Critical Minerals:
A South African Perspective

A South African Perspective on Critical Minerals

Critical minerals are metallic and non-metallic mineral resources that are deemed to be vital to world economies. The International Energy Agency published the South African "Targeted Critical Minerals and Metals List" in 2022.

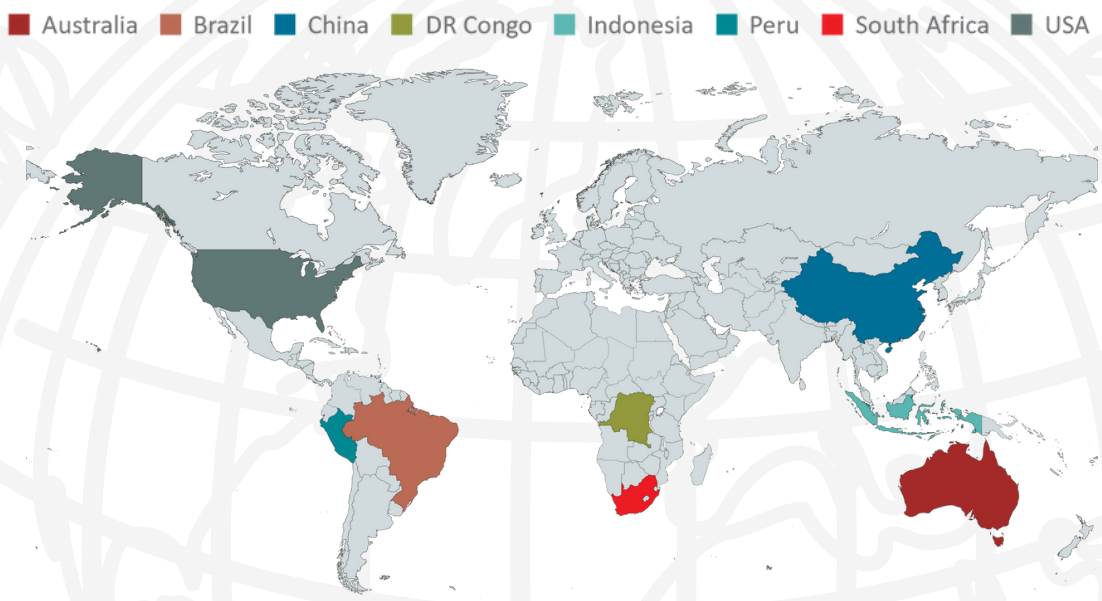
This list is comprised of all of the critical minerals and metals that have been deemed as being fundamental for South Africa to respond to the changes being brought on by the transition to a green economy, low-carbon energy production, and other high-tech technological advancements. The list was captured in the 2022 South African Exploration Strategy for the Mining Industry. The list is comprised of current and future needs:

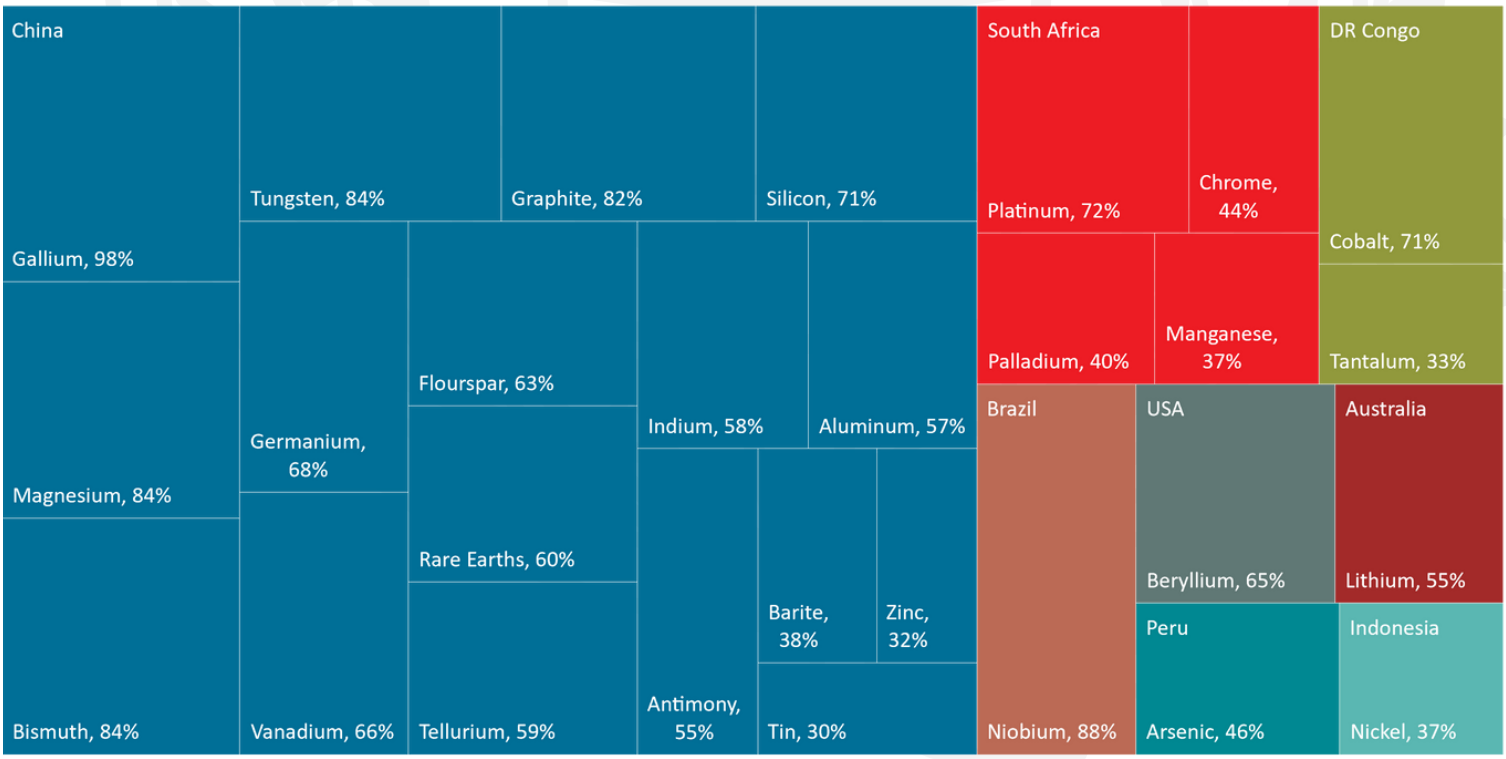
- Minerals for the future / Green economy
  - Cobalt
  - Nickel
  - Copper
  - Zinc
  - Lead
  - Rare Earths
- Steelmaking
  - Manganese
  - Iron Ore
- Energy Minerals
  - Coal
  - Uranium
- Competitive advantage and hydrogen economy
  - PGMs
  - Chrome
- Battery Minerals
  - Vanadium
  - Lithium

Critical Minerals by majority producing country as at 2021

Various minerals have been classified as being critical to world economies. According to Statista, South Africa was the majority producer in 2021 of the following critical minerals:

- 72% of all Platinum requirements
- 44% of all Chromium requirements
- 40% of all Palladium requirements
- 37% of all Manganese requirements





Source: Statista

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What are Critical Minerals

Critical minerals are metallic and non-metallic mineral resources that are deemed to be vital to world economies. Apart from the demand factor, critical minerals are also defined by their supply factor, where there is a risk that their supply chains can be disrupted. As the world and technology advance, so do what are deemed critical minerals. Civilisation and technological advancement determine the necessity.

As to critical minerals in today's sense, "many critical minerals are metals that are central to high-tech sectors", according to the American Geosciences Institute (AGI).

Countries' governments specify their own lists of which minerals they classify as being critical. These lists are based on their industrial needs, supply risks, and strategic development goals.

With the change in the energy mix and more pressure being applied to move towards clean technologies, such as renewable power generation, electric vehicles, and the use of hydrogen battery storage, the global demand for critical minerals used in these technologies is increasing significantly.

Globally there is a movement toward the decarbonisation of economic sectors through the use of zero-emission energy production.

The role of the clean energy technologies

The spectrum of clean energy technologies requires various minerals and metals, and the requirement for each clean energy technology is diversified in the types and volumes needed. Demand for critical minerals such as cobalt, copper, lithium and nickel will increase rapidly with the transition to clean energy technologies.

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Clean energy technology critical mineral requirements

The demand for critical minerals in the deployment of clean energy technologies within clean energy varies widely. Below is a table that the International Energy Agency developed depicting the requirement of various minerals based on the importance of these minerals for a particular clean energy technology:

	Copper	Cobalt	Nickel	Lithium	REEs	Chromium	Zinc	PGMs	Aluminium
Solar PV	●	●	●	●	●	●	●	●	●
Wind	●	●	●	●	●	●	●	●	●
Hydro	●	●	●	●	●	●	●	●	●
CSP	●	●	●	●	●	●	●	●	●
Bioenergy	●	●	●	●	●	●	●	●	●
Geothermal	●	●	●	●	●	●	●	●	●
Nuclear	●	●	●	●	●	●	●	●	●
Electricity networks	●	●	●	●	●	●	●	●	●
EVs and battery storage	●	●	●	●	●	●	●	●	●
Hydrogen	●	●	●	●	●	●	●	●	●

Relative importance of minerals for a particular clean energy technology: High: ● Moderate: ● Low: ●

Source: International Energy Agency

The International Energy Agency estimated the overall demand for the various minerals each clean energy technology would require based on four scenarios under the IEA's Stated Policies Scenario (STEPS) and the Sustainable Development Scenarios (SDS):

- Low-carbon power generation through solar PV, wind and nuclear
- Electricity networks
- Electric vehicles and battery storage
- Hydrogen

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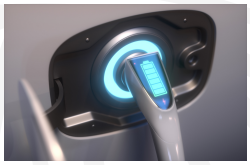
Mineral resources in vehicles and power generation

The type of clean energy technology dictates a variety of critical minerals that are crucial to ensure optimal performance.

Critical Minerals in vehicles

Conventional vehicles (Petroleum, Diesel)

29 Cu Copper | 25 Mn Manganese



Electrical vehicles

29 Cu Copper | 25 Mn Manganese | 3 Li Lithium | 28 Ni Nickel | 27 Co Cobalt | 6 C Carbon

Critical Minerals in power generation

Coal Power Generation

29 Cu Copper | 24 Cr Chromium | 28 Ni Nickel | 27 Co Cobalt

Nuclear Power Generation

29 Cu Copper | 24 Cr Chrome | 28 Ni Nickel | 25 Mn Manganese

Solar Photovoltaic Power Generation

29 Cu Copper | 14 Si Silicon | 30 Zn Zinc

Onshore Wind Turbines Power Generation

29 Cu Copper | 30 Zn Zinc | 25 Mn Manganese | 24 Cr Chromium | 28 Ni Nickel

Source: International Energy Agency

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Critical Mineral Supply Chains

The global demand to move towards clean technologies, such as renewable power generation, electric vehicles, and the use of hydrogen battery storage, and the need for the critical minerals used in these technologies has increased significantly.

A recent report by the International Energy Agency (2022) stated that the substantial upwards price trends of many minerals and metals due to supply chain interruptions and reserve shrinkage "called for policy intervention to enhance critical mineral supply reliability and resiliency." Additionally, these minerals are produced and processed in a very small number of countries, which exposes supply disruption vulnerabilities.

Countries can employ a variety of policy strategies and response mechanisms to curtail and be prepared to respond to the risks of supply disruptions. Some of these mechanisms countries can employ include:

- Strategic plans (to identify priority actions for later policy development)
- Strategic mineral lists (country-specific critical raw materials, accompanied by an outline of policy provisions)
- International coordination mechanisms
- Stockpiling mechanisms
- Public investment

Although this article focusses mainly on the minerals required within the clean energy transition, the energy sector is considered as a single component to a larger strategy by the various country's governing bodies.

Exploration, Project Evaluation and Project Development

In 2021, the International Energy Agency reported, "Critical mineral supply projects have long development lead times. In fact, analysis of major mines that became operational between 2010 and 2019 shows that it takes more than 16 years on average to develop projects from discovery to first production, although exact duration varies by mineral, location and mine type. These long lead times raise doubts about whether supply output can be ramped up quickly enough to meet rapid demand rises."

To decrease supply disruptions due to shortages, governments could promote investment and innovation to ensure timely project development.

Key supply challenges

There are concerns regarding the reliable supply of critical minerals amongst the increasing demand for these minerals. Some of these supply concerns include:

- Volatile commodity prices
- Production geographically concentrated with potential geopolitical risks and export restrictions
- Lengthy project development time from discovery to first production
- Declining ore quality impacts costs on extraction, processing, waste and carbon emissions
- Addressing ESG, particularly environmental performance of energy-intensive operations
- Expanding sustainable water sourcing risks

Selected minerals face unique supply challenges:

- Cobalt
  - Large geographical concentration of production in the DRC, and refining in China
  - Small-scale subsistence/artisanal mining of cobalt
  - Approximately 90% of cobalt produced is as a by-product to nickel and copper mining, and new supply is dependent on new project developments of nickel and copper operations
- Copper
  - Little to no substitution options for copper in electrical applications
  - Declining ore quality and reserves exhaustion of current operations
  - Increased production costs, emissions and waste due to declining ore quality
  - Water sourcing risks in South America and Australia
- Lithium
  - Financial pressure on chemical production and small-scale producers due to lengthy low commodity prices
  - Geographical concentration of chemical production in China
  - Water sourcing risks in South America and Australia
- Nickel
  - Increasing environmental burden regarding emissions and tailings disposal
  - Limited substitution options due to high production costs or emissions
  - Production delays and cost overruns in high-pressure acid leaching projects

Source: International Energy Agency

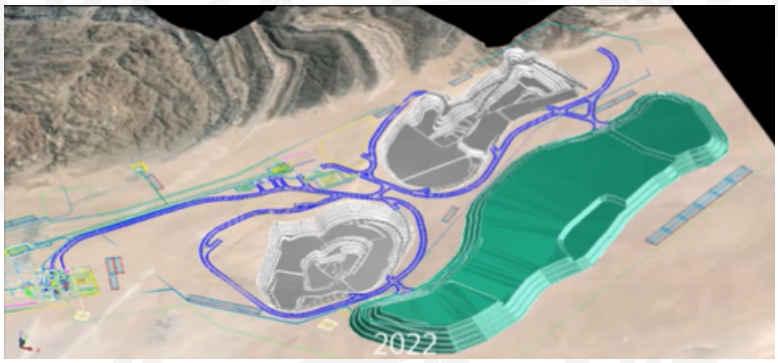
VBKOM's Role

The mining industry is one of the South Africa's most vital contributors when it comes to economic growth, but at what environmental cost?

For years, the mining and minerals industry has been classified as one of the biggest users of electricity and natural resources, such as water. It is also one of the biggest contributors to carbon emissions and negative environmental impacts, such as erosion, water pollution, and habitat modification.

A renewed focus on Environmental, Social, and Governance (ESG) principles alongside the clean energy transition are being driven through corporate governance and financial reporting standards within the mining industry. Environmental sustainability and conservation are two of the most topical elements of ESG, and two of the aspects that are usually most evident or measurable when change is implemented.

Environmental conservation is not a new concept, but it is one that the mining industry has been taking more seriously than ever before. Mining strategies have changed enormously in the past decade to include comprehensive environmental management systems, alternative mine planning, and greater emphasis on mine closures and mine rehabilitation.



Globally, mine designs are deliberately focussing on minimising the impact on the environment in a sustainable manner. Environmental and regulatory considerations are taken more seriously by all stakeholders and investors.

It is no longer just about the bottom line. It is about investing responsibly in the future of our people's lives and environment. VBKOM aims to assist the mining industry in extracting the critical minerals required for the clean energy transition responsibly and strategically through our multi-disciplinary services offering.

VBKOM has encountered many projects that are short of funds and do not have access to the right resources to find the right investors – or the projects are not adequately geared to be presented in their best possible light.

We have also encountered many potential investors and investment companies who are searching for the correct project to invest in and are not often exposed to a project's true realisable potential and seldom find a project that suits their pocket or their long-term aspirations.

Our progressive approach to project promotions includes reviews by geologists and engineers experienced in assessing project potential in all exploration, mining and engineering spaces.

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Our Value Proposition

VBKOM is a provider of innovative business and technical consulting services and solutions for the mining and capital-intensive industries. We challenge ourselves to apply fresh thinking and to utilise our experience and technology in pioneering new ways to deliver forward-thinking solutions.

Due to VBKOM's diverse pool of expertise, we can offer our clients specialised skills within a one-stop-shop culture. Our engineering, risk, and project management capabilities as well as simulation and decision support expertise, make us an ideal partner to the mining, petrochemical, agricultural, and construction industries.

Our focus on long-term client relationships, combined with our technical skills, ensures that our clients can fully optimise their value chain.

At VBKOM, the quality of our work is guided by a simple philosophy – our success is driven only by the success of our clients and the achievement of our professionals. Our technical expertise comes unrivaled by using cutting-edge technology and the most advanced computer modelling systems on the market. Our capacity and continuity have earned us the trust of some of the world's most prestigious mineral resource companies. Staying true to our core values; utilizing our vast project-specific experience and qualifications; and applying proven world-class methodologies and processes, makes the VBKOM team a dynamic, flexible, and innovative team with a track record standing as solid proof of our competitive edge in our field.

VBKOM employees have been successful in providing solutions of an independent nature to a range of clients. We believe that independent consultants can provide optimal solutions to the Client without any risk of delivering a solution with an inherent conflict of interest. The VBKOM strategy is to form part of the owner's team, to define and protect the owner's interest within our area of influence and control. VBKOM is committed to adding value to each client through innovative, practical, and trustworthy engineering solutions.
We look forward to adding value to your company.

VBKOM website and social media website:

Sources

- American Geosciences Institution, accessed 24 October 2022
- International Energy Agency, accessed 21 October 2022, 11 January 2023
- SpringerLink, accessed 12 January 2023
- Statista, accessed 24 January 2023

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