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Resource nationalism and downstreaming:

Lessons for African producers of critical minerals from Indonesia

By Bradford Simmons and Julien Marcilly

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The mission of the Atlantic Council's Africa Center is to prepare policy makers and investors for the onset of the African Century by supporting dynamic geopolitical partnerships with African states and multilateral institutions.

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Cover: Workers monitor the nickel melting process at a nickel smelter of PT Vale Tbk in Sorowako, South Sulawesi province, Indonesia, March 30, 2023. REUTERS/Ajeng Dinar Ulfiana

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Preface

The examples of Botswana with diamonds and Qatar with gas prove that a natural resource curse is not at work in these instances. However, when it comes to Africa, this denunciation discourages any positive perspective. What if African countries used good practices to learn from foreign models? This is the subject of this excellent Africa Center report by Julien Marcilly, chief economist at Global Sovereignty Advisors, and Bradford Simmons, senior director for energy, climate, and resources at BowerGroupAsia.

Their initial observation is alarming.

Despite the presence in its soil of a third of the world's known mineral reserves, Africa remains marginal in this sector, not attracting the investments necessary for its development. As of 2022, Africa accounted for only 10 percent of global exploration spending. In 2023, the continent's share of global investment in minerals was 8 percent. Yet global demand for critical minerals like copper, nickel, cobalt, and lithium is expected to generate revenues of sixteen trillion dollars over the next twenty-five years. For African countries, the question is simple: how to move from the extractive or even predatory model of which they have often been victims to a model that guarantees economic diversification, infrastructure development, increased revenue, fiscal stability, improved environmental management, and workforce training?

The foreign model that Marcilly and Simmons have taken here as an example for Africa is Indonesia.

Indonesia is a former colony that had made the fortunes of Europeans without, for instance, creating wealth for the Spice Islands—now known as Moluccas, an Indonesian archipelago—which remained underdeveloped for a long time. It is the leading producer of nickel, with 42 percent of the world's nickel reserves, and also has copper reserves, ranking as the world's third-largest copper exporter. This Asian country has become essential for the Chinese economy and meeting the growing demand for electric vehicles around the world. However, from the 2010s onward, Indonesia wanted to turn its back on the extractive model marked by numerous Chinese investments by betting on value chains and the diversification of its partners. To achieve this, Indonesia has employed a wide range of tools, including banning raw mineral exports, supporting national champions, and creating value chains.

But it is unlikely that this Indonesian mining nationalism can be replicated without nuance in the African context. First, in this country, which is home to the fourth-largest population in the world with 282 million inhabitants, it was necessary to set up an ecosystem favorable to investment, including adequate tax and regulatory measures. Second, the diversity of African countries calls for differentiated strategies in an international context where external partners are redefining their strategies. Above all, the ecological impact of this production model can weigh heavily on biodiversity and public health.

In Indonesia, the first successes were followed by difficulties, for which the Indonesians have not always been responsible. While it is understandable that the European Union (EU) is concerned about competition rules or that the United States subjects its Inflation Reducation Act mechanisms to national interest imperatives, it would be good policy to support the West's traditional allies, from Asia to Africa, including those who prioritize a national agenda in the ruthless competition being played out with China.

Rama Yade
Senior Director, Africa Center

Introduction

Indonesia is poised to play a pivotal role in the global energy transition. The country's role as the sixth-largest greenhouse gas emitter[1] and one of the world's fastest demographically and economically developing states places particular emphasis on its ability to balance its climate and economic aspirations. In this respect, meeting the challenges that Indonesia faces in reaching its climate goals in both geographic and development terms will be a formative experience from which other developing countries and island states can draw lessons and case studies.

Indonesia's archipelagic geography and its location in the Pacific equatorial tropics endow it with a resource base that requires unique and innovative infrastructure and policy solutions to decarbonize. Given the accelerating energy transition and global supply chain disruptions amid both the COVID-19 pandemic and the Russia-Ukraine war, addressing global climate change will also necessitate an enhanced and potentially fraught reliance on select critical materials[2] to produce decarbonization technologies. Indonesia's rich mineral resource endowment of various minerals is essential to the production of clean energy. With 42 percent of the world's nickel reserves and a dramatic increase in its global extraction share—from 5 percent in 2015 to 50 percent in 2023—Indonesia has become the largest nickel producer globally. From 2019 to 2022, investment in Indonesia's mineral-processing sector surged from USD 3.6 billion to USD 11 billion, raising the value of Indonesia's nickel exports from USD 3 billion to USD 30 billion. The country is also the world's third copper ore exporter and produces cobalt, bauxite, and rare earth elements.

In the postcolonial era, Indonesia's leaders have consistently put greater and greater emphasis on maximizing the value of its natural resources for its population, moving up the value chain, and supporting the formation and growth of the domestic industry. Its various policy applications and experiments aiming to create a sustainable domestic industry and greater prosperity have a mixed track record in investment and resource production terms. From a constantly evolving contractual structure and fiscal regime governing its upstream oil and gas industry to its more recent experimentation with export bans on unprocessed mineral ores, Indonesia has deployed a diverse range of policy tools to move to the higher-level, more lucrative work of production, i.e., up the value chain, in its natural resource sectors. Indonesia's more recent success in attracting investment to its nickel sector has, however, built upon its historical experience to develop a novel model for resource governance defined by three central characteristics:

- Creation of national champions and state-owned enterprises (SOEs) that are given substantial roles in extractives industries and advantaged treatment.
- Focused sectoral-level prohibitions such as a ban on the export of raw materials under the 2009 Mining Law.
- Institution of complementary industrial and trade policies such as the development of import tax exemptions, industrial-park development, commodity price floors, industry-creation planning, and incentive formation.

As demand for clean energy technologies has accelerated, Indonesia's experience with imposing export bans has drawn greater interest, particularly in light of the astonishing growth in Indonesian nickel output and market share. The policy has driven a renaissance in the country's processing sector, quickly attracting investment and expanding capacity. While these results have been favorably reviewed by Indonesian policymakers, the broader socioeconomic impact of the export bans and the differentiated results across bespoke classes of minerals present more mixed results. The Indonesian government strategically capitalized on Chinese industrial growth and energy transition dynamics, but notable and coincidental technology developments helped contribute to the areas where the export ban policy has succeeded.

While its growth and ability to quickly "crowd in" investment (i.e., when government investment spurs private investment) have garnered positive reviews, Indonesia's mining activities have significant environmental and social repercussions. The intensive energy consumption required for smelting, predominantly powered by coal, exacerbates environmental degradation and contributes to high carbon emissions, which will further exacerbate Indonesia's significant vulnerability to the impacts of climate change. Extreme weather events, rising sea levels, and the sinking of Jakarta illustrate the urgent need for the country's climate resilience and imperative to reduce its emissions trajectory. These challenges emphasize the importance of transitioning to a low-carbon economy to mitigate the effects of climate change and safeguard the country's environmental and socioeconomic stability. Additionally, mining operations have led to protests over unsafe working conditions, displacement of local communities, and conflicts with Indige-

1. "Global Greenhouse Gas Overview," US Environmental Protection Agency, https://www.epa.gov/ghgemissions/global-greenhouse-gas-overview.
2. For the purposes of this paper, "critical materials" will refer to those identified as meeting criticality thresholds for energy, as defined by the US Department of Energy. See DOE's 2023 "Final Critical Materials List," published on its website: https://www.energy.gov/cmm/what-are-critical-materials-and-critical-minerals/.

nous tribes, highlighting the need for more sustainable and socially responsible mining practices.

With the attention that Indonesia's nickel supply surge has garnered, critical mineral resource-rich nations, including many in Africa, have considered similar policies against the backdrop of fast-rising global demand for critical minerals. Indeed, about a third of the world's known mineral reserves are in Africa, including significant reserves of minerals that are critical to the green energy transition, such as 56 percent of the world's cobalt, 54 percent of manganese,[3] 36 percent of chromium, more than 20 percent of both bauxite and graphite, and 92 percent of platinum group metals.[4] Despite these known reserves, Africa remains underexplored and a recipient of less investment than competing critical mineral jurisdictions. As of 2022, Africa accounted for only 10 percent of global exploration spending and the continent's share of global investment in minerals was 8 percent in 2023.[5]

For policymakers hailing from those resource-rich jurisdictions, there are insightful lessons to be drawn from Indonesia's experience.

This paper seeks to unpack the Indonesian government's approach to the development of its critical minerals sector, discusses its historical context and background, and evaluates its impact by asking three central research questions:

- How much of Indonesia's success can be attributed to its strategic acumen versus exogenous market and technology developments?
- What enabling conditions predated the downstreaming[6] agenda and were they unique to the Indonesian context?
- Is Indonesia's success in moving up the value chain replicable for critical mineral resource-rich African governments?

In examining those questions, this paper argues that the unique governance model and set of external conditions that led to the Indonesian nickel sector's profound growth will make successful replication exceedingly difficult in Africa's resource rich markets. While nickel's success in Indonesia has been of central focus, its experience in bauxite and copper offer more cautionary lessons that must be heeded.

Table 1: Africa's share of critical energy minerals

Mineral	Clean energy technology	Share of global reserves in Africa	African countries wirh reserves
Platinum group metals	Green hydrogen	92%	South Africa, Zimbabwe
Cobalt	EVs	56%	DRC, South Africa, Zambia, Madagascar
Manganese	EVs, wind	54%	Gabon, South Africa, Côte d'Ivoire, Ghana
Chromium	Geothermal, solar, wind	36%	South Africa
Bauxite	Wind, solar	24%	Guinea
Graphite	EVs	22%	Madagascar, Mozambique, Tanzania
Zirconium (ores and concetrates)	Green hydrogen	15%	South Africa, Senegal, Mozambique
Vanadium	Steel, batteries	13%	South Africa
Copper	EVs, wind, solar	6%	DRC, Zambia
Lithium	Batteries	4%	DRC, Zambia, Mali
Nickel	EVs, wind	4%	Madagascar, South Africa
Tellurium	Solar	3%	South Africa
Rare earth	Wind	1%	Tanzania, South Africa, Madagascar, Burundi

Source: Zero Carbon Analytics, "Developing Africa's Mineral Resources," zerocarbon-analytics.org/archives/netzero/developing-africas-mineral-resources-what-needs-to-happen. .

3. "Cobalt Institute Fact Sheet 2023," Cobalt Institute, 2023, www.cobaltinstitute.org/wp-content/uploads/2023/02/cobalt_institute_fact_sheet_2023.pdf.
4. Mo Ibrahim Foundation, *Minerals Resource Governance in Africa: Lessons Learned from 10 Years of Implementation of the African Mining Vision*, Mo Ibrahim Foundation, 2022, https://mo.ibrahim.foundation/sites/default/files/2022-11/minerals-resource-governance.pdf.
5. S&P Global, "Africa–Mining by the Mumbers, 2022," December 16, 2022, https://www.spglobal.com/market-intelligence/en/news-insights/research/africa-mining-by-the-numbers-2022.
6. The "downstreaming" agenda is the term that the Indonesian government assigned to its policy initiative to compel investments into minerals and metals processing to enable mobility up the value chain.

Background and context of Indonesia's mining sector

The Indonesian economy has grown strongly in recent decades, consolidating its position as a rising economic power in the global economy. Despite the challenges posed by the Asian financial crisis of 1997–1998, the Indonesian economy has shown remarkable resilience and recovery. The sharp economic contraction during this period was a significant setback, but subsequent reforms, major infrastructure investments, and prudent economic management have enabled Indonesia to rebound strongly. From 2000 to 2023, the country's real gross domestic product (GDP) has doubled, and GDP per capita has tripled, highlighting significant economic progress.[7] This robust economic expansion has been characterized by low output volatility and relatively stable inflation, reflecting the resilience of the country's economic structure. This growth has been fueled by a dynamic demographic profile and fast integration into global production networks as well as an ambitious infrastructure development agenda led by the authorities, including the construction of industrial facilities, transportation systems, and hydropower plants favored by foreign investments. This recovery has positioned Indonesia as a rising Asian economy. A key factor in this performance has been Indonesia's wealth of natural resources, which have been harnessed efficiently with a young and growing workforce.

Indonesia's economic structure has undergone significant transformation over the decades. Historically, the economy was largely dominated by the primary sector, reflecting both its economic developmental stage and the government's focus on agricultural self-sufficiency during the 1950s and 1960s. However, starting in the late 1960s, like many Asian countries, Indonesia began a gradual shift toward industrialization alongside progressive urbanization.

This process accelerated in the 1980s when the government began diversifying the economy away from oil exports and toward manufacturing. Between 1967 and 2010, the manufacturing sector's share of GDP increased by 19 percentage points, while agriculture's share decreased by 35 points (to 14 points in 2010). Indonesia's manufacturing industry primarily focused on food, tobacco, and textiles rather than more complex manufactured goods. Additionally, Indonesia boasts a more substantial resource sector compared to many Asian countries, with mining and utilities consistently contributing around 12 percent of GDP since the late 1980s. Since the Asian financial crisis, Indonesia has experienced steady growth with reduced economic volatility, even during the global financial downturn of 2008–2009. In the last fifteen years, the share of the mining and utilities sector has increased, contributing around 11 percent to GDP. Indonesia has increasingly focused its diversification strategy on developing downstream activities to create more value-added activity.

This economic shift went hand in hand with a demographic one. The country is the fourth most populous nation globally, with approximately 282 million people as of mid-2024, and is projected to reach 321 million by 2050.[8] This expanding population, which is relatively young, with a median age below age 29, underpins domestic demand and provides a growing workforce. The low dependency ratio and rising working-age population have been key drivers of GDP growth, a trend expected to continue for the next two decades. Educational attainment has also markedly improved, with primary school enrollment near 100 percent in 2023, up from 70 percent in 1975, and secondary school enrollment surpassing two-thirds, up from less than 20 percent in 1975 and 56 percent in 2010, in both rural and urban areas without major difference between sexes. Additionally, urbanization has increased significantly, with the urbanization rate rising from 50 percent to 57 percent between 2010 and 2020.[9]

Despite these significant strides, the wealth generated by the mining sector has not been evenly distributed across the archipelago or within these regions. Extreme poverty has decreased only marginally: from 11.4 percent of the population in 2013 to 9.4 percent in 2019 (and has been stable since then). Besides, the Gini index, which measures income inequalities, has not decreased significantly in the last decade despite the fast development of the mining sector (from 0.40 in 2014 to 0.38 in 2019, and then to 0.39 in 2023).

Overview of Indonesia's mining sector, its evolution, relevant policies and rules, and current state

Historically and as a result of its globally significant natural-resource deposits and reserves, Indonesia's extractive sectors, particularly oil, gas, and mining, have been significant drivers of economic growth. In the Indonesian state's modern history, foreign investors have played foundational roles in developing Indonesia's natural-resource assets, including through hydrocarbon-production projects offshore Sumatra, since the 1950s and in the formation of a modern mining sector through the exploitation of copper and gold assets in Papua beginning in the 1970s.

7. World Economic Outlook, April 2024 database, International Monetary Fund (IMF).
8. United Nations Department of Economic and Social Affairs, *World Population Prospects* 2024, 2024.
9. BPS-Statistics Indonesia.

The swell of global nationalism surrounding oil and gas resources that accompanied the promulgation of new sovereign states in the post-World War II era also manifested in Indonesia's extractives industry. Following decades of dominance by foreign operators, Indonesia overhauled its regulatory regime whereby new concessions would only be granted in a manner that provides for the maximum benefit income to the state, contributing to the general welfare of its population. Indonesia became the first oil- and gas-producing state to introduce the production-sharing contract in 1966 as its postindependence period of instability transitioned to consolidated rule under General Suharto.[10]

In similar fashion, the Indonesian state assumed ownership of its natural resources and began to assert its institutional role in the mining sector with the establishment of a contracting structure to transact with foreign miners for state leasing of resource concessions. International Nickel Indonesia (INCO) became the first nickel concession owner in 1968, initiating operations across three provinces in Sulawesi: South Sulawesi, Central Sulawesi, and Southeast Sulawesi. In 1978, INCO converted to PT Vale Indonesia and subsequently grew to become the most productive nickel mining company in Indonesia through 2013. Alongside the institution of a new regulatory regime after independence, the Indonesian government consolidated several of the existing state-owned mining companies into a new state-owned enterprise (SOE) Aneka Tambang (ANTAM). As an SOE, ANTAM benefited from low-interest credit from state-owned banks and had extensive access to mining concessions, becoming the largest holder of such concessions in Indonesia prior to 2013.

The year 2013 marked a turning point for Indonesia's mining sector, driven by increased Chinese interest in mineral assets such as nickel and bauxite. Two major companies, Tsingshan, which focuses on nickel, and China Hongqiao, which focuses on bauxite, became front-runners in acquiring mining concessions and partnering with local conglomerates and state-owned enterprises. The shifts in the mining sector from 2013–14 grew both out of a significant change in direction in the domestic policymaking agenda (e.g., aggressive pursuit of a downstreaming agenda) as well as from exogenous market and technology dynamics.

In the institution of the downstreaming agenda, the Indonesian government sought to avoid the risk that investor anxieties over increasing resource nationalism would ward off the very investment the government sought to stimulate in processing and refining capacity. To counteract this dynamic, the government devised significant fiscal and nonfiscal incentives. The fiscal incentives offered by the Indonesian government include tax holidays, reduced import duties on capital goods and raw materials, and exemptions from value-added tax for certain sectors to help lower the capital and operational expenditures for mineral processors.

The corporate income tax holiday grants full exemption from payment for a period of five to twenty years depending on the amount and type of investment made by qualifying corporations, which is intended to help defray the very high initial capital costs for mineral-processing projects.[11] In addition to tax holidays, the government has introduced import duty exemptions on capital goods and raw materials. This policy enables companies to import machinery, equipment, and essential raw materials needed for the construction and expansion of processing facilities without incurring the usual import duties. By lowering the cost of setting up and upgrading facilities, this incentive directly reduces capital expenditure, making it more financially viable for companies to establish and expand their operations in Indonesia.[12] To further incentivize investment, Indonesia has also implemented an investment allowance scheme. This allows companies to deduct a significant portion of their investment costs from their taxable income, thereby reducing the overall tax liability. This deduction is particularly beneficial for companies making large capital investments in new or expanded facilities, as it enables them to recover some of their upfront costs more quickly.[13] Finally, the government has introduced accelerated depreciation and amortization for assets in the mineral processing and refining sectors. Under this policy, companies can depreciate the value of their capital assets more rapidly, allowing for quicker recovery of investment costs. This policy is particularly advantageous in capital-intensive industries like mineral processing, where equipment and facilities represent a significant portion of total investment.

Nonfiscal incentives include simplifying the bureaucratic process, enhancing infrastructure development, and providing support for land acquisition. The government has streamlined procedures for obtaining permits and licenses, making it easier for companies to establish and expand their operations.

One crucial component of these incentives is the industrial park policy. The Indonesian government recognized that bureaucratic and administrative processes are a significant concern for investors, and reforming the system would take time that investors cannot afford to wait. To address this, the government expanded the development of industrial parks as a key strategy to foster industrial development and attract investment in the mineral-processing sector. These industrial parks, strategically located near resource-rich areas, are designed to provide companies with the necessary infrastructure, utilities, and administrative support to streamline their operations and reduce costs.

Recognizing that bureaucratic processing and procedures have historically been significant barriers to investment, the government implemented a one-stop service system within these parks. This system consolidates all the necessary administrative procedures into a single point of contact, drastically reducing the time and complexity involved in obtaining the required permits and licenses.[14] In addition, Indonesia constructed the parks to provide shared infrastructure such as power plants, water-treatment facilities, transportation networks, and ports. This shared infrastructure is particularly important for heavy industries, like mineral processing, which require reliable and cost-effective access to utilities and transportation.[15] The government also provides subsidies on land acquisition and utility costs within these industrial parks, lowering the operational expenditures for its corporate tenants.[16]

10. Kirsten Bidemann, *Production Sharing Agreements: An Economic Analysis*, Oxford Institute for Energy Studies, October 1999.
11. PwC Indonesia, *Mining in Indonesia: Investment and Taxation Guide*, Twelfth Edition, September 2022, 100-101, https://www.pwc.com/id/en/energy-utilities-mining/assets/mining/mining-guide-2022.pdf.
12. Deloitte, *Indonesia Taxation and Investment*, 2023.
13. Investment Coordinating Board of Indonesia (BKPM), *Indonesia Investment Guidebook*, 2022, 126-131, https://bkpm.go.id/storage/file/pdf/1683512273.pdf.
14. BKPM, *Indonesia Investment Guidebook*, 28-30.
15. Policies to Support the Development of Indonesia's Manufacturing Sector 2020-2024, Asian Development Bank (ADB) and the Indonesian Ministry of National Development Planning (BAPPENAS), 2019, 101-104, https://www.adb.org/publications/policies-manufacturing-sector-indonesia-2020-2024.
16. "Investing in Indonesia–2023: Industrial Incentives and Zones," OOSGA, https://oosga.com/briefings/idn-incentives/.

Policy foundations and key insights on the downstreaming agenda

Indonesia's downstreaming strategy in the mining sector has been heavily shaped by a complex interplay of political and economic factors, including global commodity trends and the country's specific resource endowments. Fluctuations in global commodity prices and demand have influenced Indonesia's strategy. For instance, the surge in global demand for nickel, driven by the growing electric vehicle (EV) market, reinforced the government's focus on expanding nickel-processing capabilities. Conversely, the downturn in bauxite prices following the export ban highlighted the risks of relying too heavily on commodity-specific strategies without adequately addressing market conditions.

Specific policies have played a key role in the development of the mining sector. Indeed, the Indonesian government has implemented a series of legislative and policy measures to foster a more favorable investment climate and enhance its mining sector, aiming at downstreaming the mining value chain. In 2010, to increase local ownership and control within the mining sector, the Indonesian Ministry of Energy and Mineral Resources mandated that foreign companies divest a 20 percent stake in their local mining firms to Indonesian shareholders after five years of operation. This divestment requirement was strengthened in 2012 when foreign companies were obligated to sell 51 percent of their shares after ten years of exploitation.

In 2014, Indonesia aimed to ban the export of unprocessed nickel and bauxite ores, along with concentrates of other minerals, enforcing a requirement from the 2009 Mining Law that companies must process their ore locally before export. However, under pressure from mining companies, the government partially eased this ban. From 2014 to 2017, companies were permitted to export certain mineral concentrates (including nickel, copper, lead, and iron) if they paid an export tax that escalated from 20 percent to 60 percent and met other requirements, such as building smelters in Indonesia. Indonesia temporarily eased the nickel export ban in 2017, intending for the full ban to be reinstated in January 2022.

Government Regulation 1/2017 introduced further requirements for the mining industry. It required companies with existing contracts to convert to special mining business licenses and mandated the construction of domestic smelters by January 2022 in order to be able to export mineral concentrates. In August 2019, Indonesia announced that it would reinstate the full export ban on nickel ore and concentrates effective January 1, 2020, earlier than the initially planned January 2022 date. Following the nickel ore export ban in 2020, the government extended the ban to bauxite in mid-2023. Plans to extend the ban to other strategic minerals, such as copper and potentially tin, are expected, with a copper export ban anticipated in January 2025.[17] In 2020, the Indonesian government passed the Omnibus Law on Job Creation, a major step in the country's economic transformation as it revised more than seventy existing laws. This law aimed to streamline bureaucracy, make labor laws more attractive to corporations, reformulate minimum wage calculations, and simplify licensing requirements, thereby increasing the ease of starting a business and attracting more investment.[18]

Alongside that law, the government enacted the 2020 Indonesia Mining Law (Law No. 3 of 2020), amending the previous Mineral and Coal Mining Law No. 4 of 2009. This new law introduced significant changes to improve the management and regulation of Indonesia's mining sector. It centralized the control over the issuance and management of mining permits under the central government, aiming to reduce bureaucratic delays and mitigate concerns about corruption at the subnational level. Additionally, upon approval from the Ministry of Energy and Mineral Resources, the law allowed the transfer and merger of mining business permits to facilitate investment transactions.[19]

Finally, with the institution of Government Regulation 11/2020, Indonesia instituted a price floor for domestic mineral ore transactions. With the regulation, the government intended for the smaller, domestically based miners that have capital or other constraints preventing them from investing in smelting facilities to be able to command a profitable price from smelters owned by other firms despite limited offtake options and market power. To balance the distribution of benefits, however, the government established a blended pricing formula that would remain slightly below prevailing international prices to bolster the competitiveness of Indonesia's refined products.[20]

17. Anna Perry, Samantha Schreiber, and David Guberman, *Export Restrictions on Minerals and Metals: Indonesia's Export Ban of Nickel*, Office of Industry and Competitiveness Analysis, US International Trade Commission, February 2024, https://www.usitc.gov/publications/332/working_papers/export_restrictions_on_minerals_and_metals_perry_schreigber_guberman.pdf.
18. Mita N. Djajadiredja, Daniel Pardede, and Abimata Putra, "The House of Representatives Approves Omnibus Law," Baker McKenzie, October 9, 2020, https://www.lexology.com/library/detail.aspx?g=325667ec-4f80-4cba-af93-a540842edaa1.
19. Kresna Panggabean and Jeremiah Purba, "Indonesia Amends the Mining Law," Norton Rose Fulbright, June 2020, https://www.nortonrosefulbright.com/en/knowledge/publications/b545e479/indonesia-amends-the-mining-law.
20. "New Regulation on Mineral Ore Benchmark Price Issued," Ministry of Energy and Mineral Resources, Republic of Indonesia, July 20, 2020, https://www.esdm.go.id/en/media-center/news-archives/-new-regulation-on-mineral-ore-benchmark-price-issued.

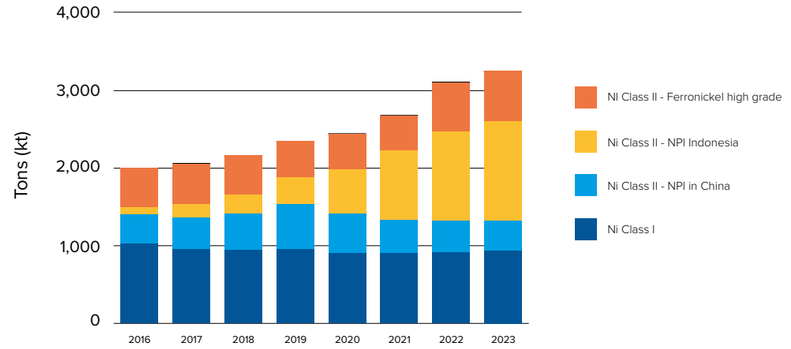
Exogenous multipliers drive growth in nickel

The Indonesian government astutely harnessed the commodity consumption boom that accompanied the extraordinary growth of China's economy—following the global financial crisis and the accelerating energy-transition trend to electrify passenger vehicles—with the timing of its imposition of a raw material export ban. Combined, however, these readily observable dynamics likely were insufficient to ensure the success of the export ban in growing investment and moving up the value chain in the industry.

Besides, this evolution in sentiment by Chinese industry is evidenced in the divergent outcomes from the 2014 and 2020 raw material export bans. In 2014, across all three primary affected minerals—bauxite, copper, and nickel—Indonesian production and exports dropped precipitously as Chinese firms leveraged stockpiles that swelled in anticipation of the ban and increased their reliance on alternative suppliers (see figures 4 and 5 on production impact). In 2020, several novel technology developments coincided with the broader economic and climate-rooted motives to drive expansion in foreign investment via the downstreaming policy. These developments involved Chinese nickel miners and conglomerates, leading them to not only comply with Indonesian government's policy but also expand investment and capacity in the post-2020 period.

The first of these technology shifts was the transition made by Chinese steel producers to cost effectively convert lower-grade nickel laterite resources, the type indigenous to Indonesia, into nickel pig iron (NPI) as the primary feedstock for stainless steel. Though these production methods had been known for the better part of a century, the prevailing high prices of class I nickel resources (see figure 3, i.e., London Metal Exchange prices), coupled with the introduction of electric arc furnaces in Chinese steel mills, realized cost reductions that enabled the NPI-based process to commercialize.[21] Due to the lower concentration of nickel in laterite versus sulfide deposits, larger volumes of NPI are required to produce the same amount of steel compared to alternative production processes. As a result, Chinese stainless steel producer demand for nickel pig iron derived from laterite sources began to grow and increase market share relative to other stainless steel feedstock (see figure 1). With a novel production process taking hold, there were fewer incumbent and depreciation-related pressures for Chinese nickel producers to aggressively oppose the Indonesian export ban, similar to the legal challenges and negotiation tracks pursued by various Western copper producers with longer production tenures in Indonesia. Alternative resources did exist for Chinese stainless steel producers, namely in the Philippines and New Caledonia, but policy barriers[22] in the former and operational challenges in the latter led to a concentrated period of growth in nickel pig iron processing capacity following the imposition of the export ban.

Figure 1: Growth of nickel pig iron (NPI) production and market share



Source: Eramet half-year results presentations, 2018-2024, https://www.eramet.com/en/media/publications-and-documents/.

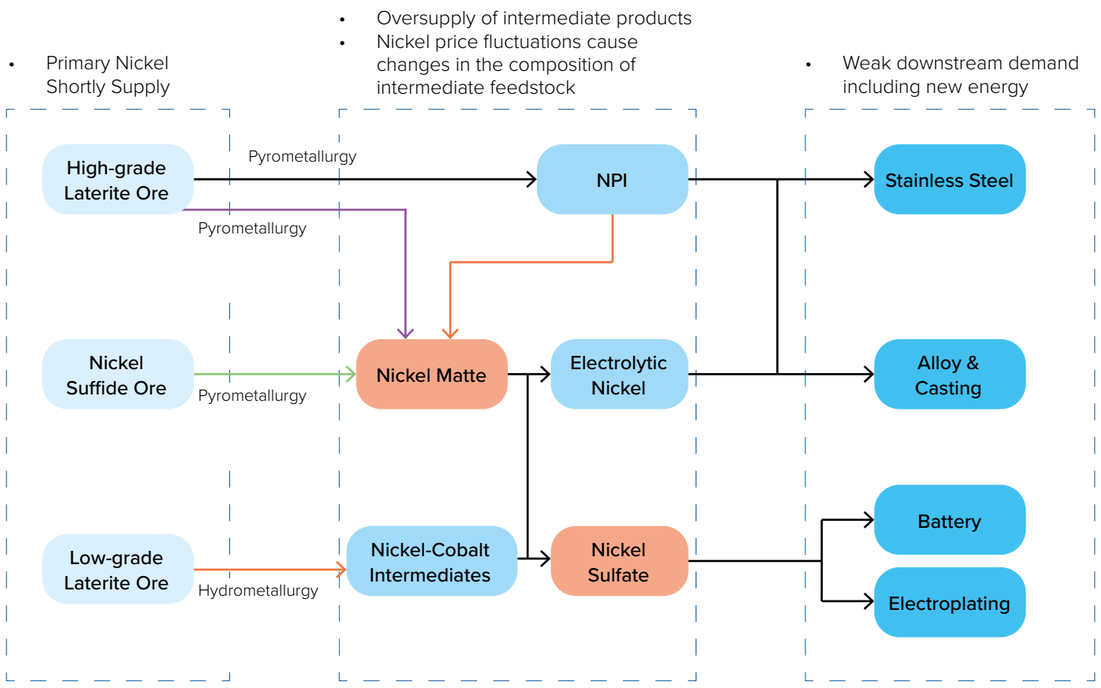
21. Halil Yildirim, Ahmet Turan, and Onuralp Yucel, "Nickel Pig Iron (NPI) Production from Domestic Lateritic Nickel Ores Using Induction Furnace, " International Iron & Steel Symposium in Turkey, 2012.
22. Under President Rodrigo Duterte, the Philippines instituted a ban on open pit mining in 2017.

Stainless steel production continues to be the primary source of nickel demand, representing 65 percent of demand as of 2023 (as compared to battery demand, which represented 17 percent of demand the same year).[23]

Second, battery chemistries have evolved as consumer demand for EVs has grown over the past decade. It has bent toward cathodes with higher nickel concentrations due to superior performance characteristics[24] and geopolitical concerns surrounding the ability to grow cobalt production to meet projected demand. The emergence of nickel-dominant cathodes into mass lithium-ion battery production coincided with a global depletion of higher grade, or sulfide, nickel deposits that represented around 60 percent of global production in 2010.

To meet the forthcoming and rapid demand growth projected for batteries, the industry turned to the lower grade laterite deposits such as those found in Indonesia, but confronted a challenge in converting these resources into the very high purity concentrations required for battery technology (see figure 2). A significant contributor to the unlocking of the value of these deposits and driver of the willingness of Chinese nickel producers to invest heavily in the downstream was a processing breakthrough enabling the conversion of nickel pig iron into nickel matte (higher concentration of roughly 75 percent nickel-refined product) pioneered by a Chinese industrial conglomerate, Tsingshan. Historically, nickel matte production required sulfide as the feedstock, but Tsingshan's innovation added a converter stage to its flow sheet that allows laterite-derived NPI to be further refined into matte.[25]

Figure 2: Nickel supply chain infographic



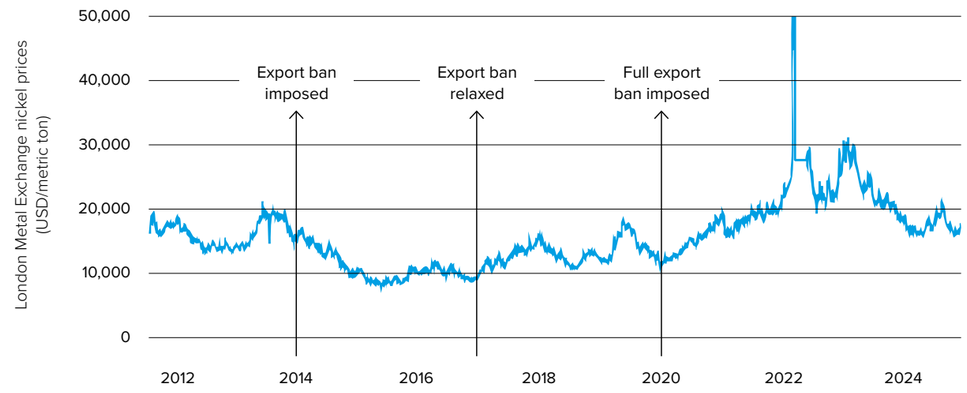
Source: Shanghai Metals Exchange

23. 2024 half-year results presentation, Eramet, July 26, 2024, https://www.eramet.com/en/news/2024/10/eramet-presentation-_-regaining-full-ownership-in-our-flagship-lithium-business-in-argentina-en-anglais-uniquement/.
24. Xiaqiao Zeng et al., "Stabilization of a High-capacity and High-power Nickel-based Cathode for Li-ion Batteries," *Chem* 4, no. 4 (2018): 690–704, https://doi.org/10.1016/j.chempr.2017.12.027. "The Ni-based cathode family. . . [is] able to achieve improved rate capability, cycle performance, and safety characteristics with advanced designs."
25. "Does Matte Matter? Is Nickel Pig Iron the Answer to EV Battery Demand?" Sherritt International Corp., 2021, https://s2.q4cdn.com/343762060/files/doc_downloads/2021/Does-Matte-Matter-Sept-2021.pdf.

This technique added to the energy and capital intensity of nickel processing projects given the additional step and requirement for industrial heat inputs. With Indonesia's abundant coal production and reserves centered in East and South Kalimantan, the adjacent provinces to the emerging nickel-industry industrial parks in Sulawesi, the country possessed unique attributes valued by Chinese nickel producers in spite of the raw material export ban. Furthermore, Tsingshan's processing evolution endowed the firm with greater market pricing power by opening arbitrage capability across class I and II nickel markets to take advantage of class I premiums and revert to class II production when market imbalances and associated price responses emerge.[26]

The combined effects of these technological and market developments have yielded significant success in growing investment into the nickel-related sector. In all, over the last decade, Chinese investment has facilitated the construction of numerous nickel processing plants across Indonesia, accounting for more than 90 percent of Indonesia's nickel smelters. A key aspect of this partnership is the "Two Countries, Twin Parks" initiative,[27] which was further solidified through the latest investment pledge of USD 44.9 billion, made in July 2023. This initiative, part of China's Belt and Road Initiative (BRI), aims to enhance infrastructure and industrial capabilities in Indonesia, including in the critical mining sector. In 2023, Southeast Asia received around 50 percent of China's regional investments (USD 7.3 billion), a significant increase from the previous year. Today, Chinese groups control a significant portion of Indonesia's nickel mines, processing facilities, and supply agreements. This control has been instrumental in dramatically increasing Indonesia's nickel production, which has surged fourfold over the past decade. The influx of nickel into the global market, driven by Indonesia's expanded production capacity, has caused a significant drop in nickel prices, plummeting more than 40 percent in the past year.[28] This price decline has had a severe impact on production outside Indonesia, with some nickel mines in regions like Western Australia being forced to close. Consequently, Indonesia's dominance in the nickel market has increased.

Figure 3: Nickel price and export ban



Source: Bloomberg data, as of July 23, 2024

26. Tsingshan surprised markets in March 2021 when it unexpectedly announced contracts for the supply of 100,000 metric tons of NPI-derived nickel matte. A year later Tsingshan again drew headlines with its famed nickel short squeeze induced by Russia's invasion of Ukraine, an unexpected disruption to its newfound ability to arbitrage class I and II markets. This arbitrage capability has been threatened by an emerging imbalance in NPI feedstock production, which the Indonesian government has sought to address by placing limitations on the issuance of new permits for class II nickel/NPI processing facilities.
27. Trissia Wijaya, "China-Indonesia Economic Cooperation Cannot Continue to Overlook Human Security," *Indonesia at Melbourne* blog, University of Melbourne, April 16, 2024, https://indonesiaatmelbourne.unimelb.edu.au/china-indonesia-economic-cooperation-cannot-continue-to-overlook-human-security/.
28. Part of the impact on global markets could be due to potential illegal shipments. In July 2023, Indonesian authorities began investigating potential illegal shipments of nickel ore to China. While official exports ceased at the beginning of 2020, Chinese customs data indicated that the country continued to import nickel ore from Indonesia—amounting to 5.5 million metric tons between 2020 and May 2023. This figure significantly exceeds the corresponding nickel ore exports reported by Indonesian statistics during the same period. Some analysts and traders have speculated that the ore was classified as iron ore instead of nickel ore (which generally contains some iron) when exported from Indonesia and then reclassified upon arrival in China, according to the ***Financial Times***.

Assessing the impact on other energy transition minerals

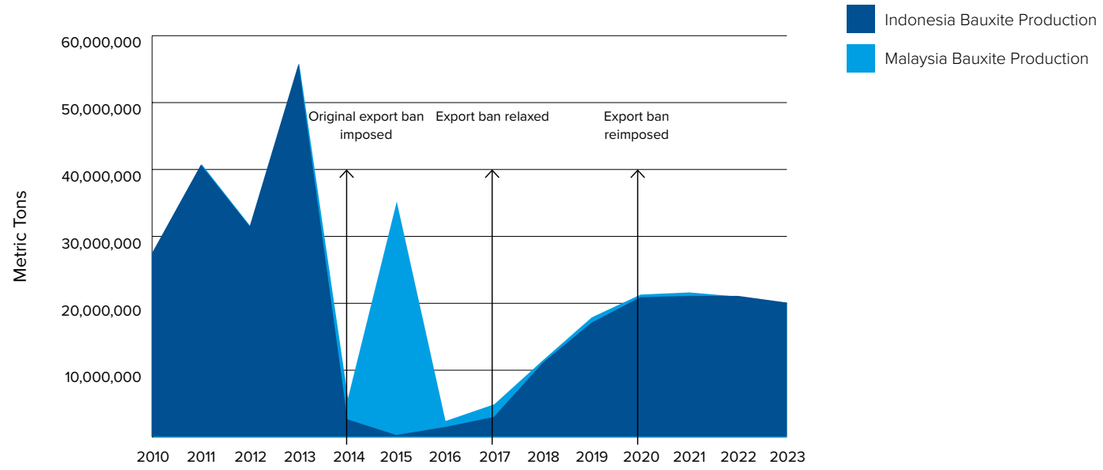
This success of the nickel sector stands in significant contrast to the copper industry. Copper demand is forecast to grow significantly over the next fifteen years, with the International Energy Agency (IEA) projecting over 40 percent growth between 2023 and 2040—95 percent of which will be driven by clean technology manufacturing and deployment. Despite this projected demand growth, the same dynamics surrounding technology development and enabling conditions unique to Indonesia that existed for the nickel industry did not exist for copper.[29] In fact, a US Agency for International Development (USAID) study commissioned in April 2013 in advance of the 2014 export ban found that 96 percent of copper market value is created in the mining and concentration stages of the supply chain. To achieve an acceptable rate of return on capital-intensive, copper-processing-complex investments, operators require revenue generation from the sale of processing by-products in the domestic market to realize positive margins.[30] The lack of constituent demand and infrastructure for such by-products in Indonesia and the challenging project economics led to vigorous challenges mounted by multinational mining firms in the copper industry in response to the 2014 export ban. The immediate effect of the ban on Indonesian copper production in 2014 was a 35 percent decline in output. Between 2014 and 2020, incumbent foreign copper miners executed substantial divestments of their locally incorporated entities to local industry players, SOEs, and the Indonesian government, which was followed by the initiation of plans to construct smelting facilities for the assets in question.[31]

Besides, while the export ban on nickel brought notable advantages, its impact on bauxite exports was highly detrimental. In 2013, Indonesia was a leading global player in bauxite production, having surpassed China to become the world's second-largest producer with 55.7 million metric tons. Bauxite, essential for producing aluminum and various industrial goods, was a significant export commodity for Indonesia. However, the ban's impending implementation created considerable uncertainty regarding Indonesia's bauxite reserves. This uncertainty deterred foreign investment in bauxite refining facilities, as potential investors questioned whether Indonesia could maintain its competitive edge and provide high-quality bauxite in the long term. As the ban came into effect in 2014, Chinese operators began stockpiling bauxite and seeking alternative sources (namely from Malaysia, as shown in figure 4), leading to a sharp decline in production. Bauxite output plummeted by 95 percent, falling to just 2.6 million metric tons. This drastic reduction in production led to a dramatic drop in export revenue, which plummeted from USD 1.3 billion in 2013 to a mere USD 46 million in 2014.[32]

Indonesia's policies to bolster its downstream mining sector have had a significant impact on both the economy and the environment, driven primarily by the 2020 export ban on raw nickel ore and extensive infrastructure investments.

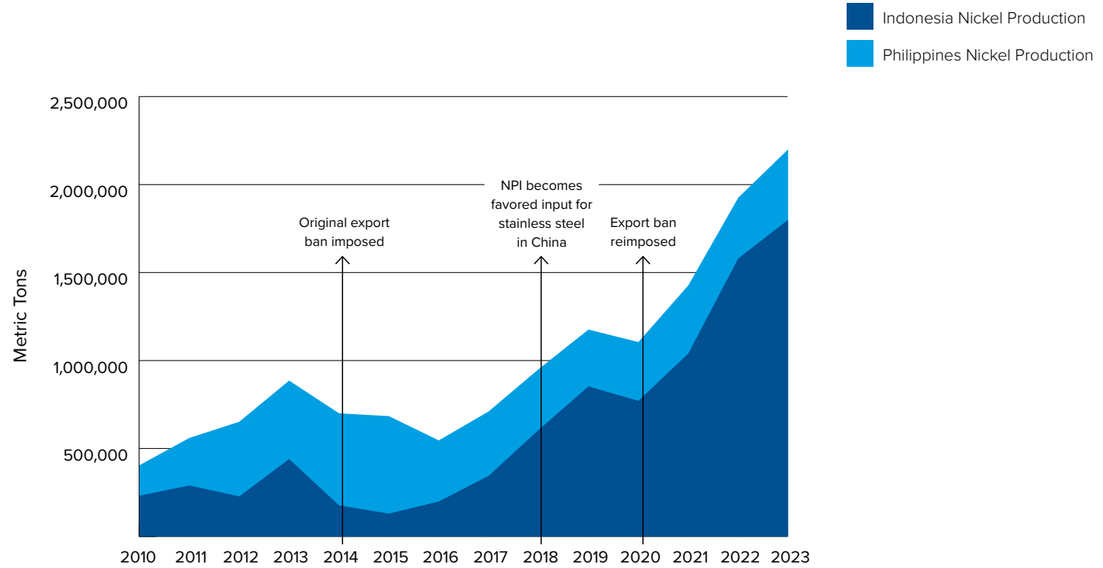
29. *Global Critical Minerals Outlook 2024*, International Energy Agency, May 2024.
30. *Economic Effects of Indonesia's Mineral-Processing Requirements for Export*, USAID publication produced by Nathan Associates Inc., April 2013.
31. PT Freeport divested 51.2 percent to PT Mineral Industri Indonesia, a wholly owned state enterprise, and agreed to construct a smelter for the Grasberg mine, which began operation in July 2024. Newmont and Sumitomo had divested entirely from PT Newmont, leading to PT Amman Minerali Industri's absorption of its Batu Hijau mine, and anticipates inaugurating operations of an associated smelter in Q4 2024. See related company press releases.
32. "Resource Nationalism in Indonesia–Effects of the 2014 Mineral Export Ban," USGS, September 2016.

Figure 4: Bauxite production and the timing of Indonesia's export bans



Source: US Geologic Survey (USGS), "Bauxite and Alumina Statistics and Information," Bauxite and Alumina Commodity Summaries, 2010–2023, https://www.usgs.gov/centers/national-minerals-information-center/bauxite-and-alumina-statistics-and-information.

Figure 5: Nickel production and the timing of Indonesian export bans



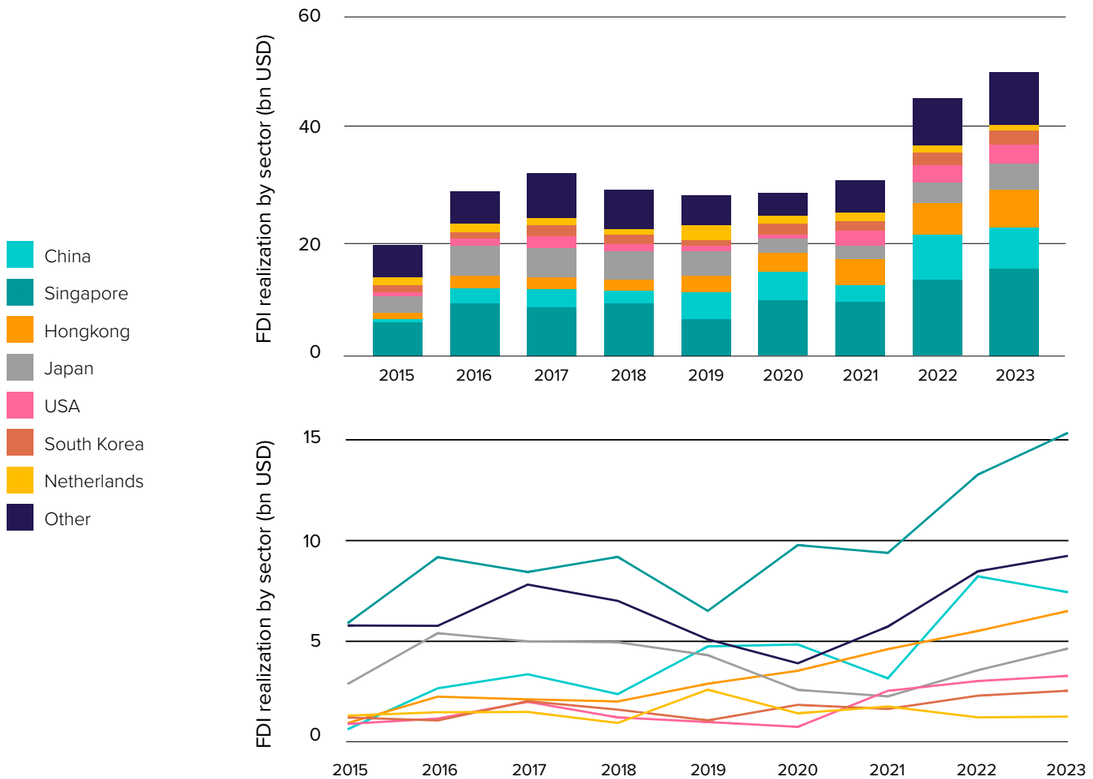
Source: USGS, "Nickel Statistics and Information," Nickel Commodity Summaries, 2010–2023, https://www.usgs.gov/centers/national-minerals-information-center/nickel-statistics-and-information.

Positive macroeconomic impacts and room to improve inclusivity

The expansion of smelting and refining facilities has increased the value-added component of the mining sector and bolstered the country's export capabilities in higher-value nickel products. As discussed above, the 2020 export ban on nickel ore effectively resulted in a dramatic increase in foreign direct investment (FDI) focused on nickel smelting and refining. From 2019 to 2022, investment in Indonesia's mineral-processing sector surged from USD 3.6 billion to USD 11 billion. This influx of capital, predominantly from Chinese investors, spurred the rapid expansion of nickel-smelting infrastructure. By July 2023, Indonesia boasted forty-three operational nickel smelters, with twenty-eight more under construction and an additional twenty-four in the planning stages. This surge in investment and infrastructure development has solidified Indonesia's position as a global leader in nickel production and processing.

However, despite significant investments in the mining sector, the impact on employment seems modest. The share of secondary-sector jobs as a percentage of overall employment only increased marginally from 13.5 percent in 2015 to 14.2 percent in 2022.[33] In contrast, the value added in the secondary sector as a share of GDP exhibited a more pronounced shift: After remaining broadly stable from 21.5 percent in 2015 to 20.5 percent in 2022, it surged to 30.4 percent in 2023—suggesting that the increase in value added by the manufacturing sector has not proportionally translated into employment growth within the sector.[34]

Figure 6: FDI inflows in Indonesia (billion USD)



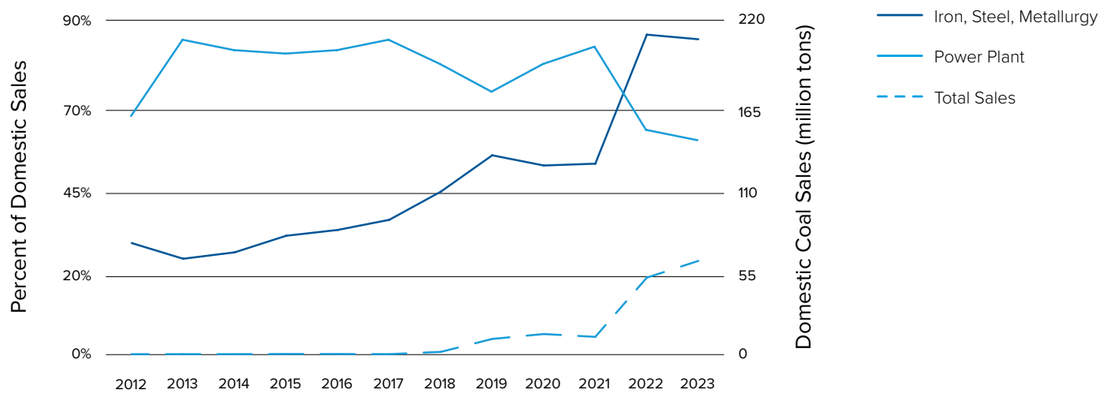
Source: BPS-Statistics Indonesia.

33. BPS Statistics Indonesia.
34. BPS Statistics Indonesia.

In addition, the impacts of this fast development at an environmental level are a source of concern. Indeed, the expansion of nickel mining and processing has been heavily reliant on coal-powered energy, leading to higher carbon emissions than other global producers. Although 70 percent of Indonesia's coal was exported in 2023, domestic sales have been growing rapidly over the past two years with volumes up by 54 percent compared to 2019, according to Indonesian government data. The growth in domestic consumption over the past two years has been almost entirely driven by metallurgical processing (see figure 7). In this context, reducing Indonesia's emissions will be a substantial challenge: It is likely to impact negatively on margins of Indonesian nickel producers, and the uptick of coal consumption for industrial, hard-to-abate processes have fewer commercially available alternatives than for coal usage in the power sector. The efficiency gains of the adjacency of Indonesia's coal production to its industrial parks housing nickel smelters, combined with the number of Indonesian upstream players that are active in both the nickel and coal industries (including firms such as Adaro, Bayan, and Harita), will add to the challenges of displacing coal as the preferred and most economical fuel driving the nickel sector's expansion.

The swift increase in mining activities has led to environmental degradation, including deforestation and biodiversity loss. A recent study by Mighty Earth and Brown Brothers Energy and Environment revealed that a minimum of 76,301 hectares of tropical forests have been cleared within 329 nickel concessions in Indonesia,[35] a cleared area equivalent to the size of New York City. Approximately 30 percent of this deforestation has occurred since 2019, coinciding with the enforcement of nickel ore export restrictions and the increasing global demand for nickel used in lithium-ion batteries for EVs.[36] The use of coal in the production process of critical minerals has also contributed to air pollution and health problems.[37]

Figure 7: Indonesian domestic coal sales by industry



Source: *Handbook of Energy & Economic Statistics of Indonesia 2023*, Ministry of Energy and Mineral Resources, https://esdm.go.id/assets/media/content/content-handbook-of-energy-and-economic-statistics-of-indonesia-2023.pdf.

35. "From Forests to Electric Vehicles: Quantifying and Addressing the Environmental Toll of Indonesian Nickel," Mighty Earth and Brown Brothers Energy and Environment, last updated May 1, 2024, https://mightyearth.org/wp-content/uploads/2024/05/FromForeststoEVs.pdf.
36. Mercedes Ruehl and Harry Dempsey, "Nickel Miners Linked to Devastation of Indonesian Forests," *Financial Times*, October 7, 2023.
37. "An Energy Sector Roadmap to Net Zero Emissions in Indonesia," International Energy Agency, September, 2022.

Even before the October 2024 inauguration of President Prabowo, the new administration signaled its intent to further diversify the application of the export ban to include other critical minerals like rare earth elements as a means of tempering the Indonesian economy's exposure to volatility associated with any single commodity market and enhancing the prospects for long-term sustainable growth. These factors signal both a recognition of external expressions of concern surrounding the environmental sustainability of Indonesia's downstreaming agenda and a commitment to rehabilitate this image, particularly by addressing the significant reliance on coal and enforcing stricter environmental regulations to mitigate the ecological impact of mining activities.[38]

Effects on international relations and Indonesia's integration into global value chains

Finally, Indonesia's mining value chain policy has been questioned by stakeholders in the international community, affecting its stance on the international stage and its downstreaming strategy, which requires international partners.

In 2019, the EU filed a complaint with the World Trade Organization (WTO) regarding Indonesia's export ban and related domestic processing requirements. After attempts to reach a consensual agreement, the EU initiated a consultation in July 2023 to consider the possible use of its enforcement regulation. Depending on the outcomes of this consultation, the EU may propose countermeasures against Indonesia in the future, which could include import duties or quantitative trade restrictions. The dispute exacerbates challenges in the negotiations—underway since 2016—for a free trade agreement (FTA).

Similarly, the United States also expressed concerns about the impact of Indonesia's export ban on global nickel supply and prices, as well as Indonesia's increased volume of downstream stainless-steel products. On December 11, 2019, the United States joined the EU-initiated consultations concerning the consistency of Indonesia's export ban with Indonesia's WTO obligations. The impact of the ban is particularly significant as it could impede Indonesia's ability to benefit from the US Inflation Reduction Act (IRA), signature legislation of the Biden administration, which includes a consumer tax credit program for EV purchases, but with stringent eligibility requirements related to the sourcing of battery components and critical raw materials. For an EV to qualify for the tax credit, 50 percent of its battery components must be sourced from North America, and 40 percent of critical raw materials must come from either the United States or countries with which it has an FTA—with those percentages increasing 10 percent per year through the end of the credit's lifespan. Given these criteria, Indonesia's ability to diversify its nickel trading partners likely depends to a large extent on executing a critical materials FTA with the United States.

Moreover, other elements of US IRA regulations are likely to further complicate Indonesia's position. The US government targets entities deemed foreign entities of concern (FEOC), including companies from nations such as China, Russia, Iran, and North Korea. If any battery components or critical minerals in EVs are manufactured or processed by FEOCs, the vehicles will not be eligible for the IRA tax credits. This poses an additional challenge, as many Chinese companies have substantial investments in Indonesia's nickel sector. The uncertainty around whether these companies or their joint ventures would be classified as FEOCs could adversely impact Indonesia's efforts to integrate its nickel industry into the global EV supply chain.

38. Somini Sengupta, "Indonesia's Vote: Three Takeaways for Climate Change," *New York Times*, February 14, 2024, https://www.nytimes.com/2024/02/14/climate/indonesia-election-climate-coal-nickel.html; and Anita Nugraha and Eric Yep, "Risk of Energy Policy Disruptions in Indonesia Low amid Presidential Elections," S&P Global, February 9, 2024, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/lng/020924-risk-of-energy-policy-disruptions-in-indonesia-low-amid-presidential-elections.

Africa's positioning in the race for critical raw materials

The global market for critical minerals is set to grow significantly. Countries with near monopolies on key resources such as Indonesia, with its nickel reserves, stand to benefit greatly. Consequently, the new paradigm of securing global supply chains for critical materials could also present opportunities for other countries, particularly in sub-Saharan Africa. According to the IMF, sub-Saharan Africa, which holds 30 percent of the world's proven reserves of critical minerals, is on the brink of transformative economic change. The extraction of certain minerals could potentially increase the region's GDP by 12 percent or more by 2050.[39]

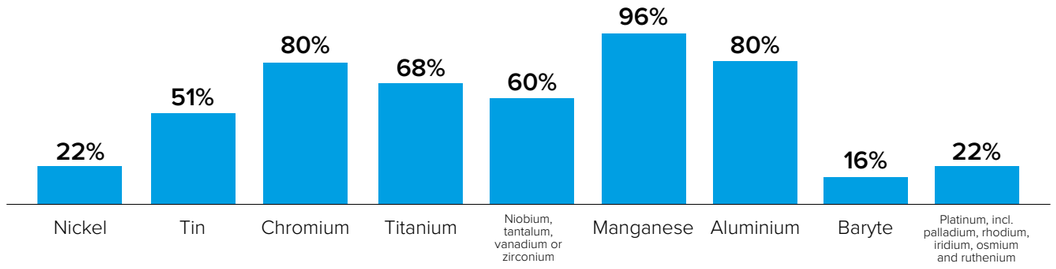
Global demand for essential minerals like copper, nickel, cobalt, and lithium is expected to generate revenues of USD 16 trillion over the next twenty-five years, with sub-Saharan Africa potentially capturing nearly USD 2 trillion of this total. However, the region must move beyond the low-value-added stages of raw extraction to fully capitalize on this opportunity. By developing local processing industries, these countries could significantly boost their profits, tax revenues, and job creation, while also fostering technological advancements.

Africa is strategically positioned to play a major role in the global supply chain, as the continent holds a substantial share of the reserves and production of several key minerals. Notably, it possesses nearly half of the world's cobalt and manganese reserves, which are crucial components for EV batteries. Furthermore, Africa is home to more than 80 percent of the world's phosphate reserves, primarily located in the Maghreb, and also holds 92% of global reserves of platinum group metals, located primarily in southern Africa. The continent also contains other essential metals and minerals for the transition to a carbon-neutral economy, such as lithium, nickel, and rare earth metals.[40]

In terms of production, some countries stand out. For instance, the Democratic Republic of Congo (DRC) alone accounts for approximately 70 percent of global cobalt production, making it a central player in the supply of materials for lithium-ion batteries used in electronic devices and EVs. Similarly, Gabon accounts for 47 percent of global manganese production— a mineral essential for battery production and wind turbine steel alloying— while South Africa contributes 42 percent. Copper, another critical metal for the energy transition, is still insufficiently produced in Africa, but the DRC and Zambia hold significant reserves at 8 percent and 2.1 percent, respectively; however, their production levels currently represents only 11.5 percent and 3.5 percent of global exports.[41] These two countries also produce significant quantities of tin, tungsten, and zinc, positioning them as potential hubs for refining and processing metal products. Moreover, South Africa is the world's leading exporter of titanium, accounting for 24 percent of global exports, followed by Mozambique (15 percent), and Sierra Leone (8 percent). The same is true for platinum group metals, where South Africa is the leading exporter, representing 21 percent of global exports.

Notably, sub-Saharan Africa attracted only 13 percent of global foreign direct investment in the metals and minerals sector between 2016 and 2022, with 73 percent directed toward extraction and only 26 percent toward manufacturing and processing.[42] To fully realize their potential, African governments and businesses need to focus more on local mineral processing and refining, which would allow these nations to diversify their economies and reduce their dependence on volatile commodity markets.

Figure 8: Africa's export shares for key CRM



Source: USGS Mineral Commodity Summaries 2024; and IMF (2024) "Digging for opportunity: Harnessing Sub-Saharan Africa's Wealth in Critical Minerals."

39. IMF, *Regional Economic Outlook on Sub-Saharan Africa,* April 2024.
40. USGS Commodity Statistics and Information database.
41. USGS Commodity Statistics and Information database.
42. Wenjie Chen et al., "Digging for Opportunity: Harnessing Sub-Saharan Africa's Wealth in Critical Minerals," Regional Economic Outlook: Analytical Note, IMF, 2024.

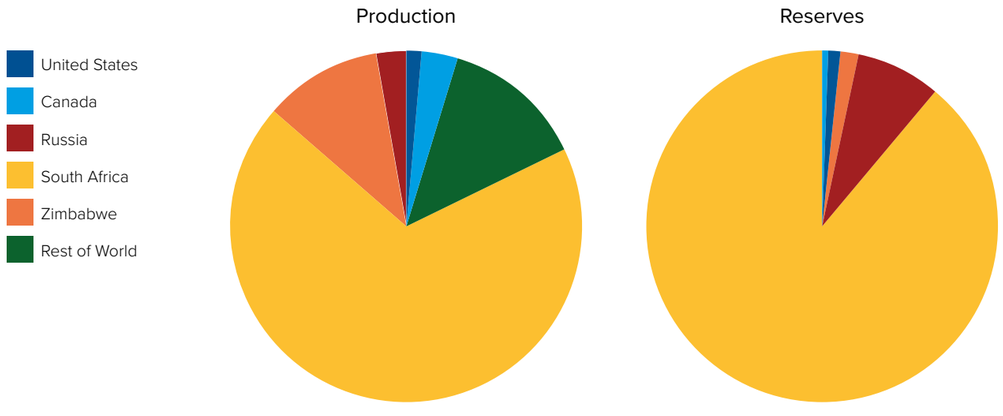
Market and demand dynamics for select critical minerals in Africa

Indonesia's track record on converting its raw material export ban to successful economic growth-stimulating investment is decidedly mixed and, as this paper finds, dependent on external market and technology factors that transpired independently of the Indonesian policymaking process. To endorse these policies as unquestionably worthy of replication in the African context and carry forward implementation without further scrutiny would be unlikely to generate the same results that Indonesia experienced in its nickel sector. To narrow the parameters of countries examined and relevant minerals critical to clean energy supply chains, this section unpacks the demand outlook for select minerals important in the energy transition where Africa represents more than 20 percent of global recoverable reserves, given comparability to Indonesia's role in nickel markets in the post-2020 time frame.

Platinum group metals

No single energy-transition critical mineral is as concentrated in Africa in terms of global reserves as platinum group metals (PGM), which are essential to production of catalysts enabling the conversion of water to hydrogen via electrolysis. PGMs are currently vital inputs in the production of catalytic converters in internal combustion engines as well as catalysts utilized in the petroleum refining sector. While those use cases are projected to decline as dependency on fossil fuels wanes globally, PGM demand, specifically for platinum and iridium, is poised to grow rapidly as polymer electrolyte membrane (PEM) electrolyzers emerge as one of two commercialized technologies for the electrolytic (green) production of hydrogen. The US Department of Energy projects the need for a tenfold increase in iridium production by 2032 to meet forecast deployments of PEM electrolyzers.[43] As of 2023, South Africa was responsible for more than 38 percent of global production of platinum,[44] and possessed 89 percent of global PGM reserves—meaning there is no future scenario in which South Africa fails to be at the center of the PEM electrolyzer supply chain as long as iridium catalysts remain an essential input for electrolysis reactions.

Figure 9: 2023 PGM global production and reserves



Source: USGS, "Platinum-Group Metals Statistics and Information," PGM Mineral Commodity Summary for 2024, https://www.usgs.gov/centers/national-minerals-information-center/platinum-group-metals-statistics-and-information.

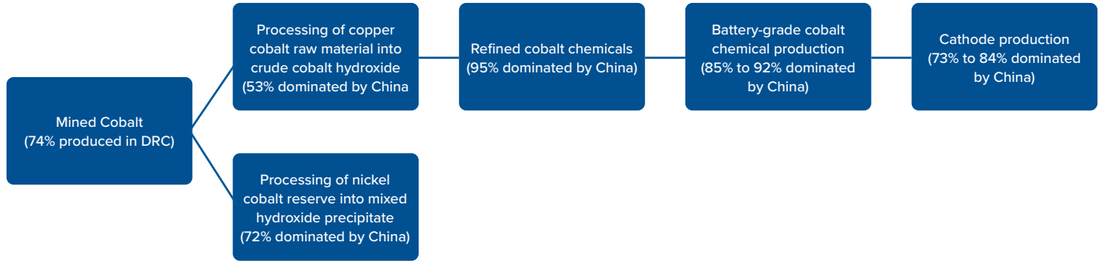
43. US Department of Energy, *America's Strategy to Secure the Supply Chain for a Robust Clean Energy Transition*, DOE Office of Policy, February 24, 2022, 28, https://www.energy.gov/policy/securing-americas-clean-energy-supply-chain.
44. Iridium presents as a constituent material in mined platinum.

Unlike the dynamics facing Indonesia's nickel sector, structural demand for PEM catalysts will be less dominated by Chinese offtakers, at least during the steep growth curve anticipated in the coming decade. China's largest public tender for green hydrogen projects in December 2023 offered an insightful data point on the electrolyzer technology competition among domestic original equipment manufacturers (OEMs). In that tender, eleven of the fifteen successful bids went to projects utilizing alkaline electrolyzer technology; in the four successful bids from PEM OEMs, the average project bid was more than three times as expensive than the average alkaline bid.[45] With the flexibility advantages of PEM electrolyzers over alkaline,[46] and the fact that alkaline electrolyzers don't require PGM catalysts in its operations, South Africa will likely face a more diversified set of offtakers for its PGM production in the PEM electrolyzer supply chain. South Africa's current integrated production capacity includes firms engaged from the mining stage to the smelting, covering, and refining stages of PGM volumes. Further movement up the value chain would involve onshoring catalyst fabrication, but raw material bans similar to those instituted in Indonesia would likely have limited, if any, domestic economic benefit given the PGM industry's existing integration in South Africa. Nonetheless, there are opportunities for Africa to consider a broader regional strategy for green hydrogen supply chain development given the centrality of South Africa's PGM reserves to the scaling of green hydrogen production globally.[47]

Cobalt

As of 2023, the DRC maintained its status as the largest cobalt producer globally, representing 74 percent of mined production.[48] Among Africa's largest mineral reserves, cobalt demand dynamics most closely reflect the nickel market trajectories Indonesia faced as it undertook to institute its export ban. Cobalt demand has grown significantly in recent years in association with growing production of lithium-ion batteries, particularly as nickel-manganese-cobalt (NMC) cathode chemistries have emerged as a favored technology among EV manufacturers. A recent Mineral Economics paper[49] sought to demonstrate the full scale of China's monopoly over cobalt battery materials and found that the supply chain stages for lithium-ion batteries utilizing cobalt inputs are heavily dominated by Chinese entities, as demonstrated in the figure below:

Figure 10: China dominates many supply chain stages of lithium-ion batteries with cobalt inputs



Source: A. L. Gulley, "The Development of China's Monopoly Over Cobalt Battery Materials," *Mineral Economics* 37 (2024): 619–631, https://doi.org/10.1007/s13563-024-00447-w.

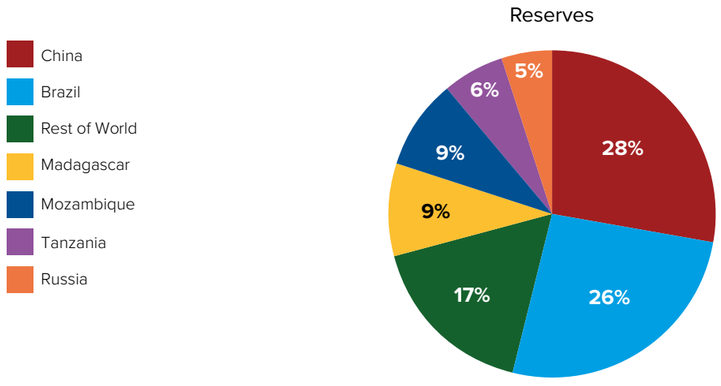
45. "China Energy Construction 2023 Hydrogen Production Equipment Centralized Procurement," Energy China Electronic Procurement Platform (website), December 12, 2023, https://ec.ceec.net.cn/HomeInfo/winDidDetails.aspx?bigtype=SABYAFIARwBTAA==&threadID=0ac5ea5f-bd4e-4c32-9700-54f902c2887c.
46. For safety reasons, alkaline electrolyzers must operate at a minimum capacity factor of 20 percent, which poses challenges if the feedstock electricity must be carbon free. Initial drafts of the US Inflation Reduction Act's hydrogen tax credit indicate that those green hydrogen projects that meet qualifying criteria will necessitate the type of flexibility that PEM technology provides.
47. There are a number of electrolyzer OEMs advancing iridium-free PEM electrolyzer stack technologies. Cost competitiveness of incumbent PEM technology versus those that reduce reliance on PGM inputs would be vital to the success of any integrated hydrogen supply chain strategy in Africa.
48. "Graphite Metals Statistics and Information," Cobalt Mineral Commodity Summary for 2024, USGS.
49. A. L. Gulley, "The Development of China's Monopoly Over Cobalt Battery Materials," *Mineral Economics* 37 (2024): 619–631, https://doi.org/10.1007/s13563-024-00447-w.

Most crude cobalt hydroxide production takes place as an initial processing step in the DRC while the subsequent supply chain stages are almost entirely completed in China. The IEA anticipates very limited changes to China's dominance of cobalt refining out to 2040, relinquishing only two percent of its market share of refined product supply by 2040 amid continued demand growth.[50] Because of its share of global mining production and vast reserves of cobalt, the DRC could exercise significant leverage to move further up the value chain to capture investment in battery-grade cobalt chemical refining, provided that NMC cathodes remain a prevalent technology choice for EV manufacturers. That said, the increased competition between various battery technologies negatively affects the DRC's natural resource endowment-based leverage. Already, the DRC's instability, volatile contracting and legal regimes, and abundant concerns about human-rights and labor abuse have almost certainly been motivating factors behind competing battery technologies that reduce or altogether eliminate reliance on cobalt as a required input. This shifting landscape is most evident in the recent surge in growth achieved by lithium iron phosphate (LFP) cathodes in the last five years. Representing a paltry three percent of the global cathode market in 2019, LFP catapulted to 27 percent as of 2022, and past 40 percent in 2023, vastly outperforming expectations and forecasts.[51] Given the surge in LFP market share and its improving performance capabilities, both the DRC and Indonesia—the latter because LFP cathodes likewise do not require any nickel-based inputs—face a daunting task in attempting to further leverage their critical mineral production into higher value investments given increased flexibility and optionality in the Chinese domestic battery industry. Similarly, as battery recycling technology improves and capacity is established, recycled materials, likely prioritizing those originally sourced from the most expensive inputs and supply chains under the most stress, will begin to further infringe upon the market shares of mined cobalt and nickel, thereby further reducing leverage with Chinese buyers in particular.

Graphite

Within the lithium-ion battery supply chain, graphite has emerged as a severe area of concentration as it relates to China's dominance in natural graphite processing and synthetic graphite fabrication for the battery anode precursor material. The US Department of Energy's recent decision[52] to exempt graphite from the IRA's sourcing criteria for the passenger EV tax credit requiring diversification away from China is an indication of the challenge battery manufacturers and automakers must confront in diluting this supply chain concentration. China possesses both the largest single reserve resource for natural graphite and maintains more than 90 percent of battery grade graphite active anode material production as of 2023 (see figure 12). Unlike Indonesia's advantage over China in terms of nickel reserves, African countries with significant graphite resources, namely Madagascar, Mozambique, and Tanzania, will have a comparatively limited ability to command Chinese capital as part of any downstreaming agenda or in response to any raw material export ban.

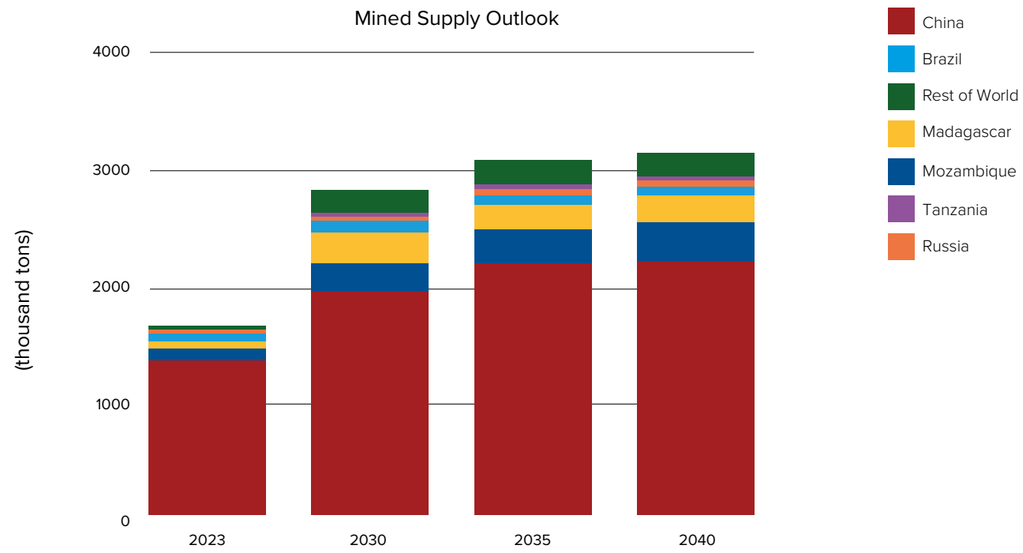
Figure 11A: Graphite mining and processing outlook and reserves



Source: USGS, "Graphite Metals Statistics and Information," Graphite Mineral Commodity Summary for 2024, https://www.usgs.gov/centers/national-minerals-information-center/graphite-statistics-and-information; and IEA, "Critical Minerals Data Explorer, 2024 Edition," https://www.iea.org/data-and-statistics/data-product/critical-minerals-dataset.

50. *Critical Minerals Data Explorer 2024 Edition*, IEA.
51. *Global EV Outlook 2023: Catching Up with Climate Ambitions*, IEA Energy Technology Policy Division of the Directorate of Sustainability, Technology and Outlooks, 2023, https://www.iea.org/reports/global-ev-outlook-2023.
52. See final IRA section 30(d) rule in 26 C.F.R. (2024), https://www.federalregister.gov/documents/2024/05/06/2024-09094/clean-vehicle-credits-under-sections-25e-and-30d-transfer-of-credits-critical-minerals-and-battery.

Figure 11B: Graphite mining and processing outlook and reserves



Source: USGS, "Graphite Metals Statistics and Information," Graphite Mineral Commodity Summary for 2024, https://www.usgs.gov/centers/national-minerals-information-center/graphite-statistics-and-information; and IEA, "Critical Minerals Data Explorer, 2024 Edition," https://www.iea.org/data-and-statistics/data-product/critical-minerals-dataset.

Each of these graphite-rich jurisdictions has in recent history instituted raw commodity export bans. Most relevant for this report is an announcement by the Tanzanian government to restrict the export of unprocessed lithium, effective May 2024.

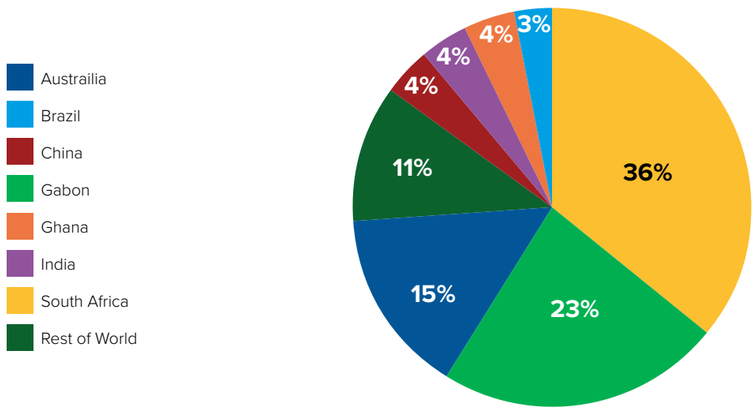
Moving up the value chain via an export ban to attract graphite processing or spheroidization capacity would therefore likely depend on investment from North America, Europe, or Northeast Asia—i.e., leading economies in terms of EV deployment and battery-manufacturing capacity outside of China. Globally, however, 14 percent of battery-grade graphite material is sourced from natural graphite and 78 percent is derived from artificial graphite, as of 2022.[53] As such, successful downstreaming in graphite-rich countries would require technological advancements and cost reductions for battery anodes with high blending rates for natural graphite, likely developed in parallel with significant policy interventions to limit Chinese artificial graphite and anode market access in key demand centers globally. Even in such a scenario, China's concentration in the graphite supply chain and the energy and carbon intensity of the graphitization process to synthesize artificial graphite present significant incentives for innovation in anode chemistries that do not rely on graphite inputs. Silicon-based anodes have the potential to increase the energy density of batteries by 20 percent to 40 percent if degradation and lifespan challenges can be addressed, which could reduce the market share of graphite inputs in the battery supply chain.[54] The latest IEA forecasts for net-zero emission scenarios do not, however, foresee that market-share erosion materializing until after 2035, when demand for battery-grade graphite is expected to begin plateauing before entering a decline of about 30 percent between 2035 and 2050.[55]

Manganese

As noted, NMC chemistries have grabbed substantial market share in the lithium-ion battery industry for its generally desi-

53. "Fake It Till You Make It: Synthetic Graphite Holds the Key to Meeting Battery Demand Surge, Despite ESG Concerns," Press Release, Rystad Energy, November 10, 2022, https://www.rystadenergy.com/news/fake-it-till-you-make-it-synthetic-graphite-holds-the-key-to-meeting-battery-dema.
54. "Innovations on Low-Cost Production of Silicon-Based High-Performance Lithium-ion Batteries," Pacific Northwest National Laboratory, Battelle no. 31788-E, n.d., https://www.pnnl.gov/available-technologies/innovations-low-cost-production-silicon-based-high-performance-lithium-ion.
55. "Critical Minerals Data Explorer," IEA.

Figure 12: Global manganese production



Source: USGS, "Manganese Metals Statistics and Information," Graphite Mineral Commodity Summary for 2024, https://www.usgs.gov/centers/national-minerals-information-center/graphite-statistics-and-information.

rable performance characteristics in EV applications. As a core input to that cathode chemistry, manganese demand has been growing steadily, focusing attention on Africa's outsized role in production and reserves in a global context. As of 2023, South Africa, Ghana, and Gabon represented 64 percent of global production volumes, contributing 36 percent, 23 percent, and 4 percent of the market, respectively.

Although manganese faces a similar demand-side uncertainty with the rapid growth in market share that LFP cathode chemistries have achieved, its usage in lithium manganese oxide (LMO) batteries for use in smaller battery-powered equipment, electric drivetrains, and as a steel-alloying element in wind turbines provides alternative use cases for energy transition technologies. Further, LFP's growth has been driven more as a result of battery-pack and cell-architecture improvements than enhancements to the underlying cathodes themselves. As a result, there are firms seeking performance gains and innovation breakthroughs to achieve further performance improvement compared to NMC chemistries and wrest market share from Chinese LFP producers. This pursuit of innovation includes the integration of manganese into LFP cathodes forming a lithium manganese iron phosphate (LMFP) to improve energy density, but still avoiding use of nickel inputs.[56] As China continues to scale its LFP productive capacity, achieving further cost declines and embarking on an aggressive campaign to establish battery-manufacturing capacity external to China to combat growing trade protectionism and industrial-policy applications, the pressures for innovation and alternatives in the cathode competition will become more significant. These pressures could drive greater European, Korean, Japanese, and US interest in securing manganese production and refining capacity for manganese sulfate that does not retain existing Chinese dominance of NMC and LFP supply chains. Per S&P Global, battery-grade manganese sulfate demand will increase by a factor of fifteen from 2020 to 2031, with 90 percent of existing capacity under the control of China and only two operating refineries outside of China.[57]

56. See Mitra Chem's corporate announcement of LMFP cathode active material commercial sample sales for global customers, December 7, 2023, https://www.mitrachem.com/post/mitra-chem-announces-commercial-lmfp-cathode-active-material-sample-shipments-have-begun-to-global-customers.
57. Eri Silva, "Manganese Sulfate Bottleneck Looms Over US, European EV Manufacturers," S&P Global, January 24, 2023, https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/manganese-sulfate-bottleneck-looms-over-us-european-ev-manufacturers-73926378.

Implementation of export bans on CRM and their consequences

In recent years, the use of export restrictions on critical raw materials has significantly intensified, expanding more than fivefold in the world over the last decade. Currently, approximately 10 percent of the global value of CRM exports faces at least one export-restriction measure, according to data from the Global Trade Alerts database. The most commonly affected materials by these restrictions are aluminum, cobalt, and helium, followed closely by nickel, titanium metals, and platinum group metals. Governments worldwide have implemented these restrictions for a variety of reasons, including the protection of domestic industries, ensuring a stable domestic supply, addressing national security concerns, promoting sustainable practices, managing trade imbalances, complying with international agreements, and controlling the flow of sensitive technologies or materials. Additionally, there has been a notable trend toward promoting further processing activities and increasing value-added in terms of local economies.

On the African continent, governments are increasingly turning to export bans on raw commodities. Recently, several African governments have resorted to such measures again. In December 2022, Zimbabwe imposed a ban on the export of unprocessed lithium, followed by Namibia in June 2023, which banned the export of lithium ore, cobalt, manganese, graphite, and rare-earth elements. Shortly afterward, Ghana introduced a ban on the export of a wide array of unprocessed critical minerals, including lithium, bauxite, cobalt, and copper. The stated goal of these bans is to encourage the development of downstream industries and enhance the value-added through mineral-based exports.

While it is too early to gauge the success of these recent bans, historical examples provide valuable insights into their potential outcomes. An Organisation of Economic Co-operation and Development (OECD) study found no evidence that export restrictions have effectively stimulated economic activity downstream in the mineral industries of countries such as Gabon, South Africa, Zambia, and Zimbabwe.[58] These nations, despite their efforts to expand local processing through export-control measures, have not seen significant benefits in their value chains. Empirical analysis of past export taxes on unprocessed minerals in countries like Zambia (copper), Zimbabwe (chromium), and Gabon (manganese) revealed that these taxes had minimal impact on improving the comparative advantage of their respective mineral-processing industries. For instance, Zimbabwe oscillated between export bans and taxes on chromite, but these measures did little to enhance the country's position in global trade. Similarly, South Africa's requirement for firms to obtain export licenses and Gabon's and Zimbabwe's restrictions on raw material exports have not yielded the desired outcomes.

Overall, these export-control measures, while well-intentioned, have often fallen short of their objectives. In most cases, they have even negatively impacted the industry by reducing mineral exports, leading to a deterioration in these countries' positions in global trade—especially as global supplies of these minerals have increased over the past two decades. However, these measures can be strategically beneficial if applied sparingly and under the right conditions particularly when a country has a dominant position in the market or when another dominant player or even the main producers coordinate similar actions, thereby maximizing the chances of success.

Considering these findings and the question of the replicability of the successful inflow of investment into Indonesia's nickel-processing sector, a clear set of variables emerges as necessitating focused attention to evaluate a particular resource's potential to be harnessed via export bans to extract additional economic value and investment. Four categories in particular are likely to have substantial bearing on the likelihood for success and merit close consideration by African extractive-industry policymakers:

- Market competition risk: e.g., the availability for demand centers and downstream industries to substitute with supplies from alternative jurisdictions rather than comply with an export ban.
- Technology evolution risk: the likelihood that innovation and technology shifts could structurally reduce demand for a specific critical energy transition mineral.
- Supply chain concentration risk: the degree to which there is a motivated class of investors or governments seeking to achieve greater diversification.
- Value addition potential risk (VAPR): the degree to which further value chain upward mobility is economically beneficial.

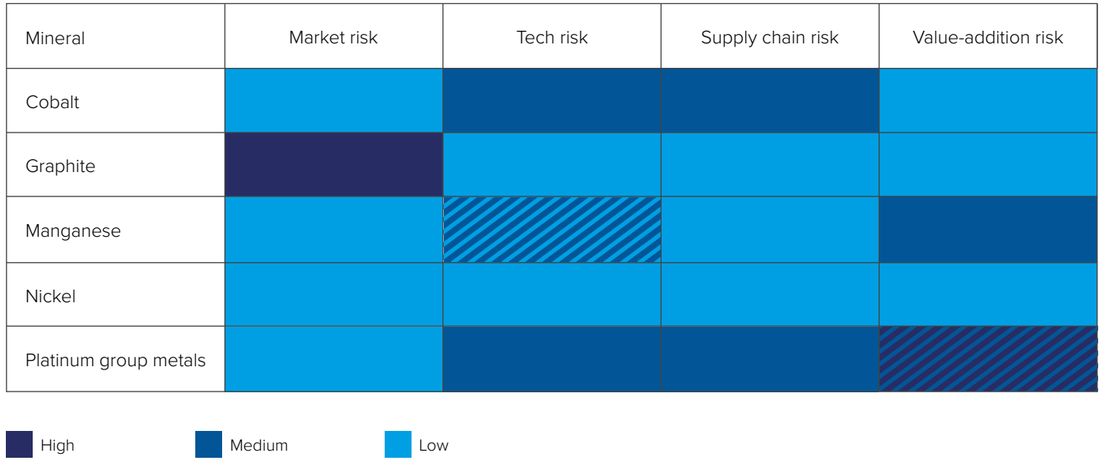
58. Barbara Fliess, Ernst Idsardi, and Riaan Rossouw, *Export Controls and Competitiveness in African Mining and Minerals Processing Industries*, OECD Trade Policy Papers, no. 204, OECD Publishing, 2017, https://doi.org/10.1787/1fddd828-en.

The below table evaluates the likely intensity of these risks across the various energy transition mineral-use cases and demand outlooks (outlined in the previous section) across the next decade. A low risk rating in the market and technology competition categories signifies leverage for African mineral producers that could increase the likelihood of attracting investment via a raw material export ban. Likewise, a low risk rating in the supply chain concentration risk category signifies an ability to identify motivated investors or governments seeking supply chain diversification regardless of export restrictions. Finally, a low risk rating for value addition indicates the availability of economically beneficial value-addition opportunities given existing value chain dynamics and structures.

As the table demonstrates, no singular mineral evaluated in this study provides the same configuration of enabling conditions that mirror those surrounding Indonesia's reinstitution of a raw material export ban in 2020. As a result, evaluation of potential risk-mitigation tools facing those specific commodities would be required to improve the prospects for successful attraction on investment capital in processing or refining capacity as the result of an export ban.

Instituting export bans would also antagonize trading relationships with key Western demand centers at a time of significant motivation to dilute Chinese concentration over critical energy supply chains and materials processing. Both the EU Critical Raw Materials Act (CRMA) and elements of the IRA (along with other related critical material international initiatives) prioritize the enhancement of trade ties with friendly supply jurisdictions; a wave of export bans across Africa would certainly complicate and potentially delay the integration of select African producing nations from these frameworks and supply chain diversification efforts. Further, there may be more effective approaches in the near term to harness the value of Africa's critical mineral resource deposits and avoid risking acceleration of both upstream competition from other raw material producers and incentives to scale competing technologies that reduce demand for African minerals. The policy recommendations section that follows focuses on these opportunities, which could support Africa's pursuit.

Table 2: Risk variables affecting export-ban prospects for success (2024–2034)



*Representative of conditions at the time of Indonesia's 2020 ban.

Source: Table compiled based on author's nonquantitative approximations. A ten-year period of evaluation was selected on the basis of reasonable timelines for policy formulation, implementation, investment, and technology evolution and associated uncertainty.

Policy recommendations

Under the African Green Minerals Strategy (AGMS), commission techno-economic studies to assess where value creation is most substantial in individual critical mineral supply chains for the energy transition and to improve resource mapping and characterization data across the continent. These studies should include an emphasis on identifying those mineral-refining processes that require by-product revenue generation and adjacency with downstream, secondary industries. Invoking the lessons learned from the copper industry and its evolution following the institution of an export ban in Indonesia, the AGMS should account for and prioritize effectively those minerals with the paths of least resistance to upward mobility in the value chain. The modest value gains from copper extraction to copper processing plagued Indonesia's ability to compel value-added investment from Western miners in the course of its export ban implementation efforts. Conducting effective and publicly transparent assessments of value addition opportunities across core energy transition critical minerals will enable effective prioritization and sequencing of policy frameworks. Further, the AGMS and the select minerals of focus in this paper are limited to existing, but inadequate data on the scale and commercial viability of resources across Africa. Dedicated efforts under the AGMS and through international aid-based partnerships with donor country geologic surveys and mining authorities should be leveraged to improve resource characterization and data transparency especially as technology holds promise for improving surveying and exploration processes.

Launch new, dedicated special economic zones (SEZs) for critical minerals in resource-rich jurisdictions. Promoting SEZs presents a viable strategy for encouraging the local transformation of minerals in Africa. SEZs offer a structured environment with tailored policies that can attract the necessary investment to build processing infrastructure, which is often a major hurdle for mineral-rich states. In recent years, numerous SEZs have been established in Africa specifically to cater to the mining industry. In South Africa, the Platinum Valley Initiative is set to transform the continent's production of hydrogen fuel cells. Similarly, a landmark agreement in 2022 between the DRC and Zambia highlights the potential of SEZs. The two countries have joined forces, with backing from private and public sectors, to establish SEZs aiming to process nickel, manganese, and cobalt locally for the production of EVs and batteries.

Leverage the African Continental Free Trade Area (AfCFTA) to accelerate the formation of continental commodity markets capable of attracting international investment. AfCFTA holds significant potential to support the development of local mineral-processing industries in Africa by expanding the local market. One of the key challenges facing the emergence of processing industries on the continent is the fragmented nature of African markets, which are often too small individually to justify the investment needed to develop processing units and local value chains. By pooling mineral supplies across borders and creating a unified market, African countries can achieve the scale needed to attract investment in processing facilities. The AfCFTA aims to address this by fostering continental and regional integration, removing tariffs on 90 percent of goods, liberalizing trade in services, harmonizing trade rules across regional economic communities and eliminating other nontariff barriers. Through such pooling of resources into an integrated commodity market, there also is an opportunity to diversify Africa's capital markets supporting the mining sector. Incentivizing the formation of African equity-investing institutions in its natural-resources sector could help create domestic constituencies for good governance, investor protections, and the rule of law. Establishment of continentally based sources of early-stage risk capital also will be essential to first-of-a-kind investments for processing in markets that have not been able to mature past extraction in the value chain.

Create "fast lane" regulatory and permitting approval mechanisms and corporate procurement tools for captive power-generation assets dedicated to supplying critical mineral processing and refining facilities. Provide further inducements for carbon-free power projects. Infrastructure remains a significant obstacle to the development of a local processing industry in Africa, particularly when it comes to energy and transportation. The energy requirements for mineral processing are exceptionally high, far exceeding the energy needs of extraction. For example, extracting bauxite consumes only about 34 kilowatt-hour (kWh) per metric ton, while refining it into aluminum requires over 3,000 kWh per metric ton.[59] This immense energy demand poses a serious challenge for many African countries, where energy infrastructure is either underdeveloped or insufficient to support such high consumption levels. The establishment of energy-intensive processing plants could strain already limited energy resources, potentially to the detriment of local populations needing electricity for everyday use. Without access to affordable and reliable energy, African nations face difficulties in attracting the kind of investments necessary to develop local processing industries, while, in contrast, many of the world's largest mineral refineries are located in regions with abundant and inexpensive energy sources that give them a competitive advantage that African countries currently lack. As in the case study with Indonesia, battery and EV OEMs have expressed concern with the distinct carbon intensity of Indonesian nickel production as the country's consumption of coal has increased, driven by smelter capacity expansion. Charting an industrial development path for energy transition critical mineral processing

59. S. H. Farjana, N. Huda, and M. A. Mahmud, "Life Cycle Assessment of Cobalt Extraction Process," *Journal of Sustainable Mining* 18, no. 3 (2019).

and refining would be a valuable point of differentiation for African mineral producers seeking to attract capital from climate-minded investors and to ensure long-term compatibility with global climate goals.

Work with Morrocco to institute African sourcing incentives for critical material inputs for its burgeoning lithium-ion battery-manufacturing sector. As a result of the sourcing eligibility requirements of the IRA's EV tax incentives, Morocco's free trade agreement with the United States is prompting battery supply chain firms to establish continental footholds in the country to seek compliance with the tax credit's requirements. A spate of cathode precursor material plants has been announced by Chinese firms to capitalize on the EV demand growth in North America and Europe, while at the same time taking advantage of potential adjacency benefits given Africa's natural resources and proximity to those markets. As Morocco emerges as a strategic investment destination in the battery supply chain,[60] African leaders are already fixated on its potential to act as a value-add multiplier in Africa's mining sector, as referenced in the African Green Minerals Development Strategy Approach paper.[61] Given market concentration in graphite and manganese battery-grade material supply, Morocco could take advantage of Western imperatives for diversification by incentivizing manganese sulfate and natural graphite sourcing from continental capacity. If combined with targeted import tariffs and coordinated closely with African manganese and graphite producers, an effectively designed trade package for battery materials could significantly expand the incentives for greenfield processing-capacity investment. Such measures would be more in line with the supply chain resiliency and reshoring provisions of the IRA and CRMA, would likely cause less trade friction than an outright raw material export ban, and have the added benefit of contributing momentum to African aspirations for battery and EV supply chain investments and industry formation.

Pursue a memorandum of understanding to establish a battery materials and components innovation strategic partnership among the United States, the EU, and the African Union. A Western strategy to diversify battery material supply chains away from Chinese dominance is unlikely to succeed if it is centered solely on trying to establish competing capacity for existing battery technology. The United States and EU are both investing in innovation within lithium-ion technologies and the battery ecosystem more broadly. Both partners should seek to design an initiative that provides African nations with relevant mineral deposits an opportunity to have a stake in that innovation's potential success, including through avenues for equity stakes and value-added investment in battery material production backed by US and EU development finance institutions. The partnership could be further leveraged to provide a networking platform for early-stage technology developers to secure raw and refined material supplies in the low volumes that they are seeking from African producers. Such a platform could leverage the existing frameworks and bureaucracy surrounding the mineral security partnership. Finally, a formidable risk for aspiring African battery material producers is the ability of Chinese incumbents to flood the market with supplies at pivotal maturation points for new market entrants, pushing them into insolvency to preserve Chinese market share. As the United States evaluates potential policy tools and authorities to combat this coercive market-manipulation capability, African critical materials producers could enter in agreements with the United States and the EU to enable targeted market interventions by the governments, stockpiling, and bridge capital to countermand China's market price manipulation.

Advance investment-grade transport infrastructure network investments under the US Partnership for Global Infrastructure and Investment (PGII) and EU Global Gateway initiatives targeting routes to market for priority energy transition critical materials. In addition to energy concerns, inadequate transportation infrastructure further complicates efforts to develop local processing industries. The logistics of transporting minerals from extraction sites to processing facilities and then to export markets require robust and specialized transport networks. These include trains, trucks, storage areas, specialized port facilities, and efficient customs processes. Roads and railways in many regions are still not equipped to handle the heavy loads associated with bulk mineral transport, and the lack of modern port facilities hampers export capabilities, leading to high costs and inefficiencies. Trade policies and investments provided by partners and allies can play a crucial role in bridging Africa's infrastructure gap and opportunities for minerals exportation, offering both opportunities for growth and the means to overcome existing challenges. One key area where this is evident is in the development of strategic corridors and trade routes, such as PGII's Lobito Corridor. This corridor is a major infrastructure project that runs through Angola, Zambia, and the DRC, connecting the mineral-rich central African Copperbelt to Angola's Atlantic port of Lobito. This corridor is designed to facilitate the efficient transport of critical minerals such as copper and cobalt, which are essential for the global green energy transition. An assessment of where transportation networks for scaling graphite and manganese production and optimizing potential processing industrial zones would enhance the near-term feasibility of value-added investments in those supply chains could build on the Lobito Corridor model to advance further strategic transportation-infrastructure upgrades.

60. See Cameron Hughes and Sam Adham, "Chinese Companies Look to Morocco for Access to N America and Europe's Battery Market," Insights section, CRU website, October 4, 2023, https://www.crugroup.com/knowledge-and-insights/insights/2023/chinese-companies-look-to-morocco-for-access-to-n-american-and-europe-s-battery-market/.
61. *Approach Paper to Guide Preparation of an African Green Minerals Strategy*, Africa Natural Resources Management and Investment Center, African Development Bank, 2022, https://www.afdb.org/sites/default/files/documents/publications/approach_paper_towards_preparation_of_an_african_green_minerals_strategy.pdf.

Resource nationalism and downstreaming: Lessons for African producers of critical minerals from Indonesia

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