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# Friend-shoring critical mineral supply chains

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# Contents

# Executive summary

Critical minerals go beyond “rare earths”, constituting the key ingredients in a wide variety of high-end technology we use every day, from appliances to entertainment to the tools of our trades. Quietly, steadily, over the past two decades, China has built up its leadership status in this field, and the US and its partners are just waking up to the disruptive potential of this reliance. This study maps the critical minerals that have become part of daily life, shows how China assumed a central role in harvesting and distributing them, and offers suggestions on how to diversify. Based on a variety of factors – from availability to friendliness toward the US to capacity for processing – it recommends Canada, Australia, and Chile as ideal alternatives to China for meeting modern critical mineral needs.


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# Introduction

The demand for critical minerals have soared and China has significant control over the critical mineral value chain.

The Austrian Chancellor Klemens von Metternich once famously said, "When France sneezes, Europe catches a cold." Cathie Wood, chief executive and investment officer of asset management firm ARK Invest, has updated this phrase to fit modern times – "When China catches a cold[1], the commodities markets catch a pneumonia" – to summarize the economic connectivity between the Middle Kingdom and the world. This paradigm is glaringly apparent in the critical mineral industry.

Over the last two decades, China has steadily become the leader in mining most of the world's critical minerals and in processing all major critical minerals. Given its rapid technological advancements and rapid transition to clean energy sources in the last decade, China's demand for critical minerals soared. As a result, China exerts significant control over the critical mineral value chain, both upstream and downstream mining and as a market.

But first: Nations across the world have defined "critical minerals" differently. Unlike rare-earth elements – a broadly accepted nomenclature for a group of seventeen metallic elements – nations have identified minerals to be critical to their national security based on analysis of their own economy's supply chain vulnerabilities. For example, the US Geological Survey defines critical minerals as "mineral commodities that have important uses and no viable substitutes, yet face potential disruption in supply, and critical to the nation's economic and national security." Geosciences Australia defines them as a "metallic or non-metallic element" with two characteristics: "It is essential for the functioning of our modern technologies, economies or national security" and "There is a risk that its supply chains could be disrupted."[2] Nonetheless, five minerals – lithium, cobalt, manganese, nickel, copper, and rare earth elements – broadly make up the critical minerals in most advanced economies.

These minerals by and large go into advanced, critical, and renewable energy technologies such as fighter jets, solar panels, and advanced batteries; and into most everyday technologies of the 21st century such as smartphones, electric shavers, motorbikes, and automobiles (conventional and EVs), among other things. Critical minerals have thus become omnipresent in modern-day societies and their significance has expanded in scope. In particular, as nations work toward their climate change goals, access to these minerals becomes essential to the production of clean energy.

The race against climate change goals coupled with the geopolitical tensions brewing between different nations exacerbate the challenges associated with accessing, refining, and processing minerals to become part of the end-product. With this complexity, some critical minerals, such as nickel, are much more finite in supply than others. Such limitations and supply constraints mean that scientists must explore different chemistries for batteries and substitutes for other products that use nickel.

In this environment, the weaponization of interdependence by countries at the top of the hierarchical network of value chains will significantly impact climate

change goals, affect innovation in industries such as new battery chemistries, and potentially hamper advancements in technologies should one country (such as China) or just a few economies control the entire value chain. The impact on innovation will in turn lead to inefficient use by limiting progress in clean mining processes, leading to the destruction of natural resources and even environmental destruction, such as in forestry and water aquifers, as observed in nickel and lithium mining, respectively.

This provides the impetus for assessing the potential for friend-shoring supply chains in the critical minerals sector amongst like-minded nations of the US that possess these minerals and ones that have the capital, and technological know-how to successfully mine, process and get them to the market for the end product.

Nations such as Australia, Indonesia, Chile, Canada, and South Korea can play different roles in addressing this challenge.

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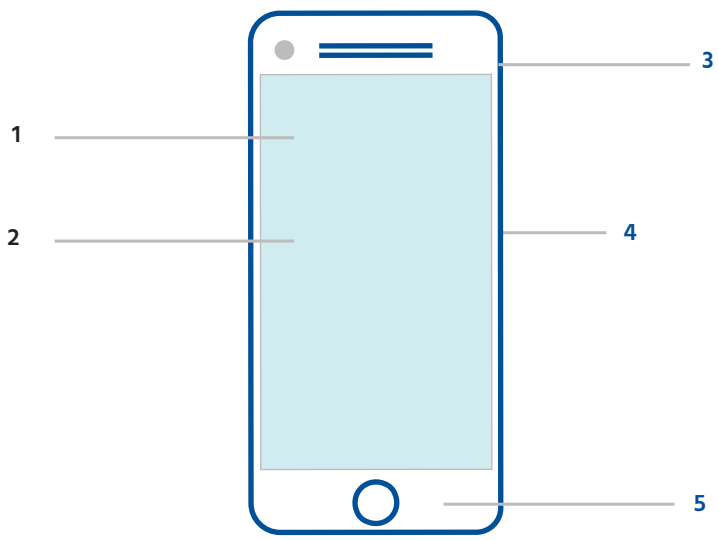
# Supply chain mapping

The amount of critical minerals required to build a device vary greatly, and they form the building blocks of most modern technologies.

While semiconductors have become ubiquitous in society, with most modern technologies, personal electronics, and automobiles running on them, critical minerals make the building blocks of all those technologies. They have widespread applications in energy storage systems, electric mobility, power generation, aerospace, and data transmission software. In day-to-day use, they can be found in mobile phones, tablets, computers, batteries, and automobiles. The amount of a critical mineral needed for a given end differs. Figure 1 illustrates the importance of critical minerals to our devices in our day-to-day use by portraying them in a single smartphone.

The vast difference in the amount of minerals required for a device as small as a smartphone vs an electric vehicle exacerbates the challenge. For example, one Tesla Model S uses 140 pounds/63.5 Kg of lithium, equivalent to the lithium found in 10,000 smartphones.[3] As of 2023, most clean automobiles use lithium-ion batteries rather than hydrogen or other chemistries. The vagaries in critical mineral supply chains are closely tied to the developments in the end-use in the value chain, such as technological advancements and changes in battery chemistry. In particular, minerals such as lithium are predominantly used in batteries rather than other end products. Around 70% of the lithium mined goes into batteries and only the remaining 30% goes into ceramics, glasses, and medicines.[4]

**Figure 1 – Critical minerals in a smartphone**




**1. Display**
Gallium, Lanthanum, Prasodymium, Europium, Gadelinium, Terbium, Dysprosium

**2. Touchscreen**
Indium

**3. Electronics**
Gallium, Nickel, Tantalum, Antimony, Arsenic

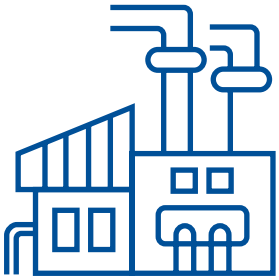
**4. Battery**
Lithium, Cobalt, Nickel

**5. Casing**
Nickel, Magnesium

**6. Microphone & speaker**
Nickel, Presodymium, Neodymium, Gadolinlom, Terbium, Dysprosium

**Source:** Data collected by authors

## Figure 2 – Critical minerals in a giga factory

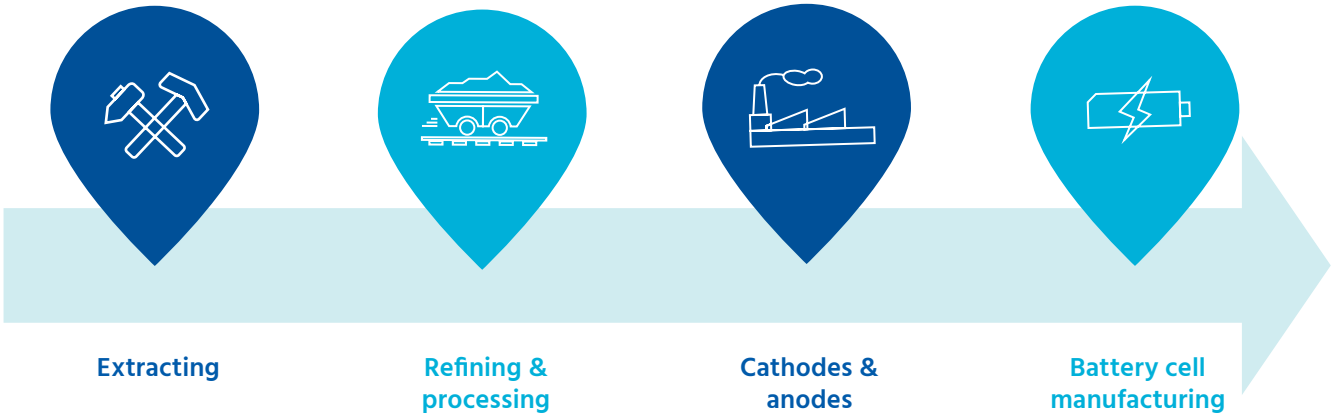


| Aluminium | Lithium | Nickel |
|---|---|---|
| 1,000 - 1,500 tonnes | 100,000 - 115,000 tonnes | 110,000 - 125,000 tonnes |
| **Cobalt** | **Graphite Anode** | **Manganese** |
| 11,000 - 15,000 tonnes | 140,000 - 170,000 tonnes | 9,000 - 14,000 tonnes |

**Source:** Data collected and graphic designed by authors

China's steady economic growth over the last three decades and the parallel technological advancements made it the largest market for various high-technology end products that use critical minerals. Capitalizing on economies of scale, the Chinese government embarked on building its indigenous value chain for these critical minerals. For example, much like in semiconductors and many other industries, the US was once the market leader in the production of several critical minerals. In 1995, the US share of lithium production was at 37%, while in 2021 it was a meager 1%.[5] While the uses and purposes of several minerals, including lithium, have evolved over the last three decades and found new significance, the US and its allies are playing catch-up now that China has successfully captured entire value chains in all the major critical minerals. Furthermore, China is a leader in the production of cathodes and anodes[6] that go into batteries. Figure 3 lays out the value chain.

## Figure 3 – China's control of the entire value chain to end-use



# Demand

While other countries focused on upstream activity such as extraction, China has strengthened and grown its comparative advantage in midstream and downstream processes.

## China

The ebbs and flows in the Chinese economy have a direct impact on the prices of most commodities. Volatility brought on by Covid lockdowns and the subsequent lifting of the same has proven that as one of the major sources of global demand for commodities, China has a vital role to play in the supply chains of most minerals. Critical minerals that go into advanced technologies and renewable energy are no exception. The demand for critical minerals is fueled by the surging demand for end-use goods such as EVs, mobile phones, solar panels, and wind turbines. As a result of China's rapid economic transformation, the demand for advanced technologies skyrocketed, and, by 2021, China overtook the US and the EU in demand for these goods. Cognizant of this development, the Chinese government used targeted industrial policy to strengthen midstream and downstream processes in the critical minerals sector. While resource-rich nations such as the Democratic Republic of Congo (DRC), Chile, Argentina, Bolivia, Indonesia, and Australia engage in the upstream activity of extracting minerals, over the last two decades China has steadily grown its comparative advantage in midstream and downstream processes. For emerging markets, the development of midstream and downstream activities was out of reach due to its capital-intensive nature and for wealthier nations such as Australia, the limitations associated with its market size and therefore economy of scale made the development of these parts of the value chain inefficient.

Biden's CHIPS Act, the Bipartisan Infrastructure Law, and the IRA are all different legislation designed for one overarching goal of making up ground lost to China in manufacturing competitiveness.

## The US: The new vortex of demand

In August 2022, the Biden administration embarked on an ambitious industrial policy drive through the Inflation Reduction Act (IRA). The administration initially proposed the Build Back Better plan to transform the American economy into a green economy, one that runs on renewable energy while simultaneously reducing its overreliance on China for critical goods that go into creating that power and, lastly, reviving domestic manufacturing in that process. The IRA was designed to address a host of immediate challenges such as inflation and funding the Internal Revenue Service (IRS), long-term goals such as catalyzing investments in domestic manufacturing capacity, incentivizing procurement of critical supplies domestically or from free-trade partners, jump-starting research and development, and commercializing leading-edge technologies such as carbon capture, energy storage, and clean hydrogen. While initially there was discontent[7] about the proposed Build Back Better plan amongst American allies with existing free trade agreements, as of 2023, companies have begun to capitalize on the benefits offered by the Inflation Reduction Act. The private sector has highlighted the challenges associated with onshoring entire value chains, particularly since most components for batteries and other parts cannot be sourced in the US. President Biden's CHIPS Act, the Bipartisan Infrastructure Law, and the IRA are all different legislation designed for one overarching goal of making up ground lost to China in manufacturing competitiveness. This emphasis on reviving manufacturing through both nearshoring and friend-shoring for parts with no source in America in Washington DC has trickled down to local elections. Even Democratic contenders, who otherwise would be against reviving old mines, let alone sanctioning new ones, are voicing support for increasing American competitiveness by supporting the mines affected by environmental regulations over the last few decades. For example, the Democratic candidate Rep. Catherine Cortez Masto in the western state of Nevada voiced support for mining operations in her state during the elections in 2022.[8] This bipartisan consensus on improving American manufacturing competitiveness, at times even at the cost of environmental standards, indicates a bipartisan resolve in America for both "America First" economic policies and competition with China. The US and China have been the largest sources of demand for advanced technologies over the last few years, with Europe trailing at third.

## IRA comes with a catch but transforms rust belt into EV belt

Several IRA tax incentives contain a sliding scale of incentives encouraging domestic production and procurement. In order to unlock the full EV consumer credit (US$4,000), 40% of critical minerals and 50% of components in the battery are required to have been recycled in North America or been extracted or processed in a country with a free trade agreement (FTA) with the United States. This requirement is designed to progressively increase to more than 80% in the critical minerals sector and 100% in the battery sector by 2029 (see figure 4). Furthermore, the battery must have also been manufactured or assembled in North America.[9]

This has in turn incentivized companies to move the entire or part of their supply chains to the US, stimulating manufacturing activity in states that had lost manufacturing competitiveness since China's accession to the WTO. Companies such as Hyundai, Toyota, and American household names such as Ford and GM, have already begun rushing to make investments so that they might capitalize on these benefits. And, notably, states in the Midwest, South, and Southwest have the most to gain from the legislation.

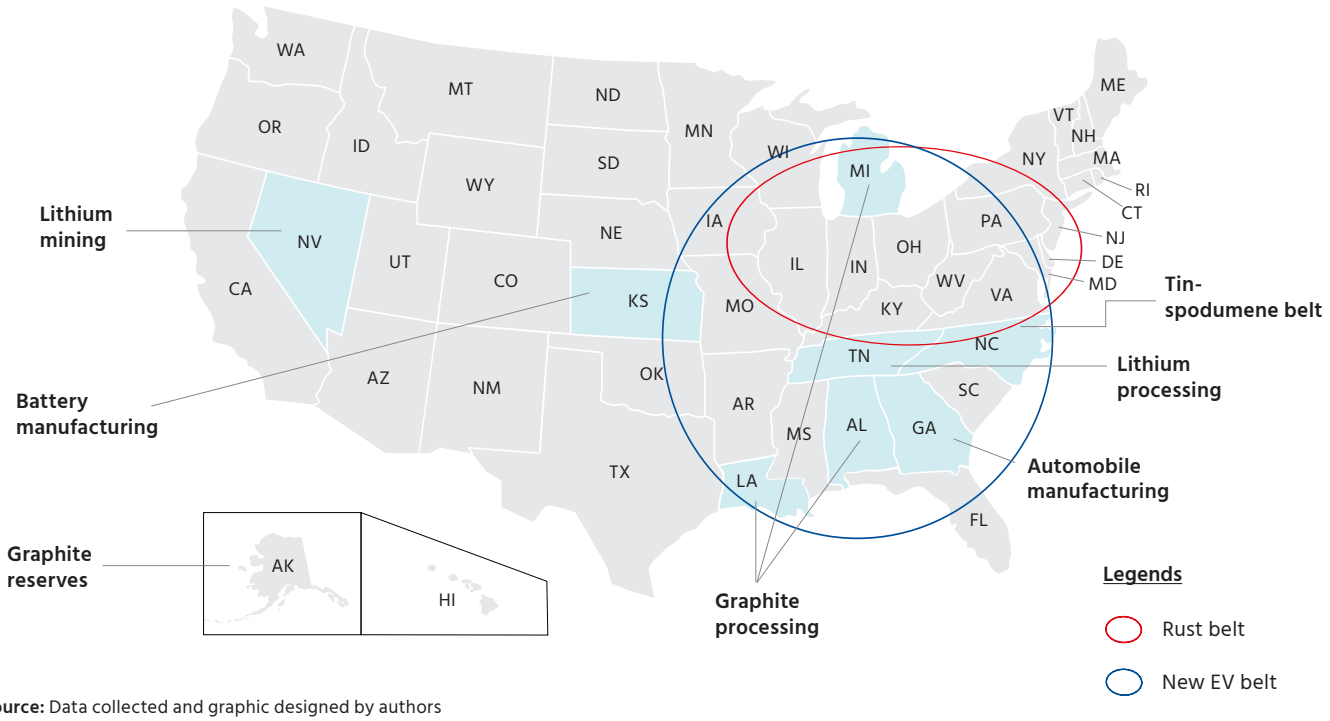
The IRA will stoke around US$400 billion in federal funding to address climate change over the next five to ten years. Of the US$400 billion, more than US$250 billion is allocated for energy production, US$48 billion for manufacturing, and US$24 billion for EVs.[10]

## Figure 4 – Share of domestic manufacturing of battery components and critical minerals

| | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 and beyond |
|---|---|---|---|---|---|---|---|
| Minimum percentage of battery components to be produced in North America | 50% | 60% | 60% | 70% | 80% | 90% | 100% |
| Minimum percentage of critical minerals extracted, processed, and/or recycled in nations with free trade agreements | 40% | 50% | 60% | 70% | 80% | 80% | 80% |

**Source:** Bipartisan Policy Center

## Figure 5 – Critical minerals, batteries, and EV ecosystem in the US




**Source:** Data collected and graphic designed by authors

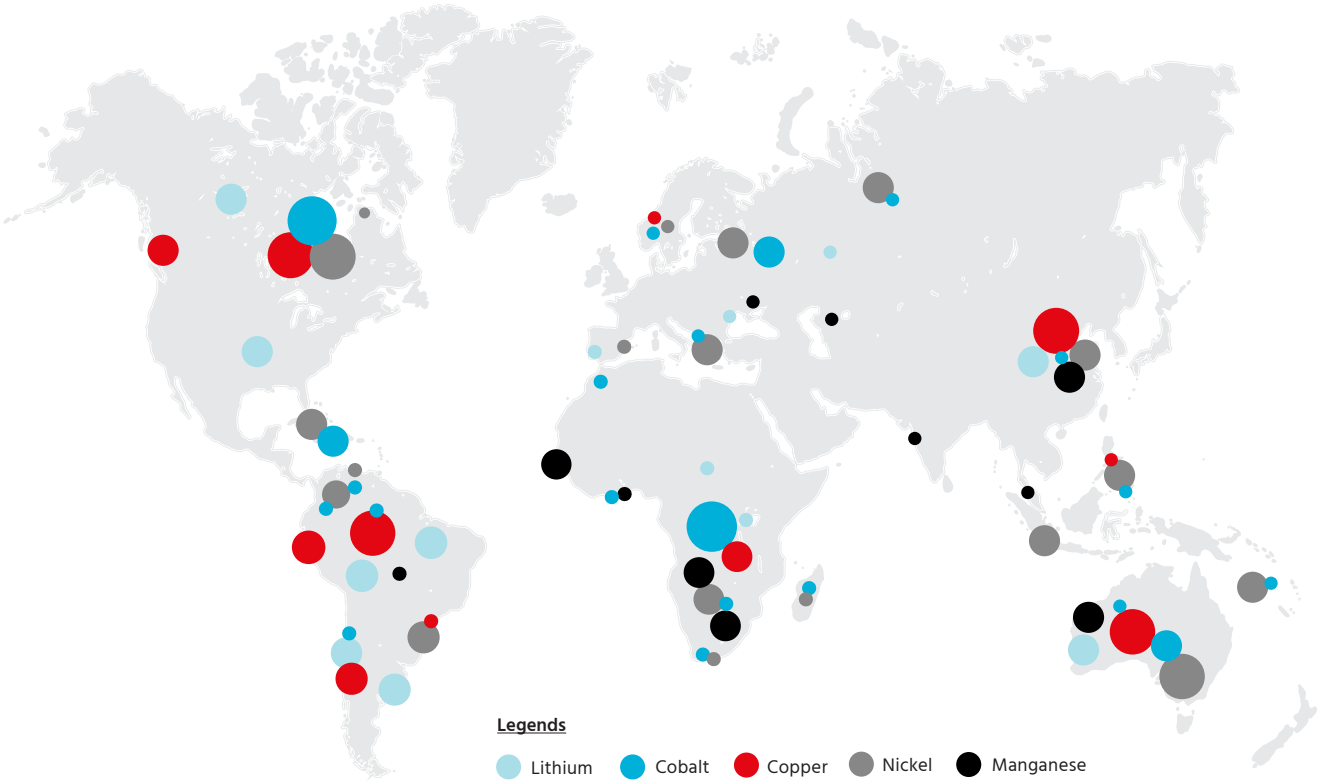
# Supply

**Australia** – Australia is one of the strongest contenders to friend-shore critical mineral supply chains. Australia houses all the critical minerals required for advanced technologies. It is blessed with critical minerals and has decades of experience mining, not just hydrocarbons but critical minerals such as lithium, nickel, and cobalt as well. It is a leading exporter of lithium and houses one of the cleanest sources of cobalt. Unlike emerging markets such as Indonesia or Bolivia, Australia does not face an infrastructure deficit. The critical mineral mining sector in Western Australia has successfully raised capital from global markets and built infrastructure to sustain mining operations without delays in the upstream sector if not as much in the downstream.

**Indonesia** – Indonesia holds the world's largest reserves of nickel.

**Chile** – Chile is the largest producer of copper and is among the largest suppliers of lithium with production increasing multifold thanks to the Biden administration's IRA.

**Figure 6 – Concentration of critical minerals around the world**[11]

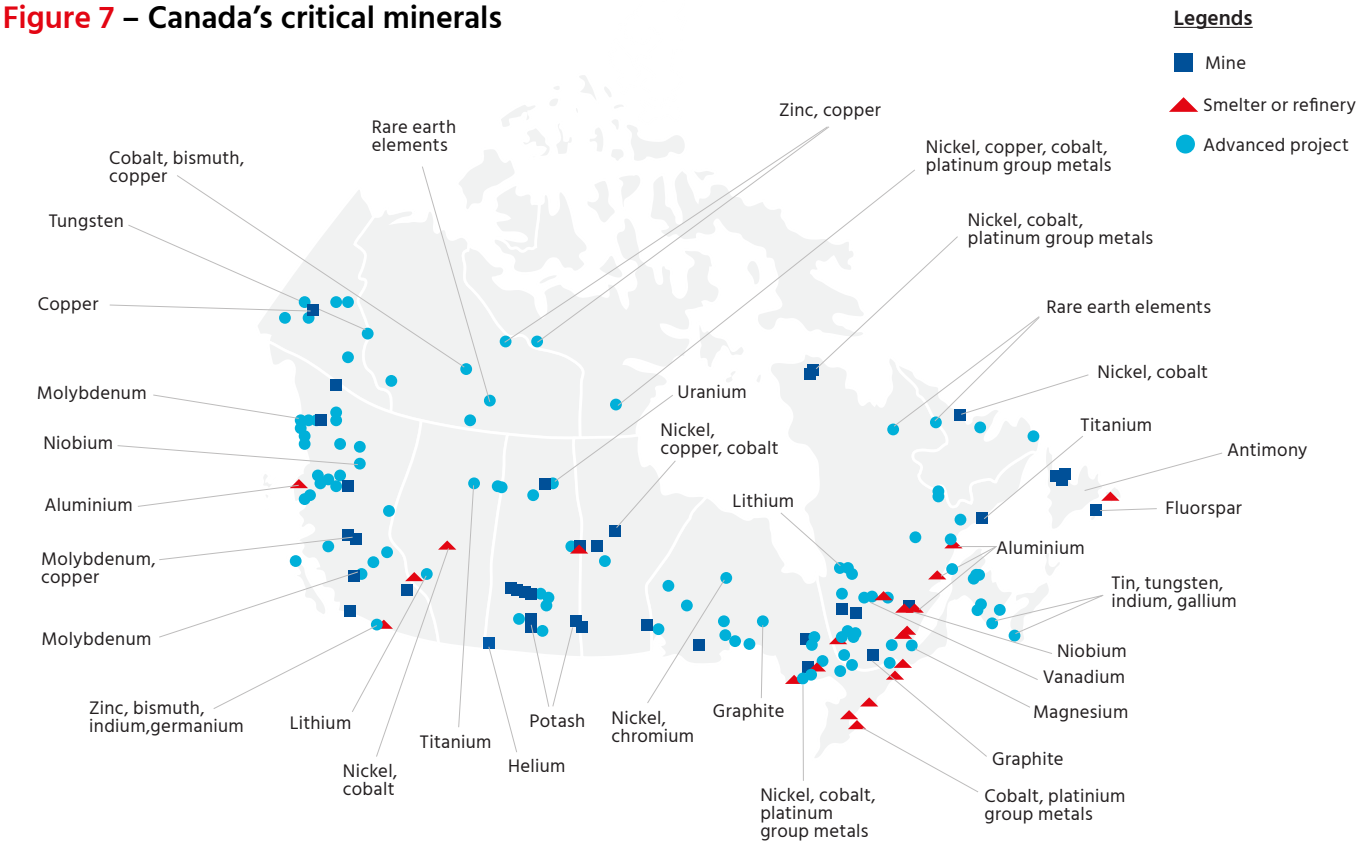



**Source:** Monash University

**Canada** – Canada is another strong contender for friend-shoring critical mineral and EV supply chains. The country houses all the minerals required for an EV and through the FTA with the US, it can attract companies to set up operations in North America.

**South Korea** – While South Korea is not a critical mineral-rich country, like the other four referenced nations, its companies have rapidly advanced to the top of a hierarchical network of value chains in the critical mineral industry. Over the last decade, Korea has successfully developed an indigenous lithium-processing industry.

## Figure 7 – Canada's critical minerals




**Source:** Government of Canada (data and image)

# Opportunities for friend-shoring

As the momentum for friend-shoring grows, the economic and political environments are crucial considerations even among friendly shores.

The IRA provides a basic definition of friend-shoring – procuring supplies from nations with an FTA that do not pose an immediate national security threat to the US. While this definition has multiple leaks to plug – such as defining "friendly" and addressing Chinese capital in American companies – the overarching goal of legislations in the US has been to limit exposure to Chinese monopolies and increase supply chain resiliency.

The Pentagon in the US has been the most vocal proponent for closing the gap between trade and national security policymaking in the critical minerals sector. Defense leadership has consistently advocated for expanding the scope of the Defense Authorization Act to fund projects abroad and not just in the US.[12] As shown earlier, in the critical minerals sector select countries possess large reserves. This forces even ardent advocates for protectionism and onshoring to consider friendly shores.

The economic and political environments are crucial for expanding mining operations and subsequently creating an ecosystem for either battery component manufacturing or exports. There are challenges unique to emerging markets such as Indonesia and broader challenges to developed markets such as Canada and Australia. For example, Indonesia is highly reliant on foreign capital for its indigenization of the EV ecosystem. Not to mention its reliance on Chinese capital even for its new capital city. Nonetheless, the US, Japan, and the EU have committed between US$15–$20 billion for Indonesia to transition to cleaner energy and away from its reliance on coal for its energy needs.[13] Furthermore, there is no reason to believe that Indonesia will weaponize the growing interdependence with the US or its allies as China has done with the Japanese on rare earth minerals[14] and its recent export controls on components going into solar panels.[15]

Australia is a developed market that faces the same challenge. However, Canada and Chile have FTAs with the US and friendly nations as export destinations, limiting their vulnerability to the weaponization of interdependence by China.

### Political and economic policies shaping the industry

**Australia** – Australia has offered tax offsets to increase battery cell production and capitalize on its FTA with the US to reduce reliance on its small domestic market and China.

**Chile** – Chile is the world's largest producer of copper and one of the leading suppliers of processed lithium carbonate and hydroxide. The Chilean government has incentivized the local processing of minerals by offering companies processing in Chile the option to buy 25% of lithium production at special rates.

**Indonesia** – The Indonesian government under President Joko Widodo has implemented several import substitution measures to curb the raw material outflow from the country. To transform the raw material exporting economy into a value-added exporting economy, the Jokowi administration has implemented successive policies between 2009 and 2019, and as of April 2022, banned the

export of nickel ore, requiring nickel to be processed domestically for export.[16] However, the domestic processing of nickel is done through industrial parks and facilities created and financially supported by Chinese state-owned enterprises as part of China's Belt and Road Initiative. On the Indonesian islands of Sulawesi and Halmahera, Chinese mining companies have built refineries, smelters, a new metallurgy school, and even a nickel museum to secure nickel for Chinese companies' demand for the critical mineral. The metal primarily used for stainless steel comes with a warning attached that it is much more finite than its peers going into EVs. This compounds the challenge of friend-shoring to Indonesia. Furthermore, the quality of nickel found in Indonesia will not satisfy the requirements for batteries in EV production, though it will for stainless steel production. This has kept many Western players out of the mix and environmental costs remain a concern for those companies. Chinese mining giants along with CATL have used techniques such as high-pressure acid leaching to access new supplies in the country and explore higher-grade nickel for lithium batteries.[17]

**Canada** – Canada has joined the US in its trade tussle with China. In November 2022, the Canadian government forced Chinese companies to divest from three Canadian-listed lithium companies.[18]

Earlier in 2022, the Canadian government announced a slew of economic incentives, "To enable the exploration of critical minerals, a new 30 percent Critical Mineral Exploration Tax Credit is being introduced that would be available to investors under certain flow-through shares agreements to support specified exploration expenditures incurred in Canada".[19] This tax credit is applicable to specific critical minerals including nickel, lithium, cobalt, graphite, copper, rare earth elements, vanadium, and uranium, among others.

Furthermore, the government has repeatedly prioritized funding for critical mineral projects:

- US$1.5 billion for the Strategic Innovation Fund (SIF) to support critical minerals projects, with preference given to advanced manufacturing, processing, and recycling applications.
- US$40 million to support northern regulatory processes in reviewing and permitting critical minerals projects.
- US$21.5 million to support the Critical Minerals Centre of Excellence (CMCE) to develop federal policies and programs on critical minerals and to assist project developers in navigating regulatory processes and federal support measures.

The SIF is the most significant direct funding mechanism in Canada's toolkit presented under its critical mineral strategy. It aims to support projects that decrease or remove reliance on foreign critical mineral inputs across a range of priority industrial sectors or technologies. As a result, it could help grow Canada's critical mineral value chains in areas of research, development, extraction, processing, manufacturing, and/or recycling.

## Figure 8 – Advantages and disadvantages of different friendly-shores

| Country | Critical mineral | Advantage | Disadvantage |
|---|---|---|---|
| **Australia** | Cobalt<br>Lithium<br>Manganese<br>Graphite | – Higher ESG standards<br>– Established infrastructure<br>– Security partnership with the US (Five Eyes)<br>– Significant upstream operations<br>– The US and Australia have an FTA making it eligible for benefits under IRA | – Industry reliant on the Chinese market[20]<br>– Lacks economies-of-scale to grow an indigenous midstream and particularly downstream operations<br>– Private sector is reliant on Chinese capital |
| **Indonesia** | Nickel | – Emerging market with lower cost of labor<br>– Generous government subsidies<br>– Large market size provides opportunities to scale upstream, midstream, and downstream<br>– Possesses the world's largest nickel reserves | – Lacks established infrastructure for mining operations<br>– Highly reliant on foreign support, particularly from China<br>– Participant in China's BRI and most mineral processing industrial parks fall under the initiative<br>– Is averse to choosing sides between the US and China and does not endorse bifurcation of the world |
| **Chile** | Lithium<br>Copper | – US-Chile FTA provides Chile the benefits offered under IRA<br>– Largest producer of copper in the world<br>– Unlike Australia's dependence on China, Chile's market dependence is on two US allies – South Korea and Japan | – Chinese SOE's stake in its largest lithium mining company – Chinese company Tanqui acquired a 24% stake in Sociedad Quimica y Minera (SQM)[21]<br>– Active participant in China's Belt and Road Initiative<br>– Due to BRI and increased Chinese investments, Chile may not be enticed into a grouping against China |
| **Canada** | Cobalt<br>Lithium<br>Nickel | – Ottawa has joined Washington in addressing the economic threats from China. Banned Chinese investments in Canadian lithium – announced under the Investment Canada Act on October 28, 2022, the government stated that "investments by SOEs and foreign-influenced private investors in Canadian entities in the critical minerals sectors would be scrutinized more closely"[22])<br>– Through the USMCA, FTA with the US making it eligible for benefits under IRA<br>– Potential to capitalize on the market size of the US to attain economies of scale<br>– Higher ESG standards<br>– Several bilateral critical mineral-related exchanges – Canada-U.S. Joint Action Plan on Critical Minerals; Canada-EU Strategic Partnership on Raw Materials; Canada-Japan Sectoral Working Group on Critical Minerals | – High ESG standards and civil society (indigenous lands) opposition to mining<br>– Lacks midstream and downstream mining capabilities<br>– Critical mineral mining is a work in progress and not as established as uranium, gold, and diamonds |
| **Korea** | Lithium | – Fastest growing processor of minerals (mid-stream)<br>– Seoul has an active FTA with Washington<br>– Excluding upstream, Korean companies are the strongest competitors to Chinese near-monopolies | – Does not possess critical minerals<br>– Will not be keen to become part of any anti-China coalition |

**Source:** Author's compilation

The commercial viability of mineral reserves in Australia was made prominent when Prime Minister Anthony Albanese related national security policymaking to trade policymaking.

## Commercial viability

While Australia, through the sheer magnitude of its critical mineral reserves, constitutes a strong candidate for friend-shoring, it has nonetheless become largely dependent on the Chinese market for its exports across sectors, including critical minerals. This level of export reliance has made it vulnerable to acts of economic coercion.

In an address to the National Press Club in late February 2023, Australian Prime Minister Anthony Albanese used AUKUS and critical minerals supply chains in the same sentence, ending the divide between national security policymaking and trade policymaking in Australia. "It's about our sovereign capability, it's about our defense," Albanese said of AUKUS and local manufacturing. "But it is also about our industry policy, about our economy, about jobs here." "We need to not just dig it up. I want to make sure we use lithium and nickel and other products. We must make batteries here," he continued, adding "that's part of the vision of protecting our national economy going forward. I think we should be making solar panels here. I think we should be making so many more things here in order to protect our national sovereignty."[23]

Albanese administration's push for setting up midstream operations within its borders through the National Reconstruction Fund of A$15 billion is a meager amount compared to China's investments in the sector over the last two decades. Notably, while the leadership was speaking of protectionism and new industrial policies, the private sector had different plans. Core Lithium started exporting lithium to China as recently as January 2023. Furthermore, continuing the trend of the last two decades, Chinese companies have sought a stake in West Australian mining firms. While the overall investment had dropped significantly from A$477 billion to less than A$300 billion between 2021 and 2022, the M&A (mergers and acquisitions) in Australia witnessed a A$136 million bid by Chinese company Tianqi Lithium for Australian lithium developer Essential Metals.

Over the last three years, Chinese state-owned mining companies have acquired stakes in the largest major mines outside China, such as 51% in the Greenbushes in Australia, a 23.8% stake in Chile's SQM, and a 50% stake in the Cauchari-Olaroz mine in Argentina.

Albeit the M&A data and investment inflow into China portrays a strong interconnectedness and persisting overreliance on China, companies such as Piedmont – a lithium processing company that redomiciled to the US from Australia – demonstrate the plausibility of Western companies being enticed by generous government support.

Furthermore, several Australian and Canadian companies are making investments in other parts of the world while not foregoing the Chinese market in its entirety, as shown in Figure 9.

## Figure 9 – Mining expansion by friendly shores

| Location | Name of company (country of origin) | Capacity (in tons per year) |
|---|---|---|
| Mount Holland, Australia | SQM (Chile), Wesfarmers (Australia) | 45,000 |
| Xuxa, Brazil | Sigma Lithium (Canada) | 60,000 |
| Sal de Vida, Argentina | Galaxy Resources (Australia) | 15,000 |

**Source:** Nikkei Asia

The private sector is playing an increasingly active role in sourcing for critical minerals, at home and abroad.

In the US, the Midwest, South, and Southwest have capitalized on Washington's industrial policies. Particularly, companies such as Tennessee Lithium have planned lithium hydroxide production facilities in small-town America such as Etowah in McMinn County in Tennessee.[24] Once fully operational, the plant will produce 30,000 MT of lithium hydroxide per year – double the amount of total lithium hydroxide currently produced in the US. Not very far from this production facility (see Figure 5), another lithium project in Gaston County, North Carolina, is planned to be a fully integrated site.[25] This facility is located within the renowned tin-spodumene belt in North Carolina. These companies have moved their facilities or revived production since their end-customers, such as EV manufacturers, have been left with no choice but to move their production to the US to avoid losing the market. For example, Toyota has announced that Rutherford County, North Carolina, will be the home of its new EV battery plant. VinFast and Forza have chosen Chatham County and McDowell County for their electric-powered cars and boats, respectively.[26] Battery manufacturing in Kansas, automobile manufacturing in Georgia, graphite processing in Louisiana, and semiconductor manufacturing in Ohio, Arizona, and Texas jump-start the revival of American manufacturing – both through American companies and companies from partners and allies.

With LG chemicals and Piedmont signing a deal for access to lithium,[27] the value chain is rapidly changing from an overreliance on a state-owned company or a single country.

The US's northern neighbor, Canada, has also witnessed several such private-sector initiatives. To name a few, American GM and Korean POSCO have established a joint venture to produce cathode materials in Becancour, Quebec.[28] LG Energy solutions and Stellantis have set up a joint venture for a US$5 billion EV plant in Windsor, Ontario.

Indonesia has taken a similar approach to establish an indigenous ecosystem for mineral processing and EV manufacturing. However, as mentioned earlier, the sector is largely dependent on Chinese capital, dismissing benefits from friend-shoring. Nevertheless, its private sector has raised funds from venture capitalists in California, complicating the trade relationship. Figure 10 shows a list of Indonesian companies across the value chain that started in the last decade or so.

### Challenges closer to home

American mining giant Albermale's case could prove to be the biggest challenge for friend-shoring critical mineral supply chains and reducing the reliance on China. The North Carolina-headquartered lithium mining giant has invested heavily in the production of lithium in China. As recently as 2021, Albemarle signed investment agreements with the Pengshan Economic Development Park in the Pengshan District in Sichuan province, as well as the Yangtze River International Chemical Industrial Park in the Zhangjiagang Free Trade Zone in Jiangsu province.[29]

While market dependence is one challenge to overcome, the near monopoly of Chinese companies in the upstream of the critical mineral mining value chain such as batteries has proven to be a harder challenge to overcome.

**Figure 10 – Indonesian companies across the critical mineral value chain**

| Electric two-wheelers | Battery materials | Commerical EVs |
|---|---|---|
| – Bike Smart Electric<br>– Energi Kreasi Bersama<br>– Gaya Abadi Sempura<br>– Ilectra Motor Group<br>– Smoot Motor | – Adaro Minerals Indonesia<br>– Aneka Tambang<br>– Bukaka Teknik Utama<br>– Ceria Metalindo Prima | – Bakrie & Brothers<br>– Indika Energy |

**Source:** Author's compilation

**Figure 11 – Leading critical mineral mining companies and their countries of origin**

| Critical mineral | Company | Country of origin |
|---|---|---|
| Lithium | Albermale Corp | US |
| Cobalt | Glencore | Switzerland |
| Nickel | Norlisk Nickel | Russia |
| Graphite | Syrah Resources | Australia |
| Manganese | South32 | Australia |

**Source:** Author's compilation

# Risk assessment

Friend-shoring whole supply chains neither simple nor feasible, and has several short-term challenges that requires consideration of long-term impacts.

In June 2021, the White House released the National Blueprint for Lithium Batteries report,[30] essentially outlining the future of the industry from 2021 to 2030. Subsequently, in a report released in early 2023, Li-Bridge[31], the public-private alliance convened by the US Department of Energy (DOE) and managed by Argonne National Laboratory, addressed outstanding questions on the feasibility of reshoring supply chains and offered 26 recommendations. However, upon reviewing the report, private consulting firms such as supply chain risk consulting firm, Resilinc, have highlighted that the US cannot reshore entire supply chains all by itself as the report suggests.[32] Resilinc recommended a Pan-American approach, suggesting friend-shoring in the region as a final plug for achieving supply chain resiliency. However, the pathway to friend-shoring critical mineral supply chains near or afar has several short-term challenges and requires consideration of long-term impacts.

### 1. Near monopoly at the top of a hierarchical network of value chains – CATL

As Farrell and Newman identified in their paper on weaponized interdependence,[33] countries at the top of the hierarchical network of value chains can weaponize their position against the ones below them. In the critical minerals sector, China not only enjoys the top position in the critical mineral value chain but also in the end-use battery value chain. China's CATL has the largest market share[34] for a single company, with only Korean battery makers trailing behind. While Korean and even Japanese battery makers trail CATL, for immediate needs American companies have at times chosen CATL. Ford's move from Virginia to Michigan is a case in point. Post-IRA, American automobile pioneers such as Ford have sought Chinese partners such as CATL for their battery-powered vehicles. When Republican Governor Glenn Youngkin of Virginia rejected Ford's proposal to set up a plant in his state citing its partnership with Chinese battery maker CATL,[35] Ford, instead of canceling their proposed partnership, moved to Michigan and proceeded to license the technology from CATL.

There is increased awareness and concern over this monopoly – more than US$80 billion in federal spending is allocated for batteries in the IRA and BIL. However, in the near term, CATL is the market leader and companies (including American) due to cost concerns may continue to use CATL through loopholes in the IRA.

### 2. Without "rules of origin" mandates friend-shoring becomes frenemy-shoring

Mandates pertaining to "rules of origin[36]" will distinguish between friend-shoring and "frenemy-shoring" as friendly nations have been used by countries to rout their goods averting trade tariffs, anti-dumping, and other countervailing duties. The case of solar panels coming from China via Southeast Asia is a case in point. In mid-2022, the Department of Commerce opened an investigation into solar cell and module imports after the California-based solar manufacturer, Auxin Solar, raised the issue.[37] The company alleged that the parts were made by Chinese companies operating out of Malaysia and other Southeast Asian nations. The critical mineral industry is highly vulnerable to this challenge as the entire value chain and note processing of minerals is undertaken by China or by Chinese

companies. These companies are operating in third countries such as Indonesia, as part of the Belt and Road Initiative. Alternatively, given the dominance of Chinese state-owned companies in the field and their M&A deals, companies in Australia and Chile are not immune to this challenge either.

### 3. Race to climate change goals and ESG

The Indonesian documentary *From Dreams to Dust* about the coastal community of Tapunggaeya, a mining town in Indonesia, brought to light the ugly side of mining for lithium-ion batteries. Sulawesi's mines have a devastating impact on the environment and people's lives.[38] As automobiles move away from the internal combustion engine to the electric vehicle, mining for nickel, lithium, and cobalt increases multifold. From Congo to Indonesia, the progression in the value chain comes at the cost of regression in environmental protection. While in Indonesia it is the local communities and the wild forests that are damaged, in places such as Chile, aquifers have been damaged with the country losing a few of its most needed freshwater reserves (in the Atacama Desert). As countries move away from the internal combustion engine and towards cleaner technologies, the damage done by these "cleaner" sources will witness further scrutiny. This will subsequently slow down the process of friend-shoring and attaining supply chain resiliency. Moreover, these environmental challenges are not limited to foreign shores. The US has grappled with this challenge since the founding of the Environmental Protection Agency (EPA). More recently, the work on the Rhyolite Ridge deposit, home to one of two known lithium-boron deposits, has stalled its approval due to its proximity to a site with the endangered wildflower Tiehm's buckwheat.[39]

However, this is no recent phenomenon. Across the US, from Minnesota to Arizona to Alaska, mining operations and local communities have been at odds. Native American tribes have opposed mining operations on the reservations. Given the

From Congo to Indonesia, the progression in the value chain comes at the cost of regression in environmental protection.

history of protests associated with Standing Rock and others, US administrations, particularly Democratic ones, may not be able to so easily kickstart mining operations.

Since the Obama years, the EPA through climate-related regulations has been an impediment to operating mines in the US. While the Trump administration deregulated and worked toward reopening mines, the Biden administration is in a quandary as it champions inclusivity, environmental protection, reviving manufacturing, and competition with China.[40]

While the China Chamber of Commerce of Metals, Minerals & Chemicals Importers & Exporters (CCCMC) lays out guidelines for responsible mining operations, several independent watchdogs have raised questions about its mining practices abroad.[41] Moreover, European nations have clamped down on their corporations that engage in unethical practices in nations such as the DRC. Regulations such as Switzerland's Conflict Minerals and Child Labor Due Diligence Legislation, France's Corporate Duty of Vigilance Law, Germany's Supply Chain Act, and Norway's Transparency Act are tailored to address violations in the critical mineral sector.

### 4. Bifurcation of the world into democracy vs. autocracy

The US has time and again sought to divide the world based on ideological groupings. However, natural resources are not always located in democracies. This complicates measures toward reducing reliance on China. While the Trump administration initiated the study and analysis of the extent of overreliance on China for critical minerals, the Biden administration built on it. Nevertheless, the distinction is the Biden administration's focus on democracy promotion and building partnerships based on ideologies over strategic interests. This provides countries such as China that invest in high-risk projects in autocracies and nations with unstable governments such as Zimbabwe, Bolivia, etc. more opportunities. For example, the US-led Mineral Security Partnership is a coalition of nations based on their roles in the mineral supply chain and their ideological alliance. Similarly, US efforts to bring the UK and South Korea into an alliance for the securitization of critical mineral supply chains are efforts at restricting the partnerships to existing relationships. Traders in China had a similar initiative, however, limited to Chinese companies that controlled the manganese trade.[42]

### 5. Changes in battery chemistry from technological advancements

Technological advancements in the battery sector have disrupted capital investments in the industry. Innovation provides batteries of various compositions that are viable in the long term due to their chemistry. They efficiently uses scarce minerals such as nickel and hard-to-access minerals such as cobalt.[43] This has incentivized companies to seek alternate chemistries such as manganese in place of cobalt[44], sodium-ion batteries, and even zinc-based batteries. This poses a unique challenge to the highly capital-intensive industry. Hence market intervention through industrial policies could lead to inefficient use of taxes. The end use battery determines the fate of critical minerals. Lastly, nations that do not possess viable mines nor have resources to access minerals may choose green hydrogen and other engines for their clean energy transition.

# Conclusion

To effectively friend-shore critical mineral supply chains, supply must quickly meet demand and governments should play an active role in easing the burdens of doing business with friendly shores.

The US, Europe, and Japan have become patently aware of the risks associated with a single closed economy controlling entire value chains – particularly as China's ability to weaponize its hegemony against the West's own clean energy transition and progress in the fourth industrial revolution becomes evident with its export control measures and securitization of commodity trade, such as the closed loop in manganese supply chains and bilateral deals through the BRI. While the US has used the IRA, BIL, and other legislations and Europe has unveiled its Critical Raw Materials Act, these legislation are not immediate fixes. Moreover, industrial policies in the US and Europe are limited by external and internal factors, respectively. In the US, legislation has been amended and tailored to assuage the concerns of allies and partners, resulting in watered down bills. In Europe's case, the CRM Act itself is limited in scope and not as ambitious as the IRA or other legislation in the US. While the US has set a target of 80% indigenization by 2029, the European Union through the CRM Act has proposed only 10% of the raw critical minerals consumed to be mined in the region, 15% of needs met by recycled sources, and 40% of all critical minerals be processed within the EU.[45] Furthermore, Europe has not taken as antagonistic an approach as the US toward China and its corporations, particularly as automakers count on the Chinese market for exports. This limits European policymakers' options in limiting imports from foreign markets such as China.

In 2023, it takes ten-plus years to build and finance a lithium mine in most parts of the world, whereas a gigafactory can be built in less than two years.[46] As it stands, permissions for a mine in the US take more than a decade's time.[47]

The success of friend-shoring relies on supply quickly meeting demand. Governments should accelerate measures toward supporting friend-shoring of different parts of the supply chain for mining while also rapidly transforming the attainable end-use industry of battery manufacturing. Rather than deregulating environmental standards, governments could ease the burdens of doing business by efficiently approving mining permits. Such compromises will not offer the high-quality and standard of agreements and operations that the US champions against China's practices.

"Lithium is the new oil" has become the new catchphrase. Unfortunately, this reality is as geopolitically inflammatory as the oil wars were. For example, the economic competition between Chile and Bolivia, or the recent discovery of lithium in Kashmir, could quickly evolve into a larger security challenge. While securing resources from partners, knowledge of pre-existing disputes is crucial to avoiding flaring geopolitical tensions.

The USMCA provided a template for high-quality trade agreements by mandating vehicle manufacturers produce at least 75% of automobile components in the trade zone.[48] Similarly, friend-shoring of critical minerals will be a success only if "rules of origin" are mandated and provisioned in all security and trade partnerships.

In conclusion, Canada, followed by Chile and Australia present the most viable options for friend-shoring critical mineral supply chains in the Indo-Pacific region.

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