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Testimony Submitted on Behalf of SAFE

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Introduction

Chairman, Ranking Member, and Members of the Subcommittee:

On behalf of SAFE, thank you for the opportunity to submit this written testimony as part of your important hearing on "Examining Ways to Enhance Our Critical Mineral Supply Chains."

SAFE is a non-partisan, non-profit policy organization committed to advancing secure, resilient, and sustainable transportation and energy solutions for the United States and its allies. Through our Ambassador Alfred Hoffman Jr. Center for Critical Minerals Strategy, we work to secure all aspects of the critical minerals supply chain to strengthen national and economic security. SAFE draws on the expertise of retired four-star military officers, Fortune 500 CEOs, and experienced technical staff to produce actionable, fact-based recommendations for policymakers.

This testimony aims to underscore a central truth: America's critical mineral supply chains cannot be secured without addressing the bottleneck of processing. This midstream segment is not just a logistical step—it is the strategic hinge upon which national resilience, industrial competitiveness, and defense readiness now turn. Yet solving it requires more than just infrastructure—it demands tailored, mineral-specific policy that accounts for varying technical and market realities. Still, shared constraints across minerals processing—demand shortfalls, cost hurdles, lagging timelines, and market distortions—point to common priorities that must be built into any national strategy. The real test for policymakers is not whether to act, but whether actions are calibrated to the realities of the minerals we need in the timelines we need them.

I. The Chokepoint: Processing as a Tool of Strategic Leverage

China has become dominant in multiple stages of critical minerals supply chains and has demonstrated a willingness to weaponize that dominance. The People's Republic of China (PRC) holds influence across mineral supply chains, particularly the midstream processing, through government-owned entities and their proxies and American companies now have no choice but to effectively compete against a foreign government. Given the rapid shift to a minerals-based economy, for which minerals are an imperative for both cutting-edge technologies and maintaining our defense capabilities, policymakers must urgently find solutions. Those solutions cannot be homogenous; they must go beyond tariffs, permitting reform, or sector tax credits alone. While lowering regulatory barriers, addressing trade exposure, and maintaining policies that send clear demand signals to the domestic mining industry are needed, these policies alone will not achieve mineral supply chain security. Policymakers must urgently address the midstream, which is where China represents a robust chokepoint.

Regardless of whether a mineral ends up in a fighter jet, an electric vehicle (EV), or a cell phone, it must undergo a series of complex transformations. Minerals are not immediately useful in their raw form. They must be crushed, milled, separated, refined, and in many cases, chemically converted to achieve the purity, specification, and form required for manufacturing. For instance, rare earth elements (REEs) used in permanent magnets must be separated with extreme precision using solvent extraction and then metallized and converted into alloys before they are shaped into magnets. Lithium extracted from brines or hard rock must be processed into lithium hydroxide or carbonate to be used in battery cathodes. Regardless of whether the United States gets minerals from our own subsoil, partner countries, the seabed, or recycled sources, all of these materials must undergo significant transformation before they can be used in advanced manufacturing. Without this intricate middle step—the processing stage—we cannot unlock the tailored material qualities required by our manufacturers or the defense sector.

But China realized this first. Through state-backed subsidies and the provision of low- or zero-cost capital, the PRC has built a formidable competitive advantage with more than 65 percent of global lithium refining, over 70 percent of battery-grade nickel and cobalt, and more than 90 percent of graphite and REE processing.[1] These policies are not isolated; rather, they are integral to Beijing's long-term industrial vision, including its "Made in China 2025" initiative, which targets PRC leadership in a number of strategic sectors. Processing is the chokepoint today and is expected to remain so for at least the next 10 to 15 years. According to the International Energy Agency's Global Critical Minerals Outlook 2024, project pipeline data shows China is expected to maintain its dominance over this period, especially in the refined materials segment.[2]

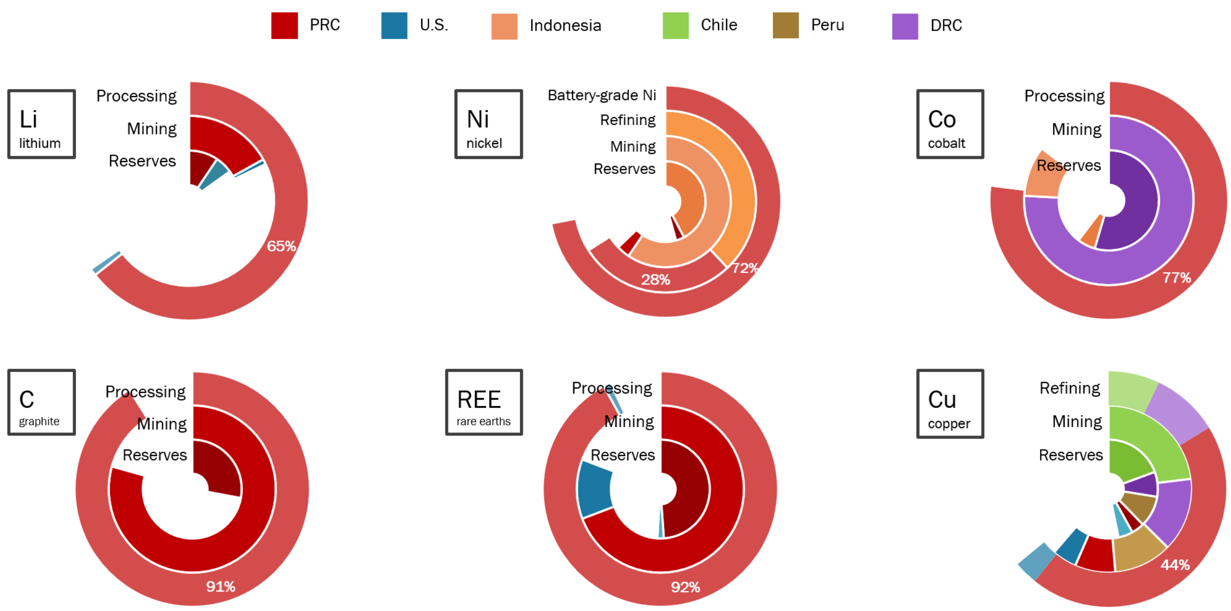
This matters because the PRC has not only built dominant processing capacity, but it has also demonstrated a willingness to use it coercively. The Chinese government has imposed export controls multiple times in response to geopolitical tensions. In just the last two years, China has implemented stringent restrictions on gallium, germanium, antimony, graphite, REEs, and permanent magnets, while also adding U.S. defense contractors to its export control list. In the December 2024 export controls on dual-use materials and their production technology, the PRC's

[1] International Energy Agency, *"Global Critical Minerals Outlook 2024*."
[2] Ibid.

Ministry of Commerce was explicit about their goal to prevent the U.S. defense industrial base and military from access.

This is not market competition. It is strategic leverage. The PRC dominates through subsidies, predatory pricing, state-owned enterprises, and aggressive overseas investments. Between 2000 and 2021, it invested $57 billion abroad, mostly in foreign mining operations, to secure supply and channel materials back to China for processing and manufacturing.[3]

Figure 1. Global Supply Chain Concentration for Select Critical and Strategic Minerals



Source: SAFE analysis based on data from U.S. Geological Survey, International Energy Agency and Benchmark Mineral Intelligence.

Processing is the linchpin between raw materials and finished technologies. It is where industrial capability is either captured or outsourced. If current trajectories continue and processing remains dominated by China, the United States will remain dependent on foreign decision-making for the technologies that define future economic and national security leadership. Beijing understands

[3] Escobar, B., Malik, A. A., Zhang, S., Walsh, K., Joosse, A., Parks, B. C., Zimmerman, J., & R. Fedorochko. (2025). *Power Playbook: Beijing's Bid to Secure Overseas Transition Minerals*. Williamsburg, VA: AidData at William & Mary.

that controlling processing means controlling the pace, price, and availability of next-generation manufacturing. This trajectory is not tenable—continued dependence will forfeit an American-led global industrial economy.

II. Understanding the Chokepoint: Points of Divergence in Critical Minerals Processing

While minerals processing is a known bottleneck across the critical mineral supply chain, this catch-all framing masks nuanced differences between minerals when it comes to how they are transformed into usable industrial inputs. Not all minerals follow the same processing pathway, and four key areas of divergence shape whether and how processing can take place: the types and technical needs of processing, the underlying economics that dictate investment viability—particularly the difference between primary and byproduct minerals—the maturity and structure of their respective markets, and the specification requirements that determine what form and quality of material is acceptable for end-users. These factors collectively shape the feasibility, cost, and strategy required to build processing capacity at scale—and they must be weighed carefully in policy discussions.

1. Types and Technical Needs of Processing

Processing requires tailored approaches depending on the ore body, brine, nodule, or recycled input being used. This means building processing facilities demands mineral-specific expertise, customized infrastructure, and often novel permitting and environmental compliance pathways.

Processing can vary even within a single mineral—lithium is a good example. Different feedstocks—like hard rock spodumene versus brine—require fundamentally different processing techniques, and the desired final product also shapes the pathway. To produce lithium hydroxide from spodumene, the process involves mining, crushing, calcination at over 1,000°C, acid roasting with sulfuric acid, leaching, and purification.[4] In contrast, lithium from brine is extracted through solar evaporation over several months to yield lithium carbonate, which then must be converted to hydroxide if required. These differences affect not just the chemical steps involved, but also timelines, permitting, infrastructure, and capital investment. Thus, even within a single mineral, the processing strategy is not monolithic but dependent on both the input feedstock and final product specifications.

Different feedstocks—such as ores, brines, or recycled materials—possess unique chemical compositions and physical properties, necessitating customized processing techniques to efficiently extract and purify the desired minerals. For instance, processing polymetallic nodules from the seabed requires distinct methodologies compared to terrestrial ores due to their unique mineralogy and the presence of multiple valuable metals in a single matrix. Similarly, recycled materials may contain impurities or varying concentrations of target minerals, requiring specialized refining processes to achieve the purity levels needed for high-tech applications. Therefore, as policy discussions advance to support the development of alternative mineral sources, it's crucial to understand processing is not simply a matter of adding new sources of supply—it is an engineering, economic, and market challenge that must be solved on a material-by-material basis.

2. Economics of Primary vs. Byproduct Production

Sixteen of the minerals on the 2022 United States Geological Survey (USGS) list of critical minerals are predominantly recovered as primary products such as nickel, zinc, lithium, and aluminum (see Figure 2 below for the full list), meaning that the economic viability of the entire operation depends on efficiently extracting, smelting, refining, and processing that primary product and selling it at a

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viable price point.[5] The United States' ability to expand its processing capacity for primary metals and minerals will depend on the following market-driven conditions:

1. high enough market prices to justify investments, supported in part by strong demand that can absorb the processed material,
2. secure, reliable, and affordable feedstock for processors,
3. a predictable and efficient permitting framework that facilitates rather than delays projects, and
4. technical know-how to successfully execute complex projects from design through construction and procurement, including a skilled workforce capable of delivering at each stage.

While private industry must lead in developing commercially viable primary projects, the U.S. government can play a facilitating role by removing regulatory red tape, directing investments to strategic jurisdictions (either domestic or abroad), or providing the type of strategic support that allows companies to scale up future growth plans more quickly than they otherwise could. However, the most essential role for the government is addressing risks that arise from non-market actors (e.g., market distortion and price manipulation) that can undermine otherwise viable projects.

Twenty of the USGS-designated critical minerals (when all REEs except scandium and yttrium are grouped) are predominantly produced as byproducts.[6] Their production and sale alone typically do not justify dedicated investments, particularly in the early stages of extraction, recovery, and separation. As a result, their production is closely tied to the market dynamics and production volumes of the primary "host" commodity.

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[5] SAFE analysis based in the U.S. Geological Survey Methodology and Technical Input for the 2021 Review and Revision of the U.S. Critical Minerals List.

[6] Ibid.

Once recovered into a stable intermediate form, these critical minerals can be processed as a standalone input—essentially treated like a primary product from that point onwards, but only if there is enough volume and commercial interests to support downstream processing and derivative product manufacturing facilities.

Figure 2. Critical Minerals by Primary vs. Byproduct Production

Predominantly Produced as a Primary Product			Predominantly Produced as a Byproduct		
aluminum	lithium	tin	antimony	hafnium	scandium
barite	manganese	titanium	arsenic	indium	tellurium
beryllium	nickel	tungsten	bismuth	iridium	vanadium
chromium	niobium	zinc	cesium	magnesium	yttrium
fluorspar	platinum		cobalt	palladium	zirconium
graphite	tantalum		gallium	rhodium	REEs
			germanium	rubidium	

Note: Additional clarification is needed on the categorization of REEs. REEs are mined both as byproducts of other mineral commodities (produced as a byproduct of iron ore mining at the PRC's Bayan Obo mine) and as the main product (as is the case at MP Materials' Mountain Pass mine located in California). They are mainly categorized as byproducts under this classification since individual REEs are produced as byproducts or coproducts of each other.

Source: U.S. Geological Survey.

The same four enabling conditions discussed above for primary products—adequate market prices, reliable feedstock, efficient permitting, and technical execution capabilities—also apply to byproduct production. However, an added layer of complexity exists: the viability of recovering byproducts is directly tied to the economic feasibility of producing and processing the host metal. Higher market prices or tariffs on byproducts, no matter how steep, will not unlock domestic supply unless the primary metal's production is also viable. In other words, the opportunity to produce critical mineral byproducts domestically will only materialize if the United States maintains or expands smelting, refining, or processing capacity for host metals such as copper, zinc, aluminum, or gold.

3. Market Maturity and Structures

The distinction between primary and byproduct materials is also a useful illustration of how different minerals participate in fundamentally different market structures. These differences underscore that while all critical minerals face a shared processing chokepoint, they do not operate within a uniform market. Instead, each group of minerals—whether bulk, emerging, or obscure—faces unique challenges in pricing, transparency, and susceptibility to distortion. These market features are key to understanding which minerals are investable, scalable, and strategically vulnerable.

Mineral markets vary widely in structure and, as a result, transparency:

- **Bulk metals** (e.g., copper, aluminum, nickel, zinc) are traded at larger volumes, with price discovery mechanisms established through public exchanges like the London Metal Exchange (LME) and COMEX. While not all processed forms are exchange-traded, the sheer volume of material and the presence of benchmark prices make these markets harder to manipulate directly. Instead, the PRC distorts these markets through structural overcapacity, subsidies, and the steady supply of low-cost products. These indirect distortions pressure global prices and crowd out U.S. and allied producers.
- **Emerging markets** (e.g., lithium, cobalt, REEs) face fast-growing demand but lack mature price discovery mechanisms. Trading volumes on exchanges remain low (or, in the case of REEs, do not exist), with most material sold via bilateral contracts. Thus, market participants still rely on third-party reporting agencies for price assessments. The lack of transparent, exchange-based price discovery leads to information asymmetry, allowing market participants, particularly dominant Chinese firms, to use their market position to intentionally distort prices to their advantage.

- **Obscure markets** (e.g., gallium, germanium, rubidium) are often byproducts, with prices determined through sporadic trades of low production volumes and limited reporting. Their markets lack daily or even weekly price reporting, with pricing assessments issued monthly or annually. Additionally, the majority of these lower volume minerals are recovered as byproducts. Because cost allocation between primary and byproduct metals varies significantly, it is difficult to construct cost curves for byproducts, making it harder to determine what constitutes a fair price. Finally, for the smallest markets like cesium and rubidium, the absence of reliable production and inventory data makes it more difficult to identify market failures and assess what kind of interventions are needed and where.

These differences also impact how susceptible different mineral markets are to price manipulation by the PRC. Less mature or opaque markets provide more room for distortion—whether through selective underpricing, sudden export restrictions, or flooding of global markets with subsidized material. Understanding these market structures is essential for designing related policy tools, including tariffs, price supports, and stockpiling strategies, whose effectiveness will vary depending on market maturity and opacity.

4. Specification and Qualification for Final Use

Finally, even when processed materials are available, downstream users—especially in defense, automotive, and advanced technology sectors—require qualification. This means processed minerals must be validated for technical performance, consistency, and safety before they can be integrated into high-performance applications. These qualification processes can sometimes take more than a year and vary significantly by customer and sector. Without meeting these precise material specifications, domestically processed materials will be excluded from critical applications, rendering policy supports like tariff walls or subsidies ineffective.

Even within the same mineral category, different end uses require different processing routes and specifications. Battery-grade lithium carbonate, used in EVs, must exceed 99.5 percent purity with tight limits on impurities, while technical-grade lithium carbonate, like that produced at Silver Peak—the only operating lithium mine in the United States—does not meet these standards and is used for ceramics and lubricants instead. A similar challenge exists in graphite, where anode active material (AAM) for EVs must meet rigorous performance and safety specifications. This issue is central to the ongoing countervailing investigation into AAM imports from China, where U.S. EV makers argue that domestic alternatives do not meet their qualification requirements.

III. Understanding the Chokepoint: Areas of Convergence in Minerals Processing

While there are clear points of divergence in how different minerals are processed—ranging from feedstock requirements to market maturity—there are also common threads that cut across materials. Recognizing these commonalities can help ensure that policy interventions—whether financial, regulatory, or trade-related—are designed to address real bottlenecks across the supply chain and unlock scalable, competitive, and secure processing capacity. Whether we are talking about lithium, nickel, or REEs, successful processing depends on a set of shared enablers:

1. connecting to sustained demand,
2. aligning project timing with policies,
3. overcoming capital and operating cost hurdles, and
4. countering market manipulation.

1. Demand Must Come First: Building the Business Case for Processing

Even when technical and economic conditions align, the business case for minerals processing hinges on downstream demand. Without a guaranteed customer, processors cannot secure financing or justify investment.

For instance, U.S.-based MP Materials made strides in separating REEs, but it currently separates only a small share of the REE materials it extracts. In 2024, MP Materials produced approximately 1,300 metric tons of neodymium-praseodymium (NdPr) oxide, a fraction of the more than 45,000 metric tons of REEs it extracted. While MP Materials has helped position the United States as a net exporter of REEs, this is largely due to the lack of a substantial domestic market to absorb their products. The challenge lies in scaling up production: without robust domestic demand, it becomes difficult to justify large-scale production and investment in further processing capacity. The small amount of U.S. magnet production that exists today is insufficient to drive the volume of demand required to justify ramping up REE processing.

Similarly, the success of other critical mineral projects is contingent on the presence of domestic demand at scale. Lithium producers, for example, are in the process of developing and constructing projects that will potentially supply critical materials for key industries like the automotive industry. Thacker Pass, a lithium project in Nevada, has a phase 1 production plan supported by a binding offtake agreement with General Motors.[7] This kind of offtake agreement is crucial because it guarantees a market for lithium, which in turn supports investment in production

[7] Lithium Americas, "Unlocking Thacker Pass: General Motors to Contribute Combined $625 Million in Cash and Letters of Credit to New Joint Venture with Lithium Americas," October 16, 2024.

and processing facilities. This same dynamic applies to other lithium projects in the pipeline, including the direct lithium extraction (DLE) projects located in the Smackover formation.

This relationship can impact smaller market materials, like germanium and gallium as well. Nyrstar's Clarksville smelter in Tennessee is currently the only primary zinc producer in the United States and produces germanium concentrate for export because there are no domestic buyers. The company has plans to expand its capabilities to process germanium and gallium concentrates into higher-value products, but its mining operations are currently paused and the business case for the processing facility is still under evaluation.

If no direct buyers of processed critical minerals exist in the United States, U.S. critical mineral processors face two undesirable scenarios. Companies looking to build domestic production capacity may have no option but to sell materials to the PRC if no other buyer exists. This scenario would not improve supply chain security. Alternatively, U.S. producers will find themselves competing with Chinese suppliers in third-country markets. For example, in the absence of cathode active material (CAM) facilities in the United States, lithium, nickel, and cobalt processed domestically may be sold to countries like South Korea or Japan, where they will face stiff competition from Chinese suppliers. U.S. producers will already face competitive disadvantages in these markets due to higher transportation costs, before considering the impact of subsidies and other market distortions that allow Chinese competitors to undercut prices.

This commercial disadvantage weakens the case for domestic processing investment, even as national security needs intensify. Defense needs alone are not enough to anchor this supply chain. As President Trump's Executive Order 14272 makes clear, the commercial sector is not merely a partner to the defense industrial base—it is its foundation.

In today's environment, it is the commercial sector—driven by civilian applications—that must lead the development and scaling of supply chains to ensure that defense systems have access to the materials they require. Moreover, in the event of a national crisis, the United States' ability to surge defense production hinges on pre-existing, reliable commercial capacity. From upstream extraction to midstream processing and downstream manufacturing, the U.S. commercial industrial base functions as a latent reserve of military industrial capability, like it did in World War II. Sustaining and expanding that commercial base—particularly for high-specification materials—is not just industrial policy, but a pillar of deterrence.

Relevant demand-side policy tools, such as sourcing and provenance requirements, can play a critical role in shaping commercial incentives and sustaining U.S. processing capacity. Today, these tools exist in limited areas—for example, the defense procurement provenance requirements for magnets and the sourcing provisions for 30D Clean Vehicle tax credit. But the logic behind these tools applies more broadly. As new domestic production capacity comes online, similar mechanisms should extend to additional sectors that rely on critical minerals. However, these measures should be implemented carefully and in a phased manner, reflecting market readiness to avoid disruptions. Aligning such policies with the pace of infrastructure buildout and qualification timelines (as discussed in the next section) will be essential to ensuring they support—not hinder—the development of secure supply chains.

2. Investing in Processing at Home: Capital and Operating Realities

As the United States ramps up its ambition to scale mineral processing capacity, it must also confront the hard economic realities of building and operating such facilities on U.S. soil. Despite growing recognition of the midstream chokepoint, domestic investment remains constrained by persistently high capital and operating costs. These financial challenges, when paired with the relative inexperience of new entrants and structural cost disadvantages compared to competitors like China, create a tough investment environment that policy alone must work harder to de-risk and correct. Understanding these cost pressures is key to designing effective support tools that can close the gap between policy goals and commercial feasibility.

Capital Expenses

Capital expenditure (CapEx) for critical minerals processing is at a minimum two to three times higher in the United States compared to jurisdictions in East and Southeast Asia, largely due to higher construction costs (labor and building materials) and equipment costs. Delays in permitting can also increase a project's CapEx by extending the period during which financing costs, such as interest on loans, accrue before production begins. These delays can also leave companies more exposed to unexpected escalations in the cost of equipment, construction materials, and labor—risks that become acute during periods of high inflation.

Another factor that can increase costs is the lack of experience associated with new market entrants or the use of next-generation technologies. New entrants without prior experience in building or operating similar facilities often face steep learning curves. Without an established technical foundation, they are more prone to mistakes in design, procurement, construction, and early operations. Even experienced firms face cost challenges when deploying new or unproven technologies at commercial scale for the first time. Technical uncertainties, process inefficiencies, and the need for custom engineering can all raise capital requirements. In both cases, execution risks are high: design flaws, construction delays, underperforming equipment, and misjudged operating conditions can result in costly setbacks and budget overruns. To justify these first-of-a-kind investments, firms typically require high market prices and strong demand signals. Over time, as operational knowledge improves and processes are refined, subsequent facilities tend to be significantly more cost-efficient.

A clear example comes from the PRC's experience with high-pressure acid leaching (HPAL) to produce mixed hydroxide precipitate (MHP), an intermediate processed product used to produce nickel and cobalt sulfate. Japan's Sumitomo Metal Mining was the first to successfully commercialize HPAL in the early 2000s with its Coral Bay plant in the Philippines.[8] The process was considered expensive and technically challenging due to the use of sulfuric acid, high-pressure reactors, and significant corrosion risks, all of which drive up operational and maintenance costs. The PRC's first major effort to enter this space was through the Ramu Nickel project in Papua New Guinea, developed by the state-owned Metallurgical Corporation of China (MCC). The project suffered significant cost overruns and delays. Nevertheless, access to low-cost capital and state backing allowed MCC to absorb these early losses and use the project as a learning platform.[9] The technical and operational lessons learned from that facility were subsequently applied to newer MHP plants being built by Chinese companies in Indonesia, which are now being deployed at significantly lower costs and faster timelines thanks to standardized designs and experienced engineering teams.[10]

As evidenced by the PRC's experience with HPAL, high upfront costs—particularly for first-of-a-kind facilities and new market entrants—do not preclude the United States from establishing domestic processing capabilities. However, they must be factored into any strategy to build a competitive critical minerals sector. Western investors—both companies and financiers—will only commit

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[8] The History of Sumitomo Metal Mining," Sumitomo Metal Mining, Webpage.
[9] See e.g., Nick Evans, "Australian operations put serious dent in MCC's reputation," Papua New Guinea Mine Watch, February 7, 2012.
[10] Jon Emont, "China Harnesses a Technology That Vexed the West, Unlocking a Treasure Chest," The Wall Street Journal, September 9, 2024; and Earl Cotton, "China Harnesses a Technology That Vexed the West, Unlocking a Treasure Chest," Medium, September 9, 2024.

capital if they can achieve a sufficient internal rate of return (IRR). When CapEx is high, this typically requires higher market prices sustained over a long enough period to justify the investment and allow entities to recoup upfront costs.

Even with tariffs in place, domestic producers, particularly the new market entrants, may still not reach profitability if global market prices remain low. Setting tariff rates high enough to offset what can often be a more than two to threefold CapEx disadvantage could be highly disruptive to the downstream, potentially driving up input costs to the point that domestic processors lose their customer base altogether. Additional forms of policy support—public financing tools that de-risk projects (e.g., grants, low-cost debt financing), offtake commitments at higher prices to improve project IRR, or mechanisms to support higher market prices (e.g., sourcing requirements for downstream producers, other mechanisms to support premiums, pricing support, or alternative pricing arrangements)—will be necessary to crowd in private sector capital.

Operating Expenses

Operating expenses (OpEx) at the processing stage are dependent on a number of factors, including economies of scale, complexity of extraction/processing, material costs, energy costs, the efficiency of technologies, and the grade/quality of the raw material input. In the case of aluminum and synthetic graphite, the major cost differentiator is access to affordable energy. The picture is different when it comes to REE separation using solvent extraction.

While still an energy-intensive process, the major cost contributors for solvent extraction are labor and material inputs such as chemical reagents. Material inputs lead to particularly high-cost differentials with competitors in the PRC. Because there is an overproduction of hydrochloric acid, critical mineral processors in the PRC are often paid to consume the excess, effectively turning a cost into a revenue stream for the critical mineral processor. This is because offloading hydrochloric acid to nearby processors is cheaper than alternatives such as storage, neutralization, or long-distance transport.[11]

The United States does not have such industrial overproduction; therefore, processors purchase chemical reagents like hydrochloric acid at full market prices, which can exceed $200 per ton of contracted volumes. Depending on their market price at the time, chemical reagents can account for 30 percent or more of the total production costs in the domestic separation of REEs, making them the highest continuous operating expense for REE solvent extraction facilities after labor.[12]

Overlying the input cost dynamics is the regulatory environment. Companies are incentivized to locate operations in jurisdictions with lax regulations, avoiding the cost of complying with the stricter environmental rules found in higher-income countries. Regulatory requirements in the United States comparatively contribute to higher OpEx.

The OpEx cost differentials described above reflect underlying structural disadvantages that need to be addressed separately. The United States must adopt a broader strategy—one that includes pursuing energy dominance in cases where access to cheap, abundant energy can create a competitive advantage. Efforts by the Trump administration to advance domestic energy production will represent an important step toward enhancing U.S. competitiveness in energy-intensive sectors. Other measures under a coordinated suite of actions should include the Section 45X Advanced Manufacturing Production Credit for applicable critical minerals, which is meant to offset a portion of the U.S. production costs that are higher than strategic competitors. A 10 percent production tax credit also provides a degree of insulation from market volatility, barring drastic

[11] SAFE findings from interview with industry players
[12] Ibid.

price swings. Additional tools—such as offtake commitments or mechanisms to support higher market prices for certain minerals (e.g., price floors or premiums)—may also be considered.

3. Timing and Scale: Policy Must Match Market Reality

Mineral supply chains face a series of overlapping lags. Many minerals the United States needs are years away from being mined domestically due to long permitting and construction timelines. At the same time, component part manufacturing—such as CAM and magnets—does not yet exist at scale outside of China. Meanwhile, processing capacity takes multiple years to come online even under ideal conditions. These timing mismatches compound one another, increasing the risk of underutilized infrastructure, stranded investments, and prolonged overreliance on adversarial sources. To avoid these risks, policy must be phased in carefully. Restrictions and incentives should align with real-world development timelines—especially for upstream mining, midstream processing, and downstream manufacturing—to ensure a smooth transition to secure, commercially viable supply chains.

In the near term, interim feedstock strategies will be necessary. Sourcing critical minerals from allied and partner nations that are already producing provides an immediate path to support U.S. processing investment while reducing dependence on China (see the Appendix for what an allied supply chain could look like). This strategy also accelerates time-to-impact for processing facilities that might otherwise remain idle due to lack of input supply.

But sourcing is not the only constraint—timing mismatches also exist between policy and infrastructure buildout. Constructing greenfield processing and advanced manufacturing facilities typically takes two to three years. These timelines can be extended by permitting delays, financing bottlenecks, or technical complexity. Once operational, plants face a stabilization and ramp-up period. For example, two U.S. CAM facilities are expected to begin production in 2026, and the first domestic cobalt processing facility is projected to start initial operations in 2027.

Even then, materials must pass the aforementioned stringent qualification requirements before entering defense, automotive, or other high-specification markets. These processes can last a year or more. Without a qualified domestic or allied source of supply, even newly available materials may remain commercially unusable. This means downstream manufacturers cannot shift away from Chinese inputs until processing capacity is not just available—but certified and reliable.

The stakes for misalignment are high. If policy restrictions—such as tariffs, sourcing requirements, or Foreign Entity of Concern (FEOC) designations—are implemented before alternative supply chains are ready, they risk weakening U.S. manufacturing rather than strengthening it. If manufacturers cannot source policy-compliant inputs, they will forgo policy benefits and continue sourcing from PRC-aligned producers. At best, this stalls momentum toward securing U.S. mineral supply chains; at worst, it chills investment and burdens American producers with added uncertainty. Aligning these tools with realistic development horizons is essential to ensuring they support—not undercut—the goal of building a secure, resilient minerals supply chain. Otherwise, the United States risks doing to itself what China's export controls are designed to achieve: cutting off access to the processing technologies and materials it does not yet have.

Conclusion

This hearing—"Examining Ways to Enhance Our Critical Mineral Supply Chains"—speaks directly to the challenge and opportunity before us. As this testimony has underscored, the United States cannot enhance its mineral supply chains without tackling the chokepoint of processing. This midstream bottleneck is where strategic risk, technical complexity, and economic barriers converge—but also where smart, well-sequenced policy can deliver the greatest impact. Chinese mineral dominance is not only an economic threat—it is a national security vulnerability that leaves the United States dependent on a strategic competitor for foundational inputs to modern technology, energy, and defense systems.

To meet this moment, several coordinated actions are needed:

1. **Anchor minerals policy in midstream chokepoint realities.** Without robust processing capabilities, even domestic upstream extraction or downstream manufacturing will remain dependent on adversarial supply chains. Policies must also account for today's gaps in upstream feedstock and downstream demand. Without complementary actions processors risk remaining reliant on China as both a buyer and supplier.

2. **Tailor strategies by material.** Processing technologies, market structures, and qualification requirements differ significantly across minerals. Pricing and stockpiling policies must reflect these variations to be effective.
3. **Align trade, sourcing, and incentive policies with infrastructure and commercial readiness.** Policy implementation should match production timelines and downstream demand growth to avoid outpacing market viability or discouraging investment. In the near term, the United States must lean on allies and partners that already produce critical minerals or host advanced downstream industries to fill supply and demand gaps for processors. In the long term, success will depend on removing the risk of Chinese oversupply from both U.S. and allied markets and ensuring that critical mineral supply chains are no longer shaped by non-market behavior.

4. **Connect U.S. energy abundance to midstream mineral strategy.** Processing facilities need affordable, reliable energy. Leveraging all energy forms paired with modernized transmission and streamlined permitting is vital to unlocking processing capacity.

5. **Maintain and develop targeted incentives to close cost gaps and stimulate demand.** Targeted technology-neutral incentives can help bridge cost differentials for U.S. processors (utilizing both mature and innovative technologies), attract investment to the United States, and accelerate the growth of domestic magnet and battery component industries that will ultimately anchor new mineral supply chains. Innovation and development of alternatives will be especially important for improving efficiency and mitigating regulatory disadvantages, as the United States decreases reliance on China.

SAFE appreciates the Subcommittee's leadership on American mineral security and stands ready to support your efforts through targeted, practical, and strategic policy action.

Thank you.

Appendix. What does an Allied Supply Chain Look Like?

	Antimony	Bismuth*	Cobalt	Gallium*	Graphite
Top Reserves	**Australia** (#5, 7.0%) **Turkey** (#7, 5.0%) **Canada** (#8, 3.9%)		**Australia** (#2, 15%) **Philippines** (#5, 2.4%) **Canada** (#7, 2%)		**Brazil** (#2, 26%) **India** (#6, 3.0%) **Turkey** (#7, 2.4%)
Top Producers	**Australia** (#6, 2.0%) **Turkey** (#7, 1.6%) **Mexico** (#8, 0.8%)	**South Korea** (#2, 7.6%) **Japan** (#3, 3.1%)	Canada (#4, 1.6%) Philippines (#5, 1.3%) Australia (#6, 1.2%)	**Japan** (#3, 0.4%) **South Korea** (#3, 0.4%)	**Brazil** (#4, 4.3%) **India** (#5, 1.7%) **Canada** (#6, 1.3%)
Top Sources of U.S. Processed Material Imports (2020-2023)	**Belgium** (#2, 8%) **India** (#3, 6%)	**South Korea** (#1, 23%)	**Norway** (#1, 27%) **Finland** (#2, 17%) **Japan** (#3, 14%)	**Japan** (#1, 24%) **Germany** (#3, 19%) **Canada** (#4, 17%)	**Canada** (#2, 13%) **Mexico** (#3, 13%)

Note (*): All production numbers are for mine production except for bismuth, which shows refinery production, and gallium, which shows primary gallium production.
Source: U.S. Geological Survey, *Mineral Commodity Summaries 2025*.

	Lithium	Nickel	Rare Earth Elements	Tungsten
Top Reserves	**Chile** (#1, 31%) **Australia** (#2, 23%) **Argentina** (#3, 13%)	**Australia** (#2, 18%) **Brazil** (#3, 12%) **Philippines** (#6, 3.7%)	**Brazil** (#2, 23%) **India** (#3, 7.7%) **Australia** (#4, 6.3%)	**Australia** (#2, 12%) **Spain** (#5, 1.4%) **Austria** (#7, 0.2%)
Top Producers	**Australia** (#1, 37%) **Chile** (#2, 20%) **Argentina** (#3, 7.5%)	**Philippines** (#2, 8.9%) **Canada** (#4, 5.1%) **Australia** (#6, 3.0%)	**Australia** (#4, 3.3%) **Thailand** (#4, 3.3%) **India** (#7, 0.7%)	**Australia** (#7, 1.1%) **Austria** (#8, 0.9%) **Spain** (#9, 0.9%)
Top Sources of U.S. Processed Material Imports (2020-2023)	**Chile** (#1, 50%) **Argentina** (#2, 47%)	**Canada** (#1, 46%) **Norway** (#2, 11%) **Australia** (#3, 8%)	**Japan** (#3, 6%) **Estonia** (#4, 5%)	**Germany** (#2, 14%)

Source: U.S. Geological Survey, *Mineral Commodity Summaries 2025*.