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POLICY BRIEF

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Developing a Critical Minerals' Masterplan for effective participation in the electric vehicle battery supply chain

Executive Summary

The rapid pace of the global energy transition – from non-renewable (unclean) generation to green energy (clean and renewable energy) – necessitates proactive engagement with local stakeholders to reach a comprehensive agreement on a critical minerals strategy (adaptation strategy). Given how essential certain minerals are for producing green technologies, the sustainable extraction of these minerals and systems that ensure their equitable benefits have become crucial. The guiding strategy is essential, as there are ongoing short-term and long-term projects (both small- and large-scale) for the extraction and processing of minerals. Closely-linked to this are the broader issues of oil, gas, and coal supply and demand, renewable energy technologies, electricity and energy efficiency, and energy access (versus energy poverty), including the sustainability of energy markets.

Against the current State operations targeting 2032 (including land clearance) for the initial energy production and transmission of clean energy, there are mining sustainability activities (firm investments) that are safeguarded for a lifespan from 2044 to 2081. Alongside these protections, there is infrastructure development, including the construction of mineral processing facilities, the rehabilitation of old mines, the beneficiation, job creation, and the provision of electricity access. Given the above arguments, it is essential to develop a well-crafted Critical Minerals Strategy (Masterplan) that will guide and facilitate access to minerals for local production and support a smooth transition from non-renewable energy production to clean energy. Primarily, this plan should be comprehensive enough to encompass the country's role in the supply chain processes for electric vehicle (EV) batteries, as well as addressing energy efficiency, accessibility, affordability, sustainability and ensuring just beneficiation

Introduction

The urgent transition to a carbon-neutral and net-zero economy depends on minerals extracted from the ground, which are essential for manufacturing metals used in green renewable technologies. These minerals, interchangeably referred to as 'green minerals', 'transition minerals' or 'critical minerals', underpin modern society's efforts to produce clean energy. They are also crucial in

advancing progress towards achieving the United Nations (UN) Sustainable Development Goals (SDGs) (Jowitt et al., 2020). Transition minerals in South Africa, such as manganese, are critical for Lithium-ion batteries in the electric supply chain. Other minerals, including vanadium, spodumene ore, and rare earth elements (REEs) present a potential lifeline to the coal mining sector, which is approaching a breaking point. These minerals also offer a strategic advantage in clean technology, supporting the nationally determined contribution (NDC) targets and promoting job creation.

Government departments and their entities are engaging in inconsistent projects, often using different terminologies on renewable energy minerals, which are frequently concealed under the "just transition" narrative. This highlights the need for a clear policy directive to govern transition minerals, including well-defined terms and objectives. The Chinese model provides a compelling example: the Chinese government achieved its current quasi-monopoly in the sector by dedicating the Ministry of Industry and Information Technology to oversee all entities involved in the REEs value chain, ensuring an uninterrupted supply.

This policy brief advocates for the development of a Critical Minerals Masterplan to articulate a clear vision and set objectives that support national mineral industrial development. The Masterplan should incentivise local value addition, promote research and development in critical mineral processing, recycling, and invest in a skilled workforce, while establishing a stable regulatory framework. Additionally, it calls for critical raw materials to be strategically traded differently from other commodities. The policy brief further recommends the creation of a directorate within the Department of Trade, Industry and Competition (DTIC) to coordinate the activities of all government departments and entities, serving as a strategic convenor for the sector.

Policy context

The increasing global demand for transition minerals

The increasing global demand for transition minerals, driven by the transition to renewable energy, presents South Africa with opportunities to leverage its transition minerals and develop the Lithium-ion battery and REEs industry to offset the decline of its fossil fuel sector. However, as the renewable energy sector is unlikely to match the coal sector in terms of its economic contribution to the economy, there is notable concern that the renewables-based energy transition may result in trading dependency on the South Africa's fossil fuel resources for reliance on imported green energy components.

South Africa possesses significant reserves of transition minerals, including rare earth elements located at Namakwa Sands, Tronox and Steenkampskraal mine. Among these, the Steenkampskraal Mine in the Northern Cape boasts the highest grade of REEs. Additionally, South Africa has substantial manganese deposits, which are critical for lithium-ion batteries and complementary to producing renewable energy on an industrial scale. South Africa requires an effective governance structure to oversee the mining and beneficiation of these minerals. Establishing an integrated value chain with sufficient capacity to convert the ore extracted in the country into valuable end-products crucial for a low-carbon future is essential. This structure should also include regulations for the end-use of recycled components to ensure sustainable practices and avert the situation that befalls the steel industry.

The governance of the value chain for REEs and Lithium-ion batteries in South Africa lags behind that of countries that actively beneficiate minerals for energy production due to current governance regimes. This is an anomaly, considering South Africa's strategic position in Africa as a mineral-rich nation and its role as the leader of a 12-country working group under the African Mining Partnership (AMP), with South Africa serving as the project leader (DMRE, 2021). Furthermore, the United States (US) and the European Union (EU) are seeking alternative sources of critical minerals, aiming to reduce dependency on China amidst ongoing threats of supply disruptions and lessons learnt from the Russian-Ukraine war regarding energy dependency.

China is actively acquiring concessions for exploration and mining control in Africa and South America through its Belt and Road Initiative (BRI). Poor governance of the transition mineral resources value chain means that value addition will benefit the economies of other countries while causing environmental damage to the African continent, including South Africa. Chinese dominance in the rare earth mineral market, combined with the increasing policy decisions of the G7 countries, poses the risk of exposing South Africa to anti-competitive practices. The Russia-Ukrainian war, which began in March 2022, highlighted how monopolies and the geopolitics of minerals can lead to economic crises. The EU's reliance on Russian natural gas interrupted supplies and heightened energy requirements.

Research method and approach

This policy brief utilised secondary data, which includes ongoing stakeholder engagements (such as conferences), strategies and publications from lead government departments, including the Department of Mineral Resources and the DTIC.

Results and policy implications

The value chain, segmented into a value addition process encompassing upstream, midstream, and downstream activities, has the potential to drive economic growth and contribute to the realisation of a socially sustainable future through local content manufacturing. The mining and processing of REEs can facilitate the development of green technologies, foster research and development, and enable technology transfer, ultimately creating millions of jobs. "There are no plans in Africa for further development of the value chain of REEs for product manufacturing of magnets or battery manufacturing" (African Natural Resources Centre (ANRC), 2021). Challenges in South Africa's renewable energy potential have resulted in reservations within the sector and an inability to fully leverage clean energy technology in a holistic manner. This has impacted affordability, the capacity to address energy supply shortages, and the labour market while limiting contributions to the country's national climate change obligations (Renaud et al., 2020).

The literature on rare earth minerals, for example, is predominantly shaped by Chinese contributions. This is due to China's advanced technology in the global REEs and EV industries, its well-established value chain, and its significant progress in research and development within the renewable energy sector (Mancheri et al., 2019). The European Union is intensifying its research and development efforts as part of a strategy to reduce reliance on the Chinese market. In South Africa, the value addition of minerals is expected to be achieved through the coordination of several government institutions and departments. Key players include the Department of Mineral Resources (DMRE), the Department of Trade, Industry and Competition (DTIC), the Department of Science and Innovation (DSI), the Department of Energy and the National Treasury, and other government business entities such as the Industrial Development Corporation of South Africa (IDC), the Council for Geoscience and Mintek.

The emerging renewable energy faces threats from global production networks (GPNs), which could hinder South Africa's ability to develop local renewable energy technologies (Baker & Sovacool, 2017). These dynamics exclude South Africa and the region's transition minerals from a fully integrated value chain. China's rare earth sector's sustainability is driven by a comprehensive lifestyle approach, from sourcing renewable energy minerals to recycling materials once they reach the end of their use. Notably, China employs "31 indicators to construct the sustainable rare earth resource development evaluation index system" (Liang et al., 2018).

South Africa's most prominent electric vehicle (EV)-related minerals and metals are primarily exported. This policy brief highlights the potential contribution these minerals could make to South Africa's growing renewable energy sector. According to Bonfante et al., (2021, p.1), "research and developments with Neodymium-Iron-Boron (NdFeB)-based Rare Earth Magnets (REM) have intensified" due to their critical role in EVs, wind generators and electric motors, which demand improved magnetic properties. REMs were introduced into the market in the 1960s as a significant technological breakthrough, relying on the tetragonal compound Neodymium-Iron-Boron (NdFeB) (Bonfante et al., 2021). China's current success in this domain is attributed to its comprehensive value-adding chain, supported by various independent entities dedicated to the research and production of REEs. (Barakos et al., 2018). These entities are governed by the China Ministry of Industry and Information Technology to ensure an uninterrupted supply. The government plays a crucial role in identifying companies capable of adding value by producing technologically advanced products rather than merely exporting raw materials (Mancheri et al., 2019).

Policy alternatives

Geopolitics of transition minerals and their implications

The infrastructure required to provide sustainable and clean energy relies primarily on minerals. Wind turbines and EV motors depend on rare earth permanent magnets, which, together with battery technology, will enable many regions of the world to achieve their zero-emission targets with the support of our mineral resources. While advanced green energy technology will benefit many societies, numerous countries will likely bear the burden of pollution from mining minerals to meet the demands of the green energy revolution while facing carbon border adjustment taxes. Therefore, it is essential to link the extractive industry with the renewable energy infrastructure to ensure that the manufacturing and utilisation of wind turbines and batteries do not result in irreversible social and environmental harm in mining communities by disrupting the value chain.

Furthermore, institutions in the Global North are primarily focused on ensuring the sustainable supply of raw materials and mitigating the geopolitical risks associated with minerals. Comparatively less attention is given to the social and environmental consequences of mining, which often occurs in the Global South. The EU has introduced the Critical Raw Material Act, designed to secure a sustainable and reliable supply of critical raw materials for the region (European Commission, 2020).

REEs, as a subcategory of renewable energy minerals – referred to by the EU Commission as critical minerals – represent an emerging sector in South Africa. However, this

sector is not clearly defined by the organisation beyond its role in the commodities market. South Africa's participation in Global Value Chains (GVCs) is largely limited to upstream activities, with value addition taking place in other regions.

China, as the world leader in the production of rare earth minerals and a key supplier to industrialised nations, has become a significant source of geopolitical concern, particularly regarding the global governance of the value chain for transition minerals. The international community has categorised critical minerals as a security issue, signalling an emerging trajectory away from technological innovation to address the climate crisis towards a geopolitics-driven approach. This necessitates governance measures to minimise negative environmental and social impacts. Paradoxically, while renewable energy aims to mitigate global warming, the extraction and processing of transition minerals may pose significant risks. Monazite's rare earth minerals, comprising 17 Rare Earth Metals, hold immense value. A key aspect of their value addition lies in their application within renewable energy, which presents vast opportunities for innovation and sustainability.

Policy recommendations

To achieve a governance and regulatory framework for transition minerals, anticipatory governance should be implemented – a concept of the South African Institute of International Affairs (SAIIA). Strengthening foresight or anticipatory governance and action addresses uncertainties and challenges related to the future of critical minerals, offering threefold benefits for their value chain:

Engage with the critical minerals landscape

- **Future scenario predictions:** Forecast based on emerging trends to provide strategic direction, enabling policymakers and stakeholders to identify opportunities and risks effectively.
- **Sustainable resource management:** Emphasise the importance of evaluating critical mineral reserves to promote sustainable practices and long-term resource availability.
- **Research and innovation investment:** Advocate for funding research into alternative extraction methods to foster a sustainable and resilient sector.

Strengthen the governance and regulatory framework

- **Policy directives:** Establish clear governance frameworks for the sector, with precise definitions of terms and objectives, such as the Chinese model. This is crucial given the findings that government entities are engaging in inconsistent projects and using varying terminologies for renewable energy minerals.
- **Critical Mineral Masterplan:** Develop a comprehensive plan to articulate a clear vision and objectives aimed at supporting national mineral industrial development. The Masterplan should incentivise local value addition, foster research and development in transition minerals and rare earth processing, invest in creating a skilled workforce, and establish a stable regulatory framework.
- Strategic trade: Develop strategies to trade all critical energy transition raw materials separately from other commodities, guided by a comprehensive criticality assessment.

Pursue a responsible (just), sustainable and innovative pathway

The extraction and processing of critical minerals has implications for social inequalities (social contract for redress-equity), and environmental degradation, thereby safeguarding regulations for responsible practices is essential.

- **Dedicated directorate within the DTIC:** Establish a specialised directorate to coordinate the activities of all government departments and entities involved in the sector. This directorate would serve as a strategic convenor of the sector. It would also act as a foresight institution, cultivating a culture of strategic planning and establishing frameworks through networks and committees responsible for drafting legislation and policy.

The central argument is that the governance and regulatory framework should be attuned to broader economic and geopolitical events, including strategic partnerships, the geographic location of major EV manufacturers, and demand forecasting. This perspective would guide the country's investment in battery chemistry development, fostering a competitive advantage, alongside efforts in the extraction and processing of critical materials.

Conclusion

The foundations of future plans must seriously account for geopolitical systems (political economy). While not the only determinant of strategic partnerships, these systems are crucial considerations for ensuring the sustainability and resilience of the energy revolution to benefit both the economy and society. This brief emphasises the importance of pre-planning, including securing consensus, which should adequately reflect the insights emerging from Civil Society Organisations (CSOs), government as the lead shareholder, and interested individuals and experts (advocacy). Such an inclusive approach ensures that all relevant issues are addressed. This heightened awareness and methodology will ensure that South Africa remains a significant actor in the energy resource spectrum (oil, coal, gas, and electricity) while enhancing access by balancing demand and supply, improving efficiency, expanding markets, ensuring reliability and maintaining affordability.

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