Africa proposed export taxes to encourage local processing.

Policy Recommendations for Downstream Growth

Invest in low-carbon smelting: Support hydrogen-based and renewable energy-powered smelting processes to reduce carbon emissions.

Energy sector reforms: Address energy issues by investing in renewable energy for smelting.

Regional integration: Promote regional collaboration to enhance infrastructure, trade policies, and beneficiation efforts across SADC.

Manganese

Historical and Current Position

South Africa and Zambia are key manganese producers, mainly exporting raw ore to Asia and Europe.

Limited local beneficiation, with most manganese exported unprocessed.

South Africa, the largest producer, has developed a ferroalloy industry but continues exporting raw ore.

Manganese Metal Company (MMC) is the only producer of high-purity electrolytic

manganese metal (EMM) in South Africa and one of the world's largest producers.

Zambia and Mozambique are in the early stages of local beneficiation efforts.

Regional policies are emerging to promote domestic smelting and refining.

South Africa leads in local processing, but high volumes of manganese are still exported raw.

Infrastructure development, especially in power generation, is being ramped up to support beneficiation.

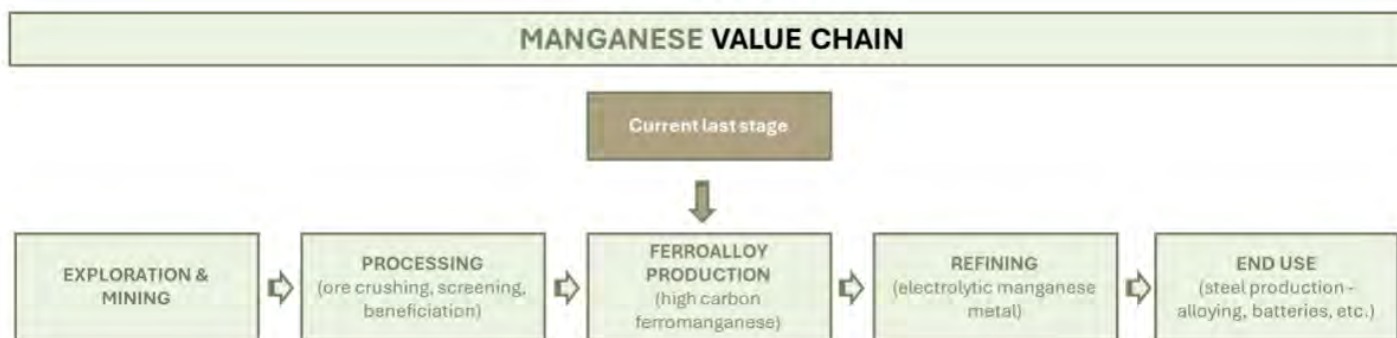
Policy Recommendations for Downstream Growth

Enhance beneficiation policies: Enforce targeted export restrictions on unprocessed green minerals and introduce tax incentives for companies investing in local mineral processing and value addition.

Develop processing hubs: Create regional processing hubs for economies of scale.

Support infrastructure development: Invest in power and infrastructure to attract beneficiation investments.

"Regional policies are emerging to promote domestic smelting and refining."



Cobalt

Historical and Current Position

Historically, cobalt has been mainly extracted as a by-product of copper mining, with refining done outside the region.

Limited local beneficiation resulted in raw or semi-refined cobalt being exported.

The DRC and Zambia have significant cobalt reserves but lacked the infrastructure and capacity for domestic refining.

The cobalt industry primarily served global markets, without creating much local value-added industry.

Local beneficiation efforts are underway, with the DRC and Zambia setting up refining plants.

Raw and semi-refined cobalt are still largely exported, with limited processing in the region.

The DRC is the world's largest cobalt producer, but beneficiation is still in early stages; Zambia is making progress with supportive policies.

Challenges include poor infrastructure, political instability, lack of expertise, and insufficient financing.

Rising global cobalt demand due to the green energy transition presents an opportunity for further beneficiation in the region.

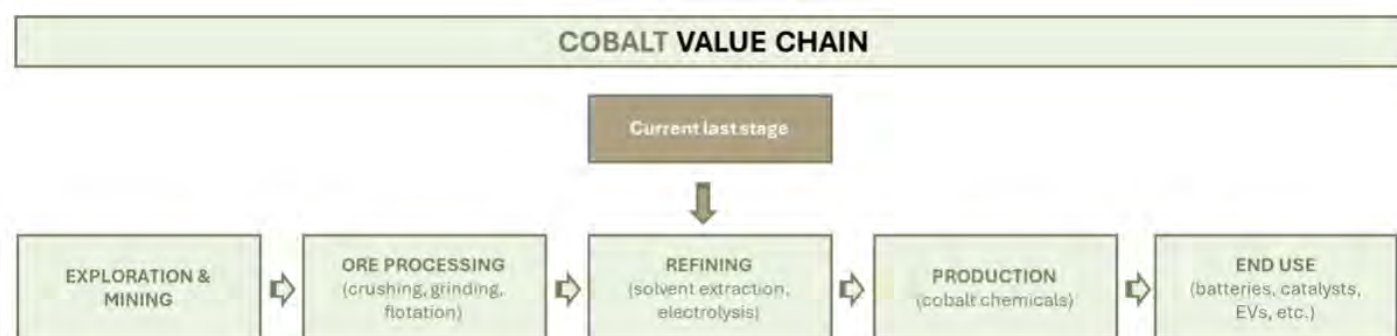
Policy Recommendations for Downstream Growth

Policy and regulatory support: DRC and Zambia should introduce stronger policies and tax incentives to promote local cobalt processing and reduce raw exports.

Investment in infrastructure: Invest in energy, transport, and processing facilities to lower costs and improve efficiency in local beneficiation.

Encourage private sector engagement: Provide incentives for local and international companies to invest in refining and manufacturing capacities, boosting downstream activities.

Promote regional collaboration: Strengthen cooperation within SADC to align policies, share resources, and support joint beneficiation projects.



Copper



Historical and Current Position

Copper mining in Zambia and the DRC has mainly focused on raw extraction with limited local processing.

The region is a major global copper supplier but has faced economic challenges due to external dependencies and market fluctuations.

Copper has mostly been exported raw or semi-processed, missing out on value-added industries.

Zambia, Africa's largest copper producer, is increasingly recognising the importance of beneficiation.

The region is slowly moving towards manufacturing copper products, such as wires and cables for power transmission and construction.

Global demand for copper is rising due to the push for decarbonisation and renewable energy.

Energy and technological limitations, along with insufficient regulations, pose challenges.

Despite some beneficiation, much copper is still exported raw or semi-processed.

"Energy and technological limitations, along with insufficient regulations, pose challenges."

Policy Recommendations for Downstream Growth

Invest in local refining and smelting: Increase investment in refining and smelting technologies to reduce reliance on foreign refineries.

Incentivise value-added copper industries: Focus on manufacturing high-value products like electrical cables and renewable energy components (e.g. copper cathodes).

Promote green copper production: Encourage sustainable, energy-efficient mining practices and integrate renewable energy in production.

Foster regional integration and collaboration: Strengthen cross-border cooperation to leverage resources and expertise in beneficiation and infrastructure.

Strengthen policy and regulatory frameworks: Improve regulations to support beneficiation and attract investment in the copper value chain.

Rare Earth Elements

Historical and Current Position

The SADC region (South Africa, Mozambique and Zimbabwe) has significant REE deposits, but beneficiation has historically been limited, with much of the production exported raw.

RARE EARTH ELEMENTS VALUE CHAIN



Malawi, Namibia and Zambia have REE resources and are emerging producers, with limited beneficiation.

South Africa has mined monazite but has not consistently processed it into high-purity REEs.

Zimbabwe is focusing on local processing and refining, with companies like ZimRare leading the charge.

Advancements in hydrometallurgical refining are making beneficiation more cost-effective and sustainable.

The region is aligning its beneficiation efforts with the green energy transition as demand for REEs grows due to EVs, wind turbines, and renewable energy technologies.

Policy Recommendations for Downstream Growth

Encourage investment in infrastructure:
Attract investments in beneficiation infrastructure (e.g. refineries, smelters) through partnerships with international players like China and the European Union.

Implement favourable tax regimes: create tax incentives to encourage local beneficiation and retain value within the region.

Promote Technological Advancements: invest in research for new refining technologies and improve access to innovative processing methods.

Support sustainable green energy initiatives: align REE beneficiation with the green energy transition to strengthen the region's role in the global REE supply chain while benefiting local communities.

PGMs

Historical and Current Position

The SADC region holds significant PGM reserves, especially in South Africa and Zimbabwe,, crucial for hydrogen fuel cells and clean energy.

Historically, the region's mining sector has focused on extraction and export, with minimal local beneficiation or industrialisation.

Most PGMs have been exported raw or semi-processed due to limited refining capacity in South Africa and lack of processing facilities in Zimbabwe.

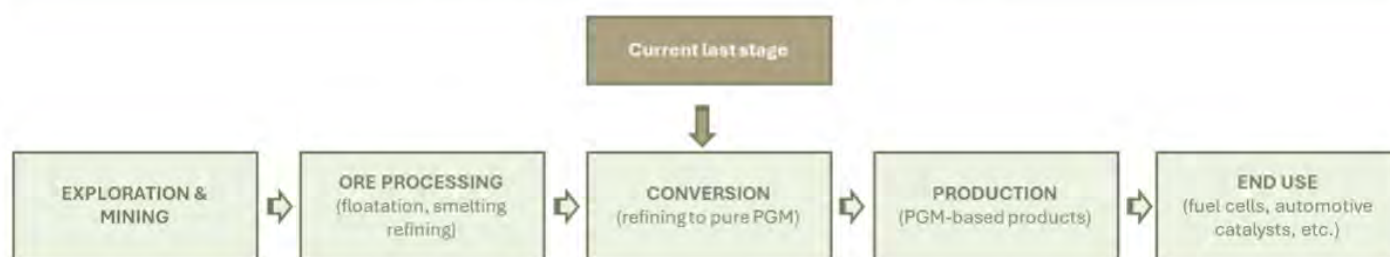
South Africa is expanding refining and smelting capacities through Anglo American Platinum and Sibanye-Stillwater.

Zimbabwe is pursuing local smelting via Zimplats and government initiatives to reduce raw concentrate exports.

South Africa is advancing hydrogen fuel cell projects (e.g. Hydrogen Valley) to boost local PGM use in clean energy.

South Africa faces challenges in the PGM value chain, including insufficient infrastructure and limited regional industrial use. Transportation inefficiencies in remote areas like the North West province, hinder the

PLATINUM GROUP METALS VALUE CHAIN



movement of PGM ores. Additionally, power shortages affect PGM refining operations, leading to inconsistencies and inefficiencies in processing plants.

Policy Recommendations for downstream growth and focus on high potential applications

Strengthen local content and incentives: Implement policies to increase local content and offer incentives to attract investments in the PGM value chain (from exploration to value addition).

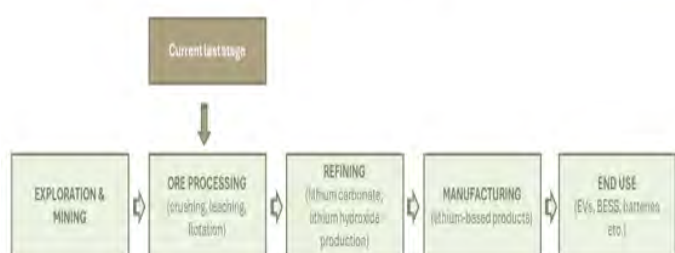
Regional effort to integrate into global supply chains: Position SADC as a key supplier of processed PGMs for clean energy.

Develop a green hydrogen economy: Invest in hydrogen production and fuel cell technologies.

Skills development: The skills needed to drive the green energy transition are different to those needed by the colonial PGM industry, so updating of skills is necessary.

Lithium

LITHIUM VALUE CHAIN



Historical and Current Position

Lithium has been a key resource in Zimbabwe since the 1950s, mainly exported as raw material with minimal local processing.

Limited processing capabilities meant that most lithium concentrate was shipped to international markets, particularly China, for refining.

Zimbabwe was a dominant lithium producer, but value addition was underdeveloped.

The SADC region is shifting towards local beneficiation, focusing on improving processing and refining capacities.

Zimbabwe, Zambia, Namibia, and the DRC are working to refine lithium locally, aiming to produce battery-grade products like lithium hydroxide and carbonate.

Bans on raw lithium exports, especially in Zimbabwe, are aimed at boosting local processing, attracting foreign investment, and creating jobs.

Foreign direct investment (FDI), particularly from China, has played a key role in introducing advanced technologies for lithium processing.

Policy Recommendations for Downstream Growth

Local refining capabilities: Implement incentives to boost investment in refining technologies and develop a value-added lithium industry.

Industrialisation: Develop industries focused on lithium-ion batteries and energy storage systems to support the green energy transition.

Regional cooperation: Foster cross-border collaboration to strengthen value chains, share technologies, and create a unified approach to the lithium sector.

Sustainability: Promote sustainable extraction, processing practices, recycling, and waste management for long-term environmental and economic benefits.

Infrastructure and Technology Investments: Invest in infrastructure (e.g., refineries, transportation) and technology to meet global demand for green energy solutions.

3. POLICY RECOMMENDATIONS

Policy recommendations include:

Policy development: Strengthen policies that encourage local value addition through refining and processing to retain more economic benefits within the region (through strengthening linkages between the green mineral sector and economy).

Support innovation: promote AI-driven activities along the value chain in the green minerals sector.

Research and development: Investing in research, development and innovation (RDI) aimed at dry processing to reduce reliance on water resources.

Hubs: Develop regional processing hubs or special economic zones.

Energy: Invest in renewable and reliable energy sources for mining and processing activities.

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Southern Africa Resource Watch