Critical Minerals, Strategic Connectivity, Searching Beyond China

Central Asia and the New Critical Mienrals Frontier: Progress in Reshaping Global Supply Chains

A Follow-on Guide for Policymakers

CASPIAN POLICY CENTER 10 YEARS

About Us

The Caspian Policy Center (CPC) is an independent, nonprofit research think tank based in Washington D.C. Economic, political, energy, and security issues of the Caspian region constitute the central research focus of the Center.

CPC aims at becoming a premier research and debate platform in the Caspian region with relevant publications, events, projects, and media productions to nurture a comprehensive understanding of the intertwined affairs of the Caspian region. With an inclusive, scholarly, and innovative approach, the Caspian Policy Center presents a platform where diverse voices from academia, business, and policy world from both the region and the nation's capital interact to produce distinct ideas and insights to the outstanding issues of the Caspian region.

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Contents

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Contents

CPC CASPIAN POLICY CENTER

Creating This Report — Introduction

The Caspian Policy Center published its first report dedicated to critical minerals diplomacy in 2025. Titled "A Guide for Policymakers: How to Meet US Strategic Mineral Needs," the report explained the issue of U.S. dependence on foreign suppliers, namely China. It presented Central Asia's potential as a source for minerals that can meet U.S. demands for energy and strategic defense applications. It then provided information on U.S. and European Union (E.U.) minerals initiatives, followed by policy recommendations to bolster diplomacy with Central Asia.

A year later, U.S. minerals supply chains remain vulnerable, and China still plays a crucial role in the global production of refined and processed mineral materials. U.S.-Central Asia cooperation in the minerals sector has improved. Washington now recognizes the region's strategic potential and critical mineral deposits, and the Central Asian states hope to further capitalize on the newfound mineral rush. However, making alternative supply chains a commercial reality requires grounded analysis of the entire minerals supply chain and the region's minerals landscape, which will determine whether Central Asia can feasibly fill U.S. supply gaps.

This report highlights foreign exposure in minerals supply chains and analyzes how U.S.-led initiatives have sought to correct these gaps since the beginning of 2025. It delves into the Central Asian minerals environment, from investments and diplomacy to the legal codes that define subsoil use. The report goes on to discuss critical constraints that must be addressed to build resilient and profitable supply chains from Central Asia to the U.S. The final section offers policy options for the Central Asian governments and Washington to resolve existing challenges, build investor confidence, and transform summits into concrete deals.

— Efgan Nifti
President, Caspian Policy Center

Scan to read more of CPC's work on critical minerals:

Foreword *by Dr. Eric Rudenshiold*

Finding Rocks in Hard Places:

A Follow-on Practical Guide to Strategic Minerals for Policymakers

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Photo from a U.S. underground mining operation in Carlsbad, New Mexico
Source: United States Geological Survey

The United States faces a significant strategic challenge in securing access to rare earth elements and critical minerals essential for economic vitality and national security. Currently, the United States imports significant amounts of refined rare earths and minerals from China. The geopolitical risks of reliance on a concentrated supply chain, particularly one dominated by Beijing, have long been acknowledged.

This issue gained prominence under the previous Trump administration that identified the vulnerabilities inherent in China's near monopoly on refining and processing these indispensable materials. The current Trump administration has continued to prioritize efforts to diversify and secure alternative sources of critical minerals through initiatives such as Project Vault, the Critical Minerals Ministerial, and the FORGE Framework.

China's dominance in critical mineral markets, combined with its ability to influence supply chains through protectionist policies or outright supply disruptions, presents a

direct challenge to U.S. and global industries reliant on these resources. From advanced electronics and renewable energy technologies to defense systems, **the strategic implications of supply-chain dependence on Beijing extend beyond economic considerations, intertwining with national security concerns.**

As the United States intensifies its efforts to reduce risks and diversify its critical mineral supplies, regions such as the South Caucasus, Central Asia, and Ukraine emerge as strategic partners, offering abundant reserves and favorable transport and logistics, as well as a strong interest in collaboration with the United States.

China's Critical Mineral Supremacy

China's central role in the global critical mineral supply chain is not accidental. Over decades, Beijing has cultivated significant refining and processing capabilities alongside efforts to corner limited and strategic supplies, securing its current dominance in rare earth elements and other strategic minerals. These materials are essential to modern technological manufacturing and production in the fields of aviation, communications, renewable energy systems, and advanced electronics. By 2022, China controlled 100% of global graphite processing, 90% of rare earths, and 74% of cobalt, cementing its status as the world's primary supplier.

In stark contrast, according to 2024 data, **the United States remains heavily reliant on imports, including more than 50% of its annual consumption for 41 of 60 critical minerals and is entirely dependent on foreign supply for 12 of these materials**. This reliance renders the United States vulnerable to external disruptions and price manipulation, particularly as China's critical mineral strategy prioritizes national security and geopolitical leverage alongside economic gain.

Recent actions, such as China's imposition of export controls on germanium and gallium in retaliation to U.S. semiconductor restrictions, underscore the potential for strategic mineral supply chains to be weaponized. These materials are integral to defense technologies and semiconductor production, and such measures demonstrate China's capacity to disrupt global markets in response to geopolitical tensions. Ranging from defense to renewable energy, the risks to U.S. industries are profound, as the availability and cost of these critical inputs remain at the mercy of Beijing's policy decisions.

The Strategic Value of the South Caucasus and Central Asia

Amid growing awareness of these vulnerabilities, the South Caucasus and Central Asia present themselves as pivotal regions in addressing U.S. and global critical mineral

needs. These areas are rich in strategic mineral reserves, with some nations possessing developed mining sectors while others possess unexplored mountainous areas that promise future development opportunities.

In addition to their resource abundance, these regions offer the geopolitical advantage of diversifying critical mineral supply chains away from China. By cultivating partnerships with nations eager to collaborate and bolster their own economic development, the United States and its allies can advance mutual strategic objectives.

By leveraging the strategic potential of the South Caucasus and Central Asia, the U.S. administration can take decisive steps toward reducing reliance on a single strategic mineral supplier, strengthening U.S. supply-chain resilience, and safeguarding industries that underpin U.S. economic and national security interests.

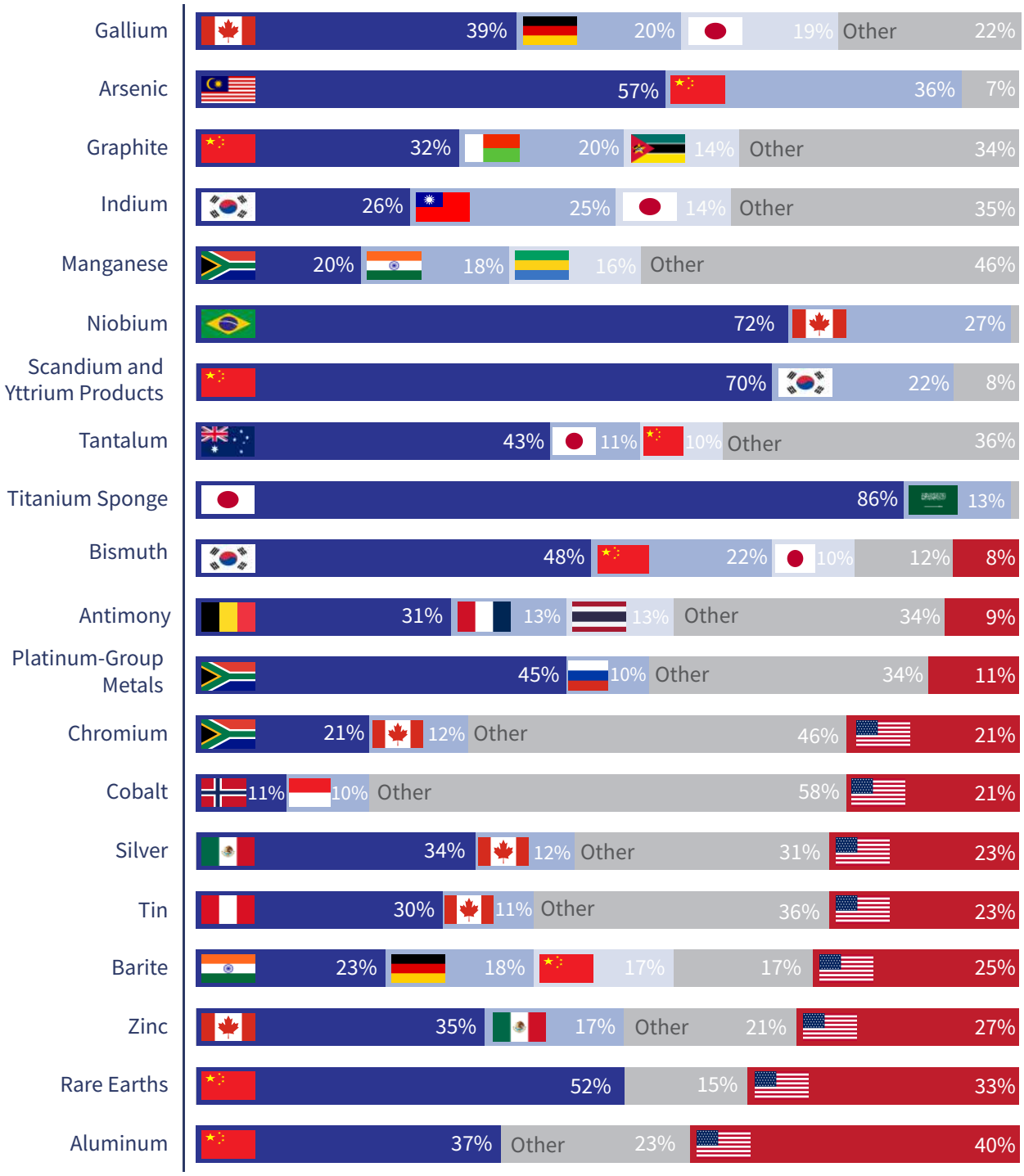
Figure 1: U.S. Import Reliance of Select Critical Minerals

By Kurtis Yan

Figure 1 illustrates the share of a country's production as a proportion of estimated total consumption by the U.S. This includes both foreign imports and U.S.-based production, which often comes from recycling and scrap. States that did not provide at least 10 percent in total U.S. consumption were grouped with "others." As the data demonstrates, strong dependencies still remain on foreign imports for key minerals. China still accounts for the highest share of U.S. rare earths consumption, most notably for heavy rare earths like yttrium and scandium.

Proportions were calculated based on total reported imports for consumption, disaggregated by country for every mineral. We assumed that a country's imports and U.S. production had a chance of consumption proportional to their share in total consumption. Minerals were accounted for based on Harmonized Tariff Schedule (HTS) commodity codes collected for 2025. These codes included raw materials, scrap, and refined products, such as chemical compounds and alloys. HTS codes were verified through the U.S. Geological Survey's methodology, based on their 2026 commodity summaries. It is important to note that the HTS system accounts for immediate imports and does not reflect where the importer may have extracted the upstream material from. For instance, much of Norway and Poland's cobalt originates from the Democratic Republic of the Congo (DRC).

Figure 1:
2025 U.S. Import Reliance of Select Critical Minerals



Source: U.S. Census Bureau
USGS Mineral Commodity Summaries 2026

Research by Kurtis Yan
Graphics by Lilly Horrigan

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Section 1
De-Risking from China

The U.S. Upends Global Competition and the Supply Chain Race

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Section 1

Dr. Eric Rudenshiold

Supply Chains of Power:

How Critical Minerals Are Shaping China–U.S. Competition in Central Asia

US President Donald Trump Meeting with Chinese President Xi Jinping in Busan, South Korea, in October 2025. Source: White House

Central Asia is no longer a distant frontier for global geopolitics. It is developing into a central arena of competition for critical minerals, supply chains, and industrial power where minerals are no longer simple commodities but have instead become key components of contemporary statecraft.

In essence, this transformation highlights a recognition in Washington and other capitals that critical mineral supply chains are fundamental to next-generation energy systems, the development of artificial intelligence (AI), as well as to strategic defense capabilities. Even as the global economy is multipolar, critical mineral supply chains remain highly concentrated and dominated by China.

Control of rare earths is increasingly geopolitical, with clear economic, political, and security consequences. The significance of that imbalance is now shaping U.S. foreign policy, Central Asia's development strategies, and the future of global economics.

China's Strategy: Control the Chain, Not Just the Mine

Though many years in the making, China's critical minerals strategy is still often misunderstood as focused primarily on resource access. However, Beijing's efforts are far broader and more effective. Not only securing raw materials, the Chinese leadership has worked to control the entire supply chain—from extraction to processing, refining, and manufacturing.

China's long-term focus and investments began in the 1980s with efforts that culminated in the Made in China 2025 plan for national and overseas manufacturing. In 2023 alone, Chinese firms invested more than $120 billion in overseas mining and processing, targeting key elements used in energy supply chains. Beijing also fed its industrial base by providing over $220 billion for production of electric vehicles, batteries, and renewable infrastructure.

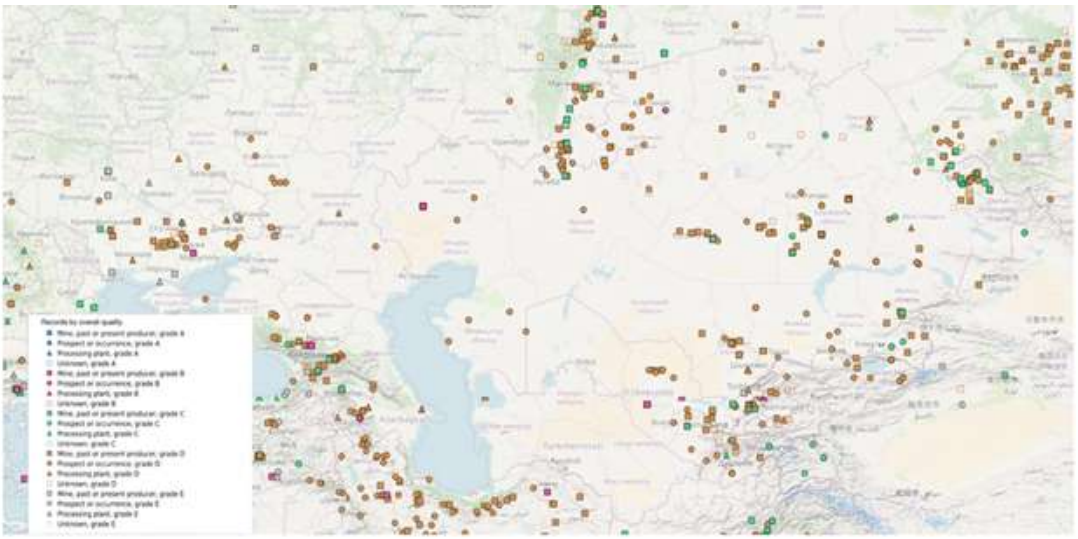
As a result, China now controls approximately 60% of lithium processing, more than 70% of cobalt refining, and over 90% of battery material manufacturing. Strategically, China controls roughly 90% of global rare earth refining and associated technologies. Early investments in supplies enabled Beijing to subsequently concentrate funds into refining capacity to feed its industrial sector. This integrated approach has shifted the power dynamic for global supply chains tied to the critical minerals economy.

As evidenced by Beijing's near monopoly on processing, market control is not just associated with geological supplies but with processing capacity. China's willingness to weaponize access not only to rare earths but also to processing technology demonstrates Beijing's market muscle.

This distinction is critical. Rare earth elements are not inherently scarce, but they are rarely found in concentrated deposits, making them difficult to extract and refine. Over decades, Beijing developed unique refining capabilities and subsidized an industrial base that disincentivized competition and encouraged processing to shift to China.

The Vicious Circle

Prohibitive investment costs, long development timelines, and market volatility have discouraged Western investment in alternative supply chains. **Each stage (mining, processing, refining, manufacturing) is interdependent: miners won't invest without buyers and offtake agreements, processors and refiners need secure financing and stable mineral supply, and manufacturers need steady inputs. Such interdependence creates an investment standoff and heightens perceptions of risk.**



USGS data reveals abundant deposits, mines, and processing facilities for critical minerals across Central Asia, the South Caucuses, and Ukraine. Source: United States Geological Survey

By integrating all stages, Beijing exerts influence across global markets, from pricing to production. This has conditioned global markets to depend upon Chinese materials and standards. To build competing systems requires substantial up-front capital and long time horizons which together can pose significant deterrents to investment.

While some countries are seeking to break out of this vicious cycle of dependency, China is also adapting to compensate. Through the Belt and Road Initiative (BRI), Beijing is advancing loan and infrastructure projects in exchange for expanding into offshore processing partnerships tied to long-term offtake agreements. This secures Beijing stable supplies for its industries, but also extends its influence across global markets.

The U.S. Shifts to Being a Strategic Actor

The United States has been slow to respond, but this is changing. Critical minerals are now a national security priority. Initiatives such as Project Vault, the Critical Minerals Ministerial, and the FORGE framework represent a strategic shift. These are not simply funding efforts but strategic attempts to build U.S. resilience while disrupting and restructuring the global mineral market away from China's unchecked dominance. Project Vault, a $12 billion public–private initiative, is designed as a strategic reserve to stabilize demand and support investment. Building off the 1939 U.S. National Defense Stockpile initiative, Project Vault goes beyond defense to protect broader U.S. industrial needs, using price floors and trade mechanisms to reduce volatility and encourage private investment.

FORGE represents a broader ambition of building a parallel supply chain among trusted partners with aligned policies and access. Elevating multilateral economic cooperation, this new market would create a trusted trading system outside China's orbit.

However, out of the new and expanded list of 60 critical minerals identified by the U.S. Geological Survey, the United States is completely "import-reliant" on 11 of these minerals and rare earth elements. Of the remaining minerals needed by U.S. industries, many depend upon foreign sources for more than half of their supply. Overall, China remains the central supplier.

With so high a level of dependence comes acute vulnerability. U.S. supply chains are exposed not only to market fluctuations, but to geopolitical leverage. China's 2025 imposition of export controls on rare earth elements (germanium and gallium) in retaliation for U.S. semiconductor restrictions is a prime example of how effective such leverage can be deployed.

Central Asia: From Frontier to Strategic Market

Central Asia is gaining prominence in this context. Long viewed as a frontier zone under Russian and Chinese influence, the region is now emerging as an independent and strategic market with scale and growth potential. The region's fundamentals are strong: **over seven percent GDP growth, significant foreign investment, and a young population of 80 million. It also possesses major reserves of rare earths and critical minerals, producing 50% of global uranium along with significant gold and copper.**

Historically, infrastructure tied the region to exporting raw materials to China and Russia. China's BRI investments further incentivized these transfers through large-scale infrastructure projects that promised transformative benefits. But sales and shipment of cheap raw ore from Central Asia to China for refining and processing only netted significant added value for Beijing.

Central Asian governments now seek to change the equation. They aim to capture more value at home while foreign backers get secure, off-take supplies at better prices than from Beijing. This shift reflects both a newfound economic ambition and geopolitical awareness.

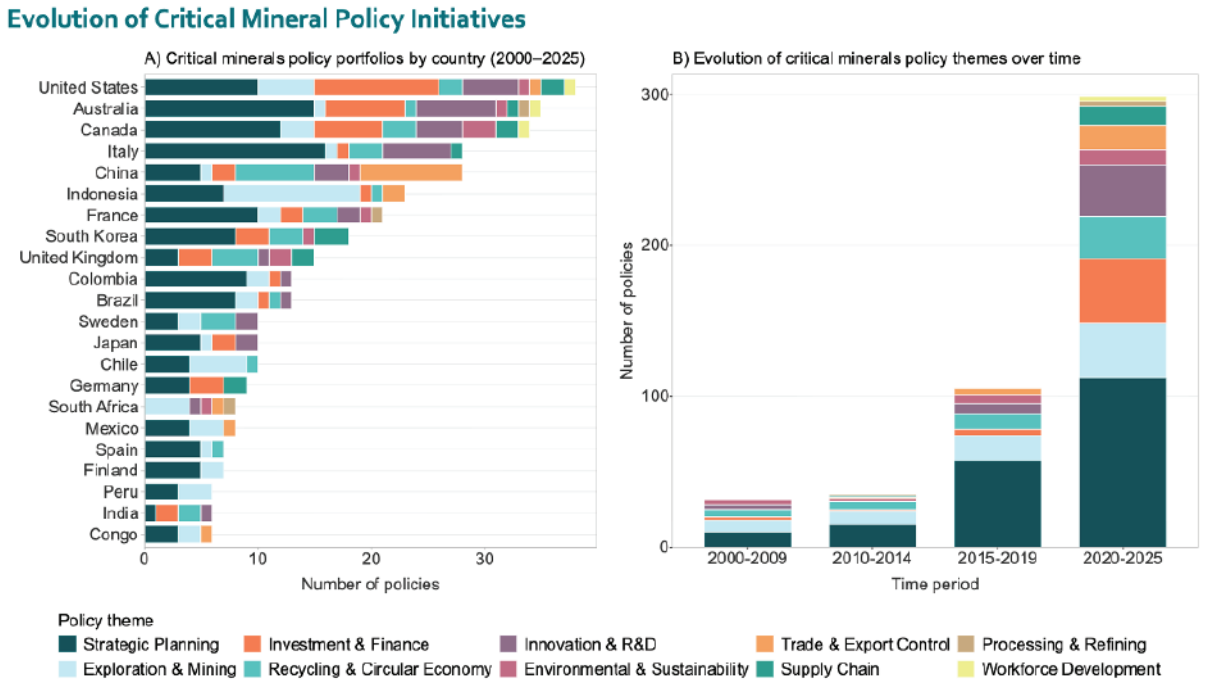
Leaders across the region emphasize diversification and multi-vector partnerships. Noting that Astana is working with U.S. partners on major mineral projects, Kazakhstan's President Kassym-Jomart Tokayev implies that critical minerals are not just a resource, but a pathway to economic development and geopolitical agency.

The Missing Ingredient: Long-Term Capital

Despite momentum, a key constraint remains—lack of capital. Western investment has been limited and inconsistent, while mining and processing projects require decades of commitment. Many Central Asian deposits have already been located, but developing a major mining project can still take decades from inception to production. Processing and refining require additional capital and technology.

Political cycles further complicate investment. While projects require long-term commitments, policy and political cycles are often much shorter. China has filled this gap offering long-term project financing and development packages that sometimes created a significant debt burden for the Central Asians which enabled Beijing to lock down mineral resources and export networks.

Central Asian governments are increasingly seeking to diversify partnerships and regain autonomy and agency in managing their relations. To reverse China's existing supply chain and export advantages, sustained Western engagement (financial, diplomatic, and institutional) will be needed to compete.



Distribution of mineral policy initiatives passed across select countries from 2000-2025, disaggregated by theme. Source: International Energy Forum

Wars and the New Geopolitical Geography

Recent geopolitical developments are accelerating Central Asia's importance. The war in Ukraine has catalyzed the development of the Middle Corridor, a transport route linking Asia and Europe while bypassing Russia. At the same time, instability in the Middle East has exposed vulnerabilities in maritime routes such as the Strait of Hormuz. Overland transport, especially rail, is gaining further importance as a result.

Central Asia sits at the intersection of these shifts—as both a resource base and a transit hub. Freight along the Middle Corridor has increased fivefold in seven years. Kazakhstan has expanded oil output and refining capacity in response to global disruptions.

This convergence enhances the region's strategic value. It is not only what Central Asia produces, but how those resources reach global markets**.** The Middle Corridor is evolving from a convenience to a necessity, representing a resilient routing that provides vital economic flexibility, redundancy, and risk reduction for Central Asia.

> ***It is not only what Central Asia produces, but how those resources reach global market.***

Conclusion: The Next Phase of Competition

Power in today's global economy is evolving. Critical minerals are now central to industrial capacity, technological leadership, and geopolitical influence. China's dominance reflects decades of sustained strategy and investment. Building alternatives will require similar commitment. The United States must move from recognition to execution by developing long-term frameworks that endure beyond political cycles. Central Asia presents **a rare and timely opportunity combining resource abundance with growing economic dynamism and a desire for diversifying its partnerships**. Plus, the region seeks to move beyond extraction toward value creation. Yet the window for competitors to enter is narrowing as China expands its integrated supply chain model and raises barriers.

Western policymakers have begun to recognize that the competition over critical minerals is not just about output, but about who controls supply chains and industrial systems. Recent rare earth export restrictions, sanctions, and war-related disturbances highlight the core reality that supply chains must be built before crises emerge and not in response to disruption.

Source: NATO Science and Technology Organization (STO)

Mines and associated processing capabilities take decades to develop. For the United States and its partners, the imperative is to move beyond discussion to implementation. Capital needs to be mobilized, policies aligned, and institutional frameworks that enhance resilience need to be built. For Central Asia, the opportunity is transformative. By building value chains and leveraging geography, it can move from the periphery to the center of global markets.

The stakes extend far beyond economics. Control over critical mineral supply chains may help define not only patterns of trade and production, but balance of power in the 21st century itself.

Figure 2: Shifts in U.S. Import Dependence 2022-25

Research by Kurtis Yan
Graphics by Lilly Horrigan

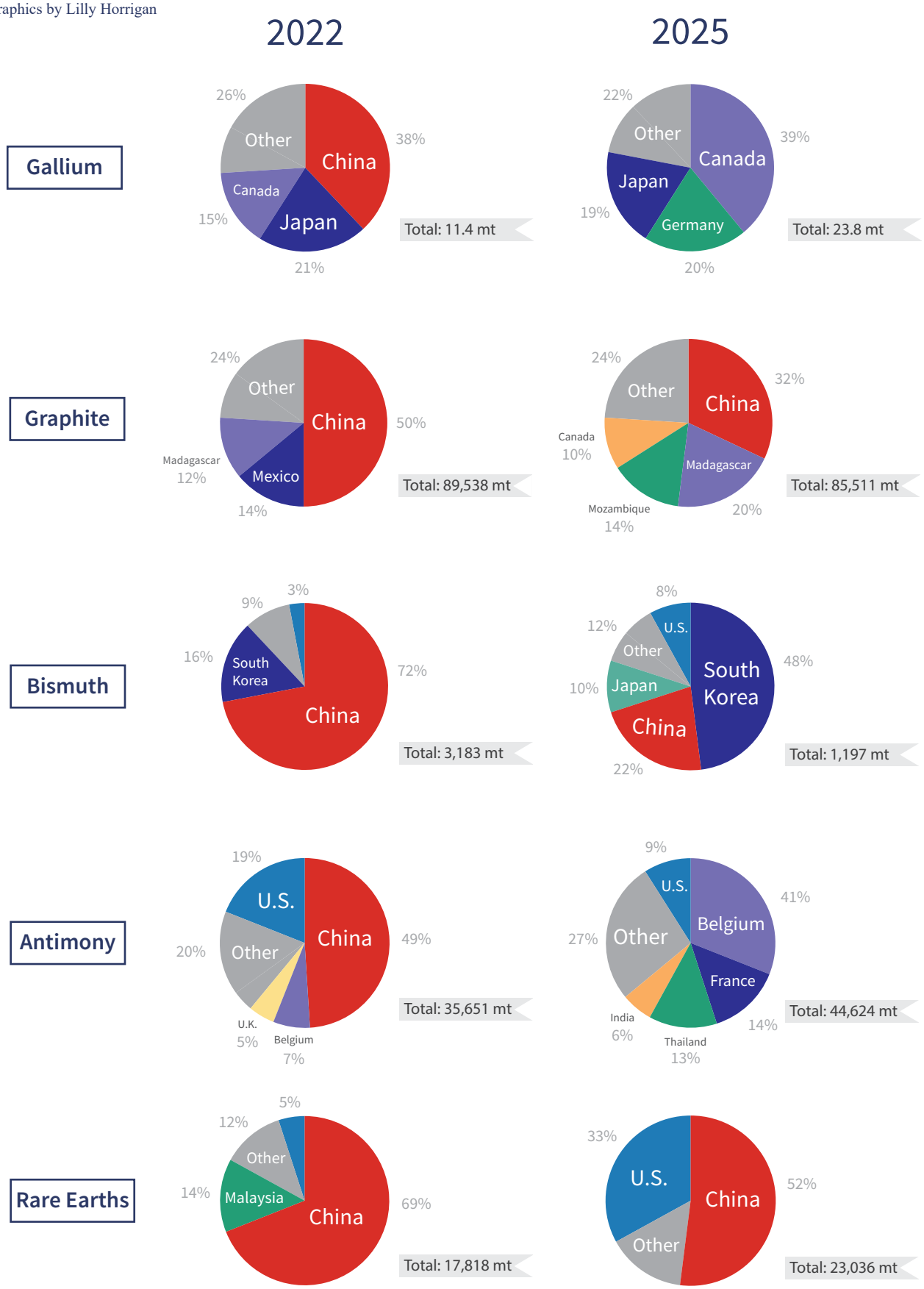


Figure 2: Shifts in U.S. Import Dependence 2022-25: Minerals Subject to Chinese Export Controls

By Kurtis Yan

China placed both gallium and graphite under export controls to the U.S. in the second half of 2023, though these bans were temporarily suspended in November 2025. Between 2022 and 2025, China's share of U.S. consumption for both minerals declined, though China still remains the top import source for natural graphite. Total gallium imports increased, and graphite imports stayed relatively level, indicating that the U.S. has had some success in diversifying import sources to supplement demand despite the export controls. The U.S. is still 100 percent import reliant for these two minerals.

Proportions for each country were calculated based on total reported imports for consumption, disaggregated by country for each of the selected minerals. Foreign producers with a share under 5% were aggregated into the "others" category. Data was drawn from the U.S. Census Bureau website and based on Harmonized Tariff Schedule (HTS) commodity codes from 2022 and 2025.

China placed export controls on antimony in September 2024, and bismuth and rare earths underwent export controls in February 2025. However, Beijing lifted its antimony and rare earth bans to the U.S. in November 2025. Malaysia also placed export bans on its rare earths in January 2024, which have yet to be lifted. The pie charts demonstrate that the share of U.S. imports from countries beyond China rose for both bismuth and antimony, while the U.S.'s share of domestic production of rare earths through mining and recycling rose by roughly 28 percent between 2022 and 2025.

Section 1

Kurtis Yan

Progress in U.S. Minerals Policy and Domestic Initiativees

Officials from 54 Countries Visited Washington to Attend the U.S. Critical Minerals Ministerial in February 2026. Source: USTDA

With a rush of renewed attention and urgency among public and private stakeholders, the United States shifted its approach to critical minerals policy in 2025. This evolving strategy reflects four key trends. First, Washington has begun a gradual shift from bilateral to more multilateral minerals diplomacy. Second, policymakers have increasingly recognized the urgency of directing attention toward the midstream segments of the supply chain, supported by key financing mechanisms and tools. Third, the Trump administration reworked the framing around minerals policy and critical minerals themselves, reshaping how these issues are communicated and prioritized. Finally, the United States has sought to strengthen the deployment of domestic mining initiatives, reinforcing the supply chain at home while engaging more strategically abroad.

An Initial Focus on Bilateral Deals

Throughout 2025, the United States acted to deploy minerals agreements as tools to enhance bilateral diplomacy and strengthen existing relationships. Bilateral Memoranda

of Understanding (MoUs) and investment commitments composed the majority of critical minerals diplomacy. Many of these deals also focused on the upstream and midstream parts of the mining process, and this bilateral approach aligned with Trump's preferences to deploy special envoys and construct business deals with partner states.

U.S. MoUs and strategic partnerships aimed to enhance cooperation, promote strategic alignment, and bolster upstream to downstream resilience in supply chains. During his Asia trip in October 2025, President Trump signed a strategic framework with Japan to mobilize capital for investment, encourage innovation in recycling technologies, and intensify cooperation to identify joint projects of interest. Notably, at the end of Trump's visit to Busan, he met with Chinese President Xi Jinping, where the two leaders struck a trade deal that would ease U.S. tariffs on China in exchange for Beijing's cessation of rare-earth export controls. To round out 2025, the United States signed a new strategic partnership with the Democratic Republic of the Congo (DRC), building on existing efforts to complete the Lobito Corridor and develop cobalt and copper supply chains.

Beyond these broader partnerships, the United States looked to generate concrete investment deals. Especially important were joint ventures and fielded investment for domestic projects. For instance, following Trump's Asia swing, South Korea's Korea Zinc company agreed to commit up to $7.4B to open new zinc mines and processing facilities in Tennessee. Likewise, the United Arab Emirates' (UAE) ADQ and Orion Resource Partners, together with the U.S. Development Finance Corporation (DFC), created a consortium valued at $1.8B for future mining projects.

In some instances, MoUs accompanied concrete action agreements. The United States and Saudi Arabia signed a strategic framework agreement to develop alternative rare earths supply chains, while Saudi company Maaden signed a deal with the Department of War (DoW) (formerly Department of Defense) and MP Materials to manage a new refinery. Saudi Arabia's ambitious minerals goals and untapped deposits of heavy rare earths have made it a prime target for U.S. investment. Similarly, Washington and Canberra's investment commitments deepened expectations for further cooperation in developing minerals supply chains, backed by capital and strategic alignment.

Diversification efforts proved that the United States had begun to recognize the urgency of de-risking vulnerable supply chains. However, China's overall dominance over the minerals sector and Washington's relatively small share of the market illustrated that joint, coordinated action between allies would be necessary to truly alter the minerals landscape.

Key Agreements Signed in 2025

Partner Country	Date	Type	Details
Ukraine	April 30, 2025	Long-term Investment	• Establishment of the United States-Ukraine Reconstruction Investment Fund to finance development of infrastructure and mining sector • $150M in initial capital by U.S. and Ukraine
Australia	October 20, 2025	Framework	• Securing financing for new domestic mining projects that diversify supply chains and support industrial bases • $2B in joint financing, with goal of $8.5 billion in new projects
United Arab Emirates	October 23, 2025	Consortium	• Joint investment tool to develop mining and processing projects across the globe • $1.8B split three ways between DFC, ADQ, and Orion Resource Partners
Malaysia	October 26, 2025	MoU	• Enhance cooperation by promoting supply chain resilience, technology transfers, and investment in extraction and processing. Malaysia also agrees to refrain from imposing export bans on REEs to the U.S.
Thailand	October 26, 2025	MoU	• Enhance cooperation by promoting supply chain diversification and improving Thailand's minerals competitiveness
Cambodia	October 26, 2025	MoU	• Reciprocal trade agreement allowing the U.S. to invest in minerals extraction and processing in Cambodia, while promising exports
Japan	October 27, 2025	Framework	• Strengthen minerals supply chain resilience by jointly identifying projects of interest, streamlining permitting, and investing in processing
China	October 30, 2025	Trade Agreement	• China temporarily agrees to relax rare earth export controls in exchange for U.S. reduction in tariff rates
Saudi Arabia	November 18, 2025	Framework + Deal	• Coordinate investment to strengthen U.S.-Saudi Arabia supply chains of uranium and rare earths • 51/49 equity stake between Maaden and DoD over new rare earths refinery in KSA
Democratic Republic of the Congo	December 4, 2025	Strategic Partner	• Commitment to secure offtake of critical minerals like cobalt and copper, while recognizing the need to invest in infrastructure and energy supply
South Korea	December 15, 2025	Private Investment	• Korea Zinc will finance construction of zinc refinery and the reopening of a mine in Tennessee • $6.6B-$7.4B of investment by Korea Zinc, over 700 jobs

Representatives of member states of Pax Silica. Source: U.S. Department of State

A Shift towards the Plurilateral: Financing and Midstream Management

In January 2026, Trump announced an executive order (EO), "Adjusting Imports of Processed Critical Minerals and Their Derivative Products into the United States," under Section 232 of the 1962 Trade Expansion Act. It recognized the strategic vulnerabilities tied to import reliance on "processed critical minerals and their derivative products" (PCMDPs). It also solidified the notion that the U.S.'s minerals supplies can and should be secured by expanding international partnerships. In particular, the EO states that processed derivatives are essential to all 16 critical infrastructure sectors.

Furthermore, it recognized price volatility as a national security concern, owing to the fact that China has weaponized its supply chains to maintain dominance. Mineral companies outside China often struggle to acquire capital or turn a profit when Beijing chooses to flood the market with its vast mineral supplies. Chinese-owned mines can often extract and sell outputs at far cheaper prices due to lower Environmental, Social, and Governance (ESG) standards, forcing other companies out of competition.

In February 2026, Washington played host for the U.S. Critical Minerals Ministerial, which brought together representatives from 54 countries. On the sidelines, the United States signed MoUs with 11 different countries, including Argentina, Peru, and Uzbekistan. However, what stands out most from the ministerial was the recognition that states must build upon existing platforms, like the Minerals Security Partnership (MSP) and Pax Silica, and harmonize plurilateral interstate efforts en masse. As such, the

ministerial launched new initiatives and established expectations to meet this goal.

First, U.S. Secretary of State Marco Rubio announced the creation of the Forum on Resource Geostrategic Engagement (FORGE), which serves as an enhanced version of the MSP. FORGE will consist of the MSP's 17 members and aims to improve interstate supply chain coordination, ensuring that upstream investments into extraction align with midstream processing projects. It also aims to unify environmental and legal standards across jurisdictions.

Second, dialogue at the ministerial emphasized the importance of addressing pricing concerns in industry. U.S. Vice President J.D. Vance promoted the idea of creating a **preferential trade zone**, which would likely occur through FORGE. Through "adjustable tariffs," the trade bloc would be able to set fair prices that protect investors and companies from undercutting by Chinese market manipulation. Though price flooring within an allied trade bloc would encourage supply chain diversification, the approach to employ tariffs and import prices might not prove effective in reducing operating costs or in preventing downstream inflationary costs on producers and consumers.

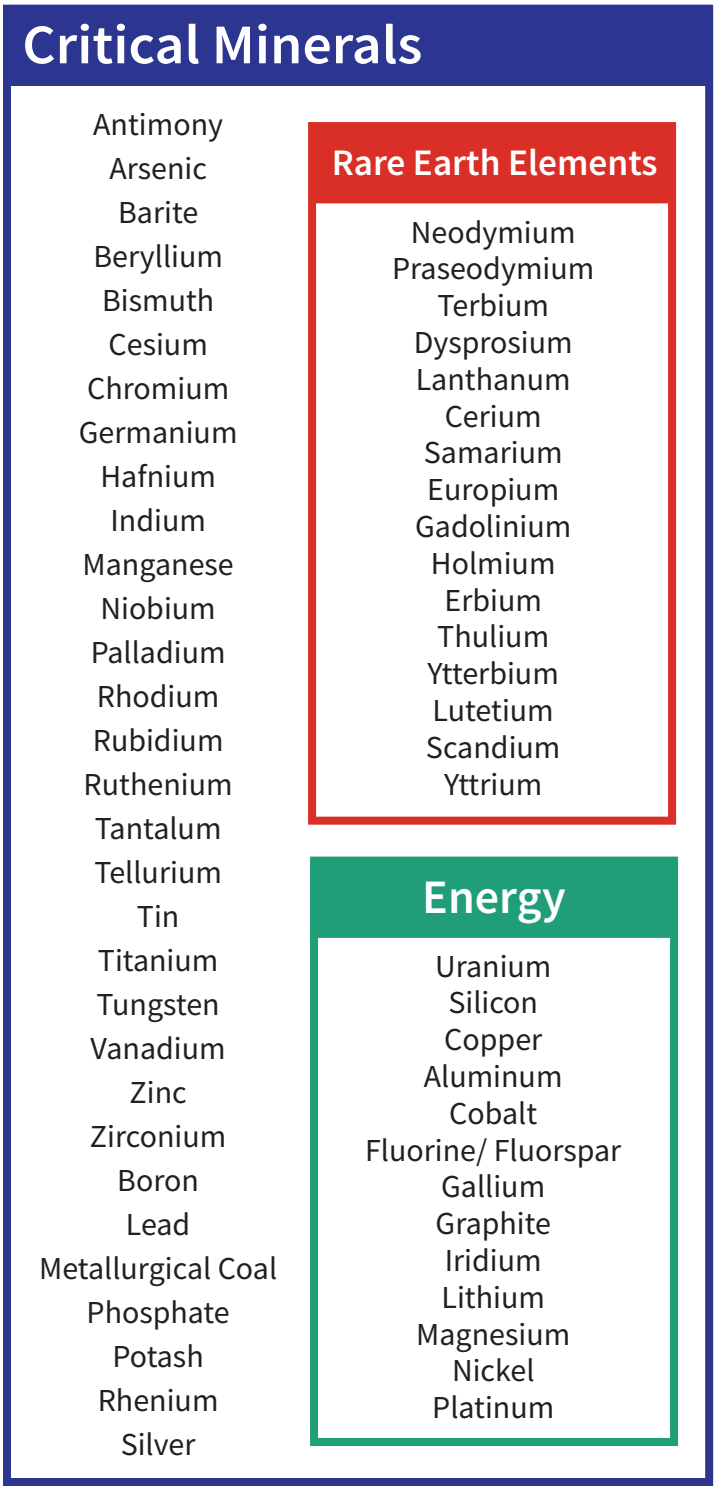
FORGE will consist of the MSP's 17 members and aims to improve interstate supply chain coordination, ensuring that upstream investments into extraction align with midstream processing projects. It also aims to unify environmental and legal standards across jurisdictions.

Third, the idea of an extended market might signal a shift towards further plurilateralism—an approach that builds mining development agreements between like-minded partners. Given that China's production and consumption of strategic minerals far surpass that of other countries, any policies extended by the U.S. alone to counter this influence would prove insufficient. Creating a harmonized bloc with real market sway is an expectation that FORGE must live up to.

Fourth, the United States announced the launch of Project Vault, supported by an $8 billion loan from the Export-Import (EXIM) Bank with an additional $2 billion in private financing. Not only does this stockpile increase the market share of the U.S.'s consumption, but its scope also goes beyond the National Defense Stockpile to support commercial actors. Manufacturers will pay a fee in exchange for access to the project's stockpile minerals amidst market shocks or supply disruptions. In early stages, Project Vault will have no geographic limitations for sourcing its minerals.

Definitions and Reworked Framework

U.S. defense policy played a key role in the push for increased minerals acquisition. For one, the U.S. National Security Strategy acknowledges supply chain dependence as a national security threat, with critical minerals listed as a vital supply chain to protect from market manipulation practices. This represents a broader push to centralize critical minerals into U.S. statecraft. The U.S. Geological Survey also added 10 minerals to the existing list of critical minerals, including copper, silver, and uranium. These additions support applications towards energy production and storage, such as grid expansion, batteries, and nuclear energy.



Moreover, the Trump administration has sought to reduce the impetus to deploy critical minerals towards green energy, choosing instead to emphasize the military and technological uses of minerals commodities. Trump signed the One Big Beautiful Bill Act (OBBBA) in July 2025, which rescinded clean energy tax credits under the Inflation Reduction Act. These tax credits incentivized the procurement of battery minerals from countries with Free Trade Agreements (FTA) to assist domestic electric vehicle producers. The repeal of these measures **aligns with Trump's preference for tariffs and protectionist measures to support domestic companies and production from friendly nations, as opposed to government-led market-support mechanisms**.

Aerial view of the Mountain Pass rare earths mine in the Mojave Desert, California.
Source: MP Materials

Domestic Mining Initiatives

To secure mineral inputs and incentivize U.S. production, government agencies took several initiatives to spur domestic mining. A March EO levied the Defense Production Act to increase the power of government agencies like DFC in supporting domestic mining projects. It empowered the Export-Import (EXIM) Bank to secure offtake agreements for U.S. domestic processing companies. The EO also aimed to streamline and expedite permitting by identifying federal lands for private mining development. Moreover, the Department of Energy announced up to $1 billion in investments to scale up domestic mining capabilities for the whole of the supply chain and align with energy security goals.

Furthermore, U.S. government agencies have started to take direct stakes in domestic mining projects as a form of de-risking. For instance, the Trump administration took a 10 percent equity stake of USA Rare Earth Inc. to supplement $1.6 billion in CHIPS financing for a mine in Sierra Blanca, Texas. The planned rare earth mine will accompany a magnet production facility in Oklahoma by 2026. The DoW also purchased $400

million in shares of MP Materials to accelerate the completion of its second magnet production facility in the U.S. These efforts have all helped increase domestic mining initiatives by securing investor confidence, overcoming capital expenditure costs, and addressing all parts of the mineral commodity supply chains.

To generate interest towards deep-sea mining, President Trump signed an EO in April, which signaled that the United States would begin exploring options to mine its own Economic Exclusive Zones (EEZ) or even mine in international waters. The Clarion-Clipperton Zone has piqued the greatest interest thus far, containing over 21 billion tons of polymetallic nodules. The EO also directs the National Oceanic and Atmospheric Administration to expedite application reviews for exploration licenses and recovery permits.

Agency	Notable Tools and Initiatives	Focus	Month and Year
Department of Energy	Notices of Funding Opportunities for up to $1B	Strengthen domestic minerals production and supply chain resilience	August, 2025
Department of Interior	Critical Minerals List	60 minerals, after adding 10 new minerals in 2025	November, 2025
Department of State	G7's Partnership for Global Infrastructure and Investment	Fund infrastructure projects, including for strategic minerals, in developing countries	2022-Present
Department of State	Forum on Resource Geostrategic Engagement (FORGE)	Secure, diversify, strengthen critical mineral supply chains through preferential trade zone	2026-Present
Department of War (formerly Department of Defense)	National Defense Stockpile	Ensure access to materials that are critical to defense and essential civilian needs in times of emergency	1939-Present
Export-Import Bank	Make More in America Initiative	Finance domestic manufacturing projects that bolster U.S. supply chain resiliency	2022-Present
Export-Import Bank	Supply Chain Resiliency Initiative	Secure supply chains of strategic minerals	2025-Present
Export-Import Bank	Project Vault: $10B loan	Critical Minerals Stockpile	February, 2026
International Development Finance Corporation	Critical Minerals Portfolio	Invest in mining, processing, and transportation to build alternative supply chains	2019-Present

What's Next

The United States will likely continue to center its efforts around its new plurilateral initiatives. It will continue to push for the normalization of minerals extraction and processing in the U.S. and in other jurisdictions, independent of China. The goals will be not only to create further government-led initiatives but also to spur private investment by de-risking the minerals sector altogether. **However, further efforts should address issues that will continue to arise, namely price volatility and a lack of minerals workforce personnel in the United States and among its allies.** These issues should take precedence in the creation of a coherent national strategy that aligns goals and efforts among all relevant public and private actors.

Section 1

Jack Halsey

The Partnership That Could Be:

Central Asia and the European Union

Presidents of Central Asian Countries with the President of the European Commission, Ursula von der Leyen, at the first Central Asia-EU Summit. Source: President of Uzbekistan

While the United States continues to bolster and secure critical mineral deals with Central Asian states, the European Union is falling behind. Although Central Asian state leaders continue to hold bilateral and regional talks, Europe is slow to invest and incorporate Central Asia into its critical minerals strategy. **Should Europe truly prioritize the goal of being net-zero in greenhouse gases by 2050 and decouple its critical mineral reliance on China, it could turn towards Central Asia and invest in a new market to offset dependence on Chinese companies**. With legislation in place, this seems a strategic opportunity for Brussels.

EU Critical Minerals Strategy

Passed in 2024, the Critical Raw Minerals Act (CRM) established an updated list of critical raw materials necessary for the EU economy and listed strategic raw materials crucial in the creation of strategic green, digital, defense, and aerospace applications. The CRM provides four benchmarks to achieve before 2030. Out of the EU's annual consumption of strategic raw materials, the three domestic goals include (1) extract at

least 10% of their collective needs, (2) process at least 40%, and (3) recycle at least 25%. Internationally, the final goal states that **no more than 65% of strategic raw material can come from a third country, placing priority on establishing deals with countries that share strategic agreements with the EU**. In combination, these four benchmarks aim to decouple the EU's supply-chain reliance on China and other individual states as well as mitigate any future supply-chain disturbances.

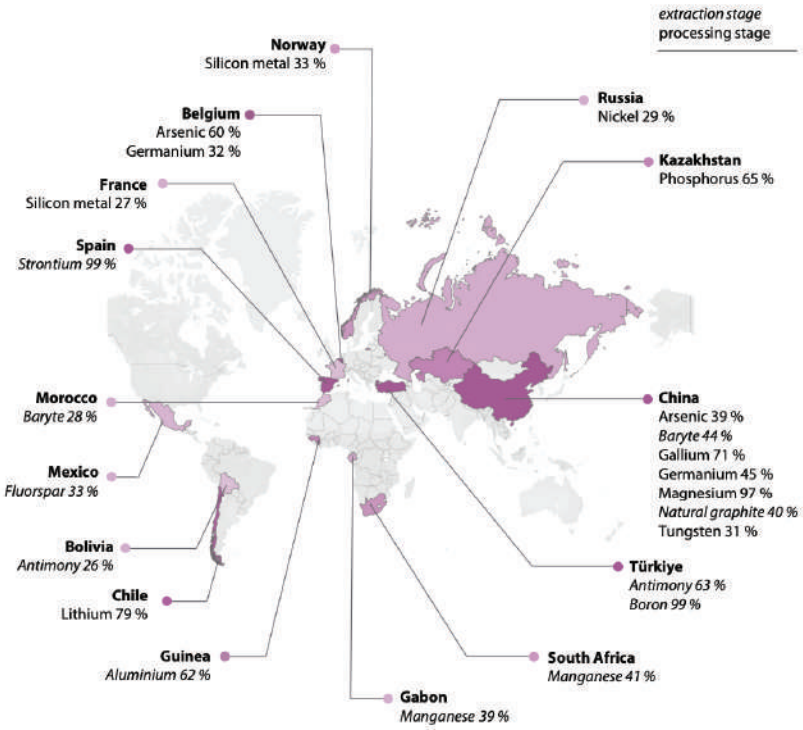
The report underlines several reasons for the slow-rolling of the CRM: (1) Financial, legal, and administrative bottlenecks which hamper progress in EU production; (2) EU legislation and national circularity plans have not accessed the full potential of sustainable resource management; and (3) EU Strategic projects abroad are struggling with permitting and financing.

In a 2026 Special Report from the European Court of Auditors, it was found that the CRM in action appears to have holes: "While the Critical Raw Materials Act sets a strategic course, its targets lack justification and underlying data is not robust. Efforts to diversify imports have yet to produce tangible results, and bottlenecks hamper progress in domestic production and recycling." The report underlines several reasons for the slow-rolling of the CRM: (1) Financial, legal, and administrative bottlenecks which hamper progress in EU production; (2) EU legislation and national circularity plans have not accessed the full potential of sustainable resource management; and (3) EU Strategic projects abroad are struggling with permitting and financing.

Regarding EU strategic projects abroad, the Union concluded 14 strategic partnerships between January 2021 and June 2025 on both critical and strategic materials. However, as of March 2026, none of these strategic projects has begun to extract or process critical minerals. The project closest to breaking ground is the Maniry Graphite Project, led by the Evion Group. The company is currently waiting for the Madagascar Ministry of Mines to issue a fast tracking permit and should open this year.

Out of the recently created strategic partnerships, the Kobaloni Energy Zambia project might be the first off the ground. Following the 2023 strategic partnership agreement, the project was expected to break ground in 2026. However, the project is still working to raise capital, with the expectation that the plant can be constructed 14 months after capital is secured. The new schedule expects production to begin in the second half of 2027.

With the European Union's consumption of critical minerals remaining constant and the current inability for domestic or foreign strategic projects to produce the necessary amounts, Europe has continued to rely on historical trade partners. Encompassing both extraction and processing of critical and strategic minerals, for instance, the EU imports 99% of boron from Türkiye and 79% of processed lithium from Chile. Meanwhile, China provides 97% of the EU's magnesium, 71% of gallium, and over 65% of six other rare earth elements needed for permanent magnets.

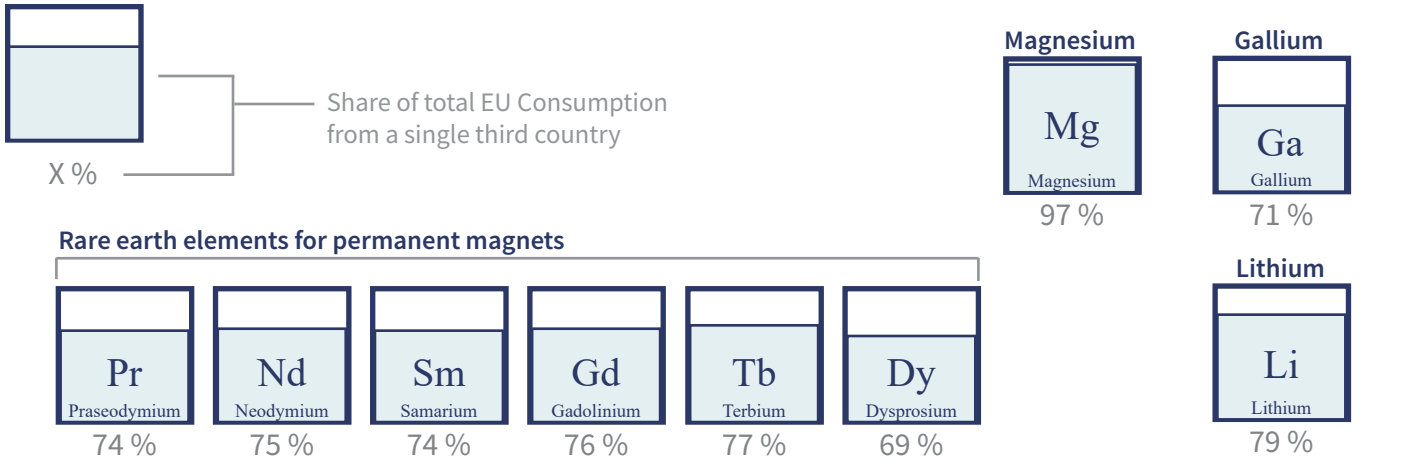


Source: ECA

EU Dealings with Central Asia

Central Asia's critical mineral potential has not gone unnoticed by Brussels. Kazakhstan's officials have stated that their nation can supply 21 of 34 raw materials classified as critical by the EU, and several that are considered strategic. Out of the 21 minerals, 19

Figure 3: EU Processed Strategic Raw Materials Dependency from Countries Above 65%



Source: ECA, based on DG GROW data from January 2025

Critical material	Project Name	Location	Project start	Project Type	EU investor name	Country
Lithium, cobalt, and nickel	German company HMS Bergbau AG acquired a controlling stake in Kazakh company Creada Corporation, which holds exploration licenses for adjacent documented lithium, cobalt, and nickel deposits	Kazakhstan	2022	Extraction and export	HMS Bergbau AG	Germany
Lithium	Construction of a mining and processing plant for the extraction and processing of lithium in the East Kazakhstan region for USD 500 million	East Kazakhstan region, Kazakhstan	2024	Extraction and export	HMS Bergbau AG	Germany
Graphite	EBRD is acquiring a stake of approximately 17.4% in the mining company Sarytogan Graphite for the equivalent of EUR 3 million.	Karaganda region, Kazakhstan	2024	Extraction and export	Sarytogan Graphite and EBRD	Australia and EBRD
Lithium, copper, and antimony	The MOU signed between Danish firm FLSmith and the Ministry of Industry and New Technologies of the Republic of Tajikistan.	Tajikistan	2024	Exploration and mining	FLSmith	Denmark
Rare earth metals	Development of rare earth metal deposits needed for the production of solar panels in the Samarkand region.	Samarakand region, Uzbekistan	2023	Extraction/processing in Uzbekistan	TotalEnergies	France

Source: Friedrich Ebert Stiftung

are already being extracted and processed in Kazakhstan. Uzbekistan's President Shavkat Mirziyoyev also claimed that his country has "enormous untapped potential" regarding 32 different critical minerals.

However, despite having product-generating or potential sites to mine, the EU has been slow to break into the market. **Since 2022, European companies have established five different projects spread across Kazakhstan, Uzbekistan, and Tajikistan**. On a policy level, the EU and Kazakhstan signed a strategic agreement in 2022 regarding sustainable raw materials, batteries, and renewable hydrogen value chains. A modified roadmap with concrete goals to achieve the standards set by the agreement was implemented in 2025 on the sidelines of the EU-Central Asia Summit in Samarkand.

The EU also signed a strategic partnership agreement with Uzbekistan in 2024. Similar to the agreement with Kazakhstan, this partnership covers areas including integration of sustainable CRM value chains, increasing the resilience of CRM supply chains, and cooperation on research and innovation, as well as cooperation on building of capacity to enforce relevant rules and on developing training and skills.

During the 2025 Samarkand Summit, attending leaders signed the Joint Declaration of Intent on Critical Raw Materials to "confirm the willingness to a deeper cooperation involving critical minerals." Although not a strategic partnership, it does open the doors for continued cooperation and private investment into extraction and processing in the region.

Contributors to Slow Rollout

The European Union's glacially slow pace to substantially diversify critical mineral export origins can be attributed to its bureaucratic tendencies. From the ECA special report, auditors found that, although the EU has sought to establish free trade agreements (FTA), the Commission cannot demonstrate how these agreements have helped to increase the supply of critical raw materials.

The report goes on to state that similarly to FTAs, **the strategic partnerships have improved cooperation with third countries on raw materials but have not led to new secure supply chains of minerals**. It also recognizes that seven of 14 partnerships are located in countries with low governance scores. In theory, the partnerships are meant to address governance challenges that could impact European companies. Practically, 12 of 14 have established roadmaps that include actions to implement partnerships, but only six have implementation deadlines. While the Commission is focused on making sure that roadmaps are followed and completed, auditors have found that the Commission "does not assess [the roadmaps] effects on the supply of critical raw materials or on achieving the EU strategic raw materials target."

Another barrier for European critical mineral companies in Central Asia is perceived excessive bureaucracy. When interviewed, local stakeholders highlighted how Chinese investors do not require substantive documentation and complicated procedures to establish partnerships or to sign contracts. The EU must also compete with China's geographical proximity to the region, which provides stakeholders easier access to Chinese financial markets and eases conducting business in person. However, interviewees do recognize that EU investors more often offer a business model that includes joint ventures with local companies that stakeholders appreciate.

Finally, European visa regulations restrict and complicate Central Asian stakeholders' ability to travel to Europe for educational or professional endeavors. These trips are essential for supporting the growth of the critical minerals industry and development. **Alone, this fact is not enough to deter European business in the region, but it is enough to keep relations with stakeholders weak and makes those stakeholders more willing to consider other competitors with which to work**.

Following Russia's invasion of Ukraine in 2022, Europeans realized the need to decentralize their export origins on strategic products such as gas and minerals. This drive to decouple market dependencies, paired with Europe's net zero goal for greenhouse gases by 2050, creates a real demand for new critical mineral sources.

Currently, a major challenge standing in the way of Brussels achieving both these goals appears to be its own bureaucracy.

Central Asia is ready and willing to be an enthusiastic partner in the critical minerals market. Approximately 70% of Central Asia's extracted minerals are shipped to China for processing and resale. The mines and potential for deeper ties with Central Asia exist. Europe needs to support its private businesses as they invest into the region's industry. With the expansion of the Middle Corridor for trade and transport into Azerbaijan and onward into Armenia along the proposed Trump Route for International Peace and Prosperity (TRIPP), Central Asia will have the means and capabilities to circumvent China from the market circle and directly trade processed materials to Europe.

Section 2
Is Central Asia the Critical Minerals Answer?

The Lay of the Land

CPC CASPIAN POLICY CENTER

Section 2

Kurtis Yan

Strategic Minerals at the Forefront of Diplomacy:

2025 in Review

Kazakh President Kassym-Jomart Tokayev and U.S. Commerce Secretary Howard Lutnick Present at Signing of Memorandum of Understanding on Critical Minerals. Source: x.com/aqorda_press

Throughout 2025, the Greater Caspian Region aimed to improve its standing in the world as a source of critical minerals potential. Although China's and Russia's grip on the mining industry remains strong in Central Asia, the region itself has sought to diversify its economic partnerships westward, beyond its immediate neighbors. Regional governments look to leverage critical mineral deposits to attract investment from a multitude of partners, namely the United States and the European Union (EU). As they seek to diversify their mineral supply chains away from China, the nations of the Greater Caspian Region can build off progress in 2025 to secure the region's position as a potentially competitive alternative.

Key Initiatives in 2025

Kazakhstan and Uzbekistan stood out as frontrunners in minerals diplomacy and diversification. Uzbekistan possesses some of the world's largest deposits of copper, tungsten, tellurium, and gold. It also ranks fifth in global uranium production.

In March, Uzbekistan announced investments of $2.6 billion to develop 76 mining projects over the next three years, in alignment with C5+1 dialogue and a 2024 U.S.-Uzbekistan memorandum of understanding (MoU). In April, Uzbek officials met with U.S. business executives in Washington, where the two parties agreed to deals on exploration and processing. U.S.-Uzbekistan ties only strengthened throughout the year in the buildup to the C5+1 Heads of State Summit in Washington on November 6. There, Uzbekistan and the United States pledged up to $400 million into the critical minerals industry, strengthening U.S. supply chains. Meanwhile, Uzbekistan signed an enhanced partnership agreement with the EU, which included investments of 10 billion euros into various sectors, namely critical minerals and logistics.

Within its vast territory, Kazakhstan possesses a wealth of unexplored and untapped mineral deposits. Globally, it ranks first in production of chromite and unenriched uranium, seventh in zinc reserves, eighth in copper production, ninth in silver production, and tenth in production of bauxite—a critical ore for aluminum and gallium extraction.

In April, German mining company HMS Bergbau AG agreed to invest $500 million into lithium extraction and processing facilities in the East Kazakhstan Region. In the summer, Kazakhstan established plans with $20 million from Eurasian Resources Group to open a gallium mine in late 2026, equipped with on-site processing to produce up to 15 tons.

Tau-Ken Samruk, a Kazakh national mining company, and Cove Capital LLC, a U.S. firm, agreed to commence rare earths exploration in the Kostanay region, which comes after Kazakh geologists claimed the discovery of over 20 million metric tons of rare earth metals in April. Overall, the country attracted over $150 million in exploration investment.

At the C5+1 Washington summit in November, Kazakhstan and the United States signed an MoU on deepening critical minerals cooperation, ramping up minerals exploration, and shoring up supply chains. Moreover, Cove Capital announced an agreement with Kazakh state mining company Tau-Ken Samruk to quarry the world's largest undeveloped tungsten deposit. Tungsten serves many functions, ranging from energy and electricity conduction to military applications. An on-site processing plant will accompany the mines at the Northern Katpar and Upper Kayrakty deposits in Karaganda. The project will cost $1.1 billion, and the U.S. Export-Import Bank will provide $900 million for capital expenditures.

Central Asia's Heads of States meeting with Japanese Prime Minister Sanae Takaichi for the Central Asia plus Japan Dialogue in December 2025. Source: Prime Minister's Office of Japan

To round out 2025, Eurasian Resources Group signed a deal with Japan's Mitsubishi Corporation to launch gallium production at the Pavlodar Alumina Plant. Beginning in late 2026, the Kazakh mine will provide 15 tons of the mineral annually to Japan's Mitsubishi Corporation. The deal previewed the first heads of state summit under the Central Asia plus Japan Dialogue (CA+JAD), where Tokyo pledged over $19B in investments to the C5.

China and Russia Stand Firm in the Mining Sector

Furthermore, as the largest unenriched uranium producer in the world, Kazakhstan continued its exports to its primary customers with enrichment capabilities—Russia, China, Canada, and France. However, dependence on enrichment capabilities abroad restricts its circle of partners, and so Kazakhstan selected Russia's Rosatom and China's CNNC to back its own plans for civilian nuclear power plants.

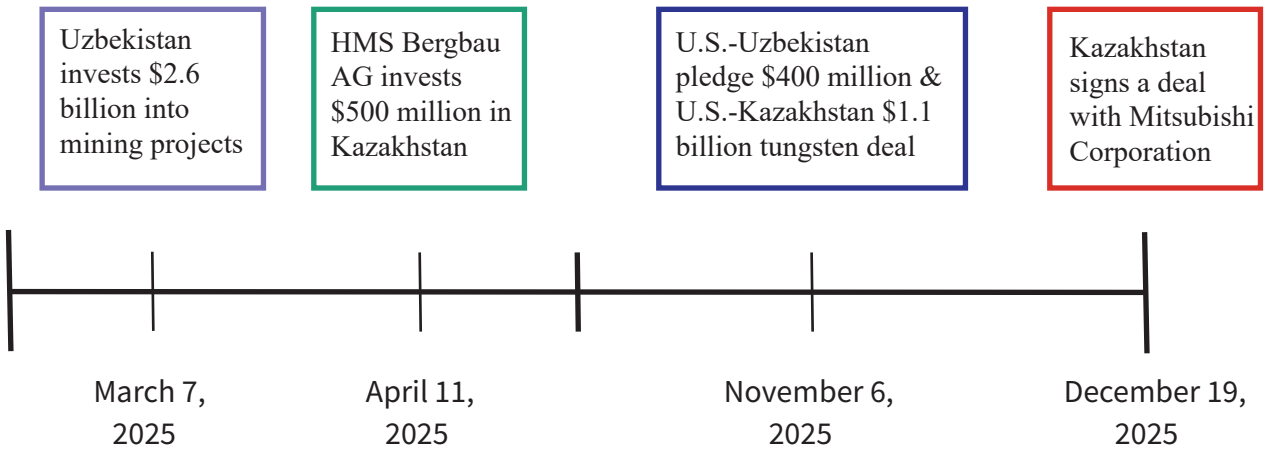
Throughout the region, China continued to bolster its already-established Belt and Road (BRI) mining projects. Beijing receives raw materials from mines in Tajikistan, from which it processes antimony, a critical mineral with defense applications. Tajikistan is the second-largest producer of antimony in the world, and China-Tajikistan ties only continue to grow, although security concerns at mines remain a concern. A similar story plays out in Kyrgyzstan, where Chinese firms control stakes and licenses in the country's gold mines. Chinese-owned mines, however, remain controversial because of labor conditions, environmental concerns, and accusations of taking jobs away from locals.

Looking at the South Caucasus, in February, the Armenian government offered a $150 million loan to fund the opening of the Amulsar gold mine—a project under U.S.-Canadian company Lydian Armenia that is challenged by environmental contamination concerns. Gold itself is not considered a critical mineral, but there is significant demand for byproducts found in ore at gold deposits. Armenia's economy also relies on the extraction of antimony, copper, magnesium, molybdenum, and zinc, although Russia owns Armenia's largest mines for these minerals.

Perhaps more notably, the August peace agreement that Armenia and Azerbaijan initialed facilitates the projected establishment of the Trump Route for International Peace and Prosperity, commonly known as the TRIPP Corridor. **The corridor aims to increase more direct throughput on the Middle Corridor between China and Europe and could serve as a key lever in the future for unlocking U.S. and EU access to minerals from Central Asia**. However, aside from the high logistical costs of transit to the United States along the current corridor, so far the route lacks sufficient capital to assuage investor concerns of East-West commercial viability. Furthermore, geopolitical risk versus mineral reward is a challenge to some investors' confidence, given instability in neighboring states and proximity to Russia, China, and Iran.

Looking Ahead

Several states in the Greater Caspian Region made important strides on connectivity and minerals diplomacy in 2025, but diversification of the sector still remains limited. Shipping volatility and interstate misalignment in customs and railways create bottlenecks along the Middle Corridor. Because China stands as the primary investor in its development, the U.S., the E.U., and other investors would have to provide over $20 billion in the Middle Corridor's transit infrastructure, and perhaps more into local energy



grids to facilitate intensive mining processes that are projected. This strongly indicates the importance of turning towards other interested actors for financing as well, such as the EU, East Asia, and the Gulf States.

The U.S. has demonstrated a clear interest in friendshoring to counter China's dominance over critical mineral supplies, striking a number of deals with alternate suppliers and refiners. The United States signed a deal to fund Ukraine's post-war reconstruction in exchange for access to strategic mineral deposits, and it seeks to secure cobalt and copper supply by mediating peace between the Democratic Republic of the Congo and Rwandan-backed militias. In October, the United States signed an $8.5 billion agreement with Australia on critical minerals cooperation, and it continues to strengthen minerals diplomacy with South American states like Argentina.

What Changed Since 2025

In February 2026, delegates from Uzbekistan and Kazakhstan were invited to Washington to participate in the U.S.-led Critical Minerals Ministerial, which brought together representatives from a total of 54 countries. On the sidelines, Uzbekistan and the U.S. signed an MoU on minerals cooperation. That same month, Mirziyoyev announced that Uzbekistan would field $1B in financing from Traxys—a Luxembourg-based minerals company.

These deals suggest that the United States will continue to take the threat of Chinese minerals dominance seriously, and the Greater Caspian Region can still compete for a role in this calculus. **To turn hopes into reality, regional actors must continue to enhance connectivity along the Middle Corridor and rapidly fill gaps in their mining industries through directed investment and cooperation within and beyond the region**.

Section 2

Dr. Ruchan Kaya

No Reform, No Mining:

How Legal Frameworks Decide Critical Minerals Success

16th International Mining and Geological Forum and Exhibition KazMinex hosted in Astana in April 2026. Source: Navoi Mining and Metallurgical Company

As much as availability matters, critical minerals legal frameworks largely determine investment outcomes. These structures demonstrate the conditions in which exploration and extraction rights are obtained. The fiscal terms of a deal and the administrative procedures also depend on the legal structures. In doing so, they help determine whether projects are bankable for investors and whether investors can rely on stable dispute resolution, convert earnings, repatriate profits, and enforce long-term offtake arrangements across borders. Often, these factors separate geological potential from commercially viable production. In turn, clearer and more credible legal regimes can help regional states attract greater foreign investment. At the same time, Western governments and firms are likely to have more confidence that new supply relationships will be durable, scalable, and less vulnerable to political or contractual disruption.

Evolution of Legal Frameworks

The evolution of legal frameworks across Central Asia has been a gradual reform process.

The shift from state socialism to market governance included reductions in politicized control over minerals while establishing more legible, investor-oriented rules. In the early post-Soviet years, extractive licensing was often state-dominated and opaque. Informal bargaining processes dominated the scene. The courts did not have strong legal standing and the contract expectations were rather unstable. Because of such conditions, the business environment created high political risk for international investors.

For investors, the Australian framework signals secure and transferable mining environments, as well as harmonized and transparent reporting structures. The new code includes first-come-first-served allocation, clearer guarantees for moving from exploration to extraction, and more structured administrative timelines.

Across much of Central Asia, the business environment often included discretionary allocation and fragile enforcement. A decade of legal modernization is now attempting to overcome the legacy of state control over mineral rights. Kazakhstan's 2017 Code on Subsoil and Subsoil Use (SSU) marked the most important regional turning point in recent years, replacing older discretionary practices in the solid minerals sector with a more streamlined licensing framework modeled in part on Western Australia. For investors, the Australian framework signals secure and transferable mining environments, as well as harmonized and transparent reporting structures. The new code includes first-come-first-served allocation, clearer guarantees for moving from exploration to extraction, and more structured administrative timelines.

Uzbekistan started to move forward around the same time. Since 2017, it has liberalized key parts of its investment regime and, in the OECD's words, "completely restructured" its legal framework on investment, by adopting new laws on investment activity and public-private partnerships. Since the collapse of the Soviet Union, the region has come a long way with fewer ad hoc bargains. The countries moved towards more standardized procedures and a greater effort to present the mining sector in terms foreign investors can recognize.

Despite the positive developments, the real issue is consistent implementation. The existence of reform laws is not enough. Kazakhstan remains the most institutionally mature case, but even there the OECD stresses that investor confidence will depend on fair, consistent, and transparent application of the new rules. This is especially true where

environmental review, taxation, and administrative oversight still create friction for investors. Uzbekistan's reform drive is more rapid and ambitious, but also less settled. Uncertainty still exists as the formal framework improves.

Current Investment Framework

Title— The most important part of the investment framework is whether critical minerals can be turned into legally secure, financeable projects. For investors, the first step is figuring out the security of the title. The investment decisions depend on multiple factors including the granting of rights and their nature. Their length, renewal processes, and marketability are essential as well. The marketability depends on whether these rights can be transferred or sold to other potential investors. To improve conditions, Kazakhstan took new steps in the last ten years to mirror efforts already taken for hydrocarbons.

Licensing— Now, for minerals outside the hydrocarbon sector, the process has been improved in the SSU Code with the adoption of a streamlined licensing system for most solid minerals over the old practice of negotiated access. The SSU allows the transfer of licenses and uses a first-come-first-served approach for many exploration rights, excluding hydrocarbons and uranium. The legal and institutional structures already exist for hydrocarbons while uranium has additional requirements due to tighter state control and nuclear-governance constraints. **This also linked reserve reporting to CRIRSCO-style standards through the KAZRC system**. CRIRSCO is the international umbrella that harmonizes comparable national reporting codes across mining jurisdictions while KAZRC is Kazakhstan's code for the results of exploring

Representatives from CRIRSCO and KAZRC in 2016. Source: KAZRC

exploring mineral reserves. Uzbekistan is also headed in the right direction by combining e-auctions and first-come-first-served access. Their investor guidance emphasizes a fully digitalized licensing process on formally equal terms for foreign and domestic firms.

Fiscal— Once the access part of the question is resolved, the next issue is the fiscal side, evaluating the additional costs of operation and a state's overall take. These include single headline tax, royalties, profit taxes, mineral extraction charges, export-related levies, and other subsoil-user payments. In Kazakhstan, taxes are charged on income, rental, subsoil use, royalties, and extraction.

Permitting— Furthermore, environmental approval timelines, water-use permissions, and technical reviews can delay a project even after a license is approved and secured. The World Bank notes the additional hurdles under Environmental Impact Assessments (EIAs) and submission of water-use plans for operations. They note that environmental permits can extend application periods to six to eight months. Similarly, Uzbekistan has issues regarding environmental impact. These include EIAs, public hearings, abstraction quotas, and special permits for water use and discharge. The IMF agrees with such evaluation, saying that Uzbekistan made progress on rule of law and business-environment reform, yet it still faces vulnerabilities and institutional gaps. Finally, especially in strategic sectors, Kazakhstan still preserves state pre-emptive rights over strategically significant deposits, and uranium remains under a more state-managed contractual model than ordinary solid minerals.

Capital Repatriation— Along with the legal framework around capital markets, repatriation issues are rather complex. Capital is rarely blocked by a single law and usually happens in a combination of withholding, cap limits, and cross-border scrutiny. However, when transfer rights are embedded into investment law and foreign currency is available in the market, investor sentiment will improve. Uzbek law is a clear example with their free transfer of funds guarantee. Article 17 of The Law on Investments and Investment Activity clearly guarantees such transfers without impediments. Official trade guidance of Kazakhstan, on the other hand, attempts to achieve this by declaring that the country is bound by IMF Article VIII, barring restrictions on repatriation.

Outstanding Public-Private Concerns and What's Next

Similar to the outstanding need for legal reforms, private investor confidence is stifled by gaps in data collection and troubles working with government entities. **Opaque data sharing practices, outdated information, and bureaucratic steps to retrieve data add to the challenge of navigating the private sector in Central Asia**. To correct this, Kazakhstan has invested into extensive geological mapping initiatives, which can reduce

Participants in MINEX Central Asia 2024 at the Kumtor Gold Mine in Kyrgyzstan.Source: Kumtor

risk of investment and improve investor confidence in early project stages.

Regional reliance on state-owned enterprises (SOEs) continues to permit state overreach in mining partnerships with foreign companies. For instance, joint ventures in Kyrgyzstan are required to grant SOEs at least a 30 percent stake. Furthermore, a lack of financial transparency and a risk of expropriation by state governments all contribute to perceived political risk in the eyes of investors. Kyrgyzstan's Kumtor is another warning sign. The Kumtor gold mining project was established in Kyrgyzstan in 1992 with flagship foreign investment. However, it faced repeated impediments, finalized with state expropriation in 2021. Weak institutional credibility can turn a major resource project into a long-running sovereignty dispute .

In the end, the target for Central Asian efforts should be moving beyond mining and including extraction in their industrial basket. Such diversification is needed for a healthier economy, wider tax base, and sustainable economic development. In order for this to happen, investors will ask for locations for mid-stream operations (free zones and industrial parks) and predictability in taxes, customs, and repatriation. Azerbaijan has moved aggressively in this direction through industrial parks that offer state-financed infrastructure and 10-year exemptions on land, taxes, and customs relief. The country can continue to build on the Alat/AFEZ industrial platform to support export-oriented processing.

Extraction in Central Asia can be combined with processing in Azerbaijan, transported to the customers in the West. Still, similar to Kazakhstan's preservation of pre-emptive rights over strategic sources, Azerbaijan also announced amendments to law. These allow state acquisition of strategic investments under broad national-interest grounds and act as deterrents. IMF's 2025 Article IV argues in favor of private-sector-led diversification with legal improvements in capital markets and access to finance. Without improvements in capital markets, developing processing of critical minerals and improving the Middle Corridor will be harder to achieve.

Section 3
What Needs to Get Done?

Central Asia's Capacity Gaps and Barriers to Building Strategic Supply Chains

CPC CASPIAN POLICY CENTER

Dr. Akbota Karibayeva Meyer

From Potential to Production:

What It Takes to Make Central Asia's Critical Minerals Boom Real

Khorgos Dry Port at the Kazakhstan-China Border. Source: Central Asia Regional Economic Cooperation Program (CAREC)

The November 2025 C5+1 Business Conference and Heads of State Summit in Washington produced a notable set of commitments. Among them, the joint venture between U.S. firm Cove Capital and Kazakhstan's state mining company Tau-Ken Samruk to develop the world's largest known tungsten deposit was the clearest signal yet that the United States is prepared to move from rhetoric to investment. This tungsten joint venture represents exactly the kind of outcome this moment calls for, but the risk is that it becomes a unicorn rather than spearheading a trend. Converting political momentum into durable supply-chain architecture requires confronting a set of structural challenges that diplomatic frameworks alone cannot resolve.

1. The Processing Question: Where, What, and at What Cost?

The first structural challenge is where and how critical minerals are processed. Central Asian governments are understandably determined to move away from the extractive model that characterized their Soviet-era resource economies, in which raw materials

were exported while value addition happened elsewhere. There is strong and legitimate pressure, embedded in investment frameworks across the region, for new deals to include not just extraction but midstream processing and the production of higher-value products that require less volume to transport. This is economically rational from the perspective of resource-holding states. However, it provides another layer of pressure for investors, as processing infrastructure adds enormously to capital requirements, increases technical complexity, and significantly amplifies the risks of operating in jurisdictions with limited industrial track records.

The technical complexity of processing is frequently underestimated in policy discussions. Rare earth separation through solvent extraction (the standard commercial process) involves potentially dozens of sequential stages conducted in very large industrial facilities, requires access to significant quantities of specialized chemicals, and is highly sensitive to variations in ore composition and deposit geology. Each deposit has its own mineralogical characteristics that require tailored metallurgical solutions. New processing technologies exist at the laboratory stage, but none appear ready to replace conventional approaches at commercial scale in the near term. **Plans for regional processing hubs must be evaluated against these realities.**

The region also faces a coordination challenge. Multiple Central Asian countries aspire to become a regional hub for critical mineral processing. That ambition is understandable, but if pursued independently and without coordination, it risks producing redundant or under-scaled facilities that fail to attract the international investment they need to succeed. A processing facility optimized for rare earth separation has very different siting requirements than one focused on copper refining or titanium production; the logic of mineral type, ore grade, energy access, water availability, and logistics connectivity does not produce the same answer for every country or every mineral. The region's governments would be better served by a coordinated specialization strategy. For instance, Kazakhstan's established metallurgical infrastructure and energy base positions it differently than Tajikistan's antimony and aluminum concentrations, or Uzbekistan’s emerging tungsten and copper refining capacity. The countries of Central Asia are not simply competitors for the same investment. They are potential components of an integrated regional supply chain that would be more valuable to Western partners than any single country's offering in isolation.

2. The Workforce Gap: Why the Long Horizon May Be an Asset

Two of the challenges most frequently cited in discussions of Central Asian mining – workforce capacity and infrastructure – share a feature that is easy to miss when the

dominating framing is one of urgency: they are problems that respond to sustained effort over a decade or more, which is precisely the time horizon on which mine development and processing capacity also operate. The region's technical workforce in mining, geology, and mineral processing reflects its Soviet institutional inheritance that does not map onto the practices expected by Western investors and international capital markets. Geological data in several countries remains fragmented, not digitized, and not fully reported in the international formats – e.g., **Committee for Mineral Reserves International Reporting Standards (CRIRSCO)** – that credible investment due diligence requires. Engineering expertise in the specific metallurgical challenges of rare earth separation, or in the environmental management of tailings and water use, is limited.

> *If the region's governments make a serious and sustained commitment to training the next generation of geologists, mining engineers, and mineral economists, then the workforce will be trained by the time mines and processing plants reach operational scale.*

However, these constraints are not permanent. Central Asian governments have significant capacity to direct educational investment, allocate scholarships, and build institutional capacity in targeted fields. If the region's governments make a serious and sustained commitment to training the next generation of geologists, mining engineers, and mineral economists, then the workforce will be trained by the time mines and processing plants reach operational scale. Partnerships with institutions like the Colorado School of Mines, which actively seeks to establish a regional presence, represent one model for accelerating that process. The time horizon that looks like a liability from an urgency standpoint is, from a workforce development standpoint, an opportunity.

3. The Middle Corridor: Urgency and Time Are Not Contradictory

The same logic applies to the Middle Corridor, which would carry Central Asian minerals westward through the South Caucasus to European and U.S. markets, bypassing both Russia and Iran. The corridor is currently underdeveloped relative to the demands that critical mineral export at scale would place on it, as bottlenecks persist and customs harmonization across jurisdictions is incomplete.

Signing of MoU on education and training in the nuclear industry between Kazakhstan's National Atomic Company Kazatomprom JSC and France's state-owned nuclear corporation Orano SA. Source: Kazatomprom

This is a challenge for critical minerals transit, but one with a reasonable solution timeline if action begins now. Mines currently in early development or exploration will not require high-volume export capacity for years. That window means that sustained effort now on logistics infrastructure, customs harmonization, digital tracking, port capacity, and multimodal connectivity can produce a corridor that is genuinely ready to carry commercial-scale mineral flows when they materialize. The Middle Corridor's importance extends beyond critical minerals. It is a versatile, general-purpose trade route whose development increases economic connectivity across a region that has historically been pulled between Russian and Chinese economic orbits. Every ton of non-mineral goods that moves through an improved corridor helps build the commercial case for further infrastructure investment and helps anchor Central Asian states more firmly in Western-facing trade networks. Progress on the corridor also sends a critical signal to investors: **that transport constraints are being addressed and that export pathways will be reliable by the time production comes online**.

The past year has demonstrated that political will and diplomatic engagement around U.S.-Central Asia critical minerals cooperation are strengthening. However, moving to production requires aligning investment, processing capacity, workforce development, infrastructure, and regional coordination into a system that can operate at commercial scale. Without this alignment, even the most promising projects risk remaining isolated successes rather than forming the foundation of durable partnerships and joint prosperity.

Copper Processing Plant No. 3 at the Almalyk Mining and Metallurgical Complex in Uzbekistan. Source: president.uz

Section 3

Kurtis Yan

Commercial Viability:

Developing Critical Minerals Supply Chains from Central Asia

Source: ZCMC

The creation of new alternative supply chains for the United States requires strong strategic coherence and a commitment to push forward with long time horizons. That said, this also requires that a source country fosters the proper conditions so that U.S. investment is commercially profitable. States like Kazakhstan and Uzbekistan have already made significant progress on legal frameworks and bureaucratic processes, so that Western companies more positively view the business environment.

In the minerals sector, **other important considerations typically revolve around profitability, return on investment, logistical feasibility, and complementary resources for mining operations**. To stand out amidst strong competition in the minerals sector, the Central Asian states need to coordinate with each other and with foreign actors. What follows are some essential steps to address current obstacles, attract further U.S. investment, and present a case for commercial viability.

Improving the Value-Add in Central Asia

In the eyes of U.S. investors, much of Central Asia's supply chain value is upstream. A lack of midstream capabilities limits the value of materials, because Russia and China typically control these processes that add value to outputs. This not only raises geopolitical implications for Central Asia's position between these two powers but also limits the region's current potential to integrate into a U.S.-focused supply chain that avoids Chinese involvement.

> *. . . processing and refining capabilities need to be present within the region or logistically aligned with an attractive alternative supply chain towards Western markets.*

To boost profits and attract foreign investment, Central Asian states should commit to adding value to their outputs within the region. In other words, processing and refining capabilities need to be present within the region or logistically aligned with an attractive alternative supply chain towards Western markets. The Cove Capital tungsten deal is a key example of co-location of midstream facilities at extraction sites, while Uzbekistan is ramping up its already existing copper refinement capacities. This approach must carry over to new projects, though the location of processing facilities should consider real constraints in electrical supplies and proximity to existing logistical infrastructure.

However, competition among Central Asian states can stifle opportunity to build logistical coherence. Each state possesses different mineral deposits, while some possess geographic advantages. Thus, the construction of processing facilities in the region should not be superfluous but rather strategic and complementary to existing logistical infrastructure and extraction sites. In April 2026, Kazakhstani and Uzbekistani officials agreed to create a regular working group to enhance minerals cooperation at government, private-sector, and academic levels. This initiative is one step in the right direction that can be bolstered with further regional integration.

Overcoming Geographic and Logistical Hurdles

Though strong progress with the Middle Corridor has improved connectivity, other efforts must be made to encourage private investment. The Middle Corridor's current capacities still face bottlenecks, infrastructural shortcomings, and an absence of customs harmonization across the Central Asian states. **Naturally, it proves more complex than routes from other alternative minerals source countries, many of which are not landlocked and can more simply and more cost-effectively deliver materials on**

shipping containers to the United States by sea. Low rail density in the region's expansive territory limits routes across which minerals can be transported, and the Caspian Sea's water levels are dropping, threatening the long-term viability of port infrastructure. And so, the commercial viability of future minerals projects deeply depends on further development of the Middle Corridor.

Few real alternatives remain in the region. The Northern Corridor from Kazakhstan through Russia was the most cost-effective variant to reach European markets before the Russia-Ukraine War re-erupted in 2022. Clouded with doubt for the foreseeable future, the Middle Corridor's efficiency and resilience becomes all the more important for the strategic interests of the United States and its allies. Meanwhile, alternate routes to the Indian Ocean through South Asia have yet to be realized. The Middle Corridor is also an essential tool to ensure the region's economic autonomy, both as a geopolitical symbol and an economic practicality. Near regions of geopolitical volatility, it represents the most practical East-West trade route that avoids political rivalry and the Russia-Ukraine War.

The Middle Corridor question provides a key opportunity to strengthen U.S.-Caspian

Map of the Planned TRIPP Corridor. Source: Caspian Policy Center

engagement. Though carrying a fraction of the Northern Corridor's total volume, its annual throughput is 6 million tons, which could be boosted by directed investment at reducing bottlenecks and delays. One positive indication of such focused engagement is **Kazakhstan's $4.2B order for Wabtec locomotives and future maintenance**. Heightened attention towards the TRIPP Corridor across the Caspian Sea in the South Caucasus and its strategic potential also indicates future potential growth in the Middle Corridor's utility for investors and logistical companies. In April 2026, the World Bank signed a deal with Türkiye to provide $2B for the development of its rail sections of the Middle Corridor, representing a continued push towards strengthening the connectivity through the South Caucasus.

Above all, **answering the logistics question becomes easier with a strategic push toward developing midstream mining processes**. The transit of raw materials, namely ores and unseparated rare earth elements (REE), requires higher transit costs due to higher volume and restrictions on the transit of potentially radioactive materials. However, the implementation of processing capabilities in the immediate region can reduce transit costs and complications. It also opens the potential to ship smaller end-products, like alloys and magnets, by air, significantly shortening shipping times and reducing reliance on the Middle Corridor. And so, processing provides dual benefits of adding value and of cutting inherent logistical costs to developing a full-fledged minerals supply chain.

Addressing Infrastructural Shortcomings and Resource Limitations

Third, addressing infrastructural limitations and resource constraints will require significant capital expenditures to improve investor confidence. Electrification is sparse in rural areas, and the absence of a consistent power supply can discourage investors from working in the region. Power-intensive processing facilities for minerals would require reliable energy supplies, most of which are located near urban population centers. Water resources for processing facilities are also at threat due to climate change and melting glaciers. As water resources become scarcer, competition may rise among the varying projects that Central Asian governments hope to take on, from minerals to AI development.

Much like the Middle Corridor, the time horizon to build up infrastructure is not misaligned with the launch of new mining projects, and the Central Asian states have already demonstrated a commitment to identifying and addressing these core issues. Initiatives to build infrastructure and better manage resources can attract capital, not only to their significance for the mining sector but also for broader civilian livelihoods.

Electrification efforts can either involve bilateral deals with specific states or Central Asian outreach to multilateral organizations, namely the World Bank, which aims to improve energy security across the region. Similarly, Japan has historically invested in renewable energy capabilities for the region to harness its high solar and wind potential. Meanwhile, Central Asian states participate in the Interstate Commission for Water Coordination (ICWC), which promotes managed use of the Syr and Amu Darya Basins, the Aral Sea, and other transboundary freshwater sources. Individual states have also invested separately as well as with international partners in the integration of water-saving agricultural practices and technologies.

> *The Cove Capital tungsten deal proved especially timely in increasing tungsten supply at a time when global prices are historically high and U.S. supply is delicate.*

Becoming Commercially Competitive: The Case for Central Asia

As noted, a pathway exists for the Caspian region to become an integral player in future supply chains that supplement U.S. strategic demands. Thus, the outstanding question remains of turning net-negatives not only into net-neutrals, but also into net-positives that convey attractive partnerships compared to strong alternative countries. After all, commercial viability by definition demands that competitors present a more compelling case than their counterparts.

Central Asia possesses the minerals that matter and that from which profits can be attained by pursuing investment in the region. **Market trends suggest that energy demands and energy transitions will occupy the largest share of future consumption of critical minerals**. Price volatility is a consistent hurdle that investors must overcome to ensure that they receive adequate returns on investment. In that regard, more production should focus on scaling-up corresponding minerals that are pursued selectively, while ensuring that the equivalent processing capabilities are in place. These minerals are typically easier to extract from raw ores than rare earths, and they require less capital and less resource-intensive processes to refine them.

Sizable reserves of uranium, copper, graphite, lithium, rare earth elements, and silver all would prove useful in not only following demand projections but also filling energy and technological gaps that the United States could be exposed to in the future. This exposure also exists in materials for strategic applications and defense, highlighting the overall significance of Central Asia's deposits of rare earths, tungsten, and alumina. The Cove Capital tungsten deal proved especially timely in increasing tungsten supply at a time

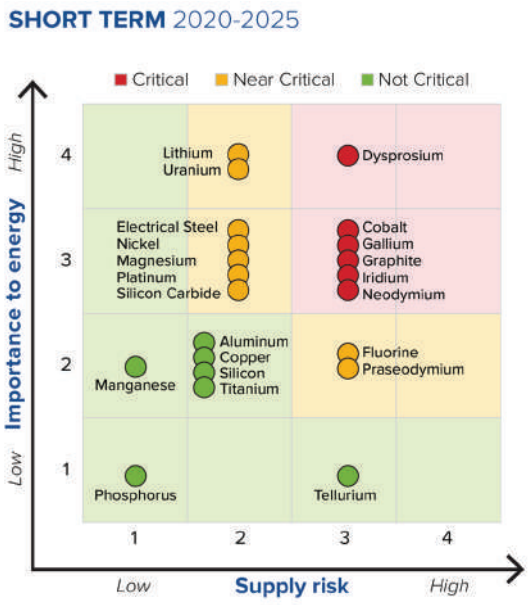


Figure 3.1 Short-term (2020–2025) criticality matrix

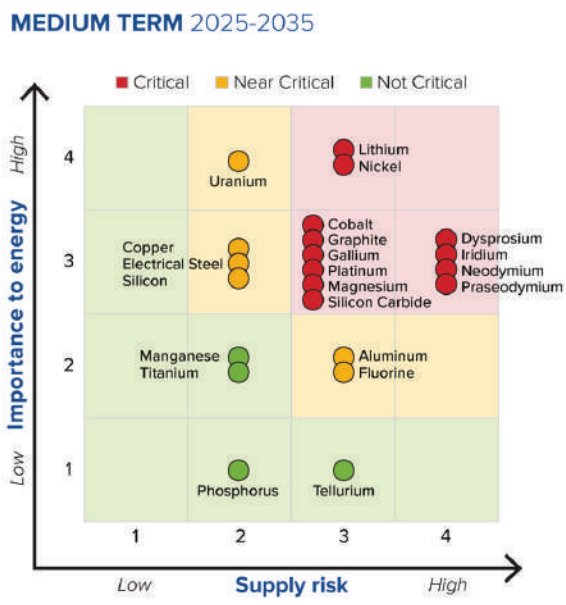


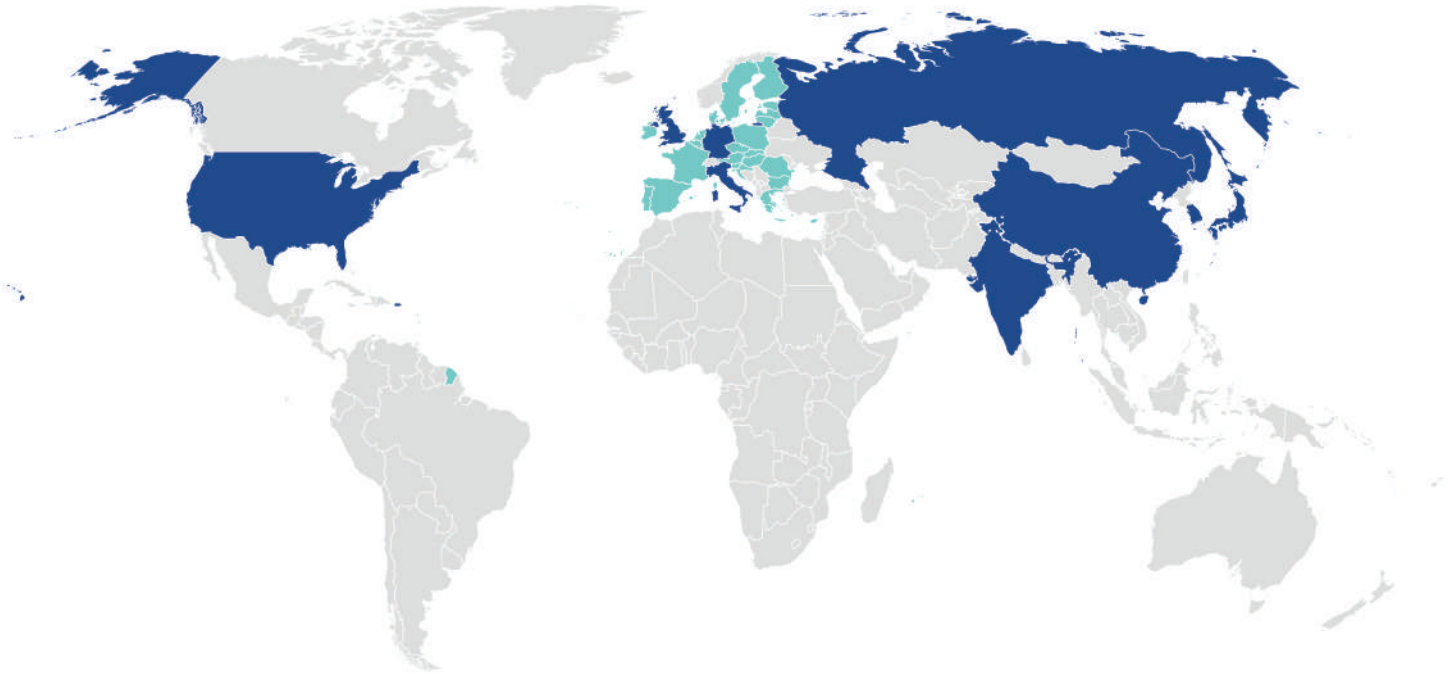
Figure 3.2 Medium-term (2025–2035) criticality matrix

Source: Department of Energy

when global prices are historically high and U.S. supply is delicate.

The uranium sector is especially strong in Central Asia, with Kazakhstan as the world's largest producer and Uzbekistan the sixth. **This existing industry could spearhead a deeper, longer-term strategy of U.S. investment into the region, especially considering the growing nuclear energy demands of Western countries**. Moreover, uranium is found in monazite—a critical ore that, when dissolved, produces rare earth elements. Technological innovation has also yielded new approaches to recovering REEs from uranium tailings.

Another convincing argument favoring Central Asia is its increasing success in attracting foreign direct investment from states beyond its traditional partners of Russia and China. The Gulf states frequently invest in the Middle Corridor and in Central Asia's infrastructure, while Japan and South Korea have frequently contributed to development and technological projects. The Tokyo Declaration confirms Japan's continued interest in cooperation with Central Asia, including its historical focus on transportation and minerals extraction. **More states, like the United Kingdom, are also becoming interested in raising cooperation through their own versions of C5+1 platforms at ministerial and heads-of-state levels**. Thus, a diverse array of states alongside the U.S. can funnel capital and facilitate U.S. engagement with lower risk while steering clear of geopolitical rivalries.



Map highlighting C5+ format partner countries. The EU, shown in lighter blue, has held a collective EU–Central Asia Summit, while individual European countries such as Italy and Germany, shown in darker blue, have held separate bilateral meetings.

Furthermore, Central Asia possesses a recognized extractive sector and a proven track record of attracting diverse capital. The region's extensive Soviet mining legacy produced many abandoned brownfield sites that could be used to restart projects with shorter time frames and without permitting constraints. However, much of this history as well as post-Soviet development has been dedicated to the extraction of oil, natural gas, coal, and selective minerals. Growing interest in the region's broader extractive sectors signals a potential inflection point for further diversification, and recent legal reforms in the mining sector demonstrate a key success in improving investor confidence. Therefore, part of the challenge inevitably becomes shifting government capital and societal interest from hydrocarbons to the minerals sector.

Section 3

Dr. Akbota Karibayeva Meyer

Mining for Talent:

Central Asia's Workforce Challenge in a Global Context

Source: KAZ Minerals

The global race to secure critical minerals has produced a paradox. Governments have designated mining a strategic priority, launched diplomatic campaigns to lock in supply chains, and pledged billions toward extraction and processing capacity. Yet one foundational constraint receives far less attention than the geology, the geopolitics, or the capital: there are not enough trained people to do the work.

Kazakhstan and Uzbekistan possess substantial critical minerals reserves and have signaled ambitions to move up the value chain toward processing and refining. Both have been actively pursuing partnerships with leading Western universities to build the technical workforce those ambitions require. But they face a structural inconsistency: **governments want to point to a strong workforce to attract investors, yet students will not flock to mining programs without a visible, established industry offering credible career paths**. Resolving this requires governments to artificially shift incentives, using policy tools to develop the high-skill workforce that industry needs before the market signals are strong enough to do so organically.

A Global Deficit

The workforce challenge is not unique to the region. The number of mining and mineral engineering programs in the United States has dropped from 25 in 1982 to 15 in 2023, with just 327 degrees awarded in 2020 – a 39% net drop since 2016. In 2023, U.S. universities across these 15 programs graduated only 312 mining engineers, but there will be an estimated 500 entry-level job openings annually over the next 10 years. China, by contrast, operates 45 mining engineering schools and graduates over 3,000 students annually. Saudi Arabia, working from near zero, is building out its mining workforce as part of its Vision 2030's push to make mining the third pillar of the national economy, alongside oil and petrochemicals. The proposed U.S. Mining Schools Act, which would fund recruitment and education grants for domestic mining schools, passed the Senate in July 2024, but was not enacted before the 118th Congress ended. Enrollment at some leading U.S. programs has reportedly begun to recover in recent years, but the trend is not sector-wide.

> ***The number of mining and mineral engineering programs in the United States has dropped from 25 in 1982 to 15 in 2023, with just 327 degrees awarded in 2020 — a 39% net drop since 2016.***

The global shortage complicates Central Asia's position in two ways. First, it limits the supply of credible Western technical partners available to engage in the region. A country that cannot train enough mining engineers for its own industry is constrained in its ability to staff partnerships and advisory projects abroad. Second, any world-class professionals trained in Kazakhstan or Uzbekistan will graduate into a global labor market actively competing for their skills—a retention dynamic not yet adequately reflected in regional policy.

Central Asia's Specific Gap

Kazakhstan has several institutions training mining and geosciences professionals, including Nazarbayev University's School of Mining and Geosciences (NU SMG), Satbayev University's Mining and Metallurgical Institute, Abylkas Saginov Karaganda Technical University's Mining Department, Semey Geological Prospecting College, and others. NU SMG, the sector's flagship program, reportedly produces roughly 50 petroleum engineers, 30 geoscientists, and 20 mining engineers annually, with a very limited PhD pipeline. Combined output across institutions remains far below government projections estimating demand for approximately 400 geologists per year alone.

Source: KATCO

The supply gap is compounded by a perception problem that turns out to be nearly universal. Students across Kazakhstan, Uzbekistan, the United States, and Europe often choose what they perceive as 'cleaner' and more 'lucrative' majors over mining. Petroleum engineering attracts stronger applicant pools, perceived as high-paying, technically sophisticated, and professionally respectable, which are perceptions built over decades of oil and gas visibility.

Mining triggers a different set of associations: physical danger, remote locations, coal dust. Surveys at U.S. universities confirm that students' first association with "mining" is still coal. That the sector now deploys autonomous systems, AI-assisted exploration, and advanced remote sensing has not translated into a coherent rebranding effort, either globally or in Central Asia.

The Research Gap

The hydrocarbons and minerals sectors also diverge structurally on research investment. Large international gas and oil corporations, with long-term operational presence in the region and direct incentives to develop local technical capacity, have historically funded university research and workforce development. The critical minerals sector does not yet have comparably large or sufficiently established players in Central Asia with the same resources and incentives to invest in education and staffing. Some early engagement exists: Kaz Minerals has reportedly directed roughly $2.3 million toward a phosphate tailing reprocessing and rare earth recovery pilot at NU SMG, and Kazatomprom, through its joint venture company KatCo, has supported geological modeling work for uranium deposit exploration. But scale is limited and continuity remains uneven.

The Partnershp Problem

Both Kazakhstan and Uzbekistan have been actively scoping partnerships with Western institutions, such as the Colorado School of Mines, through joint degree programs, research centers, and student mobility arrangements to fill gaps that domestic capacity cannot fill. **But Western universities cannot absorb upfront operational risk without financial guarantees**. Conditional scholarship commitments do not constitute guarantees, since they are contingent on recruiting students into programs that already struggle to attract applicants. For students from average Central Asian households, Western-quality technical education is unaffordable without government subsidies.

Case Study

Saudi Arabia's national mining company, Ma'aden, offers a working template. It reportedly funds scholarships for students to complete mining engineering degrees at leading U.S. institutions, with guaranteed employment and salary upon graduation. The employment guarantee is itself the recruitment mechanism, in that it makes mining study attractive by removing career uncertainty. Meanwhile, the upfront financial commitment gives university partners the revenue predictability to invest in operations. Kazakhstan's and Uzbekistan's governments and their state-owned enterprises have both the strategic motive and the fiscal capacity to structure comparable arrangements. The missing ingredient is institutional will to commit upfront rather than conditionally.

What Needs to Happen

Central Asia's critical minerals ambitions are real, and the resource base exists to support them. Closing the workforce gap requires three things: governments structuring educational partnership commitments with upfront financial guarantees; a coordinated industry-government-university effort to reframe mining as a high-technology, high-purpose career; and domestic labor market development with desirable salaries that incentivize trained professionals to stay. Workforce development is not a downstream problem to be addressed once investment arrives. It is a precondition for that investment that needs to be treated with the same urgency.

Section 3

Samuel Ruggio, Jake Vickers, and Christopher Zrazik

Closing the Midstream Gap:

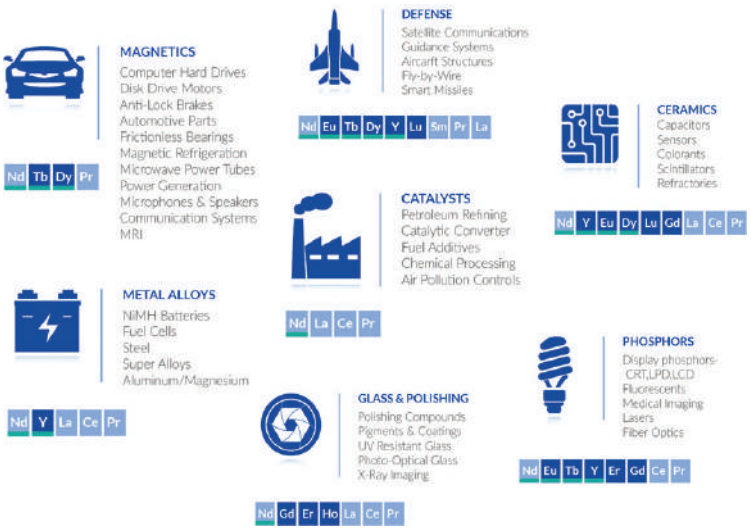
Realizing Central Asia's Potential for Rare Earth Processing

Source: KAZ Minerals

Central Asia has significant rare earth element (REE) deposits and growing strategic importance for U.S. efforts to counter Chinese and Russian influence. At the same time, the United States and its Western allies need more diverse, resilient REE supply chains - especially in REE processing, where China dominates. In this context, Central Asian countries are seeking to leverage their mineral resources for economic development and support more diverse Western mineral supply chains. However, developing commercially viable REE processing capacity in the region requires more than strong geologic potential. Key constraints include limited transportation infrastructure, energy and water availability, environmental impacts, and broader geopolitical dynamics. As a result, the United States and allied nations have so far prioritized REE project investments in other regions. While near-term prospects for REE processing in Central Asia remain limited, targeted policy frameworks could reduce these barriers and improve the region's competitiveness for future investment.

Geostrategic Implications of REEs' Role in the Global Economy

Overview of REEs— Rare earth elements (REE) are essential materials for the modern economy due to their unique physical and chemical properties. Although widely distributed in the Earth's crust, these 17 metallic elements are considered "rare" because they occur in low concentrations and share similar chemical characteristics, complicating their extraction and separation from mined ore. In this sense, REEs are not geologically rare but difficult to process into useful forms.

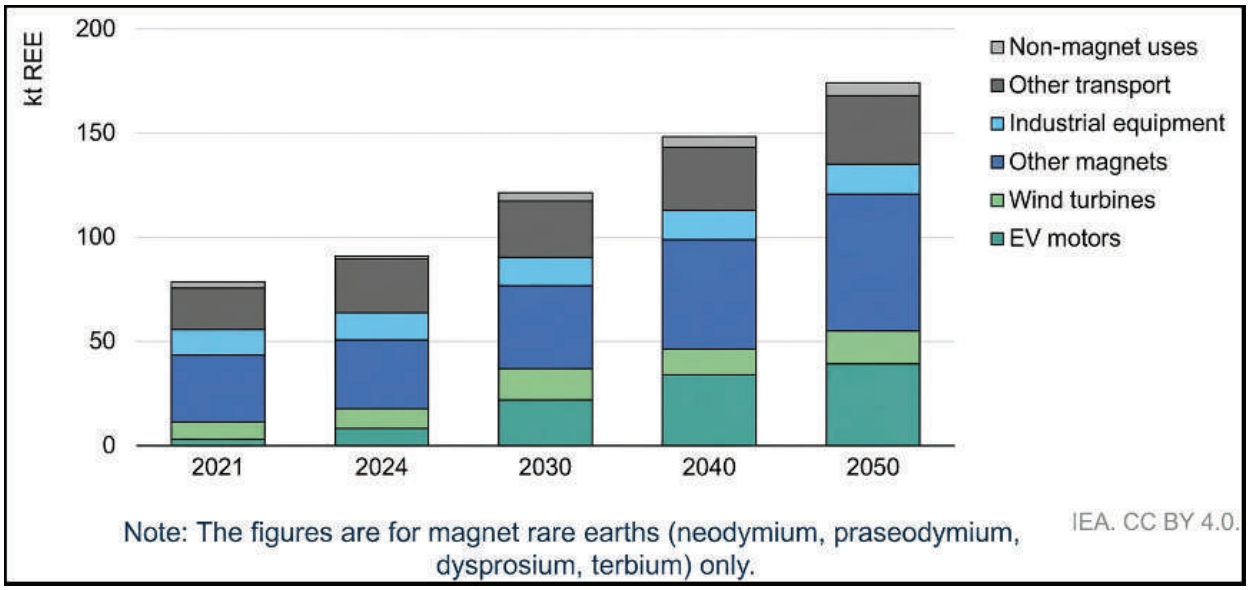


REEs Applications. Source: National Energy Technology Laboratory

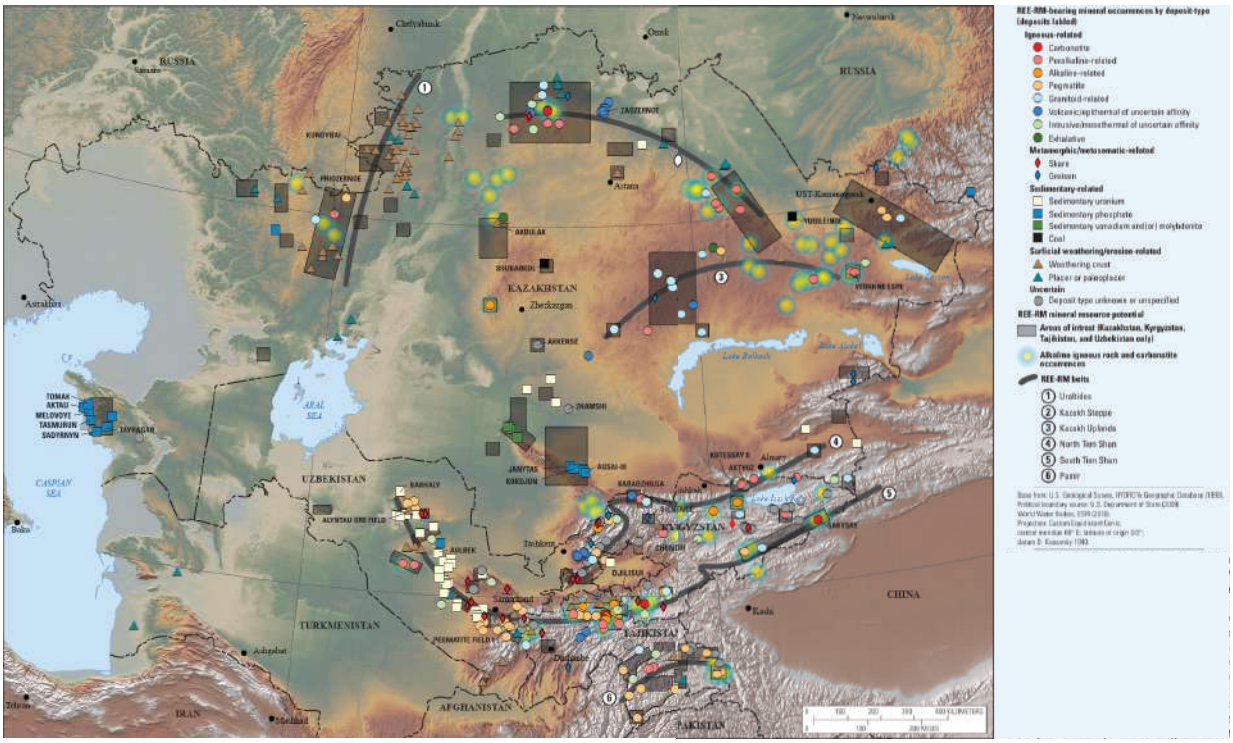
As a subset of critical minerals, REEs are essential for hundreds of end-uses that underpin the modern global economy. Key applications for these metals include defense systems, advanced electronics, and renewable energy technologies. The four REEs needed to make rare earth magnets - **neodymium (Nd), praseodymium (Pr), dysprosium (Dy), and terbium (Tb)** - are especially critical in the global value chain. **Although these four magnet REEs only make up 50% of global market volume, they account for 96% of the total market value across the supply chain**, given rare earth magnets' key role in high-tech applications.

Global demand for these four magnet REEs has already doubled since 2015 and is expected to grow rapidly through 2050, driven by the expansion of renewable energy, rising defense spending, and increased manufacturing of advanced technologies.

China's Dominance and Negative Actions with Supply Chain Dependence— China maintains a near-monopoly across the global REE supply chain, accounting for 70% of mining, 90% of separation and processing, and 93% of magnet manufacturing. Moreover, China has a record of utilizing its supply chain dominance as a political weapon. Chinese-affiliated companies inject excess supply into the market, which can drive down prices to uneconomic levels in other countries and force mining operations to cease. Conversely, prices surge when China imposes export restrictions and tightens supplies, as seen over the last year. What China's monopolistic grip shows is that the United States



Global Magnet REE Demand by Sector. Source: International Energy Agency



REE-Bearing Mineral Deposits and Areas of Interest for Mineral Exploration. Source: USGS

and its allied partners must continue to diversify their supply chains.

The Central Asian REE Landscape: Reserves, Records, and Reforms

Central Asia holds promising but largely undeveloped deposits, particularly in the Tien Shan and Pamir Mountain regions. In 2018, the U.S. Geological Survey, working with regional geoscientists and governments, identified these deposits and highlighted several areas for further REE exploration.

Kazakhstan and Uzbekistan are leading regional efforts to reform their mining sectors and attract foreign investment. In 2023, Kazakhstan launched a comprehensive plan to develop its REE industry, including expanding exploration, increasing transparency of reserve data, strengthening regulatory frameworks, modernizing existing infrastructure, developing new mines, and adopting advanced processing technologies. Similarly, Uzbekistan's 2025 subsoil legislation streamlines licensing, allows mining permits to serve as collateral, and improves access to geological data.

Critical Factors for Developing REE Processing in Central Asia

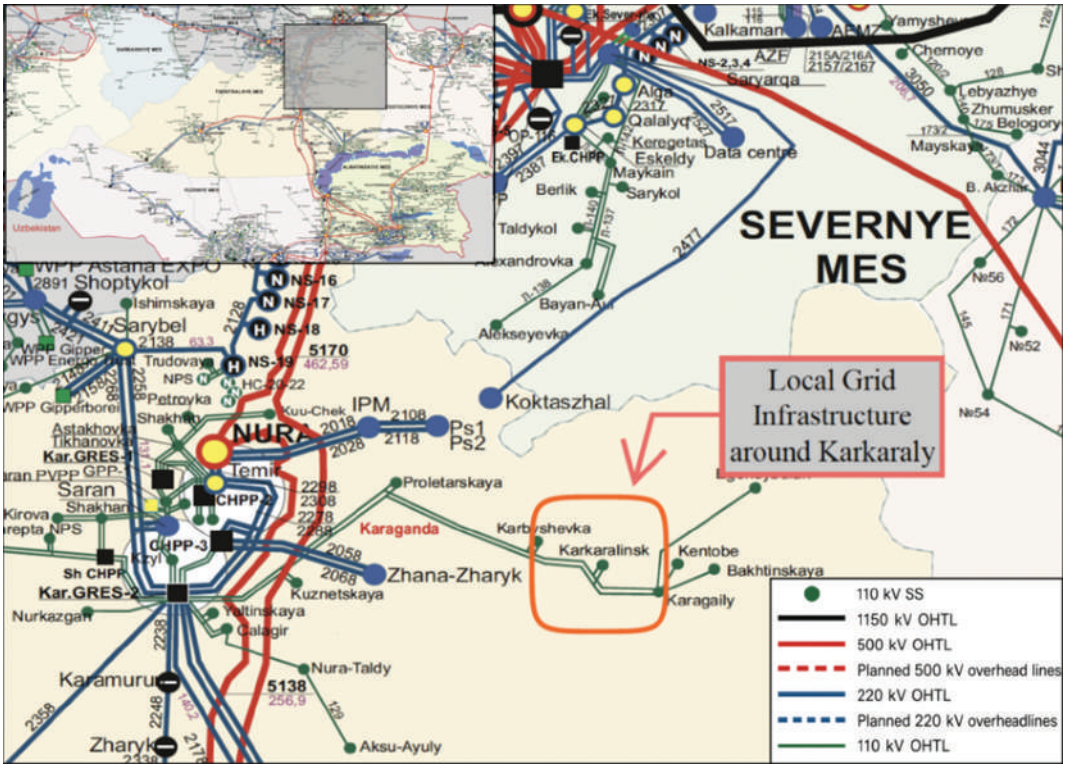
Transportation Routes— Since Moscow's full-scale invasion of Ukraine in 2022, the Middle Corridor has gained renewed attention as an alternative to the Northern Route through Russia. Once the fastest path to Europe, use of the Northern Route has dropped sharply since the invasion, with shipping volumes falling 51% in 2023 compared to 2022. Increased investment in the Middle Corridor has followed. The European Union announced €12 billion in 2025 to enhance infrastructure, critical raw materials, and energy security across Central Asia. In June 2024, South Korea announced the K-Silk Road, with the five Central Asian nations playing key roles. At its heads-of-state summit with Central Asia in 2025, Japan announced the Tokyo Declaration, which lays out a framework for clean energy development, connectivity for the Middle Corridor, and $19 billion in public and private investments.

Despite the route's potential and significant investments, the Middle Corridor still faces financial and logistical hurdles. A May 2023 survey among corridor operators identified cost as the primary barrier to investment and increased usage. Delays are experienced at nearly all border crossings due to outdated technology and bureaucratic structures, insufficient capacity, and locomotive delays. The Middle Corridor also lacks effective cargo tracking and regulatory harmonization.

Energy Needs for REE Mining and Processing Facilities— REE mining and processing both require affordable and reliable energy, but they have vastly different energy profiles.

Processing is far more energy-intensive, requiring roughly 9-13 times more energy than mining and, therefore, depends on nearby grid infrastructure for economic viability. Mining operations, by contrast, can remain viable in remote areas using off-grid energy sources such as diesel generators, though at higher cost. As a result, energy-intensive processing facilities, like aluminum smelters, are typically located near robust, low-cost grid power.

For instance, a prospective mining project at the Kuirektykol deposit in Kazakhstan's Karaganda region, where 28.2 million tons of rare earth-bearing ore have been identified, may not encounter significant energy limitations. This project could likely proceed with access to local grid infrastructure around Karkaraly or rely on decentralized energy, if needed, despite its higher cost. However, developing economically viable processing capacity on-site or nearby would require substantial grid infrastructure. Even if interconnection to the local power sources was feasible, it is likely that the existing grid infrastructure would need costly upgrades to handle the additional demand.



Local Grid Infrastructure Near Identified Kuirektykol REE Deposit. Source: Kazakhstan Electricity Grid Operating Company

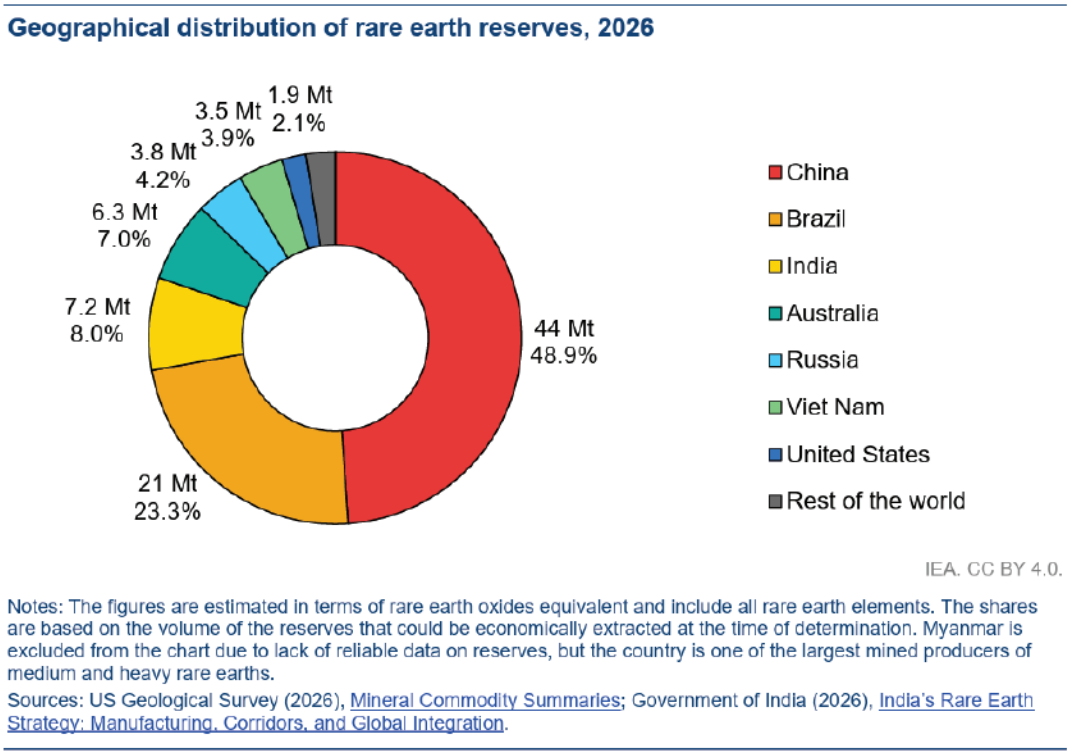
More broadly, Central Asia faces a structural energy challenge for REE processing: a geographic mismatch between mineral resources and electrical infrastructure. Identified rare earth deposits typically exist in remote, mountainous areas (see Figure 4 above), where grid capacity is limited or absent entirely. Where grid infrastructure does exist, it is often decades-old and outdated across the region. 70% of Soviet-era power plants and other grid equipment have reached the end of their useful life and 60% of distribution networks require repair or replacement. Inefficient electricity pricing in the region further complicates this challenge by discouraging the grid upgrades necessary to bridge this infrastructure gap. As a result, co-locating processing facilities with mining operations is currently impractical. The significant cost of building sufficient energy infrastructure in remote areas would likely outweigh any efficiency gains from closer proximity to the mineral feedstock.

Water Security and Associated Environmental Risks— REE processing demands significant water resources, yet Central Asia already faces acute water scarcity that is expected to worsen as reduced glacier melt in the Tien Shan and Pamir Mountains reduces flows into the Amu Darya and v Darya rivers. Although governments have pursued policies to better manage irrigation, modernize canals, and promote regional cooperation, these efforts cannot fully replace declining glacial runoff.

Intensive water use for agriculture, a major industry in the region, intensifies pressure on limited supplies. More broadly, Central Asian states rank among the world's highest in per capita water consumption. Low water prices of $0.10 to $0.15 per cubic meter across Central Asia also discourage efficient water use and infrastructure investment. For comparison, water costs about $0.49 per cubic meter in Russia and several dollars per cubic meters in some developed countries. Despite the need for water subsidy reductions, price increases, and investments to support more efficient water infrastructure, higher prices risk worsening socioeconomic conditions for the region's population.

REE extraction and processing also produce negative environmental impacts that could pollute water resources. Each ton of rare earths produced generates 13 kilograms of dust, 9,600 to 12,000 cubic meters of waste gas, 75 cubic meters of wastewater, and one ton of radioactive residue. REE projects therefore risk increasing water contamination in a region that is already water scarce.

Alternative Countries as REE Sources— There are other options for risk-averse investors dissuaded by the geostrategic environment of Central Asia. Australia hosts the most mature REE industry outside of China and the United States, while Brazil, India, and Greenland also possess substantial REE reserves and emerging potential to develop



Geographical Distribution of REE Reserves in 2026. Source: International Energy Agency

processing capacity. Australia alone has 89 active rare earth exploration projects, compared to 18 in Canada and 13 in Brazil. In March 2025, Australian firm Lynas Rare Earths became the first company outside China to produce commercial quantities of dysprosium oxide at its processing facility in Malaysia, using feedstock from Western Australia. The United States and Australia also signed agreements for ownership stakes in Australian REE projects to strengthen supply chain resilience. Meanwhile, Brazil holds the world's second largest REE reserves, and the U.S. Development Finance Corporation has committed $565 million for heavy and light rare earth extraction. In Greenland, the Tanbreez deposit has attracted EXIM Bank financing and is strategically notable, given its location within the NATO sphere and the government's exclusion of Chinese investors.

Saudi Arabia has also been proposed as an REE mining and processing hub. In 2025, MP Materials signed a MOU with Saudi Arabia's Maaden mining company to develop a domestic REE supply chain. Backed by Saudi Arabia's Public Investment Fund, this effort would provide the United States with an allied-nation option positioned closer to REE deposits in Asia and Africa. One focal point of this effort is the Jabal Sayid mine, believed to host a prospective large deposit of heavy rare earths.

Conclusion / Policy Recommendations

Despite the current challenges of developing REE processing capacity in Central Asia, the region holds strong mineral potential and strategic importance to U.S. foreign policy. Potential policy frameworks to support the region's integration into Western mineral supply chains include:

- **The development of a regional processing hub**. Pooling intra-regional resources to develop REE processing facilities would reduce infrastructure costs, streamline regulation, and capture economies of scale, while attracting foreign investment and building technical expertise.

- **Expanded funding for U.S. R&D on advanced REE processing technologies**. Innovations that reduce energy use, water consumption, and environmental impacts would improve efficiency and make new processing hubs more viable.

- **Scaled up financing for REE projects in the region**. The U.S. DFC and EXIM Bank should leverage existing momentum to support development and reduce reliance on China-dominated supply chains.

- **Appoint critical minerals czars and post technical experts abroad**. The State Department should appoint czars within the six geographic bureaus, including the Bureau of South and Central Asian Affairs. State should also train and assign technical experts to select diplomatic posts. These initiatives will further elevate critical minerals policy by giving private-sector actors and foreign governments clear points of contact to engage.

Section 4
Conclusions, Policy Paths, and Strategic Recommendations

CPC CASPIAN POLICY CENTER

Section 4

Dr. Akbota Karibayeva Meyer

Building Investor Confidence:

The Need for Capital and Coherence

Railcars loaded with ores at the Muruntau mine in Uzbekistan. Source: NMMC

The sections of this report unpacked state-level, regional, and international dynamics in greater depth. They examined how U.S. and European policy has evolved over the past year, what tools are being deployed and which remain underused, and what the supply chain question, from mine to market, actually looks like for the specific minerals most likely to underpin a durable diversification strategy. These realities will determine whether the momentum of 2025 becomes the foundation of a lasting strategic shift, or a set of promising one-off deals that never quite coalesce into a system. However, they also illustrate the need to strategically deploy large-scale capital to strengthen investor confidence in the face of market unpredictability.

The Market Paradox: Politically Critical, Commercially Uncertain

The foundational problem tends to get obscured by the "urgency" framing: the critical minerals sector, despite its geopolitical salience, is a relatively small and economically uncertain industry. The global critical minerals market is estimated at roughly $325 billion – not even a tenth of the $3.5 trillion global oil and gas trade. That scale matters because it shapes the commercial logic that ultimately drives investment decisions.

> *. . .critical minerals markets are characterized by high capital requirements, price volatility, long development timelines, and uncertainty about future mineral-specific demand.*

Unlike oil, where demand is massive, price signals are relatively legible, and where the global trade infrastructure is mature, critical minerals markets are characterized by high capital requirements, price volatility, long development timelines, and uncertainty about future mineral-specific demand. A new mine agreed upon today will not produce at scale for well over a decade. By that time, the specific minerals it targets could have been partially displaced by substitutes, reduced in demand by recycling advances, or repriced by unexpected shifts in technology or geopolitics. Thus, investors are being asked to commit enormous capital to projects whose output might face structurally diminished demand by the time they reach production.

This uncertainty is not hypothetical. The U.S. Department of Energy's own critical minerals program is explicitly organized around three research directions: producing more, wasting less, and using less – meaning that even as Washington sends strong demand signals for mineral procurement, researchers are simultaneously working to develop substitutes, improve recycling efficiency, and reduce the intensity of critical mineral use in key technologies. Meanwhile, the urgency emanating from the U.S. Department of War is more a function of its vulnerability to small disruptions rather than the absolute scale of its demand. Defense applications account for a relatively small share of total critical mineral consumption.

Pushing Past Uncertainty

All of this points to a clear conclusion: market forces alone will not mobilize the investment required at the necessary scale and speed. It is difficult for rational private investors to commit under such uncertainty without material government support. Public-private partnerships are, therefore, not just a policy option but also a real necessity. This includes tax incentives for exploration, concessional financing for processing infrastructure, offtake agreements that provide revenue certainty, and price floor mechanisms to mitigate volatility.

On the viability of price floors, there is a major structural obstacle: China currently controls 60-70% of global rare earth mine production and over 90% of separation and processing capacity. Since China is also the dominant consumer of intermediate rare earth products, its scale of market influence ensures that processing and offtake decisions

gravitate to its supply chains. Changing that equation requires not just American engagement, but the kind of coordinated plurilateral effort that can credibly anchor enough collective demand to sustain alternative supply chains and support viable price floors.

The policy consensus is already established: diversifying critical minerals supply chains away from China is a strategic imperative for the United States, and Central Asia is a promising alternative supplier. Central Asia holds significant reserves of strategic importance for modern defense, energy, and electronics systems, and stands ready to support global supply chain security. The question is no longer whether to engage. It is what engagement actually will require. Despite a year of immense diplomatic progress, the gap between political momentum and commercial reality remains. To promote coherence and alignment, the following section offers concrete policy recommendations grounded in commercial and institutional realities.

Section 4

Kurtis Yan
and Dr. Akbota Karibayeva Meyer

Policy Recommendations:

Operationalizing Cooperation on Critical Mineral Supply Chains

U.S. Special Envoy for South and Central Asia Sergio Gor with Officials from Central Asian states at the 2026 B5+1 Forum in Bishkek. Source: Center for International Private Enterprise

Central Asia can become an essential node integrated into broader efforts to diversify mineral supply chains away from China. Current hurdles can transform the region into an impactful global player in the minerals sector. This will require calculated coordination and investment by Central Asia, along with strategic coherence on the part of the United States, so that both parties can most efficiently align supply and demand with concrete action.

For the United States, investing in Central Asia provides an appealing opportunity to expand its circle of minerals partners, to counter China's monopoly on the market, and to further inject U.S. geostrategic influence into the region. Because the region's minerals industry is comparatively nascent and outside the typical U.S. orbit, it allows Washington to initiate long-term projects and to develop new and trusted partnerships in the zero-sum calculus of critical minerals.

Policy Options for Central Asia

1. Establish a C5 minerals platform to coordinate mineral extraction and processing efforts— Current minerals discussions take place in regional platforms that involve external partner countries, such as the C5+1 minerals dialogue. States also hold bilateral meetings to develop mineral projects, but a comprehensive regional platform would allow for opportunities for integration and coordinated action. This platform should involve the ministries of industry and construction, ministries of ecology, representatives from state-owned enterprises (SOE), and academic researchers in the field of geology. These specialized ministries would meet regularly at different levels. Together, they would work to address critical mining questions related to financing, logistics, construction, and energy. Namely, they should discuss which minerals and which projects to strategically invest in depending on profitability and global demand trends. This platform should also consider questions about electricity and water use. These are not only potential areas of concern for mining operations, but also avenues for collaboration with foreign partners and international organizations that can be addressed through the platform.

2. Fund early-stage exploration and create pathways for private enterprise to enter the market— Investors typically consider the earliest stages the riskiest parts of the mining process. Geological exploration could fail to uncover lucrative deposits, and feasibility tests could also yield poor results. As such, private companies risk that their millions in capital expenditures will fail to produce investment returns. In a region like Central Asia, it is crucial to improve the conditions under which these tests will be conducted. Governments could directly fund exploration in their jurisdictions to build the evidentiary base to attract private follow-on investment. To further incentivize capital commitments before any revenue flows, governments could introduce exploration-stage tax incentives, such as value-added tax (VAT) refunds on drilling inputs and tax holidays until a defined production threshold is reached.

Alongside direct public investment, governments could create a dedicated framework for junior mining companies that would represent a low-cost mechanism to extend geographic coverage without governments bearing all the risk. This would mean designated exploration zones, streamlined licensing distinct from large-scale producer requirements, lighter reporting obligations, and cost-sharing arrangements for early-stage operators. This would also involve establishing a functioning public-license registry through which investors could identify available areas, access associated data, and submit applications independently.

3. Digitize geological data and adopt international reporting standards— Central Asia's geological data remains incomplete, largely analog, and not reported in the standard international formats that investors require to make investment decisions. Governments should prioritize digitizing geological archives and mandating standards for all new tenders that conform to the Committee for Mineral Reserves International Reporting Standards, better known in the industry by its acronym, CRIRSCO. Without data in formats that international capital markets recognize, no investment decision can be made, regardless of a deposit's underlying quality.

Kazakhstan's existing KAZRC framework, developed specifically to bridge Soviet-era reporting and CRIRSCO standards, offers a practical regional template for adaptation rather than requiring each country to build from scratch. To be accessible and attractive to investors, digitization needs to produce openly accessible platforms and restricted internal archives. Several governments already hold partially digitized datasets that remain commercially inaccessible due to institutional gatekeeping. The goal is searchable, public-facing registries that allow investors to conduct independent due diligence. This is a relatively low-cost reform with outsized impact on investor confidence, and one that directly reinforces the case for a coordinated C5 approach to data infrastructure.

4. Increase workforce development investments as part of a broader minerals sector reframing strategy— Central Asia needs to channel financing and resources in order to build a workforce that can operate regional extraction and processing. Current geology departments at universities struggle to increase enrollment for programs dedicated to the study of minerals and geological engineering, and a lack of state funding for these academic departments conveys misalignment between stated priorities and financial backing. Governments need to provide adequate funding to enlarge mining cohorts, and when seeking partnerships with Western universities, they should present upfront financial commitments to reduce revenue uncertainty when entering a new market.

Government scholarships should also lay a security net for program graduates. The Saudi program of scholarship plus post-graduate employment guarantees provides an applicable example of how the region can boost confidence and youth interest in becoming part of the mining workforce. More importantly, this should accompany harmonized efforts by public- and private-sector actors to improve popular perceptions of the mining sector. This is crucial to placing interest on par with that of well-financed and lucrative hydrocarbon industry careers.

5. Continue to drive legal reforms and reduce government oversight of the private sector— Legal reforms to the mining code, such as the "first-come-first-served" provision, have created a more enticing business environment. Kazakhstan's 2017 SSU Code has yielded tangible results in attracting foreign investment. Similarly, Uzbekistan has moved aggressively since 2017, combining e-auctions with first-come-first-served access and guaranteeing free transfer of funds under its Law on Investments and Investment Activity – a level of capital repatriation clarity that other C5 states have yet to match.

The next step is replicating, enhancing, and building on these reforms across other jurisdictions. However, the fear of reform backsliding, with states expanding oversight roles, will remain until a track record of consistent and transparent implementation earns investor confidence. Kazakhstan's Astana International Financial Center, for instance, offers a regional model for dispute resolution. Its Court and International Arbitration Centre operate under English common law, providing an independent forum for mining-related disputes that reduces reliance on domestic courts. Judgments are enforceable in Kazakhstan and recognized in other common-law jurisdictions, a critical assurance for Western investors. Other C5 states would benefit by pursuing comparable mechanisms suited to their institutional contexts.

Signing of joint venture between U.S. company Cove Capital and Kazakh national mining company Tau-Ken Samruk during the 2025 C5+1 Summit in Washington, D.C. Source: Sk.kz

Policy Options for the United States

1. Establish clear project readiness benchmarks to build a bankable Central Asian deal pipeline— The U.S. government has deployed significant new capital authority through tools like EXIM's Supply Chain Resiliency Initiative that allows EXIM to lend to foreign projects without U.S. content requirements, provided offtake is directed to U.S. manufacturers. However, a structural gap persists between the availability of these tools and the pipeline of projects prepared to access them. U.S. embassy personnel, DFC, and EXIM representatives should be equipped to provide structured guidance to project sponsors on what lender-ready means in practice: committed equity sponsors in place before approaching a public lender, a project plan past the pilot stage, identified offtakers, skilled engineering and construction contractors, and permitting in process. A useful U.S. platform would fund an incubator to assist foreign projects in the development of lender-ready materials.

2. Increase government funding for research institutions and utilize a whole-of-society approach to promote study and work in the minerals sector— The United States should offer interested host countries innovative approaches to promote sustainability and limit negative consequences from mining and processing. While the U.S. mining workforce does possess these skills, it is simply stretched too thin, with too few specialists and university graduates. If the United States wants to improve the appeal of its mining initiatives and undercut Chinese practices, which are often cheaper yet less cautious to limit environmental damage, it must have sufficient personnel. To do this, it must increase funding for geology programs and create a whole-of-society initiative to improve public knowledge around the minerals sector.

There is no doubt that mining often is perceived negatively, given barriers to domestic projects and environmental risks. That said, vital materials that the United States and the world rely on originate from these projects, from renewable energy materials to defense applications. The best step forward is to encourage innovative voices to enter the field, particularly those interested in improving the efficiency, cleanliness, and diplomatic utility of the mining sector.

3. Position responsible mining standards as an additional U.S. value proposition— The United States cannot compete with China on price, processing scale, or speed of project execution. What U.S.-backed deals can offer that Chinese projects do not enjoy is a governance model with sustainability standards, water management expertise, corporate social responsibility frameworks, and supply chain traceability that downstream manufacturers and capital markets increasingly require. The U.S. government should

emphasize this in its engagement with Central Asian partners and actively fund the sharing of technical expertise alongside capital.

The well-documented contrast between U.S. and Chinese mining practices, known for poor labor conditions, environmental damage, limited job creation, and community grievances, is a diplomatic asset that should be deployed deliberately. Mining projects do not just have to carry benefits from returns on extraction or processing but should be paired with infrastructure and other projects that benefit local populations.

4. Invest in the Middle Corridor now to avoid bottlenecks and logistical issues, once minerals projects are operational— The Middle Corridor continues to grow in both appeal and in utility for the mining industry. The challenge is to transform that interest into real financing and the completion of ambitious projects, such as the TRIPP Corridor in the South Caucasus. Given the time horizon for mining projects, the Middle Corridor can become useful in ensuring that outputs from mining projects efficiently and cost-effectively transit across the region to Western markets. This needs to include not only improvements to physical infrastructure and electrification, but also the harmonization of customs procedures across the states and improved data transparency for cargo in transit. The U.S. Development Finance Corporation (DFC) could play a leading role in coordinating such infrastructural projects from start to finish. Investments in intraregional processing capacity should also be treated as part of the logistics solution. Shipping refined metal rather than bulk ore reduces volume and transit costs, and sidesteps unprocessed ore handling restrictions. Together, these improvements would add significantly to the commercial value of the corridor.

5. Work with other interested states to coordinate a Central Asia investment strategy, spearheaded by public-private partnerships, offtake agreements, and other de-risking efforts— Because mining projects require high capital expenditure numbers, the United States could field interest and cooperation from other interested states, per the Forum on Resource Geostrategic Engagement (FORGE) initiative. For instance, the G7 and its Partnership for Global Infrastructure and Investment (PGI) represents a premier financing tool to pool capital between the U.S. and its partners to invest in long-term projects and mitigate risk. Its investment into the Lobito Corridor of $6.7B is a key example to replicate collective action and a comprehensive development plan centered around mining ventures.

Joint ventures, consortia, and research exchanges are all key examples of how states can tackle upfront capital expenditures. Independently or in coordination with other states, DFC and EXIM Bank could establish additional, targeted public-private initiatives to

help private companies enter the region with confidence. The United States and other interested states should also utilize their authorities to enter joint ventures and secure long-term offtake agreements with private companies. This can counter fears of future price volatility and build investor confidence.

Appendix

CPC CASPIAN POLICY CENTER

Appendix Contents

CPC CASPIAN POLICY CENTER

Appendix

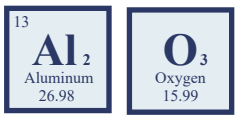
Relevant Critical Minerals:

Defining Critical Minerals and Key Minerals in the Caspian Region

Relevant Critical Minerals: Defining Critical Minerals and Key Minerals in the Caspian Region

What is a "critical" or "strategic" mineral?

While definitions often vary across U.S. government departments and agencies, the Energy Act of 2020 defines critical minerals as those that are "essential to the economic or national security of the United States; have a supply chain that is vulnerable to disruption; and serve an essential function in the manufacturing of a product." The following list highlights key minerals that the Caspian region can supply to the United States to help fill existing supply gaps.



Alumina (Al_2O_3) (Aluminum:13 Al, 26.982)

Alumina, refined from bauxite ore, is the primary intermediate material used in aluminum production and has applications in abrasives, ceramics, and refractory materials that are important for industrial manufacturing. According to the 2023 USGS Minerals Yearbook on Kazakhstan, the country ranked 12th globally in alumina production, accounting for approximately 0.9% of global alumina output, and 10th in bauxite production. Kazakhstan's Pavlodar aluminum refinery has historically been one of the region's primary alumina production facilities and is also a significant producer of byproduct gallium.

Antimony (51 Sb, 121.760)

Antimony is primarily used in flame retardants, alloys, semiconductors, and batteries, with applications in electronics, defense, and energy storage. According to the U.S. Geological Survey (USGS), Tajikistan is the world's second-largest producer of antimony after China, accounting for a quarter of global production in 2023. Kazakhstan also produces a significant quantity of antimony, while Kyrgyzstan produces a smaller amount but holds the 4th largest reserves in the world.

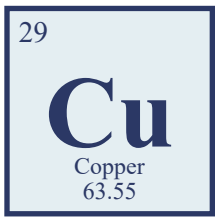
Barite (56 Ba, 137.327)

Barite is used in manufacturing paints, plastics, and rubber, as well as in medical applications like X-ray contrast media. It is also crucial to the oil and gas industry, used as a weighting agent to help control the pressure during drilling operations. Kazakhstan is a major producer of Barite, ranking 4th globally in 2023 according to USGS statistics. There is potential for growth in U.S. trade, given that, despite these high production levels, Kazakhstan was not listed by the USGS as a major Barite exporter to the United States. Additional reserves have also been identified in Georgia.

Relevant Critical Minerals

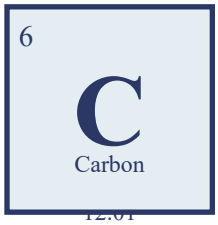
Chromium (24 Cr, 51.996)

Chromium is used in the production of stainless steel for critical infrastructure, such as military vehicles, aircraft, and naval ships. It also has key applications in producing chemical catalysts, as well as secure communication and electronics systems. Kazakhstan is tied as the second-largest producer but has the capacity to expand even further, holding the world's largest Chromium reserves, according to the USGS.



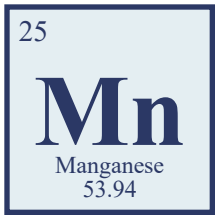
Copper (29 Cu, 63.546)

Copper is essential for electrical wiring, motors, heat exchangers, and is a foundational material in renewable energy infrastructure, electronics, and construction. According to USGS data, Kazakhstan ranked 11th in the world in both copper reserves and production in 2023, holding approximately 20 million metric tons in reserves and producing around 600,000 metric tons annually. Uzbekistan is also a notable producer through its mining and metallurgical complex, one of the largest copper operations in Central Asia, and has announced plans to significantly expand its output in coming years.



Graphite (6 C, 12.011)

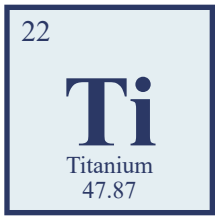
Pure graphite is a mineral form of the element Carbon (C). Graphite is a critical material used in lithium-ion battery anodes, lubricants, refractory linings, and steelmaking, with demand growing rapidly due to the global expansion of electric vehicles and energy storage systems. The USGS has conducted qualitative mineral resource assessments identifying amorphous graphite deposits in Uzbekistan, representing an additional source of untapped regional supply.



Manganese (25 Mn, 53.938)

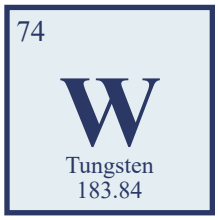
Manganese is essential in producing steel for military-grade armor, bridges, and railways, where it enhances strength and corrosion resistance. It is also used in lithium-ion batteries, electric vehicles, and chemical catalysts. Kazakhstan, Ukraine, and Georgia all produce significant amounts of manganese. World Bank estimates claim Kazakhstan holds the second-largest reserves of manganese ore, while Ukraine holds the fifth largest reserves of the metal, according to the USGS.

Relevant Critical Minerals



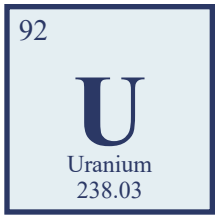
Titanium (22 Ti, 47.867)

Due to its high strength, low weight, and resistance to corrosion, titanium is widely used in aerospace, military, and medical applications. This includes the manufacturing of implants, aircraft parts, and desalination plants. Kazakhstan is a major producer of titanium. In 2023, the country was the 4th-largest producer of titanium sponge in the world and had the capacity to nearly double that production, according to USGS estimates. With the largest titanium reserves in Europe, Ukraine was also a major producer before Russia's full-scale invasion, ranked as the 5th largest producer in 2021.



Tungsten (74 W, 183.84)

Tungsten is primarily used to produce hard materials, like tungsten carbide, that are often used as industrial catalysts. The carbide's largest use is in metalworking, mining, and construction. Tungsten application also includes incandescent light bulb filaments, X-ray tubes, radiation shielding, armor-piercing ammunition, and other things. According to the USGS, Kazakhstan is the third largest tungsten producer in the world and is estimated to possess more than 10% of global reserves. Uzbekistan has known tungsten deposits that potentially could make the country the third-leading tungsten producer.



Uranium (92 U, 238.03)

Uranium is primarily used as fuel for nuclear power plants, which generate low-carbon electricity, and has applications in defense, medical imaging, and industrial processes. According to the USGS, Kazakhstan is the world's largest producer of uranium, accounting for approximately 40% of global mine supply, with reserves estimated at 990,000 metric tons as of 2023. Uzbekistan is likewise a major regional producer, ranking fifth globally with an output of approximately 3,300 metric tons in 2022, and seventh in the world in terms of identified reserves.

Relevant Critical Minerals

Zinc (30 Zn, 65.380)

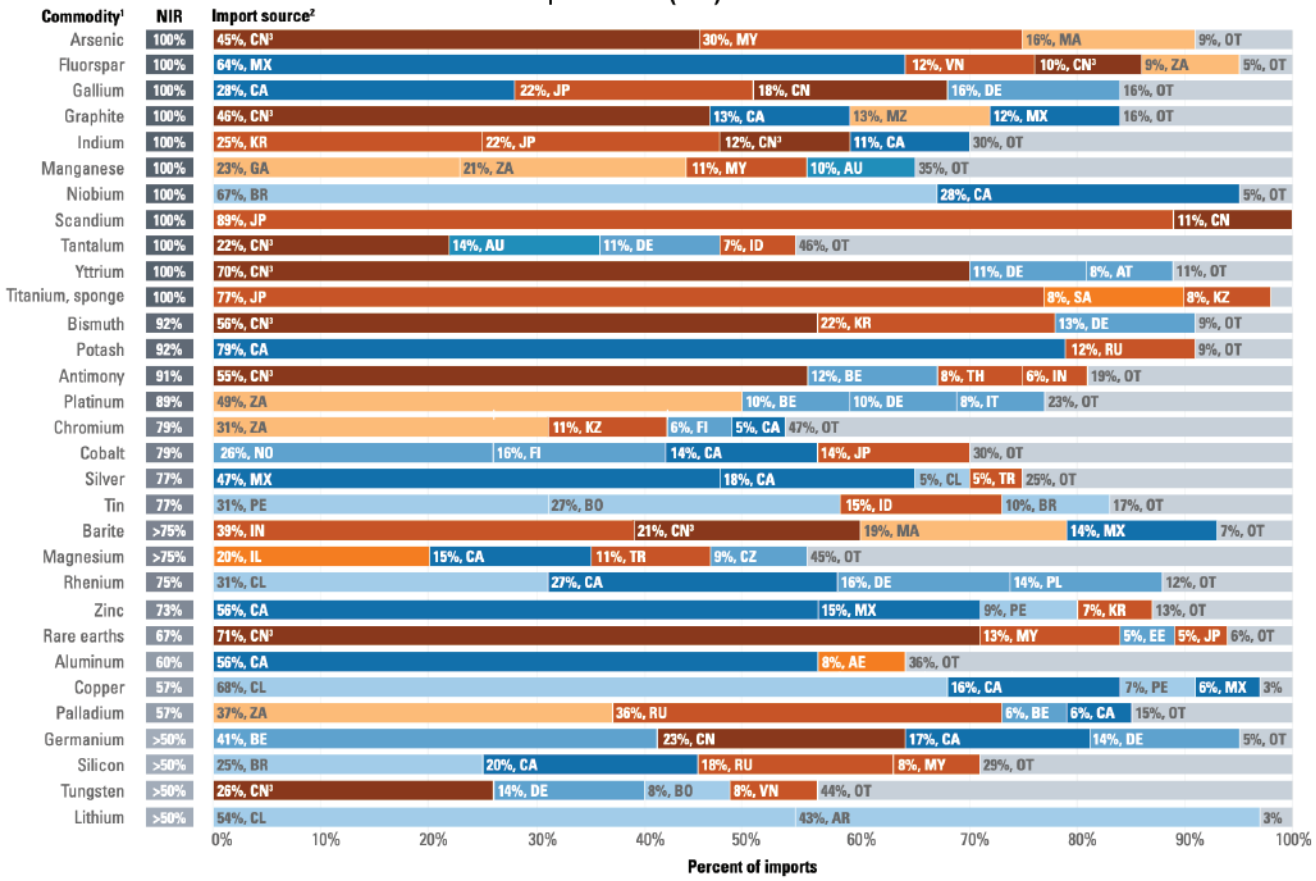
Zinc is widely used for galvanizing steel to prevent corrosion, as well as in batteries, alloys, and pharmaceuticals, making it a critical input for construction, automotive, and energy-storage industries. According to USGS statistics, Kazakhstan ranked 7th in the world in zinc production in 2023, contributing approximately 2.8% of global output, and holds the second-largest zinc reserves globally. The country's Kazzinc operations, headquartered in Oskemen, represent one of the largest integrated zinc production complexes in the world.

Rare Earth Elements

Rare earth elements are a group of 17 minerals with unique magnetic, optical, and catalytic properties often grouped together due to these similar properties and their prevalence in combined deposits. They are crucial to almost every advanced electronic device, used in smartphones, electric vehicles, wind turbines, and military equipment. In 2016, the USGS listed 384 rare earth and rare metal deposits across Central Asia. This included 160 in Kazakhstan, 87 in Uzbekistan, 75 in Kyrgyzstan, 60 in Tajikistan, and two in Turkmenistan. All of these countries have announced initiatives and measures to increase the identification and extraction of these deposits, resulting in a constant stream of new discoveries. For example, 15 new major deposits were identified in Tajikistan in early December.

U.S. Critical Mineral Import Reliance

Figure 3A.—Import Sources (2021–24) of Critical Minerals for Which the United States Was Greater Than 50% Net Import Reliant (NIR) in 2025



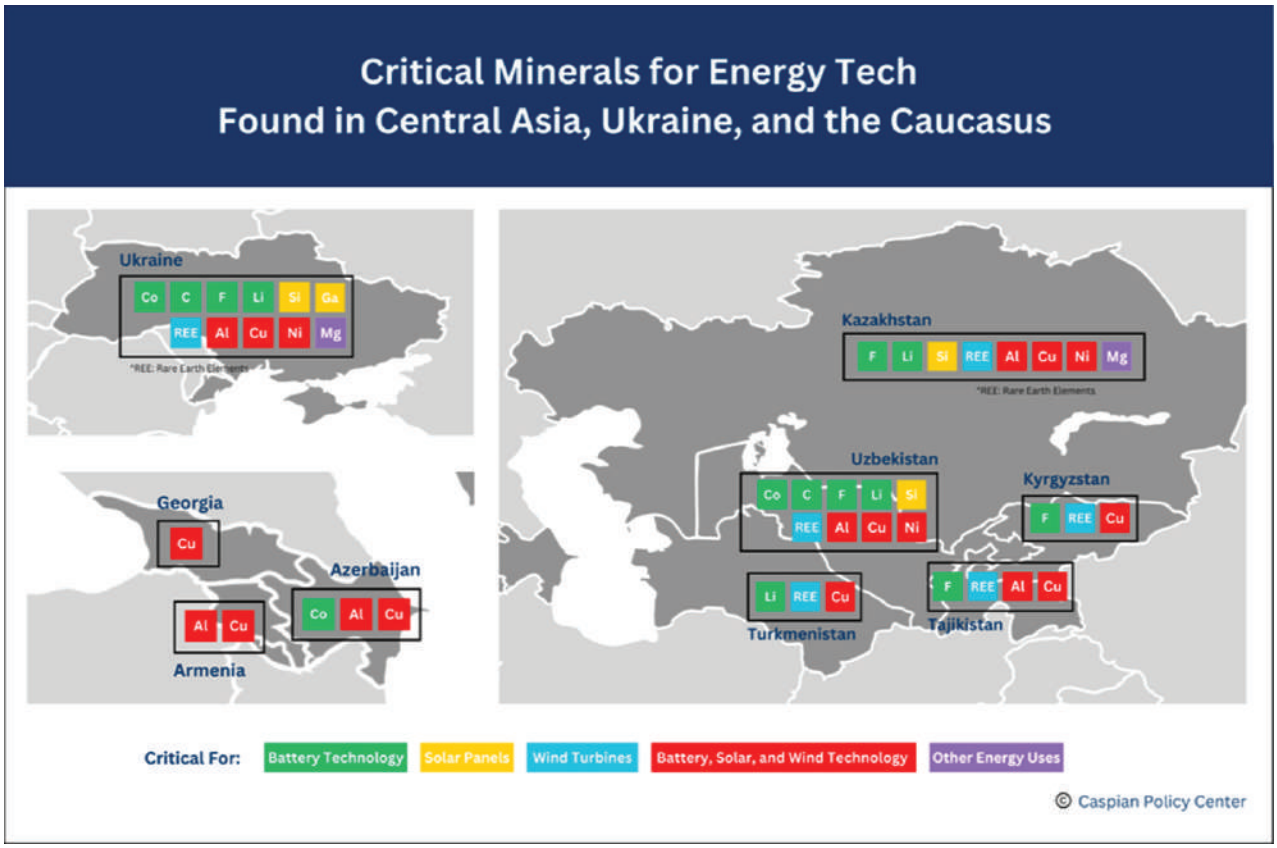
[1]Copper is limited to refined copper. Graphite is limited to natural graphite. Magnesium is limited to metal. Rare earths are limited to compounds and metals. Silicon includes ferrosilicon and silicon metal. Tin is limited to refined tin. Zinc is limited to refined zinc. Does not consider metallurgical coal or uranium; the U.S. Geological Survey does not collect data for these mineral commodities.
[2]AE, United Arab Emirates; AR, Argentina; AT, Austria; AU, Australia; BE, Belgium; BO, Bolivia; BR, Brazil; CA, Canada; CL, Chile; CN, China; CZ, Czechia; DE, Germany; EE, Estonia; FI, Finland; GA, Gabon; ID, Indonesia; IL, Israel; IN, India; IT, Italy; JP, Japan; KR, Republic of Korea; KZ, Kazakhstan; MA, Morocco; MG, Madagascar; MX, Mexico; MY, Malaysia; MZ, Mozambique; NO, Norway; OT, Other; PE, Peru; PL, Poland; RU, Russia; SA, Saudi Arabia; TH, Thailand; TR, Turkey; VN, Vietnam; ZA, South Africa.
[3]Includes Hong Kong.

Appendix

Joshua Bernard-Pearl

Green Energy Minerals:

Strategic Opportunities in Central Asia and the Caucasus



The critical minerals necessary to build green energy technologies like wind turbines, solar panels, and batteries can be found across Central Asia, Ukraine, and the South Caucasus

As the world accelerates toward a greener future, the demand for clean energy technologies is soaring. Solar panels, wind turbines, and advanced batteries are at the forefront of this transition, promising a sustainable and environmentally friendly energy landscape. However, realizing this future hinges not only on technological innovation but also on securing a steady supply of critical minerals essential for these technologies. The global supply chain for these minerals is under significant strain, driven by skyrocketing demand and a heavy reliance on China that is creating vulnerabilities and prompting an urgent search for alternative sources.

The Department of Energy's "Critical Materials for Energy List" identifies 18 materials (often called the "electric 18") that are essential to the green energy transition. Among these are 16 minerals. Four of these — terbium, dysprosium, praseodymium, and neodymium — belong to the broader category of Rare Earth Elements (REEs), which share unusual electrical and structural properties that make them especially valuable for industrial and technological applications. These minerals were designated "critical,"

based on both their importance to energy technologies and the high supply risks stemming largely from overdependence on China.

Three green energy technologies dominate the critical minerals conversation: photovoltaic cells to capture solar energy, wind turbines to harness wind energy, and batteries to store energy for use regardless of weather conditions. Aluminum, nickel, and copper are indispensable to all three. Aluminum and nickel form the alloys used in structural elements such as wind turbine blades and towers, battery casings, and solar panel frames, with aluminum making up over 85% of the components in solar panels alone. Copper, prized for its exceptional electrical conductivity, is found throughout internal wiring, battery current collectors, wind turbine generators, and solar panel heat exchangers. Kazakhstan stands out in this space as the 11th largest copper producer in the world, with Central Asia and the Caucasus more broadly offering abundant reserves of these three foundational minerals.

Battery technology is equally dependent on a specific set of critical minerals. Lithium-ion batteries, which are the dominant technology for energy storage and electric vehicles, rely on graphite anodes paired with copper current collectors, and cathodes made from lithium, cobalt, and nickel oxides on aluminum current collectors. Uzbekistan, Kazakhstan, and Azerbaijan all contain notable reserves of minerals critical to battery production, though these resources remain largely untapped. Developing these reserves is essential: without reliable, long-lasting batteries, any expansion of renewable energy generation will fall short of its potential. Unlocking the mineral wealth of these nations could be key to making a green future both attainable and affordable on a global scale.

REEs (neodymium, praseodymium, dysprosium, and terbium) are critical to manufacturing the powerful permanent magnets used in wind turbine generators. Uzbekistan, Kyrgyzstan, and Kazakhstan hold significant REE deposits, and growing concern over Chinese dominance in the sector has sparked renewed investment across the region. A notable example is a 2019 Uzbek-Korean partnership to establish the first regional center for the study of REE extraction. Given the high cost of extraction and processing technologies, foreign investment is crucial to develop a supply chain that is independent of China and capable of fueling wind energy expansion across the globe.

Silicon and gallium round out the list of minerals critical to solar energy infrastructure. Silicon serves as the semiconductor in 95% of all solar cells, while gallium enhances efficiency in more advanced models. Kazakhstan ranks as the 10th largest silicon producer in the world, making it a strategically important partner for solar energy development.

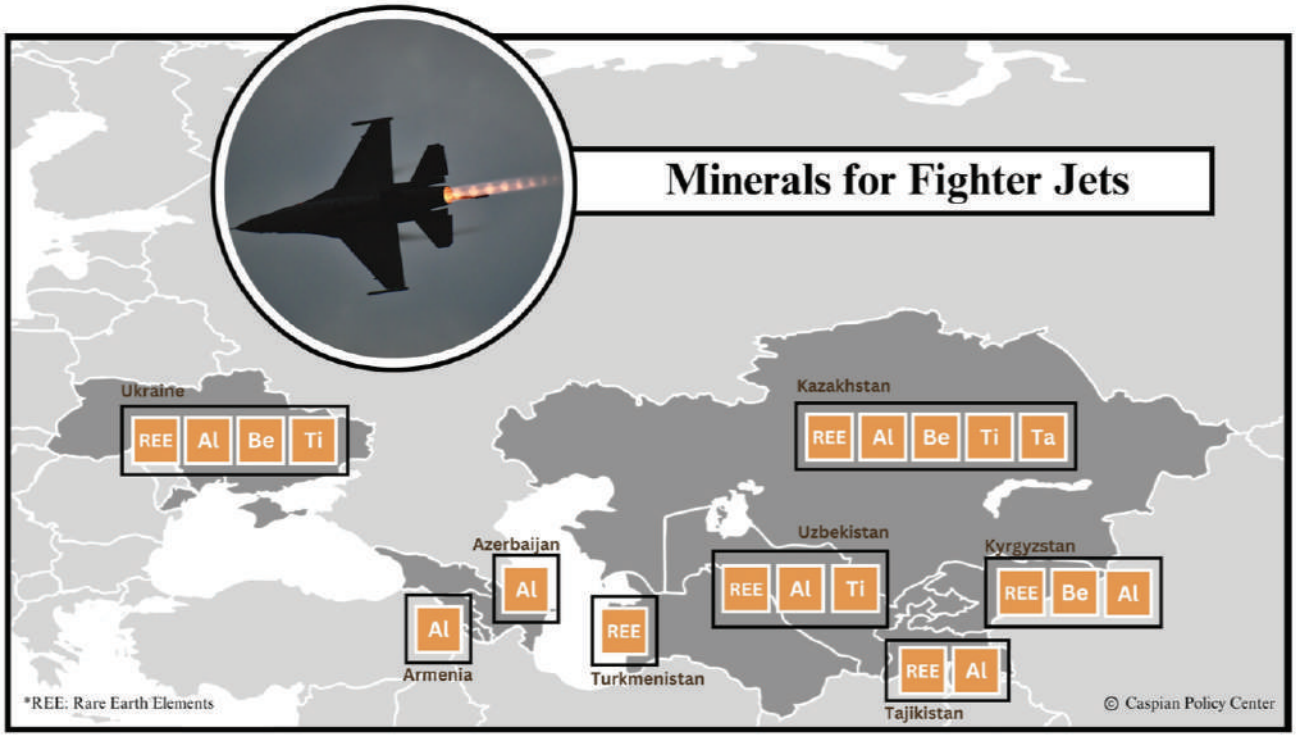
Despite these vast reserves, Central Asia and the Caucasus face real challenges in transportation and processing. The middle corridor is gaining investment as a westbound alternative to Russian-dependent routes, though refining capacity remains heavily tied to China. For Western nations, the path forward requires prioritizing investment in processing and refining infrastructure and not just extraction and shipping. This is crucial to truly unlock the region's mineral potential and build a resilient, diversified green energy supply chain.

Appendix

Joshua Bernard-Pearl

The Minerals That Make Our Military:

Defense Implications



The minerals necessary to produce US fighter jets can be found across the Caspian region in Ukraine, Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, Armenia, Azerbaijan, and Turkmenistan.

In the high-stakes world of defense technology, the United States faces a dangerous vulnerability: an overreliance on China for strategic minerals that form the backbone of national defense and economic resilience. As U.S. Secretary of Defense Lloyd Austin has stated, strategic and critical materials are vital to both national defense and economic prosperity, enabling the development and sustainment of emerging technologies. By leaning so heavily on China, America risks crippling its own security in the event of conflict.

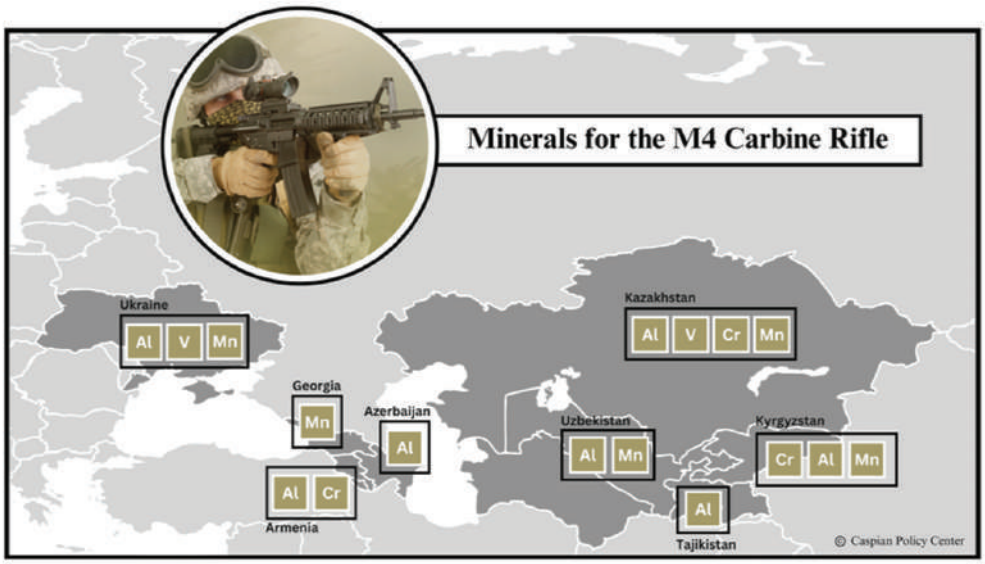
This reality has heightened U.S. interest in the relatively undeveloped strategic resources of Central Asia and the Caucasus. These regions are rich in essential materials that are critical for everything from night-vision goggles to precision-guided munitions. By pivoting to these sources, the United States could reduce its China dependency, fortify its supply chains, and develop new strategic partnerships. A robust minerals trade relationship with these regions would also serve a second U.S. defense interest: strengthening regional connectivity and economic independence from Russia, thereby

diminishing Russian global influence and advancing American soft power.

Advanced semiconductor chips are among the most critical components of modern military equipment, appearing in nearly every weapons system from drones to missiles to submarines. Russia's extreme efforts to import thousands of large appliances just to extract their chips and circumvent sanctions to secure semiconductors for its war underscores just how vital these components are. Producing these chips requires over 300 materials, with silicon, germanium, gallium, and arsenic among the most widely used. Kazakhstan is currently the 10th largest producer of silicon in the world, and reserves of germanium exist in Uzbekistan, though they remain unexploited. China has moved to restrict exports of both gallium and germanium, making alternative sources in Central Asia increasingly strategically important.

Semiconductor chips also rely on cobalt, palladium, and rare earth elements such as scandium, titanium, and fluorite. All of the listed have deposits within Central Asia and the Caucasus. Without a secure supply of these minerals, the massive investments the United States has made in domestic semiconductor manufacturing through initiatives like the chips and science act will ultimately fall short of their intended impact.

Beyond electronics, strategic minerals are equally essential to the mechanical components of advanced weapons systems. Rare earth elements are used in jet engine



The M4 Carbine Rifle is the standard service rifle across the U.S. Army. The minerals necessary to produce them can be found across the Caspian region in Ukraine, Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, Armenia, Azerbaijan, and Georgia.

manufacturing, aluminum makes up over 80% of most aircraft including the F-16, and titanium and beryllium are prized for their durability, heat resistance, and lightweight properties in aerospace applications. Uzbekistan, Kyrgyzstan, and Kazakhstan all hold substantial REE deposits and have launched initiatives to increase production over the past four years. In 2023, Kazakhstan ranked as the fourth-largest producer of titanium globally, producing approximately 16,000 metric tons annually. Kazakhstan is also a critical source of beryllium, home to one of only three beryllium production facilities in the world and responsible for 25% of the global supply. Aluminum reserves are abundant across nearly every country in Central Asia.

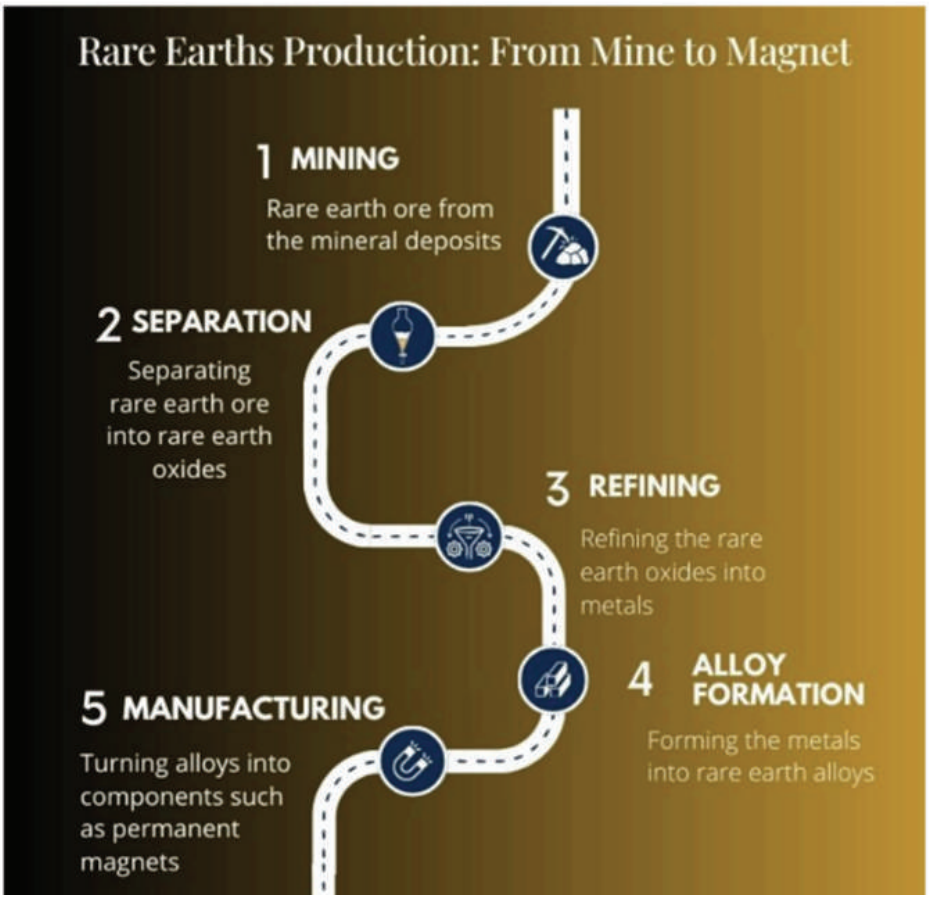
Strategic minerals are equally important at the individual soldier level. Nickel is used in body armor; aluminum, manganese, chromium, and vanadium go into the M4 Carbine rifle; and aluminum, gallium, arsenic, germanium, and various REEs are essential components of night-vision goggles. Kazakhstan is a dominant global producer of both chromium and manganese, ranking second in the world in chromium production, with 30% of global chromite reserves, and holding the second-largest manganese reserves at an estimated 600 million tons.

The strategic minerals landscape presents a clear opportunity for the United States to reshape its defense future. By investing in the mineral wealth of Central Asia and the Caucasus, America can secure its defense capabilities, reduce dependence on China, and reinforce its geopolitical influence through durable regional partnerships to safeguard the production of critical defense technology for decades to come.

Appendix

Samuel Ruggio, Jake Vickers, and Christopher Zrazik

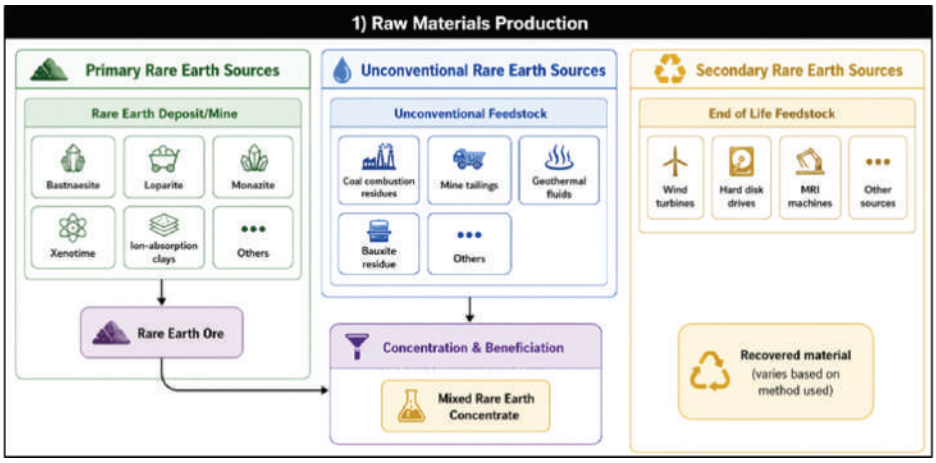
Mine-to-Magnet Supply Chain Mapping



Source: New Security Beat

Governments and corporations are prioritizing the development of more secure, resilient rare earth element (REE) supply chains due to the essential role these metals play in modern technologies and defense applications. The United States, for instance, is seeking to develop a REE supply chain that aims to integrate all of the production stages for rare earth magnets either domestically or in allied nations. This "mine-to-magnet" supply chain involves a sequence of stages, with each stage adding distinct forms of value as materials move downstream from mined ore to refined products.

While certain steps in the supply chain can differ slightly for certain mineral deposit types, the general process follows a consistent structure: (1) raw materials production, (2) beneficiation, (3) separation, (4) metal refining, (5) alloy making, and (6) manufacturing of permanent magnets. Below, we outline several stages of this mine-to-magnet supply chain including the mining, separation, and refining of REEs, followed by a brief



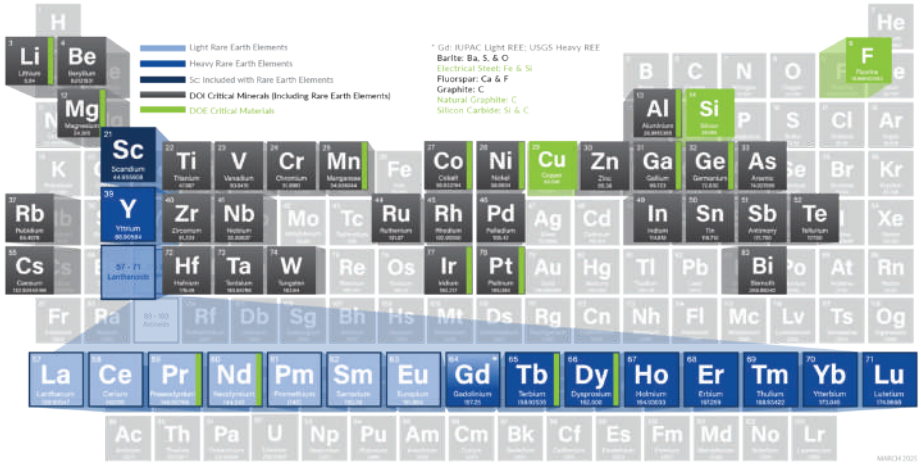
Source: U.S. Department of Energy

overview of the geographical demand for processed REEs to be used in magnet production.

Raw Materials Production and Beneficiation - REE Concentrate

The first stage of the REE supply chain involves the production of rare earth ore from mining. The mined ore is then milled and crushed to a smaller size before undergoing beneficiation to remove excess material and increase the concentration of REEs. A range of physical separation methods are used here to enhance the ore quality and facilitate the recovery of rare earth concentrate, typically including gravity, froth, and flotation separation. In contrast, ion-adsorption clay deposits undergo chemically-intensive beneficiation processes that require attritioning and scrubbing before subsequent leaching or ion-exchange treatment. While most REEs are currently sourced through mining, they can also be recovered and recycled from electronic waste (e.g., batteries, permanent magnets, and fluorescent lamps) and found in unconventional sources like coal fly ash or mine tailings (e.g., collecting REEs from uranium mine tailings).

REEs often occur together in mineral deposits due to their similar chemical properties and are commonly found alongside other mineral co-products. REEs can be further classified as light REEs (atomic numbers 57-63) or heavy REEs (atomic numbers 64-71), based on their atomic weight and chemical properties. Mineral deposit type determines their relative abundance: bastnaesite and monazite deposits are typically rich in light REEs, whereas ion-adsorption clays and xenotime deposits are more abundant in heavy REEs. Among the four REEs critical for rare earth magnets, neodymium (Nd) and praseodymium (Pr) are light REEs while dysprosium (Dy) and terbium (Tb) are heavy REEs.



Source: National Energy Technology Laboratory

Although REEs are found in many geological settings, the economic viability of mining and processing ore from a deposit depends on multiple factors, including available infrastructure at the deposit site, the specific REEs present in the deposit, and the presence of radioactive elements such as uranium or thorium, which can increase costs. Rare earth-bearing deposits are evaluated during their exploration by the total percentage of the deposit that can be produced as rare earth oxide, a refined form of REEs. REEs are typically traded in this oxide form. Some operations process mined ore into rare earth oxides on-site, while others produce intermediate rare earth concentrates for further processing. Importantly, ore grade alone does not determine viability: high-grade deposits may be difficult or costly to develop (e.g., ~8% grade ore at Mountain Pass, CA), while lower-grade deposits can be economically viable due to favorable geology or extraction conditions (e.g., 0.05% grade ore at some Chinese clay deposits).

Separation - Individual Rare Earth Oxides

Separation is the technical core of rare earth processing. This step involves the separation of individual REEs within concentrate to produce individual rare earth oxides. Solvent extraction is the dominant method used to separate REEs, with processes uniquely tailored to the composition of each ore body. Some ore types, for example, require high-temperature treatment with sulfuric acid or other reagents before separation even begins, adding additional cost and complexity. Separation occurs in large-scale solvent extraction systems, often involving hundreds of mixer-settler containers in large industrial spaces, that use multiple stages to isolate lighter REEs from heavier REEs, followed by further refinement. These systems are complex, capital-intensive, and require significant amounts of acid and water supplies. Wastewater treatment, solvent use, and energy demands are the prominent costs for these facilities. The process must also

manage radioactive byproducts such as uranium and thorium. Notably, traditional methods of solvent extraction create several environmental impacts, including the production of harmful toxic waste byproducts and water pollution. Solvent extraction processes are also energy-intensive, requiring accessible and affordable electricity to produce rare earth oxides at a competitive cost.

Efforts to develop novel REE separation technologies with lower environmental impacts and energy demands have gained momentum in recent years. Much of this ongoing research aims to reduce the chemical intensity and improve the efficiency of existing solvent extraction methods, while other areas focus on solvent recycling and alternative extraction methods. Some of these emerging, alternative technologies include advanced precipitation, crystallization, dissolution, and improved solvent extraction techniques. However, most of these novel approaches remain at an early development stage, and their successful application in a laboratory setting does not ensure economic viability when applied to an actual REE deposit. Scaling these technologies will require multistage testing and large-scale demonstrations before they can replace existing methods. Developing REE separation facilities in the near future will therefore likely require utilizing solvent extraction processes, whether in Central Asia or elsewhere.

Though solvent extraction is well understood in the mining industry for minerals beyond REEs, separating and processing REEs is generally more difficult due to the varying mineralogy and chemical composition of the feedstock. Given the difficulty and technical expertise associated with REE separations, the economic viability of this process often leads producers to discard REEs as waste or send concentrate overseas for processing. Until recently, the mine at Mountain Pass, California, for instance, has historically sent its concentrate to China for separation and processing. Meanwhile, clay deposits in south China with relatively low REE concentrations, ranging from 0.03 to 0.20 percent grade, become economically viable deposits partially because the REEs in these clay deposits are more easily extracted from the clays with weaker acids.

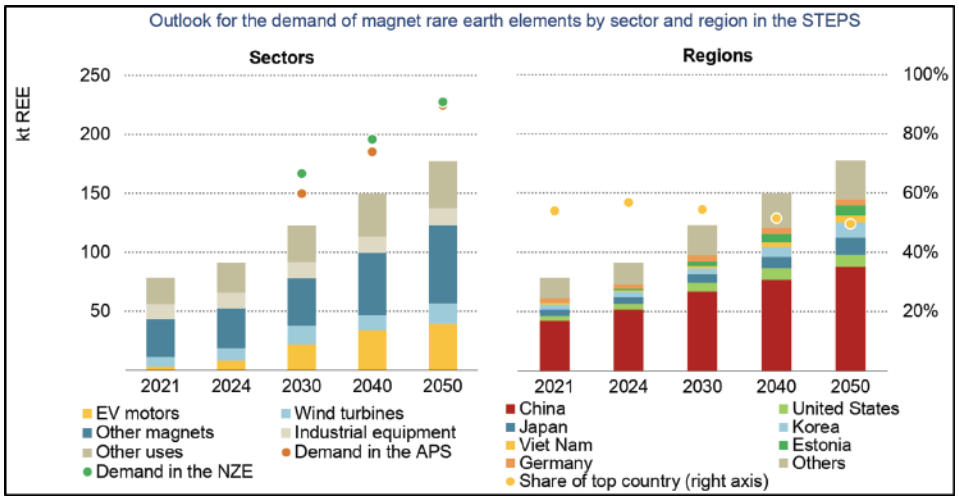
Refining - REE Metals

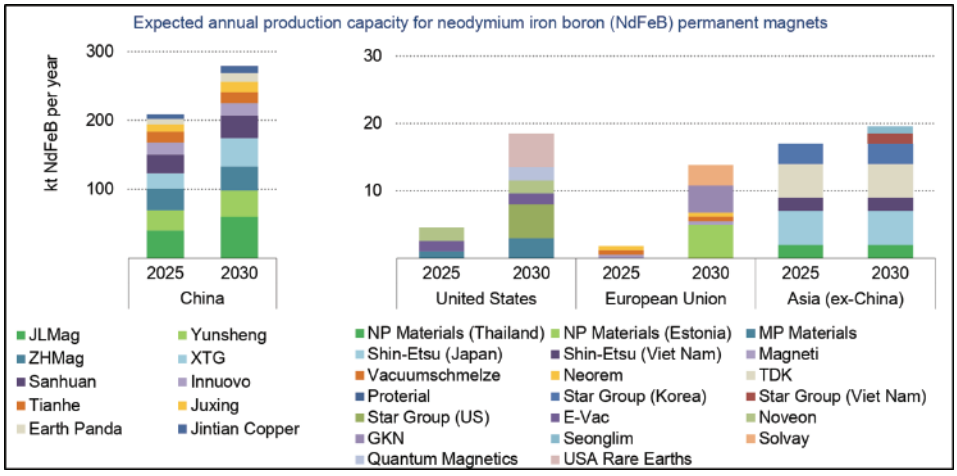
Rare earth oxides are then converted into metals before their use in downstream products. While separated REE oxides can be used in certain applications without further refining, magnetic or alloy applications require refined metallic forms of REEs. The most common processes for REE metal refining are molten-salt electrowinning and sodium reduction. These processes are capital-intensive, with electrolytes representing a significant share of upfront costs. Sodium reduction offers an alternative approach, using sodium metal to convert rare earth oxides into metals. However, it presents technical challenges, including handling moisture-sensitive materials, securing sodium inputs, and managing byproducts.

Downstream Manufacturing - Global Market for REE Magnets

Global demand for the four magnet REEs closely mirrors the China-concentrated supply landscape. In 2024, China accounted for more than 55 percent of global demand, reflecting its dominance in magnet manufacturing. IEA forecasts indicate that this trend will persist through 2050, driven largely by China's significant production of electric vehicles and wind turbines.

In response to recent geopolitical tensions and supply chain disruptions, several countries are accelerating efforts to build domestic magnet manufacturing capacity. However, these efforts remain far behind China's scale. In 2025, the combined annual rare earth magnet production capacity of the U.S., the EU, and the rest of Asia (excluding China) totaled roughly 24 kilotons, compared to more than 200 kilotons produced by China alone. While this gap is expected to narrow modestly as Western economies accelerate efforts to build capacity, China's position is likely to endure due to the tight integration between its rare earth magnet production and its clean energy industrial ecosystem.





Source: International Energy Agency

Appendix

Who's Got What:

A Mineral Deposit Guide

Armenia

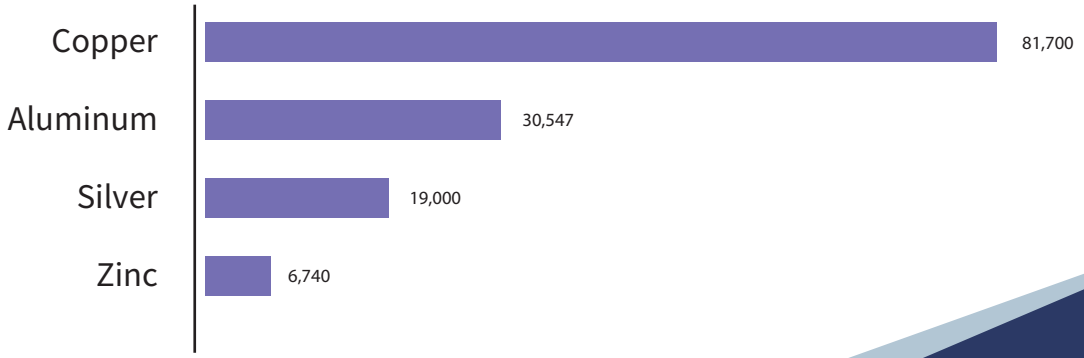
Though not as mineral-rich as some regional neighbors, Armenia's mining industry has long been a pillar of its economy, accounting for 28% of exports in 2024. Strategic minerals include copper, zinc, antimony, and aluminum, with copper being the most abundant. Major deposits are concentrated in Lori province, the Kapan area, and the Zangezur mountain range, with the Kajaran, Agarak, and Shamlugh mines among the most productive.

Foreign investment dominates the sector, with Russian-owned entities historically controlling the most productive assets. The leading copper producer, Zangezur Copper Molybdenum Combine (ZCMC), accounts for 60% of annual mining sector turnover. Its ownership has shifted following Western sanctions on its former Russian parent company, GeoProMining. The prominent aluminum processor ARMENAL is a wholly owned subsidiary of RUSAL, the world's second-largest aluminum producer, itself majority-owned by funds linked to Russian oligarchs. The largest zinc producer is Chaarat Gold Holdings, a British Virgin Islands-based company with significant Chinese shareholding.

The government adopted the "Mineral Sector Development Strategy of Armenia 2035" to modernize licensing, digitize subsoil data, and attract new investment. However, the World Bank notes declining output, weak regulation, and low investor confidence due to concentrated ownership among a few established companies.

Strategic Mineral Production 2022-2025 (Metric Tons)

Research by Kurtis Yan, Graphic Design by Lilly Horrigan



Source: United States Geological Survey

Azerbaijan

Azerbaijan possesses economically extractable reserves of cobalt, copper, zinc, and aluminum, and is actively diversifying investment toward its strategic mineral extraction capabilities. Cobalt is essential for rechargeable batteries, while zinc is critical for galvanized steel production. The most prominent mining regions include Dashkasan, Shaki-Zagatala, and East Zangezur. According to the USGS, Azerbaijan produced 25,724 metric tons of aluminum and 2,657 metric tons of copper in 2021, with production and reserve data for other minerals currently being compiled into a public database by state geological regulators.

Mining is governed by the Ministry of Ecology and Natural Resources, supported by several recently created agencies: the State Agency for Utilization of Mineral Resources, the Geological Survey Agency, and the State Geological Information Fund. Until 2019, Azerbaijan's extractive focus centered on hydrocarbons. The 2020 "State Program for the Geological Study of Subsoil and Efficient Use of the Mineral Resource Base until 2024" shifted attention toward critical minerals, supplementing the foundational 1998 Law on Subsoil Use, which was expanded in 2022.

The leading mining companies are Azeraluminum, a fully state-owned entity, and UK-based Anglo Asian Mining PLC, whose subsidiary, the Azerbaijan International Mining Company Limited, was the first to deploy modern extraction technology for critical minerals in the country.

Strategic Mineral Production 2022-2025 (Metric Tons)

Research by Kurtis Yan, Graphic Design by Lilly Horrigan

Source: United States Geological Survey

Georgia

Georgia's strategic mineral profile, while smaller than some regional neighbors, is expected to grow in the coming years. The government's 2019 mining strategy introduced mandatory minimum investments for production licenses and encourages in-country mineral refinement prior to export. The industry is overseen by Georgia's National Agency of Mineral Resources.

The two most prominent strategic minerals are copper and manganese. Manganese, critical for strengthening steel used in railway tracks, rifle barrels, and infrastructure, is produced solely by the Chiatura Manganese Company, owned by U.S.-based Georgian American Alloys Inc., which plans to construct a nearby processing plant to expand output. Georgia's copper industry ranks 19th globally in export size, with China and Bulgaria as the leading destinations. The sector is actively expanding, with the Georgian Copper and Gold Company and the Caucasian Mining Group jointly exploring significant copper and gold reserves near the city of Bolnisi.

Strategic Mineral Production 2022-2025 (Metric Tons)

Research by Kurtis Yan, Graphic Design by Lilly Horrigan

Source: United States Geological Survey

Kazakhstan

Kazakhstan is richly endowed with strategic minerals, ranking first globally in chromium reserves, second in uranium and manganese, seventh in zinc, and 11th in copper, with significant untapped potential in lithium, nickel, and rare earth elements. The mining sector is diversifying beyond its traditional focus on gold, silver, and lead, with the government actively promoting private investment through simplified permitting, data digitalization, and priority rights frameworks. In December 2023, Kazakhstan adopted a Complex Plan on Rare Metals and Rare Earth Metals for 2024–2028, committing approximately $5.3 million to rare earth development. The most productive mining regions are Pavlodar, East Kazakhstan, and Karaganda, though the USGS notes that refining capacity remains largely limited to zinc and copper.

Uranium is by far the most strategically significant mineral. Kazakhstan became the world's largest uranium producer in 2009 and continues to hold that position, with state-owned Kazatomprom controlling over 40% of national supply. China and Russia are the primary export destinations, though the government has announced plans to grow nuclear energy's share of the domestic generation mix to 5% by 2035.

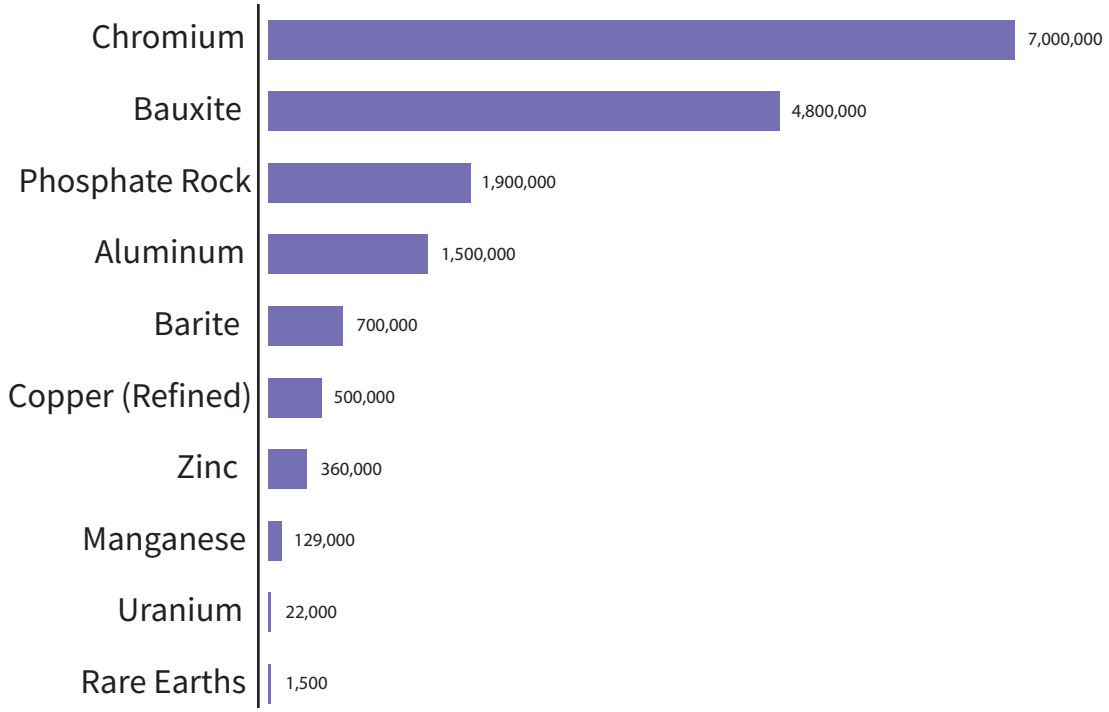
The sector is regulated primarily by the Ministry of Industry and Infrastructure Development, which houses the Committee on Geology, the National Geological Survey, and the Kazgeologyexploration company. The Ministry of Finance oversees taxation of strategic assets. In December 2025, Kazakhstan's Senate approved amendments to the Code on Subsoil and Subsoil Use introducing a digital licensing platform, electronic auctions for subsoil use rights, and expanded local content requirements.

Ownership across the sector is mixed. Major players include government-owned Kazatomprom, the partially state-owned Eurasian Resources Group, Glencore-majority-owned Kazzinc, and privately held Kazakhmys. Kazakhstan has also partnered with the United States and European nations through the Minerals Security Partnership on the Sarytogan Graphite Project, signaling growing Western engagement in the country's critical minerals sector.

Kazakhstan

Strategic Mineral Production 2022-2025 (Metric Tons)

Research by Kurtis Yan, Graphic Design by Lilly Horrigan



Source: United States Geological Survey

Kyrgyzstan

Despite recent declines due to higher production costs and lower commodity prices, mining remains Kyrgyzstan's largest economic sector. The country holds proven reserves of copper, antimony, uranium, tin, tungsten, beryllium, fluorspar, zinc, and various rare earth elements. According to the most recent USGS data, copper is the only strategic mineral currently produced in significant quantities, at approximately 6,900 metric tons of concentrate annually.

Kyrgyzstan has a historically significant rare earth sector, once supplying 80% of the Soviet Union's rare earth needs. The USGS has identified 20 sites with rare earth mineral occurrences suggesting considerable undiscovered resources, and Canadian investors have sought to revive production, though the current status of these efforts remains unclear.

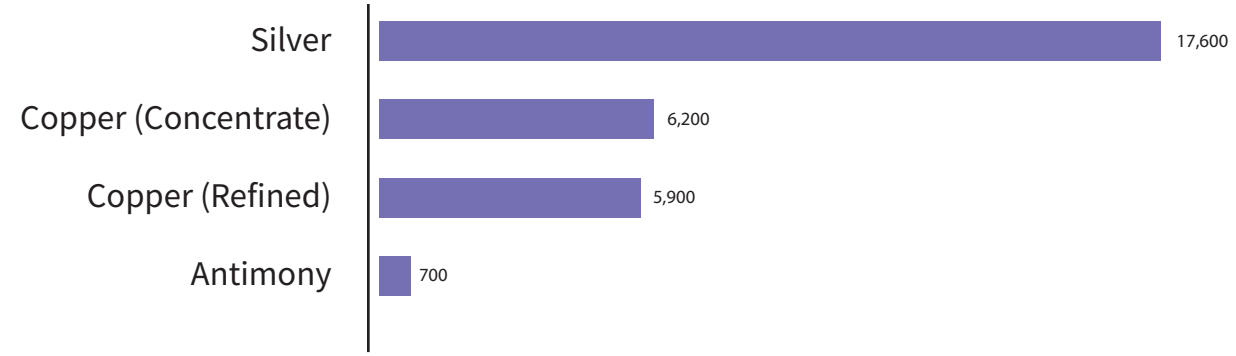
Antimony production, previously processed at the Kadamzhay complex using raw materials from Russia and Tajikistan, was halted in 2017 but partially resumed, with USGS data indicating 40 metric tons of output in 2023. Uranium mining ceased in 2016 and was formally banned in 2019 following public protests, but the ban was lifted in July 2024, with President Sadyr Japarov citing potential state revenues of $2 billion. Ongoing cooperation with Russia's Rosatom on a nuclear reactor suggests Russia might play a role in uranium mining's resumption.

The sector is regulated by the Ministry of Natural Resources, Ecology, and Technical Supervision. Kazakhstan is a significant foreign investor through KAZ Minerals in copper production, while Russia has historically dominated uranium mining through the Renova Group.

Kyrgyzstan

Strategic Mineral Production 2022-2025 (Metric Tons)

Research by Kurtis Yan, Graphic Design by Lilly Horrigan



Source: United States Geological Survey

Tajikistan

Tajikistan's strategic mineral profile, while smaller than some regional neighbors, includes significant aluminum, antimony, and zinc industries, alongside deposits of copper, bismuth, tungsten, fluorspar, uranium, and rare earth metals. The most productive mining regions are the Karamazar mountains in the Sughd Region and the Hissar district.

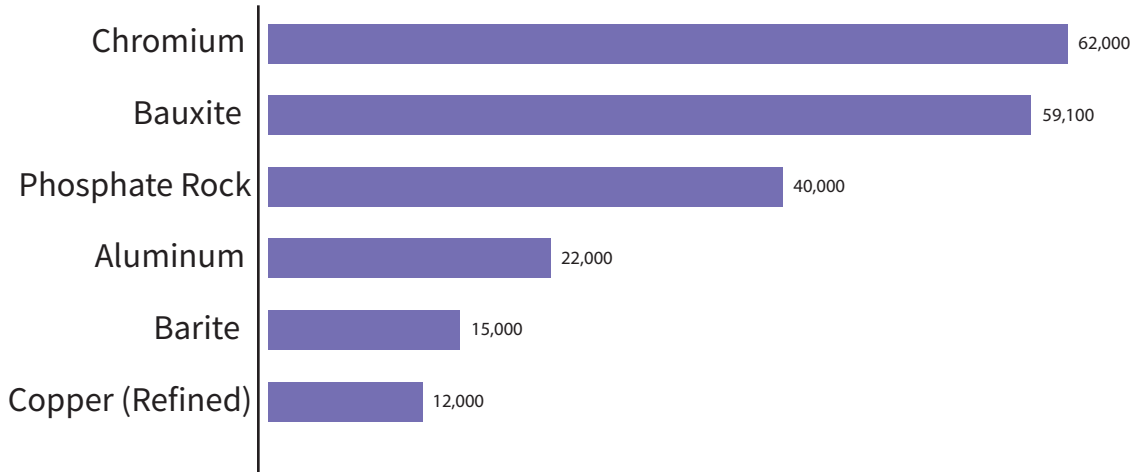
Tajikistan is the world's second-largest antimony producer, accounting for about 25% of global production in 2023. This represents a growing strategic importance following China's August 2024 export restrictions on antimony. Antimony is used in battery alloys, flame retardants, semiconductors, and defense applications including armor-piercing ammunition and night vision devices. However, Tajikistan remains heavily reliant on China for antimony refining, with 78% of its antimony exports destined there. Aluminum is also a significant industry, with plans to increase production to 380,000 tons by 2030.

The sector is governed by the Ministry of Finance, which issues permits, and the Main Directorate of Geology, which conducts surveys and sets mining policy. The dominant company is TALCO, a 100% state-owned entity, and the country's sole aluminum producer. Chinese investment is pervasive across the sector, particularly in zinc, where the Shanghai-based Tibet Summit Industry Company and its subsidiary, the Tajik-China Mining Company, play leading roles alongside state-owned complexes.

Tajikistan

Strategic Mineral Production 2022-2025 (Metric Tons)

Research by Kurtis Yan, Graphic Design by Lilly Horrigan



Source: United States Geological Survey

Turkmenistan

Turkmenistan has only just begun exploring its strategic mineral export potential. According to state geologists, there might be lithium reserves in the Balkan province and rare earth materials in the Lebap province. The country also has proven copper reserves, but their economic viability needs to be assessed. The International Atomic Energy Agency (IAEA) reported that there are occurrences of uranium in the country's north-western areas, but there is insufficient data to estimate potential uranium resources.

Unlike its hydrocarbon sector, Turkmenistan does not allow for any foreign ownership or leasing of mineral rights. Mining is dominated by the public sector through the Ministry of Energy's Türkmengeologiýa State Corporation. Despite government claims of reforming the industry to include more private sector participation, the World Bank has reported that tight administrative controls have hindered private mining expansion. Apart from the hydrocarbon sector, foreign direct investment remains limited.

Uzbekistan

Uzbekistan's mineral industry is thriving, with copper, uranium, and zinc among the commodities expected to increase in production according to the most recent USGS data. The country ranks fourth globally in tellurium reserves, sixth in tungsten, ninth in indium, 11th in uranium, and 12th in copper. It also holds notable reserves of manganese, zinc, graphite, titanium, and rare earth elements, with deposits of lithium, silicon, nickel, cobalt, and germanium identified across the country.

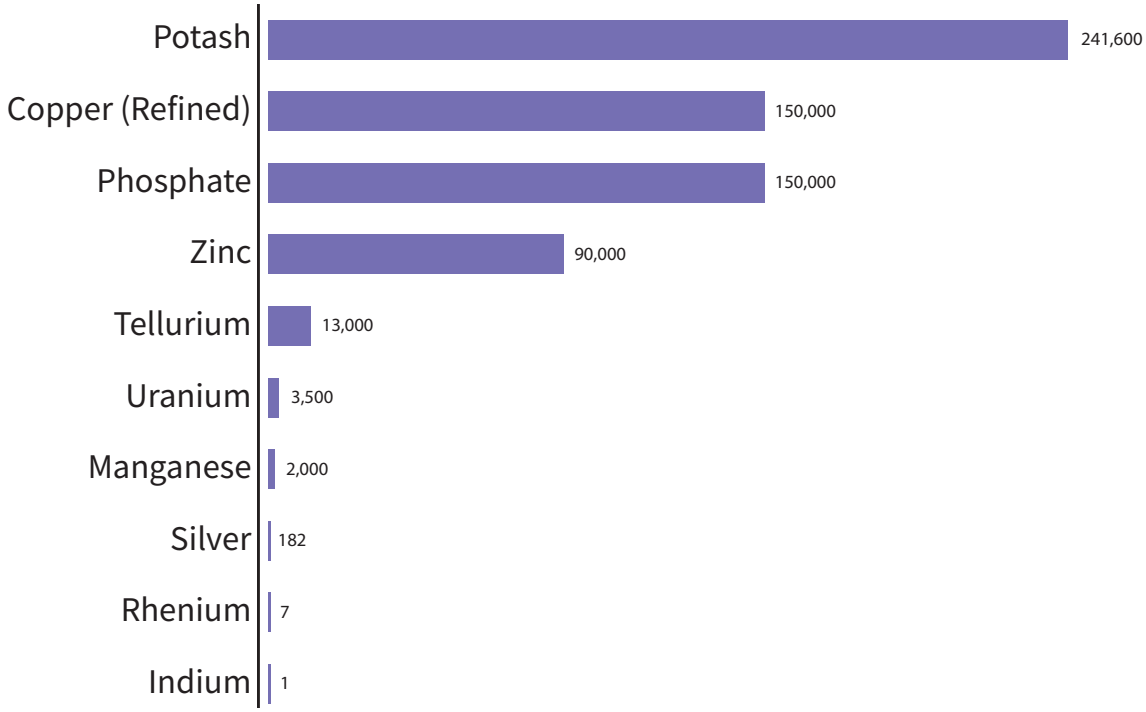
The government has invested heavily in developing the sector, spending roughly $390 million on geological surveys from 2017 to 2021 and introducing a competitive online auction system — E-IJRO AUKSION — in 2020 to streamline exploration and mining licenses. These efforts reflect the fact that only 20% of Uzbekistan's territory had been surveyed for mineral resources as recently as 2018.

Two state-linked entities have historically dominated the sector. The Almalyk Mining and Metallurgical Complex holds a monopoly on copper mining, while the Navoi Mining and Metallurgical Complex controlled uranium, before being restructured in 2020 into three entities: AO Navoi GMK, the uranium-focused Navoiuran, and a socio-cultural fund. The largest foreign investors in 2025 included China, Russia, South Korea, Kazakhstan, and Turkey. In April 2024, Uzbekistan and the EU signed a Memorandum of Understanding on a strategic partnership for critical raw materials.

Uzbekistan

Strategic Mineral Production 2022-2025 (Metric Tons)

Research by Kurtis Yan, Graphic Design by Lilly Horrigan



Source: United States Geological Survey

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10 YEARS