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Onshoring Critical Minerals: Constraints, the Role of Environmental Safeguards, and Policy Options

Before the House Committee on Energy and Commerce's Environment Subcommittee

Hearing on *Help or Hindrance? The Impact of US Environmental Laws on Critical Material Supply Chains, National Security, and Economic Growth*

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Testimony
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Introduction

Good morning, Chairman Palmer, Chairman Guthrie, Ranking Member Tonko, Ranking Member Pallone and distinguished members of the Subcommittee,

Thank you for the opportunity to provide testimony to the Environment Subcommittee today. My name is Beia Spiller. I am a Fellow at Resources for the Future (RFF) and the Director of RFF's Transportation Program. I lead RFF's critical minerals research dealing with environmental and social sustainability issues and critical mineral supply chain economics. I also direct RFF's Critical Minerals Research Lab, which brings together a large group of interdisciplinary PhD students working on policy-relevant critical minerals research. RFF is an independent, nonprofit research institution in Washington, DC. RFF's mission is to improve environmental, energy, and natural resource decisions through impartial economic research and policy engagement. The institution is committed to being the most widely trusted source of research insights and policy solutions leading to a healthy environment and a thriving economy. While RFF researchers are encouraged to offer their expertise to inform policy decisions, the views expressed here are my own and may differ from those of other RFF experts, its officers, or its directors. RFF does not take positions on specific legislative proposals.

Background

Growing our nation's critical mineral supply chain has been advanced on a bipartisan basis for the past several administrations to achieve goals around supply chain security (i.e., our ability to acquire the minerals we need for advanced technologies and defense purposes at prices we can afford), industrial policy (i.e., ramping up US-based jobs in the manufacturing and production sector), and US competitiveness in the global minerals market. However, there are considerable challenges to achieving such goals, including high input costs, low and volatile mineral pricing, long permitting times and lack of technical know-how. Because of these extensive challenges, removing environmental protections will not be sufficient to stand up a successful domestic supply chain; and inappropriately eliminating environmental regulations can shift these costs onto workers and local communities in the form of illnesses, property damage and devaluation, and harmed ecosystem services. Furthermore, insufficient government staffing reduces our ability to effectively govern and implement our environmental policies- leading to unnecessary delays in development and challenges in growing a sustainable supply chain.

In this testimony, I will first describe the primary challenges critical mineral supply chains have faced (and continue to face) in ramping up domestic production. I will then discuss the importance of maintaining environmental regulations throughout all components of mineral supply chains, even as industry continues to face obstacles in building capacity. Finally, I will examine policy options available to overcome some of these challenges without negatively impacting the health and wellbeing of our environment and communities.

Challenges to Ramping Up the Mineral Supply Chain

The United States is not currently a major player in the critical mineral supply chain. There are many reasons why this is the case, including:

- high domestic production costs,
- low and volatile global mineral pricing,
- long permitting times; and,
- lack of technical know-how.

These challenges are described in detail below.

High Costs

One of the largest challenges in ramping up the domestic supply chain is its cost: it is more expensive to extract and process minerals in the United States than it is in many parts of the world, including in many US-allied nations.

In Figure 1, using proprietary data from Supply Chain Insights (SC Insights), we demonstrate the weighted average (projected 2030) cost of lithium extraction in the United States versus the rest of the world. As shown in the figure, the United States has higher average extraction costs than most regions. Though this only shows costs for lithium, similar results are found for other critical minerals and other settings, such as for processing and manufacturing.

Figure 1. 2030 Lithium Extraction Cost Competitiveness by Bloc and Ownership Status

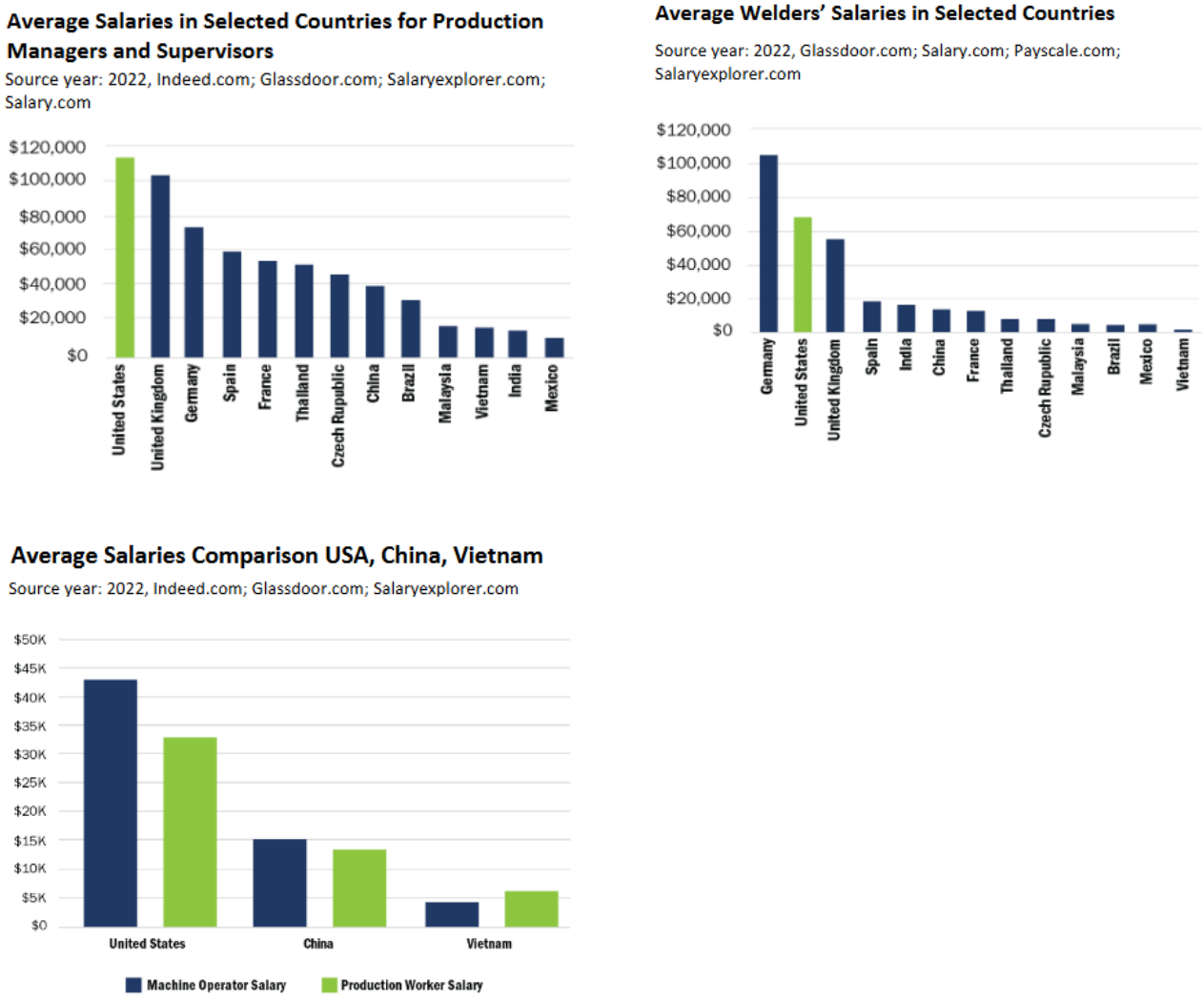
Note: This figure illustrates aggregate production with a weighted average C3 cost across countries, national blocs, and plurilateral agreements or summits of interest. Importantly, the Critical Minerals Ministerial was not

a formal agreement but rather a summit of which future coordination between the US and attending nations is not ensured. The Pax Silica agreement is excluded because assets are the same as MSP / FORGE agreement.

There are many factors that contribute to high costs of production in the United States. One of the factors cited by industry is environmental regulations, which require companies to internalize the externalities of mineral production. However, the extent to which environmental regulations affect the cost of doing business is challenging to calculate and depends entirely on the type of regulation, the way in which the regulation is structured, the industry involved, and whether the company upon which the regulation imposed is greenfield or brownfield. Either way, it is not clear that the cost of regulations is burdensome when compared to other costs (Dechezleprêtre and Sato 2017), even for industries where regulations do incur costs.

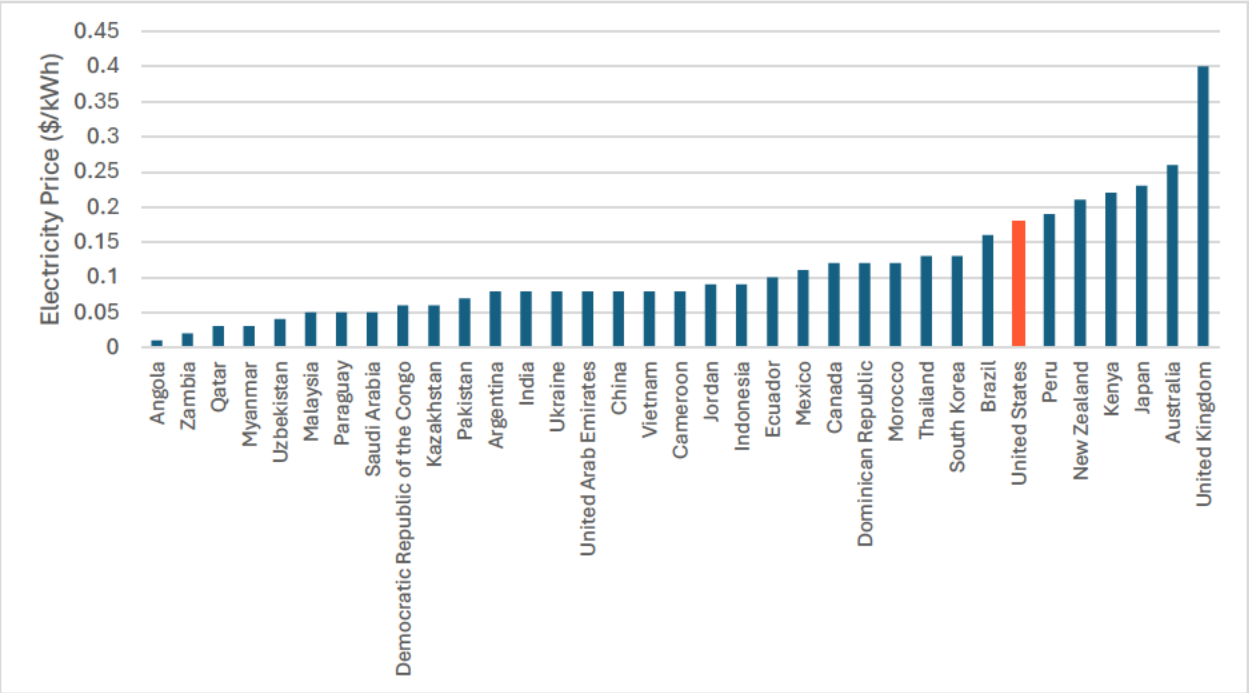
High labor costs for extracting and processing critical minerals also contribute to high domestic costs of production overall. The data shown in Figure 2, sourced from the Reshoring Institute's 2022 Study: "Global Labor Rate Comparisons: The Impact on Manufacturing Location Decisions and Reshoring", demonstrate that the United States has consistently higher labor rates than many other producing countries, leading to higher costs of doing business domestically.

Figure 2. Salaries Cross Country



Another driver of costs is the relatively high cost of electricity, which is a major input into the production of critical minerals. Though the United States has average electricity costs compared to worldwide prices, electricity costs are higher than in many major producing countries, including China, Latin American countries, Indonesia, and African countries (Figure 3). Furthermore, electricity prices and structures vary widely across states and utility service territories, and demand charges (which charge customers not by the total quantity of electricity, or kilowatt-hours (kWh), consumed, but by the speed of consumption, or kilowatts (kW) consumed, can be burdensome. Thus, even if the average electric rate appears low across the country, the actual electric bill can result in order of magnitude cost differences, depending on the way the electric tariff is applied for the industrial customer (Lolli et al. 2021).

Figure 3. Electricity Price in Select Mineral Producing Countries

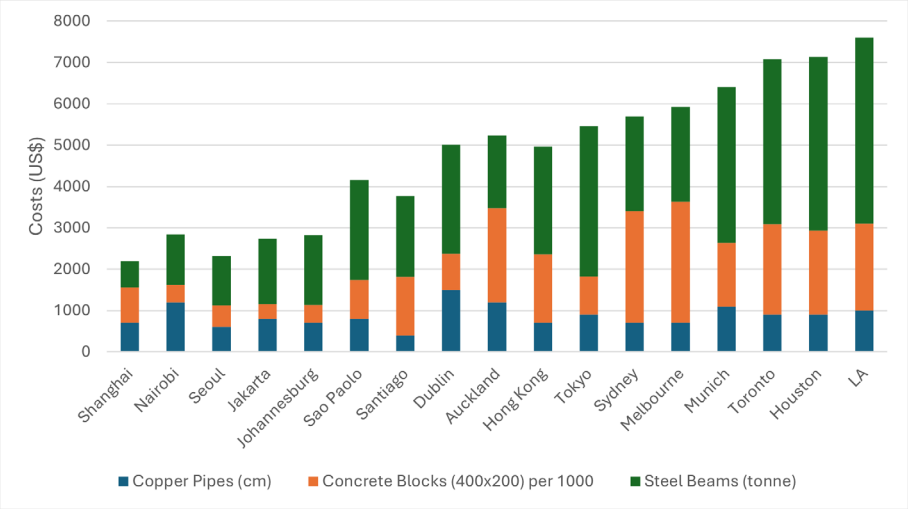


Data Source: World Population Review (Accessed on April 19, 2026).

Other construction inputs also contribute. Construction material costs are relatively higher in the United States than in other nations. Figure 4 displays the cost of several key materials, including steel beams, copper pipes, and concrete blocks, in different cities across the world. These data, taken from Turner and Townsend's 2024 International Construction Market Survey, demonstrate how material inputs vary globally. As shown in the figure, cities in the United States tend to have higher material costs than cities in Asia, South America and Africa, particularly when it comes to steel and concrete. Broad import tariffs such as those imposed by the federal government only serve to exacerbate these higher prices, given our higher proportion of construction material that is imported into the United States. (The United States is the 2nd largest importer of construction material in the world, according to the Construction Financial Management Association[1]).

[1] See https://cfma.org/articles/we-are-the-world.

Figure 4. Construction Material Costs, by City



Data from Townsend & Turner 2024, Regional Analysis.

Low Prices and Market Volatility

While critical mineral production and processing costs are relatively high in the United States, another major challenge for domestic developers comes from competitive pressures on pricing. Critical mineral prices are set globally. Given China's dominance in mineral production and processing worldwide, China sets prices strategically (US House Select Committee on the Chinese Communist Party (CCP) 2025). Such price interventions have led to low and volatile prices, causing market uncertainty and higher investment risk. This is an external challenge over which domestic producers have little to no control over pricing; this challenge is independent from domestic input and production costs.

China's decades-long overinvestment in processing capacity means that it controls most minerals processing globally (International Energy Agency (IEA) 2025) and can do so at a very low price. This makes it difficult to compete on price—not just for US producers, but for other producers worldwide. Low mineral prices discourage entry by producers and can result in early exit from producers even after development has begun. One example of a US project that suffered price disruptions was the Jervois cobalt mine in Idaho, which had to shut down shortly after ribbon cutting due to sustained low cobalt prices.

Another reason why prices can be artificially low is due to the lack of environmental or labor regulations in other producing countries. In Indonesia and the Democratic Republic of Congo (DRC), for example, their mining sector's environmental and labor regulations do not provide adequate protections for workers, communities or the environment. As a result, the market prices for minerals do not account for adjustments mining companies could take to protect the health, safety or

wellbeing of their workers and surrounding communities. Mining and mineral processing in these countries is thus associated with severe environmental degradation and human rights violations.

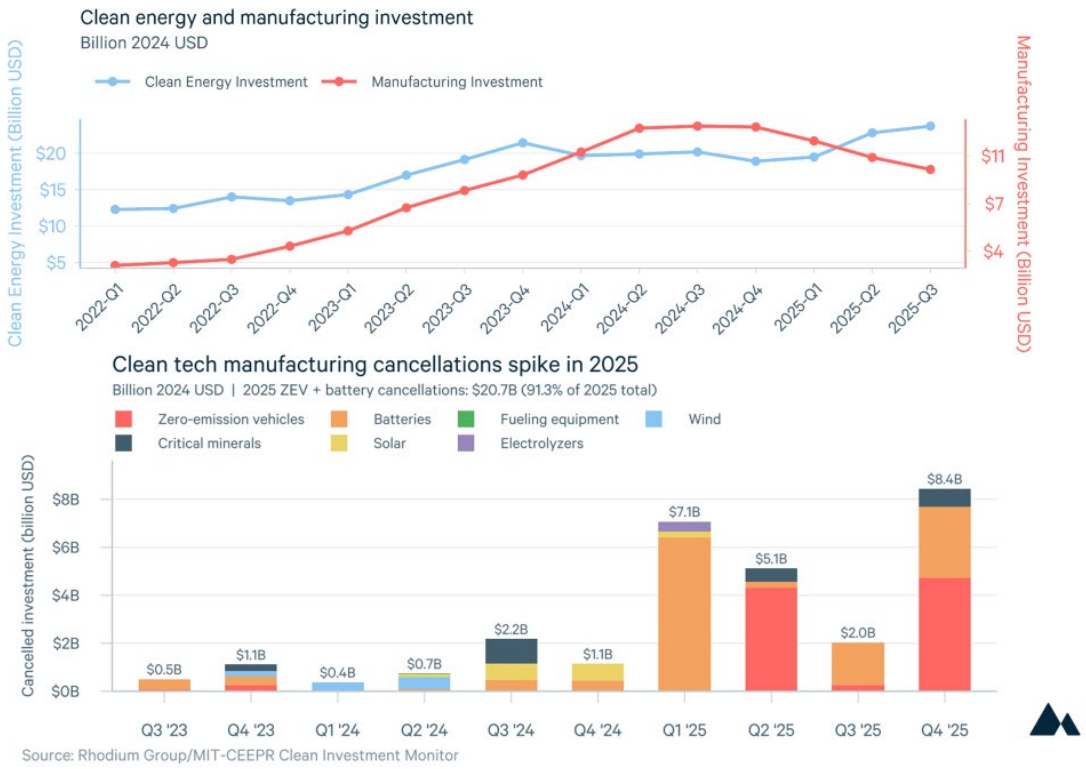
For example, in Indonesia, nickel is processed through high pressure acid leaching (HPAL), allowing the country to produce battery-grade nickel at very low costs. However, this process uses sulfuric acid, a highly corrosive chemical, and produces magnesium sulphate as tail-waste. These tail-wastes have been dumped into streams and oceans, leading to broad environmental and health damages, as well as negative impacts on fishery-dependent communities (EarthWorks 2026). Because these externalities have not been internalized into the cost of processing, the resulting nickel price is artificially low, as the costs have simply been shifted onto the communities surrounding the plants. Similarly, in the DRC, human rights abuses, child labor, and forced labor mean that the cost of extraction is artificially low as workers are not paid fairly (US Department of Labor 2023).

Thus, lax environmental and social regulations in certain extractive countries and excess capacity investments in China both artificially lower the price point of minerals, making it challenging for domestic producers to compete on price alone. However, if domestic producers were able to market their products as sustainable, this could garner a "green premium" (Righetti et al 2025). A major challenge in this approach is the lack of a clear market signal or demand pull for this type of product.

The Inflation Reduction Act's (IRA's) 30D tax credit, which had sourcing requirements attached to the electric vehicle subsidies, was a clear example of how to connect the two sides of the supply chain. It required manufacturers to source minerals domestically[2], creating an incentive to enter into off-take agreements with domestic mineral producers. Off-take agreements have the benefit of providing long-term, stable demand for a producer at a specific price, cultivating investment certainty. Along with the IRA's 45X credit, the number of manufacturing investments grew significantly from 2022 to 2024. However, once the federal government began to reverse course on policies that would boost renewable energy and electric vehicle demand—including eliminating/phasing out the IRA tax credits, eliminating the greenhouse gas emissions standards and the Corporate Average Fuel Economy (CAFE) standard penalties, and revoking the Clean Air Act waiver allowing California and other states to set electric vehicle mandates—clean tech manufacturing investments were canceled to the order of $20.7 billion (Clean Investment Monitor 2026; see Figure 5).

[2] Or from countries with which the United States had a free trade agreement.

Figure 5. Clean Energy and Manufacturing Investments Over Time



Source: Clean Investment Monitor, a joint project of Rhodium Group and MIT-CEEPR.

While it is still not a resolved question of whether the reversal of clean tech-supporting policies *causally* led to the cancellation of clean tech manufacturing cancellations, what is clear is that policies do affect demand for downstream products. For example, in Spiller et al (2025), we modeled the effect of weakening the greenhouse gas standards on light-duty vehicle sales in 2030, and find that it would reduce electric vehicle sales by nearly 60 percent. Given the large quantity of minerals that electric vehicle batteries require, this major reduction in electric vehicle demands would likely have a chilling effect on domestic battery manufacturing, and in turn, the adoption of domestic off-take agreements.

Long Permitting Timelines

A challenge that concerns many developers is the lengthy time it takes to acquire permits in this country, though this phenomenon is not unique to the United States (European Court of Auditors 2026; Johnson et al. 2023; Green and Jackson 2016). However, conflicting evidence makes it difficult to determine why permitting times are as long as they are, requiring further study to these permitting delays. Furthermore, one of the main points of contention in the permitting discussion surrounds

community engagement and its impact on timelines. It is important to note that eliminating the requirement to engage local communities is unlikely to speed up timelines. Rather, it has been demonstrated to increase the likelihood of litigation in the post-permitting stage, thereby leading to lengthened development times (Ruple and Race 2019).

Lack of Technical Know-how

Finally, given the stunted historical development of the domestic mineral supply chain, the United States lacks both the technical knowledge and the proper specialized workforce to be able to scale up the critical mineral supply chain quickly (Jackson 2023). For example, in 2023, only 312 mining engineers graduated from US universities, though the annual domestic need for this position is estimated to be around 500 over the next decade (SME 2025).

There are also significant gaps in technical knowledge at the federal level, given the large number of positions that have been eliminated in the past year; these staffing losses also contribute to the delays associated with regulations such as permitting and environmental policies. This is because many of these former federal workers played key roles in supporting permitting, mineral mapping, and processing deployments in the Department of the Interior (DOI) and the EPA. Yet these agencies have lost 14,400 and 4,100 staff, respectively, since 2025 (US Office of Personnel Management 2026). Furthermore, the federal government's reductions of $8.2 billion in grants and funding targeted towards higher education (Center for American Progress 2025) further limit the ability of universities to train the next generation of the minerals sector workforce.

On the Value of Maintaining Environmental Regulations

While environmental regulations will impose some costs on the mineral supply chain as it seeks to ramp up, there are still significant benefits to maintaining these regulations which should not be overlooked—not just to the local community and environment, but also to the communities and workers involved. Removing environmental protections alone is not sufficient to provide a clear runway towards success for domestic critical mineral companies.

Ensuring a Sustainable Supply Chain

Given the major environmental and social damages imposed by the mineral supply chain in some countries overseas, onshoring the supply chain provides a clear advantage: the strength of our regulations (and the ability of our government to effectively implement these) allows us the opportunity to produce minerals in a more sustainable manner domestically. As Congressman Pete

Stauber stated in his recent conversation[3] with America First Policy Institute: "These minerals will be mined somewhere. The question is: do we mine them here with our standards, or rely on countries that use child labor and have no environmental protections?"

To his point, removing appropriate domestic protections will eliminate our ability to improve how we mine and process minerals here. However, unless the strength of our governance system is maintained, our regulations won't be able to work as intended; hence the need for well-staffed agencies goes hand in hand with well-structured regulations to ensure a sustainable supply chain. Under-funded and under-staffed government agencies tasked with implementing these regulations will cause unnecessary delays and lengthen development and regulatory approval times, increasing industry costs and risks.

Internalizing the Costs of Emissions Through Regulation

When environmental regulations are structured well, they can serve as a mechanism for companies to identify and quantify the costs associated with their emissions or pollutants, rather than have them paid as societal costs in the form of reduced human health, property damage and devaluation, and harmed ecosystem services. These costs are thus "internalized," meaning that the company assumes responsibility for them as part of its operational expenses. This process encourages businesses to reduce emissions to lower their overall costs, aligning with the "polluter pays principle," which dictates that those who cause pollution are financially responsible for mitigating its effects (Schwartz 2010).

In contrast, inappropriately removing regulations eliminates the incentive for companies to decrease their emissions. However, the actual cost of those emissions does not vanish. Instead, the cost is transferred onto other parties, such as local communities or the broader environment. The consequences imposed on these communities can be significant, as mining and processing can emit a variety of pollutants—including airborne pollutants (such as particulate matter, SO_2, NO_x), waterborne pollutants, and toxics that contaminate the soil (Kříbek et al 2014, Noble et al 2016, Farjana et al 2018, Ruppen et al 2021). All of these can have severe health effects, such as increased premature mortality, cancer, and other illnesses (Fernandez-Navarro et al 2012, Gibb and O'Leary 2014). They can also negatively affect agriculture and fishing jobs (Mensah et al 2015, Esheya and Awolumate 2025).

[3] See https://www.americafirstpolicy.com/issues/congressman-pete-stauber-on-critical-minerals-american-mining-and-the-path-to-energy-security.

Companies also Benefit from Well-Designed Environmental Standards

Corporations can benefit from well-designed environmental regulations that reduce emissions, both broadly and in the workplace. To start, if mining companies are not emitting (or significantly limiting their emissions of) air pollution or toxics, the surrounding area will be a more attractive place to live, thereby improving quality of life for surrounding communities. This is important if companies want to attract a highly educated and trained workforce. In many parts of the country where mineral resources exist, surrounding areas are underdeveloped and very rural; thus, the companies need to attract and retain workers. Ensuring quality of life is key to retention, and a clean environment is part of that attraction (Weinstein et al. 2023).

Furthermore, there is ample evidence that exposure to toxics and emissions from the mining and processing sector increases worker illnesses (Nuhu 2012; Keyser et al. 2019; Nesbitt 2022; Fadeev et al. 2024). Thus, clean air, improved worker health and safety outcomes, and reduced exposure to hazardous materials help boost worker performance and reduce sick leave, leading to increased output for the company (Chai et al. 2020; Hemmati and Shahraki 2025).

Finally, innovation along environmental dimensions can also lead to reductions in cost[4]. For example, Rock Zero, a start-up spodumene processing company has developed technology that eliminates the need to roast and leach the rock—a process that typically requires very high heat and lots of electricity—thereby avoiding emissions. The company also has developed an approach to recycling the reagent, reducing liquid waste and operating costs. Because of these innovations, Rock Zero claims that it is able to process lithium at a much lower cost. Thus, this innovation not only reduces air, toxic and water emissions, but also appears to do so at a fraction of the cost of traditional methods, allowing hardrock to be as competitive as brine sources. Environmental regulations can provide similar companies with an incentive to enter the market (Zhang et al. 2024).

Policy Options to Spur Domestic Mineral Supply Chains

Given the challenges that the industry faces in scaling domestically, the question that we should be asking is thus: what are the most effective policies to spur US mineral supply chains? And can we achieve this objective without sacrificing the environment and the wellbeing of communities?

[4] More broadly, innovation can also help offset the cost of environmental regulatory compliance for companies that incur costs (see, Harrington, Morgenstern, and Nelson 2000, 2010; Simpson 2014), though the extent to which the cost is offset may be limited (Ambec et al. 2013).

Improve Efficiency of Permitting

One way in which permitting timelines can be shortened is through targeting efficiency improvements. For example, increasing cross-agency collaboration and implementing concurrent reviews could speed up timelines without skipping important steps of community engagement or regulatory review. Other options for improving the efficiency of permitting in a beneficial manner can be found in the Interagency Working Group (IWG) on *Mining Laws, Regulations, and Permitting's 2023 report* (US DOI 2023).

A key note here is that improving efficiency of permitting does not mean foregoing environmental or social best practices. In fact, in the Interagency Working Group's report, the section on "*improving coordination and efficiency during the [National Environmental Policy Act (NEPA)] and permitting process*" includes the following recommendations:

- "Prioritize plans that maximize best environmental and social practices" (p.110),
- "Incentivize or require social impact and community benefit planning documents" (p. 112),
- "Provide more specific procedures for engaging with communities with environmental justice concerns during and outside of the plan approval and NEPA process." (p. 113); and,
- "Develop more inclusive policies for stakeholder engagement." (p. 114).

Thus, improving efficiency of permitting can in fact mean leaning into the environmental and social dimensions of the process, rather than circumventing them.

Boost Technical Know-how and Workforce development

Many of the programs to develop the supply chain workforce have been led by states and regional groups, such as LiTHIUMLEARNS/LiTHIUMWORKS in Arkansas or the Nevada Tech Hub. The federal government can support these programs through targeted grants and also support higher education—such as graduate programs for more technical training (i.e., chemical engineering)—through increased grant funding and targeted scholarships. US workforce education can also be supported through continued funding of the Department of Education and the National Science Foundation.

More broadly, investing in the federal workforce that supplies technical support to the mineral industry will be fundamental. This includes staff in the US Geological Survey (USGS) (who participate in mapping mineral resources), in the EPA and Bureau of Land Management (BLM) (who work on permitting), and the Department of Energy (DOE) (who work on innovation resources).

Investing in R&D and Innovation

The United States is a powerhouse when it comes to innovating and does not have a shortage of start-up companies working to innovate along the supply chain. Yet, we struggle to bring these companies to scale. Investing in research and development and innovation broadly and working to overcome the valley of death that so frequently leads to these companies failing to enter the market can help the United States leapfrog Chinese technology—leading to lower costs, lower emissions, and global competitiveness. This is important also because if we invest in these companies, though some will fail, those who do not will be able to stand on their own without market support in the future. If we continue to only invest in companies with "tried and true" technologies that require subsidization to compete in the market, we will always be at the mercy of market volatility and will face high fiscal costs for the foreseeable future.

Connecting the Upstream and the Downstream Sides of the Supply Chain

Investing in the supply chain requires consideration of the entirety of the supply chain. By linking the upstream and downstream sides of the supply chain domestically, we can create a stable flow of materials and demands that are less affected by the variations in the global market.

For example, when battery manufacturers have strong expectations of growing demand, they will make investments in manufacturing plants and will require mineral inputs for their battery components. These manufacturers can then enter into off-take agreements, joint ventures, or vertically integrate with mineral producers to secure long-term supply of minerals at stable prices.

For battery manufacturers, ensuring stable prices is fundamental for their viability due to stickiness in technology; meaning, it is both very expensive for battery manufacturers to change battery chemistries when mineral prices fluctuate and it also takes time for them to adjust their manufacturing approaches to change battery chemistries[5]. This makes them vulnerable to price shocks. To that end, entering long-term price contracts with mineral producers can insulate them from these price shocks and allow them to avoid having to make costly infrastructure investments (e.g., building out several different battery chemistry assembly lines) to hedge against future price variations in the minerals markets.

On the upstream side of the market, having this type of off-take agreement creates a stable price over a pre-determined period. Without the agreement in place, mineral producers are subject to price volatility. When mineral producers are exposed to sustained low prices, this can lead to shutdowns, as witnessed both with the Jervois cobalt mine and the Sibanye Stillwater mine in Montana that went

[5] Different battery chemistries exist that allow manufacturers to use different amounts or types of minerals. For example, LFP (lithium iron phosphate) batteries do not use cobalt in their cathode active material, while NMC (nickel manganese cobalt) batteries do.

into care and maintenance in 2024 after a prolonged period of low palladium and platinum prices. By utilizing off-take agreements, supported by sustained high demands for materials that require mineral inputs, we are more likely to stabilize domestic mineral markets and also be able to promote more jobs in manufacturing all along the supply chain.

Conclusion

In conclusion, building a domestic critical minerals supply chain is a bipartisan goal—but it requires recognizing the binding constraints domestic mineral producers and processors face. These challenges include high input costs (such as labor, electricity, and construction materials), low and volatile global mineral prices, long development timelines driven in part by permitting, and a limited pool of specialized technical know-how and trained workers. To that end, policies focused on improving permitting efficiency (without sacrificing meaningful community engagement, which can reduce the risk of post-permitting litigation delays), investing in workforce development, supporting R&D and innovation, and ensuring strong demand for downstream products are more likely to expand domestic supply than weakening environmental safeguards. Furthermore, well-designed environmental policies, paired with a strong governance system that includes well-staffed and well-trained federal agencies capable of implementing those policies, can protect communities, support long-term competitiveness, and help ensure sustainable supply chains.

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