Policy Paper

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“When Elephants Fight” , Africa Transforms: The New Geopolitics of Critical Mineral Supply Chains and the Emergence of Local Value Chains

By Sabrine Emran & Oussama Tayebi

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The heightened and persistent geopolitical tensions of recent years, marked by the deterioration of U.S.-China relations, the escalation of tensions in Taiwan, and the conflict between Russia and Ukraine, have had significant repercussions on the strategic and critical minerals supply policies of several states. Recent crises, particularly the COVID-19 pandemic and the war in Ukraine, have exposed the vulnerability of global supply chains to geopolitical shocks and disruptions, prompting many countries to rethink their approach to securing raw materials and diversifying their supply sources.

Concerns about excessive dependence on supplies from certain partners deemed risky or unreliable have led many states to reconsider their supply security strategies. In this context, strategies have emerged to promote the relocation, "nearshoring," or "friendshoring" of parts or entire segments of critical minerals value chains, along with investments in the development of recycling and substitution processes.

10 YEARS
POLICY CENTER FOR THE NEW SOUTH

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POLICY PAPER

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1. The title is inspired by the African proverb: “when elephants fight, it's the grass that suffers”. The idea is to highlight the fact that rivalry between major powers over critical mineral supply chains opens significant opportunities for African nations to develop local value chains for these minerals. The aim is also to demonstrate the continent's own initiative (in the 'agency' sense) on these issues.

Introduction

The heightened and persistent geopolitical tensions that the world has been experiencing in recent years, marked by the deterioration in relations between the United States and China, the escalation of tensions related to Taiwan, and the conflict between Russia and Ukraine, have had major repercussions for the supply policies of several states for strategic and critical minerals. Crises, notably the COVID-19 pandemic and the conflict in Ukraine, have highlighted the vulnerability to geopolitical shocks and hazards of global supply chains, prompting many countries to rethink their approaches to securing raw materials and diversifying sources of supply.

In particular, concerns about over-dependence on supplies from certain partners, considered risky or unreliable, have prompted many countries to rethink their approaches to security of supply. This has led to the emergence of strategies aimed at encouraging the relocation, 'near-shoring' or 'friend-shoring' of all or part of certain value chains linked to critical minerals, as well as investment in the development of recycling and substitution processes.

I- Geopolitics of critical mineral supply chains: opportunities, ambitions, and impact on the energy transition

Understand the challenges and strategies for critical supply chains worldwide

The attention that the issue of supply chains has attracted in recent years is explained by fears—mainly American, European and Japanese—that these channels could be exploited geopolitically. President Joe Biden's National Security Advisor, Jake Sullivan, for example, warned that *"clean energy supply chains could be weaponized in the same way that oil was in the 1970s, or natural gas in Europe in 2022"* (White House, 2023).

Prior to this, President Donald Trump during his first term signed Executive Order 13953 with the stated aim of *"combating the threat to the domestic supply chain posed by reliance on critical minerals from foreign adversaries and supporting domestic mining and processing industries"*. At European level, legislation on critical raw materials has echoed these fears, stressing the importance of reducing the risks associated with import dependency in supply chains *"often from third-country suppliers in a quasi-monopoly situation"*—a thinly veiled reference to China. These objectives are also partly reflected in the national strategies of Germany and France. For these countries, the aim is to avoid becoming the target of economic disruption or coercive measures, in particular export restrictions designed to influence internal political decisions, or those countries' positions on the international stage.

Several precedents reinforce these fears. China is said to have used this strategy on several occasions in the past, notably against Japan, Norway, and Lithuania. The case of the alleged rare earths embargo imposed by China on Japan in 2010 over a dispute surrounding the Senkaku/Diaoyu islands is presented almost systematically as a clear example of the risks associated with very strong dependence on a single supplier. In 2021, Russia reportedly threatened to halt nickel exports to Europe (Lazard, 2023). The International Energy Agency

noted that worldwide *"export restrictions on critical raw materials have increased fivefold since 2009"* (IEA a, 2023). The specter of a Chinese decision impacting supply is all the more worrying for decision-makers in these countries, given the importance of Chinese companies in the supply of critical minerals.

China holds a strong position in the extraction of critical minerals and a dominant position in processing and manufacturing. China accounts for 85% to 90% of the world's rare earth refining, and refines 68% of the cobalt, 65% of the nickel, and 60% of the lithium needed to make batteries for electric vehicles (Goldman Sachs Research, 2023). China's growing role in the industries associated with these minerals is also cited as a decisive factor in the decisions of several countries to reconfigure their supply chains. According to estimates, 65% of battery components, 71% of battery cells, and 57% of electric vehicles worldwide are manufactured in China (Goldman Sachs Research, 2023). China's emergence as a major player in renewable energy and green technology value chains is also one of the driving forces behind the many initiatives to 'de-risk' and diversify supply chains.

The significant growth in Chinese demand has led to fears of the introduction of new export quotas and restrictions. In 2018, China became a net importer of seven rare earths, raising the risk of a tightening market. The sharp rise in Chinese demand is partly a response to the ambitions of the *Made in China 2025* strategy. The development of the 'new materials' industry is seen in this strategy as the foundation for the development of Chinese production capacity in nine other sectors, including electric vehicles, new information technologies, and aeronautics (Nakano, 2021).

Another reason for putting supply chains on the agenda is political. The achievement of carbon neutrality and green transition objectives—the subject of electoral commitments and government programs in several countries—has made it necessary to reduce dependence on suppliers considered risky or unreliable. During his 2020 presidential campaign, Joe Biden declared that climate change was the *"number one problem facing humanity"* and promised a transition from fossil fuels to renewable energies that could *"create millions of jobs"* (CNBC, 2020). He sought to deliver on this promise by passing the Inflation Reduction Act (IRA) in 2022. Among other things, this law set ambitious targets for the relocation of supply chains linked to green industries. The IRA pledges to increase the U.S. supply of critical minerals—lithium, nickel, manganese, among others—to provide the raw materials needed for a vast expansion in demand for electric vehicles, batteries, and renewable energy infrastructure. The law creates new production tax credits for domestic manufacturing of components throughout the supply chains for solar modules, wind turbines, battery cells and modules, and critical mineral processing. These incentives also apply to countries that have signed free trade agreements with the U.S.

At European level, political impetus has been provided by the adoption of the European Green Deal, the European Climate Act, and the European Industrial Strategy. The European Green Deal stresses, for example, that access to resources is a matter of strategic security, calling for *"securing the supply of sustainable raw materials, in particular critical raw materials, needed for clean technologies, digital and space applications, as well as defense applications, through*

the diversification of both primary and secondary sources of supply". The European Union has also defined the reduction of strategic dependencies as one of the main objectives of its industrial strategy.

In short, the growing concern over supply chains stems from geopolitical uncertainties, with players such as the U.S., Europe, and Japan expressing fears of dependence and vulnerability in the face of the introduction of export restrictions. These geopolitical dynamics reinforce the need to rethink and diversify supply chains to ensure the security and competitiveness of several strategic industrial sectors, notably the defense industry, as well as the achievement of political objectives set in terms of climate-change mitigation. In order to explore the trends shaping the current debate on global supply chains, we look first at the different definitions attributed to critical minerals, their utility, and their role in the current economic, energy, and geopolitical context.

An Overview of Critical Minerals: Definitions and Structuring Issues

Critical ores are mineral resources essential to the economy, the supply which can be disrupted by a number of factors. The criticality of a mineral changes over time, depending on supply and society's needs. Currently, many critical minerals are metals at the heart of high-tech sectors. These include rare earths and other metals such as lithium, indium, tellurium, gallium, and platinum-group elements (American Geosciences Institute, 2023).

We can divide critical ores into three main categories according to the vulnerability of the supply chain and use of the ores: critical ores[2], technological metals, and strategic ores. Classification may vary within a single country, depending on industry, defense strategies, and technological advances. However, geological scarcity remains one of the main factors affecting the criticality of metals and minerals. As the world's resources are depleted, those yet to be found are increasingly located in frontier regions and at greater depths, driving up the costs of exploration and mining. One of the major problems of critical minerals is their criticality, which continues to be affected by the absence of substitution or recycling, and by the limits of recovery in these processes (Critical Minerals Association, 2021).

In terms of definitions attributed by different countries, the trade agreement signed between the United States and Japan on March 28, 2023, on strengthening supply chains for critical minerals, highlighted two distinctions made between the critical minerals covered by the agreement, and those covered by the Inflation Reduction Act (IRA). The definition of 'critical minerals' in the trade agreement includes only a list of five minerals—cobalt, graphite, lithium, manganese, and nickel—whereas, under the IRA, 50 minerals are considered critical.

[2] Morocco's Economic, Social and Environmental Council defines essential minerals as those crucial to the economic, defense or energy policy of a State or industrial player, based on their importance and the risk of disrupting supply chains.

The Role of Minerals in Energy Transition

With the need for a more prominent effort in the energy transition, and to combat the impact of climate change, 185 parties ratified the 2016 Paris Agreement aimed at keeping global temperatures below 2 degrees Celsius. This effort requires increased investment in the green-energy sector, as well as the deployment of new energy storage technologies such as batteries. Demand for green technologies including solar panels, wind turbines, electric vehicles, and energy storage batteries will be accompanied by growth in demand for several minerals required for their facilitation and development (Church and Crawford, 2020).

Table 1. Minerals required for green energy technologies

Critical minerals	Use in green energy technology
Silver	Solar
Bauxite and alumina	Solar, wind and electric vehicles and energy storage
Cadmium	Solar
Cobalt	Solar, wind and electric vehicles and energy storage
Copper	Solar, wind and electric vehicles and energy storage
Chrome	Wind
Iron	Solar, wind and electric vehicles and energy storage
Gallium	Solar
Germanium	Solar
Graphite	Electric vehicles and energy storage
Indium	Solar
Lithium	Electric vehicles and energy storage
Manganese	Wind power, electric vehicles and energy storage
Molybdenum	Wind
Nickel	Solar, and Electric vehicles and energy storage
Lead	Solar, wind and electric vehicles and energy storage
Selenium	Solar
Silicon	Solar
Tellurium	Solar
Rare earths	Wind power, electric vehicles and energy storage
Titanium	Electric vehicles and energy storage
Zinc	Solar and wind power

Source: Data mainly from World Bank (2017), Levin Sources (2017a, b), USGS (2017), Bloomberg New Energy Finance (2018) and American Exploration & Mining Association (2013).

In 2020, 37 ores were used directly in technologies for the energy transition, while seven ores were used in supporting technologies. Among the ores directly used in the technology needed for the energy transition are nickel, silver, copper, zinc, lithium, and cobalt (ESCWA, 2023).

The energy transition that has begun on a global scale is currently constrained by limited financial, natural, and skills resources. At the national level, this process is uneven, depending on economic development, national strategies, implementation, and, consequently, access to a number of technologies and mineral resources. Over the next 20 years, the shift towards clean-energy sources will have an impact on demand for minerals worldwide. Electric vehicles and batteries will account for around half of the growth in mineral demand for clean-energy technologies over the next two decades, driven by growing demand for battery

materials. Mineral demand for electric vehicles and battery storage by 2040 will increase almost tenfold under STEPS scenarios, and by around 30 times under sustainable development scenarios (IEA, 2022).

In addition, demand for the extraction of critical minerals is set to continue to grow, driven by the following factors: (1) growing demand for electric vehicles, linked to demand for lithium, nickel, cobalt, manganese, and graphite; (2) increasing demand for, and use of, wind power, linked to demand for copper, nickel, manganese, chromium, and zinc; and (3) increasing demand for and use of solar power, linked to demand for copper and silicon (Citigroup, 2023).

According to the International Renewable Energy Agency (IRENA)[3], the energy transition will be one of the main drivers of demand for several essential minerals. The scenario in which the global temperature rise is kept to 1.5°C above pre-industrial levels highlights the scale of the energy-transition infrastructure—and essential materials—needed to achieve climate stabilization. This infrastructure will include 33,000 gigawatts of renewable energy and the electrification of 90% of road transport by 2050. The mismatch between supply and demand for several minerals is already evident, with particularly high levels observed for lithium (IRENA, 2023).

Furthermore, one of the most constraining aspects of the demand for minerals for the energy transition is the concentration of production of critical minerals including lithium, nickel, and cobalt in a few countries, which increases the risk of shortages arising because of natural disasters, regulatory changes, or geopolitical events. In this context, the Russia-Ukraine conflict has also disrupted global supplies of certain minerals, underlining the new interdependencies likely to form in the global market for critical minerals (Berahab, 2022).

Finally, we understand that critical minerals, indispensable to the economy and advanced technologies, are playing a central role in the global energy transition. However, their criticality is complex, marked by geological and technological challenges, and by risks linked to the concentration of production, underlining the need for enlightened management of these resources.

New Impetus for International Cooperation to Secure Supply Chains

Fears of exploitation of supply chains for geopolitical purposes or industrial competitiveness, combined with the growing political importance of carbon neutrality and green-transition objectives, explain the efforts to strengthen international cooperation on this issue. The launch of several initiatives and partnership frameworks, such as the Energy Resources Governance Initiative, the Partnership for Safe Minerals (PSM), and the Critical Raw Materials Club, demonstrates the growing international consensus on the need to implement actions to reduce supply-chain risks. The PSM aims, for example, to accelerate the development of critical minerals supply chains by encouraging collaboration between governments and the

[3] Declared policy scenario, an indication of where the energy system is heading based on a sector-by-sector analysis of current policies and policy announcements.

private sector *"to facilitate targeted financial and diplomatic support for strategic projects along the value chain"*. The fact that members including Australia, Canada, the European Union, Finland, France, Germany, India, Italy, Japan, Norway, South Korea, Sweden, the United Kingdom, and the United States have signed up to this initiative demonstrates the growing convergence of opinion on the subject. The issue of supply chains is also now the subject of greater coordination within international forums such as the Group of Seven (G7). The final communiqué from the G7's 2023 Sapporo summit referred to *"the growing importance of critical minerals in various fields, in particular for the global transition to clean energy, as well as the need to address the economic and security risks resulting from the vulnerability of supply chains"*. The G7 climate, energy, and environment ministers also adopted a five-point plan for critical minerals security.

The dynamic of international cooperation on the issue of supply chains has also materialized through the conclusion of bilateral arrangements between several countries. The signing in March 2023 of an agreement between the United States and Japan on strengthening supply chains for critical minerals exemplified the collaborative approach that certain countries have chosen to adopt on this issue. In particular, the agreement provides for the non-imposition of export duties on critical minerals, and for the implementation of domestic measures to remedy other countries' non-commercial policies and practices affecting trade in critical minerals. Ongoing negotiations between the U.S. and the EU on the issue of critical minerals supply chains are also part of this framework. In the event of an agreement, benefit from a status equivalent to that of countries that have concluded a free trade agreement with the United States under the American Inflation Reduction Act. European companies will thus be able to *"benefit from subsidies granted by the United States under the Clean Vehicle Tax Credit"*.

The international initiatives and agreements mentioned above underline the importance of critical minerals in the transition to a clean, sustainable economy. Among these minerals, cobalt plays a central role, being essential to the manufacture of lithium-ion batteries that power electric vehicles and various other technological applications.

The growing demand for cobalt, particularly in the portable electronics and electric vehicle sectors, raises crucial questions about the security and sustainability of global supply chains. The convergence of international efforts to strengthen these chains must also take into account cobalt's vital role in this global dynamic.

The Central Place of DR Congo in Global Cobalt Supply

Cobalt is an essential mineral for the manufacture of lithium-ion batteries for electric cars and stationary applications, making it an important factor in the energy transition (Roelfsema *et al*, 2022). In fact, cobalt enables batteries to guarantee thermal stability, longevity, autonomy, and high energy density. It plays an essential role in the manufacture of high-energy-density lithium-ion batteries, ensuring the stability of the active material structure. It is also used to improve the speed at which batteries can be charged and discharged. In addition to batteries, it is also used in alloys and superalloys for gas turbines, aircraft

construction, cemented carbides, and modern medicine. It can also be used as a catalyst in the petrochemical industry (Debrah and Danielson, 2023). Thus, the electric-vehicle sector is likely to continue to exacerbate demand for cobalt over the next few years.

Global demand for cobalt is set to quadruple by 2030, because of its use in portable electronics and electric vehicles, some of which is intended to address growing concerns about climate change. These two major industries are the most demanding for refined cobalt (Debrah and Danielson, 2023). Global demand for cobalt in the lithium-ion battery industry is expected to increase by 1.5 times between 2021 and 2030. Increased domestic cobalt extraction could contribute to Europe's[4] open strategic autonomy, given that 70% of the world's cobalt supply is extracted in the Democratic Republic of Congo (DRC), and 70% of the world's cobalt refining capacity is located in China. Furthermore, the future contribution of domestic cobalt extraction to meeting European demand in 2035 could amount to 3.1% (Patrahau and Rademaker, 2022). Despite the risks to cobalt use and availability, and efforts to substitute cobalt in battery applications, cobalt remains a key raw material in the battery supply chain. As well as the DRC, Indonesia is set to play a major role in supply growth. According to forecasts, the DRC could contribute 44% of growth, while Indonesia could support 37% of mining supply growth by 2030.

In terms of reserves, the DRC remains the world's most cobalt-rich country. However, most cobalt is produced as a by-product of copper and nickel mining; in 2020, 60.7% of global production came from primary copper mines and 29.3% from nickel mines (USGS, 2023). This means that the joint costs associated with mining cobalt-bearing copper ore (e.g. capital expenditure, fixed costs, equipment, labor) are fully covered by the revenues from the main product, copper (Gulley, 2022).

Most of the major cobalt deposits are located in the Central African copper belt, straddling the DRC and Zambia. In 2020, global production amounted to 139,480 metric tons, including 95,600 tons from the DRC. The top 15 cobalt-producing mines forecast for 2025 include 10 copper mines in the DRC and five nickel mines in Madagascar, Russia, Australia, Cuba, and Papua New Guinea. Only the Luiswishi cobalt mine is identified in the list, with production of 540 tons in 2020 and 2025 (estimated). The Tenke Fungurume copper mine in the DRC recorded production of 15,400 tons in 2020, a total that is set to rise to 4,120 tons in 2025. The largest mine on the list remains the Kamoto copper mine in the DRC, which recorded a total of 23,900 tons in 2020, with production forecast to reach 41,200 tons in 2025 (Yao, 2023).

Aware of the mineral wealth of its territory, the DRC aspires to increase the production of minerals such as cobalt and lithium, while generating additional revenues, with the aim of processing these resources locally to boost its development.

[4] Open strategic autonomy is a concept focused on strengthening Europe's independence in crucial sectors, while promoting global cooperation and trade. The aim is to forge a more unified, assertive and robust Europe, putting the interests and values of its citizens first.

Figure 1: Cobalt Consumption by Sector

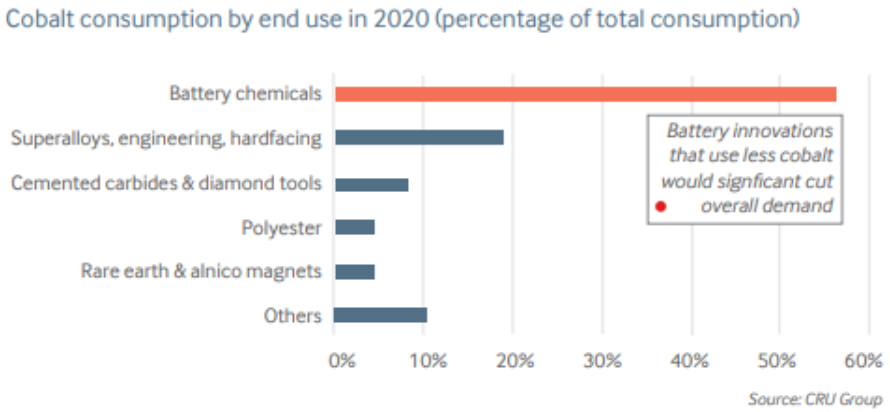
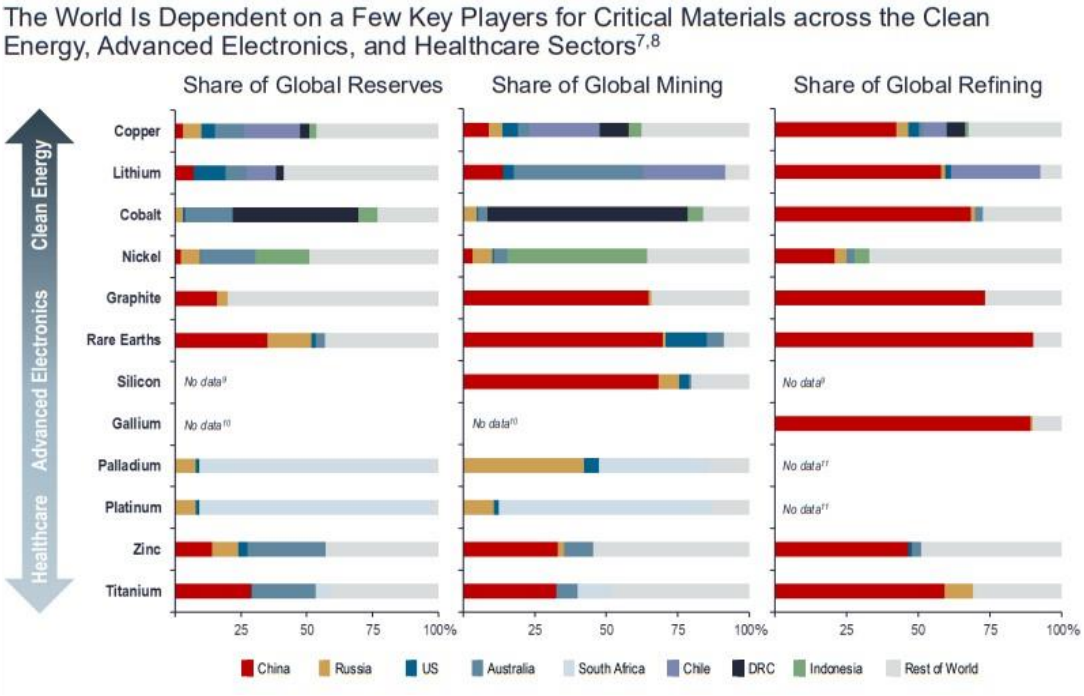


Figure 2: Global Distribution of Critical Mineral Reserves, Production, and Refining Capacity



Source: Lazard Gestion, Geopolitical Advisory, Research Brief, Critical Minerals: Geopolitics, Interdependence, and Strategic Competition,

The second part of this paper will look at how the DRC could benefit more equitably from its abundant mineral resources, to foster inter-African cooperation for a just energy transition on the continent, and to contribute to strengthening the security of supply of critical minerals.

II- Towards Economic Autonomy in Africa: Strategies and Challenges for Local Processing of Mining Resources

"From Africa as a tool to Africa as a partner"[5]

Raw materials processing represents a major challenge for Africa's economic development. Since independence, leaders of African countries have expressed their ambition to add value to the continent's natural resources by processing them locally, rather than simply exporting them in their raw forms, perpetuating a pattern of asymmetrical trade inherited from the colonial period. African leaders have understood the strategic importance of processing raw materials. They see it as a means of stimulating economic development, creating local jobs, and diversifying national economies. In his inaugural address at the first summit of the Organization of African Unity (OAU) in Addis Ababa, Kwame Nkrumah highlighted the importance of creating major industrial complexes in Africa. He stressed that political independence would only be fully beneficial *"to the workers of the cities and the countryside, who cultivate overpopulated lands"* if the latter could enjoy the benefits resulting from the establishment of advanced facilities dedicated to education, technical training, and energy, to get out of unemployment and no longer be tied to *"tasks reserved for unskilled labor"*. Nkrumah therefore considered economic independence and development, resulting from the local transformation of raw materials, to be indispensable prerequisites for Africa's *"total independence"* (Ola, 1979).

The Sudanese Prime Minister, Ibrahim Abboud, followed suit, calling on the powers that be to devote a greater proportion of their technical resources to enabling African countries to industrialize their raw materials, in order to raise the economic and social level of their peoples (AU, 2021). More recently, the initiators of the New Partnership for Africa's Development (NEPAD) have attributed the continent's impoverishment to the delay in implementing strategies to create local added value. The document points out that *"for centuries, Africa has been integrated into the global economy primarily as a supplier of cheap labor and raw materials. This has necessarily meant a hemorrhaging of Africa's resources rather than their use for the continent's development. Africa missed the opportunity to use minerals and raw materials to develop processing industries and a highly skilled human base to support growth and development"* (OAU, 2001).

This observation goes a long way towards explaining the importance attached to the subject by the African Union (AU) in recent years, particularly with regard to agriculture and the mining sector. The formulation of an African commodities strategy has been made a flagship project of Agenda 2063. The development of a continental commodity strategy is seen as crucial to enable African countries to increase the value of their products, realize more substantial profits, integrate into global value chains, and promote *"vertical and horizontal diversification anchored in value addition and local content development"*. According to the AU,

[5] Reference to Professor Joseph Ki-Zerbo's paper at the 4th session of the African Studies Congress on "Africa's dependence and how to overcome it".

this strategy aims to transform Africa from a mere supplier of raw materials to the rest of the world, into a continent that actively exploits its own resources to ensure the economic development of its people.

Similar objectives were put forward as part of the Vision for Africa's Mining Regime published in 2009. The Vision emphasized the importance of mineral beneficiation (producing higher grade product from ores) and the formulation and implementation of *"effective industrialization strategies based on our continent's unique assets"* (AU, 2009). The strategy highlighted the opportunities offered by the continent's mining heritage to generate added value both upstream and downstream. It advocated exploiting the regional advantage in the production of raw materials to promote the establishment of resource-processing industries (beneficiation). In turn, these industries must supply the raw materials needed for production and industrialization. The development of the production sector for resources and inputs such as capital goods, consumables, and services was also advocated.

However, this ambition has not been fully realized. Obstacles have included chronic under-investment in research and development, a persistent infrastructure deficit, and a lack of the capital needed to set up modern processing facilities. The geopolitical dimension that the issue of supply chains for critical minerals has taken on in recent years offers, however, a historic opportunity for the African countries concerned to overcome these difficulties and realize the ambitions of their leaders—past and present—for the local transformation of mineral resources. The concerns expressed by some countries about the need to ensure security of supply in the face of the risk of geopolitical instrumentalization fundamentally reshuffle the deck. When supply chains are discussed, it is no longer a question of purely economic considerations relating to price or logistical efficiency, but also of where the raw materials and products come from, and whether they are essential to national security or industrial competitiveness.

This new situation explains the emphasis placed on international partnerships in the various de-risking strategies published by the U.S. and the EU. As part of its international commitment to critical raw materials supply chains, the EU intends to promote the strengthening of strategic partnerships by working with trusted partners. The aim is to support their sustainable economic development by promoting the creation of national value chains, while encouraging the establishment of secure value chains that are *"resilient, affordable and sufficiently diversified"* to meet European needs.

The report on the first 100 days of the U.S. Supply Chains strategy, drawn up by the Biden administration in accordance with Executive Order 14017, advocated, like the EU strategy, the promotion of sustainable production in collaboration with allies and partners. It mentioned that various U.S. government agencies could provide support for the sustainable production and processing of critical minerals and other materials among U.S. allies and partners. As an example, it cited the Export-Import Bank of the United States (EXIM), which could provide loans or loan guarantees to facilitate the export of U.S. mining equipment and engineering services. The paper also highlighted the capabilities of the U.S. International

Development Finance Corporation (DFC) to invest in viable strategic and critical materials projects in emerging markets, through its debt, equity, and political-risk insurance products.

The unique opportunity represented by the adoption by several countries of strategies to redefine supply chains seems to have prompted several African countries to formulate what could be described as 'national' offers for the local processing of critical raw materials and minerals. This is notably the case for the DRC and Zambia, which signed a cooperation agreement in April 2022 to facilitate value-chain development in the electric battery and clean-energy sector. The agreement provides for the establishment of a joint governance framework called the DRC-Zambia Battery Council, and a technical committee in charge of monitoring and evaluating the project. The two countries plan to establish cross-border Special Economic Zones—with sites identified at Kipushi in the DRC and Ndola in Zambia—dedicated to the production of battery precursors, batteries and electric vehicles.

This initiative was followed by the signing by participants in the December 2022 US-Africa Leaders' Summit, of a tripartite DRC-Zambia-U.S. memorandum of understanding to support the development of value chains in the electric-vehicle battery sector. The stated aim of the MOU was to strengthen cooperation between the participants in order to promote to the U.S. private sector the investment opportunities offered by the joint DRC-Zambia initiative, and to identify co-financing opportunities for investments related to the electric-vehicle value chain. U.S. support for the joint DRC-Zambia initiative on battery value-chain development is a concrete illustration of the significant opportunities presented by the adoption of new strategies on critical mineral supply chains.

The signing by the EU and DRC in October 2023 of a memorandum of understanding on a partnership on sustainable value chains for critical and strategic raw materials fits into the same framework (EU, 2023). The partnership covers strategic and critical *"non-energy and non-agricultural raw materials that are necessary for the clean and digital energy transition along the entire value chain (exploration, extraction, refining, processing, recovery and recycling)"*. It sets out five areas for collaboration, including the joint development of projects (through joint ventures), the mobilization of funds for the development of the infrastructure needed to expand the raw materials value chain, and cooperation in research and innovation.

Another concrete manifestation of the opportunities offered by this new geopolitical situation is EU and U.S. support through Global Gateway and the G7 Partnership for Infrastructure and Global Investment for the Lobito Corridor development project. This project, which involves renovating the railroads between Kolwezi (DRC) and Lobito (Angola)—and which should be extended to Zambia—aims to reduce mineral transport times from three weeks to four days, and could in future be used for the export of processed products (ISS,2023).

Other African countries, including South Africa and Morocco, have also positioned themselves to take advantage of the new geopolitical situation in terms of supply chains, in order to promote the goal of local transformation of their resources (DBT & DESNZ, 2023). Morocco,

for example, with its cobalt, lithium, and phosphate resources, has succeeded in attracting several foreign investors to develop an ecosystem of gigafactories.

Based on the elements discussed above, there is a need for, and interest in, an African vision that emphasizes the domestic transformation of critical minerals. To illustrate this approach, we look below at the examples of Chile and Indonesia, before analyzing in figures the transformative effect it could have for the DRC.

Resource Nationalism: A Case Study of Domestic Processing Strategies For Critical Minerals in Chile and Indonesia

According to the International Energy Agency, the production and processing of critical minerals is concentrated in just three major producing countries, which could lead to supply vulnerability in cases of political instability, geopolitical risks, and possible export restrictions. For example, most rare earths are controlled by China, the U.S., and Myanmar, while lithium is controlled by Australia, Chile, and China, and nickel is controlled by Indonesia, the Philippines, and Russia (Hertanti,2023).

Case Studies on Critical Minerals in Chile

Latin America accounts for 40% of global copper production, with Chile at the top of the list, as well as 35% of lithium, with 26% coming from the same country (IEAb, 2023). Given that demand for copper and lithium is set to increase in the coming years, given their importance for non-conventional renewable energy technologies, Chile has decided to implement EITI's[6] multi-stakeholder platform and reporting framework, which would enable it to strengthen public oversight of its mineral value chain, from licensing and contracting to revenue collection, management, and distribution (Vasquez, 2023).

The country is currently developing a national lithium strategy for 2023. It is important to note that this strategy does not imply the nationalization of the lithium industry. As a result, Chile can respect existing agreements and does not envisage any expropriation of production facilities (EITI, 2023).

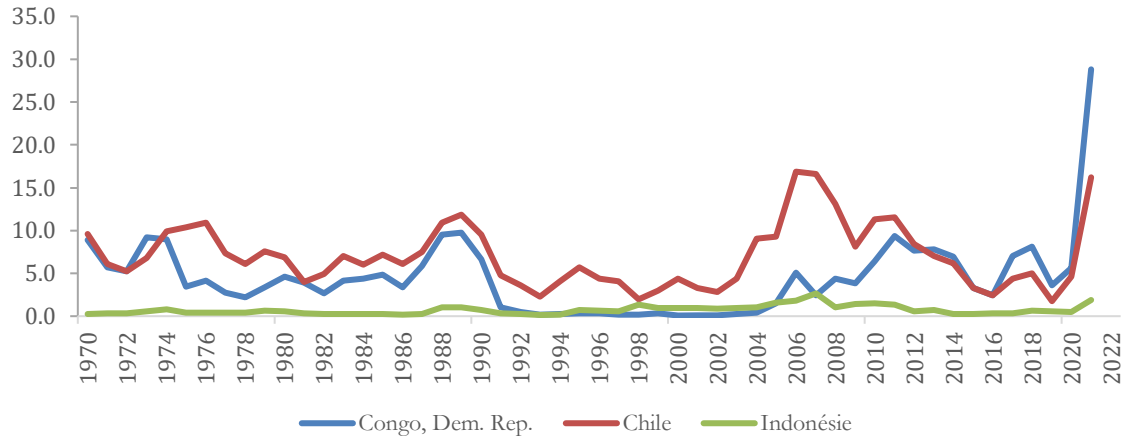
Chinese companies play a crucial role in the mining-sector value chain, particularly with regard to minerals processing in Chile. Despite the implementation of the national lithium strategy and the Extractive Industries Transparency Initiative, Chinese companies continue to conclude agreements that have an impact on this transformation in Chile. In 2022, one of China's largest carmakers, BYD, won a contract to extract 80,000 metric tons of lithium in Chile, spread over 20 years. However, this contract was suspended by a Chilean court. Another indication of China's involvement in the Chilean mining sector is the acquisition by the Chinese company Tianqi Litthium of a 24% stake in SQM, one of Chile's leading lithium producers (Castillon and Purdy, 2022).

[6] Extractive Industries Transparency Initiative

Figure [7]3 highlights mining product rents as a share of GDP in three of the main countries in global mining production. In effect, mining rents are payments made by governments and other entities to mineral resource owners to develop and extract natural resources. These payments are made in exchange for the right to use and develop the resources, and can take the form of royalties, taxes, or other rights (Wang and Zhang, 2023).

In Chile, it remains difficult to quantify the impact of mining on human development, although an improvement in citizens' living conditions has been observed in parallel with the development of the copper sector. However, it is difficult in practice to determine to what extent social progress is directly attributable to mining versus its indirect effect via social public spending (Afdb,2011).

Figure 3: Rents From Mining Products as a % of GDP



Source: World Bank, 2021

Case Studies on Critical Minerals in Indonesia

Indonesia is one of the world's leading nickel producers, but its contribution to the mining sector is not limited to this resource. In 2023, the country was estimated to hold significant reserves, including 1.5 billion tons of nickel, 640 million tons of copper, 927 million tons of bauxite, and 1.2 billion tons of tin (U.S. Department of Commerce, 2023). The mining sector's contribution to the Indonesian economy has continued to grow over the years. In 2016, it was estimated at just 7.18% of GDP, rising to over 12% by the end of 2022. These developments can be attributed partly to the repercussions of the COVID-19 pandemic and the Russian-Ukrainian conflict in February 2022, causing a significant increase, from 80% to 120%, in the prices of base metals including nickel and copper. However, another major reason for the rapid growth of the Indonesian mining sector lies in the Indonesian executive's efforts to develop the country's refinery industry (Business Indonesia.org, 2023). This process aims to

[7] This figure represents the difference between the production value of a mineral stock at world prices and its total production costs. The minerals included in the calculation are tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite and phosphate.

maximize state revenues through a downstreaming policy, which prohibits the raw export of certain raw materials, thus encouraging increased investment to support the development of the processing and refining industry in Indonesia. This creates an environment conducive to the formation of value chains (Schinderlawfirm, 2023).

Indeed, the aim of downstreaming is to stimulate the national economy by leveraging Indonesia's mining sector. With this in mind, the country has taken crucial steps towards nationalizing some of its critical minerals by banning exports, despite the fact that these minerals, including metals, account for 20% of Indonesian export revenues (Warwick, 2022). In 2020, Indonesia banned the export of raw nickel ore in order to attract investment, mainly for the development of nickel smelters. A year later, the country attracted downstream investments and financial commitments from Chinese companies, totaling around $30 billion. By July 2023, there were already 43 nickel smelters in operation, 28 under construction, and 24 in the planning phase (Habir,2023), reinforcing the role of downstreaming in the development of an in-house refining business in Indonesia. This could partly explain the relatively low level of mining rents in Indonesia compared with Chile and the DRC, given that most of Indonesia's mining output is processed within the country (Figure 3).

Table 2: Indonesia's Contribution to the Global Mining Sector

Raw material	Indonesia's Share of Global Mined Production Volume	Indonesia's position as a world producer
Nickel	23 %	77 %
Pewter	19 %	81 %
Coal	7 %	92 %
Bauxite	9 %	91 %
Gold	3 %	97 %
Copper Concentrate	2 %	98 %

Mt = Million metric tons; Kt = Thousand metric tons.

Source: McKinsey, 2023

In the years to come, Indonesia intends to capitalize on this industry and combine the economy with the mining sector, making it a lever for social and economic prosperity. The value of Indonesia's nickel exports increased tenfold between 2018 and 2023, with the aim of doubling GDP *per capita* to $10,000 by 2045, bringing Indonesia closer to the high-income threshold set by the World Bank (Listiyorini and Harsono, 2023). Between 2020 and 2023, Indonesia became one of the centers of competition for access to minerals critical to the energy transition, particularly for advanced industrial countries seeking partners to secure supplies of critical minerals outside China. On December 21, 2022, Indonesia's then-President Joko Widodo extended the ban on bauxite exports, effective from June 2023, requiring instead that the ore be processed and refined in the country. This latest policy decision was part of a series of measures that began in 2014, when Indonesia banned the export of raw minerals, followed by a ban on the export of nickel ore in January 2020. It is plausible to anticipate further Indonesian government policies in the future, particularly

regarding the export of other raw mineral commodities, including copper and tin (Hertanti, 2023).

As Table 3 shows, Indonesia's strategy is to strengthen the production and processing of its minerals, with particular emphasis on nickel, the country's most competitive critical mineral. The aim is to stimulate downstream industries and increase the value of exported products. This approach has translated into immediate economic benefit, boosting the value of Indonesia's nickel exports from $71 million in 2020 to $945 million in 2022 (NHK.org, 2023).

Table 3: Development of Smelting Facilities to Accelerate Nickel and Cobalt Production

	Nickel mine production	Cobalt mine production
2019	885	0.9
2020	770	0.9
2021	1034	2.5
2022	1574	7.6
2023*	1825	19.2
2024*	2075	32.4
2025*	2251	51.4
2026*	2390	57.4
2027*	2507	59.4

* : Future projections.

Source: S&P Global Market Intelligence, 2023

How the DRC could benefit from the domestic processing of its critical minerals: focus on cobalt

Scenario For Domestic Cobalt Processing in the DRC

The DRC's significant role in the global energy transition is highlighted by its dominant position in the mining industry, particularly for cobalt, as discussed in the first part of this study. However, following the examples of Chile and Indonesia, which are already undertaking processing of their ores internally, there is an opportunity for the DRC to increase the value of its raw materials. This can be seen in the context of Indonesian exports in recent years, also illustrating the regulation of the social framework and labor market in the mining sector, in line with Organization for Economic Cooperation and Development initiatives in the Antofagasta region of Chile. In the case of the DRC, it is clear that countries with abundant natural resources do not always manage to maximize the value their industries could offer (Colthorpe, 2021).

In the context of the energy transition, African nations will play a crucial role, particularly in the lithium-battery supply chain. A significant market opportunity is estimated at around $7,000 billion by 2030 and $46,000 billion by 2050. This outlook is in line with the rapid increase in annual demand for lithium batteries, which is expected to reach 4.5 terawatt-hours (TWh) per year by 2035. To meet this trajectory, substantial increases in metal, precursor, and cell production will be required. (BloombergNEF, 2021).

Currently, the DRC exports cobalt as raw ore to the world market, placing the country at the bottom of the global value chain for batteries and electric vehicles. This export approach limits the country to capturing just 3% of the global market value, estimated to reach $8.8 billion in 2025. From this observation, it becomes clear that the DRC has the opportunity to transform its mining sector by establishing a complete value chain, going beyond the raw extraction of mineral resources. This transformation could take the form of the creation of a battery precursor production unit, as a natural extension of the DRC's mining activities. The development of this value chain could generate $271 billion by 2025, giving the country a significant share of the profits (UNCTAD, 2022).

Raw materials account for 85% of the total cost of operating an NMC 622 chemistry cathode precursor plant, including cobalt, manganese, and nickel. If mining can be integrated with such facilities, the DRC could be highly competitive in the production of the essential ingredient, especially with significant manganese and nickel supplies available from neighboring countries such as Madagascar, Mozambique, and Gabon—a realistic prospect in view of the African Continental Free Trade Area (Colthorpe, 2021). Indeed, setting up a single 10,000-ton cathode precursor plant in the DRC would require an investment of $39 million, three times less than the cost of a similar plant in the U.S. or China. Consequently, operating such a plant in the DRC, sourcing cobalt at cost from a captive mine, would prove to be the most competitive option, compared to a similar plant in the U.S., China, or Poland (BloombergNEF, 2021). It would be twice as expensive to do so in China and around $25 million more expensive in Poland. In terms of energy transition, the DRC, using mainly hydroelectric power, a new supply chain involving the manufacture of precursor materials on site, would reduce emissions linked to battery production by around 30% compared with existing supply chains dependent on China (Colthorpe, 2021).

What are the obstacles to, and recommendations for, domestic cobalt processing in the DRC?

The DRC's contribution to the global energy transition could be even more significant thanks to its rich mining sector. However, it is crucial that the private sector plays a substantial role in making this contribution a reality. Alongside the development of internal mining transformation, the country should strengthen sector governance and promote human capital. In addition, it would be necessary to modernize the country's infrastructure, particularly in the areas of electricity, roads, ports, and railroads. This would support low-cost manufacturing and the integration of electric vehicles (WorldBank, 2023). There is also a need to improve fiscal certainty and political support by providing favorable laws and regulations for local businesses, while ensuring business continuity and reducing the risks associated with operating in the country (Bloomberg NEF, 2021). Today, 20% of cobalt in the DRC is mined artisanally, exposing workers to sometimes harsh working conditions. In this context, international institutions are working closely with the DRC to improve working conditions, including the effective elimination of child labor, and to improve access to drinking water and sanitation (IMF, 2023). Initiatives in this area have already been launched, with the revision of the DRC's mining code, but further efforts will be needed to create a favorable environment for mining transformation in the DRC.

In addition, the financial market must play an important role for this effort to succeed. It is recommended that a diversified financial market be set up in Africa, to support research and product development related to the electric-vehicle industry, at an early stage, and to contribute to the expansion of manufacturing. To this end, institutions such as the IFC (International Finance Corporation) can play an important role in promoting private investment in Africa. Beyond the financing of priority activities in key development sectors such as housing and infrastructure, equity markets often suffer from a lack of liquidity, and bond markets from rigid regulatory frameworks and insufficient infrastructure (IFC, 2023).

Domestic cobalt processing offers an opportunity not only for the DRC, but also for the rest of the world. For African countries, this is an opportunity to work together in the growth sectors of the automotive industry and the energy transition. It would also allow us to respond once again to the indications of ESG criteria, which should be unified, and which include the duty to guarantee workers adequate working conditions that are currently absent in artisanal mines. While the idea of transforming the DRC's mining resources locally represents an important ambition for the wellbeing of the country, Africa, and the planet, it requires significant improvements in the financial, fiscal, and investment climate, and in socio-economic conditions. These improvements could eventually lead to progress in cobalt extraction and processing, generating positive spin-offs for the country's economy and financial sector, and potentially for the continent.

Conclusion

In both geopolitical and geo-economic terms, critical minerals will play a crucial role in the global energy transition, and in the electric vehicle and battery industries, over the next few years. Although this sector brings added value, it does not always contribute to the economic and social progress of the countries that possess the critical mineral resources. In this context, we have examined the case study of the DRC, which could benefit from growing demand for minerals such as cobalt, and the efforts made by several countries as part of strategies to redefine supply chains, to develop value chains for batteries for electric vehicles.

Currently, the concentration of critical mineral processing and refining capacities in a few countries presents a structuring risk because of geopolitical tensions and geo-economic fragmentation. In this paper, we have highlighted the importance of encouraging local or regional processing of critical minerals, and, more generally, raw materials in Africa. The examples of Chile and Indonesia demonstrate the positive economic benefits of such local value-chain development strategies.

However, the realization of this African vision depends on a number of factors. We emphasize the need to develop innovative financing mechanisms to support African financial markets, unlocking the private capital needed to build downstream processing infrastructure to take advantage of economies of scale and lower costs.

In addition, it is crucial to focus on human-capital training to accompany this change, a contribution that could be made on a continental scale. For example, Mohammed VI Polytechnic University is exploring a potential partnership with the Congolese Ministry of Mines to formulate a training matrix for Congolese students, and to enable collaboration between the Moroccan University and Congolese geologists. Finally, the realization of this aspiration is linked to the need to seek complementarity of approaches to enhance the attractiveness of the African offer. ZLECAF and the DRC-Zambia Battery Council are preliminary examples of this, but to realize the potential of this African dream, in which the continent's raw materials contribute to its economic prosperity, it is imperative to implement ambitious and effective public policies—such as on access to reliable and affordable energy, road, and rail infrastructure, and development of human capital—aimed at creating the right conditions for the success of the various projects.

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