

The Scramble for Critical Minerals

Christopher ADAM, Rabah AREZKI, Rick VAN DER PLOEG

- ➔ CHRISOPHER ADAM, University of Oxford and EUDN.
- ➔ RABAH AREZKI, FERDI, Université Clermont Auvergne, CNRS, IRD, CERDI, F-63000, Clermont-Ferrand, France, and Harvard Kennedy School of Government.
- ➔ RICK VAN DER PLOEG, University of Oxford, University of Amsterdam, and CEPR.

Abstract

This paper examines economic and geo-political consequences of the current phase of superpower competition to secure access to the critical minerals that are central to the global energy transition, digitalisation, and the AI-led transformation of the global economy. We first review the upstream mining of critical minerals, which takes place primarily in developing countries, before considering downstream elements of critical mineral supply chains, including the central role of China in the processing of these minerals. We discuss the socio-economic and environmental consequences associated with the race for critical minerals and conclude with a discussion of policies that may be deployed to support equitable and sustainable management of these minerals in an era of unprecedented technological and geopolitical uncertainty.

Keywords: critical minerals, geo-economics, resource curse, policy.

JEL Codes: O12, O13, F14, F10, L12.

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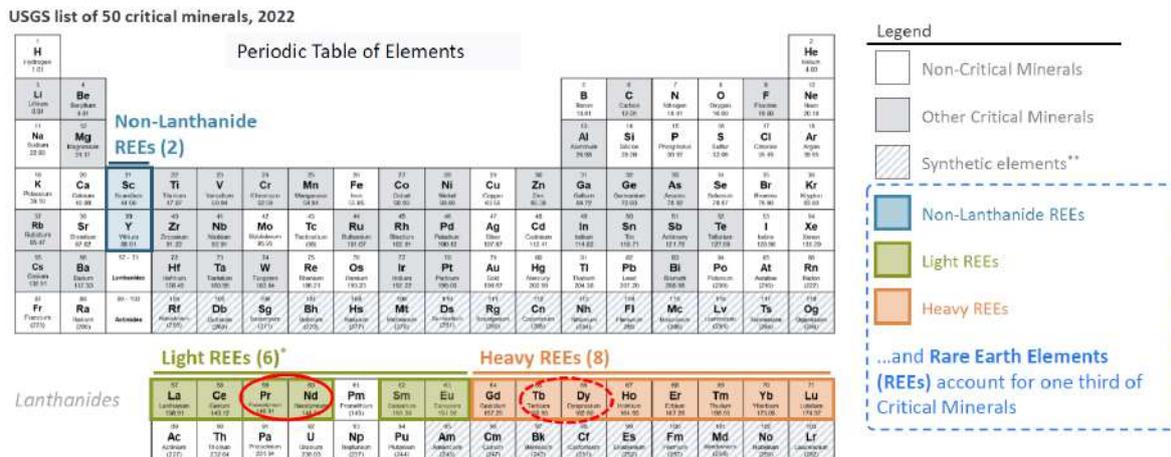
I. Introduction

The world is in the midst of a new scramble for natural resources, this time not for fossil fuels but for critical minerals such as lithium, cobalt, nickel, and rare earth elements. These commodities are essential inputs into the energy and digital transitions, currently underway across the world and the rapidly transforming defence, security, and aerospace industries. These minerals are key components in batteries, semiconductors, digital handheld devices, and many of the new clean-energy technologies that underpin the transition to low-carbon growth. Figure 1 presents the list of critical minerals established by the United States Geological Survey (USGS).¹ As this dependence accelerates, the global economic superpowers, the US, China and the EU, are seeking to secure access to these resources. With primary critical mineral production overwhelmingly concentrated in developing economies and with China controlling much of downstream processing and refining of critical minerals, this modern scramble risks fuelling renewed conflict, exacerbating poverty, and provoking further environmental damage.

This competition is reshaping the global political economy in ways reminiscent of the nineteenth-century race for raw materials that fuelled the industrial revolution. Today's contest, however, is unfolding amid acute geopolitical rivalries, technological uncertainty, and mounting environmental pressures. China currently dominates large segments of the critical minerals value chain, from extraction to processing, controlling between 60 and 80 percent of final global supply of processed critical minerals (Leruth *et al.*, 2022). In response, the United States and the European Union are actively looking to diversify supply chains and secure their own access to these essential materials, often through partnerships and contracts in Africa, Latin America, and Central Asia.

¹ Critical minerals or raw materials (we use the two terms interchangeably) are usually defined as those that are both (a) essential in a modern technology and (b) subject to supply-chain risk (see US National Research Council, 2008, here: <https://www.nationalacademies.org/read/12034/chapter/1#ii>). Both qualities are necessary for mineral to be designated as 'critical.' There are, however, different ways to define 'essential' and 'supply-chain risk' and this is evident from the list of critical minerals published by different countries and institutions. Blundy (2026) examines critical mineral lists across the UK, EU, USA, Russia, Japan, China, South Africa, South Korea, Brazil, Australia, Canada and India and finds that only lithium and the rare earths appear on all twelve lists, while nickel, cobalt, platinum, scandium and graphite appear on eleven lists, aluminum, manganese, niobium, palladium, rhodium, tantalum, titanium, tungsten, titanium and vanadium appear on ten. Fetzer and Lambert (2026) suggest that such lists tend to be expert-driven and static and say little about how upstream raw materials and downstream technologies knit together in global production networks. As an alternative, they propose a network-based index of criticality (NIC) that combines information about a product's share in world trade, the degree of supplier and buyer concentration, and how products fit into product input networks. They argue that this integrated measure of criticality carries signals for official critical mineral designations from a broad range of stakeholders

Figure 1. Critical minerals include over half of the 94 naturally occurring elements



Notes: * Promethium (PM) is excluded from the Critical Minerals list due to extreme scarcity (<600 grams in Earth’s crust), instability, and minimal industrial applications.** Synthetic elements do not occur naturally on Earth and must be created in laboratories or nuclear reactors.

Sources: Rystad Energy research and analysis; US Geological Survey, April 2025

Much of the promise and peril of the new scramble for critical minerals are playing out in the Democratic Republic of Congo (DRC), dubbed the “Saudi Arabia of critical minerals”. The DRC is home to 70 per cent of the world’s reserves of cobalt and 60 per cent of its lithium reserves, as well as significant deposits of copper, uranium and nickel.² But the abundance of these minerals has not yet improved the lives of the citizens in one of the poorest countries in the world. Rather, the DRC encapsulates the profound and intertwined challenges of conflict, corruption, and impoverishment posed by critical mineral abundance in the context of a weak and low-income state.

These challenges and opportunities repeat across the mineral-abundant economies of the Global South. While the surge in demand could deliver unprecedented opportunities for growth and industrialisation, it also risks deepening long-standing asymmetries between resource exporters and industrialised consumers. Weak institutions of taxation and regulation, opaque contracts with transnational oil and mining companies, and volatile commodity markets have historically limited the developmental gains from ‘conventional’ resource booms. To avoid a repeat and ensure that the extraction of critical minerals translates into sustainable prosperity, resource-

² See US International Trade Administration, <https://www.trade.gov/country-commercial-guides/democratic-republic-congo-mining-and-minerals>

rich countries must strengthen governance and fiscal frameworks, negotiate transparent contracts, manage revenues effectively, and develop downstream processing.

Success in downstream development has been mixed. The obvious success story is China where heavy state engagement, combined with reforms to the tax system, has supported the processing of minerals at scale; see Rota-Graziosi (2026) and Arezki *et al.* (2025) for a discussion. On a slightly smaller scale, Indonesia has effected a successful transformation into the world's top nickel producer and processor countries, controlling roughly 60 per cent of global production. The success was partly based on regulations which imposed a ban on raw ore exports enforced from 2020, although the primary impetus was heavy support from Chinese firms and technology investments in industrial parks.

A third example is the development of local value addition in Botswana. Building on its long-term and successful diamond mining joint venture with the South African De Beers mining house, Botswana began to develop domestic diamond cutting and processing industries in the 2010s. While similar strategies could help mineral-rich countries move up the value chain and reduce dependence on raw exports, constraints to successful domestic beneficiation remain substantial, with limitations of comparative advantage, local human capital capacity, and the absence of scale economies combining to limit the scope for local value added.³

These examples point to a central role of protectionism, directed industrial policy, and tax reforms to promote downstream development of the critical mineral sector, but such policies raise the risk of trade wars and retaliation with the prospect of reduced economic welfare globally. On top of these trade-diversion risks, the scramble for minerals carries significant risks of social conflict, environmental degradation, and human rights violations. In regions such as the eastern DRC, competition for control of resource-rich territories between central authorities and rebels supported by neighbours, including Rwanda and Uganda, continues to fuel violence and instability. Moreover, extraction activities are frequently associated with deforestation, biodiversity loss, water pollution, and harmful labour practices, including child labour, outcomes that are exacerbated by the 'not in my backyard' (Nimby) politics of the industrialised countries that have been focused on securing their access to large volumes of critical minerals with limited concern for the damage being done through extraction activities in developing

³ Even in Botswana, cutting and polishing has struggled in the face of significant cost disadvantages compared to India, which processes the vast majority of the world's diamonds far more cheaply. As a result, the country still exports mostly rough or semi-processed stones, thus capturing only a fraction of the final retail value.

economies endowed with large reserves of critical minerals. Effective enforcement of environmental and social standards, and for international cooperation to ensure responsible sourcing and traceable supply chains, remains a serious failing of global regulation of the sector.

As these dynamics intensify, the global contest over critical minerals will increasingly shape not only the trajectory of the energy and digital transitions, but also the future of development for many countries in the Global South. How this race is managed, through governance, transparency, and cooperation, will determine whether it becomes a source of sustainable progress or renewed dependency.

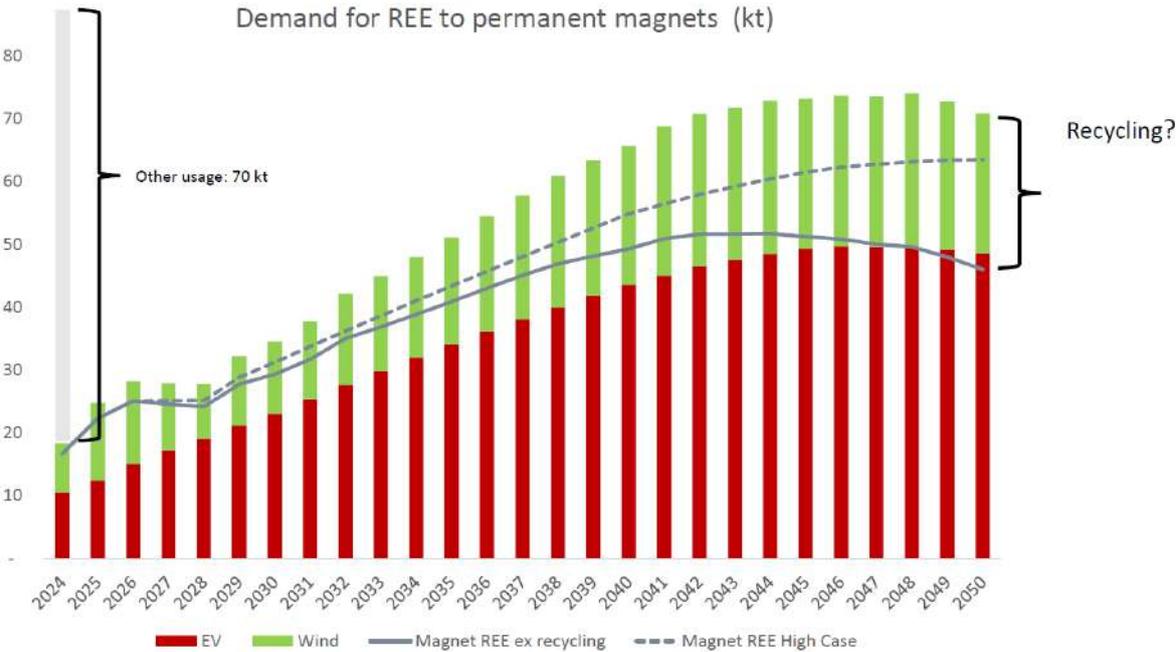
This issue of OxREP explores various facets of the global scramble for critical minerals. It draws on contributions from leading scholars in the field, including geologists, political scientists, economists, and practitioners. This introductory paper weaves the various strands of this intellectual collaboration together, starting with a consideration of the structure of demand for and the production and supply of raw and processed critical minerals. In doing so we focus on contributions which employ the latest knowledge and state-of-art techniques to help deepen our understanding of the geological, economic, and technological dynamics driving the supply and demand for critical minerals. From there, the paper then highlights the geo-economic dimensions of critical minerals including the central role of China in the processing of these minerals, and how the scramble for critical minerals reflects the shifting global order and the consequent reshaping of global trade, the energy transition, and international relations across the world. Third, we examine the socio-economic and environmental consequences of that race for critical minerals, along with the heightened risks of internal and cross-border conflict that the scramble may trigger before turning to consider policies to harness the power of critical minerals, focusing on fiscal and industrial policy strategies for mineral-rich economies, particularly in developing economies, to capture a fair and sustainable share of the benefits, through improved governance, taxation reform, local value creation, and institutional strengthening. Finally, we conclude by discussing the radical uncertainty surrounding the era of critical minerals on account of technological and geopolitical factors.

II. Demand, Production and Processing of Critical Minerals

The energy and digital transitions both rely on technologies that require critical minerals. Technologies including wind turbines, solar PVs, electricity networks, electric vehicles, magnets, and nuclear power require minerals such as copper, lithium, nickel, silicon, cobalt,

rare earth elements, and uranium. Demand for these minerals is expected to grow quickly as the energy transition gathers pace. Figure 2 presents scenario of the evolution of demand for rare earth magnets for the different segments of the energy transition.⁴ It is noteworthy, that recycling could play an important role in taming the demand for these materials.

Figure 2. Rare earth magnets demand for energy sector will double, moderated by recycling



Source: RystadEnergy

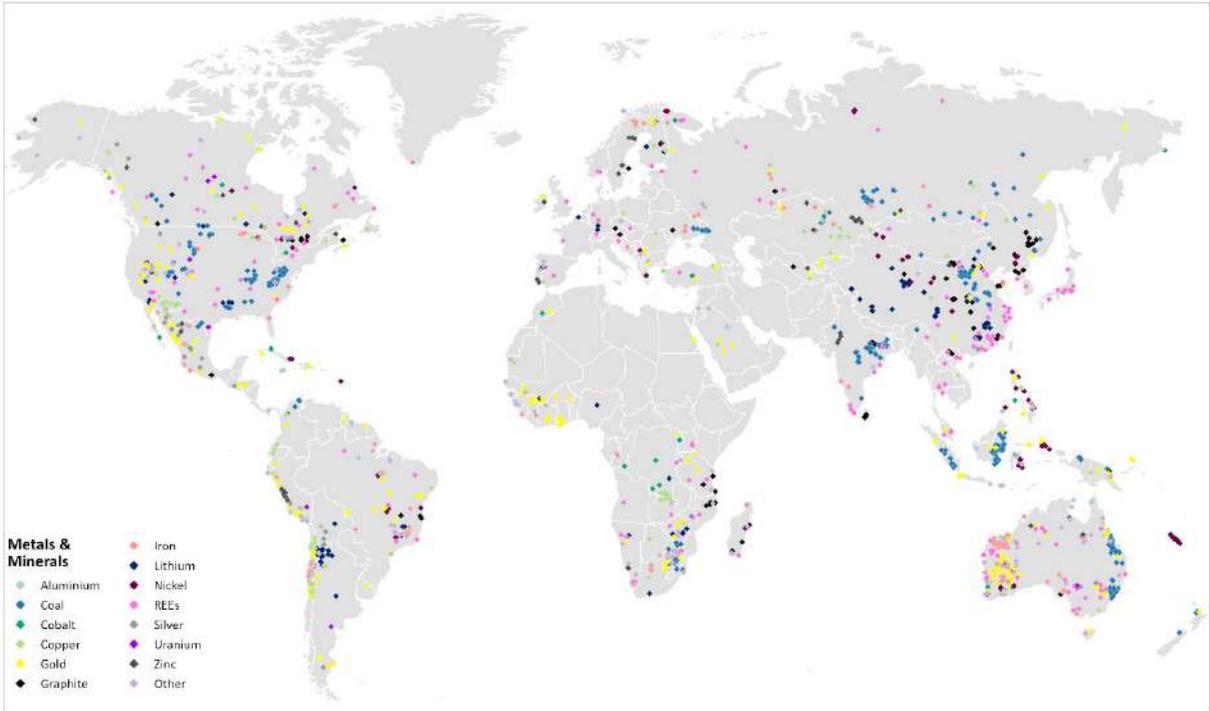
While the clean energy transition is prominently associated with the intensive use of these minerals, critical minerals are also indispensable for the physical backbone of the digital transition, enabling the infrastructure, devices, and AI technologies that drive modern digital economies. The rapid shift toward digitalisation, including data centers, 5G networks, and AI, is highly mineral-intensive, with demand for these materials projected to multiply in the coming years. What is more, the shift in geopolitics is spurring a global arms race including modern warfare weapons such as unmanned aerial vehicles (drones), which depend strategically on critical minerals.

⁴ Rare earth (REE) magnets are the strongest type of permanent magnets, composed of alloys containing elements like neodymium, samarium, and dysprosium. They are crucial for high-performance applications, including EV motors, wind turbines, and consumer electronics, due to their superior magnetic strength. They are brittle, often coated to prevent corrosion, and predominantly produced in China.

Historical forecasts from the International Energy Agency (IEA) suggest that demand for minerals for clean energy technologies will rise at least four-fold by 2040 to meet climate goals, with particularly high growth for minerals needed for electric vehicles (IEA, 2021). Graphite, nickel, lithium, and rare earth minerals are thus expected to witness explosive demand as a result of policy changes to meet climate goals. Although, recent setbacks to the global climate consensus cast uncertainty over future demand for energy-related critical minerals, the IEA (2025) still expects demand for critical minerals will continue to grow strongly.

While demand is global and heavily concentrated in the high-income, industrialised countries, primary production of critical minerals is relatively scattered, particularly amongst lower-income developing countries. Figure 3 presents a world map of active mines for select critical minerals showing that the spatial distribution of these mines is quite concentrated.

Figure 3. The distribution of active critical mines around the world is quite concentrated



Source: RystadEnergy

As a result, the major economic blocs, the United States, China, and Europe, are net importers of unprocessed critical minerals. The large net producers, on the other hand, include Australia, Russia, Kazakhstan, DRC, Mozambique, Chile, South Africa, and Zimbabwe. This structural imbalance between demand and supply lies at the heart of the geoeconomic tensions that characterise critical minerals.

The growing demand for critical minerals and concerns over global supply focuses attention on the nature and distribution of the production. Blundy (2026) contrasts the formation and distribution of ‘conventional’ metal ores, typically extracted through conventional mining techniques, with its reliance on energy-intensive and environmentally impactful rock excavation, crushing, beneficiation and hydrometallurgy, with alternative newer sources for critical minerals, notably saline geofluids and engineered aqueous solutions, such as geothermal or oilfield brines. Greater global distribution of saline geofluids compared to orebodies is highly advantageous for security of supply.

This focus on production also raises issues of the reliability of data on production data and its use in economic analysis. Barzin *et al.* (2026) use state-of-the-art techniques, combining satellite imaging and artificial intelligence to detect mines, and build a global database. A comparison of “new” and “old” techniques to record mines indicates a significant gap in the form of missing mines. In other words, global mining activity is substantially undercounted. Reasons for mismeasurement are multiple. They include strategic non-disclosure, sparse ground monitoring, weak state capacity, corruption, and disincentives to report illegal, taxable or environmentally damaging activities. The gap in data forces a rethink of the existing evidence on the environmental, social and developmental spillovers, stemming from the rapidly growing number of critical mines linked to critical mines.

In a similar vein, Eggert and Romani (2026) describe how standard tools from resource and energy economics, often developed in the context of analysing hydrocarbon markets, miss several critical features of the economics of critical minerals. They argue that engineering approaches, including bottom-up engineering models, life cycle assessment, material flow analysis, and other approaches, may lead to a better understanding of supply dynamics, demand and substitution opportunities and market prices, providing a stronger basis on which to support policy debates on supply chains, industrial strategy, and the energy transition.

A key feature of the demand for, and hence prices of, critical minerals is the impact of technology. Longer-term structural change and the greening of the energy sector will lead to a steady decline in the demand for hydrocarbons in favour of those materials that are inputs into renewable energy sources. But a key feature of this transition is the high degree of substitution *within* the class of critical minerals. Take for example lithium, which is used to make batteries. While lithium-ion batteries currently dominate the EV and hand-held device markets, a myriad of potential alternative technologies is being developed, including sodium-based batteries (Vu, 2025). Rapid and price-sensitive technological innovation raises the risk of obsolescence and

alters economic incentives from bringing forward production of critical minerals to the disruption of (partially) irreversible investment.

In sum, critical minerals pose new challenges to developing economies including in the way technological uncertainty and geopolitical tensions may affect demand and hence prices. Rapid technological evolution is driven by the usual “market size” effect but also importantly by the superpowers’ concerns about economic security, including the security of supply from politically unstable countries. Moreover, geopolitical tensions *between* economic superpowers risk disrupting these same supply chains. China controls the supply of lithium iron phosphate cells which essentially make other economic superpowers dependent.

The combination of technological uncertainty and geopolitical tensions, both of which may risk accelerated obsolescence, mean that expected price dynamics and hence strategies for reserve depletion are likely to stand in sharp contrast with those of conventional minerals.

From the perspective of developing economies, this potential obsolescence could have major economic consequences from the drying out of exports of critical minerals to the disruption of new investments, often associated with high sunk costs. This calls for more fiscal prudence and design of extraction and sale contracts to ensure adequate risk sharing between multinational corporations and governments in developing economies.

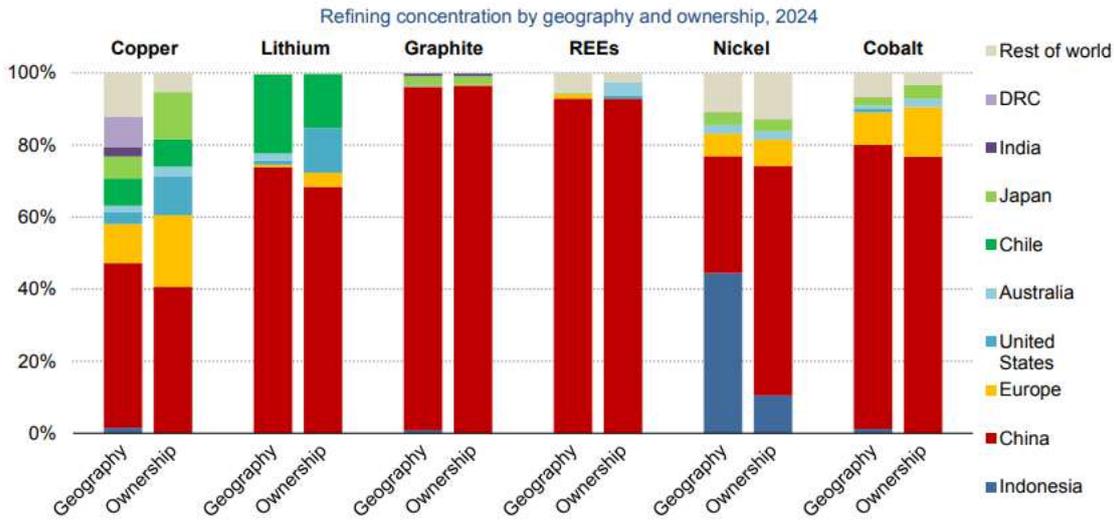
III. Geo-economic Considerations

The geography of primary mining versus processing of critical minerals is strikingly different. The supply of refined critical minerals is highly concentrated (IEA, 2025). Chile and Peru dominate in the production of copper, Indonesia the production of nickel, DRC the production of cobalt, and Australia and Chile the production of lithium. Aside from its dominance in the production of the group of rare earth metals,⁵ China is a minority producer of most other critical minerals. By contrast, China dominates the processing of copper, nickel, cobalt, rare earths, and lithium, accounting for 60% to 80% of global processed output. Figure 4 shows the concentration of the refining of critical minerals.

⁵ Rare earth elements consist of 15 Lanthanides (Lanthanum, Cerium, Praseodymium, Neodymium, Promethium, Samarium, Europium, Gadolinium, Terbium, Dysprosium, Holmium, Erbium, Thulium, Ytterbium, and Lutetium) plus Scandium and Yttrium and are used in high-tech magnets used in EVs wind turbines, catalytic converters, screens for digital devices, camera lenses, batteries, and so on.

It is the interaction of global imbalances in primary production and the extreme concentration in processing combination that underpins the two axes of geopolitical tensions around critical minerals. The first axis of tension is between strategic powers, especially China, and countries of the Global South around the security of upstream supply, and the second is between China and the US and Europe around security of downstream processed supply. These tensions are manifested in the proliferation of trade restrictions, including export controls by China on including gallium, germanium, antimony, and graphite with significant impacts on US semiconductor, defense and battery sectors,⁶ and retaliatory measures from the US ranging from strategic mineral stockpiling (Project Vault) to a range of bilateral critical mineral deals, both friendly and hostile, with countries such as DRC, Greenland and Ukraine. Figure 5 illustrates how essential inputs in the form of critical minerals put the US supply chain at risk, notably vis-à-vis China.

Figure 4. China dominates critical mineral mining by geography and ownership



Source: RystadEnergy

⁶ See discussion on IEA website: <https://www.iea.org/commentaries/with-new-export-controls-on-critical-minerals-supply-concentration-risks-become-reality>

projection framework. The authors find that geopolitical deterioration systematically induces significant precautionary stockpiling. They then construct a multidimensional friend-shoring index incorporating reserves, alignment, regime type and distance, showing that only a narrow set of United States partners, primarily Australia and Canada, offer feasible pathways for refining diversification. The policy recommendation stemming from these findings is that the United States should make strategic stockpiling of refined critical minerals, rather than raw ores, the centerpiece of its strategy to build supply chain resilience, while negotiating long-term bilateral packages for the supply of refined critical minerals with Australia and Canada.

Finally, Fodha *et al.* (2026) examine the economic rationale for opening new mines to extract critical raw materials in Europe, in search of strategic autonomy. They use a real-options framework to analyse a government's decision on the optimal timing of such an investment, taking into account mineral prices and domestic economic activity. The model incorporates geo-economic fragmentation risk as a source of uncertainty that materialises as jumps in critical raw material prices. While uncertainty would be expected to delay the start of mining operations, the results show that a countervailing effect also exists, which increases the expected value of the developed mine. Furthermore, the development of recycling does not clarify whether advancing extraction is ultimately socially desirable, underscoring the ambiguous theoretical implications of an expanding supply of secondary materials.

IV. Socio-Economic and Environmental Consequences of the Race for Critical Minerals

Natural-resource dependence, particularly amongst developing countries has always seen the prospect of substantial income gains paid with a range of 'resource curse' challenges, from environmental degradation, adverse health and poor labour conditions in mining localities, poor distributional outcome, and an elevated risk of local and cross-border conflict. Couttenier and Rohner (2026) revisit the complex links between mineral extraction and conflict in the context of a green transition that entails the simultaneous transition away from fossil fuel production and towards greater reliance on critical minerals. While the former may reduce traditional conflict flash points, increased, highly location-specific demand for critical minerals may replace these with other ones, reproducing the conflict dynamics observed in previous commodity booms, the archetypical example being the DRC, where violence is endemic in mineral-abundant provinces such as Katanga and North Kivu, fuelled by neighbours including Rwanda and Uganda. Couttenier and Rohner argue that targeted policy interventions including

corporate governance reforms, transparency initiatives, and the strengthening of democratic institutions and multilateral frameworks, can mitigate the risk of green-transition conflict, producing a “double dividend” of environmental sustainability and peace. Recent geo-political developments suggest, however, this “double dividend” will be extremely difficult to reap.

Mining of critical minerals can cause irreversible damages to the environment and are also a significant source of emissions of greenhouse gases, thus undermining climate goals. For instance, Azadi *et al.* (2020) provide evidence that primary mineral and metal extraction constitute 10 percent of greenhouse gas emission in 2018. That is set to increase significantly as demand for these minerals explodes and ore quality dwindles, which requires more energy-intensive forms of mining and processing to extract the same quantity of material. Importantly, Borgwardt *et al.* (2025) documents the century-long persistence of mineral pollutants. Mining of critical minerals is intensive in the use of water and can contaminate water, especially where standards and controls are weak. Winder *et al.* (2017) show how mining-induced heavy metal leaching creates toxic water and soil environments. Victurine *et al.* (2025) document that the risk of the energy transition causing a net-negative impact on nature.

These risks are exacerbated by the ‘Nimby’ politics of industrialised countries, where concerns over security of supply dominate considerations of environmental stewardship in producing countries. There is both need and scope for international corporations to step up their efforts and adhere to their home standards to avoid environmental and health damages in the most vulnerable countries where these minerals are extracted. If not confronted, these environmental degradations risk leaving people behind for decades in developing countries where the minerals are extracted. The same considerations are present with mining labour standards (e.g. Kutscher *et al.*, 2025).

The new geo-political environment in which mineral-rich developing countries have become the centre of attention of major powers may slow down, or even reverse, democratisation in many of these developing countries. This echoes the deleterious effect of oil on democratisation as documented by Ross (2012). Arezki, van der Ploeg and Ross (2026) argue that the shift from oil to mine in exporting countries perpetuates political power concentration. The strong hands of leaders on their societies are reinforced through these leaders’ international alignment with superpowers scrambling for critical minerals. That does not augur well for citizens and for the prospects of improved economic governance in those developing countries.

Katovich and Rexer (2026) use highly granular global data to explore these questions of local-level economic and ecological spillovers. They find that critical mineral price booms do lead to

local level spillovers, with both economic activity and deforestation increasing around mine, but that *both* of these effects are only significant in setting where regulatory environments are weak and corruption is high. This suggests a paradox: strong environmental and anti-corruption regulation may help mitigate environmental damage but at the cost of limiting potential local economic gains.

V. Managing Critical Minerals

The final cluster of papers in this issue of *OxREP* are concerned with policy options and choices. From the perspective of advanced economies, the critical policy issues centre around securing the resilience of access to critical minerals and the security of supply chains. Building on their network-based index of criticality of minerals, Fetzer and Lambert (2026) develop a taxonomy of industrial and regulatory policy instruments and choices consistent with supply-chain resilience, illustrating how the optimal constellation of alternative policy instruments (such as standards on procurement, recycling and demand management; strategic reserve management, trusted partner agreements, processing capacity guarantees, and offtake agreements; and tax, customs and registration policies) by particular countries depends on the nature of their dependency on others, in terms of trade shares, market concentration and the network centrality of partners, as well as on broader geopolitical considerations.

With a similar focus on supply-chain security, Felbermayr (2026) examines the role of so-called ‘diversification tariffs’ (DTs) for countries dependent on imports of critical minerals. These tariffs would apply to critical products from any country if its share of total domestic demand exceeds a certain threshold. DTs are practical and market-friendly instruments to incentivise diversification to guard against the risk of supply disruption, whether because unfriendly governments seek to weaponise dependency or for other reasons. Such a design would help to diversify the supplier base by encouraging imports from new sources. Compared to “laissez-faire”, DTs would push up the market price to be paid by users as the marginal seller would no longer be the least expensive one. However, if well implemented, in equilibrium, DTs are never really paid.

For developing country critical mineral exporters, the challenges are somewhat different. Traditionally, such countries have struggled to manage the proceeds from the exploitation of their natural resources leading to the well-known ‘resource curse’ problem, where countries rich in natural resources have consistently performed worse, across time and space, than those

that are resource-poor (e.g. van der Ploeg, 2011; Arezki *et al.*, 2018). The new geo-political environment in which the current scramble for critical minerals is occurring brings risks exacerbating resource curse problems. Two elements of the resource curse are the prevalence of rent-seeking and the so-called ‘Dutch disease’. Resource extraction generates very substantial rents, which increase the incentives for rent-seeking and state capture which, in turn, leads in the absence of strong political institutions to distorted public policy choices. Tornell and Lane (1999) describe a ‘voracity effect’ in which a terms-of-trade windfall leads to state capture by powerful groups. Robinson *et al.* (2014) provide a similar model in which incentives for state capture increase with exports of natural resources, while Ross (2012) provides evidence of rent-seeking in the oil industry.

The ‘Dutch disease’ effect, whereby a natural resource discovery or price appreciation leads to an expansion of the natural resource exporting sector and, as spending drives up the prices of non-tradable prices, leads to an overvalued real exchange rate, which in turn shrinks the non-resource export sector and typically depresses growth prospects (Eastwood and Venables (1982)). Arezki, et. al. (2017) suggest further that these effects are often driven by ‘anticipation effects’ so that the real exchange rate appreciates, the current account goes into deficit, and investment booms in response to the news of oil and gas discoveries ahead of a discovery.

The mitigation of the Dutch disease entails a range of institutional and policy responses. Torvik (2001) shows that the Dutch disease can be partially avoided when there is learning-by doing in the non-tradable sector and knowledge spillovers from the non-tradable to the tradable sector. Arezki and Ismail (2013) and Mehlum et al (2006) emphasise the role of the rule of law and quality of institutions, while van der Ploeg (2011) and Venables (2016) focus on the challenges of diversification of production. Arezki, van der Ploeg and Ross (2026) develop this final point by examining the risks and opportunities facing developing countries seeking to diversify within and beyond the (critical mineral and traditional) extractive sectors in environments characterised by massive technological and geo-political uncertainties associated with the era of critical minerals.

Mitigation of broader resource curse effects requires countries to establish stable and fair production sharing arrangements with multinational mining companies, supported by effective domestic fiscal regimes. This starts with transparent mining contracts, credible local contents policies, including around local processing of critical minerals, supported by effective mineral tax regimes. Collier (2026) highlights a range of measures developing country governments need to deploy to ensure international involvement in critical mineral extraction helps foster

sustainable economic growth. These include improving geological mapping, sequencing prospecting rights, implementing effective taxation, using critical minerals as leverage for debt restructuring and infrastructure investment, and addressing local impacts of mining.

On taxation, Rota-Graziosi (2026) argues that critical minerals differ from conventional extractive commodities in that the location of rent generation is moving downstream—from the mine to the plant—and toward intangible assets, including proprietary technologies, patents, and integrated digital service and support platforms. Drawing lessons from China’s fiscal approach – which helps shape the dominant node in the global critical minerals’ ecosystem – Rota-Graziosi outlines potential tax policy reform options for resource-rich economies. These include: (i) anchoring production pricing to transparent international benchmarks to mitigate transfer pricing abuses; (ii) reasserting the source principle in bilateral and multilateral tax arrangements; and (iii) revisiting the strict application of the VAT destination principle, particularly for unprocessed mineral exports. Finally, Manzano and Valdivia (2026) focus on the complement of the tax system, exploring how mining activities in Peru and the local governance structure shaping the redistribution of mining revenues affect educational at the local level. The authors show how this experience offers broader lessons for developing countries on how resource-based revenue sharing mechanisms can influence social outcomes.

VI. Conclusions

The geo-economics of the production, processing and control of critical minerals is one of the defining features of the current era of strategic rivalry between superpowers. The interaction between the fundamentals of the earth’s geology, the demand for new materials generated by the global energy and digital transitions, and the shifting balance of global economic and political power is re-defining policy choices for both advanced and developing countries. It is doing so in ways that hold out substantial potential welfare benefits to both the producers of critical minerals and to the consumers of the range of products and services. Yet without appropriate guardrails the extraction and processing of these minerals risk fuelling conflict, environmental damage and poverty with potential regional and global spillovers. That is precisely the lesson drawn from the papers in this issue. The task of embedding the economic policy frameworks that are required to realise these gains while limiting the risks is extremely challenging, both technically and politically.

Going forward, policy makers must be alert to the deep uncertainties surrounding critical minerals — structural, geopolitical, technological, and institutional. These uncertainties are of a fundamentally different nature than what we have witnessed with other commodities including oil. What the critical minerals era is generating is something closer to what the economist Frank Knight meant by uncertainty proper: not risk that can be quantified and priced, but irreducible unknowability about the structure of the game itself. The technology trajectory is uncertain. The geopolitical architecture is uncertain. The regulatory environment — who will set standards, enforce extraction norms, adjudicate supply disputes — is uncertain. The pace of the energy transition, and therefore the timing and magnitude of mineral demand, is uncertain. And for the developing countries that sit atop the richest deposits, the question of whether this moment will translate into lasting development or a new variant of the resource curse is perhaps the most uncertain of all.

Against this background, the design of extraction and sales contracts to ensure adequate risk-sharing between multinational corporations and governments in developing economies is particularly important. To do so, developing economies should consider longer-term contracts.

In the context of critical minerals, longer-term contracts can help reduce the uncertainty stemming from perceived political instability and geopolitical tensions, particularly those like the ‘take or-pay’ contracts for natural gas, which require purchasers to pay for a contractually specified minimum quantity of output, even if delivery is not taken. The counterpart of such contracts – which benefit producers – is that they blunt incentives to engage in innovation in substitutes, which may be welfare-reducing from a consumer (and indeed supply-chain security perspective) but welfare-enhancing in that they reduce inefficient R&D spending.

Long-term contracting alone will not suffice to deal with the inflexibility stemming from fluctuations in supply and demand. Contingent-claim contracts, which seek to specify the future terms of trade in a long-term contract at the outset of the relationship (Arezki, van der Ploeg and Ross, 2026). Contract design is difficult and the failure to ensure appropriate risk-sharing generates a version of the so-called ‘green paradox’ (whereby the announcement of a future carbon tax encourages fossil fuel owners to extract reserves more aggressively, thus exacerbating global warming).⁷ In this case the paradox arises when the incentives to accelerate extraction, creates supply gluts and price volatility, while at the same time increases the risk of worsening fiscal discipline amongst producers, and accelerated environmental degradation.

⁷ See van der Ploeg and Withagen (2015) for a review of the green paradox.

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www.ferdi.fr

contact@ferdi.fr

+33 (0)4 43 97 64 60