AFRICAN CLIMATE AND ECONOMIC DEVELOPMENT SERIES

HOW AFRICAN COUNTRIES CAN ADD AND CAPTURE VALUE FROM GREEN MINERALS

WORKING PAPER

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Contents

Acronyms

AfCFTA: African Continental Free Trade Area
AGMS: Africa's Green Minerals Strategy
AMDC: African Minerals Development Centre
AMV: Africa's Mining Vision
APDP: Automotive Production Development Programme
APRI: Africa Policy Research Institute
AU: African Union
BESS: Battery Energy Storage Systems
BMVC: Battery Mineral Value Chain
BRI: Belt and Road Initiative
BYD: Build Your Dream
CATL: Contemporary Amperex Technology Corporation
CBU: Completely Built-Up
CKD: Completely Knocked Down
CO_2: Carbon Dioxide
CSP: Concentrated Solar Power
DRC: Democratic Republic of Congo
ERBI: Equitable Resource-Based Industrialisation
EU: European Union
EV: Electric Vehicles
FTA: Free Trade Agreement
GDP: Gross Domestic Product
GHG: Greenhouse Gas Emissions
GIDEP: Green Industrial Development Expert Panel
GTM: Green Transition Minerals
ICE: Internal Combustion Engine
IEA: International Energy Agency
IRA: (United States's) Inflation Reduction Act
ISS: Institute for Security Studies
Li-ion: Lithium Ion
LFP: Lithium Ion Phosphate
NAAMSA: Automotive Business Council
NMC: Lithium Nickel Manganese Cobalt Oxide
OECD: Organization for Economic Co-operation and Development
OEM: Original Equipment Manufacturer
PGMs: Platinum Group Metals
PLI: (India's) Production Linked Incentive
PV: Photovoltaics
R&D: Research and Development
REEs: Rare Earth Elements
SADC: Southern African Development Community
US: United States
USD: United States Dollar

1. Introduction

This paper examines potential for the expansion of the green minerals value chain on the African continent. With the global green energy and digital industries expanding exponentially, the demand for clean-tech is growing and the green minerals landscape is swiftly transforming. While the African continent hosts a wide variety and significant share of global green minerals reserves, its value chains remain underdeveloped, with limited localised beneficiation.

Many minerals are essential for renewable energy systems, emerging low-carbon technologies, artificial intelligence, and military systems (Gnanguênon and Kretzschmar, 2025). These minerals are unevenly distributed geographically and are concentrated in a fairly small number of countries. Some African countries, individually or collectively, hold large shares of specific green minerals, notably cobalt in the Democratic Republic of Congo (DRC), copper in the DRC and Zambia, and platinum group metals (PGMs) in South Africa and Zimbabwe (IRENA, 2023).

Currently, China dominates global green value chains and is at the forefront of clean-tech manufacturing. Developed countries are playing catch-up by brokering partnership agreements with African countries to secure their supply of these 'critical minerals' and to insulate their supply chains from shocks, such as those recently triggered by the US's implementation of global tariffs.

As global value chains decarbonise, Africa has an opportunity to strategically advance its continental green growth agenda. The Green Industrial Development Expert Panel (GIDEP), established in 2025, identifies structural transformation as central to achieving a green transition on the continent (GIDEP, 2025). This transformation entails shifting African countries away from a heavy reliance on raw material exports towards more productive and diversified sectors, including manufacturing, modern agriculture, mineral value addition and capture, and high-value services.

In 2025, the African Minerals Development Centre compiled Africa's Green Minerals Strategy (AGMS) to identify the ways in which Africa could drive green industrialisation. The African Continental Free Trade Area (AfCFTA) has the potential to support the goals of the African green minerals strategy (AGMS) by developing the African green value chain further. While a coordinated effort to industrialise is needed on the continent, adequate infrastructural investment is at the core of activating such efforts. However, the AGMS, like many continental frameworks, remains largely at the level of vision and principles. It provides limited guidance on how specific markets for green minerals and associated value chains will be developed, governed, and financed in practice.

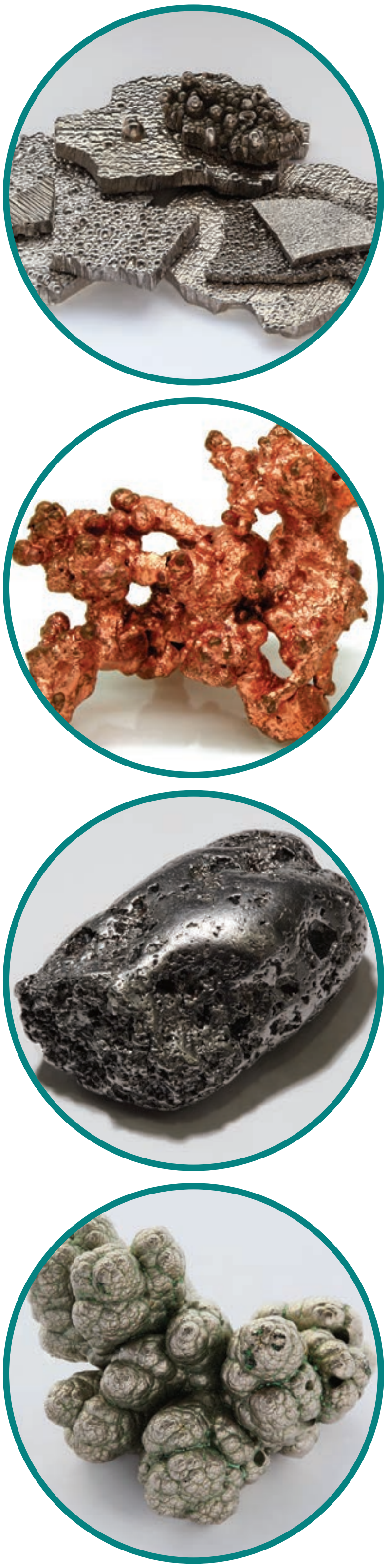
Section 2 of the paper reviews the international economic and geopolitical context underpinning Africa's green minerals landscape. The section reflects on the key market players from an extraction and processing perspective.

Section 3 examines African green industrialisation initiatives, providing details on (known) green mineral reserves on the continent and the countries with growing investments in these rare earth minerals.

Section 4 reflects on a selection of African country case studies (Morocco, the Democratic Republic of Congo and Zambia, and South Africa) to highlight successful models for developing green mineral value chains, while acknowledging systemic weaknesses that inhibit further low-carbon developments in these countries.

Section 5 consolidates the findings by proposing ways to leverage green minerals to grow Africa's green mineral value chains, including through leveraging certain 'side-stream' linkages. Various policy options are examined.

Across all sections, the paper pays particular attention to the persistent gap between stated ambitions and on-the-ground implementation, and the implications of this gap for Africa's prospects of moving beyond an extractive position in global green value chains.



From top to bottom: Cobalt, copper, platinum and nickel

Source: By Alchemist-hp (talk) (www.pse-mendelejew.de). Own work, FAL, https://commons.wikimedia.org/w/index.php?curid=11530303

By Native_Copper_Macro_Digon3.jpg: "Jonathan Zander (Digon3)" derivative work: Materialscientist (talk). Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=7223304

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2. Green minerals: The international economic and geopolitical context

2.1. Green minerals: International economic drivers

Various minerals are essential for renewable energy systems, emerging low-carbon technologies, artificial intelligence, and military systems (Gnanguênon and Kretzschmar, 2025). The geographic distribution of these minerals is uneven and concentrated in a limited number of countries. Some African countries, individually or collectively, hold large shares in specific green minerals, notably cobalt in the Democratic Republic of Congo (DRC), copper in the DRC and Zambia, and platinum group metals (PGMs) in South Africa and Zimbabwe (IRENA, 2023).

Disruptions in supply could pose risks to the critical minerals value chain and, in extreme cases, could compromise the green technology transition and result in cascading geopolitical impacts. These risks are increasingly being factored into national policies to secure the access, availability and affordability of critical minerals through policy reforms, strategic international partnerships, and enhanced public finance (International Energy Agency, 2025).

The global green energy and digital transformations are giving rise to a shift in the minerals landscape. While the long-term economic prospects of an intensive, fossil-fuel-based trajectory are increasingly uncertain, demand is growing for the green minerals required to meet the target of limiting temperature increases to below 1.5 degrees by 2050. Clean-tech manufacturing requires greater volumes and a wider variety of minerals than those required by conventional fossil-fuel-based technologies. For instance, electric vehicles (EVs) require more than double the amount of copper and manganese than internal combustion engine (ICE) vehicles, and a number of minerals that ICE vehicles do not require at all, such as nickel, graphite, cobalt and lithium (Mining.com, 2022).

The terms 'critical minerals' and 'green minerals' are often used interchangeably. In this paper, we follow the conceptualisation of green minerals used by the African Mineral Development Centre; they are minerals required for clean energy and low-carbon technologies, as set out in Africa's Green Minerals Strategy (African Minerals Development Centre (AMDC), 2025a).

As Figure 1 shows, clean-tech manufacturing is currently globally dominated by China, with 76% of the world's new clean-tech factory investments in 2024 taking place in mainland China (Bloomberg, 2025a). China maintains a particular stronghold in upstream solar, battery, and electric vehicles (GIZ, 2023). However, China is not dominant across all low-carbon value chains; for example, Germany and Denmark rank as the leading wind equipment exporters, accounting (with the Netherlands and Spain) for three quarters of global exports in 2020. In the biofuels sector, the US is the leading exporter, with the Netherlands and Brazil following (Lebdioui, 2024).

2.2 Green minerals: The geopolitical context

The United States (US) and the European Union (EU) are racing to catch up with China's lead in the green minerals value chain, striving to reduce their dependence on China for products deemed essential for energy and other aspects of national security. Both the US and EU have resorted to protectionist tariffs and other trade measures against Chinese imports. These measures go beyond low-carbon technologies and, particularly in the US under the second Trump administration, have escalated into broad, economy-wide tariffs on imports (Bloomberg, 2025b).

In the developed country context, the US's Inflation Reduction Act (IRA) once provided subsidies in support of the low-carbon technology value chain (United States Environmental Protection Agency, 2025). In the EU, the Green Deal Industrial Plan and Net-Zero Industry Act target green technologies, including renewables, batteries, electric vehicles and electrolysers (EU, n.d.). However, the second Trump administration has sought to reverse federal climate policies by dismantling the IRA and other climate policies while simultaneously weakening emissions standards regulations (Policy Center for the New South, 2025). These moves have effectively sidelined an earlier

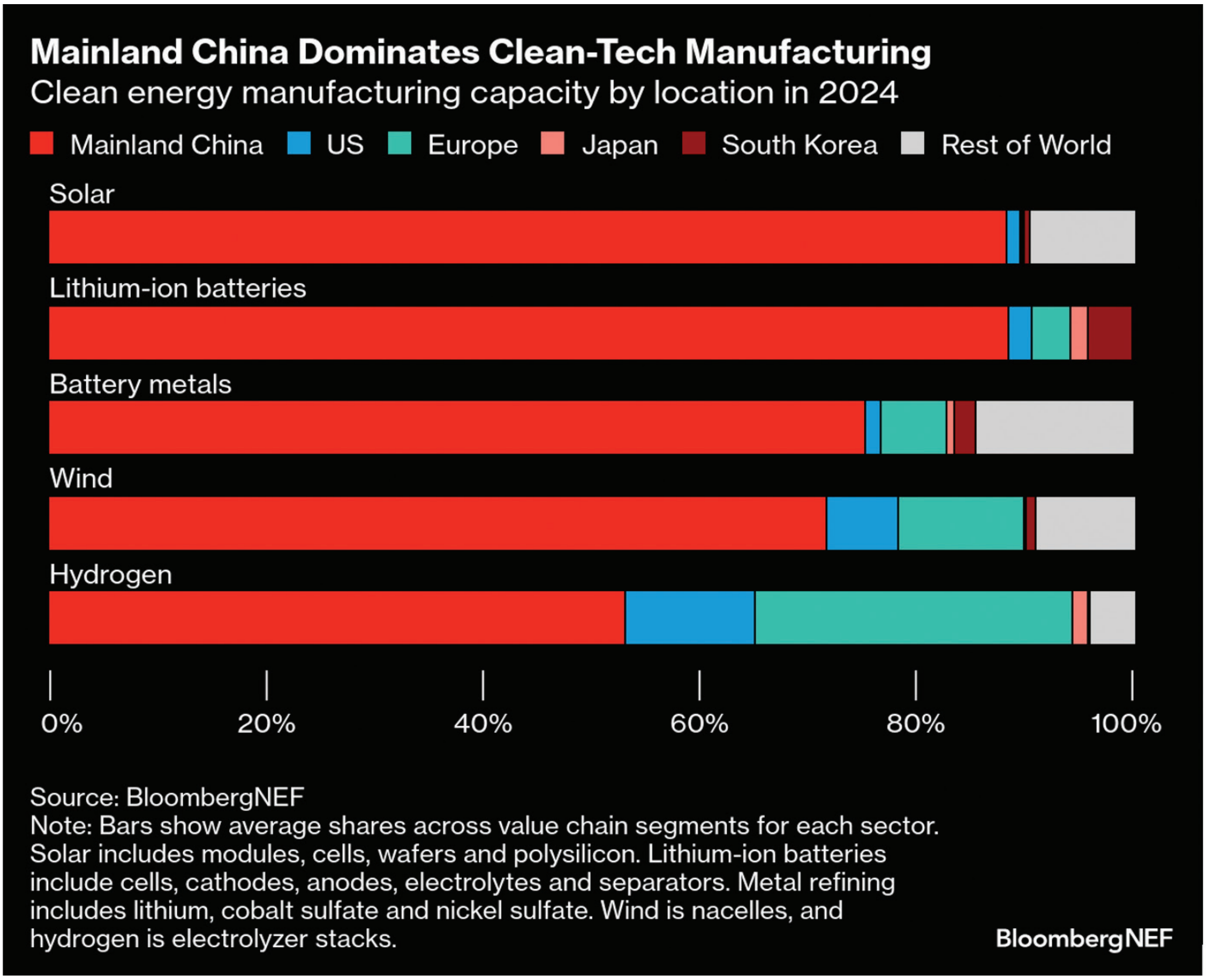


Figure 1: Clean-tech manufacturing is dominated by China

Source: Bloomberg (2025a)

trend towards renewable energy in favour of expanding fossil fuel production, signalling a substantive energy-system reversal and a broader shift to trade protectionism.

A number of developing countries have designed industrial policies aimed at low-carbon value chains. These include Brazil's new green industrial policy known as New Industry Brazil ('Nova Indústria Brasil') and India's Production-Linked Incentive (PLI) scheme (Indian Government Press Information Bureau, 2025).

Brazil's 'Nova Indústria Brasil' sets out to achieve 'neo-industrialisation' with a focus on six missions: food security, healthcare resilience, infrastructure, the digitalisation of industry, the energy transition, and national security (Presidência da República, 2025; Cambridge Industrial Innovation Policy, 2025). India's Production-Linked Incentive (PLI) scheme offers financial incentives to eligible companies across 14 prioritised sectors, including solar photovoltaic production.

Countries have also sought to attract Chinese investments in low-carbon value chains. While China's main objective is to export, it has signalled its openness to localising manufacturing in destination markets where demand is growing, in part to circumvent the trade measures of the US and the EU (Bloomberg, 2024a). Chinese firms have invested in some downstream value chain segments in countries such as Germany, Hungary, Japan, and South Korea. Some developing countries, such as Brazil, Mexico, and Morocco, have also attracted Chinese investment, largely in upstream segments like critical minerals (Bloomberg, 2025b)

While China dominates in global green value chains, African countries may find emerging opportunities to move beyond their historical role as primarily mineral extractors to greater value addition and value capture at source. Africa's Green Minerals Strategy (African Minerals Development Centre (AMDC), 2025a), discussed in Section 3.1 of this paper, sets out bold objectives for adding value to Africa's green minerals within the context of the African Continental Free Trade Area (AfCFTA). Of particular importance are the minerals necessary for batteries and EVs. Some countries, such as Zambia and the Democratic Republic of Congo, have set out high ambitions not only to process green minerals but to shift further down the value chain to producing battery components and electric vehicles (ECA, 2024).

Climate change and the current global geopolitical context raise many opportunities for Africa's economic development that should not be missed. A flagship report by the Green Industrial Development Expert Panel (GIDEP) emphasises that structural transformation is core to achieving a developmental green transition on the continent (GIDEP, 2025). This transformation will entail shifting African countries away from a heavy reliance on raw material exports towards more productive and diversified sectors, including manufacturing, modern agriculture, mineral value addition capture, and high-value services.

However, raw materials can only be transformed into higher-value products through a combination of mineral management and industrial policy that supports the acquisition of relevant industrial capabilities. It is worth noting that value can be captured from high-demand minerals through appropriate tax instruments, with the proceeds deployed towards green industrialisation across a broader set of value chains (GIDEP, 2025).

A phosphate train near Khouribga to the port of Casablanca, Morocco.

3. Green minerals: The African context

3.1. Africa's green industrialisation ambitions

The African Union (AU) has identified the need to take advantage of the opportunities afforded by its mineral resource endowments through a series of policy decisions. In addition, the AU's Africa's Green Minerals Strategy (AMDC, 2025a) focuses specifically on the opportunities and risks for Africa associated with green minerals (AMDC, 2025a). It argues that Africa needs to position itself strategically in the global shift toward green technologies, highlighting potential opportunities in the continent's battery industry, electric vehicle supply chains, and renewable energy. The AMDC notes that activities in these areas could build on Africa's extensive reserves of green minerals (AMDC, 2025a) through four strategic pillars: (i) advancing mineral development; (ii) developing people and technological capabilities; (iii) developing mineral value chains; and (iv) mineral stewardship (AMDC, 2025a).

The overall objective of the AGMS is to leverage green minerals to drive Africa's industrialisation and electrification while supporting the development of green technologies and promoting sustainable development. It calls for activating various kinds of mineral linkages, including backward, forward, fiscal, knowledge-based, and lateral linkages, to underpin equitable resource-based industrialisation (ERBI) across the continent (AMDC, 2025a).

In addition, the AfCFTA, which came into force in 2019, has the potential to support the objectives of the AGMS by contributing to the creation of regional value chains (Davis *et al.*, 2024). Beyond increasing intra-African trade and creating a single continental market, the AfCFTA offers an opportunity for the AGMS to anchor a truly African green minerals strategy (AMDC, 2025a). It can help unlock and expand continental markets for green mineral value chain products, and drive industrialisation, innovation, and regional integration.

Although these ambitions are articulated in the AGMS, the strategy offers little specific guidance on developing markets for green minerals or their associated value chains across the continent, presenting a high-level vision rather than a concrete implementation plan. This reflects a broader pattern in African policy frameworks, which frequently set ambitious goals such as advancing green mineral beneficiation without detailing the mechanisms to achieve them. The key challenge is to translate these plans into effective strategies and implement them.

In many cases, Africa's public messaging – domestically and regionally – diverges from on-the-ground realities. This gap is reflected in two key ways. First, deals with external countries and companies rarely commit to value-adding processing of green minerals. Second, high-level MOUs and project announcements show little follow-through. Examples of these are discussed below.

3.2. Africa's green mineral endowments

It is often stated that Africa holds approximately 30% of the world's mineral reserves, including substantial deposits of green minerals (Chandler, 2022). Table 1 shows the minerals in which African countries hold sizeable deposits. The AGMS proposes that these minerals form the focus of green mineral processing.

The mineral resource base is unevenly distributed. For instance Southern Africa has significant deposits of lithium, nickel, and platinum group metals (PGMs), with several rare earth element projects currently being developed across the region (Rare Earth Exchanges, 2025).

Table 1: Core green minerals identified in the African Green Mineral Strategy (AGMS)

Mineral	Hydro-power	Wind	Solar PV	CSP	Hydrogen and fuel cell	Energy Storage	Electric Vehicles
Aluminium	✓	✓	✓	✓		✓	✓
Chromium	✓	✓		✓	✓		
Cobalt						✓	✓
Copper	✓	✓	✓	✓		✓	✓
Graphite						✓	✓
Iron/steel & alloys	✓	✓	✓		✓	✓	✓
Lithium						✓	
Manganese		✓				✓	✓
Nickel	✓	✓	✓	✓	✓	✓	✓
Phosphate		✓				✓	✓
Platinum Group Metals					✓		
Rare earth elements		✓				✓	✓
Titanium						✓	
Vanadium						✓	
Zinc		✓	✓				

Source: African Minerals Development Centre (2025a: 13)

Zambia and DRC both hold major deposits of copper, and the DRC is well known for holding the largest deposits of cobalt. Several North African countries – Morocco, Egypt, Tunisia and Algeria – hold significant deposits of phosphates. See Table 2.

Table 2: Africa's estimated share of green minerals in world production and reserves, 2023

Mineral	World production	World reserve	Top African countries	Production (% of world)	Reserves (% of world)
Aluminium (smelting)	70 Mt		South Africa	720 kt (1%)	
			Mozambique	314 kt (0.5%)	
			Egypt	320 kt (0.5%)	
Alumina	140 Mt		Guinea	330 kt (0.3%)	
Bauxite	400 Mt	30 Gt	Guinea	97 Mt (24.3%)	7.4 Gt (23.8%)
Chromium	41 Mt	560 Mt	South Africa	18 Mt (43.9%)	200 Mt (35.7%)
			Zimbabwe	1.4 Mt (3.4%)	
Cobalt	230 Mt	11 Mt	DRC	170 kt (73.9%)	6 Mt (54%)
Copper mine production	22 Mt	1 Gt	DRC	2.5 Mt (11.3%)	80 Mt (8%)
			Zambia	760 kt (3.4%)	21 Mt (2.1%)
Copper refinery	27 Mt		DRC	1.9 Mt (7%)	
			Zambia	380 kt (1,3%)	
Graphite – natural	1.6 Mt	280 Mt	Mozambique	96 kt (6%)	25 Mt (8.9%)
			Madagascar	100 kt (6.2%)	24 Mt (8.5%)
			Tanzania	6 kt (0.3%)	18 Mt (5.5%)
Iron & steel (raw steel)	1.9 Gt				
Iron ore (Fe cont.)	1.5 Gt	87 Gt	South Africa	39 Mt (2.6%)	600 Mt (0.6%)
			Mauritania	8.1 Mt (0.5%)	N/A
Lithium	180 Kt	28 Mt	Zimbabwe	3.4 kt (1.8%)	310 kt (1.1%)
Manganese	20 Mt	1.9 Gt	South Africa	7.2 Mt (36%)	600 Mt (31.5%)
			Gabon	4.6 Mt (23%)	61 Mt (3.2%)
			Ghana	840 kt (4.2%)	13 Mt (0.7%)
			Cote d'Ivore	390 kt (1.9%)	N/A
Nickel	3.6 Mt	> 130 Mt			
Phosphate rock	220 Mt	74 Gt	Morocco	35 Mt (16%)	50 Gt (67%)
			Egypt	4.8 Mt (2.1%)	2.8 Gt (3.8%)
			Tunisia	3.6 Mt (1.6%)	2.5 Gt (3.4%)
			Senegal	2.5 Mt (1.1%)	50 Mt
			Algeria	1.5 Mt (1.1%)	2.2 Gt (3%)
			South Africa	1.6 Mt (0.7%)	30 Mt
			Togo	1.5 Mt (0.6%)	1.5 Gt (2%)
Platinum group metals (Pd + Pt)	390 t	1 Gt	South Africa	191 t (49%)	63 kt (90%)
			Zimbabwe	34 t (8.7%)	1.2 kt (1.7%)
Rare earths	350 kt	280 Mt	Mozambique	960 t (0.3%)	N/A
			Burundi		N/A
			Tanzania		890 kt (0.68%)
			South Africa		790 kt (0.6%)
Vanadium	100 kt	19 Mt	South Africa	9.1 kt (9.1%)	750 kt (3.9%)
Zinc	12 Mt	220 Mt	South Africa	230 kt (1.9%)	6.2 Mt (2.8%)

Source: African Minerals Development Centre (2025a: 14-15), based on United States Geological Survey (2024)

The AGMS (AMDC, 2025a) identifies several linkages that could be forged along critical mineral value chains (see Figure 2). These include, but are not limited to, forward linkages through the downstream processing of critical minerals, right through to the precursor stage of producing low-carbon products such as lithium-ion batteries. The AGMS also highlights prospective 'lateral' linkages that are often overlooked in discussions of the developmental potential of critical minerals. Lateral linkages may be formed by feeding capital goods, services, and consumables into the mining value chain. Creating fiscal linkages would entail capturing resource rents through taxes on mining. Investment in the infrastructure necessary for mining and mineral processing could stimulate other industrial and agricultural activities. 'Knowledge linkages' that involve improving geo-surveying and prospecting, developing STEM skills, and expanding research could also unlock critical mineral activities, and are high-value activities in their own right.

3.3. Prominent players in African green minerals

Africa has been and remains an important supplier of minerals to the rest of the world. Securing green raw materials has become a strategic priority for many countries, both developed and developing, driven by factors such as national security concerns, digitalisation, strategic autonomy, the green and digital transitions, and global competitiveness (Karkare and Karaki, 2025; Beuter *et al.*, 2025). As countries adopt diverse strategies for green industrialisation and seek to secure their supply of green minerals, a number of bilateral and multilateral trade agreements have been forged on the continent (Beuter *et al.*, 2025). This global interest in what Africa has to offer presents an opportunity for the continent to diversify its partnerships and integrate more deeply into different segments of the value chains within green minerals manufacturing.

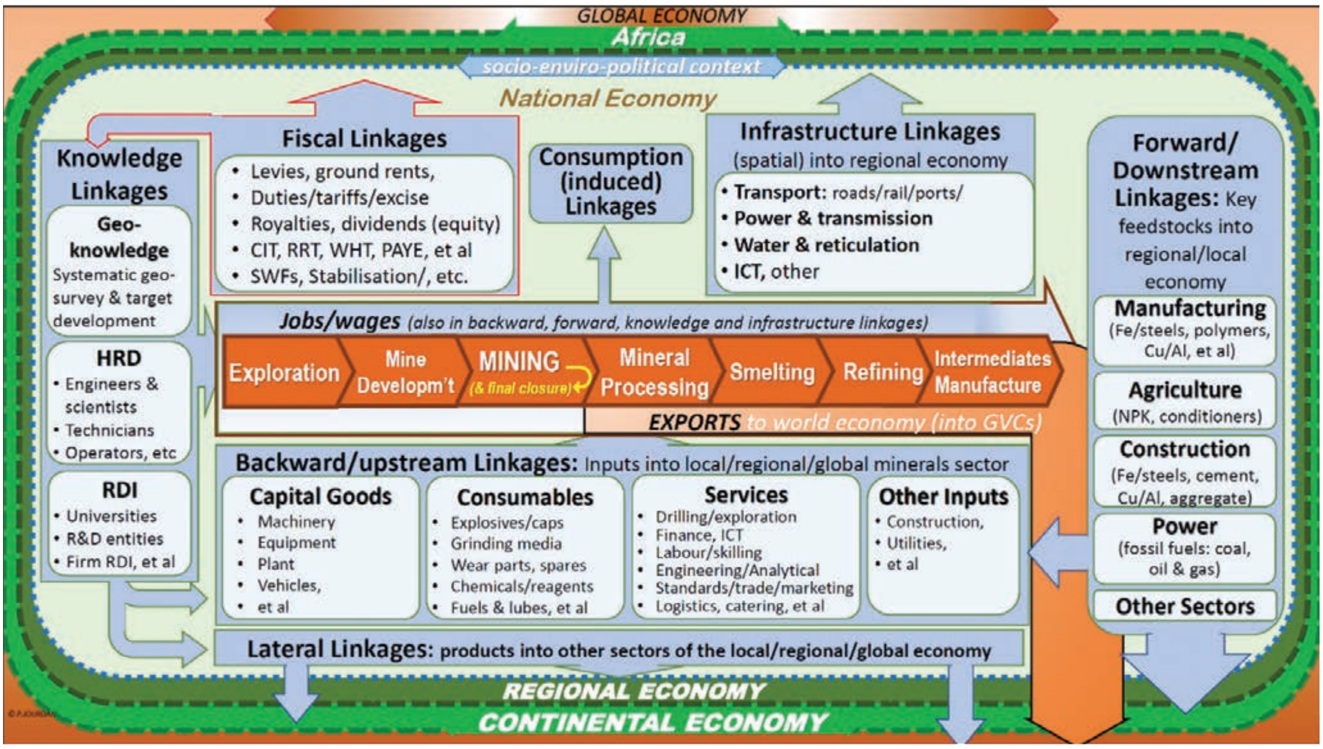


Figure 2: Mineral linkages for development and industrialisation

Source: African Minerals Development Centre (2025a)

Chinese firms, both state-owned and private, have heavily invested in Africa's green mineral sectors, particularly in cobalt (DRC), lithium (Zimbabwe), copper (Zambia), and REEs (Beuter *et al*., 2025). The country now has substantial control over green mineral mining across the continent. Unlike the US, whose engagement is often framed around national security concerns, China's approach is primarily driven by infrastructure-for-resource deals that prioritise access to raw materials (Beuter *et al*., 2025). These materials are extracted in Africa and predominantly processed in China. Notably, China's dominance extends beyond extraction to include refining and battery manufacturing, giving it control over multiple stages of the green value chain (Andreoni and Roberts, 2022).

Other countries, too, have signed bilateral agreements with African countries. These include the United Kingdom, Turkey, Saudi Arabia, the United Arab Emirates, Russia, India, South Korea, Japan, and Indonesia (Beuter *et al*., 2025). These agreements take different forms, including strategic partnerships, cooperation frameworks, and memoranda of understanding. Some agreements include statements of intent to promote joint ventures and foster deeper integration into mineral value chains (Beuter *et al*., 2025).

The following section discusses the green minerals value chains in four African countries: Morocco, Zambia, the Democratic Republic of Congo, and South Africa. These countries all have significant endowments of green minerals. They are geographically dispersed from North to Southern Africa and reflect varying degrees of progress in adding value to these minerals. Their experiences could yield insights for the further development of green minerals value chains.

This global interest in what Africa has to offer presents an opportunity for the continent to diversify its partnerships and integrate more deeply into different segments of the value chains within green minerals manufacturing.

An aerial view of the port of Tanger-med on the north Moroccan coast.
By Adam Cli. Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=86467120

4. Major developments: Selected sub-regions and countries

4.1. Morocco

Morocco has prioritised its green transition through structural transformation, notably through the development of strong forward and backward linkages to its ambitious expansion of renewable energy (Sabry, 2025). It aims to raise the country's share of renewable energy to 52% by 2030 (Forbes, 2024), an ambitious goal, given that in 2022, fossil fuels generated 83% of the country's electricity (Hafdaoui, Khallaayoun and Al-Majeed, 2025).

Beyond renewable energy, two main sectors are linked to the green economy in general and battery production specifically – the automotive industry (electric vehicles) and phosphate processing (for battery chemistries using phosphates). This integration of two major drivers of the economy and green mineral production takes advantage of free trade agreements negotiated between Morocco and both the European Union and the United States. Morocco also cooperates with China through the Belt and Road Initiative (BRI) to expand investment in green energy and industrial projects. Through targeted policies, such as the Green Morocco Plan, the Industrial Acceleration Plan, and the National Mining Strategy, Morocco is positioning itself to increase participation in certain low-carbon value chains (Agyeman and Abudu, 2025). Investment in infrastructure has played an important role, especially the Tanger Med port and industrial park complex.

Morocco's automotive industry has developed rapidly off a low base. Annual vehicle assembly increased tenfold between 2010 and 2023, from 50,000 to over 500,000 vehicles (Zalk, 2024). This has largely been based on investments by French original equipment manufacturers (OEMs), including Renault, Peugeot, Citroën, and Stellantis, taking advantage of Morocco's free trade agreement (FTA) with the EU (Wuttke, 2022). Industrial capabilities originally developed to assemble internal combustion engines (ICE) have been built upon in a shift to the production of electric vehicles. Stellantis' assembly of EVs is reportedly set to increase from 20,000 to 70,000 annually (The Arab Weekly, 2025).

At the other end of the value chain, Morocco has made progress with the processing of critical minerals, building on its experience of mining the world's largest deposits of phosphates. Phosphates are primarily used for fertiliser production. One of two major lithium ion (Li-ion) battery chemistries also requires high-quality battery-grade phosphate concentrates for lithium iron phosphate (LFP) batteries. The other major Li-ion technology is nickel manganese cobalt oxide (NMC) batteries (Tanchum, 2022). Building on its endowments of phosphates, industrial capabilities, and market access, Morocco has announced various projects in battery mineral processing. These projects are largely led by Chinese firms but include joint ventures with others, notably South Korean investors.

An important consideration, in relation not only to Morocco but to all African countries, is the need to distinguish between often ambitious memoranda of understanding and programme announcements, on the one hand, and projects that have reached construction and ultimately production stage, on the other. Some prominent projects are reported to be at production stage, such as the USD 2 bn COBCO project. COBCO is a joint venture between Moroccan investment fund Al Mada and Chinese battery materials producer CNGR Advanced Materials, producing precursor cathode active materials (pCAM) for NMC batteries (Mobity Rising, 2025). However, many projects remain at announcement stage (Ibold, 2024).[1]

4.2. Democratic Republic of Congo and Zambia

The DRC and Zambia are of growing global interest, as they are major producers of green minerals owing to their large deposits of copper and the DRC's dominance of the world's cobalt deposits.

The DRC economy remains highly reliant on commodity exports, especially oil, copper, cobalt, tin, tungsten, and tantalum (Chipanda, 2025). Mining continues to play a dominant and growing role in the DRC economy. In 2024, the DRC's economy expanded by 6.5%, largely owing to a 12.8% increase in extractive activities, particularly in copper and cobalt output. At the same time, non-mining sectors grew by 3.2%,

1 'Announcement'-stage projects in Morocco include the following:
1. The Jiangsu BTR New Material Group Co., Ltd announcement that it will complete factory construction in the Mohammed VI Tanger Technopark City in order to produce materials for lithium battery cathode material, with an annual production capacity of 50,000 tons (Planned investment of USD 500 million);
2. The CNGR Advanced Material Co., Ltd announcement that it will produce battery materials for over 1 million EVs annually in the Jorf Lasfar Park (Planned investment of USD 2.3 billion jointly with Al Mada Group);
3. An announcement by Hunan Zhongke Shinzoom Technology Co., Ltd about beginning factory construction in the Mohammed VI Tanger Technopark City, to produce lithium battery anode material (Planned investment of USD 490 million);
4. An announcement by (Sino-German) Gotion High-Tech Co., Ltd about beginning 'gigafactory' construction in Kenitra to produce EV batteries and energy storage systems (Planned investment of USD 6.5 billion);
5. An announcement by Guangzhou Tinci Materials Technology Co., Ltd about plans to produce lithium-ion batteries with an annual production of 200,000 tons (Planned investment of USD 280 million);
6. An announcement by Huayou Cobalt with LG Chem Ltd about the construction of a lithium salt processing plant with an annual capacity of 52,000 tons;
7. An announcement by Huayou Group's subsidiary Youshan, in partnership with LG Chem Ltd, that they will produce 50,000 tons of lithium-phosphate-iron (LFP) cathode materials annually for 500,000 entry-class EVs; and
8. An announcement by Zhejiang Hailiang Co., Ltd about factory construction to produce lithium-battery copper foil (Planned investment of USD 288 million) (Ibold, 2024: 8-9).

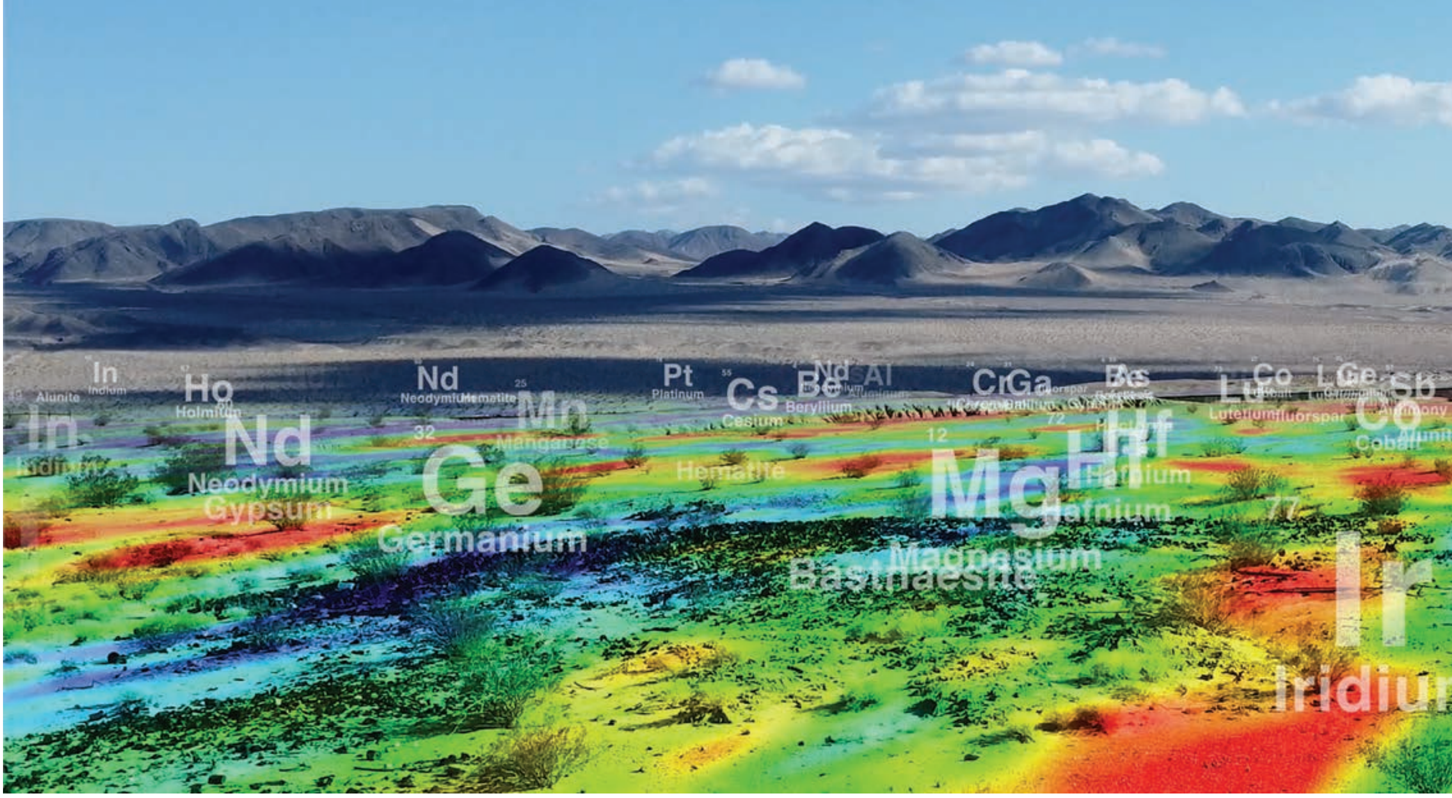
supported by gradual diversification and rising levels of private investment (World Bank Group, 2025). Revenues from non-mining sectors have consistently surpassed those from oil and gas since 2010, contributing around 17.4% of GDP, and over half of government revenue in 2017 (The World Bank, 2023). Fiscal contributions from mining rose from USD 1.68 billion in 2017 to about USD 4 billion in 2021. However, despite its mineral wealth, 72% of the population lived in extreme poverty in 2022 (The World Bank, 2023; Chipanda, 2025).

The DRC holds the world's largest cobalt reserves at approximately 54% and currently accounts for 70% of global cobalt production. It is also the world's second-largest copper producer. In addition to its essential role in Li-ion batteries used in EVs and energy storage, copper plays a crucial role in wind energy and biogas production, making it a key material in the global shift toward cleaner and more sustainable energy systems (Chandler, 2022). Other green minerals in which the DRC has significant reserves include lithium, tin, tantalum, and tungsten (Organization for Economic Co-operation and Development (OECD), 2025).

Similarly, Zambia's mining sector remains central, accounting for 15% of GDP, 70% of export earnings, and 44% of government revenue through royalties and corporate taxes (World Bank Group, 2024). Largely dominated by foreign-owned firms, the industry continues to attract substantial foreign direct investment focused on mineral extraction and early-stage processing. Nevertheless, socio-economic challenges persist, with nearly 60% of the population living below the national poverty line and unemployment remaining high at 13%, particularly among youth, at 24.7% (African Development Bank, 2024b).

Zambia is one of the world's top ten copper producers and Africa's second-largest, after the DRC. Collectively the DRC and Zambia account for over 12% of global copper production (Chandler, 2022).

Molten copper being poured, Zambia
By photosmith2011. Flickr: CC BY-SA 2.0, https://commons.wikimedia.org/w/index.php?curid=15591366



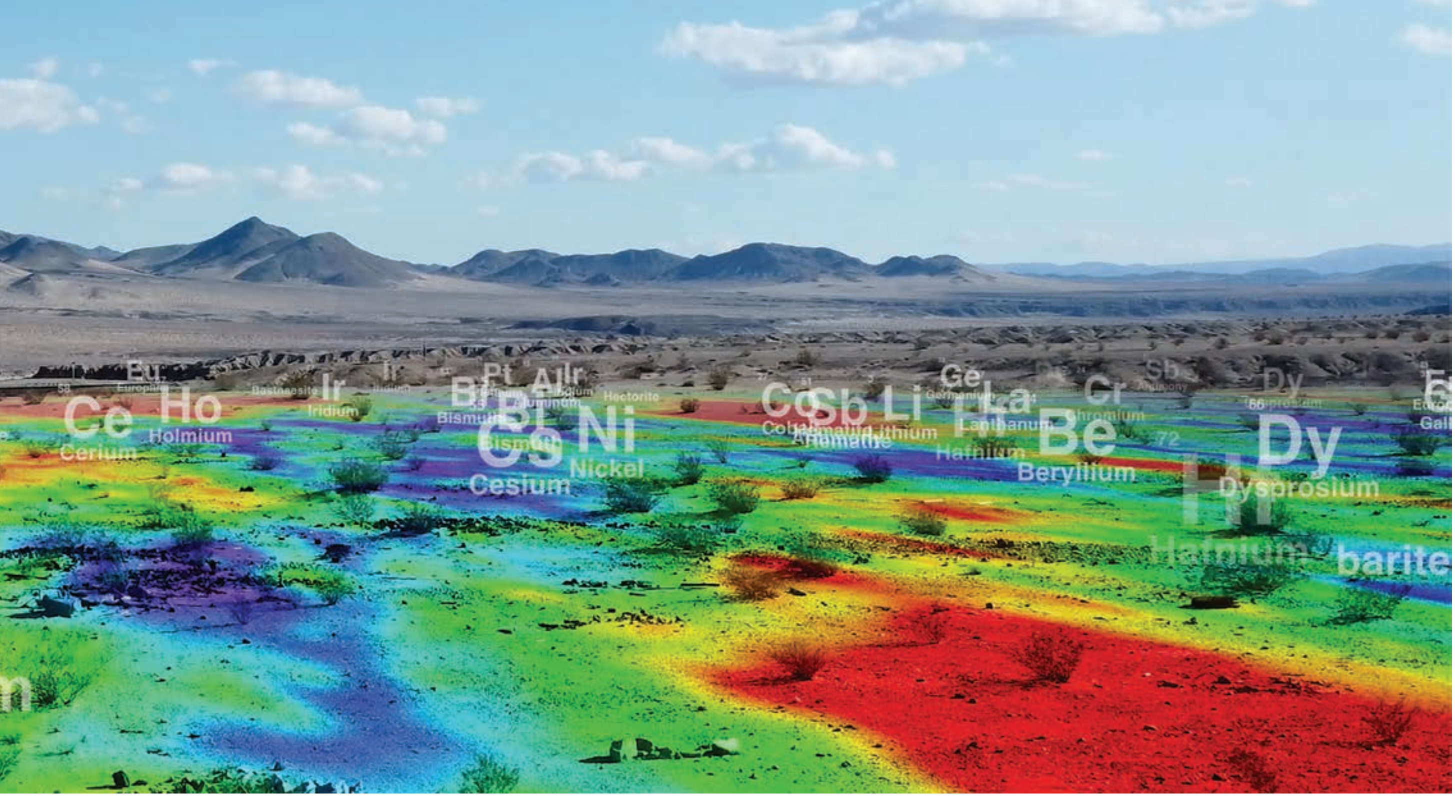
NASA Mapping Critical Minerals
By NASA's Scientific Visualization Studio. NASA Mapping Critical Minerals, Public Domain, https://commons.wikimedia.org/w/index.php?curid=175138424

Both countries have set objectives of adding and capturing further value in relation to their green mineral endowments. Value-add has been pursued, albeit very unevenly, both through internal policy instruments and external partnerships.

The DRC appears to lack a publicly available national strategy outlining its policy objectives in relation to green minerals. Nevertheless, it has undertaken some significant policy measures aimed at adding and capturing value. In February 2025 the DRC imposed a ban on cobalt exports for that month, later extending the ban to September, which significantly affected import partners such as South Korea and China (Bloomberg, 2024) The export ban led to a boost in cobalt prices, but was not matched by efforts to enhance local value addition.

The President initiated a renegotiation of the Sicomines agreement, a joint venture between state mining company Gécamines and a Chinese consortium led by Sinohydro and China Railway, to secure greater benefits for the Congolese economy. The deal granted Chinese firms access to mineral resources in exchange for infrastructure projects financed through mining revenues. The renegotiation followed concerns about delays and uncertainties surrounding the delivery of the promised infrastructure (Rakotoseheno, 2024; Landry, 2017). The government is currently exploring reforms aimed at improving conditions under which minerals are extracted and traded, paying particular attention to child labour, artisanal mining, diversifying investment, and renegotiating legacy projects to fund infrastructure such as roads. The Congolese government is also said to be working on policies to improve governance, promote local beneficiation, attract ethical investment, and reduce dependency on Chinese processing (OECD, 2025).

Zambia has stated that it is strengthening policies to boost value addition, encourage local smelting and refining, and attract Western investment (OECD, 2025). Its National Critical Minerals Strategy (2024–2028) aims to 'harness and utilise green minerals to support Zambia's socio-economic development and achieve an industrialised middle-income status by 2030' (The Republic of Zambia, 2024:6). It outlines a four-point action plan to do so, focusing on resource management, enhancing govern-



ment and private sector partnerships, promoting beneficiation and value addition, and fostering research and development (The Republic of Zambia, 2024).

Zambia initiated a programme in 2024 aiming to reach 3 million metric tonnes of copper production annually by 2031. However, despite a 30% year-on-year increase in copper output from 173,000 metric tons in the first quarter of 2024 to 224,000 metric tons in the first quarter of 2025, energy shortages remain, which raises questions about the country's ability to meet this target (Reuters, 2025). It is unclear what the programme specifically commits to with regard to infrastructure investment and ongoing support for industry. A decision to establish a state-owned entity to control 30% of green minerals production was withdrawn after opposition from private investors (Bloomberg, 2024b; Sinyangwe, 2024).

The DRC and Zambia have also entered into many agreements with external parties that offer the prospect of capturing greater value from their green minerals. However, these documents are short on details when it comes to implementation and concrete investment commitments.

Chinese mining companies currently dominate green mineral supply chains in both countries. China's involvement in these two countries was highlighted by recent investments in infrastructure to the value of USD 7 billion, particularly in upgrades to the Sicomines copper and cobalt mines in the DRC (Karkare and Byiers, 2025).

The Lobito Corridor initiative is a railway expansion project aimed at linking the copper- and cobalt-rich regions of the DRC and Zambia to the port of Lobito on Angola's Atlantic coast. (OECD, 2025). The core agreement was signed in 2023. The corridor offers an alternative to existing export routes, such as the TAZARA railway to Dar es Salaam in Tanzania and the port of Beira in Mozambique, thereby having the potential to strengthen Africa's critical mineral supply chains. It aims to increase export value, diversify trading partners, and reduce dependence on single markets (OECD, 2025). Led by the US, the project is widely viewed as a long overdue effort by the US and other Western countries to counter China's established presence in the region through its extensive mining and infrastructure investments. The project comprises three phases of railway extension and outlines high-level plans to develop battery precursor production, followed, ultimately, by battery and EV assembly in both DRC and Zambia.

However, the agreement does not specify concrete investment or funding commitments (Karkare and Byiers, 2025).

More recently the DRC entered into a 'minerals-for-security' agreement with the US, whereby American firms gain access to the DRC's green mineral reserves and related infrastructure projects in exchange for US security assistance, including training, equipment, and potential on-ground support to help stabilise Eastern Congo (Hendrix, 2025). Resources-for-security agreements carry the risk of undermining both national ambitions and regional frameworks like the AfCFTA. While they may provide short-term stability and financing, they often impose long-term costs by eroding sovereign control (Mostert and Field, 2025). Mostert and Field (2025) contend that deals such as the one between the US and the DRC risk perpetuating extractive-related harms, including community displacement and environmental degradation.

The DRC and Zambia have articulated high-level ambitions to move beyond mineral-dependent economic models by leveraging corridors and regional integration initiatives. However, there is currently limited evidence of concrete plans or actions indicating that these ambitions are being implemented.

4.3. South Africa

South Africa holds deposits of several minerals that are important for lithium-ion battery production and other low-carbon products. These include notable reserves of manganese and chrome. Thus the AMDC (2025: 11) recognises the potential for South Africa to convert its internal combustion engine vehicle assembly capacity to electric vehicle production. Depending on the pace of developments in the hydrogen economy, South Africa's overwhelming share of global platinum reserves could be potentially strategic (Zalk, 2025). While many of the minerals essential for Li-ion battery production are found in the SADC region, as noted in the discussion on the DRC and Zambia above, there is little evidence of cross-border cooperation to develop a regional battery mineral value chain (Zalk, 2025).

Despite being the continent's most industrialised economy, South Africa lags behind Morocco in the development of an integrated EV value chain. Annual vehicle assembly reached approximately 633,000 units in 2023, yet these are overwhelmingly ICE vehicles, with only limited hybrid production (Zalk, 2024). By contrast, Morocco has already entered EV assembly at scale and is expanding production for the European market (Wuttke, 2022; The Arab Weekly, 2025). This divergence illustrates that existing automotive capabilities and export market access, while necessary, are not in themselves sufficient to secure a foothold in emerging low-carbon value chains.

South Africa's platinum group metal (PGM) reserves, which account for 89% of global reserves (BloombergNEF, 2024), are currently important inputs to autocatalysts, which reduce exhaust emissions from ICE vehicles. However, as demand has begun to shift to EVs, this historical source of demand is set to decline. PGM producers are therefore looking to pivot towards the production of fuel cells for electric vehicles and stationary energy storage, and the electrolysers required for the production of green hydrogen. However, the commercialisation of hydrogen-based economy technologies globally has been slower than expected, and the demand for green hydrogen and fuel cells is not yet sufficiently high to make large investments in these technologies worthwhile. The slow uptake of EVs in the EU could in fact prolong demand for catalytic converters.

It has been observed that the rapid attainment of the commercial viability of green hydrogen projected by the EU has not materialised (Policy Center for the New South, 2025). BloombergNEF predicts that

Two Rivers Platinum Mine, Limpopo, South Africa

demand for palladium, in particular, might drop significantly by 2035 (BloombergNEF, 2024). This creates a complex and uncertain outlook for South Africa's PGM sector, underscoring the importance of diversifying into both hydrogen-related applications and other low-carbon value chains. If South Africa wishes to enable its PGM miners to pivot towards a hydrogen-based economy, it should activate policies that provide preferential conditions for investment in hydrogen-based industrial projects in South Africa.

Historically, South Africa has focused on the upstream parts of mineral value chains, with a strong emphasis on extraction and export and limited downstream manufacturing (Zalk, 2025). Zalk (2025) urges South Africa to focus on integrating its value chain in both the downstream and upstream directions. The lack of an overarching framework for green industrialisation in South Africa has meant that opportunities for green structural transformation have been underemphasised (Zalk, 2025). However, such a transformation is possible if green industrial policy develops new low-carbon sectors while simultaneously growing existing labour-intensive (and low-carbon) sectors further.

South Africa's historical mining and mineral processing capabilities place it in a relatively favourable position to move into battery-related precursor production. The country has a long track record of processing PGMs, ferro-alloys, and other minerals, supported by dedicated research institutions and industry-linked R&D. Upstream, South Africa accounts for about 36–45% of global manganese mine production and holds an even higher share of world reserves, yet the bulk of output is exported as ore or as alloys for the steel industry rather than as battery-grade inputs (AMDC, 2025a; Zalk, 2024). Manganese Metal Company (MMC) produces very high-purity manganese metal and has announced a project to produce battery-grade manganese sulphate for use in NMC cathodes (Zalk, 2024). This illustrates the potential for targeted processing investments to shift export baskets from bulk ores and generic alloys towards specialised precursors demanded by global battery manufacturers.

At the same time, South Africa faces binding constraints in energy and finance that limit the scale and pace at which such transitions can occur. The country's prolonged electricity crisis, characterised by rising electricity tariffs and recurring load-shedding since 2008, has undermined energy-intensive industries, including mineral processing. The capital-intensive chemical and metallurgical plants required for battery precursor production are particularly exposed to these constraints (Zalk, 2024). In addition, like many African economies, South Africa faces relatively high costs of capital, which raises the hurdle for large-scale investments in new low-carbon manufacturing capacity.

Nevertheless, South Africa has seen the emergence of a battery energy storage systems (BESS) sub-sector focused on stationary applications. Several firms assemble imported battery cells into packs for use in behind-the-meter storage, mini-grids, and other industrial and commercial applications, and have developed battery management systems and associated services (Zalk, 2024). These activities remain modest in scale but demonstrate South Africa's capacity to enter downstream battery-related segments that are less capital- and technology-intensive than cell manufacture. There is also experimentation with niche e-mobility solutions such as two- and three-wheelers and last-mile delivery vehicles.

If a regional battery value chain is to emerge, South Africa needs to act as the integrator within Southern Africa. This role would involve supporting greater processing of lithium, copper, and cobalt in neighbouring countries such as Zimbabwe, Zambia, and the DRC. It would also require hosting selected higher-value stages of processing and downstream assembly, including battery energy storage systems (BESS) and possibly EVs over the medium term (Zalk, 2024).

If South Africa wishes to enable its PGM miners to pivot towards a hydrogen-based economy, it should activate policies that provide preferential conditions for investment in hydrogen-based industrial projects in South Africa.

Fulfilling this function would require South Africa to champion closer coordination of industrial and trade policies across Southern Africa, mobilise significant development finance, and align infrastructure investment with regional value-chain objectives. However, none of these conditions can be assumed.

5. Conclusions and policy options

5.1. Conclusions

African countries have a spectrum of opportunities for adding and capturing value from their green minerals endowments (Zalk, 2024). These opportunities may be pursued through developing a range of forward, backward, and other linkages (AMDC, 2025).

The most obvious forward linkage opportunity is to expand the mining of green minerals while ensuring decent working conditions and environmental responsibility. This requires raising the level of mining exploration and prospecting to expand the pool of commercially viable mining deposits. Immediate downstream value-addition involves smelting and refining minerals to high-quality precursors. While the production of precursors is capital and energy intensive, precursors add significant value. They also contribute to broader macroeconomic linkages through the generation of foreign exchange and tax revenue. Foreign exchange earnings are essential to fund the import of capital goods required for structural transformation, including agricultural modernisation and manufacturing diversification (Cramer, Sender and Oqubay, 2020). As discussed above, the development of forward linkages from upstream mining is progressing unevenly across the three case studies of Morocco, DRC and Zambia, and South Africa. Morocco appears to be amongst the most advanced countries in Africa with regard to the processing of the minerals needed for a green transition, having attracted foreign investment into phosphate battery precursor production.

South Africa is making some inroads into the production of manganese precursors.

Entry into the 'mid-stream' parts of value chains is arguably the most technologically demanding and dependent on economies of scale. These include the production of solar PV wafers and cells, lithium-ion battery cells, and core electric vehicle components, such as drivetrains. Chinese firms are particularly dominant in these parts of the value chain, with Western firms struggling to keep pace or catch up. These are the most challenging segments for African (and indeed most developing countries) to enter. The mooted establishment of industrial parks to produce batteries and EVs in the DRC and Zambia appears highly ambitious, with limited indications of progress. All of this raises the difficult question of how regional value chains might be forged.

The downstream segment of the value chain involves the assembly of 'midstream' core components into integrated systems, such as solar PV panels, which need to be integrated into utility-scale plants; mounting structures, electrical components and battery cells; drivetrains; and other core electric vehicle componentry. Capabilities are emerging very unevenly in this space. For instance, Morocco has moved into EV assembly while South Africa has developed a vibrant battery assembly sub-sector focused on stationary storage applications. The AGMS document highlights the opportunity for African countries to enter EV value chains through the assembly of two- and three-wheelers.

As noted in the AGMS, various additional linkages may be generated from green mineral value chains. Various 'sidestream' linkage opportunities arise from the provision of mining capital goods, consumables, and services. For instance, infrastructural investments to enable mining expansion could support the development of other sectors and services, such as energy access. Beyond direct value addition to green minerals, countries can also capture value through 'fiscal linkages'. For instance, value-capture through mining royalties can be re-directed to build industrial capabilities in more diversified low-carbon sectors.

However, the analysis in this paper points to a persistent implementation gap between high-level visions and clear progress in building green mineral value chains. Many African policy frameworks emphasise beneficiation, regional integration, and equitable resource-based industrialisation, yet actual investment patterns continue to privilege raw or minimally processed exports, often underpinned by opaque deals and limited domestic capability development (Boafo *et al.,* 2024; Beuter *et al.,* 2025). Initiatives such as the Lobito Corridor and various 'minerals-for-infrastructure' or 'minerals-for-security' agreements illustrate both the potential and the risks of external partnerships; they can unlock finance and infrastructure, but without clear industrial policy conditionalities, they may entrench extractive dynamics and undermine regional strategies such as the AfCFTA (Karkare and Byiers, 2025; Mostert and Field, 2025).

5.2. Policy options

Policy options to develop green mineral value chains therefore need to move beyond generic calls for beneficiation towards a more selective and sequenced approach. This includes identifying value chain segments where African countries have realistic prospects of competing, such as mining services, selected precursor processing, downstream assembly of storage systems, and certain EV segments. Stakeholders need to bear in mind that capital- and technology-intensive segments like cell manufacturing may be considerably harder to enter in the short to medium term. Strategic non-alignment of foreign policy in a contested geopolitical context, combined with a more assertive use of mining, trade and industrial policy, can create greater bargaining space for African countries vis-à-vis external partners.

The question is, where to next for Africa in developing its green minerals value chain? The authors of this paper offer the following recommendations:

First, countries need to strengthen geological knowledge and exploration to fully understand the scope of their green mineral endowments.

Second, they should design licensing, royalty, and local-content regimes that create incentives for forward linkages without relying solely on blunt instruments such as export bans alone.

Third, African development banks and other public finance institutions have a critical role to play as providers of patient capital for processing and manufacturing investments aligned with green industrialisation strategies.

Finally, regional bodies and the AfCFTA institutions will need to prioritise green minerals as a test case for building truly African value chains, with mechanisms to monitor implementation and share lessons across countries.

Without such coordinated and implementation-oriented efforts, there is a real risk that the current wave of interest in Africa's green minerals will reproduce earlier patterns of extractive engagement, albeit in low-carbon guise. With appropriate policies, institutions, and regional cooperation, however, green minerals could underpin a more developmental and climate-compatible structural transformation on the continent.

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