



Trade Data on Critical Energy Transition Minerals: Exports & Imports for Renewable Energy Technologies

ABSTRACT

The Southern African Development Community (SADC) region is a major producer of Critical Energy Transition Minerals (CETMs; hereinafter critical minerals) essential for renewable energy technologies, electric vehicles (EVs), and battery storage. However, most of these critical minerals are exported as raw materials, with limited local beneficiation and high import dependencies for refined products. This policy brief analyses export trends, and market potential for key minerals, showing that China dominates global refining, while Europe provides the highest ease of trade. Using trade potential graphs, the brief identifies major export markets and accessibility challenges, particularly for lithium and rare earth elements (REEs), where data gaps and opaque supply chains persist. To maximise the benefits of critical minerals for economic growth, policy recommendations focus on expanding value addition in green energy products, aligning mineral trade with SADC regional integration objectives, and enhancing local expertise through targeted training in mineral processing and fabrication. Investment in skills and technology transfer beyond processing, and fostering co-investments in high-value mineral processing are critical to strengthening downstream capabilities and ensuring long-term industry competitiveness.

1. INTRODUCTION

The SADC region is endowed with critical mineral resources that are essential to the global energy transition and associated green technologies. Minerals such as graphite, chromium, manganese, cobalt, copper, lithium, platinum group metals (PGMs) and rare earth elements (REEs) are essential in the manufacturing of solar panels, wind turbines, battery energy storage systems (BESS), and EVs, making the SADC region a potential strategic player in the global supply chain of these minerals. Countries such as the Democratic Republic of Congo (DRC),

Madagascar, Mozambique, South Africa, Zambia and Zimbabwe, are major global suppliers of these resources. However, despite the SADC region's rich endowment, it remains largely a supplier of raw materials, with limited refining and beneficiation infrastructure. This policy brief examines the trade dynamics of the critical minerals produced by the SADC region, emphasising export trends, import dependencies, and the need for increased local beneficiation. The brief aims to support policy interventions that enhance regional trade and strengthen Africa's position in the global clean energy supply chain.

2. TRADE DATA

Numerical trade data for selected critical minerals between SADC member states and between SADC and the rest of the world is in some cases limited, but the region's significance in the global supply chain is well-recognised. This is evidenced through examples such as the DRC, which is the world's leading cobalt producer (~70% of global production). South Africa and Zambia are major suppliers of copper and manganese respectively, although these materials are primarily exported in raw form.

Despite being resource-rich, SADC nations import refined mineral products such as copper wires, battery-grade manganese, and rare earth magnets due to a lack of local beneficiation capacity. This reliance on external markets (to beneficiate materials) limits economic benefits, highlighting the need for investment in regional refining and manufacturing.

Global Export and Import Trends

Top Exporters: Countries such as Australia (lithium, spodumene), China (REEs), the DRC (cobalt) and Indonesia (nickel) dominate the export market for critical minerals.

Top Importers: China is the largest importer and processor of critical minerals, refining over 60% of the world's lithium and 80% of its

cobalt. The European Union (EU) and the United States of America (USA) are also major importers, focusing on diversifying their supply sources to reduce reliance on China.

Trade Volume and Value: Over the last five years, trade volumes for lithium carbonate and lithium hydroxide have increased by over 300%, driven by EV battery production. Nickel demand has risen due to advances in high-energy-density batteries.

Specific Global Leaders

Solar Energy

China leads in solar module manufacturing with companies such as Trina Solar and Canadian Solar.

Key Minerals: Silicon, silver, copper, aluminium, tellurium, gallium, tin, and zinc.

Suppliers: Canada, Chile, Indonesia, Japan, Mexico, Peru, Russia, and the USA

The USA plays a significant role through NextEra Energy, being major producers of wind and solar energy.

Key Minerals: Lithium, cobalt, nickel, copper REEs, silver, aluminium, and graphite.

Suppliers: Australia, Canada, China, DRC, Indonesia and the USA.

Wind Energy

Denmark and Uruguay are notable for generating a substantial portion of their electricity from wind and solar sources, with Denmark achieving 61% and Uruguay 44% in 2020. Wind turbines are primarily produced in China, Denmark, Germany, India, Spain and the USA, which serve as major global manufacturing hubs for wind energy infrastructure.

Key Minerals: Neodymium, praseodymium, dysprosium, terbium (for permanent magnets in turbines), copper, aluminium, zinc, steel

(iron ore, manganese, chromium), fibreglass materials.

Suppliers: Australia, Brazil, Canada, China, Myanmar, South Africa and the USA.

Battery Storage

China dominates battery manufacturing, with companies such as Contemporary Amperex Technology Limited (CATL) leading the market. In 2023, CATL was the world's largest EV battery manufacturer with a 37% market share.

Key Minerals: Lithium, cobalt, nickel, graphite, manganese, aluminium, copper, REEs.

Suppliers: Argentina, Australia, Brazil, Canada, Chile, China, DRC, Indonesia and South Africa.

Electric Vehicles

China is a leader in EV production, surpassing Germany and Japan in automobile exports, driven by cost advantages and international brands such as Tesla establishing a presence.

Key Minerals: Lithium, cobalt, nickel, graphite, aluminium, copper, REEs (e.g., neodymium, praseodymium, dysprosium, terbium for EV motors).

Suppliers: Argentina, Australia, Brazil, Canada, Chile, China, DRC, Myanmar and South Africa.

In the context of SADC

Renewable Energy Adoption

Africa is progressively integrating renewable energy sources, with countries (especially South Africa) investing in solar and wind projects. The nation (South Africa) has also initiated programmes to incorporate BESS to enhance grid stability.

Battery Manufacturing Potential

South Africa is exploring opportunities to become a global battery storage manufacturer, leveraging its critical mineral resources and transitioning from coal-dominated electricity generation to renewable energy sources.

3. MARKETS WITH EXPORT POTENTIAL FOR AFRICA'S CRITICAL ENERGY TRANSITION MINERALS

For brevity and practical relevance, this policy brief will focus on the leading producers and exporters of each critical mineral from the SADC region.

South Africa stands out as the largest global producer of PGMs, chrome, and manganese, making it the primary focus for discussions on these commodities. Similarly, the DRC dominates global cobalt supply. For graphite, Mozambique hosts one of the world's largest deposits, making it the region's focal producer. In the case of lithium, Zimbabwe is highlighted as a significant regional producer, while copper and nickel exports are led by the DRC, South Africa and South Africa.

The following sections present trade potential graphs, sourced from the International Trade Centre's (ITC) Export Potential Map, which illustrate export opportunities for key minerals produced within SADC. These graphs provide data-driven insights into market demand, accessibility, and trade competitiveness. Each graph maps potential export markets based on:

Chromium

(Figure 1) shows South Africa's potential export markets for chromium ores and concentrates, highlighting regions with high demand and ease of trade. China stands out as the largest and most significant market, reflecting its dominance in stainless steel production, which heavily relies on chromium. Other key East Asian markets, such as Japan, South Korea, and Taiwan, also show demand, likely due to their advanced metallurgical industries.

In Southern Africa, Mozambique emerges as a major trade partner, primarily due to its role as a transit hub for South African chrome exports through the port of Maputo. The port handles over 50% of South Africa's chrome exports, offering a more efficient and cost-effective export route compared to South Africa's domestic ports. Recent upgrades to the railway link connecting the South African interior to the port, including a US\$2-billion capacity expansion, have enhanced its efficiency (AJOT, 2024).

South Africa's logistical challenges with Transnet, the state-owned logistics provider, have driven mining companies to seek more reliable export alternatives via Mozambique (CNBC Africa, 2024). Furthermore, regional trade agreements under SADC facilitate cross-border trade, reducing tariffs and easing customs procedures (Bloomberg, 2024).

“Africa is progressively integrating renewable energy sources”

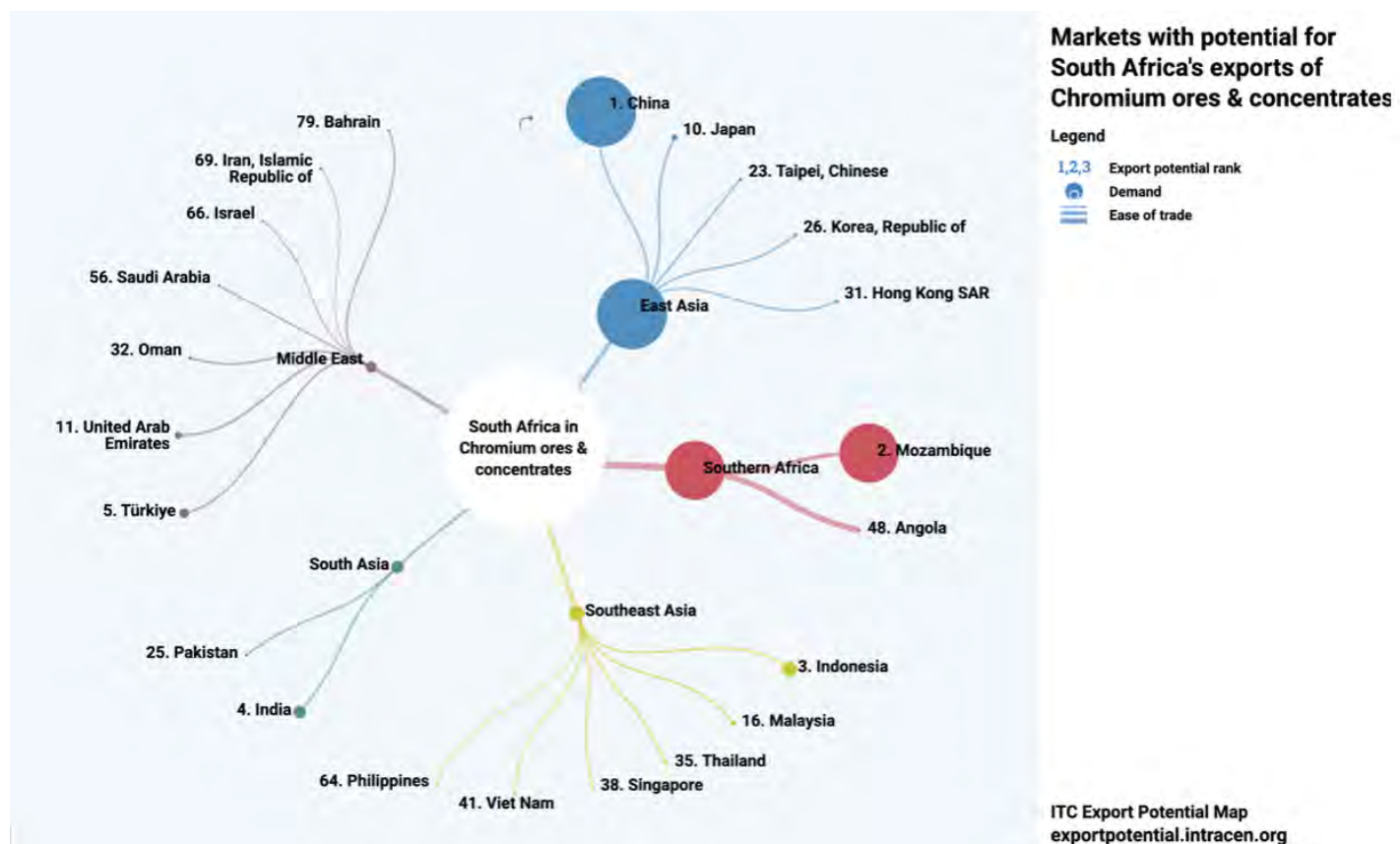


Figure 1: South Africa's potential export markets for chromium ores and concentrates (Source: ITC)

Manganese

(Figure 2) illustrates that China is the dominant importer of manganese globally, accounting for US\$2.02 billion of South Africa's manganese exports, driven by its massive steel industry, which relies heavily on manganese for alloying processes (World Bank, 2019). India ranks second, followed by Japan, Malaysia, and then various European markets, reflecting global demand for manganese in steelmaking and battery technologies (Mining Weekly, 2024).

While China and India dominate in terms of demand, the highest ease of trade is observed with European countries, particularly France, Germany, Norway and Spain. This could be attributed to well-established trade agreements, efficient customs procedures, and advanced port infrastructure, making European destinations more accessible for South African exports (Mining Weekly, 2024). Europe's focus on securing raw materials for battery production and the green energy transition has increased its reliance on South

African manganese

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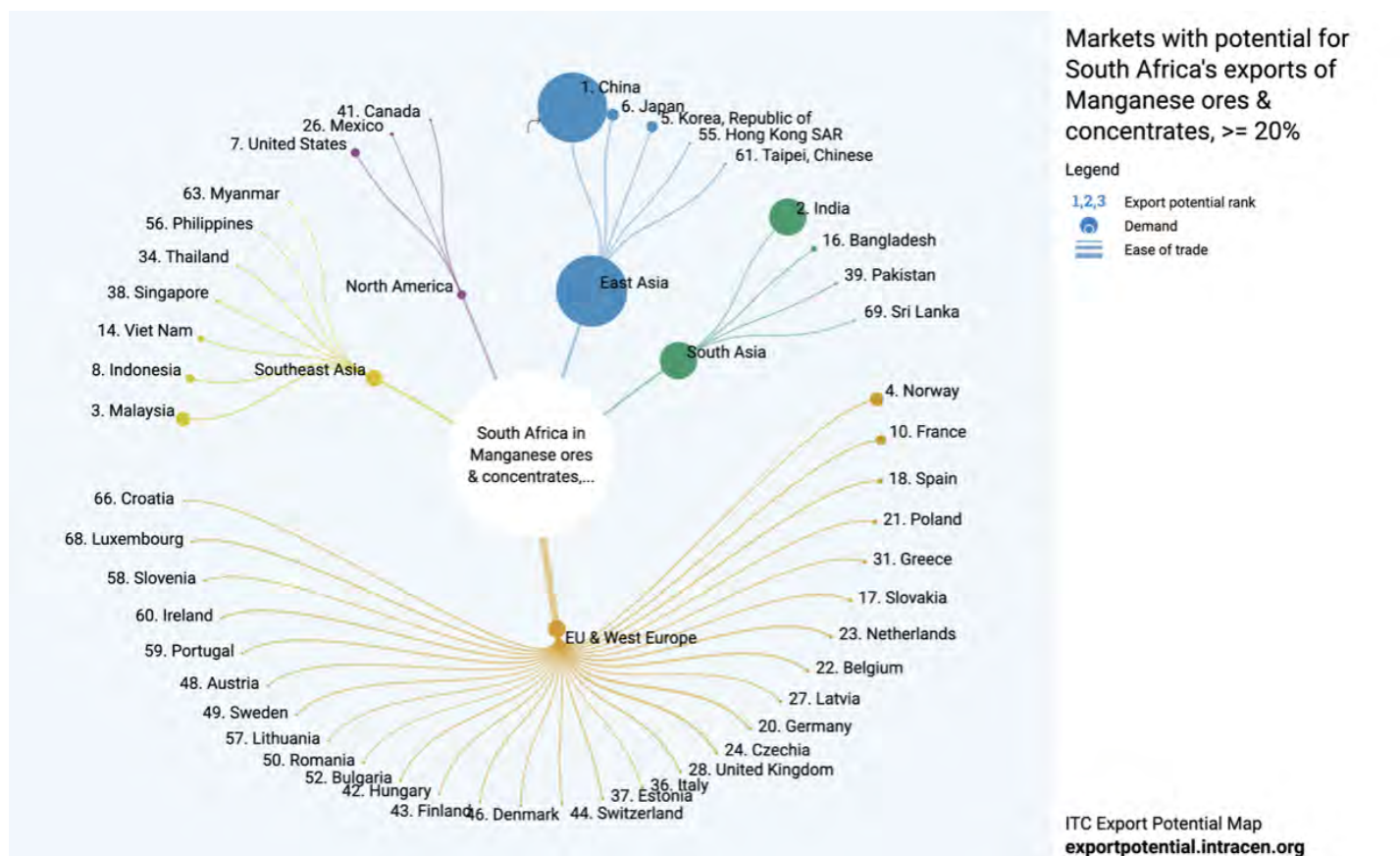


Figure 2: South Africa's export markets for manganese ores and concentrates (Source ITC)

Cobalt

(Figure 3) shows that Zambia emerges as the largest recipient, reflecting its role as a key processing hub for Congolese cobalt. While the DRC is the world's leading producer of cobalt, much of its raw output is exported for refining due to limited domestic processing capacity (OEC, 2024). Zambia, with its established smelting and refining infrastructure, processes a significant portion of the DRC's cobalt before it is re-exported to global markets (Resource Governance Institute, 2024).

Beyond Zambia, the major demand centres for DRC's cobalt include China, Japan and South Korea, aligning with their dominance in lithium-ion battery manufacturing. Europe also presents significant potential, with Spain, Belgium, Germany, and Switzerland ranking among the largest importers, likely due to the EU's efforts to secure critical minerals for its green energy transition (Resource Governance Institute, 2024). However, not all cobalt flows from the DRC to Zambia are

formal, as smuggling and corruption at border crossings remain significant issues, leading to billions in lost revenue for the DRC (ISS Africa, 2024).

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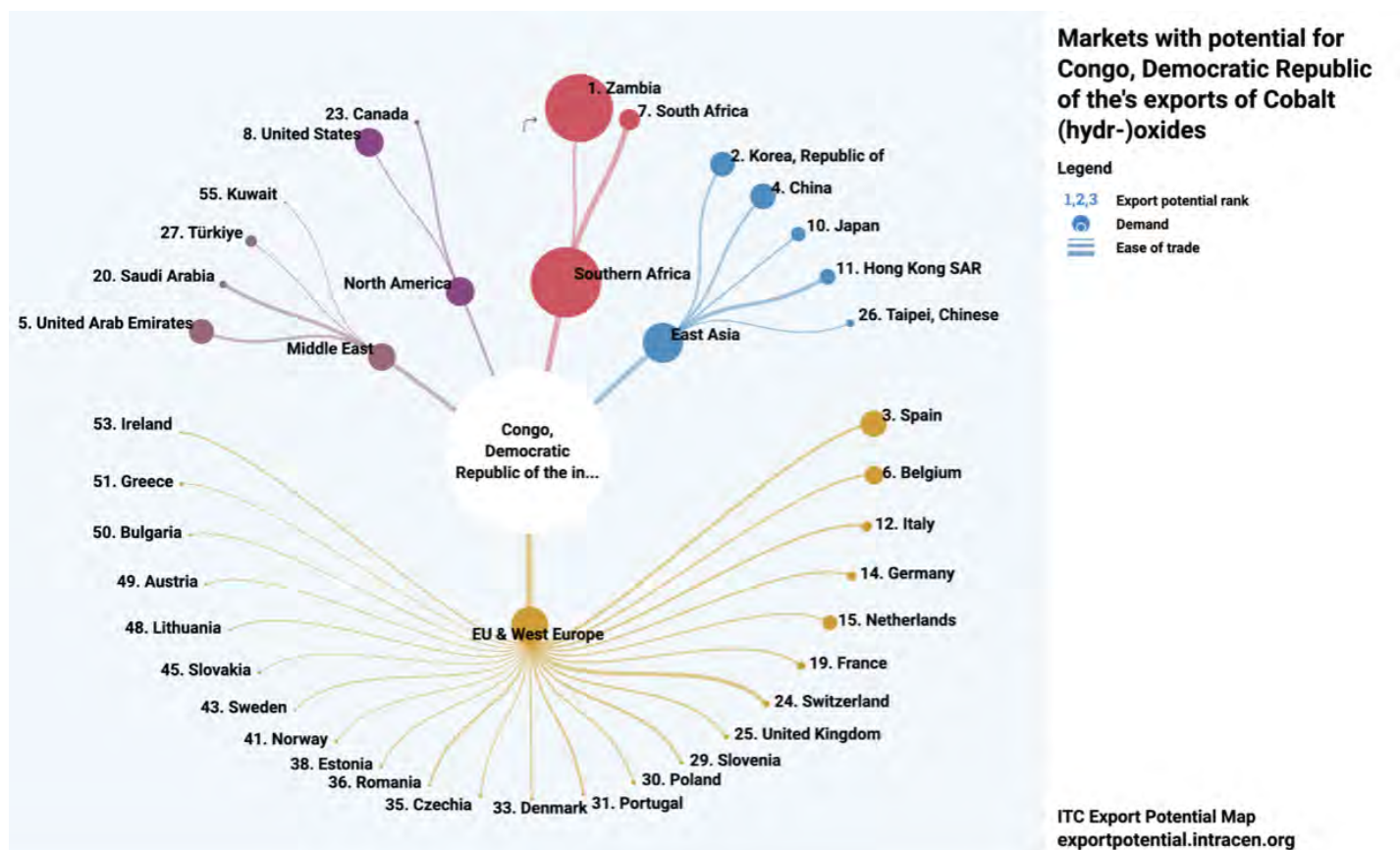


Figure 3: Democratic Republic of the Congo's (DRC) export markets for cobalt (hydr-)oxides (Source: ITC)

Copper

(Figure 4) shows that East Asia represents the largest market, with China emerging as the top importer, reflecting its massive demand for copper in construction, electronics, and renewable energy technologies. Japan, South Korea, and Taiwan also feature prominently, aligning with their advanced manufacturing sectors, which require copper for electronics, automotive production, and industrial applications.

South Africa stands out as a key trade partner due to high ease of trade, likely facilitated by regional trade agreements, logistical advantages, and established smelting infrastructure. This suggests that some of Zambia's copper may be refined or processed in South Africa before being re-exported. Europe also represents a significant destination, with Germany, Italy and Spain ranking as major importers, driven by Europe's expanding green energy sector and high copper demand for electrical wiring and industrial applications. Southeast Asia,

particularly Malaysia, Singapore, and Thailand, shows potential as a growing market, likely due to the region's increasing industrialisation and demand for copper in electronics and infrastructure development.

"...reflecting its massive demand for copper in construction, electronics, and renewable energy technologies."

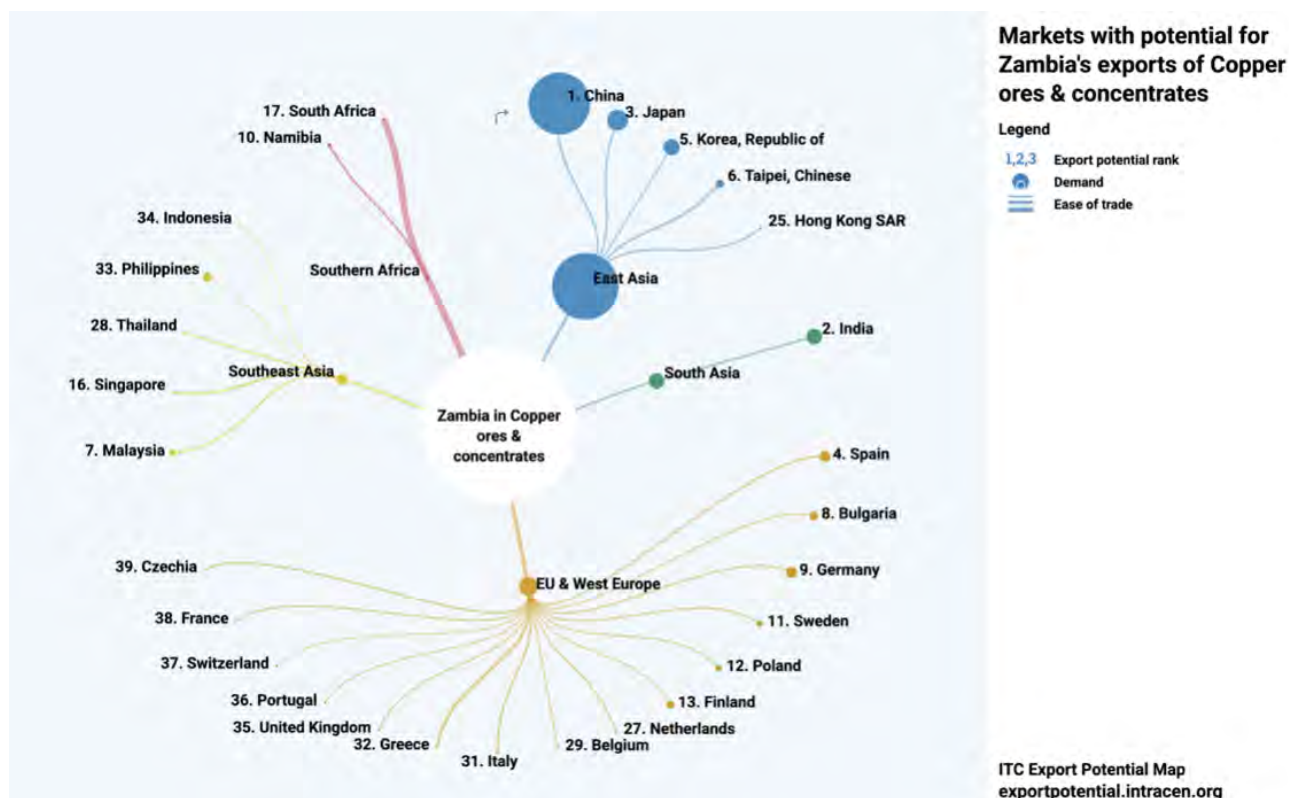


Figure 4: Zambia's key export markets for copper ores and concentrates (Source: ITC)

Graphite

(Figure 5) shows potential export markets for natural graphite in powder or flakes, highlighting regions with high demand and ease of trade. Europe and East Asia emerge as the most significant markets, with Germany and China leading in potential for the respective regions. China is the largest single market for graphite from Madagascar followed by the United States of America. However, there is a higher ease of trade with the European markets which could be attributed to well-developed industrial supply chains, established trade agreements, and strong demand from the EV and battery industries that rely heavily on graphite for lithium-ion battery production. Efficient port infrastructure and trade facilitation policies in these regions may further streamline imports. Conversely, regions such as the Middle East and South Asia show growing demand but may face logistical, regulatory, or tariff-related trade barriers, limiting the ease of market entry.

(Figure 6) shows that Europe is one of the largest and most accessible markets for

natural graphite exports from Madagascar. The strong demand in Europe is likely driven by the region's expanding battery manufacturing sector, which relies on graphite as a key component for EV batteries and energy storage systems. Similarly, East Asia, which is dominated by China, Japan, and South Korea represents the largest demand centre globally, reflecting the dominance of Asian battery and electronics industries. North America also shows notable demand, likely due to its focus on securing critical minerals for domestic manufacturing. The ease of trade with European markets may be attributed to established trade routes, strong industrial demand, and relatively transparent import regulations. In contrast, the Middle East and South Asia show growing demand but may have higher trade barriers, regulatory complexities, or logistical challenges, making them slightly less accessible despite their market potential.

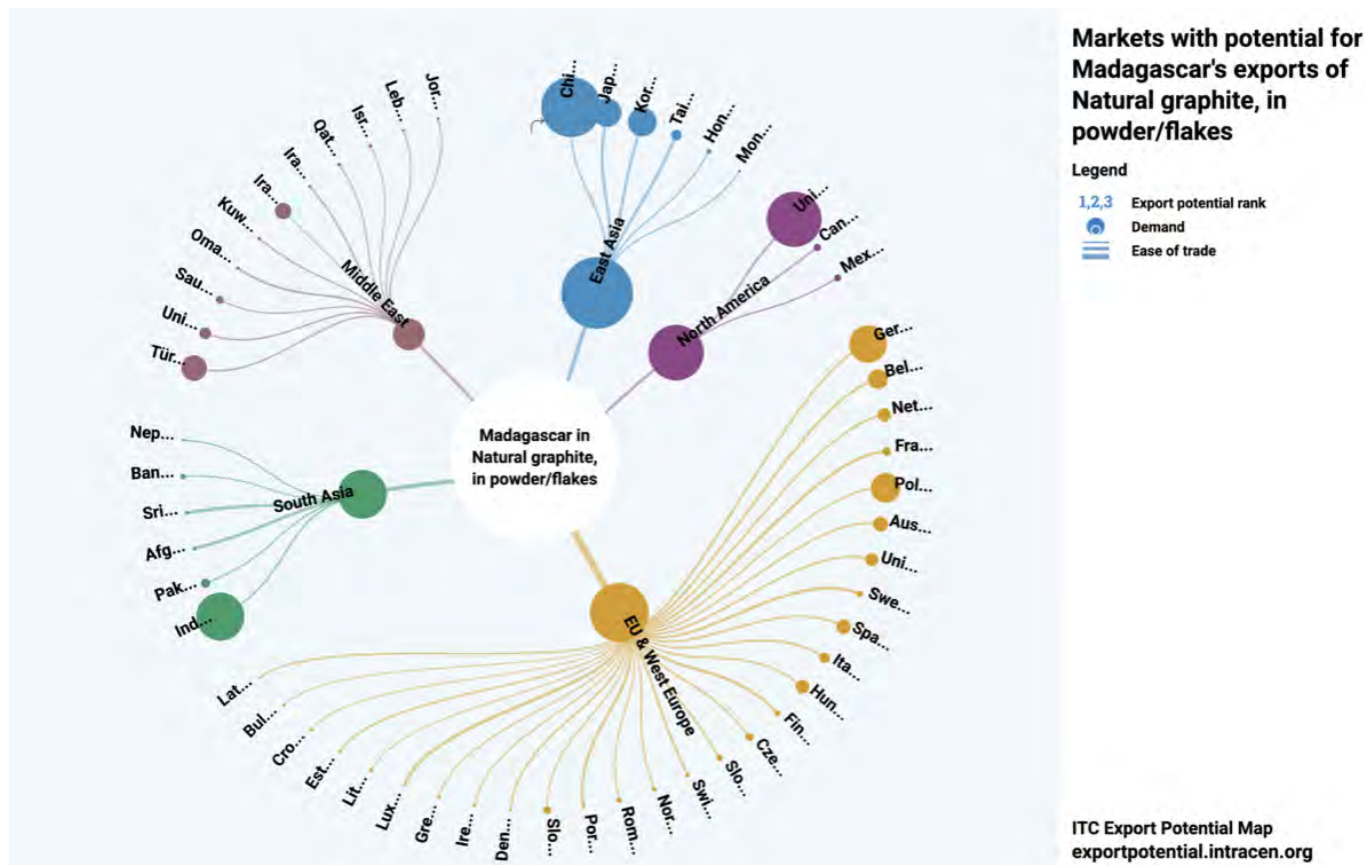


Figure 5: Madagascar's potential export markets for natural graphite in powder or flakes. (Source: ITC)

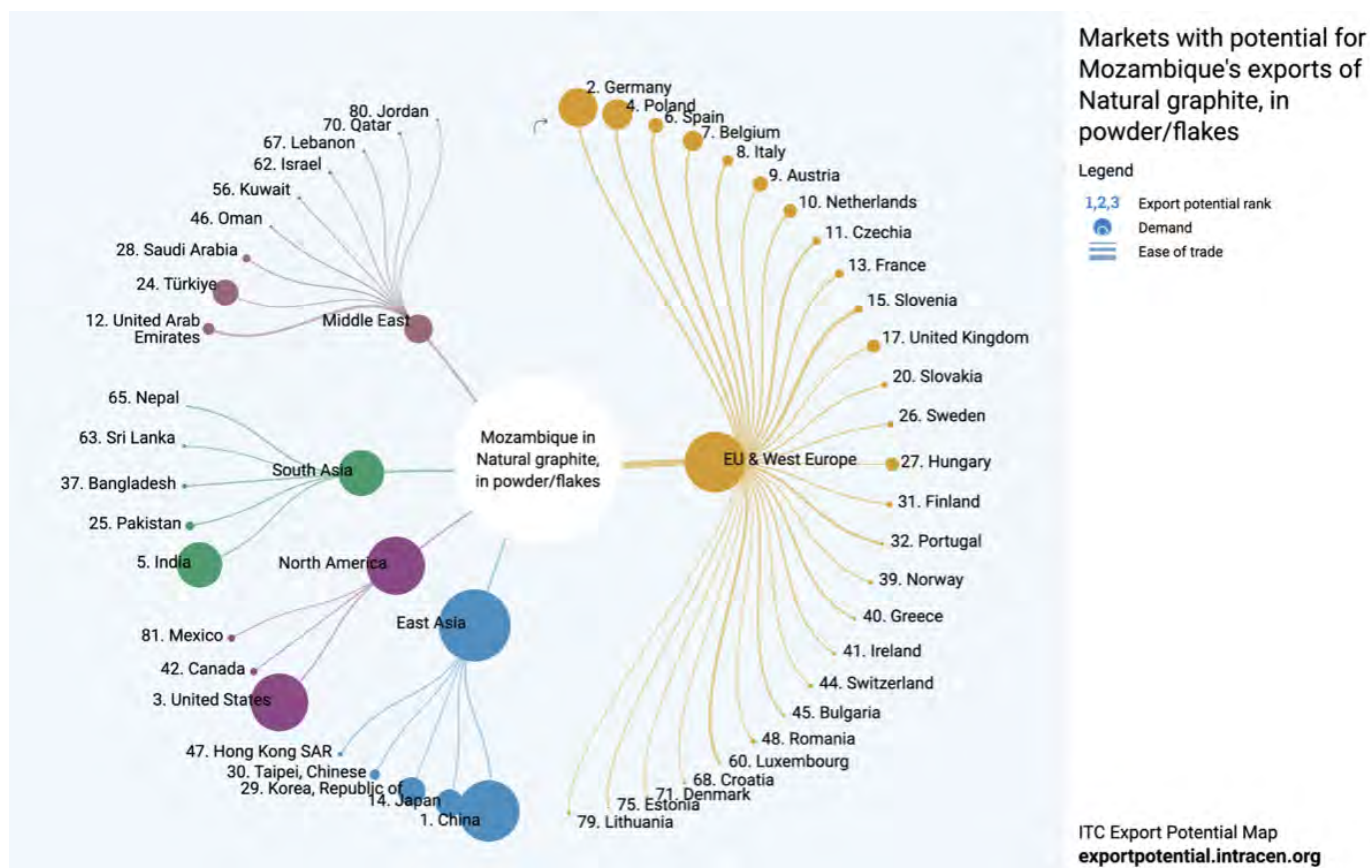


Figure 6: Mozambique's potential export markets for natural graphite in powder or flakes (Source: ITC)

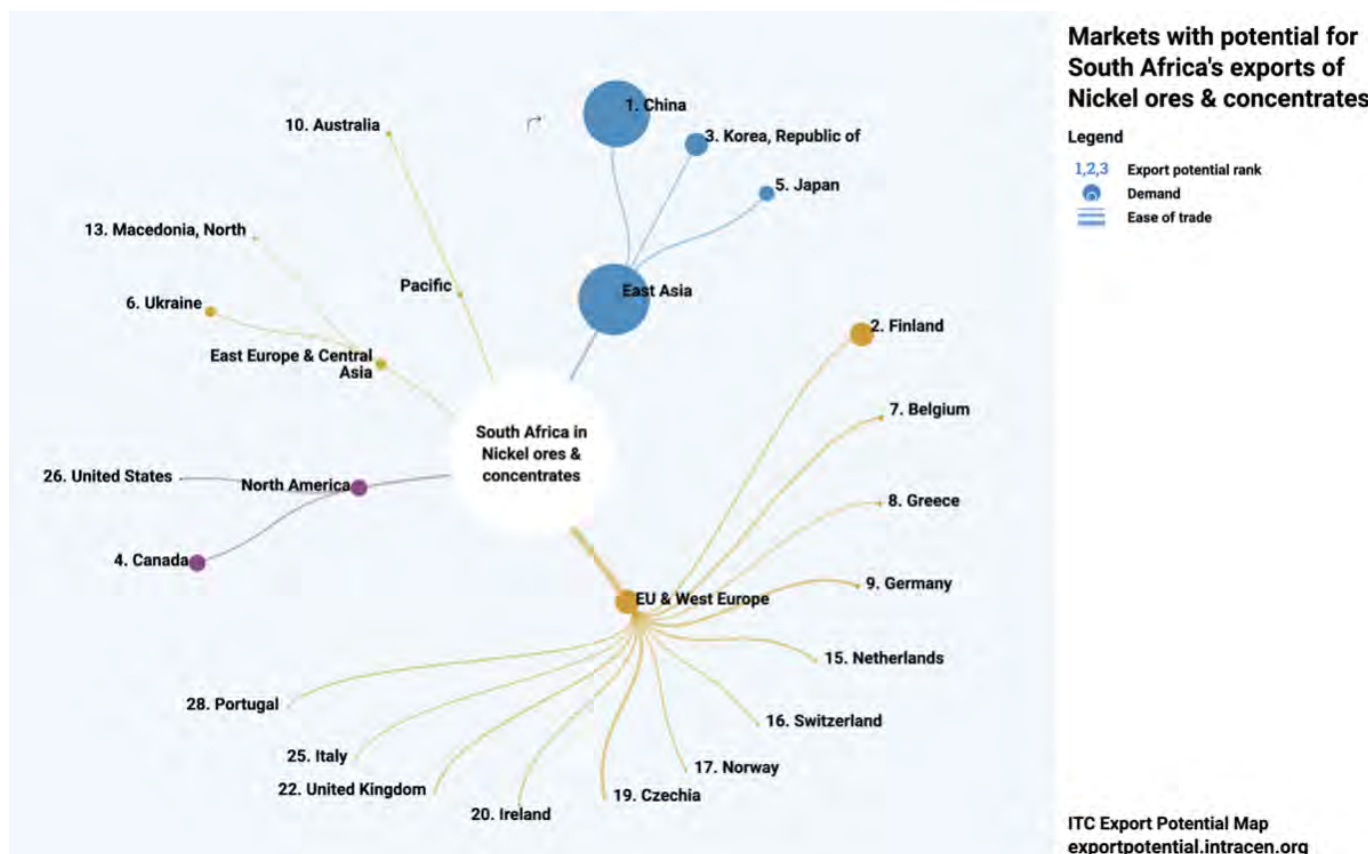


Figure 7: South Africa's potential export markets for nickel ores and concentrates (Source: ITC)

Nickel

In (Figure 7), China stands out as the largest importer of nickel ores and concentrates from South Africa, driven by its dominance in stainless steel production, which heavily relies on nickel (OEC, 2022). Belgium and Finland also feature prominently, reflecting Europe's need for nickel in battery manufacturing and industrial applications (Statista, 2024). North America presents further opportunities due to increasing investments in critical minerals for clean energy technologies (Payne Institute, 2022).

South Africa's nickel exports have grown significantly despite fluctuations in production, which declined from 57,000mt (metric tons) in 2015 to 29,500mt in 2022 (Statista, 2024). The Netherlands and Belgium saw some of the highest growth in imports from South Africa, with increases of 210% and 1,150% between 2021 and 2022, respectively (OEC, 2022). However, logistical challenges at key export hubs, such as Richards Bay, have impacted trade efficiency (InScope Logistics, 2024).

South Africa's nickel remains critical to global supply chains, particularly as demand for EV batteries and stainless-steel production persist worldwide (Mines.edu, 2022).

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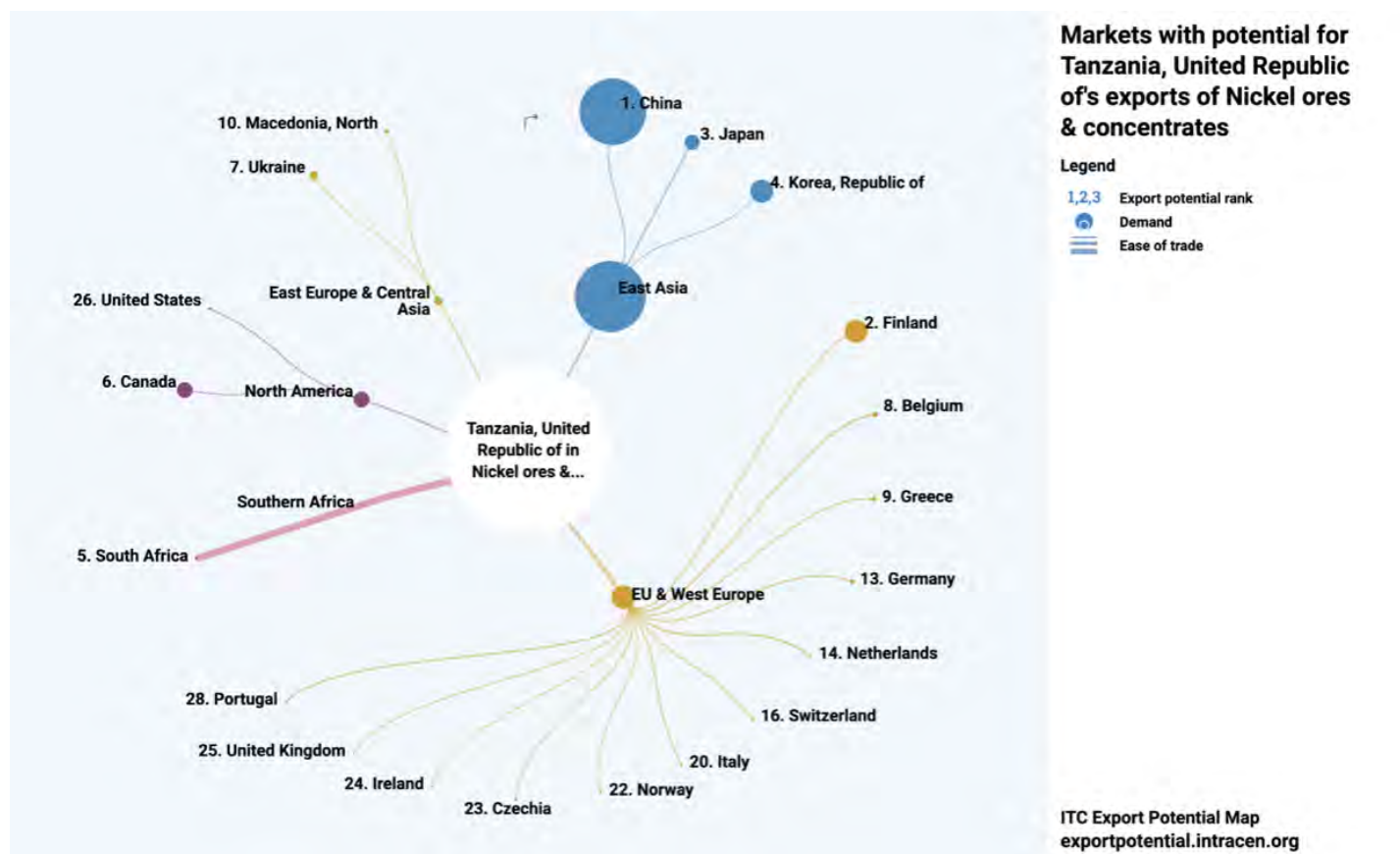


Figure 8: Tanzania's key export markets for nickel ores and concentrates (Source: ITC)

(Figure 8) illustrates Tanzania's key export markets for nickel ores and concentrates, with China emerging as the dominant destination due to its extensive stainless steel and battery production industries. Finland ranks second, reflecting Europe's growing demand for nickel in EV batteries and industrial applications. Other key European markets include Belgium, Germany, and Switzerland, all of which have established refining and processing infrastructure for nickel-based products. In East Asia, Japan and South Korea also present significant demand, aligning with their advanced battery technology and metallurgy sectors.

A notable trade relationship is with South Africa, which serves as a key regional partner. The ease of trade between Tanzania and South Africa is likely due to their geographic proximity, established mining sector connections, and trade agreements within the SADC region. South Africa's refining capabilities and logistics infrastructure make it a strategic transit point or processing hub for Tanzanian nickel before it reaches global

markets. This reinforces Tanzania's growing role as a supplier of green minerals to both regional and international players.

PGMs (Platinum and Palladium)

(Figure 9) and (Figure 10) illustrate South Africa's key export markets for palladium and platinum with the USA and Japan emerging as the largest potential markets. The automotive sector is the primary driver of demand, as both platinum and palladium are essential for catalytic converters, which reduce emissions from internal combustion engines (World Platinum Investment Council, 2024). Japan's strong hybrid and EV industry also contributes to its high demand, as platinum is used in fuel cells and other clean energy technologies (International Platinum Group Metals Association, 2023). Germany and Switzerland also play critical roles in platinum trade, as both countries are major refining and trading hubs, enabling further processing and redistribution across global markets (OEC, 2024).

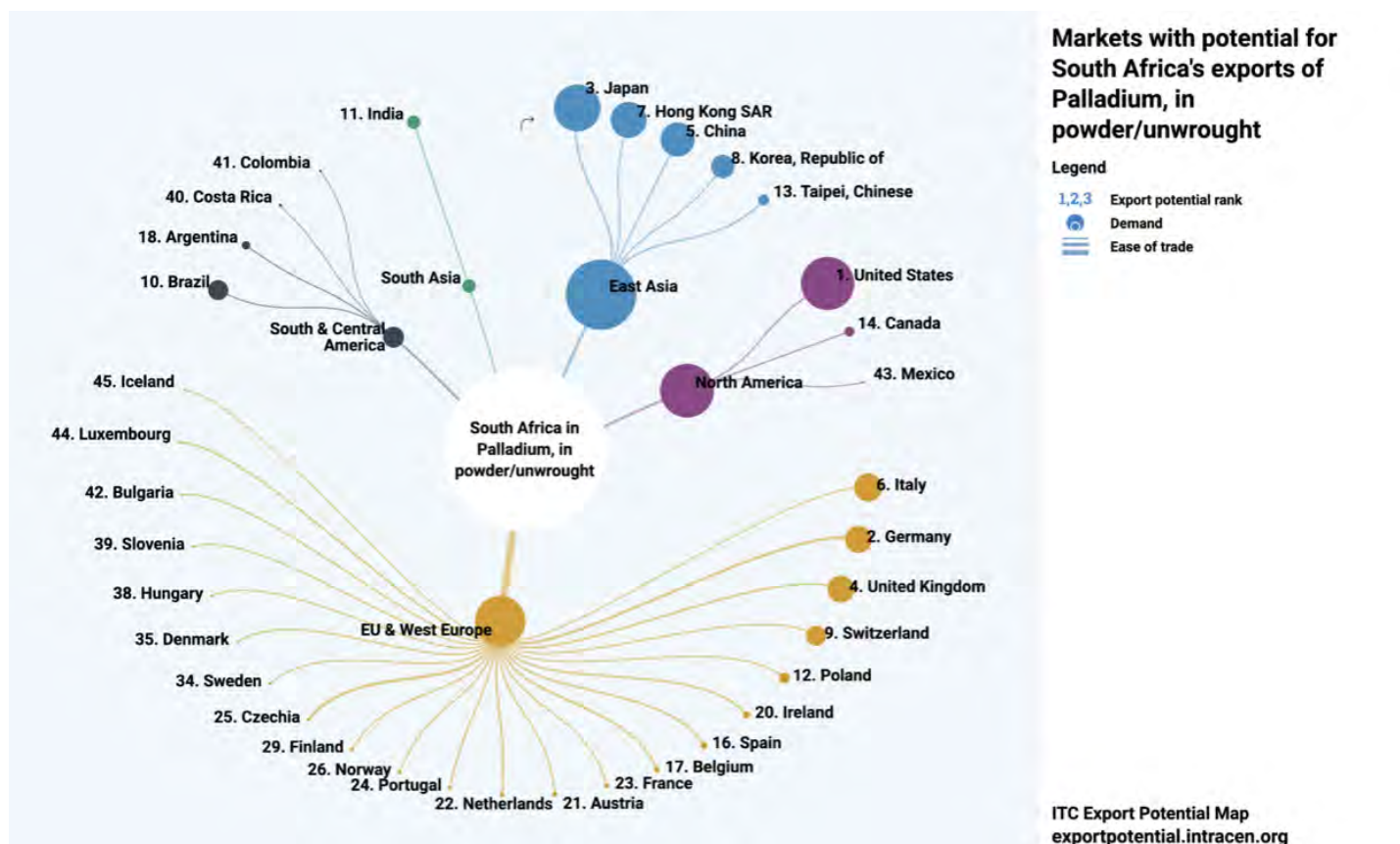


Figure 9: South Africa's key export markets for palladium (in powder/unwrought form) (Source: ITC)

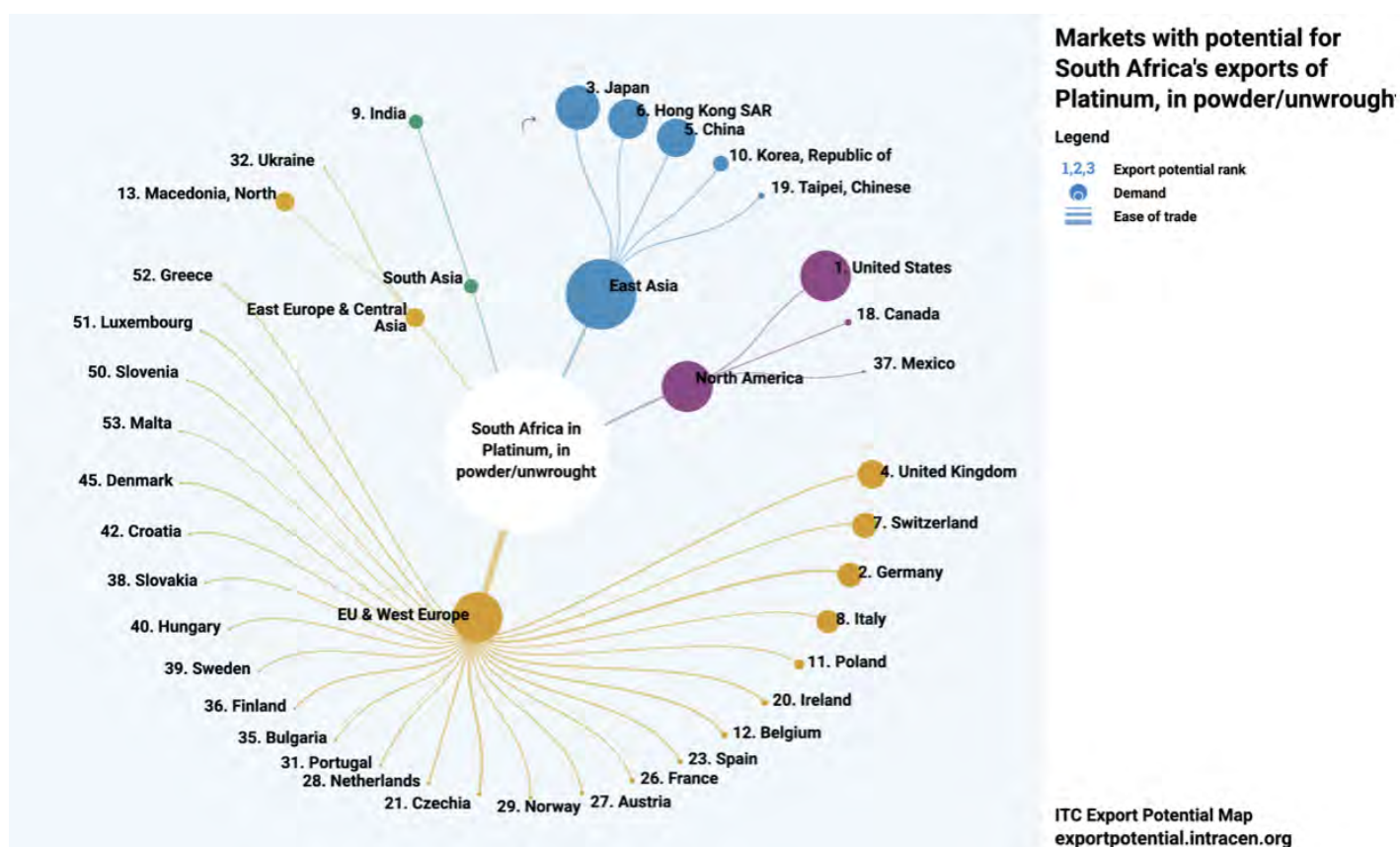


Figure 10: South Africa's key export markets for platinum (in powder/unwrought form) (Source: ITC)

In terms of ease of trade, European markets such as Germany, the United Kingdom (UK), and Switzerland stand out as the most accessible destinations for South African platinum and palladium. This is supported by long-standing trade agreements, efficient logistics, and Europe's advanced refining infrastructure (European Commission, 2024). The EU-SADC Economic Partnership Agreement facilitates low-tariff or tariff-free trade, making exports smoother and more cost-effective.

Lithium

It must be noted that there is limited or no available data for lithium markets on the ITC website. The absence of lithium export data for Africa on the ITC trade potential map raises several implications regarding market transparency, production capacity, and the structure of global lithium trade. Unlike minerals such as copper, cobalt, and manganese, which have well-documented trade flows, lithium appears to be largely untracked in Africa's export databases. This could indicate that Africa's lithium industry is still in its early stages, with limited large-scale production and few formalised trade routes. While countries like DRC, Namibia and Zimbabwe have known lithium reserves, their extraction and export may not yet be substantial enough to appear in global trade monitoring systems.

A key reason for the lack of lithium trade data may be how lithium is categorised and traded globally. Many African countries export lithium-bearing minerals like spodumene and petalite rather than refined lithium products, and these may be recorded under broader categories of "ores and concentrates" rather than explicitly listed as lithium exports. Additionally, much of Africa's lithium is likely being exported under long-term contracts with major players like China, which dominates the global lithium refining industry.

Rare Earth Elements (REEs)

There is an absence of detailed trade flow

data for REEs on the ITC platform. This suggests challenges in tracking, reporting, and transparency within global REE supply chains. Unlike more established commodity markets such as copper or PGMs, REEs are often traded under long-term contracts rather than open market transactions, making real-time trade data less accessible (Roskill, 2024). Many REEs are processed and exported in complex chemical forms, rather than as raw ores, which may result in their classification under broader or less specific trade codes, further complicating accurate data tracking (OECD, 2023).

4. TARIFFS AND PROTECTIONISM

The rising demand for critical energy transition minerals has led to increased protectionist policies globally. Trade barriers and protectionist measures are reshaping critical minerals markets, prompting countries to reorganise their supply chains to secure strategic materials amid mounting geopolitical tensions. For SADC member states, this regime presents both opportunities and challenges. The SADC region can leverage its abundant mineral resources, attract investment and foster economic development but, on the other hand, it must navigate complex geopolitical landscapes, ensuring that trade policies and agreements are favourable and that they do not become overly dependent on any single market.

To mitigate risks associated with protectionism and geopolitical tensions, SADC member states can:

By adopting these strategies, SADC member states can better position themselves in the global critical energy transition minerals market, balancing economic growth with geopolitical considerations.

5. POLICY RECOMMENDATIONS

Policy recommendations include:

Expand value addition in green energy products.

Align critical minerals trade with broader SADC regional economic integration goals.

Enhance local skills by strengthening training in mineral processing and fabrication.

Invest in skills and technology transfer, specifically downstream, beyond processing.

Foster co-investments in high-value mineral processing.

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