CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE

OCTOBER 2025

Securing America's Critical Minerals Supply

Bentley Allan and Jonas Goldman

Securing America's Critical Minerals Supply

Bentley Allan and Jonas Goldman

Carnegie Endowment for International Peace
Publications Department
1779 Massachusetts Avenue NW
Washington, DC 20036
P: + 1 202 483 7600
F: + 1 202 483 1840
CarnegieEndowment.org

This publication can be downloaded at no cost at CarnegieEndowment.org.

Contents

Executive Summary	1
Introduction	3
U.S. Production Potential and Future Consumption	4
Methodology	6
Toward an Integrated Strategy: Copper	8
Balancing Onshoring and Friendshoring	12
Conclusions and Recommendations	15
About the Authors	21
Notes	23
Carnegie Endowment for International Peace	29

Executive Summary

U.S. President Donald Trump's administration has prioritized building a secure critical minerals supply chain to create economic prosperity and geopolitical leverage. This strategy centers on streamlined permitting, legislative support via the One Big Beautiful Bill Act (OBBBA), and protective tariffs, including a planned 50 percent tariff on copper announced for summer 2025.

However, a purely domestic approach will face severe constraints. First, the United States does not have the necessary critical minerals reserves in all cases. This creates fundamental limits to supply that cannot be resolved through domestic policy measures alone. While international agreements, such as the minerals deal with Ukraine, offer potential solutions, mining development requires long lead times, which makes these efforts inherently long-term projects.

In addition, there is a tension between domestic mining goals and broader manufacturing competitiveness. Our analysis shows that even under the most optimistic scenarios, by 2035 U.S. domestic production would be able to meet projected demand only for zinc and molybdenum. Even a substantial domestic minerals boom would leave the country requiring substantial imports of copper, graphite, lithium, silver, nickel, and manganese to support industrial expansion and grid modernization. But greater minerals extraction is only half the picture, as a corresponding scaleup of U.S. smelting capacity would also be required.

Current policy measures under the OBBBA provide mixed support. While the legislation allocates $2 billion for National Defense Stockpile purchases, $5 billion for the Industrial Base Fund, and $500 million for defense credit programs, it simultaneously phases out the Inflation Reduction Act's permanent 10 percent production tax credit in 2034. These changes fail to address the structural weaknesses in U.S. mining competitiveness.

This analysis identifies two critical pathways. First, a comprehensive domestic industrial strategy must address the entire mining ecosystem—from streamlined permitting and modern equipment to efficient logistics networks and processing economies of scale. Second, a coordinated friendshoring approach must leverage partnerships with allies and developing economies to diversify supply chains away from Chinese dominance. The United States must support value-added processing in these jurisdictions, so that all countries can benefit from a global mining diversification push.

One specific policy mechanism is likely to prove crucial. Guaranteed price contracts with miners and processors—modeled on the recent MP Materials rare earths arrangement—could provide investment certainty through shared upside mechanisms rather than blanket import restrictions.

Success requires strategically coordinated domestic and international efforts. Tariffs alone will fail. Innovation support, technology standards, and infrastructure development must be integrated in a comprehensive industrial strategy. A balanced approach that strengthens domestic capabilities while securing reliable international partnerships offers the best path toward critical minerals security that enables rather than constrains American manufacturing competitiveness.

Introduction

Both the Donald Trump and Joe Biden administrations converged on the belief that the United States needed to contest China's dominance of critical minerals supply chains as part of a broader effort to reindustrialize the country. To that end, the Trump administration has made building secure and responsible critical minerals supply a key priority.[1] The U.S. energy dominance agenda seeks to build domestic mining through three avenues: streamlining and fast-tracking permitting, deploying new tools authorized by the One Big Beautiful Bill Act (OBBBA), and levying tariffs.

However, there are strong physical and practical limits on the capabilities of domestic mining in the United States. The reserves of many critical minerals are simply non-existent. Many observers determined that this reality motivated the Trump administration's minerals deal with Ukraine and other international efforts.[2] Yet any such efforts need to be considered a long-term project, given the long lead times of mining development.[3]

Moreover, creating secure critical minerals supply that enables rather than constrains U.S. manufacturing is a key objective. Doubling down on American mining might undercut American manufacturing. If U.S. mining is not cost competitive globally, any requirements on U.S. manufacturers to use domestic materials will raise their costs relative to their global peers.

This analysis assesses the ability of U.S. production to meet U.S. demand and recommends priorities for onshoring and offshoring. It focuses on three key questions, with copper as an important test case:

1. Can domestic mining meet the medium-term needs of the United States?

2. Is U.S. mining likely to be globally competitive?

3. What policy tools will be needed to ensure critical minerals supply that enables rather than constrains long-term reindustrialization of the U.S. economy?

We argue that Washington needs a strategy to secure America's critical minerals supply that balances onshoring through domestic mining and offshoring through international supply chain development. Domestically, rather than rely on tariffs, the United States needs a comprehensive industrial strategy for minerals development.[4] Internationally, the United States must work with allies to build and diversify critical minerals value chains in ways that benefit all countries.[5] Doing both in an integrated way will create economic benefits in the United States and help the country regain geopolitical advantage abroad.

U.S. Production Potential and Future Consumption

U.S. geology is rich in iron, copper, zinc, lithium, molybdenum, gold, silver, platinum group metals, and phosphate. It is a world-leader in the extraction of copper (fifth globally), molybdenum (fourth), palladium (fifth), phosphate (third), and gold (fifth).[6] It also has a healthy project development pipeline in a number of metals. It has advanced projects with the potential to add 700,000 metric tons of annual copper production, 200,000 metric tons of zinc, 350,000 metric tons of graphite, 24,000 metric tones of lithium and 3,000 metric tonnes of molybdenum.[7]

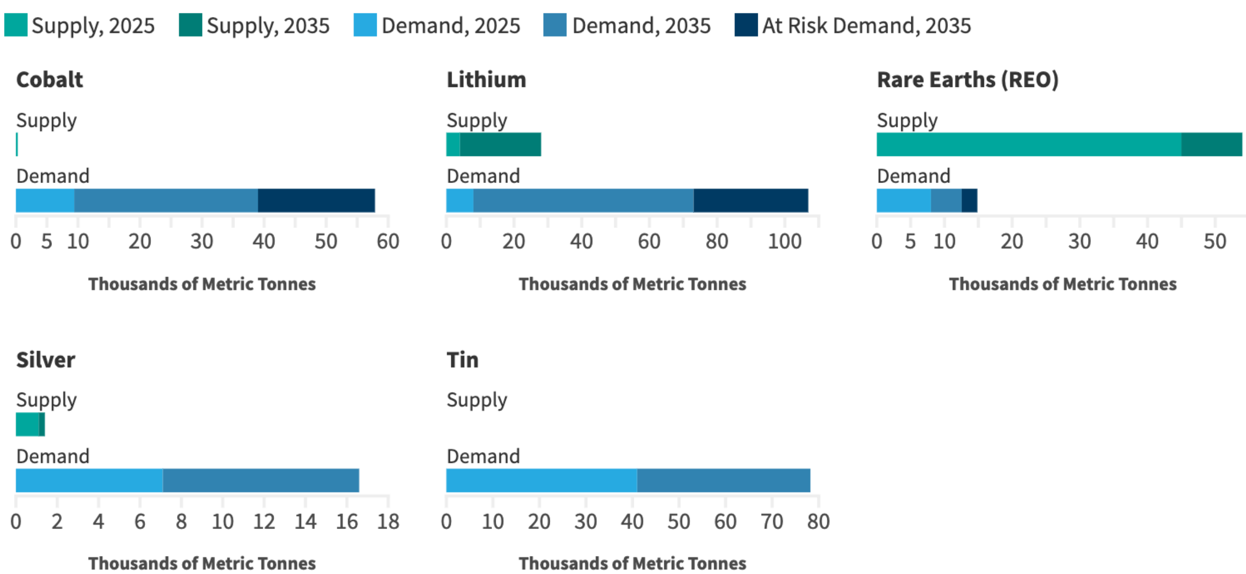
While these project pipelines represent a significant economic opportunity for the United States, they cover just a few of the metals the U.S. industrial base needs. Moreover, even if all these projects were brought online in the next five to ten years, they would only cover projected demand for molybdenum and zinc. The United States would still need to increase imports of nickel, manganese, graphite, and copper (see Table 1).[8]

Table 1. U.S. Critical Mineral Supply and Demand

All units in metric tonnes.

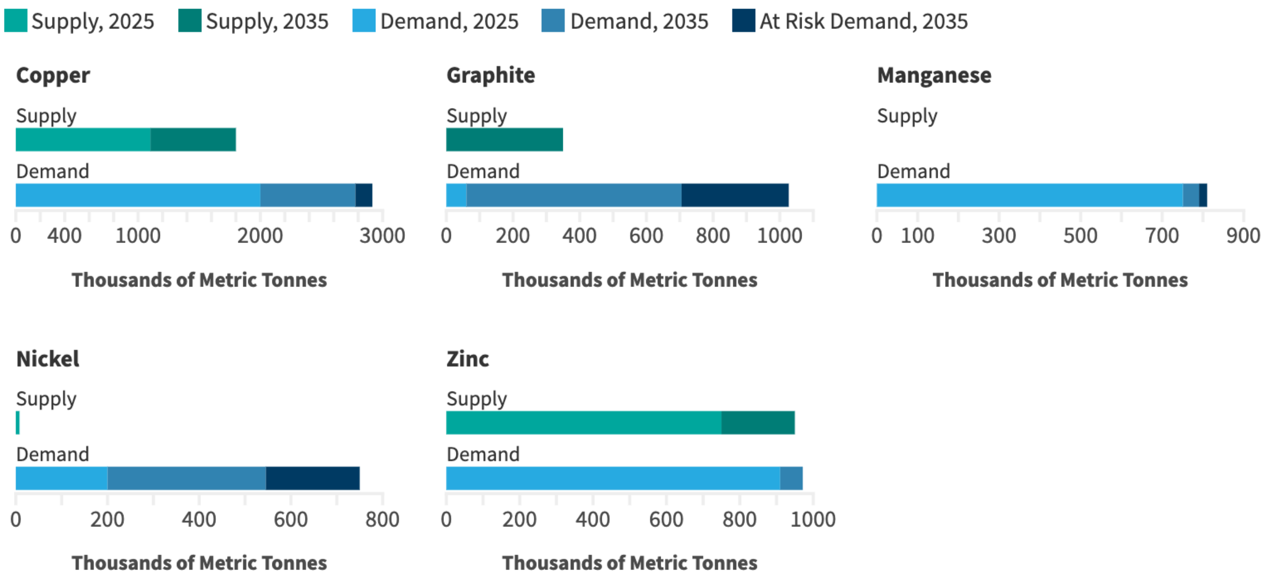
	Supply			Demand			Balance	
Mineral	**Production**	**Pipeline**	**2035 Supply**	**Consum-ption+**	**Grid+Mfg Build Scenario**	**2035 Consumption**	**By Volume**	**Import Dependence**
Copper	1,100,000	700,000	1,800,000	2,000,000	915,875	2,915,875	-1,115,875	-62%
Graphite	0	350,000	350,000	60,000	966,795	1,026,795	-676,795	-193%
Lithium	4,000	24,000	28,000	8,000	98,936	106,936	-78,936	-282%
Manganese	0	0	0	751,000	59,300	810,300	-810,300	N/A
Molybdenum	33,000	3,000	36,000	14,000	2,664	16,644	19,336	54%
Nickel	8,000	0	8,000	200,000	549,987	749,987	-741,987	-9,275%
Silver	1,100	300	1,400	7,100	9496	16,596	-15,196	-1,085%
Zinc	750,000	200,000	950,000	910,000	60,000	970,000	-20,000	-2%

Figure 1. Domestic Mineral Extraction and U.S. Demand



Note: While domestic extraction of rare earth oxides is in excess of expected demand from U.S. EV manufacturing, processing of rare earths poses the main bottleneck in securing this supply chain.

Figure 2. Domestic Mineral Extraction and U.S. Demand



Methodology

To assess the U.S. onshoring potential and offshoring needs, we first estimated the U.S. mining project pipeline. We used S&P data to identify projects at the feasibility or preproduction phase, and we included all of these projects in our pipeline data. This is a generous assumption, as many of these projects may prove financially unviable. We wanted to provide the best-case scenario for production as a hard check on our thesis that the United States will remain dependent on offshoring regardless of domestic mining.

Second, we built a simple model of the critical minerals needed to meet increased manufacturing and grid buildout needs. First, we took existing consumption and expanded it at a rate of 2 percent per annum through 2030.[9] This is a simple, optimistic assumption meant to capture the desired reindustrialization of the U.S. economy. Second, we calculated the demand for metal from planned grid and manufacturing buildouts. Electrification rollouts, AI data centers, and other energy intensive developments require a major expansion of the electricity grid that will, in turn, create massive demand for aluminum and copper.[10] Strengthening and expanding the grid is a major focus of the Trump administration's AI Action Plan from July 2025.[11] U.S. factories for lithium-ion batteries, solar panels, wind turbines, and electrolyzers will also require new metal.

Grid infrastructure buildout and batteries make up a significant amount of increased domestic U.S. critical mineral demand. Grid infrastructure requires massive amounts of aluminum and copper, though the exact amounts will vary based on the ratio of aluminum to copper cabling deployed. We estimated 2035 demand based on a pathway to doubling the grid by 2050, in line with government estimates for the expansion of the transmission system.[12]

Grid infrastructure buildout and batteries make up a significant amount of increased domestic U.S. critical mineral demand.

Battery factories will require copper, lithium, nickel, cobalt, manganese, and graphite. Solar manufacturing requires silver, tin, and molybdenum. Wind turbines need copper, molybdenum, zinc, and rare earths. Critical minerals demand to meet manufacturing plans for these technologies is indexed to the existing factory pipeline.

Table 2. Production and Pipeline for Solar, Wind, Batteries, and Electrolyzers

	U.S. Production Capacity	Projects in Pipeline	Planned 2035 Capacity
Solar GWh	38	48	86
Wind GWh	7.2	4	11.2
Batteries GWh	202	703	905
Electrolyzers GWh	3.1	3	5.7

In our projection, annual demand for critical minerals grows through 2035 as planned manufacturing comes online and the grid is built out. For each metal, we compare this to the projected pipeline and future expectations. Some expected battery demand may fail to materialize due to changes in the policy environment; this is also captured in our model and presented in the tables.[13] In any scenario (reduced demand, bolstered supply, or both), the U.S. project pipeline can only meet demand for zinc and molybdenum. The United States will still need substantial copper imports, as well as large quantities of graphite, lithium, silver, and nickel.

But even in this scenario, there is potential that reliance on U.S. mining will raise costs for American metal users. Even if minerals exist domestically, it may not be necessary or advisable for the United States to pursue these projects when cheaper sources may exist in friendly countries.

Given this situation, the choice is stark but simple. Washington has two options: maintain dependence on Chinese processing or support other partners in building out critical minerals supply chains (in both extraction and processing). The United States needs a focused strategy to diversify global critical minerals supply chains to complement onshoring efforts.

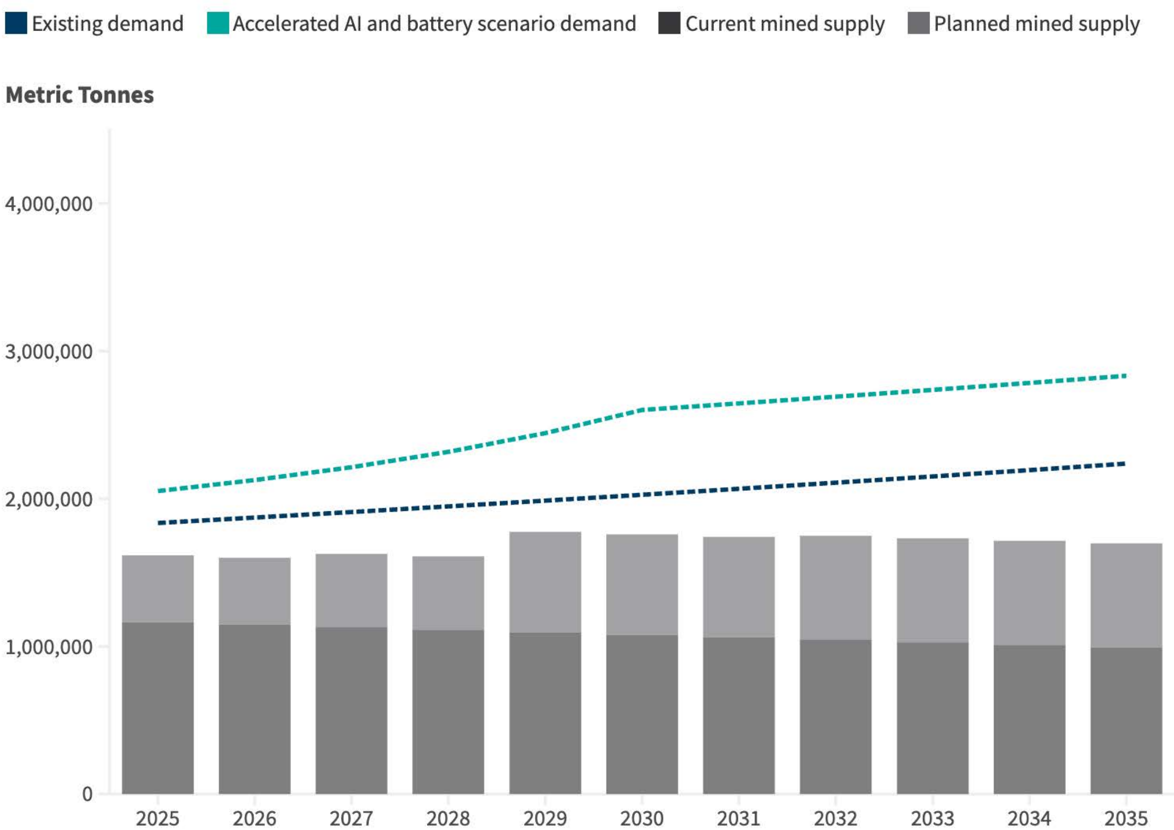
Toward an Integrated Strategy: Copper

To better understand the strategic situation and the policy options, consider the case of copper. U.S. production is on the rise, with Rio Tinto and BHP's Resolution mine in Arizona advancing pending court cases regarding the land transfer.[14] This will be the biggest North American copper mine.[15] There are also a number of mines at the advanced development stage that could be commissioned by 2030 or shortly thereafter.

At the same time, copper demand is expected to grow rapidly in support of AI, electrification, and manufacturing buildouts. That demand is projected to surpass current and planned capacity, resulting in a shortfall that can only be met by continued imports. Moreover, reliance on U.S. mining could raise manufacturing costs if the domestic mining projects are not globally competitive.

Figure 3. U.S. Copper Supply and Demand

Artificial intelligence and electrical infrastructure drive growth in the Accelerated Scenario



Source: Carnegie analysis of S&P and USGS data.

Table 3. Advanced Stage U.S. Copper Mines

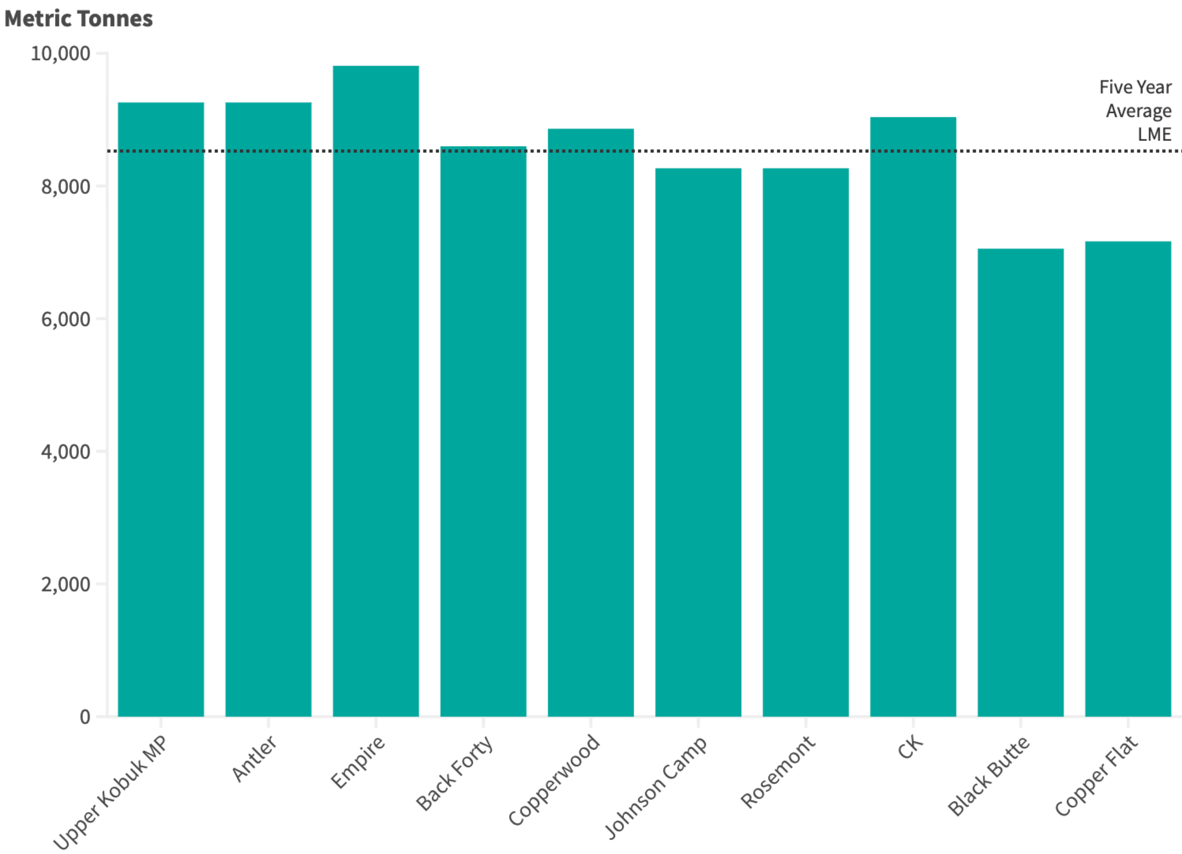
Project	Development Stage	Expected Commissioning Year	Expected Annual Production (metric tonnes)
Resolution	Pre-production	2025	453,592
Johnson Camp	Construction started	2027	11,340
Copperwood	Construction Planned	2027	29,302
Back Forty	Construction Planned	2027	3,105
Rosemont	Feasibility complete	2028	85,000
Upper Kobuk Mineral Projects	Feasibility complete	2029	49,469
Railroad-Pinion	Feasibility complete	2029	N/A
Hermosa	Feasibility complete	2029	N/A
Copper Flat	Feasibility complete	2029	25,673
Black Butte	Feasibility complete	2029	23,000
Empire	Feasibility started	2032	8,000
Clarkesdale Slag	Feasibility started	2032	--
CK	Feasibility started	2032	--
Antler	Feasibility started	2032	16,400

Source: S&P Global
Note: Mines that required at least 100 million in funding and have at least started the feasibility study process.

The United States is a leading global copper producer, but its costs are 8 percent higher than the global average.[16] U.S. operating mines fall, with one exception, in the top, more expensive, half of the production cost curve, and a majority of U.S. production falls above the ninetieth percentile. The largest advanced U.S. projects all predict profitability at reasonable price estimates (see Figure 3), but these projections are based on price estimates from aspirational analyses done by the firms and so may be unrealistic. BlackRock's analysis suggests that a copper price of $12,000 per tonne, well above the historic five-year average of $8,762, is needed to unlock U.S. projects.[17]

Any mined copper will have to be smelted. The United States has some idle smelting capacity, but a major mining expansion will exceed this capacity. Currently, the United States has two primary smelters, and one secondary smelter, yielding a total combined capacity of 558,000 tonnes.[18] An additional secondary smelter is under construction, but this is only a drop in the bucket, with total sum capacity still short of that required to smelt all domestically mined copper, let alone all projected U.S. copper demand.

Figure 4. The Price Assumptions of U.S. Mining Projects Against Historic Prices



Source: Carnegie and NZIPL analysis of S&P Global data.

Moreover, the business environment is getting more, not less, difficult for Western smelters. Over the last few months, China has been rapidly building midstream capacity in the copper supply chain. This has driven down the conversion fees charged by smelters, which is their central source of revenue, creating a crisis in Western smelting.[19] This could deepen China's control over critical minerals supply chains.

The U.S. needs a robust industrial strategy and well-calibrated policy mix to catalyze mine development and secure additional processing capacity. As yet, the Trump administration has not advanced a coherent set of policies. In July, it announced a 50 percent tariff on copper. This mobilized an army of traders to re-route shipments of copper from all over the world to the United States as they tried to front-run the tariffs.[20] The expectation was that prices would jump after August 1, when the promised tariffs would take effect, and the value of onshored stocks would soar. However, when the tariffs were announced on July 30, they excluded raw ores, concentrates, mattes, cathode, and anode—all the copper products likely to be on those re-routed boats.[21] Prices dropped 20 percent and those traders who had paid up to $1000 a ton to get sellers to cancel their other contracts were left in the lurch.

America can only onshore while counteracting rising prices if it makes strong investments in the supply side that significantly reduce mining and processing costs.

As of August 1, the Trump administration has imposed a 50 percent tariff on semifinished copper products such as wire and cables.[22] This protectionism has allowed those producers to raise prices.[23] The tariff reversal demonstrates a broader concern with the potential impact of higher copper prices and delivers a benefit to a small, concentrated group of firms. Broader tariffs would have provided strong demand-side support for domestic mining, but at the expense of raising downstream costs.

Meanwhile, the OBBBA phases out the Inflation Reduction Act's 45X tax credit which covered 10 percent of production costs for applicable critical minerals. The subsidy will decline by 2.5 percent each year from 2031 to 2034, rather than staying in place in perpetuity—with the exception of metallurgical coal, which will now receive a subsidy with no expiration date. The OBBBA does fund critical minerals purchases through the National Defense Stockpile ($2 billion in appropriations) and the Industrial Base Fund ($5 billion). It also provides $500 million to the Defense credit program for loans, loan guarantees, and technical assistance to critical minerals projects.[24] These funds could help create the offtake and price certainty necessary to drive mining investment in the United States, but they do not address the structural weaknesses in the U.S. mining industry.

To become globally cost competitive, the United States will need to invest in its mining ecosystem. America can only onshore while counteracting rising prices if it makes strong investments in the supply side that significantly reduce mining and processing costs. Streamlining permitting, creating efficient logistics networks, achieving economies of scale in processing, and modernizing mining equipment are all essential to long-term competitiveness. This requires a comprehensive industrial strategy for copper in the United States.

The Trump administration has taken steps to support deep-sea mining as a potential way to fully onshore supply. However, even if this environmentally risky, long-shot strategy is successful, it will require a major processing expansion.[25] Only decisive action by Western policymakers will preserve and create the smelting capacity necessary for either traditional or sea-based domestic processing scenarios.

Balancing Onshoring and Friendshoring

In most cases, the United States will need foreign supplies as it strengthens its industrial base and grid infrastructure. Even in copper, for which the United States has significant reserves and capabilities, substantial imports will be required.

A friendshoring strategy is the best means to create secure and reliable supply. Working with close allies, key emerging markets, and developing economies will build geopolitical leverage by building partnerships. U.S. overseas mining investment through the Development Finance Corporation (DFC), Export-Import Bank (EXIM), and Defense Production Act (DPA) has the potential to counteract China's diplomatic overtures through the Belt and Road Initiative and the Global Development Initiative.[26]

The United States needs to prioritize engagement and investment by identifying specific countries that can help to de-risk supply. By focusing investment on a small number of low-cost jurisdictions that can produce in high volumes, Washington can best create secure and reliable supply chains.

To help find suitable jurisdictions, we created an index that combines mining costs and production capacity to assess a country's ability to support U.S. offshoring.[27] Table 2 presents priority allied countries (North Atlantic Treaty Organization and Major Non-NATO Allies) and emerging market and developing economy (EMDE) partners. Engaging with both groups are important in a world where securing critical minerals through defense partnerships and rebuilding geopolitical advantage is necessary.[28]

Table 4. Priorities for U.S. Offshoring Engagement

Scenario	Offshoring priority	Allies (NATO, MNNA)	EMDE
Copper	Medium	Australia, Canada	Kazakhstan, Brazil, DRC, Indonesia, Chile, Peru
Graphite	High	Canada	Madagascar, India, Tanzania, Mozambique, Brazil
Lithium	High	Australia, Canada	Chile, Argentina
Manganese	High	Australia, Canada	South Africa, Gabon, Brazil, India
Nickel/Cobalt	Very high	Australia, Canada	Indonesia, Brazil, Philippines, Colombia
Silver	High	Australia, Canada, Poland, Spain	Argentina, Bolivia, Mexico, Peru

Low Priority for U.S. International Engagement

Molybdenum: Molybdenum is needed in wind turbine construction in steel, current generation CdTe thin film solar, and next generation perovskite thin film solar.[29] Current and pipeline domestic production of molybdenum far exceeds what is needed. Increased steel demand from other components of the U.S. clean energy economy such as transmission towers will also not exceed domestic reserves, which are substantial. As a result, the United States is likely to export molybdenum over the next decade. If outside partners are desired because of cost or product diversification, Mexico and Peru are low on the cost curve.[30]

Zinc: Demand for zinc within the clean energy economy is primarily as an anti-corrosive covering for wind turbines. There is extensive zinc extraction both current and planned in the United States, with expected output far more than what would be required by the domestic wind industry. No foreign partners would be needed for this mineral. The United States is, however, dependent on imports of refined zinc, so smelting could be an onshoring priority.[31]

Aluminum: The U.S. grid buildout will create a significant new demand for aluminum, which is needed for new distribution lines. However, the United States does not have any domestic extraction of bauxite—the initial input in manufacturing aluminum. There are also no projects in the pipeline to change this situation, as the country lacks meaningful bauxite reserves. Globally, the picture is different. Given vast quantities of existing production, sourcing a de-risked supply of bauxite sufficient to meet the demand of the U.S. clean energy manufacturing economy will not be challenging.

Elevated Priority for U.S. International Engagement

Copper: Copper is the workhorse of the future economy. It plays a key role in both grid buildout and battery manufacturing. Currently, the United States mines over 1 million metric tons of copper annually and could bring 700,000 metric tons of new extraction online by 2035.[32] However, the potential production from the U.S. mining project pipeline falls short of expected demand. To reduce reliance on China, Washington needs to pursue a strategy of both increasing domestic production of copper and securing sources from friendly low-cost producers such as Australia, Canada, Brazil, Chile, or Peru.

High Priority for U.S. International Engagement

Lithium: The United States has significant lithium reserves and, with the recent brine discovery in Arkansas, resources far in excess of what was previously estimated.[33] The United States should make all efforts to encourage greater lithium extraction, not just for domestic use but also for global export. Lithium demand beyond the 2035 horizon is bullish due to its usage in many next-gen battery chemistries such as lithium anode and lithium sulfur batteries. Paradoxically, while lithium's demand growth is positive in the long term, the market in the short term is oversaturated.[34]

Manganese: The United States does not have significant reserves of manganese. The reserves are eclipsed by a single year of demand from the U.S. steel industry. Manganese ore has also not been extracted domestically since the 1970s.[35] While domestic manganese production is in the pipeline as part of planned extraction from the Clark deposit in Arizona, estimates for expected output are unavailable, and regardless will fall short of domestic battery demand.[36] Competing demands from steel (also essential to clean energy in wind turbines and transmission towers), will further necessitate that additional supplies be sourced from partner countries. Potential breakout and scaleup of high-manganese-content batteries, as being tested by Ford and GM, could also lead to heightened demand from domestic battery supply chains.[37]

Graphite: Graphite is an essential component for battery manufacturing. The best batteries use a mix of artificial and natural graphite, though the majority of demand is likely to be for graphite from natural sources. The United States has small graphite reserves relative to its needs, making both artificial graphite production and the sourcing of alternative natural resources essential. Even more pressing, China maintains a near-stranglehold on the production of downstream graphite energy products.[38] In 2023, 99 percent of refined spheroid graphite and 79 percent of graphite anode material were produced in China.[39] Significant graphite deposits exist in southeastern Africa, running under the nations of Madagascar, Mozambique, and Tanzania, in a formation known as the African Graphite Triangle.[40] Brazil also has substantial graphite deposits. Canada provides an allied option.

Silver: Silver is an essential metal for the future economy due to its use in polysilicon solar panels. One GW of polysilicon solar requires on average 133 tonnes of silver.[41] Silver demand from planned solar manufacturing exceeds domestic extraction and pipeline production. While the United States has significant silver reserves, these reserves would be sufficient to meet about four years of U.S. consumption from the existing economy.[42] Washington, in addition to bolstering domestic production, should seek out partners, especially in Latin America.

Very High Priority for U.S. International Engagement

Nickel: Nickel demand is expected to skyrocket, and the United States has very limited ability to increase domestic production. There are only a few domestic nickel projects in the pipeline and their potential output will fall far short of demand. That said, the United States has strong international partnerships. It has already invested in Brazilian nickel.[43] Australia is a low-cost nickel producer. Canada is a significant nickel producer whose nickel demand sits in the middle of the cost curve. Indonesia, after China, is one of the lowest cost global producers. And the Philippines is another ally with strong production and potential.

Cobalt: Cobalt has long been a source of critical minerals tension. The United States lacks sufficient cobalt reserves to meet expected demand for the planned U.S. clean energy manufacturing base. Cobalt, though, is a co-product of nickel production and increases in nickel extraction will also lead to greater cobalt production. Cobalt demand itself is also increasingly uncertain. New battery chemistries are being rapidly commercialized and deployed as alternatives to the traditional NMC cathodes, potentially destroying demand.[44] While total cobalt demand by the U.S. battery industry will increase significantly between now and 2030, where demand goes beyond that is harder to predict.

The Democratic Republic of Congo is well known for having significant cobalt deposits. However, recent U.S. engagement with the country in the case of the Lobito Atlantic Railway, while intended to reduce Chinese control of the global critical minerals supply chain, may backfire and end up enabling greater export of mined minerals to Chinese manufactures.[45] Focusing on increasing accessibility of DRC cobalt deposits without increasing corresponding ex-China cobalt processing capacity, could lead to a U.S. funded logistic network transporting Cobalt to China.

Conclusions and Recommendations

The United States needs a comprehensive metals industrial strategy that balances domestic and international production. To support domestic production, Washington must deploy a comprehensive policy mix to secure demand in uncertain price environments while boosting supply chain innovation to keep costs low. Investments to bring not just mines but the whole processing and production ecosystem to scale will be necessary for long-term national success.

An industrial strategy is best pursued through public-private alliance mediated by independent experts.[46] The United States has initiated a public-private collaboration in the battery space through Li-Bridge.[47] Li-Bridge brings together industry, government, and experts to engage in collaborative problem-solving and policy design. It is convened by independent organizations, to facilitate the flow of good information between government and industry without becoming beholden to the whims of either side. A similar alliance is needed to create a roadmap to mining competitiveness in the United States.

Washington must deploy a comprehensive policy mix to secure demand in uncertain price environments while boosting supply chain innovation to keep costs low.

Within this strategy, a more robust approach to mining prices will be necessary.[48] The fundamental problem facing Western mining is price uncertainty. Chinese market manipulation is driving down prices in key metals to deter investment in other jurisdictions.[49] Tariffs can address this problem, but they do so by raising domestic costs. The higher prices will hamper efforts to reindustrialize the U.S. economy. But without tariffs, higher-cost U.S. projects will struggle to attract investment due to price and demand-side uncertainty.

Another tool, recently deployed by the Department of Defense in the MP Materials deal, can provide demand-side support without raising prices.[50] In the new partnership, the Department of Defense is taking a 15 percent stake in MP Materials and guaranteeing a price floor of $110 per kilogram of NdPr products. If the market price is below the floor, the Department of Defense will cover the gap. If the price is above the floor, the Department of Defense will receive 30 percent of the additional revenue. This creates shared upsides both through equity and through the contract.

Further, the price mechanism, known as a contract for difference in other energy contexts, is a critical policy solution because it provides the price certainty necessary to unlock U.S. mining projects in the context of geopolitical competition with China.[51] In this instance, the government could write contracts for difference for individual mines or the copper sector as a whole which guarantees a strike price of say $12,000 per ton for domestically mined and processed copper. The market price remains in the $9,000–$10,000 range, but U.S. copper could find its way to market. This would support mining projects and domestic smelters with a market-based mechanism. Versus equivalent subsidies on the supply-side, this mechanism is preferable because it provides market certainty (which subsidies do not) and presents the possibility of the government capturing some upside.

Internationally, the United States needs a coherent global mining strategy that prioritizes minerals and targets engagement with the countries most likely to create secure and reliable supplies.[52] The G7 Critical Minerals Action Plan, agreed to at the Canadian 2025 Summit, presents the right concept.[53] However, success will require a level of strategic targeting and policy alignment that has not been demonstrated through previous G7 initiatives or the Minerals Security Partnership.

Internationally, the United States needs a coherent global mining strategy that prioritizes minerals and targets engagement with the countries most likely to create secure and reliable supplies.

Getting serious at home and abroad necessitates a comprehensive policy approach. Domestically, tariffs alone are a dangerous form of industrial policy. Protecting a sector without coordination, innovation support, or technology standards leads to a sclerotic, uncompetitive industry.[54] The United States needs a strong critical minerals industry to support long-term competitiveness and generate geopolitical leverage.

Metal-Specific Policy Recommendations

We also present a number of metal-specific recommendations as a starting point for a comprehensive critical minerals industrial strategy that brings together domestic and international levers.

Aluminum:

- Leverage low energy costs to make a domestic processing play in aluminum refining.
- Bolster existing non-Chinese hubs of aluminum processing in low-cost power producers like Brazil and Canada via access to U.S. credit.

Copper:

- Implement quota-based tariffs rather than blanket tariffs, with imported supply below the threshold applicable for tariffs, to avoid needlessly taxing domestic manufacturers.
- Work with allies in the G7 to create price contracts with shared upsides across the global copper industry.

Lithium:

- Take advantage of the global lithium glut in the short run to lower the cost of domestic battery production and support domestic mid-stream processing.
- Bolster domestic lithium processing infrastructure through investment or production tax credits.
- Use strategic capital (such as through the proposed sovereign wealth fund, or DOD investments) to develop domestic reserves for large scale extraction as demand rises in the 2030s and beyond.

Manganese:

- Use the Defense Production Act's (DPA) domestic sourcing provisions to support manganese development in Australia by funding feasibility studies to increase the number of bankable projects.

- Use the Development Finance Corporation (DFC) to support Brazilian and South African manganese projects that have signed offtakes with U.S. purchasers.

Nickel:

- Channel funding through the domestic sourcing provisions of the DPA and fund more feasibility studies to increase the number of bankable projects in Australia.

- Work with allies in the G7 to create price contracts with shared upsides in Australia, Canada, and Brazil.

- Provide investor certainty to Canada by negotiating a longer duration term for the USMCA in the upcoming 2026 renegotiations.

- Complete Indonesian minerals deals to allow U.S. firms to access these commodities and break up the current Chinese oligopsony on Indonesian nickel (breaking the oligopsony on Indonesian nickel might also raise the real price of Chinese manufactured EVs that use a NMC chemistry).

Cobalt:

- Focus on building added value processing infrastructure in the Democratic Republic of Congo to build up the country as an alternative pillar of critical minerals processing, reducing Chinese dominance of the market.

Graphite:

- Use DFC financing and other U.S. strategic development tools to support graphite projects in the African Graphite Triangle (Madagascar, Mozambique, and Tanzania) that agree to sell to U.S. purchasers.

- Work with allies in the G7 to create price contracts with shared upside in Canada and Brazil.

- Support added value production of graphite materials in the African Graphite Triangle as a means of eroding Chinese hegemony in the graphite-anode vertical.

Silver:

- Offer greater financing through the DFC to Peru to encourage greater silver extraction.

- Add silver to the U.S. list of critical minerals to allow government funds through the DPA to be allotted to Australian and Canadian silver projects via eligibility under "domestic source" content requirements.

About the Authors

Bentley Allan is a nonresident scholar in the Sustainability, Climate, and Geopolitics Program at the Carnegie Endowment for International Peace. He is associate professor of political science at Johns Hopkins University, director of the Net Zero Industrial Policy Lab, and a transition pathways principal at the Transition Accelerator. He is an expert in the political economy of decarbonization, clean energy supply chains, and global climate governance.

Jonas Goldman is a policy analyst with experience in public service, academia, and electoral politics in the United States and Canada. He has served as a researcher on climate industrial policy for the Smart Prosperity Institute, is a fellow with the Climate Security Association of Canada, and is a senior research associate at the Johns Hopkins Net-Zero Industrial Policy Lab.

Notes

1 "Immediate Measures to Increase American Mineral Production," White House, March 20, 2025, https://www.whitehouse.gov/presidential-actions/2025/03/immediate-measures-to-increase-american-mineral-production/.

2 "US/Ukraine minerals deal: Digging into the detail," Norton Rose Fulbright, May 2025, https://www.nortonrosefulbright.com/en/knowledge/publications/7516f1f6/us-ukraine-minerals-deal-digging-into-the-detail.

3 Paul Manalo, "From 6 years to 18 years: The increasing trend of mine lead times," S&P Global Market Intelligence, April 11, 2025, https://www.spglobal.com/market-intelligence/en/news-insights/research/from-6years-to-18years-the-increasing-trend-of-mine-lead-times.

4 Gregory Wischer, "U.S. Needs Industrial Policy for Critical Minerals," *National Defense Magazine*, February 14, 2023, https://www.nationaldefensemagazine.org/articles/2023/2/14/us-needs-industrial-policy-for-critical-minerals.

5 Bentley Allan, "Regaining Geopolitical Advantage: How to Focus U.S. Foreign Policy for Clean Energy," Carnegie Endowment for International Peace, February 26, 2025, https://carnegieendowment.org/research/2025/02/regaining-geopolitical-advantage-how-to-focus-us-foreign-policy-for-clean-energy?lang=en.

6 "Mineral Commodity Summaries 2025," U.S. Geological Survey, January 31, 2025, revised March 3, 2025, https://pubs.usgs.gov/publication/mcs2025.

7 S&P Capital IQ, last updated 2024.

8 Table 1 sources are as follows:
Production: Production supply data comes from 2024 USGS production data for each of the minerals in question, released in 2025.
Pipeline: Pipeline supply data for each mineral comes from searching the S&P Capital IQ database for mining projects in the feasibility and pre-production stages that produce each of the minerals in question whose first feasibility study was 2016 or later.
2035 Supply: Totals the production and pipeline data.
Consumption+: Uses 2024 USGS apparent consumption data for each of the minerals in question released in 2025, then applies a 2-percent CAGAR growth rate for five years to get estimated 2030 demand.
Grid+Mfg Build Scenario: This analysis tracked both the total existing production capacity in four

technologies (solar, batteries, wind, and electrolyzers), as well as the planned production capacity from pledged investments in them. Solar data on module manufacturing production & pipeline is from an amalgamated dataset kept by the Net Zero Industrial Policy Lab (NZIPL) using Climate Investment Monitor data, BloombergNEF data, and independent NZIPL analysis. Wind manufacturing production and pipeline data is from NZIPL analysis. Battery cell manufacturing production and pipeline data is from an amalgamated dataset using BloombergNEF data, climate investment monitor data from the Big Green Machine dataset by Jay Turner out of Wellesley University. Electrolyzer production and pipeline data is from "2H 2023 Hydrogen Electrolyzer Market Outlook," BloombergNEF, August 28, 2023. Grid buildout was assumed to double by 2050, based on analysis from the National Renewable Energy Laboratory (NREL) on domestic transmission line buildout. Distribution and transmission line buildout were assumed to be equivalent based on BloombergNEF data (Specifically the Transitions Metal Outlook, January 1, 2023,) and consultations with industry experts. Critical mineral requirements for each GWh of technology manufacturing capacity, or km of grid expansion, was arrived at by NZIPL analysis using various academic sources.
2035 Consumption: Totals the Consumption+ and Grid+Mfg Buildout Scenario data.

9 According to USGS data, U.S. consumption of nickel, silver, tin, and zinc is falling while consumption of copper and manganese is rising. See "Mineral Commodity Summaries 2025."

10 Emily Mercer, "National Transmission Analysis Maps Next Chapter of US Grid Evolution," NREL, October 3, 2024, https://www.nrel.gov/news/feature/2024/national-transmission-planning-study; and Naureen S. Malik, "AI-Driven Power Boom Will Drive Demand 38% Higher on Top US Grid," *Bloomberg*, January 24, 2025, https://www.bloomberg.com/news/articles/2025-01-24/ai-driven-power-boom-will-drive-demand-38-higher-on-top-us-grid.

11 "Winning the Race: America's AI Action Plan," White House, July 2025, https://www.whitehouse.gov/wp-content/uploads/2025/07/Americas-AI-Action-Plan.pdf.

12 Mercer, "National Transmission Analysis Maps Next Chapter of US Grid Evolution."

13 For the purpose of this model, an estimated 305 GWh's of battery manufacturing was assumed to be at risk given changes in the U.S. policy environment.

14 Kevin Rector, "Trump backs huge Arizona copper mine as Apache win late reprieve to halt it," *Los Angeles Times*, August 21, 2025, https://www.latimes.com/politics/story/2025-08-21/trump-backs-oak-flat-copper-mine-arizona-apache-win-lifeline-in-court-battle.

15 S&P Capital IQ, last updated 2024.

16 S&P Capital IQ, last updated 2024. Copper production ranked on total cash cost.

17 "BlackRock Says $12,000 Copper is Needed to Incentivize New Mines," Bloomberg News, April 2024, https://www.mining.com/web/blackrock-says-12000-copper-is-needed-to-incentivize-new-mines/.

18 Gracelin Baskaran and Meredith Schwartz, "Rethinking Copper Tariffs," Center for Strategic & International Studies, July 23, 2025, https://www.csis.org/analysis/rethinking-copper-tariffs; and "Copper" from "Mineral Commodity Summaries 2025," U.S. Geological Survey, https://pubs.usgs.gov/periodicals/mcs2025/mcs2025-copper.pdf.

19 Camilla Hodgson, "Smelters pay to process copper as China expands capacity," *Financial Times*, June 10, 2025, https://www.ft.com/content/032e9250-66df-44b3-926e-3e5e8fed8e76?shareType=nongift.

20 Alfred Cang, Archie Hunter, Mark Burton, Julian Luk, and Jack Farchy, "Once-in-a-Generation Copper Trade Upends a $250 Billion Market," *Bloomberg*, July 11, 2025, https://www.bloomberg.com/news/features/2025-07-11/trump-s-copper-tariffs-deadline-marks-end-of-once-in-a-generation-trade.

21 Joe Deaux, "Trump Spares Copper Market From Worst With 50% Duty on Products," *Bloomberg*, July 30, 2025, https://www.bloomberg.com/news/articles/2025-07-30/trump-imposes-50-tarriff-on-semi-finished-copper-products.

22 "Fact Sheet: President Donald J. Trump Takes Action to Address the Threat to National Security from Imports of Copper," White House, July 2025, https://www.whitehouse.gov/fact-sheets/2025/07/fact-sheet-president-donald-j-trump-takes-action-to-address-the-threat-to-national-security-from-imports-of-copper/.

23 Jack Farchy, "US Copper Firms Hike Prices Even After Trump Tariff Reprieve," *Bloomberg*, August 19, 2025, https://www.bloomberg.com/news/articles/2025-08-19/us-copper-firms-hike-prices-even-after-trump-tariff-reprieve.

24 Gracelin Baskaran and Meredith Schwartz, "Impacts of the One Big Beautiful Bill Act on the Mining Sector," Center for Strategic & International Studies, July 23, 2025, https://www.csis.org/analysis/impacts-one-big-beautiful-act-mining-sector; "Office of Strategic Capital Announces First Loan Through DoD Agreement with MP Materials to Secure Critical Materials Supply Chain," U.S. Department of War, August 19, 2025, https://www.war.gov/News/Releases/Release/Article/4270722/office-of-strategic-capital-announces-first-loan-through-dod-agreement-with-mp/.

25 "Unleashing America's Offshore Critical Minerals and Resources," White House, April 24, 2025, https://www.whitehouse.gov/presidential-actions/2025/04/unleashing-americas-offshore-critical-minerals-and-resources/.

26 Bentley Allan, "Regaining geopolitical advantage," Carnegie Endowment for International Peace, February 2025, https://carnegieendowment.org/research/2025/02/regaining-geopolitical-advantage-how-to-focus-us-foreign-policy-for-clean-energy?lang=en.

27 The methodology: For costs, we used S&P's average cost per unit data. For production, we used S&P's data for "paid" production. Our index weighted costs and production volumes in a ratio of 3:2 to create a five-point index. A country receives a rounded up score out of 3 or 2 based on its percentile rank in the cost and production lists. Our summary table includes countries that scored a 5 or a 4 on this index listed in order of rank. If including only countries with a 5 yielded a list of 4 or more countries, then only those countries are listed. If not, we included countries scoring 4 or above. We excluded China and Russia for geopolitical reasons.

Costs provide a reasonable proxy of future competitiveness as they indicate good quality ore bodies and logistics. However, many countries have low-cost production in very small volumes. To warrant U.S. diplomatic and financial investment, there must be potential to produce significant volumes in the country. Weighting production volume in the index helps account for this. Using pure reserves would be a more direct indicator of this, but reserve data that can be obtained from USGS is limited to a small number of countries. Moreover, reserves are theoretically economical, but unless a country is generating in volumes, it is unlikely the reserves are competitive. In any event, production tends to predict reserves.

This methodology was not possible for graphite and manganese due to a lack of cost data. For graphite, we had access to historic and projected production data from S&P. The production growth rate provides a good indicator of both current and future potential, which is what we were trying to capture with costs. We took the growth rate in graphite production from 2019 to 2027 (projected), made a ranked list, and assigned a score out of 3. We calculated the production score out of 2 as described above. For manganese, we simply ranked countries by production and reserves using S&P data. The ranking on both measures is identical for both allies and EMDE countries, except that Canada has no current production so its inclusion is based on the strength of its reserves alone.

28 Bentley Allan, "Regaining geopolitical advantage," Carnegie Endowment for International Peace, February 2025, https://carnegieendowment.org/research/2025/02/regaining-geopolitical-advantage-how-to-focus-us-foreign-policy-for-clean-energy?lang=en.

29 Lukas Wagner, et al., "The resource demands of multi-terawatt-scale perovskite tandem photovoltaics," *Joule* 8, no. 4, (April 17, 2024): 1142-1160, https://doi.org/10.1016/j.joule.2024.01.024; Alicia Valero, Antonio Valero, Guiomar Calvo, Abel Ortego, "Material bottlenecks in the future development of green technologies," *Renewable and Sustainable Energy Reviews* 93 (October 2018): 178-200, https://doi.org/10.1016/j.rser.2018.05.041.

30 S&P Capital IQ. Molybdenum Mine Economics Cost Curve. Retrieved May 13, 2025.

31 "Mineral Commodity Summaries, 2025."

32 S&P Capital IQ. (2024); "Copper" from "Mineral Commodity Summaries 2025."

33 "Unlocking Arkansas' Hidden Treasure: USGS Uses Machine Learning to Show Large Lithium Potential in the Smackover Formation," U.S. Geological Survey, October 2024, https://www.usgs.gov/news/national-news-release/unlocking-arkansas-hidden-treasure-usgs-uses-machine-learning-show-large.

34 Sergio Goncalves, "China is Oversupplying Lithium to Eliminate Rivals, US Official Says," Reuters, October 2024, https://www.reuters.com/markets/commodities/china-is-oversupplying-lithium-eliminate-rivals-us-official-says-2024-10-08/.

35 "Manganese" from "Mineral Commodity Summaries 2025," U.S. Geological Survey, January 2025, https://pubs.usgs.gov/periodicals/mcs2025/mcs2025-manganese.pdf.

36 South 32, "US DoE Grant for Clark Battery-grade Manganese", September 2024, https://www.south32.net/news-media/latest-news/us-doe-grant-for-clark-battery-grade-manganese.

37 Suvrat Kothari, "How Ford and GM are Plotting a Battery Breakup with China", Inside EV's, June 2025, https://insideevs.com/news/761675/how-ford-gm-plan-ev-battery-breakup-with-china/.

38 "China Controls Three-quarters of Graphite Anode Supply Chain," Benchmark Minerals, November 2023, https://source.benchmarkminerals.com/article/infographic-china-controls-three-quarters-of-graphite-anode-supply-chain.

39 Ibid.

40 Jonas Goldman, "Creating a Battery Hib in Africa's Graphite Triangle," Net Zero Industrial Policy Lab, May 2024, https://static1.squarespace.com/static/64ca7e081e376c26a5319f0b/t/66423f81fe7cec5ab539299c/1715617665746/PB04_Africas_Graphite_Triangle_vf.pdf.

41 Valero, et al., "Material bottlenecks in the future development of green technologies."

42 "Silver," from "Mineral Commodity Summaries," U.S. Geological Survey, January 2024, https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-silver.pdf.

43 https://www.mining.com/brazilian-nickel-advances-project-financing-with-loi-for-550m/

44 "Long-Term Electric Vehicle Outlook 2024," BloombergNEF, June 2024.

45 DFC, "Lobito_PIS." https://www.dfc.gov/sites/default/files/media/documents/Lobito_PIS.pdf; Elisa Yoshiara and Fabian Villalobos, "Critical Minerals and the Clean Energy Transition." University of Texas Austin Workship Critical Minerals and the Clean Energy Transition, April 2024. https://www.strausscenter.org/wp-content/uploads/Villalobos_Yoshiara_Lobito-Corridor_2024-04-26.pdf.

46 Dani Rodrik, "Industrial Policy for the Twenty-First Century," John F. Kennedy School of Government, Harvard University, September 2004, https://drodrik.scholar.harvard.edu/files/dani-rodrik/files/industrial-policy-twenty-first-century.pdf; Bentley Allan, "Taking a strategic approach to industrial transition," October 2022, https://transitionaccelerator.ca/wp-content/uploads/2023/05/White-Paper_Net-Zero-Industrial-Summit-Transition-Accelerator.pdf.

47 "Li-Bridge," Argonne National Laboratory, https://www.anl.gov/li-bridge.

48 Jen Harris, "No country can solve critical mineral shortages alone," *Financial Times*, July 2023, https://www.ft.com/content/394dca37-ac50-4380-9b03-4fdfcef2ff7c; Bentley Allan and Derek Eaton, "Getting Prices Right: Securing Critical Minerals Demand to Catalyze Canadian Mine Development," Centre for Net-Zero Industrial Policy, https://netzeroindustrialpolicy.ca/wp-content/uploads/2024/09/CNZIP-Getting-Prices-Right-V1.pdf.

49 Gracelin Baskaran, "Building a New Market to Counter Chinese Mineral Market Manipulation," Center for Strategic & International Studies, June 12, 2025, https://www.csis.org/analysis/building-new-market-counter-chinese-mineral-market-manipulation.

50 "MP Materials Announces Transformational Public-Private Partnership with the Department of Defense to Accelerate U.S. Rare Earth Magnet Independence," MP Materials, July 10, 2025, https://mpmaterials.com/news/mp-materials-announces-transformational-public-private-partnership-with-the-department-of-defense-to-accelerate-u-s-rare-earth-magnet-independence/; Alice Wu, "Unpacking The Department Of Defense and MP Materials Critical Minerals Partnership," Federation of American Scientists, July 15, 2025. https://fas.org/publication/unpacking-dod-and-mp-partnership/.

51 Allan and Eaton, "Getting Prices Right."

52 Baskaran, "Building a New Market to Counter Chinese Mineral Market Manipulation."

53 "G7 Critical Minerals Action Plan," the G7, June 17, https://g7.canada.ca/en/news-and-media/news/g7-critical-minerals-action-plan/.

54 U.S. shipbuilding provides a vivid example. Marc Levinson, "Why the US's New Shipbuilding Strategy is Unlikely to Work," *Bloomberg*, July 10, 2025. https://www.bloomberg.com/news/articles/2025-07-11/trump-s-fees-on-china-s-cargo-ships-aren-t-enough-to-revive-us-shipyards?srnd=homepage-americas.

Carnegie Endowment for International Peace

In a complex, changing, and increasingly contested world, the Carnegie Endowment generates strategic ideas, supports diplomacy, and trains the next generation of international scholar-practitioners to help countries and institutions take on the most difficult global problems and advance peace. With a global network of more than 170 scholars across twenty countries, Carnegie is renowned for its independent analysis of major global problems and understanding of regional contexts.

Sustainability, Climate, and Geopolitics Program

The Sustainability, Climate, and Geopolitics Program explores how climate change and the responses to it are changing international politics, global governance, and world security. Our work covers topics from the geopolitical implications of decarbonization and environmental breakdown to the challenge of building out clean energy supply chains, alternative protein options, and other challenges of a warming planet.

CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE

CarnegieEndowment.org