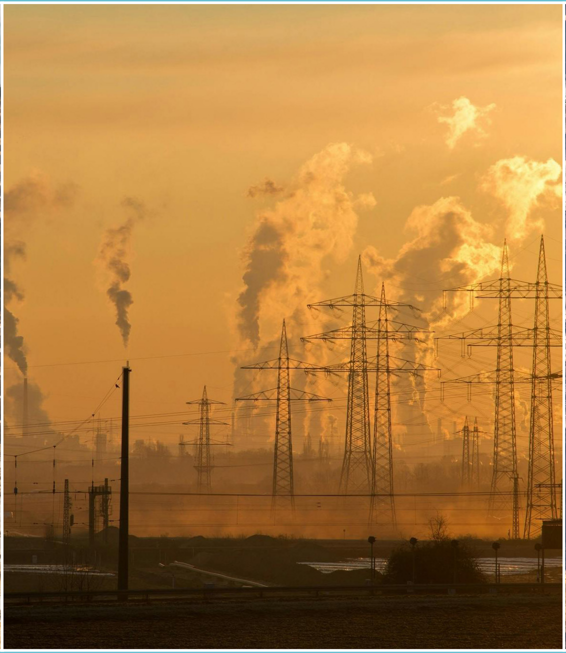
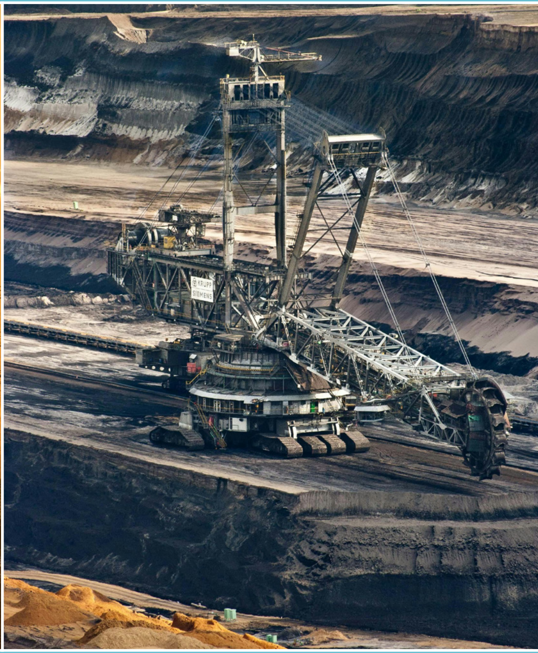
OurEnergyPolicy

EARTHSHOT FOUNDATION

Critical Minerals & National Security





June 2024

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Letters from Leadership

Earthshot Foundation hosted our first dialogues in 2008, declaring – *we already know what we need to do* – **to protect and preserve our natural capital and livable planet.** *And how to do it* – **by accelerating the deployment of abundant, accessible, clean and affordable energy for all.** Today, *Terranaut®* Dialogues are combined with motive and mission (why and how) programs. **Responsible, nature+ mining** is a foundation priority, funded to explore the motive thesis and working definition for ***true mining.*** We are delighted to introduce and co-host the 2024 Minologues Series in collaboration with OurEnergyPolicy, and invite you – energy, environment, economic and national security stakeholders – to participate and contribute. The series convenes four cohorts of expert practitioners – each participating in workshops, webinars and whitepapers – to discuss intelligent policy design across national security, supply chains, responsible mining and future-mining topics. This paper summarizes the consensus contributions from our first cohort. At Earthshot, we believe, "the aim of scientific work [and our work] is truth."

Chase Weir — Founder & Board Chair, the Earthshot Foundation

OurEnergyPolicy's mission is to bring experts together in civil, substantive dialogue to explore solutions to the energy challenges facing the United States. We have partnered with The Earthshot Foundation to explore the crucial questions regarding the availability of critical minerals for American energy needs in this Minologues Series. The Series is a nine-part program, and this paper contains the important insights and recommendations from a working session of leaders on the national security implications of critical mineral availability. This will be followed by similar workshops on supply chain issues, responsible mining and innovation. I want to thank our workshop participants and the staffs at OEP and Earthshot for their work on this document, and — consistent with OEP's non-partisan and open approach to addressing issues— I want to invite all energy stakeholders to read the paper carefully and contribute their views on this vitally important topic.

Bill Squadron — President, OurEnergyPolicy

Executive Summary

The link between critical minerals and national security has never been more important than it is today. As nations compete for a stake in emerging industries such as renewable energy, modern defense systems, and advanced electronics, the access to and control over key mineral resources have become pivotal determinants of geopolitical influence and economic strength.

America's reliance on a handful of nations and companies, which include Foreign Entities of Concern, as primary producers and processors of critical minerals introduces vulnerabilities that have the potential to cascade into far-reaching ramifications for national security.

Critical mineral supply chains are burdened by market failures, risk aversion, and concerns over public health and environmental justice. By addressing these challenges and capitalizing on opportunities, nations can build resilient supply chains that support economic growth, national security, and environmental health.

To secure critical mineral supply chains, we provide the following recommendations:

1. Maintain Strategic Stockpiles
2. Leverage U.S. Department of Defense Acquisition Authorities
3. Invest Proactively in Responsible, Non-Invasive Seabed Mining
4. Reduce Investor Risk Aversion Towards Mineral Projects
5. Improve Processing Capabilities
6. Streamline Permitting

Responsible agencies could explore either initiating a stockpile of critical minerals and products for commercial use or expanding the National Defense Stockpile (NDS) to meet commercial needs. In addition to ensuring at least immediate material availability during supply shortages and disruptions caused by national emergencies, the purchasing power of the NDS can aid in providing price stability for niche mineral producers. It is worth exploring how a similar stockpiling or reserve, perhaps one administered by the U.S. Department of Energy (DOE), can support commercial sectors.

Seabed mining is a new frontier for access to critical minerals, but there are concerns about whether it will be pursued using ecologically-conscious extraction methods by Foreign Entities of Concern. With the development of seabed harvesting, the United States can help set high environmental standards for this practice while combating the reach of adversarial entities. However, for this development to succeed, it may require a paradigm shift that balances ecological considerations with profit maximization.

Risk aversion refers to the concern about investments with higher uncertainties. The level of risk aversion is high in the field of critical minerals, specifically among Western investors, making it difficult for nations in the Global South to acquire enough capital investment for critical mineral mining and processing projects. This risk aversion requires these nations to seek capital flow from other sources, like the Republic of China (China), which already has an oversized hold on all points along international critical mineral supply chains. The investment environment of mining and critical mineral projects requires a greater appetite for risk, or government de-risking actions, if Western investors want to participate meaningfully in these foreign initiatives.

Enhancing processing capabilities, either domestically or through allied partnerships, could significantly alter mineral sourcing dynamics and reduce dependence on adversarial nations for complex technologies used in defense and communications.

Permitting reform is also a key component in addressing challenges to accessing critical minerals. Lengthy permitting processes may deter investments in domestic projects in the United States; but this is a type of reform that cannot be executed only at the Federal level. Permitting reform falls also onto state leadership, and the role of the Federal government includes building trusted partnerships with state officials. Recommended reforms include clear deadlines for permit application reviews and streamlined reviews for permits on brownfield sites.

The through point in many of the recommendations from this working group is maintaining a collaborative environment with allied parties. Nations and representatives in the private sector interested in collaborating for more resilient international supply chains should consider involvement with the Mineral Security Partnership (MSP), an international cooperative effort between nations to secure critical mineral supply chains.

Introduction

This document reflects the views of an expert working group on the issues associated with critical minerals. Perspectives contributed by the working group members include government, industry, think tanks, and academic institutions dedicated to addressing the most prominent challenges in national security and critical mineral supply chains.

This working group is the first installment of the Minologues, an in-depth series dedicated to addressing U.S. concerns over critical mineral access for the renewable energy projects and global efforts towards decarbonization and modernization. As the first chapter of this series, it lays the foundation and clarifies the international dialogue around what critical minerals are, why they matter, and what actions our leadership should consider to secure access to them.

> **"Energy security is national security."**

In an era where national security and the global economy become increasingly interwoven, the significance of critical minerals has emerged as a linchpin in the stability of nations worldwide.

Defense forces are on the front lines of responding to humanitarian crises exacerbated by the climate crisis, so they may have a vested interest in decarbonizing our energy systems. Furthermore, military personnel ay be called upon to play an active role in securing access to critical mineral.

Defense forces are on the front lines of responding to humanitarian crises exacerbated by the climate crisis, so they have a vested interest in decarbonizing our energy systems. Furthermore, military personnel may play a critical role in securing access to critical minerals and energy resources. While the energy transition brought critical minerals to the forefront of public discourse, their importance extends far beyond. Since these minerals are essential ingredients for modern defense systems and smart technologies,[1] control of critical mineral supplies is a determinant of military power. The ongoing conflict in Ukraine, its contribution to increased fuel prices, and its disruption to supply chains[2] underscores this fundamental truth: **energy security is national security.**

This report assesses the geopolitical landscape, supply chain dynamics, and frameworks for critical mineral policy from the perspective of national security, in order to offer actionable insights and policy recommendations for all stakeholders – including government, industry, and international organizations – navigating the web of defense and critical mineral supply chains. Nations that recognize the imperative of securing access to these indispensable resources can enhance their resilience, mitigate risks, and fortify their foundations for sustainable development and security.
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Key Considerations

International Markets & Policy

Energy system decarbonization and infrastructure modernization encouraged by U.S. policy have created increased demand for critical minerals and processing capabilities. Given the discrepancy between current critical mineral supply and the anticipated reliance the United States will have on them, diversifying markets through international partnerships and domestic production is essential. While there are ongoing efforts in the U.S. to localize critical mineral production and manufacturing, the reality of critical mineral availability (i.e. the geography of mineral deposits) requires international cooperation until complete circularity– a topic that will be revisited in a later installment– is achieved.

Relying on a single region or company for vital materials poses significant risks, as highlighted by events like the COVID-19 pandemic disrupting international supply chains[3] and earthquakes in Taiwan disrupting a major semiconductor manufacturing hub.[4] Risk only increases when relying on Foreign Entities of Concern in covered nations like China, which dominates international critical mineral supply chains in both mining and processing. Due to these reliances, national security implications must be considered when forming critical mineral partnerships.

Continuous analysis and monitoring is crucial to identifying weak links in the supply chain and determining where government support is necessary. Trade policy should be adjusted to align more closely with a net-zero, energy-secure future that does not sacrifice marginalized communities. Furthermore, the United States should proactively work to counter unfair trade practices or anti-competitive actions that create market failures and undermine international cooperation. Both economic and defense strategies can be considered to achieve these goals.

Considerations for Labeling Critical Minerals

The U.S. Geological Survey (USGS) last updated its list of critical minerals in 2022, identifying a total of 50 minerals (see Appendix A). A critical mineral is defined by the Energy Act of 2020 as "any mineral, element, substance, or material designated as critical" by the Secretary of the Interior, acting through the Director of the USGS. Criticality is determined by:

1. Importance and level of need in manufacturing products essential to economic and national security.
2. Vulnerabilities in supply chains, including mineral rarity, accessibility, and supplier diversity.[5]

It is imperative to prioritize minerals based on associated threats and take a targeted approach to mineral policy. Conducting comprehensive assessments of critical minerals that include supply, demand, and national security considerations is vital for informing such policy. Merely maintaining the list of critical minerals falls short; continuous monitoring of ongoing developments is paramount to adapt to evolving circumstances. This method can also facilitate proactive measures aimed at addressing issues with other potential future critical minerals before their supply chains reach criticality.

Moreover, enhancing flexibility in utilizing critical mineral lists is necessary.

"...Broader government policies should not exclusively revolve around listed minerals."

While the critical mineral list directly informs certain government initiatives, broader government policies should not exclusively revolve around listed minerals. This added flexibility would prevent unnecessary expenditure of time and energy on lobbying for the addition of unlisted materials to official critical mineral lists to have their supply chains taken seriously.

The Influence of China in Supply Chains

The dominance of China in critical mineral supply chains threatens national security. Its control and influence is akin to the dominance of OPEC in the oil industry, necessitating efforts to diversify supply sources and address the outsized influence of China in the global mining ecosystem.

The influence of China extends beyond local reserves and processing capacity. The global community has taken note that investment in these sectors internationally have largely originated from China.

Some mineral-rich countries are taking action to reduce dependence on Chinese processing capabilities and localize more economic opportunities connected to mineral supply chains within their borders. For example, Indonesia recently instituted an export ban of nickel ore so that it would need to be refined and processed within Indonesian borders before leaving the country.[6] As a result, China invested in local Indonesian refining projects. Although Indonesia successfully localized processing capabilities, it was unable to avoid Chinese influence completely.

Furthermore, different capital structures and market behaviors in China contribute to market failures like price opacity and volatility. To combat these market failures, the United States must collaborate with its allies to establish alternative supply chain ecosystems with reduced Chinese influence. A key challenge here lies in incentivizing diversification while managing the pressure for cost competitiveness.

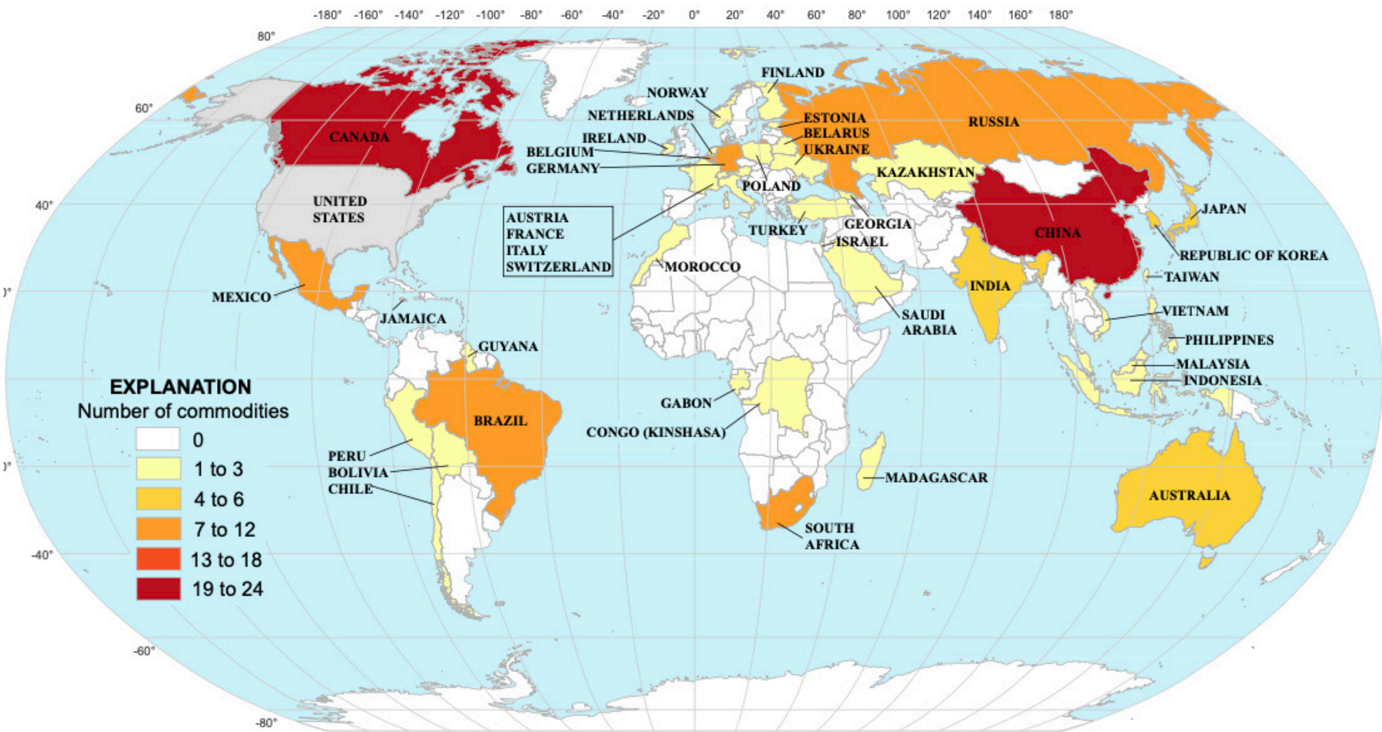
International Partnerships

The interagency initiative known as the Mineral Security Partnership (MSP) brings together 14 governments along with the EU, collectively representing over 50% of global GDP. The primary goal of this initiative is to ensure that critical mineral products reach the market with diversification, high ethical standards, and local benefits.[7] Ideally, equity funds established by partner countries within the MSP could facilitate more critical mineral projects in countries that struggle to attract enough capital from the private sector. Furthermore, the signing of a Memorandum of Understanding (MOU) with SAFE for development investment enables private sector engagement with the MSP and opens the door for public-private partnerships.[8]

Although Gulf States like Saudi Arabia are not currently part of the MSP partnership, maintaining flexibility and openness to new ideas and partners is crucial. The MSP Forum was launched to establish a network of mineral-rich countries committed to high Ethical standards, so willing advocates for these goals should be welcomed into the fold.

Strategic partnerships can also be formed with new countries, particularly those in the global South, who are seeking collaboration opportunities beyond China. This approach could foster broader

Leading U.S. Import Sources of Nonfuel Mineral Commodities (2019-22)



international cooperation in addressing critical mineral challenges. However, when collaborating with countries in the global South, it is especially important to pay attention to energy justice perspectives.

The degree of international coordination required for each critical mineral supply chain should be based on the importance of each resource and its established market structure. For instance, while each member of NATO may not need separate supply chains for niche minerals like gallium, the situation may differ for minerals with higher long-term projections of need, such as lithium.

International collaborations with allies possessing extensive experience in metallurgy and processing can lead to innovations through joint research and development efforts. Leveraging the expertise of various countries can drive innovation and enhance the overall viability of critical mineral production.

Domestically, while the Department of Defense (DOD) takes the lead in managing critical minerals for defense purposes, other agencies such as the Department of State and Department of Energy can support these efforts. Additionally, collaboration with the private sector is crucial due to its wealth of resources and expertise. Ongoing dialogues with private sector stakeholders will also help identify areas that are best suited for government intervention.

Seabed Mining

Seabed mining is still a controversial topic in the United States that poses a significant challenge, especially since domestic political disagreements have prevented the U.S. from ratifying the United Nations Convention on the Law of the Sea (UNCLOS). This lack of participation contrasts with the actions of China and Norway, two countries who are actively advancing in this field and could provide case studies for future improvement.

While this practice poses an opportunity for supply chain diversification, it will not be successful if seabed mining projects are primarily run by foreign entities of concern with lower standards and higher risk of abusing this access to influence international markets. If the U.S. falls behind on developments in this field, it would lose an opportunity to improve the security of its access to critical minerals.

To address concerns over environmental impacts, it is essential to proactively initiate conversations and pilot deep sea mining projects that meet high environmental standards. Global cooperation and technological sharing must be prioritized for less-invasive harvesting technology to accelerate its commercialization, promote diplomacy and improve trust amongst allied nations.

Though it is not a signatory, the United States maintains observer status within UNCLOS, allowing for effective contribution. Therefore, the U.S. government should collaborate with member countries of the International Seabed Authority (ISA) to promote parameters for seabed mining that are beneficial and effective. Furthermore, leveraging alliances with UNCLOS member nations and exploring opportunities within countries' Exclusive Economic Zones (EEZs) provides an opportunity for pilot programs.

National Defense Challenges & Opportunities

Addressing vulnerabilities in supply chains, both operationally and geopolitically, is an essential component to the mission of the U.S. Department of Defense (DOD). The defense industrial base plays a pivotal role in critical mineral supply chains by ensuring access to these minerals and managing capacity to process them for advanced weaponry production. It is the shared responsibility of the Under Secretary for Acquisition and Sustainment and the Defense Logistics Agency to manage critical minerals and related programs at the DOD.

The DOD is actively engaged in supply chain mapping, but its involvement in critical minerals extends beyond military applications. For example, the U.S. Navy ensures commercial transport safety on the open seas. This role is valuable, especially when 76% of global trade in the mining and quarrying sector is maritime.[9] Furthermore, military resources and personnel have been involved in the transportation of fossil fuels to battlefields, and the military is among the first to respond to natural disasters and societal unrest – both of which may be exacerbated due to climate change. Therefore, the DOD has reason to support supply chain security for critical minerals important to decarbonizing energy systems.

Acquisition Authorities & Purchasing Power

The DOD has many unique resources and capabilities that can aid in efforts to secure critical mineral supply chains. It could leverage its substantial budget alongside its acquisition authorities under Defense Production Act (DPA) Title 3 and the 2024 National Defense Authorization Act (NDAA) to diversify processing and mining capabilities, and mitigate risks associated with supply chain disruptions by adversaries. Initiatives managed by the Office of Strategic Capital (OSC) within the DOD demonstrate its dedication to addressing these critical issues, despite funding limitations.

Moreover, the DOD can be a market driver for innovative technologies. For example, the DOD is collaborating with the private sector to integrate advanced batteries into small satellites for applications in space.[10] This collaboration not only enhances defense capabilities but also supports industry growth and innovation. The same collaboration can be instituted for critical mineral innovations along the entire value chain. Most importantly, the DOD can leverage its acquisition authority to establish a greater market for critical materials produced domestically or in allied nations with strong standards and domestic production. This approach would reduce dependence on supply chains controlled by potentially adversarial countries and address environmental justice concerns that plague the critical mineral supply chain.

Strategic Stockpiles

The National Defense Stockpile (NDS) was established in 1938 to meet national security objectives, particularly in wartime scenarios. While this stockpile is critical to national security, it is not designed to fully address commercial demands within the energy sector.

The NDS today is smaller than it was during the cold war era of the late 20th century, which reflects a shift in strategic priorities over time after tensions between east and west publicly relaxed. However, the contemporary landscape is marked by great power competition and there is a renewed sense of importance on strategic minerals and their role in key infrastructure. Despite this reality, there is a gap between stockpile capabilities and strategic requirements.

To meet these evolving needs, the U.S. could mirror efforts within the International Energy Agency (IEA) to establish voluntary stockpiles, or it could grant the Department of Energy (DOE) authority for commercial stockpiling. Alternatively, the U.S. could expand the DOD's authority for commercial use beyond defense purposes by leveraging existing infrastructure under the Defense Logistics Agency (DLA).

While some members of the IEA may not prioritize stockpiling, others, particularly developing or mineral-rich countries, could view it as beneficial for diversifying export portfolios and reducing reliance on single buyers. However, for mineral-poor countries striving to decarbonize, stockpiling could only work to divert available resources away from active use in the global energy transition. Given these variations in opportunities and needs, anticipating potential supply disruptions is crucial for effective stockpiling strategies that do not unnecessarily close off available supplies of key minerals and materials for present use.

Midstream Processing and Manufacturing Capabilities

Processing capacity is a critical aspect of mineral supply chains often overshadowed by the focus on mineral sources. For example, while countries like Australia boast abundant mineral resources,[11] its lack of sufficient processing capacity makes it reliant on its neighbor, China, for this step in mineral production. This dependency reduces efficiency and highlights the vulnerability of overly relying on one nation for supply chain needs.

Proximity both to source materials and buyers, power costs, and trading practices

"...the DOD can be a market driver for innovative technologies."

are pivotal in determining the success of these processing facilities. Constructing such facilities closer to mineral sources reduces reliance on distant regions for processing and promotes sustainability by reducing transportation costs. Localizing processing facilities also increases supply chain efficiency by reducing the time it takes to turn raw materials into finished products. This strategy also reduces security risks associated with more complicated supply chains, especially ones that require transportation through potentially adversarial territory.

Processing capabilities in the U.S. are still limited. Streamlining current obstacles like lengthy permitting processes is essential to building midstream capabilities and would greatly enhance national security and supply chain resilience.

Furthermore, complex technology like computer chips imported from foreign entities of concern pose serious security risks. As technology like these chips increases in complexity, detection of embedded malware and backdoors programmed into them becomes significantly more difficult. Computer chips are used in defense systems, renewable energy, and communications technology. In a wartime scenario, potentially embedded malware could be utilized to significantly undermine national security. Therefore, maintaining domestic and trusted processing and manufacturing capabilities for critical components like computer chips is a national security imperative. Legislation like the 2024 NDAA[12] and initiatives to accelerate domestic manufacturing underscore current efforts to address these concerns and further showcases the role of the DOD in critical mineral policy.

Market Failures & Investor Wariness

Addressing the trillion-dollar issue of critical minerals supply chains requires significant capital investment. Robust financial commitments from stakeholders, including both government and private sectors, are necessary to raise enough capital for critical mineral projects. However, significant market failures – such as price opacity, volatility, and monopolization – and risk aversion among Western investors may obstruct the flow of capital to projects aimed at strengthening and diversifying critical mineral supply chains. While certain measures can and should be taken to minimize factors that contribute to investor wariness, the current level of risk aversion among western investors who want to remain competitive in critical mineral markets appears far too high to support the scale of necessary financing.

Risk Aversion

While significant market failures increase investment wariness, Western investors have been relatively risk-averse, especially when compared to other market participants like Saudi Arabia, which is actively diversifying its investment portfolio to include more critical mineral projects.[13] Although there is potential for leveraging capital from Middle Eastern investors, there may be concerns about relying too heavily on capital flow from this region alone.

Developing countries interested in expanding processing capabilities face challenges in attracting capital investment and establishing precursor development activities which require specific expertise. It is imperative for national security that these nations do not rely on investments from Foreign Entities of Concern. Public financing such as the aforementioned equity funds the MSP hopes to establish can help reduce risk aversion and attract Western capital to critical projects. The Development Finance Corporation (DFC), the Office of Strategic Capital, and the Export-Import Bank of the United States (EXIM) serve as starting points for reform. For example, if EXIM wants to be involved in critical mineral projects, it can not have a 2% default rate. This low default rate reflects unreasonably low risk aversion, and it is unsustainable in the volatile critical mineral market. Institutions like EXIM must factor in the possibility of more losses if they want to remain relevant in riskier enterprises.

Permitting

To enhance the investment landscape in the U.S. mineral sector, American leaders must continue to reform cumbersome permitting processes that deter potential investors. The sluggishness of many permitting processes has made major investors wary, placing the United States at a disadvantage compared to competitors with faster permitting procedures and more attractive terms. However, this challenge also presents an opportunity for improvement; by enhancing the efficiency and speed of permitting, American leaders can enhance the overall investment.

One approach is the streamlining of permitting processes without cutting corners. There are many opportunities for reform to improve efficiency including adoption of a place-based approach to expedite projects, particularly on brownfield sites. Another involves implementing stricter schedules for adjudication, which would contribute to greater predictability in permitting timelines and ensure these processes do not surpass maximum wait times. Since current permitting processes in the U.S. can take years to complete, this reform would attract more capital and stimulate investment in the sector. While permitting reform is a national priority, aside from federal and tribal lands, it is subject to the jurisdiction of state governments. Therefore, collaboration with state authorities is crucial for navigating the permitting process effectively. Policymakers should leverage and establish trusted relationships with state officials who can advocate for and support the permitting process to ensure timely revision.

> ***"...complex technology imported from foreign entities of concern pose serious security risks."***

Pricing Transparency

Addressing risks associated with market transparency is crucial, particularly in mitigating tensions between supply and demand. The lack of transparency in nickel products like mixed-hydroxide precipitate (MHP), an intermediate product and battery-grade nickel sulfate, for example, poses a significant challenge. This issue connects to the aforementioned dynamics of Chinese influence in nickel production both domestically and internationally in countries like Indonesia. Without participation and price information from these key players, efforts to enhance transparency without diversification will likely prove ineffective.

"...by enhancing the efficiency and speed of permitting, American leaders can enhance the overall investment climate."

Leveraging country-specific regulations could incentivize transparency and fair pricing. An example of this approach is the EU Carbon Border Adjustment Mechanism (CBAM), which rewards companies producing low-emission goods when they sell to EU markets.[14] Moreover, the EU CBAM is complementary to the EU Emission Trading System (ETS), ensuring imported goods are subject to the same carbon prices as EU produced goods. Such measures could be replicated for producers that maintain clear pricing transparency.

The extent of market transparency issues is distinct for each critical mineral. Niche mineral markets are impacted more by price opacity and volatility than larger, more liquid markets such as nickel, copper, and aluminum. In niche markets, high price volatility complicates financial models and profitability projections for private investment.

Despite these challenges, the smaller size of niche markets means that correcting market failures would necessitate less public capital injection such as price support mechanisms than larger markets. Therefore, addressing market failures in niche markets could be more feasible and cost-effective, and it presents an opportunity for targeted public intervention.

Innovation & Substitution

Innovation, particularly in recycling and material substitution, holds significant importance to reducing dependency on both rare critical minerals and minerals needed in vast amounts. Innovation can also help increase competitiveness. For example, more efficient processing technologies that use less water and energy, and produce less waste, would help companies reduce water and energy input costs and also reduce waste management costs. Federal government funding is also an option to enhance mining techniques and technologies that can propel the industry forward with higher standards. Given the constraints of limited funding, it is imperative to maximize impact by prioritizing support for innovative projects capable of bridging the gap between development and commercialization. Prioritizing the commercialization of new technologies that have the potential to revolutionize the landscape can aid the U.S. in leading international markets rather than eternally playing catch-up.

Rather than solely fixating on sourcing materials that are currently deemed necessary, there is a notable shift in interest towards adjusting the composition of manufactured products to incorporate materials that are more readily available. This disruptive innovation could reduce reliance on international markets and alleviate diplomatic concerns. Since the disruptive potential of emerging technologies could profoundly reshape market dynamics, vigilant monitoring and adaptation to these transformative innovations are essential to avoid being locked into outdated technologies.

Recommendations

1. Maintain Strategic Stockpiles

Legislative authorization would be necessary to enable commercial stockpiling, whether through the U.S. Department of Defense, Department of Energy, or Department of Commerce. Moreover, stable financing for the National Defense Stockpile would maintain its effectiveness in meeting strategic objectives. Additionally, expanding the DOD's authorities and funding for stockpiling, with an emphasis on robustness and public-private partnerships, could further strengthen strategic stockpile management.

2. Strengthen Defense Supply Chains

Strategically leveraging DOD acquisition authorities like Defense Production Act Title 3[15] and additional authorities granted through the 2024 National Defense Authorization Act[16] can incentivize innovation and domestic critical mineral production. Collaborating with the Development Finance Corporation can also support domestic production increases, offering predictable funding and contracting for long-term initiatives. In addition to enhancing energy security, this strategy aligns the needs of the energy transition with those of national security.

3. Improve Processing Capabilities

It is imperative that the United States prioritize domestic processing capabilities for technologically sensitive and complex materials such as computer chips. Additionally, the U.S. should bolster investments to friendshore processing capabilities in allied nations that are interested in expanding their economies from mining to processing critical minerals. Locating processing facilities where significant mining facilities are already active increases efficiency and reduces the environmental footprint of mineral supply chains. This strategy will also aid in reducing the influence of China in international markets.

4. Invest Proactively in Seabed Mining

As International Seabed Authority (ISA) members continue with UN Convention on the Law Of the Seas (UNCLOS), the U.S. must begin planning for pilot projects that incorporate strong environmental standards in qualifying Economic Exclusive Zones to set the standard for environmentally responsible deep sea mining and combat adversarial nations that could take advantage of this new frontier to increase influence over international markets.

Furthermore, since the U.S. still has observer status to UNCLOS, it should collaborate with ISA member countries as actively as possible and ensure it provides input into international parameters for deep sea mining.

5. Reduce Investor Risk Aversion Towards Mineral Projects

Significant capital investment is necessary to meet the high critical mineral demands of the clean energy transition. The consequences from not meeting investment needs are too great to be hindered by understandable, but challenging, risk aversion. The government should explore ways to mitigate the consequences of risk-aversion through collaboration or other means of support, and investors and financial institutions should consider adopting a less risk-averse approach that involves amending default rates and including considerations beyond short-term market factors.

6. Streamline Permitting

Cumbersome permitting processes deter investors. Permitting reform is essential across all sectors to reduce investment wariness and attract more capital into the sector. Addressing permitting challenges and streamlining the process for mining, processing, and manufacturing projects is crucial for attracting investment and promoting growth in the mineral sector. Having state officials that can champion these goals is crucial to addressing this issue, especially in states that house critical mineral reserves and potential for processing and manufacturing hubs.

Signatories Page

This document represents the collective effort of the working group, reflecting a range of perspectives and contributions. Each participant retains the right to their own opinions and reservations regarding specific aspects of the white paper. Endorsement of this document does not imply unanimous agreement with all content but rather signifies support for the overall objectives of the working group.

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Appendix A

The 2022 list of critical minerals and their uses includes the following[17]:

- Aluminum, used in almost all sectors of the economy
- Antimony, used in lead-acid batteries and flame retardants
- Arsenic, used in semi-conductors
- Barite, used in hydrocarbon production.
- Beryllium, used as an alloying agent in aerospace and defense industries
- Bismuth, used in medical and atomic research
- Cerium, used in catalytic converters, ceramics, glass, metallurgy, and polishing compounds
- Cesium, used in research and development
- Chromium, used primarily in stainless steel and other alloys
- Cobalt, used in rechargeable batteries and superalloys
- Dysprosium, used in permanent magnets, data storage devices, and lasers
- Erbium, used in fiber optics, optical amplifiers, lasers, and glass colorants
- Europium, used in phosphors and nuclear control rods
- Fluorspar, used in the manufacture of aluminum, cement, steel, gasoline, and fluorine chemicals
- Gadolinium, used in medical imaging, permanent magnets, and steelmaking
- Gallium, used for integrated circuits and optical devices like LEDs
- Germanium, used for fiber optics and night vision applications
- Graphite , used for lubricants, batteries, and fuel cells
- Hafnium, used for nuclear control rods, alloys, and high-temperature ceramics
- Holmium, used in permanent magnets, nuclear control rods, and lasers
- Indium, used in liquid crystal display screens
- Iridium, used as coating of anodes for electrochemical processes and as a chemical catalyst
- Lanthanum, used to produce catalysts, ceramics, glass, polishing compounds, metallurgy, and batteries
- Lithium, used for rechargeable batteries
- Lutetium, used in scintillators for medical imaging, electronics, and some cancer therapies
- Magnesium, used as an alloy and for reducing metals
- Manganese, used in steelmaking and batteries
- Neodymium, used in permanent magnets, rubber catalysts, and in medical and industrial lasers

- Nickel, used to make stainless steel, superalloys, and rechargeable batteries
- Niobium, used mostly in steel and superalloys
- Palladium, used in catalytic converters and as a catalyst agent
- Platinum, used in catalytic converters
- Praseodymium, used in permanent magnets, batteries, aerospace alloys, ceramics, and colorants
- Rhodium, used in catalytic converters, electrical components, and as a catalyst
- Rubidium, used for research and development in electronics
- Ruthenium, used as catalysts, as well as electrical contacts and chip resistors in computers
- Samarium, used in permanent magnets, as an absorber in nuclear reactors, and in cancer treatments
- Scandium, used for alloys, ceramics, and fuel cells
- Tantalum, used in electronic components, mostly capacitors and in superalloys
- Tellurium, used in solar cells, thermoelectric devices, and as alloying additive
- Terbium, used in permanent magnets, fiber optics, lasers, and solid-state devices
- Thulium, used in various metal alloys and in lasers
- Tin, used as protective coatings and alloys for steel
- Titanium, used as a white pigment or metal alloys
- Tungsten, primarily used to make wear-resistant metals
- Vanadium, primarily used as alloying agent for iron and steel
- Ytterbium, used for catalysts, scintillometers, lasers, and metallurgy
- Yttrium, used for ceramic, catalysts, lasers, metallurgy, and phosphors
- Zinc, primarily used in metallurgy to produce galvanized steel
- Zirconium, used in the high-temperature ceramics and corrosion-resistant alloys.

Source: U.S. Geological Survey

Appendix B

2023 U.S. Net Import Reliance[18]

Commodity	Net import reliance as a percentage of apparent consumption in 2023	Leading import sources (2019–22)[2]
ARSENIC, all forms	100	China,[3] Morocco, Malaysia, Belgium
ASBESTOS	100	Brazil, Russia
CESIUM	100	Germany
FLUORSPAR	100	Mexico, Vietnam, China, South Africa
GALLIUM	100	Japan, China, Germany, Canada
GRAPHITE (NATURAL)	100	China,[3] Mexico, Canada, Madagascar
INDIUM	100	Republic of Korea, Canada, Belgium
MANGANESE	100	Gabon, South Africa, Australia, Georgia
MICA (NATURAL), sheet	100	China, Brazil, India, Belgium
NIOBIUM (COLUMBIUM)	100	Brazil, Canada
RUBIDIUM	100	China, Germany, Russia
SCANDIUM	100	Japan, China, Germany, Philippines
STRONTIUM	100	Mexico, Germany, China
TANTALUM	100	China,[3] Germany, Australia, Indonesia
YTTRIUM	100	China,[3] Germany, France, Republic of Korea
GEMSTONES	99	India, Israel, Belgium, South Africa
ABRASIVES, fused aluminum oxide	>95	China,[3] Canada, Brazil, Austria
NEPHELINE SYENITE	>95	Canada
RARE EARTHS,[4] compounds and metals	>95	China,[3] Malaysia, Japan, Estonia
TITANIUM, sponge metal	>95	Japan, Kazakhstan, Saudi Arabia, Ukraine
BISMUTH	94	China,[3] Republic of Korea, Belgium, Mexico
POTASH	91	Canada, Russia, Belarus
STONE (DIMENSION)	87	Brazil, China,[3] Italy, Turkey
DIAMOND (INDUSTRIAL), stones	84	India, South Africa, Russia, Congo (Kinshasa)
PLATINUM	83	South Africa, Switzerland, Germany, Belgium
ANTIMONY, metal and oxide	82	China,[3] Belgium, India, Bolivia
ZINC, refined	77	Canada, Mexico, Peru, Republic of Korea
BARITE	>75	India, China,[3] Morocco, Mexico
BAUXITE	>75	Jamaica, Turkey, Guyana, Australia
IRON OXIDE PIGMENTS, natural and synthetic	75	China,[3] Germany, Brazil, Canada
TITANIUM MINERAL CONCENTRATES	75	South Africa, Madagascar, Australia, Canada
CHROMIUM, all forms	74	South Africa, Kazakhstan, Russia, Canada
PEAT	74	Canada
TIN, refined	74	Peru, Bolivia, Indonesia, Malaysia
ABRASIVES, silicon carbide	73	China,[3] Brazil, Canada, Netherlands
SILVER	69	Mexico, Canada, Poland, Switzerland
COBALT	67	Norway, Canada, Finland, Japan
GARNET (INDUSTRIAL)	67	South Africa, Australia, China,[3] India
RHENIUM	60	Chile, Canada, Germany, Kazakhstan
ALUMINA	59	Brazil, Australia, Jamaica, Canada
VANADIUM	58	Canada, Brazil, Austria, Russia
NICKEL	57	Canada, Norway, Finland, Russia
DIAMOND (INDUSTRIAL), bort, grit, and dust and powder	56	China,[3] Republic of Korea, Ireland, Russia
MAGNESIUM COMPOUNDS	52	China,[3] Israel, Canada, Brazil
GERMANIUM	>50	Belgium, China, Canada
IODINE	>50	Chile, Japan
MAGNESIUM METAL	>50	Canada, China,[3] Israel, Taiwan
SELENIUM	>50	Philippines, Mexico, Germany, Canada
TUNGSTEN	>50	China,[3] Germany, Bolivia, Vietnam
SILICON, metal and ferrosilicon	<50	Brazil, Russia, Canada, Norway
COPPER, refined	46	Chile, Canada, Mexico
ALUMINUM	44	Canada, United Arab Emirates, Bahrain, Russia
PALLADIUM	37	Russia, South Africa, Italy, Canada
LEAD, refined	35	Canada, Mexico, Republic of Korea, Australia
MICA (NATURAL), scrap and flake	28	China, Canada, India, Finland
PERLITE	26	Greece, China, Mexico
LITHIUM	>25	Argentina, Chile, China, Russia
TELLURIUM	>25	Canada, Germany, Philippines, Japan
SALT	25	Canada, Chile, Mexico, Egypt
BROMINE	<25	Israel, Jordan, China[3]
ZIRCONIUM, ores and concentrates	<25	South Africa, Australia, Senegal, Russia
CEMENT	22	Turkey, Canada, Greece, Mexico
VERMICULITE	20	South Africa, Brazil, Zimbabwe