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Critical stocks, critical stakes

The effectiveness of critical mineral stockpiles in mitigating supply risks to energy, security and information

Hugh Miller and Juan Pablo Martínez

Policy report

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Summary

The digital and energy transitions, together with renewed rearmament, are driving up demand for critical minerals such as lithium, cobalt, copper and rare earth elements. These materials are vital for low-carbon energy, digital infrastructure and defence systems. Supplies are highly geographically concentrated and exposed to geopolitical tensions; their scale-up has been slow. Governments are therefore seeking greater security of supply, including through stockpiling schemes as a buffer against disruption.

This report assesses the effectiveness of strategic stockpiling in addressing five risks linked to critical minerals: market volatility, inflation, industrial competitiveness, energy security and national security. The focus is on the energy transition, with implications also considered for the digital and defence sectors. The report does not seek to advocate for or against stockpiling, but rather to evaluate its effectiveness across a range of policy objectives.

Our analysis finds that stockpiling can be an effective measure to mitigate acute risks related to critical minerals but needs to be part of a broader strategy to mitigate supply risks. In the right circumstances, stockpiling can help stabilise commodity markets and offer insurance against geopolitical disruptions. However, stockpiling has limited effectiveness to address more long-term structural risks, such as chronic undersupply or market tightness. Figure S1 provides an overview of the effectiveness of critical mineral stockpiling as risk mitigation against our five assessed objectives.

Figure S1. Overview of stockpiling effectiveness to mitigate critical mineral supply risks

	Market volatility	Inflation	Industrial competitiveness	Energy security	National security
Critical mineral stockpiling					

Note: Green indicates the action to be potentially effective; orange indicates the results would be non-optimal or unclear; and red indicates stockpiling to be an ineffective strategy. The dual-shaded boxes reflect the differing level of effectiveness depending on how stockpiling is implemented.
Source: Authors' assessment

Well-designed international stockpiling mechanisms can support longer-term goals of supply diversification and resilience, particularly when embedded within strategies that incentivise upstream investment. For example, offtake agreements during stockpile build-up and coordinated action between import- and export-dependent countries can help stabilise prices. Conversely, poorly implemented or uncoordinated stockpiling schemes may distort markets, discourage investment and trigger international tensions. However, where objectives such as industrial competitiveness or national security dominate, the asymmetric benefits may hinder the ability of countries to agree an international stockpiling mechanism.

If multiple countries pursue stockpiling, coordination through an international framework may help to mitigate the risks of fragmented national approaches, such as market distortion or duplication of effort. For effective international coordination, the host institution must have sufficient expertise on critical minerals, the correct mandate to have the necessary credibility, and a broad enough membership. The International Energy Agency (IEA), with its mandate on energy security and emerging work on critical minerals, could be suitable to support such coordination. Its voluntary Critical Minerals Security Programme may offer a platform for exploring this further. However, more research is needed to assess the roles, mandates and capacities of different international organisations in this space. A clearer understanding of institutional complementarities will be important to inform the design of any future internationally coordinated stockpiling initiative. Given the structural challenges of the energy transition and the limited short-term flexibility in mineral supply, stockpiling is best understood as a tool for mitigating acute volatility and temporary disruptions, rather than resolving longer-term supply constraints.

Recommendations

We make five policy recommendations, developed under the assumption of an internationally coordinated stockpiling initiative, to support economic objectives concerning the energy transition:

1. **Agree international coordination on mineral scope within strategic stockpiling initiatives.** Develop common lists of minerals to be included or at least a shared methodology to assess criticality, which would enable greater flexibility but still ensure a common objective of stockpiling. This would avoid the unintended consequences of unilateral actions that may exacerbate supply risks.

2. **Establish international coordination on stock calibration.** Agree the appropriate size and timing of buffer stocks, with participation from both export- and import-dependent countries. International stock calibration will ensure there are no 'free riders' within the agreement and countries equally share the burden of accumulating buffer stocks.

3. **Develop international pre-agreement on clear release conditions.** Define transparent criteria for releasing buffer stocks, alongside transparent reporting of stocks and monitoring of commodity prices. Pre-agreed conditions would enable the quick and efficient release of stocks in response to market disruptions.

4. **Adopt hybrid policy design for the type of stockpiling programmes.** Tailor stockpiling designs – public, private or market-based – to reflect the national risk profiles, sectoral exposure and structure of different mineral markets. Hybrid policy design would offer flexibility to countries to tailor their own stockpiles to best suit their risk profile.

5. **Embed the policy within a broader industrial and trade policy strategy.** Integrate stockpiling within a comprehensive strategy to address longer-term solutions, such as supply chain diversification, circular economy measures and support for R&D for increased mineral efficiency. Partial reshoring of mineral extraction and refining may play a complementary role: these additional policies would support the objectives of stockpiling efforts and mitigate longer-term risks that stockpiling alone is unable to adequately address.

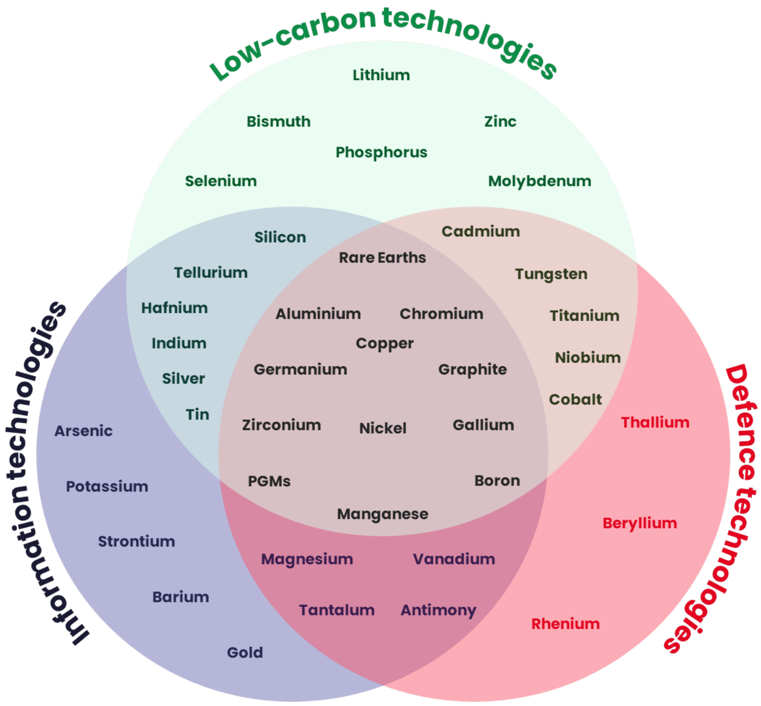
1. Introduction

Critical minerals are rising on the agendas of governments around the world due to their role in energy, digital and defence technologies. Supplies are highly geographically concentrated and growing geopolitical tensions have heightened concerns over the reliability of supply. One emerging response is strategic stockpiling, used as a buffer against disruptions to protect economic and national security. This report assesses how effective stockpiling can be in reducing supply risks. It examines the current state-of-play and the effectiveness of this policy to mitigate the associated supply risks.

Context

Critical minerals, or 'critical raw materials', first appeared in policy in the United States under the 1939 Strategic and Critical Materials Stockpiling Act (U.S. Government, 1939) . Since then, the term has become central to national security discourse, typically defined by a mineral's strategic economic importance and supply vulnerability (Coulomb et al., 2025). Today, many jurisdictions, including the US, EU, UK, Japan, South Korea, Australia and Canada, maintain formal lists of these materials (Nully and Jowitt, 2021). While traditionally linked to defence manufacturing, critical minerals have gained renewed attention amid today's dual digital and energy transitions. In a tense geopolitical climate, having reliable access to these minerals is a priority for many countries. Some minerals, such as rare earth elements (REEs), have wide-ranging uses, from electric vehicles (EVs) and wind turbines to advanced defence systems. Others, such as lithium, are primarily concentrated in a single high-demand technology: lithium-ion batteries. Figure 1.1 provides an overview of key critical minerals and their strategic uses.

Figure 1.1. Overview of critical mineral use in strategic sectors



Note: Almost all metals have cross-sectoral uses, but this chart reflects their main sectoral applications. 'PGMs' stands for Palladium Group Metals. Source: Authors' illustration adapted from IEA (2025b) and SFA, Oxford (2025).

The growing importance of critical minerals has reignited discussions around strategic stockpiling, echoing earlier initiatives for petroleum. Stockpiles are generally named for their intended purpose, which may be either national security or economic in nature. While the initial rationale for developing such reserves is often similar, the types of materials stockpiled and the conditions under which they are released can vary significantly. A defence stockpile, for instance, is designed for release only in the event of a direct conflict. By contrast, an economic stockpile functions as a buffer to mitigate supply shortages and sharp price fluctuations caused by market disruptions (Congressional Budget Office, 1983). Stockpiling, particularly for food commodities, was common post-World War II but lost traction in the latter half of the 20th century due to the rise of international trade (Caballero-Anthony et al., 2016).

Government-backed programmes for stockpiling strategic non-energy minerals have long featured in national security strategies (U.S. Government, 1939). Separately, in response to the oil supply shocks of the 1970s, members of the International Energy Agency (IEA) are required to maintain strategic petroleum reserves (SPRs) equivalent to 90 days of net imports (IEA, 2024a). These reserves have been tapped during crises such as the Arab Spring and the invasion of Ukraine (IEA, 2022b), with the aim of stabilising prices and shielding households and businesses from abrupt cost increases.

More recently, the economic rationale for stockpiling critical minerals has come to the fore. As their role in the global economy grows, and the risks to their supply chains mount, countries have begun to establish or expand economic buffer stock initiatives. For example, in 2020, Japan tasked the Japan Oil, Gas and Metals National Corporation (JOGMEC) with expanding rare metal reserves to cover up to 180 days of national consumption, specifically to mitigate economic risks (IEA, 2025d).

Aims and structure of the report

This report examines the potential of strategic stockpiling as a policy tool to address both economic and security risks related to critical minerals. The analysis takes a cross-sectoral approach, focusing primarily on the energy transition while also considering the implications for the information technology and defence sectors. The analysis evaluates the effectiveness of different stockpiling policy designs to mitigate five economic and security risks arising from critical minerals, namely market volatility, inflation, industrial competition, energy security and national security.

The report is structured into the following sections:

- **Section 2** explores the mineral demand from the twin energy and digital transitions and the changing structure of the global economy.
- **Section 3** provides an overview of current stockpiling initiatives and other supportive policies.
- **Section 4** examines options for policy design and effectiveness of strategic stockpiling.
- **Section 5** provides conclusions and recommendations to policymakers.

2. Twin transitions in a fractured geopolitical landscape

The global economy is undergoing twin transitions that are increasing the demand for critical minerals: the energy transition and a digital revolution. This is happening in a context of geopolitical fragmentation that is driving global rearmament. This section provides an overview of the different macroeconomic and political drivers that are driving demand for critical minerals.

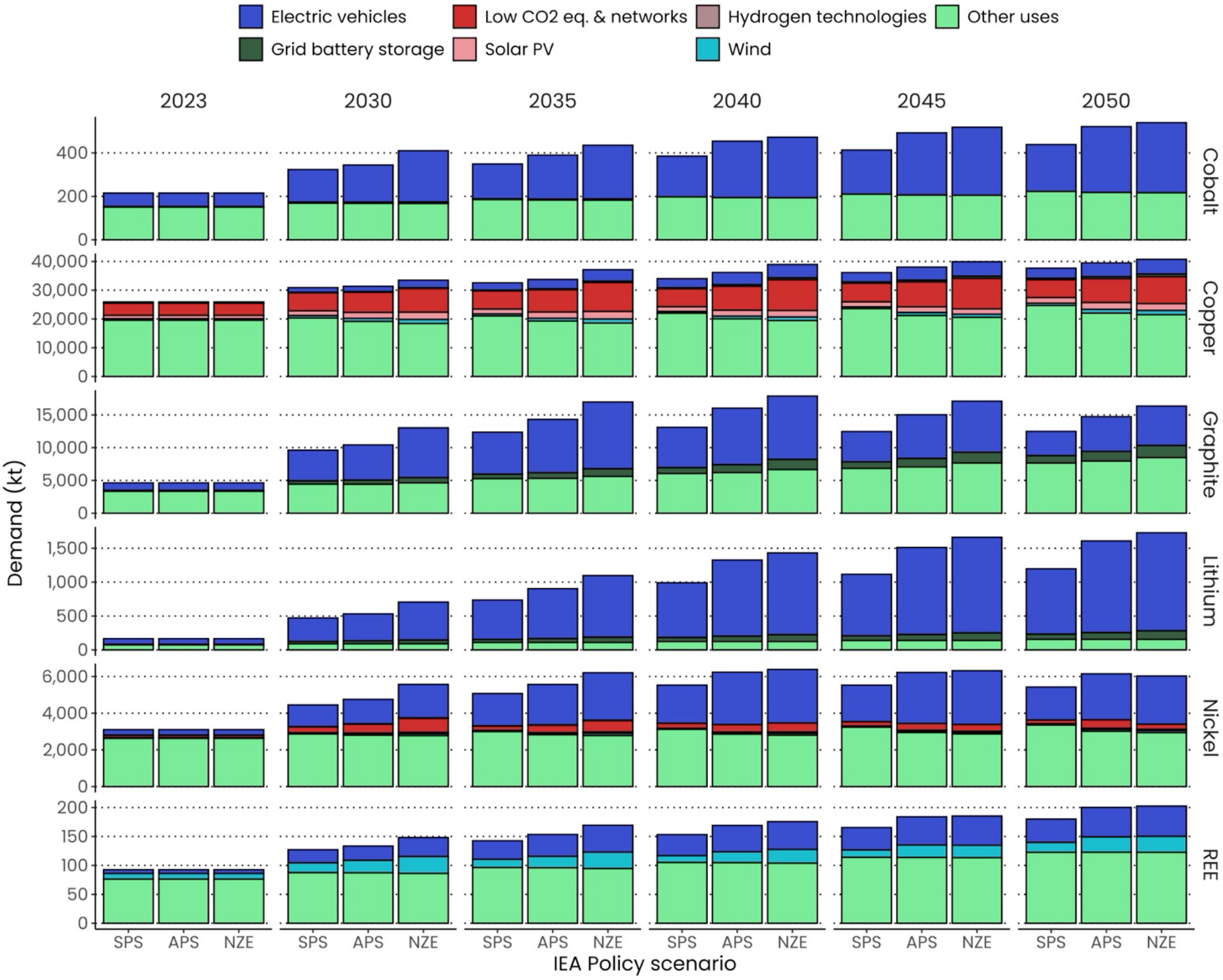
The changing structure of the global economy

The shift from fossil fuels to renewable energy technologies, alongside the rapid adoption of digital innovations such as generative artificial intelligence (Gen AI), is significantly increasing demand for specific minerals. Meanwhile, the increase in geo-fragmentation is both further driving critical mineral demand from defence technologies and inhibiting global supply, with the barriers to global trade flows of critical minerals and associated manufactured products growing significantly.

In the energy sector, two dynamics are particularly relevant. First, renewable technologies are substantially more critical mineral-intensive than fossil fuel-based systems (IEA, 2021b). Second, achieving climate targets set out in countries' nationally determined contributions (NDCs) requires a rapid shift from a commodity-based energy system that focuses on the flow supply of oil to a commodity-based system of critical minerals that are required for the infrastructure stock of energy. While fossil fuels provide energy through continuous extraction, renewables rely on infrastructure, such as solar panels, wind turbines and energy storage systems, that must be built in advance. This results in a sharp, upfront demand for the critical minerals needed to deploy these technologies at scale. This difference leads to differing severity in the ramifications of supply shocks from critical minerals compared with fossil fuels. While supply shocks to fossil fuels imply a direct shock to energy supply, shocks to critical minerals imply a shock to the growth of the supply of energy, which would have less severe economic implications.

Figure 2.1 illustrates the projected demand increase under different transition scenarios for selected critical minerals: cobalt, copper, lithium, nickel and rare earth elements (REEs). The primary demand for these stems from the deployment of electric vehicles (EVs). For REEs and graphite, demand increase is also attributed to other sectors that are not associated with the energy transition. For example, REEs and the permanent magnets they make are used in defence technologies. The current rearmament of several Western economies in response to rising geopolitical tensions may increase demand for these minerals (Wischer, 2024). Consequently, rapid increases in demand for minerals for the energy transition, digital revolution and rearmament efforts may create short- to medium-term supply–demand imbalances. This is particularly likely given the inelasticity of supply for these minerals, which remains inelastic even five years after a structural shock in some cases (Miller and Martinez, 2025).

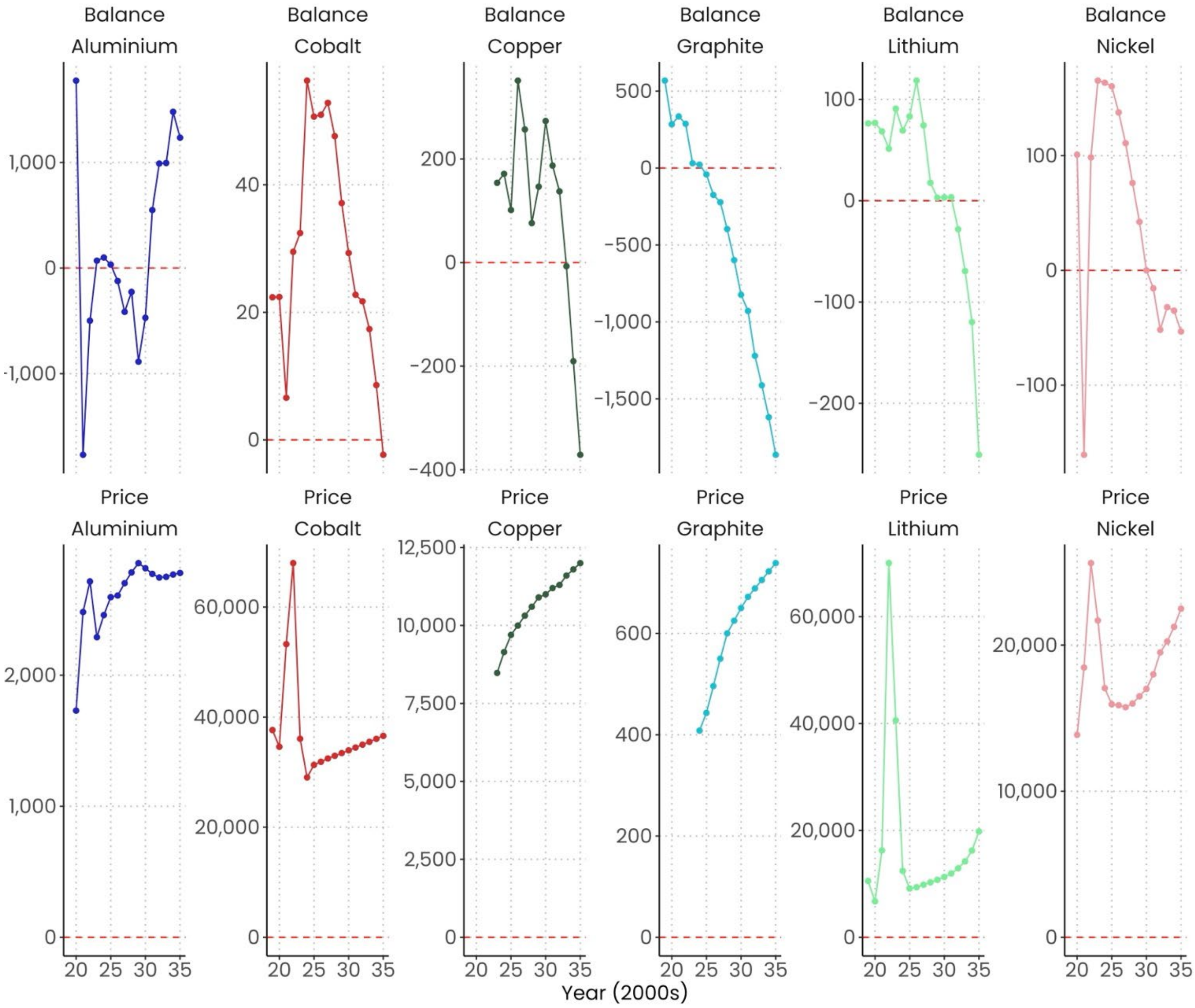
Figure 2.1. Demand projections for selected critical minerals under IEA energy transition scenarios



Notes: 1) SPS = Stated Policies Scenario, which reflects current policy settings based in sectoral and country-level assessments. 2) APS = Announced Pledges Scenarios, which assumes that all climate commitments made by governments and industries around the world are met in full and on time. 3) NZE = Net Zero Emissions by 2050 Scenario, which reflects a pathway for the global energy sector to achieve net zero CO_2 emissions by 2050. REE = magnet rare earth elements. 'Other uses' includes the defence and IT industries.
Source: Authors' adaptation from the IEA database on critical minerals (IEA, 2025a)

Several critical minerals are projected to face supply shortfalls by 2035, as shown in Figure 2.2. These imbalances are likely to result in upward pressure on prices. Importantly, market balance projections made by S&P Global, which measure projected supply against anticipated demand, fall short of demand levels anticipated under the IEA's Net Zero Emissions scenario. This suggests that more ambitious transition pathways may be further constrained by supply-demand imbalances. Beyond the differing level of climate ambition reflected in the projections, they do not account for the potential geopolitical turmoil that may reduce the availability of supply and induce market tightness in certain locations.

Figure 2.2. Projected supply-demand market balances and prices for selected minerals, 2020-2035

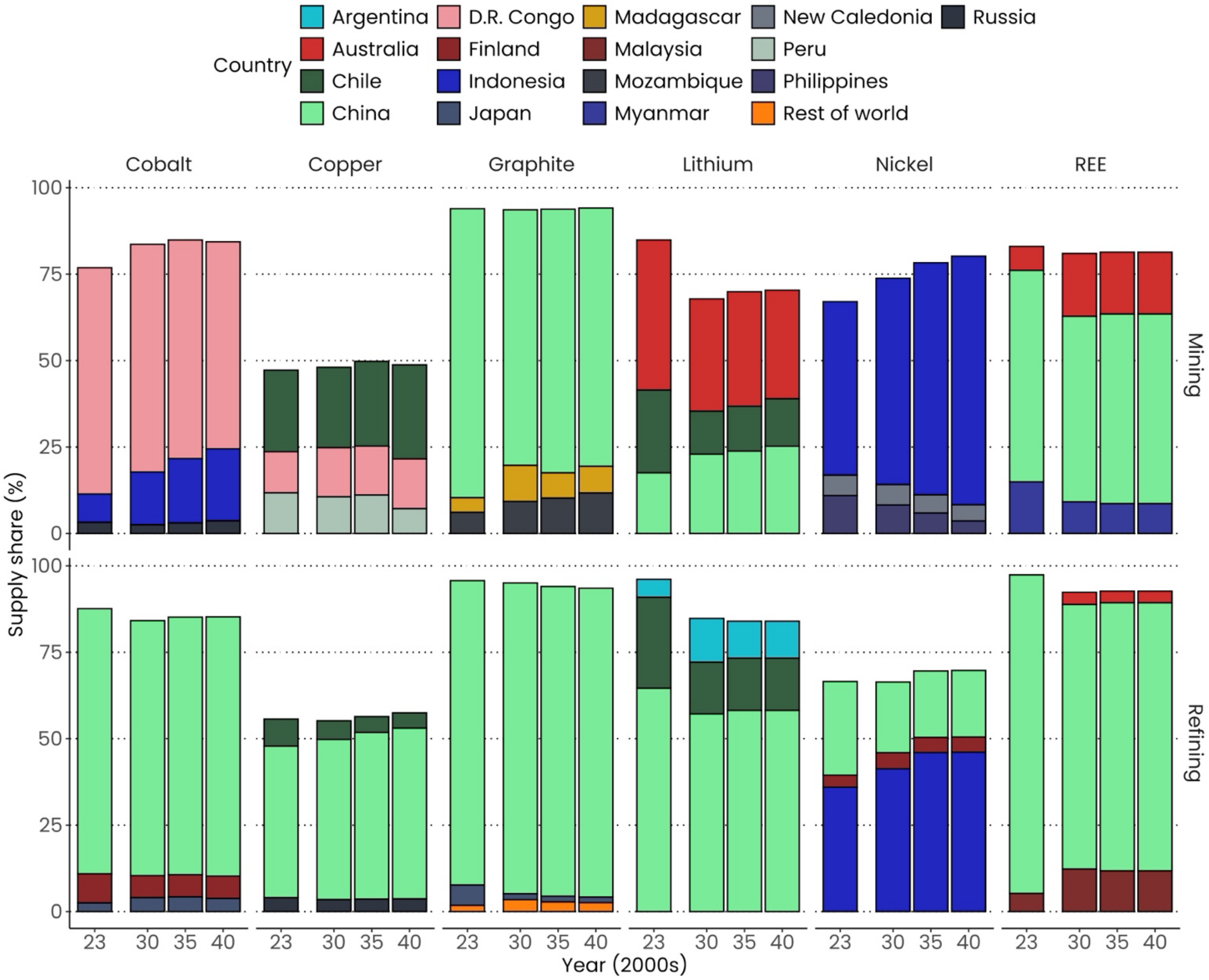


Note: Market balance is measured in thousands of tonnes. Prices are measured in US$/tonne.
Source: Authors' calculations based on data from S&P Capital IQ Pro (2025)

Critical mineral supply chains are highly geographically concentrated. As shown in the first panel of Figure 2.3, the top three country producers often account for over three-quarters of global extraction. The IEA expects this geographical concentration to rise for the next 15 years. For example, Indonesia produced half of the world's nickel in 2023, a share projected to rise above 70% by 2040.

Refining is even more concentrated. In many cases, a single country dominates global output of processed materials, with ownership of many facilities lying beyond their geographical borders (Leruth et al., 2022). This structural concentration poses risks to the energy and digital transitions, particularly in a more geopolitically volatile global context. The potential for export restrictions or supply weaponisation could undermine progress on low-carbon technologies, disrupt productivity gains associated with information technologies, and threaten national security objectives.

Figure 2.3. Geographical concentration of global supply, 2023-2040 (from IEA projection)



Note: REE = magnet rare earth elements.

Source: Authors' adaptation from the IEA database on critical minerals (IEA, 2025a)

A changing geopolitical landscape

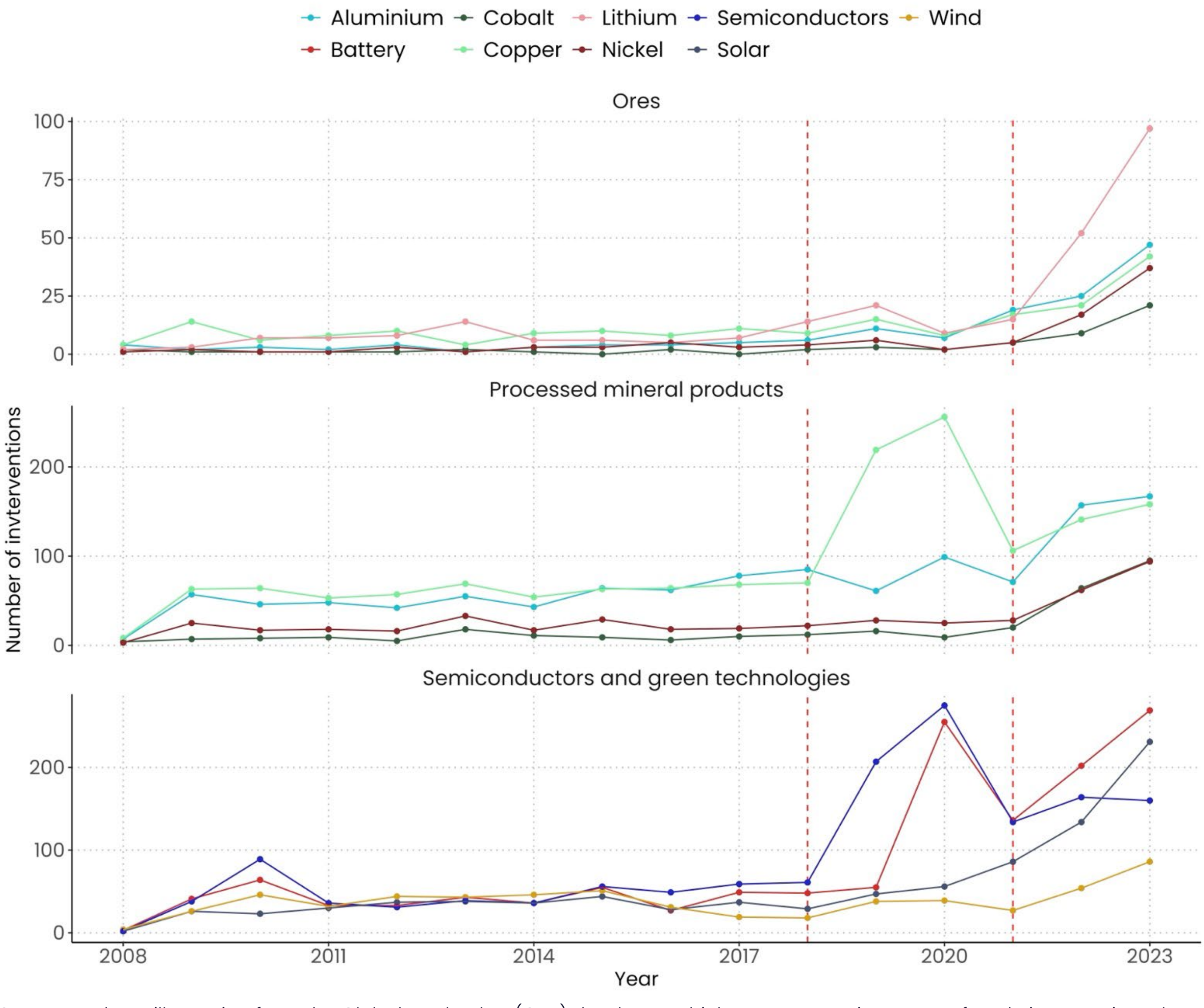
Wariness towards the globalised economy has become more common across Western economies. These concerns were exacerbated by the COVID-19 pandemic and subsequent inflationary episodes that hit the global economy, the disorderly shutdown of which highlighted supply chain vulnerabilities. Indeed, specialisation, driven by globalisation, has led to greater concentration of global supply due to comparative economic advantages, which in turn has heightened their vulnerability (Niepmann and Felbermayr, 2010).

Geo-fragmentation is on the rise. De-risking supply chains has come to the forefront of policy, with countries potentially sacrificing GDP growth in exchange for greater security of supply, by foregoing the cheapest source of imports in favour of more diversified supply chains (Cerdeiro et al., 2024). This trend is reflected in the growing number of trade restrictions affecting critical minerals and downstream strategic industries such as semiconductors and clean energy technologies (see Figure 2.4).

Since 2018 there has been a substantial increase in announced restrictive trade policies that affect critical minerals (aluminium, copper, nickel, cobalt and lithium), clean technologies and semiconductors. Battery technologies saw the greatest increase – of more than 431% – in restrictive trade policies between 2018 and 2020, while restrictive policies related to processed copper products and semiconductors increased by 265% in the same timeframe (Global Trade Alert, 2025). This reflects heightened geopolitical tensions that arose due to the trade war between the US and China over this period.

Since 2021 there has been sustained growth in policies that limit the free trade of critical mineral ores, processed products and downstream technologies. The increase in trade barriers reflects the push towards more resilient supply chains. Governments across the world are concerned by the negative effects of international trade, as well as the resulting supply vulnerabilities. Thus, reshoring and stockpiling policies have become more commonplace in the political agenda of economies.

Figure 2.4. Trends in trade restrictions against select critical minerals and strategic technologies



Source: Authors' illustration from the Global Trade Alert (GTA) database, which serves as an inventory of trade interventions that either liberalise or restrict the flow of goods in between countries (Global Trade Alert, 2025)

Five economic and security risks from critical minerals

The reliable supply of these minerals is paramount to achieving countries' climate policy targets and fulfilling the objectives of the Paris Agreement. As critical mineral demand pressures increase from the growth of strategic sectors, so too do the economic and security risks, particularly for import-dependent countries. High geographical concentration in extraction and refining further increases supply chain vulnerability. Below we outline five core fiscal and financial risks: market volatility, inflation, industrial competitiveness, energy security and national security.

Market volatility

Short-term supply disruptions can trigger sharp market reactions, often driven by 'expectational demand' shocks and liquidity constraints in financial markets. For example, nickel prices surged by 250% following Russia's invasion of Ukraine, prompting the London Metal Exchange to suspend trading (Szalay et al., 2022). Uncertainty in price volatility from supply disruptions negatively impacts import-dependent firms, particularly those without substantial inventories to mitigate the risks (Lafrogne-Joussier, 2023). Small- and medium-sized enterprises (SMEs) may have fewer resources to dedicate to inventory stockpiles and therefore may be disproportionately exposed to market volatility shocks.

Market disruptions can affect spot and futures markets in distinct ways. Immediate supply threats, such as extreme weather which may disrupt production, tend to drive up spot prices and near-term futures, potentially triggering 'hyper-backwardation'[1] (Razek et al., 2023). In contrast, disruptions that signal future supply constraints, such as trade barriers, primarily affect futures, as market participants adjust expectations in anticipation of shortages (Miller and Martinez, 2025). More broadly, the rise in financialisation of commodity markets over the last 30 years has greatly increased trading volumes, the correlation with stock market returns, and price volatility (Kang et al., 2023). This trend increases the market impact and financial risks arising from disruption in commodity markets.

Inflation

Persistent supply–demand imbalances in critical mineral markets may contribute to both core and headline inflation, particularly for broad-use metals such as copper (Miranda-Pinto et al., 2024a). In countries with high exposure to metal prices, the cumulative effect of a 1% increase in copper prices is estimated to raise regional headline and core inflation by 0.05 and 0.03 percentage points, respectively (Miranda-Pinto et al., 2024b). As demand for these metals increases from several sectors, including energy, it may magnify the impacts on inflation over the long term.

Historically, oil prices have been the main driver of global inflation volatility, accounting for over 38% of variation. A 1% increase in oil prices is estimated to raise global inflation by 0.035 percentage points on average within a year, and by 0.055 percentage points over three years (Ha et al., 2024). The evidence for metals is more limited, though: the findings indicate metal price shocks contribute significantly towards core inflation, leading to greater persistency in impacts. Indeed, analysis by the Central Bank of Finland suggests commodity supply disruptions, including those from raw materials, had a material impact on the inflationary pressures experienced in the wake of the invasion of Ukraine (Oinonen and Vilmi, 2024).

Industrial competitiveness

The twin digital and energy transitions offer significant growth opportunities for strategic sectors, particularly in regions that can leverage comparative advantages. However, realising these

[1] Backwardation refers to the state of commodity markets where spot prices are higher than futures prices, with longer dated futures prices falling. Hyper-backwardation occurs in extreme cases where spot prices are significantly higher. This reflects a severe imbalance in supply-demand dynamics in the current market, with the expectation of severe and imminent shortages.

opportunities depends on secure and reliable supply chains. Companies that import supplies have twice the inventory of firms that only purchase materials domestically (Alessandria et al., 2010). Anticipated supply disruptions and price volatility alter firm behaviour from 'just-in-time' to 'just-in-case' for inventory management (Zhang and Doan, 2023). Firms 'buy forward' to stockpile certain inputs as an implicit hedge against short-term price expectations (Gerken et al., 2019). While such strategies may reduce exposure to near-term supply and price shocks, they divert financial resources from more productive uses such as research and development (R&D) and expose firms to downside risks if prices subsequently fall. Heightened supply risks from critical minerals may force firms to either divert further resources towards inventories or expose them to acute supply disruptions. The location and reliability of upstream mineral production, and of downstream manufacturing capacity, therefore play a critical role in shaping industrial competitiveness. The geographical dispersion of semiconductor supply chains, in contrast to the concentration seen in solar PV and battery technologies (see Appendix 1), illustrates the potential risks to industrial competitiveness, particularly for clean technology firms in import-dependent countries.

Energy security

The energy transition is altering the global economy's dependence on traditional fossil fuels towards critical minerals for the deployment of clean energy infrastructure. Under a flow-based fossil fuel energy infrastructure system, disruptions to the supply of energy have immediate and substantial impacts on the economy. To mitigate these risks, import-dependent countries have typically held strategic petroleum reserves (SPRs) (IEA, 2024a). In contrast, the role of critical minerals in clean energy systems is largely stock-based, requiring large upfront investments in mineral-intensive infrastructure such as wind turbines, batteries and solar PV. In this context, supply disruptions do not create immediate energy shortfalls but instead slow down infrastructure deployment, delaying the expansion needed to meet demand. This can produce persistent 'short squeezes' in energy availability, causing gradual price rises rather than the sharp swings typical of fossil fuels. Thus, while critical mineral shocks may pose a less direct risk to energy security than traditional fuel shocks, they could still cause electricity price rises if low-carbon technological deployment lags behind demand growth.

National security

Critical minerals are essential inputs for a wide range of defence technologies, making their secure supply a national security priority. For import-dependent countries, access to these materials represents a strategic vulnerability, particularly in the current environment marked by rearmament and rising geopolitical tensions. The North Atlantic Treaty Organisation (NATO) recently identified 12 defence-critical raw materials necessary for the Allied defence industrial base (NATO, 2024). Disruptions to the supply of these inputs could impair defence preparedness and operational capability.

The risks stemming from critical minerals present a mixture of both acute and more chronic risks to the energy transition and growth of the global economy. To overcome these challenges, policy is required to mitigate immediate short-term disruptions and volatility in prices, as well as longer-term policies to diversify and increase global supply. Against this background, in the following sections we assess the effectiveness of strategic stockpiling to mitigate these risks and support the global energy transition.

3. Overview of current initiatives and supportive policies

This section examines stockpiling initiatives that are directly related to critical minerals. Given the high geographical concentration in global refining capacity, critical mineral stockpiling initiatives focus on processed minerals rather than raw ores.

Strategic stockpiling across the world

Several countries already have strategic stockpiling policies, with different objectives and mechanisms. The first state policy was the US government's, with the Strategic and Critical Materials Stockpiling Act of 1939. The Chinese authorities were next, implementing a long-run strategy to safeguard the supply of specific commodities in the 1980s (Caixabank, 2025). Subsequently, several countries have undertaken stockpiling programmes in response to growing economic security concerns. Stockpiling efforts are currently fragmented, with most countries acting unilaterally. A notable exception is the EU's Preparedness Union Strategy, which aims to coordinate stockpiling and enable joint procurement across national and EU levels (European Commission, 2025).

There is no consistent identification of critical minerals or methodology to assess criticality across jurisdictions (Nully and Jowitt, 2021). All possibles sources of supply disruption tend to be considered, but currently, particular attention is given to geopolitical risks and geographical concentration of upstream sectors (Hotchkiss et al., 2024). Criticality assessments additionally consider the substitutability and economic importance of different minerals (European Commission, 2020; Coulomb et al., 2015; Hatayama and Tahara, 2015).

Several clean energy technologies are heavily reliant on copper, lithium, nickel or graphite as inputs (see Figure 2.1). In response to risks facing the low-carbon transition, and growing pressures to capture the economic benefits of strategic technology industries, several countries have adopted policies to guarantee a reliable supply of minerals. This includes setting strategic stockpile thresholds based on minimum levels of domestic sufficiency over a defined period. For example, Japan and South Korea aim to maintain reserves sufficient for at least 60 and 100 days, respectively (METI, 2020; Ministry of Trade, Industry and Energy, 2023).

The conditions for releasing strategic stockpiles vary across countries, reflecting different policy objectives. In many cases, the goal is to stabilise domestic markets. For example, the governments of Japan, China and South Korea release stockpiles in response to sharp price increases and replenish inventories during periods of lower prices (Ministry of Trade, Industry and Energy, 2024; Reuters, 2021; Japan Organization for Metals and Energy Security, 2002). In contrast, the U.S. Strategic and Critical Materials Stockpiling Act has prioritised national defence objectives, with limited emphasis on economic or budgetary considerations (U.S. Department of Defense, 2025).

The institutional arrangements for managing strategic stockpiles vary significantly across countries. In some cases, a dedicated government body oversees inventory management. For example, Switzerland's Office for National Economic Supply (FONES) is responsible for critical goods and administers compulsory stock agreements with private companies (FONES, 2025). By contrast, in the US, stockpiling is overseen by a multi-agency board comprising representatives from the Departments of Defense, Commerce, State, Energy and the Interior (Keys, 2023). Some governments also engage actively with the private sector to identify critical inputs, develop commodity priority lists, and even allocate public funds to support downstream industries and reduce bottlenecks across supply chains (Ministry of Trade, Industry and Energy, 2023; Fones, 2025).

Table 3.1 provides an overview of current stockpiling policies announced by governments.

Table 3.1. Overview of strategic stockpiling programmes

Country	Stockpiling programme	Critical minerals covered	Aims and objectives	Mechanism
South Korea	National Program for Metal Stockpiling	Al, Cu, Pb, REE, Zn, other commodities	- Stable supply of raw materials - Diversification of import sources - Stockpile 100 days of supply	- Centralised procurement - Planned release to ensure price stability
Japan	International Resource Strategy – National Stockpiling System	Co, Li, Ni, Si, REE + 29 other minerals	- Stable supply of raw materials - Diversification of import sources - Stockpile 60-180 days of supply	- Strengthened multilateral cooperation - Strengthened industrial infrastructure
France	Multiannual Planning for Energy	U, REE	- Stable supply of raw materials - Diversification of import sources	- Long-term contracting - Recycling for reducing primary demand
United States	Strategic and Critical Materials Stockpiling Act	Co, Cr, Li, Ni, REE, Zn + 43 other minerals	- Tackle supply risks	- Acquisition and retention of materials to be used for national defense
India	National Critical Minerals Mission	Co, Li, Ni, REE	- Secure domestic and foreign sourcing - Strengthen value chains	- Domestic exploration - Facilitating acquisition of foreign assets - National stockpile for at least five critical minerals
European Union	Critical Raw Materials Act and EU Preparedness Union Strategy	Al, Co, Cu, Li, Ni, REE + 11 other minerals	- Secure domestic and foreign sourcing - Strengthen value chains - Membership coordination	- Strengthened multilateral cooperation - Facilitating joint procurement and national-level stockpiles
People's Republic of China	Belt and Road Initiative	Al, Co, Cu, Li, Ni, Zn, other undisclosed	- Domestic market stability - Strategic reserve promotion	- Long-term contracting - Strategic release and storage
Switzerland	National Economic Supply	U and non-mineral products	- Supply security	- Private-held stocks - Federal government chooses products and quantities

Notes: Minerals' IMA symbols – Al: aluminium, Co: cobalt, Cr: chromium, Cu: copper, Gr: graphite, Li: lithium, Ni: Nickel, Pb: lead, REE: rare earth elements, Si: silicon, U: uranium, Zn: zinc. Beyond the policies listed above, Australia has recently announced its intention to implement a stockpiling initiative.
Sources: IEA (2025d); Ministry of Mines (2025); European Parliament (2024); FONES (2025); Caixabank (2025)

In summary, global strategic stockpiling initiatives vary greatly, shaped by differing policy objectives and they are managed by distinct government bodies. These policies present significant institutional challenges due to the coordination required across sectors and countries. Furthermore, given the high dependence of many countries on imports of critical commodities, active international engagement is essential.

Costs and benefits of stockpiling programmes

Strategic stockpiling necessitates coordination across multiple government agencies and sustained engagement with the private sector to accurately identify priority materials for downstream industries. Given the associated costs, a comprehensive assessment of the feasibility, costs and benefits of such a strategy is essential.

Stockpiling includes the significant upfront acquisition costs of materials, long-term storage and monitoring, and the administrative burden of coordination across stakeholders. A key determinant of costs is whether governments choose to stockpile the refined commodities or the downstream intermediate and final products. For example, the estimated acquisition cost for an EU-wide critical mineral stockpiling programme to support the green and digital transitions ranges from €6.45 billion to €25.8 billion, depending on the composition of the buffer stock (Rietveld et al., 2022).

Notwithstanding the upfront cost, stockpiling initiatives offer several benefits, most notably, economic resilience against supply disruptions, and they can support longer-term policies to diversify supply, if implemented correctly. Stockpiling mechanisms may also confer monopsony power to governments, allowing them to negotiate lower prices, thereby lowering acquisition costs for local producers and the stockpile itself. This approach is used as part of the Korean National Program for Metal Stockpiling (Ministry of Trade, Industry and Energy, 2023). Strategic stockpiling can support price and financial stability by serving as a tool to smooth price volatility. This is of particular importance to capital-intensive industries, where reducing price uncertainty can lower investment risk and improve project viability.

The counterfactual of not holding buffer stocks exposes import-dependent economies to various economic and security risks (as described in Section 2). Hence, there is an unknown cost associated with the current vulnerability of countries' critical mineral supply chains. Developing domestic mining and refining capacities represents another alternative, but one that entails high entry costs, with high capital costs and environmental trade-offs. Moreover, the lead time for developing new mines is often over a decade and increasing (Manalo, 2025). This limits the possibility of developing domestic mining and refining capacity as an effective policy response to supply vulnerabilities in the short term.

Supportive policies to counteract supply vulnerabilities for the energy transition

A reliable and affordable supply of critical minerals is essential for the development and operation of downstream industries. Several critical minerals that are essential for key technologies have few viable substitutes. As a result, to support the growth of domestic strategic industries and maximise the effectiveness of stockpiling, governments may complement stockpiling policies with initiatives to strengthen supply chains and domestic upstream capabilities, and prevent shortages. These include policies facilitating the growth of domestic extraction and refining facilities, strengthening partnerships with resource-rich countries, and investing in R&D for technological innovation and more efficient recycling methods.

Policies to support the development of domestic upstream industries are present in several recent legislative acts regarding critical minerals, including India's Critical Minerals Mission, the EU's Critical Raw Materials Act (CRMA), and the United States' Inflation Reduction Act (IRA). For example, the CRMA stipulates that 40% of a material must be refined within the EU by 2030 (European Parliament, 2024). While the IRA primarily focuses on EV supply chains (Baskaran and Schwartz, 2024), it indirectly generates incentives for the development of upstream industries. For example, the inclusion of local content requirements in tax credits schemes encourages firms to source minerals locally or from countries with critical mineral agreements (Yergin et al., 2023). This can redirect investment towards a diversified and geopolitically aligned set of import partners.

Additionally, strengthening relationships with strategic partners can help diversify critical mineral supply chains without the need to onshore. In recent years several bilateral agreements have been negotiated between countries to help facilitate supply chain diversification. Examples include the US—Canada Joint Action Plan on Critical Minerals Collaboration and the Australia—Japan Critical Minerals Partnership, which aim to help build secure critical mineral supply chains through information sharing, investment and commercial arrangements (Ministers for the Department of Industry, Science and Resources, 2022; Natural Resources Canada, 2020). The main instance of multilateral coordination is the Mineral Security Partnership (MSP), which includes 12 jurisdictions, including the US and EU, and focuses on investment in mining, processing and refining, along with high environmental standards (IEA, 2024b). The MSP now also includes the EU Critical Raw Materials Club initiative, which aims to coordinate buyers and resource-rich countries to invest in critical mineral value chains (European Commission, 2024). Further broadening and deepening of such agreements may be necessary to ensure the secure supply of critical minerals over the long term.

Investments in R&D are also vital to help establish downstream industries. Innovations in mining, processing and manufacturing methods can reduce vulnerabilities by enhancing production efficiency. These aims are reflected in the establishment of laboratories that focus on process innovation and material substitution: for example, the METALLIC Facility, the Critical Minerals Innovation Hub and the proposed EU Critical Raw Materials Centre (NETL, 2025; U.S. Department of Energy, 2013; European Commission, 2025). Additionally, R&D investments in more efficient recycling may constitute a positive feedback loop by increasing the availability of domestically sourced recycled content. This, in turn, enhances self-sufficiency in building stockpiles and meeting overall critical mineral demand. Long-term procurement contracts between domestic recycling facilities and stockpiling initiatives may help foster more secure supply chains.

Both clean energy and digital technology industries require substantial capital investments. In a highly uncertain context, risk aversion may result in underinvestment (Fabr and Llobet, 2025). Policies complementary to stockpiling efforts may encourage investment in clean energy technologies and enable provisions, such as skills development, to overcome the challenge of underinvestment. The EU's Net Zero Industry Act (NZIA) includes several policies to stimulate investment in clean energy technologies, reduce red tape that inhibits the incubation of projects, and make provisions for skills development (European Commission, 2023).

While stockpiling programmes require significant upfront investment, they may offset future potential economic and security risks. Moreover, given the long time horizon to develop domestic mining capacities, stockpiling is one of the limited solutions to mitigate critical mineral supply risks in the short term. However, if the objective of stockpiling is to support the energy transition, it is most effective when implemented in conjunction with a broader set of complementary policies. In particular, countries should examine policies to support the upscaling of domestic mining and refining capabilities, proactively engage with strategic resource-rich countries to establish mutually beneficial supply relationships, and implement incentives to upscale investment in supply chains.

4. Policy design and effectiveness of stockpiling

Effective implementation of strategic stockpiling requires careful and flexible policy design to ensure it addresses key economic and security risks: namely, market volatility, inflation, industrial competitiveness, energy security and national security. There are several components of policy design that ought to be considered to ensure the policy achieves its objectives. This section assesses the effectiveness of strategic stockpiling through the lens of three different designs for stockpiling efforts: centralised, decentralised and market-based mechanisms.

Public versus market-based policy design for strategic stockpiling

There are three designs to implement strategic stockpiling:

- Public stockpiling (centralised efforts) – this approach involves a centralised government procurement and management of mineral reserves. Stock levels are typically calibrated on a net import-basis for a specified duration. The approach facilitates close monitoring and control over stockpiling inventories but requires fiscal and administrative capacity.

- Private inventories (decentralised efforts) – either government mandates import-dependent firms to hold minimum inventory levels of certain product inputs or it provides incentives to stockpile, e.g. through tax relief. These minimum inventories can be sector-specific and reflect industry risk exposure. Decentralised stocks are already embedded within operational supply chains, enabling faster and more targeted release of stocks. These differ from pure supply risk management techniques adopted by the private sector as they may include public set targets, or minimum thresholds.

- Market-based stockpiling (financial markets) – this approach leverages financial market intermediaries and operational trading firms to act as stabilisers in times of market stress. Institutions such as the London Metal Exchange may be required to hold minimum reserves to stabilise market shocks and act as 'circuit-breakers' during times of excessive price volatility. Market-based mechanisms may be most appropriate where commodity price fluctuations pose significant financial market risks.

Key components for effective policy design

The effectiveness of strategic stockpiling relies on several distinct but interlinked components of the policy design: in particular, the scope of minerals covered by the stockpiling programme, the conditions for the build-up and 'release' of reserves, and the degree of international coordination. These elements must be tailored to the specific objectives, economic resilience or national security, and the structure of mineral markets. The argument for government-led inventories for energy commodities given their vital input for the global economy and lack of substitutes has previously been made for non-renewable energy sources (Jaffe and Soligo, 2002). This same argument still applies for new renewable energy sources, given their evolving and vital use underpinning economies.

Scope of coverage

Broadly, there are two primary rationales for stockpiling: economic resilience and national security, as outlined earlier. The scope of minerals covered by stockpiling programmes depends on the intended policy objective. Regardless of the objective, both broad-use exchange-traded and non-exchange-traded minerals[2] would be included. Beyond the scope of minerals, strategic decisions must also consider whether to include intermediate goods used in downstream production. While stockpiling these goods may offer greater protection against supply disruption, they carry greater storage costs and risk of obsolescence. For example, a shift from lithium-ion to sodium-ion batteries could render an existing inventory redundant and subject to write-downs (U.S. Department of Energy, 2024).

Conditions of release

The conditions under which these stocks are built-up and released need to be clearly defined and aligned with the policy's core objectives. The conditions or rationale for the release of strategic stockpiles may be on the grounds of national security (e.g. a direct conflict), political or other supply risk in a major producing country (e.g. a natural disaster in a producing country), or for economic security, thereby smoothing price fluctuations (e.g. dampening price volatility). There is overlap between the latter two rationales; however, the difference is in intent. Smoothing price fluctuations is a proactive market intervention that may occur in the absence of an emergency or unexpected supply shock, representing a departure from free-market principles.

Under the IEA's Strategic Petroleum Reserves (SPR) programme, members are required to hold 90 days of net imports and coordinate stock releases during supply crises, subject to collective approval (IEA, 2024c). Coordinated releases have occurred in response to the supply disruptions in Libya in 2011 and from Russia's invasion of Ukraine in 2022 (U.S. Department of Energy, 2025). However, criticisms include the slow activation mechanism and unclear conditions of release, which reduces market certainty (Taylor and Van Doren, 2005; Scheitrum et al., 2017).

As a result, for critical minerals, the rationale and conditions for release, whether in response to supply shocks or economic objectives, need to be clearly pre-determined. If stockpiling objectives are to manage price fluctuations, clear guidance for the initial accumulation and replenishment of stocks is necessary. This avoids the build-up of strategic stockpiles contributing towards demand-induced pressures on commodity prices, as observed with the SPR (Stevens and Zhang, 2021). Also, given the volatility in commodity price cycles, sustained low commodity prices may undermine the financial viability of extraction and refinement operations. Establishing a minimum price threshold at which import-dependent countries must replenish their reserves could provide a price floor for producing countries, supporting investment in upstream supply and enhancing long-term reliability.

Given the diversity in market characteristics and uses of critical minerals, stockpiling rationales and release conditions need not be uniform. For broad-use market minerals such as copper and aluminium, there might be more incentive to build up and deploy stocks to achieve price smoothing. Conversely, for non-exchange-traded minerals with concentrated supply, release conditions may be closely tied to unexpected supply disruptions. In many cases, economic and supply risk considerations will overlap, warranting a dual-criteria approach to release conditions.

International coordination

Finally, the interconnectedness of mineral-dependent supply chains and commodity markets warrants international coordination to ensure policy effectiveness. Unilateral releases are unlikely to meaningfully dampen supply—demand imbalances and may even exacerbate market volatility and

[2] Broad-use exchange-traded minerals refer to materials such as aluminium, cobalt, copper, lithium and nickel, which have an established commodity market through a centralised exchange. Non-exchange-traded minerals refer to materials with more niche uses, such as rare earth elements, which are primarily traded directly via bilateral agreements rather than through centralised exchanges.

feed into inflation expectations. International coordination to balance power dynamics between import-dependent and export-dependent countries is necessary to ensure the effectiveness of strategic stockpiling, particularly if the objectives are primarily economic. For example, the IEA's role in coordinating the release of SPR provides an operational blueprint for strategic stockpiling, demonstrating how international cooperation in oil releases has greatly amplified the stabilising impacts of buffer stocks (Newell and Prest, 2017). International cooperation on critical minerals has largely taken place through bilateral agreements, with the Minerals Security Partnership being the main multilateral exception. To support effective international stockpiling, this partnership must be deepened and expanded to include more import-dependent and resource-rich countries.

However, critical minerals differ from oil in several important ways. First, regional variation in the economic importance and end-uses of different critical minerals means countries will have differing priority minerals to stockpile. International coordination would be necessary to define the scope of minerals included and how national minimum stockpile requirements are calibrated. Second, many minerals lack transparent, liquid markets, complicating the design and execution of release mechanisms, in particular to ensure international equity in the access to these reserves in the event of a release. Third, growing trade barriers against critical minerals may fragment global commodity markets. The recent divergence in copper prices between the London Metal Exchange, Shanghai Futures Exchange and the Commodity Exchange that occurred at the start of 2025 due to trade barrier concerns (Shanghai Metal Market, 2025) suggests regional pricing dynamics could lead to differing incentives for reserve deployment. Therefore, international rules on the distinction between coordinated and unilateral release of strategic reserves may be necessary.

Assessment of policy effectiveness against critical mineral risks

The effectiveness of stockpiling as a policy strategy is greatly determined by the specific risks it is designed to address. This subsection assesses the effectiveness of strategic stockpiling to mitigate the five risks outlined at the end of Section 2. We evaluate the capacity of the three stockpiling designs and their ability to mitigate critical mineral supply risks. While different rationales govern the release of buffer stocks, we focus here on their practical effectiveness in mitigating risks.

Table 4.1. Effectiveness of strategic stockpiling policy designs to mitigate identified risks

	Risks				
Type of stockpiling	Market volatility	Inflation	Industrial competitiveness	Energy security	National security
Public stockpiling					
Private inventories					
Market-based stockpiling					

Note: **Green** indicates stockpiling to be potentially effective, **orange** indicates the results are a non-optimal option or unclear, and **red** indicates stockpiling to be an ineffective strategy.
Source: Authors' assessment of risk mitigation based on prior analytical work and literature review

Market volatility

Strategic stockpiling can mitigate acute price volatility by acting as an insurance buffer, reducing the need to buy critical minerals when prices are exceptionally high (Wolf, 2022). For exchange-traded minerals, such as base metals, where price discovery is efficient, market prices respond quickly to acute supply disruptions. In this regard, the quick and efficient release of reserves may avert excessive market volatility and reduce market uncertainty by quelling demand for current and future supply.

For non-exchange-traded minerals, however, thin liquidity and opaque pricing mechanisms hinder the timely and effective release of buffer stocks. Without centralised exchanges, limited transparency and market depth make these minerals particularly vulnerable to volatility. An REE price spike in 2010 in response to export quotas and the 38% rise in germanium prices in 2023 due to tighter export controls demonstrate the sensitivity to volatility from short-term disruptions (Morrison and Tang, 2012; Reuters, 2024). These markets are also more prone to physical shortages, amplifying the risk of economic disruption. However, due to their lesser integration into financial markets, they pose less systemic financial risk than exchange-traded base metals, which are more exposed to speculative trading.

Market-based or private inventory mechanisms are best suited to efficiently identify and respond to market volatility. Private inventories offer protection to dependent sectors through pre-held reserves, while market-based stockpiling would be the most effective for circumventing excessive speculative trading during acute market disruption. Comparatively, a centralised stockpiling mechanism may take longer to respond to market volatility and disperse buffer stocks.

If the objective is to minimise financial instability from market volatility, market-based stockpiling may be the most effective approach. In terms of the types of market volatility, strategic stockpiling would be more effective to address shocks that primarily affect spot markets. For example, coordinated releases from the US SPR have been shown to dampen short-term oil price spikes, though with a more muted impact on long-run oil prices (Kilian and Zhou, 2020).

Stockpiles can also shape market expectations, helping stabilise prices through signalling. For instance, the EU's liquid natural gas (LNG) buffer build-up in 2023 is credited with having eased prices by reassuring markets (McWilliams et al., 2023). The only exception is during periods of hyper-backwardation, during which SPR drawdowns may heighten market panic by reinforcing expectations of severe supply shortages (Razek et al., 2023).

Inflation

As the global economy undergoes the twin transitions of decarbonisation and digitalisation, metals are expected to play a more prominent role across sectors and exert growing influence on cost-push inflation. Sustained higher prices in broad-use metals, such as copper and aluminium, may contribute to cost-push inflationary pressures. Strategic stockpiles could, in theory, help mitigate such pressures by dampening price spikes. However, the long-run elements of inflation complicate the effectiveness of such interventions.

Evidence from SPR for petroleum offers mixed results on its effectiveness for tempering inflation. Analysis from the 2021 drawdown on SPR indicates petrol/gasoline prices were lowered by between 17 and 42 cents per gallon (Harris and Wolfram, 2022). Simulations of historical SPR releases suggest spot prices fell by 15-20%, while backwardation in futures markets declined by five percentage points (Newell and Prest, 2017). More broadly, SPR releases and increases in OPEC production are linked to reductions in inflation (Razek et al., 2023).

The inflationary impact of stockpile releases depends heavily on market expectations. SPR interventions are more effective when supply disruptions are perceived as transitory (Newell and Prest, 2017). By contrast, metal price shocks are more likely to feed into core inflation, which tends to be persistent. As such, while strategic stockpiles may alleviate short-term price volatility and dampen inflationary shocks, their influence on long-term inflation dynamics is likely to be limited. Regarding critical minerals, projected structural supply deficits imply that cost-push inflationary pressures may be persistent, limiting the effectiveness of stockpile releases. Moreover, there are structural market differences between the crude oil and mineral markets, as the crude oil market includes the existence of an explicit cartel (OPEC+), with a swing producer. While mineral markets are highly concentrated with a degree of oligopolistic competition, they do not currently have an explicit cartel, and not all minerals are concentrated in the same country.

Nonetheless, in the absence of reserves, governments would lack any instrument to cushion short-term price shocks. While policy design is less critical than in cases of acute market volatility, release conditions should allow periodic deployment to help support price stability in the near term.

Industrial competitiveness

Reliable access to critical minerals is necessary for countries to capture growth opportunities in strategic economic sectors such as clean energy and digital technologies. Supply disruptions affect the behaviour of import-dependent firms, limiting production capacity and comparatively their competitiveness, and curb growth potential for nascent industries. For example, firms exposed to global value chains were disproportionately affected by supply shocks during the COVID-19 pandemic and faced prolonged recovery times (Chen et al., 2023; Lebastard and Serafini, 2023). In response to heightened supply chain risks, firms tend to increase inventory stockpiling, to mitigate potential future shocks (Zhang and Doan, 2023). This may divert retained earnings from productive uses such as R&D and potentially reduce long-term competitiveness.

Effective mitigation of these risks may require stockpiling both the raw materials and intermediate products, depending on the entire value chain geography. For example, the solar PV value chain is primarily concentrated in a single country, whereas the semiconductor value chain is geographically dispersed (IEA, 2022a; Varas et al., 2021). Therefore, buffer stocks must account for the sector-specific location of value chains to ensure the right materials, whether refined commodities or semi-finished goods, are available to counteract vulnerabilities.

Private inventories would be more effective than public or market-based stockpiling, as they enable import-dependent firms to hold relevant inputs at the critical stage of dependency. Conversely, public or market-based stockpiling may prioritise raw materials or redundant intermediates, offering limited protection if mid-stream components are still imported or become obsolete due to technological change.

While stockpiling can help firms manage short-term disruptions, it offers limited protection against long-term structural shortage of key inputs. Private inventory requirements may also constrain the capacity of import-dependent firms to invest in innovation by tying up capital that could otherwise support R&D, potentially undermining long-term competitiveness or their ability to find appropriate substitutes. However, without buffer stocks, firms remain fully exposed to supply disruptions, which may pose a greater overall impact on industrial competitiveness.

Energy transition and security

Energy security, in terms of the electricity grid, encompasses both short-term disruptions and longer-term structural risks to the energy system. Acute energy security risks arise from sudden supply shocks that lead to price volatility and reduce affordability. These are best mitigated through investments in energy storage technologies and improvements in grid flexibility. In contrast, structural risks relate to delays in the deployment of clean energy technologies, which can slow down the pace of the energy transition and prolong reliance on fossil fuels. However, over the long term, substitutions to less mineral-intensive low-carbon energy sources could help further mitigate these risks.

Strategic stockpiling of critical minerals is not an effective response to acute energy security risks. Unlike fossil fuels, buffer stocks of minerals or end-use products cannot quickly translate into new energy supply because renewable energy projects take years to build: these projects typically require 2.3 to 5.4 years to commission in OECD countries and 1.6 to 4.1 years in non-OECD countries (Gumber et al., 2024) . This lag means mineral stockpiles cannot be mobilised fast enough to offset short-term supply shocks.

Grid-scale long-duration energy storage (LDES) technologies offer a more viable means to enhance short-term energy resilience. In this case, buffer stocks would comprise electric energy units as opposed to critical minerals or end-use products. Stockpiling critical minerals or downstream intermediate goods could be a supportive policy to help ensure the supply of relevant inputs to deploy LDES, such as hydrogen storage. For example, maintaining inventories of intermediary products such as alkaline and proton exchange membrane electrolysers (IEA, 2021a) could facilitate downstream deployment. Given the nascency and the high level of innovation in these sectors, mandatory minimum inventories for domestic firms may be the most effective policy design to reduce the risk of obsolescence. However, for the purposes of energy security, company operations would need to be domestically located. A public-based stockpiling policy design would offer a second-best alternative, but at risk of obsolescence as technologies innovate.

For chronic energy security risks, some countries may adapt to long-term supply disruptions through altering their energy supply mix. However, depending on the country context, certain countries may be particularly reliant on specific technologies to achieve their energy transition. In such cases, stockpiling offers limited risk mitigation. Depending on the geographical distribution of the manufacturing, stockpiling either the end-use technologies or their intermediary inputs would be necessary. Buffer stocks of the components necessary for the maintenance of the energy system, such as cables, may also support long-term energy security. Overall, strategic stockpiling would only be modestly effective to address structural supply constraints and ensure a resilient energy transition.

National security

Several critical minerals are essential for advanced defence technologies, such as sonar transducers, radar systems and jet engine superalloys (SFA Oxford, 2025). Strategic stockpiling for national security purposes reflects a distinct rationale from economic risk management and underpins the current US government rationale for stockpiling (Keys, 2023). Stockpiling may act as an effective mechanism to avoid supply shortages during direct conflict, particularly if buffer stocks comprise finished technologies or intermediate inputs required for domestic defence manufacturing.

Countries may pursue one or a combination of two approaches. First, stockpiling refined critical minerals offers a cost-effective approach, provided defence manufacturing is domestically based. These stocks would act as a 'shock absorber' against unanticipated demand spikes or supply chain disruptions but would only be effective for short-term shocks (U.S. Department of Defense, 2025). Second, stockpiling end-use technologies provides better safeguards where manufacturing is non-domestic, but entails greater costs and risks of obsolescence. This option would be best suited to mitigating longer-term shortage risks in the event of a prolonged direct conflict. National security objectives would be best met through a public stockpiling programme given the required size of the programme, potential sensitivity and need for a level of secrecy.

Mitigating the unintended consequences and international ramifications of stockpiling

To ensure strategic stockpiling achieves its intended objectives and avoids unintended consequences, countries should consider three key factors for effective implementation.

First, the accumulation of buffer stocks risks short-term market distortion and heightened price volatility, particularly if cross-country efforts are not coordinated. A swift, parallel build-up of reserves across countries can amplify demand pressures, fuelling the very price instability stockpiling seeks to mitigate. Uncoordinated purchases and releases of stocks may lead to overcapacity risks and market distortions, further exacerbating price volatility (Milewski, 2024). These dynamics may undercut producers and disincentivise investment in new and diversified sources of critical minerals. Clear, coordinated approaches to stockpiling, particularly with transparent market signalling around release conditions, are essential to avoid unintended impacts. For example, unilateral actions taken by governments during the European gas crisis in 2022 led to exacerbated gas prices over the period, with countries imposing export restrictions and out-bidding one another (Perez et al., 2025).

Second, diverging interests between import-dependent and export-oriented countries, as well as producers and investors, can lead to adverse outcomes if stockpiling is poorly coordinated. Several resource-rich countries, particularly in Latin America, the Caribbean and East Asia and the Pacific, are fiscally dependent on mineral exports and stand to gain significantly from the energy transition (GIZ, 2023). Unilateral stockpiling by importers, without engagement with exporters, risks undermining the fiscal stability and development strategies of these countries by suppressing prices. Conversely, exporting countries may withhold supply to induce price spikes, particularly during periods of high demand. Recent restrictions on cobalt exports in the Democratic Republic of Congo, and their impact on cobalt prices, illustrates the extent to which national policies can influence global mineral markets (Reuters, 2025). Close coordination between import-dependent and export-oriented countries, with shared agreement on the build-up and release of reserves, is essential to ensure equitable and stable outcomes.

If stockpiles are deployed to suppress prices during normal market conditions, rather than in response to extreme market volatility driven by supply disruptions, this may deter investment in new mining projects by undermining price signals. IEA analysis estimates an additional investment need of US$360—450 billion to meet mineral demand under its Net Zero scenario (IEA, 2023). If market participants anticipate their returns to be undercut by the release of buffer stocks aimed at lowering commodity prices, this could deter further investment and strain relations between import-dependent and resource-rich countries. This could lead to two key risks: persistent underinvestment in extraction and refining capacity, jeopardising net zero targets; and increased reliance on existing facilities, exacerbating geographical supply concentration. To avoid these risks, stockpiling efforts must be transparently coordinated with export-orientated countries and underpinned by mutually agreed release conditions. Internationally coordinated stockpiling may even spur investment in new mining activities if correctly implemented, by offering greater price and demand certainty, which subsequently affects the potential return for investors.

Third, stockpiling initiatives may offer a false sense of security and expose countries to potential weaponisation of stockpiles. As discussed, stockpiling is most effective in addressing short-term disruptions and shaping market expectations while it has limited capacity to ensure reliable, long-term access to critical minerals. It should therefore form part of a broader strategy that includes long-term policies to address structural risks. In this context, stockpiling serves to cushion short-term shocks, while complementary measures strengthen supply chain resilience over time.

Beyond these three unintended consequences, there is a question surrounding the political feasibility of implementing an internationally coordinated stockpiling programme. Specifically, there are two key hindrances to the effective implementation of internationally coordinated stockpiling. First is the rise in geo-fragmentation and frayed multilateralism between major economies with the increased use of trade tariffs and more insular policy focus. In response to this trend, an internationally coordinated stockpiling initiative would have to be built on a 'coalition of the willing', with import-dependent countries making concessions to resource-rich countries to achieve agreement. Second, given the limited fiscal space within governments' budgets post-COVID, not all countries may be able to commit the financial resources to set up a critical mineral stockpiling programme. One possible option is bilateral or regional financing of stockpiling, with joint procurement to lower the cost of accumulation.

5. Conclusions and recommendations for policymakers

This report neither advocates for nor attempts to dissuade policymakers from implementing policies to strategically stockpile critical minerals. Rather, it has evaluated the extent to which stockpiling can mitigate economic, financial and security-related risks associated with critical mineral supply disruptions. Here we present our conclusions on the role of strategic stockpiling and make recommendations to support economic resilience and enable a more secure and stable energy transition.

Where countries pursue stockpiling with the primary aim of facilitating the energy transition, the rationale is largely economic: namely, to help stabilise commodity prices and improve the reliability of supply for clean energy technologies. As explored in earlier sections, stockpiling is best suited to address acute supply shocks, whereas many risks to the energy transition stem from more structural, chronic undersupply challenges (see Figure 2.2).

Nonetheless, stockpiling policies may still offer a material contribution towards ensuring the resilience and financial viability of the energy transition through two avenues. First, stockpiling may act as an insurance policy against acute supply disruptions in the short term, enabling longer-term policies, such as supply diversification, to come into effect. Second, if well designed, stockpiling can actively support more diversified and resilient supply chains. Clear coordination between import- and export-orientated economies for build-up and release phases can reduce price volatility and encourage further investment in new mining operations. For example, offtake agreements between governments and emerging mining operations can facilitate the accumulation of strategic reserves while providing minimum price guarantees that improve the bankability of new projects.

A central consideration for policymakers is the need for international coordination. In this context, international coordination would encompass monitoring of mineral dynamics, creating an internationally agreed mechanism and grounds for the release of buffer stocks, and taking a balanced approach to the build-up of stocks. While flexibility in the design and mineral scope of stockpiling initiatives is essential to satisfy country-specific contexts, shared principles are required. These include agreement on the conditions for the build-up and release of reserves, calibration of stockpile sizes, and transparent monitoring of market conditions. Effective coordination would require an international platform to align stockpiling strategies, ensure transparency and prevent unintended market distortions. This coordination would be best facilitated by a designated international secretariat with the capacity to manage implementation and serve as a forum for consensus-building. Appendix 2 assesses potential institutions for this role, based on three criteria: (i) mandate and policy levers to support international coordination; (ii) in-house expertise on energy and critical minerals; and (iii) the diversity of membership, particularly with respect to key import- and export-orientated economies.

The IEA may be well placed to coordinate international efforts on strategic stockpiling of critical minerals to support a more resilient energy transition. Its mandate on energy security, operational experience with strategic petroleum reserves and growing focus on critical minerals suggest it could provide a suitable institutional foundation. The IEA's voluntary Critical Minerals Security Programme already aims to develop tools that may include stockpiling in future (IEA, 2024b). While its limited membership presents a potential constraint, the Agency's open-door policy provides a pathway to broaden participation and include the perspectives of key export-oriented economies. Moreover, its relatively small membership base may support more agile decision-making around coordination mechanisms, such as the conditions for building and releasing reserves.

Further research and stakeholder consultation would be needed to assess the suitability of the IEA relative to other international institutions and to identify governance arrangements for effective and equitable stockpiling. In the current geopolitical context, with weakening confidence in multilateralism and greater reliance on national and regional strategies, a single global framework may be unrealistic. It is more likely that effective coordination would involve a mix of regional initiatives, such as the EU's management of strategic reserves, and selective cooperation among trusted partners, complemented by the technical expertise of global bodies. A clearer view of institutional roles remains important. The IMF could provide macroeconomic analysis on commodity price volatility, while the World Bank and other multilateral development banks could support long-term resilience through financing. Yet overlapping mandates, divergent national interests and the strategic sensitivity of mineral stockpiles mean that any framework must balance technical efficiency with political feasibility.

Based on these findings, below we outline five policy recommendations for governments considering strategic stockpiling. No single country can manage supply risks, price instability or geopolitical leverage alone. Without coordination, stockpiling may trigger market distortions and reduce collective resilience. The IEA is well-positioned to anchor this effort.

Recommendations

1. **Agree international alignment on mineral scope or adopt a shared methodology.** International stockpiling initiatives should be underpinned by either an agreed list of minerals or a shared methodology for determining inclusion. For widely traded, broad use minerals, coordinated stockpiling can enhance collective buffers and reduce price volatility during supply disruptions. For non-exchange-traded minerals, national discretion can enable stockpiling to reflect country-specific vulnerabilities, provided selection follows a transparent and consistent framework to reduce the risk of free-riding within international efforts. Mineral inclusion should be based on sector-specific exposure and supply vulnerability. The EU framework under the Preparedness Union Strategy and Critical Raw Materials Club may serve as a useful starting point to developing international alignment.

2. **Establish international coordination on stockpile calibration, with participation from both export- and import-dependent countries.** To ensure effective stockpile calibration, a designated international institution should coordinate minimum requirements, akin to the IEA's mandatory petroleum inventories requiring 90 days of net imports, or create a similar threshold for critical mineral stockpiles. A key distinction is the inclusion of export-orientated countries in the membership. Their participation is essential to effectively mitigate price risks and ensure reliable supply. This membership forum may also help establish measures to support mineral producers during price slumps, e.g. through offtake agreements, in return for ensuring reliable supply in the event of disruptions or price volatility through the release of buffer stocks. Such dual instruments would encourage sustained investment in supply capacity while helping import-dependent economies avoid supply shocks. A diverse membership would enable the design of mutually beneficial offtake agreements that stabilise demand and facilitate buffer stock accumulation.

3. **Develop internationally pre-agreed release conditions, backed by transparent monitoring.** The efficient and timely release of buffer stocks is necessary, particularly for addressing acute market volatility risks. This requires two prerequisite conditions. First, clear and pre-agreed release conditions, tied to specific economic and security triggers, can ensure swift action without delays from ad hoc negotiations. These conditions should be standardised to enable coordinated responses. Routine 'practice' releases may also help refine processes and increase operational readiness. Second, transparent monitoring and reporting are essential to assess when thresholds have been met. This includes timely data on trade flows, price movements and inventory levels. Given the complexity of mineral markets, the IEA would require expanded capacity and stronger coordination with other international bodies to support real-time surveillance.

4. **Adopt a hybrid policy design tailored to national contexts, risk profiles and commodities.** No single stockpiling model is optimal to mitigate all risk types. Countries should adopt hybrid designs that reflect their specific objectives, economic structures and positions within critical mineral value chains. For example, market-based and private inventories may be better placed to mitigate price volatility and economic risks, whereas public stockpiling may be most appropriate from a national security perspective. Flexibility in policy design allows governments to effectively target distinct vulnerabilities while aligning with broader resilience goals.

5. **Embed stockpiling initiatives within a broader industrial and trade policy strategy.** Strategic stockpiling is not a 'silver bullet' to mitigate potential risks and there are clear limitations, particularly in addressing long-term industrial competitiveness and energy security. To be effective, it must be implemented within a wider policy framework to adequately meet its intended objectives. This requires accompanying efforts to diversify supply and demand, invest in R&D to reduce dependence and mineral intensity, and upscale recycling efforts to effectively mitigate critical mineral risks. Aligning stockpiling with industrial and trade strategies will better position countries to manage critical mineral risks, particularly in the long run.

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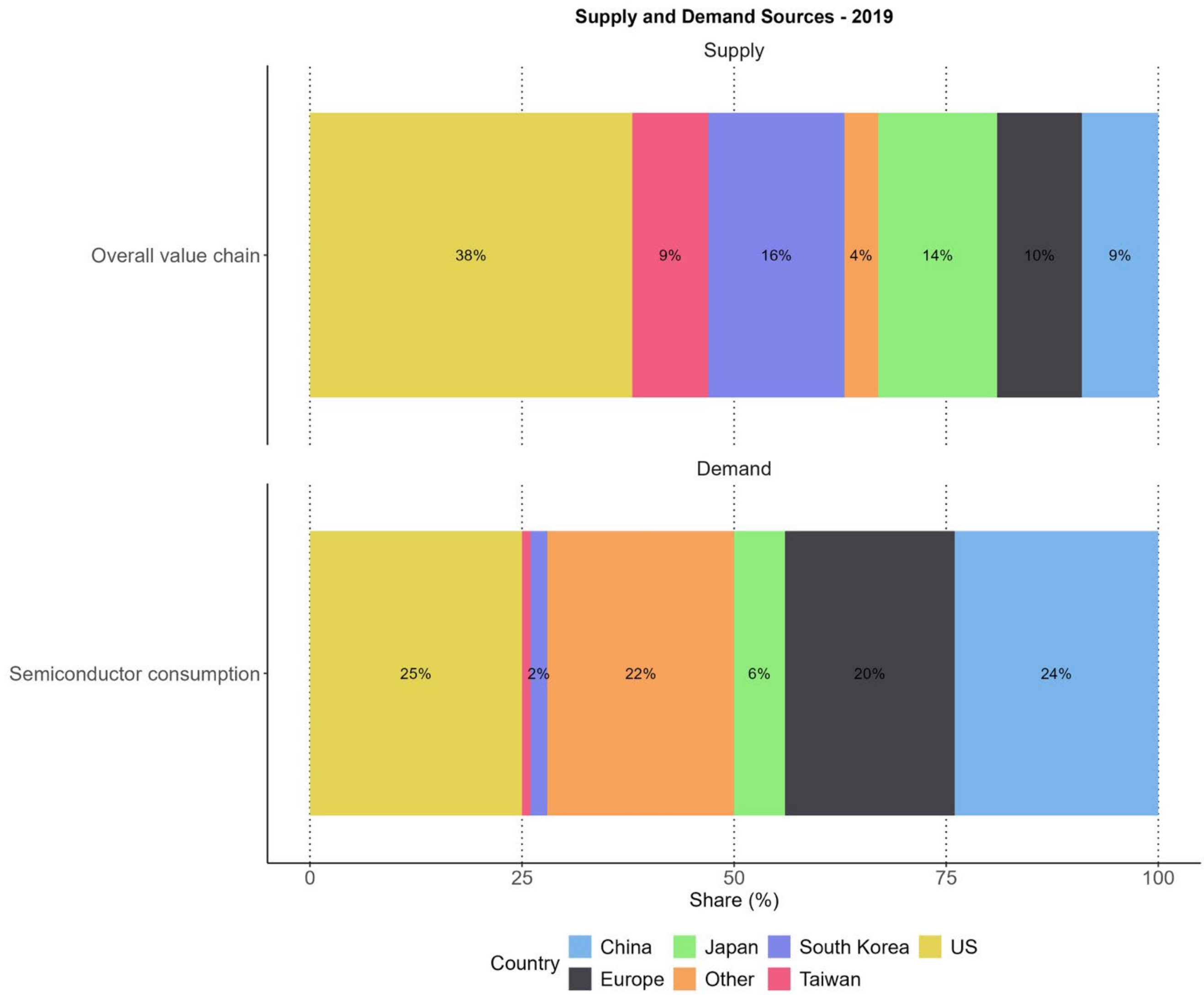
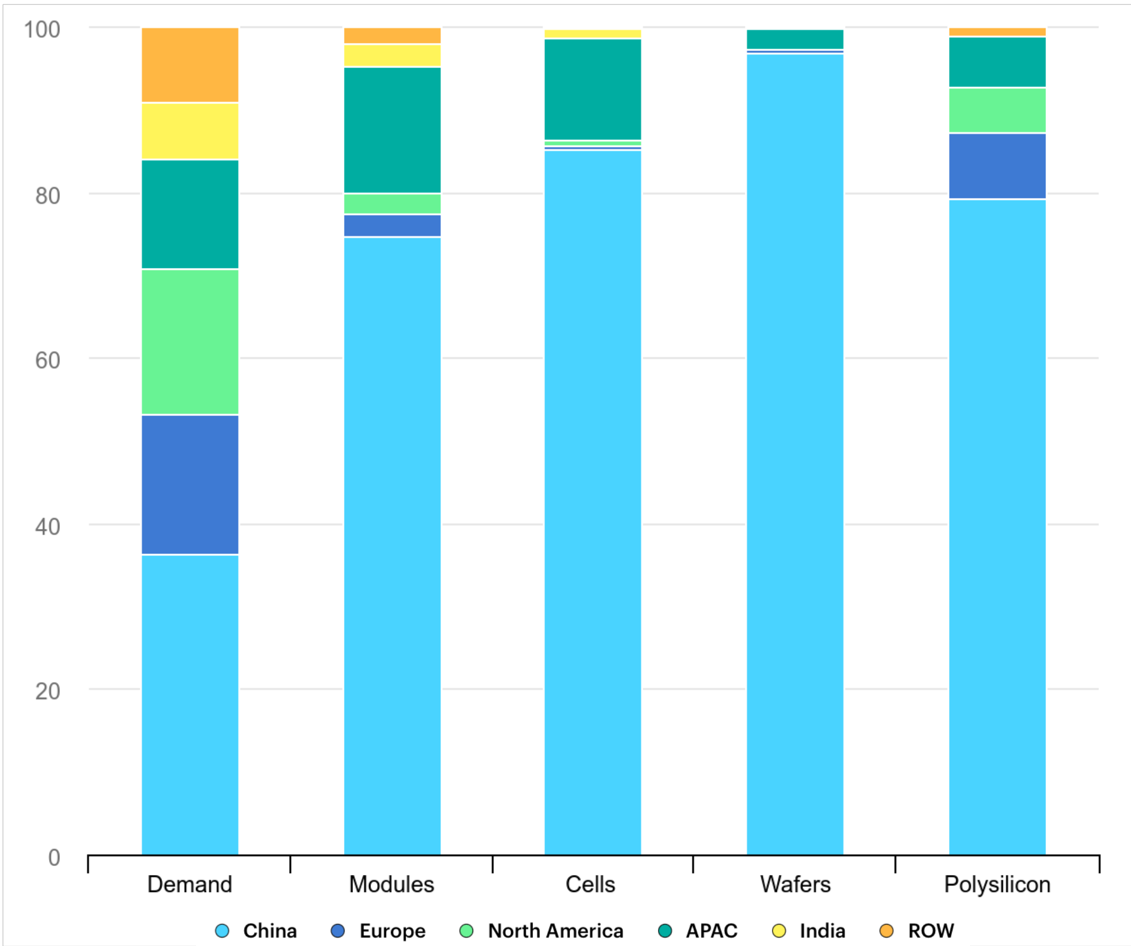
Appendix 1. Additional data on the geographical concentration of manufacturing for strategic technologies

Figure A1.1. Overview of the semiconductor supply chain



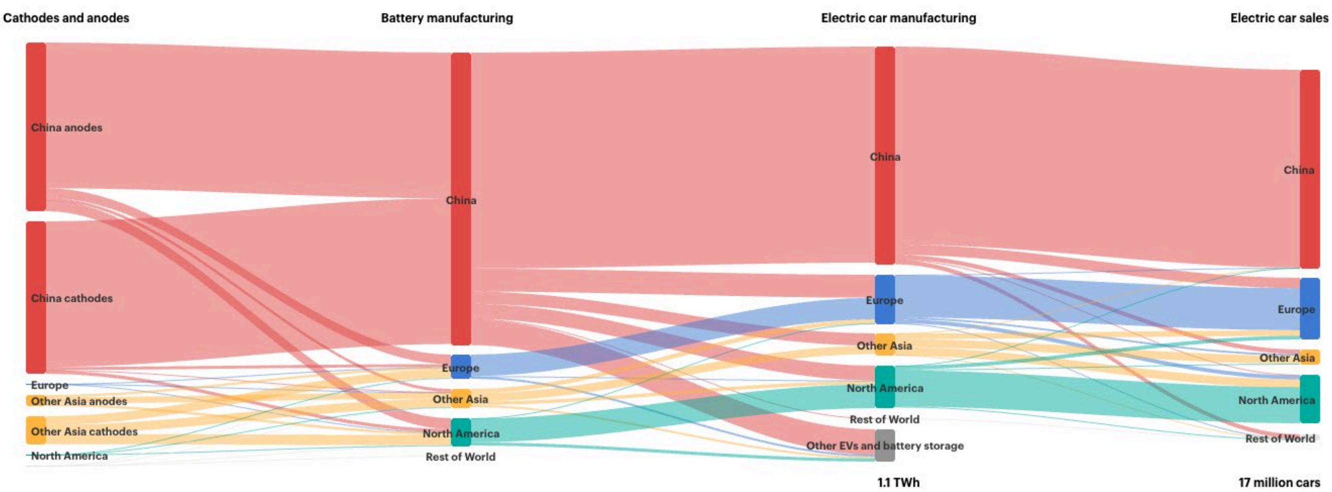
Source: Authors using data from SIA (2021)

Figure A1.2. IEA's analysis of solar PV manufacturing capacity, % by country and region, 2021



Source: IEA (2022a)

Figure A1.3. The IEA's analysis of global manufacturing and trade flows of electric cars, lithium-ion batteries and key components, 2024



Notes: EV = electric vehicle. Cathodes and anodes refer to cathode and anode active materials. Flows are normalised to the battery (cell) manufacturing step, with cathode and anode active materials normalised such that their sum is scaled to the battery cell volume. Numbers below the chart refer to total demand, not traded volume. Ther lighter-colour version of the flows going to battery manufacturing represents the anodes. Battery applications different from EVs and battery storage are excluded from the analysis. Electric vehicle and battery stockpiling are excluded from the analysis.
Source: IEA (2025c)

Appendix 2. Overview of assessments by international organisations for an international stockpiling framework

Organisation	Mandate and policy levers	Energy and critical mineral expertise	Membership and governance
International Monetary Fund (IMF)	Mandate to support the stability of the international monetary system. Is limited in its scope to cover commodities, with a focus on how price volatility could threaten economic resilience, inflation and balance of payments. Has no direct regulatory authority over commodity production or stockpile.	Has high-level expertise on commodity markets from a macro-financial perspective. Tracks commodity prices and publishes commodity indexes. Also has crisis response infrastructure which may help economies subject to commodity price shocks and evaluation of stockpiling needs.	191 country members. Has a board of governors (mostly central banks and Finance Ministries). Can indirectly enforce policy through conditions on loans but also exercises soft power through surveillance and economic advice.
World Bank	Development mandate focused on financial and technical assistance for economic development and poverty reduction. Works on critical minerals through the lens of development but does not have specific policy levers related to commodity stockpiles.	Expertise in project finance and capacity-building, with a strong focus on commodity markets from a development perspective. Invests in energy and mining projects across regions but does not directly monitor commodity markets.	189 country members for the International Bank for Reconstruction and Development. A board of 25 directors representing all countries oversees operations. Cannot impose policies on countries but influences through conditions on loans, technical advice, and assistance.
Organisation for Economic Co-operation and Development (OECD)	Provides a policy forum covering broad economic, social and environmental issues. Has some policy levers, but none which directly relate to stockpiles or energy.	Strong analytical and policy expertise across economic sectors and provides standard-setting guidance around responsible supply for minerals.	38 member countries, mainly from the Americas, Europe and Asia-Pacific, with eight countries in accession, and five key partner countries. Has no binding enforcement power but influences through reviews and 'soft law' standards.
International Energy Agency (IEA)	Has a clear mandate on energy security and supporting the energy sector's net zero transition,	In-depth data, policy analysis and expertise on energy markets and critical minerals. Already provides monitoring on critical	32 member countries with four countries in accession and 13 association countries. These include key producing countries such

	and existing policy levers on energy stockpiles.	mineral commodity markets.	as China, Indonesia and Chile. Decisions are member-driven; IEA can set binding obligations for members and coordinate collective actions.
United Nations (UN)	Mandate to promote peace, security and sustainable development. Several UN departments focus on relevant issues such as trade, commodities and the environment, with an onus on sustainable development.	Certain departments, in particular UNCTAD, have expertise in commodity markets and development.	193 country members. Typically operates on a one-country one-vote policy or consensus-based resolutions. Lacks binding force unless a formal treaty is signed.
Multilateral development banks (MDBs)	These regional development banks have a mandate of economic development, including financing infrastructure, reducing poverty and supporting green growth.	Undertake investments and produce analysis on resource sectors for their respective regional economies. Some include sustainable mining practices within their regions.	Each MDB has a board of governors, which represent each member. Voting power is usually weighted by shareholding. They may foster regional cooperation but cannot enforce policy on members.