A Global Race to the Top

Using Transparency to Secure Critical Mineral Supply Chains

March 2023

SAFE

The Ambassador Alfred Hoffman, Jr.
Center for
Critical Minerals
Strategy

Acknowledgements

Many experts assisted the SAFE team throughout the creation of this report.

Thanks especially to all the partners of SAFE's Center for Critical Minerals Strategy, with special thanks to Natural Resources Canada and the Government of Québec for their support. In addition, we extend our deepest gratitude to Sam Riggall and Bronwyn Flynn from Sunrise Energy Metals, Stephen D'Esposito from Resolve and Regeneration, the Mining Association of Canada, and the Minerals Council of Australia for their help and expertise on mining regulations and standards. We also thank the team at the Silverado Policy Accelerator their guidance on trade. Thanks also to Benchmark Minerals Intelligence and Steve LeVine from the Information and The Electric for their data contributions. We also extend our appreciation to Allison Shane, former SAFE research fellow, for her hard work and research contributions.

Finally, thanks to everyone who participated in the Minerals Center's 2021 and 2022 roundtables. Insights and conclusions reached during those events were key to helping us craft this report.

We could not have completed this without your insightful input, and we thank you for your generous contributions.

Sincerely,

The SAFE Center for Critical Minerals Strategy Team

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Executive Summary

The world is becoming increasingly electric, connected, and autonomous; transitioning toward a future powered by batteries and run using electronics that will require an ever-growing supply of critical minerals. From the Ford F-150 Lightning to the F-35 fighter jet, critical minerals already power and form the basis of our most advanced technologies and almost every facet of our everyday lives. In the coming decade, where these minerals come from and how they are produced will have profound consequences on America's national security and economic competitiveness.

Today, the People's Republic of China (China) dominates nearly all aspects of the critical mineral supply chain—from mining and mineral processing to advanced component production, manufacturing, and recycling. Chinese-owned companies have strategically purchased stakes in major mineral deposits around the world, control anywhere from 60 to 100 percent of processing (depending on the mineral), and produce upwards of 70 to 90 percent of the world's battery components.[1]

China's commanding position reflects a well-funded, planned, and coordinated national strategy from the ruling Chinese Communist Party (CCP) to accelerate its dominance in transportation, energy, and technology sectors that will increasingly depend on access to critical minerals and materials.[2] It also reflects a broader market failure—buoyed by opaque supply chains—to properly account for the true cost of mineral extraction that includes the toll on workers and the environment. This has subsequently disadvantaged responsible producers with higher labor and environmental compliance expenses and reduced America and its allies' ability to prevent and dislodge China's firm grip on the global supply chain for critical goods.

Recent efforts by the U.S. government have sought to mitigate Chinese dominance and spur more domestic and allied production of critical minerals. Most recently, these include new grant programs and federal tax incentives within the Infrastructure Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL), and the Inflation Reduction Act (IRA). However, the United States will not be able to loosen the CCP's grip in a meaningful way without much closer collaboration with allies and like-minded international partners. This should include new standards-based trading arrangements for the vital downstream transportation, energy, and defense sectors upon which the U.S. economy relies.

This report examines the extent to which the United States can work with major allies and, per IRA requirements, countries with which it shares a free trade agreement, to generate new, globally distributed critical mineral supply chains that are not dependent on the CCP to access the building blocks of a more electrified, connected, and autonomous future. This report also examines how a shared agreement among these countries to require responsible mining standards as a condition of market access—or financial penalties for failure to meet those standards—will be necessary to achieve a measure of cost parity for developing mining projects outside of CCP control.

Today, the clearest signals of society's shift toward greater electrification, as well as the harbingers of a larger transformation to a critical minerals-based

1 SAFE, *Commanding Heights of Global Transportation*, September 2022, at paged 40 to 45; and SAFE analysis based on data from Benchmark Minerals Intelligence.

2 Cindy Hurst, "China's Rare Earth Elements Industry: What Can the West Learn?" Institute for the Analysis of Global Security, 2010.

A worker checks the cables on the battery for Ford Motor Co. battery powered F-150 Lightning trucks under production at their Rouge Electric Vehicle Center in Dearborn, Michigan on September 20, 2022.

economy, have been the change in consumer attitudes and the flurry of industry investments in favor of EVs. The number of EVs on the road has more than tripled from around five million in 2018 to more than 16 million in 2021.[3] Global automakers, sensing the coming wave of consumer demand, have pledged to spend at least $860 billion on EV and EV battery production through 2030.[4] Only $100 billion of those investments are slated for the United States. While this is a large increase compared to 2019, when original equipment manufacturers (OEMs) had only earmarked $34 billion of the $300 billion planned investments for the United States, America is still relatively behind in the race to electrify.[5]

Only around one percent of vehicles on the road in America are electric.[6] U.S. targets for automotive electrification through 2030, mostly voluntary, are only half of what they are in China and the European Union (EU). The Biden Administration is currently aiming for 50 percent of all new vehicles sold by 2030 to be electric.[7] China, by comparison, is aiming for all new vehicles sold by 2035 to be eco-friendly (either electric, plug-in hybrid, or fuel cell vehicles) and recently surpassed Germany to become the second-largest EV exporter in the world.[8] The EU targets go even further by attempting to ban the sale of internal combustion engine (ICE) vehicles beginning in 2035.[9]

The risks associated with missing the electrification wave are high. First, the United States cannot afford to jeopardize the future viability of its domestic automotive sector, which directly and indirectly accounts for roughly five percent of its gross domestic product (GDP) and contributes more than one trillion dollars to its economy each year.[10] Second, as a matter of economic and national security, the U.S. transportation sector cannot continue to rely so heavily upon oil, which is tied to a volatile global market subject to geopolitical disruptions and manipulation by the Organization of the Petroleum Exporting Countries (OPEC) and its allies like Russia. Finally, securing responsible and sustainable access to the minerals, materials, and components necessary for EVs will, in turn, ensure reliable access for other mineral-reliant industries, such as clean energy technology and advanced weapons systems.

As the COVID-19 pandemic and the war in Ukraine have shown, highly concentrated supply chains are unpredictable and leave key sectors

3 International Energy Agency (IEA), Global EV Outlook 2022, May 2022, at page 4; SAFE analysis using IEA data. International Energy Agency; and "The Role of Critical Minerals in Clean Energy Transitions," Revised March 2022.

4 Noah Gabriel, "$210 Billion of Announced Investments in Electric Vehicles Manufacturing Headed for the U.S.," Atlas EV Hub, January 12, 2023.

5 Paul Lienert and Christine Chan, "Reuters Analysis of 29 Global Automakers Found That They are Investing at Least $300 Billion in Electric Vehicles, With More Than 45 Percent of That Earmarked for China," Reuters, updated April 4, 2019.

6 International Energy Agency, "Global EV Data Explorer," last updated May 23, 2022.

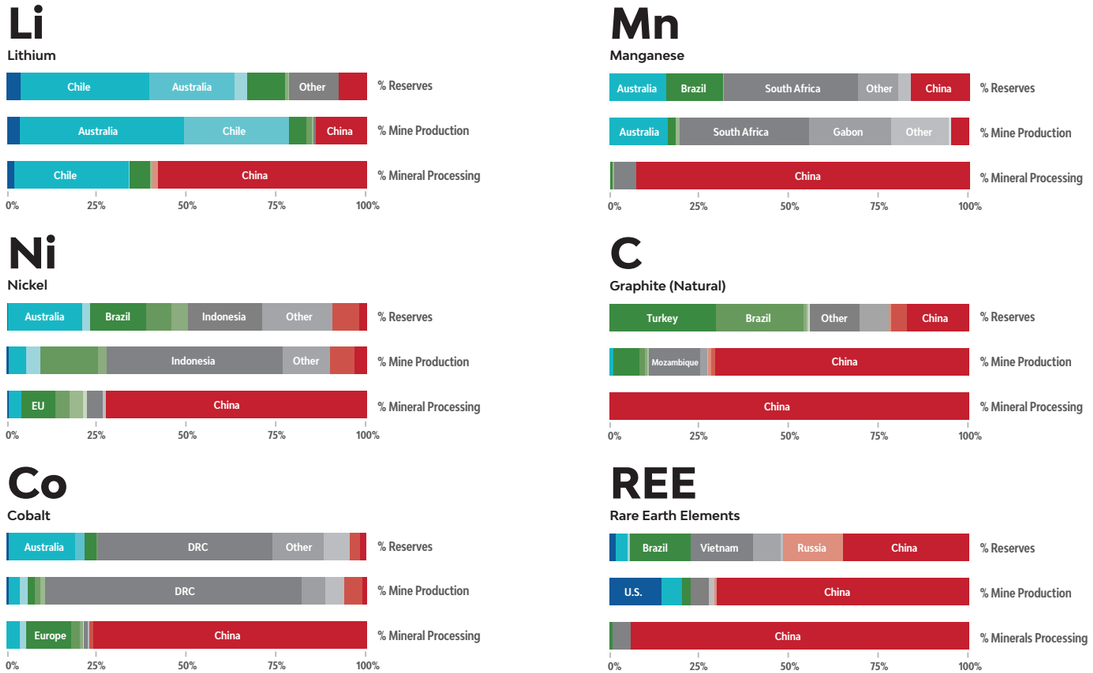
7 E.O. 14037 of Aug 5, 2021.

8 See e.g., SAFE, *The Commanding Heights of Global Transportation*, September 2020, at pages 27-35; and Daniel Ren, "China Closes Gap with Japan After 2022 Car Exports Surpass Germany with 54.4 Per Cent Surge to 3.11 Million Vehicles," South China Morning Post, January 15, 2023.

9 Frank Jordans, "Germany Threatens to Hold Up EU's Combustion Engine Car Ban," Associated Press, February 28, 2023.

10 The Alliance for Automotive Innovation, "Driving the U.S. Economy," Webpage.

Figure 1 Key Mineral Reserves, Mine Production and Processing, 2022



Note: While China does not possess a natural geological advantage for every critical mineral required for electric vehicles (EVs), it does dominate critical minerals processing—the steps necessary to convert raw materials into usable compounds or goods.
Source: U.S. Geological Survey and Benchmark Minerals Intelligence.

vulnerable to disruption—whether due to natural causes (hurricanes, earthquakes, tsunamis, etc.) or human causes (wars, embargoes, hoarding, etc.). Consequently, only through diversifying supply chains and eliminating dangerous concentration can the United States ensure reliable, resilient access to the materials and components needed for its national defense and economy.

At the heart of creating more diverse critical mineral supply chains is the ability to economically and responsibly obtain the raw or recycled materials needed to support key industries. Recycling alone will not be able to satisfy society's rising demand in the near term, and although the existence of raw material to mine is not a critical chokepoint in and of itself, extracting it economically and achieving the social license to do so responsibly is. Furthermore, overcoming the true chokepoint in the critical mineral supply chain—mineral processing[11]— cannot be fully addressed until the United States and its allies determine where they will get the material to process and how to get it in a way that does not leave them overly reliant on strategic competitors.

The International Energy Agency forecasts demand for critical and strategic minerals like lithium, cobalt, nickel, neodymium, and copper to increase rapidly through 2040. The largest increase is expected in lithium, which could see a seven-fold rise in demand through 2030 mostly driven by EV deployment.[12] The current small market share of EVs coupled with EV batteries' long lifespan (on average between 10-20 years) suggests that society will not likely be able to meet the rising demand for critical minerals through recycling alone.[13] Despite this current challenge, battery recycling will be essential for obtaining the materials the United States and its allies do not possess naturally and for minimizing mining's substantial environmental footprint in the long term. The creation of a circular economy, in which waste can be recaptured as a resource to be used again and again, will also help relieve supply pressures associated with tight mineral markets.

In the meantime, new mining projects must be financed and developed, and it will be important for affluent countries to begin bearing more of the responsibility of mining by developing projects within their own borders. These projects are capital intensive and can be environmentally destructive if not properly planned, monitored, and remediated. They can cost hundreds of millions—or even billions—of dollars and take upwards of ten years to fully permit in the United States.[14] Presently, to make projects economically feasible, many companies opt to open mines in lower regulatory, lower-income countries that are not subject to the same costly environmental rules as more highly regulated, higher-income countries. In some cases, this has resulted in grievous acts committed around the world, including polluted air, land, and water, as well as marginalized and displaced communities.[15]

These grievances are aided and obscured by opaque supply chains that benefit bad actors and limit the ability of good actors to economically compete. Historically, businesses reliant upon critical mineral-based products, including EVs and EV components, had very little visibility into where their supplies came from and their associated human and environmental costs.[16] This has inadvertently fueled a global "race to the bottom" on prices and standards alike.

For example, some miners in Indonesia are able to produce nickel at a lower cost by cheaply dumping their tailings into the ocean, which pollutes vital marine environments and destroys local livelihoods.[17] Alternatively, in Australia, which is tied with Indonesia for the world's largest nickel reserves, marine tailings disposal is banned, and tailings are instead dealt with on land at a higher cost.[18] As a result, half of the world's nickel comes from Indonesia, while only five percent comes from Australia.[19]

The United States has been similarly impacted. In the 1990s, the United States was a top producer of rare earth elements (REEs), a group of chemical elements vital for electric motors and other defense applications. In the early 2000s, Chinese suppliers flooded the market with lower priced REEs, forcing the sole U.S. producer out of business.[20] Why were Chinese REEs so much cheaper? Partly because they were able to dispose of associated radioactive mine tailings directly into the Yellow River, polluting waterways and the surrounding environment.[21]

To reverse this destructive dynamic, diversify critical mineral supply chains, and create a more secure energy transition, the United States should encourage a global "race to the top" among allies and likeminded nations and create a value proposition for responsible and sustainable production.

11 Note: Mineral processing includes the crushing, separation, dewatering, and refining of mineral-bearing ore into metal concentrates and metallic compounds. Methods include pyrometallurgy (smelting) and hydrometallurgy (leaching or electrowinning).

12 Note: This upper limit for expected increase in lithium demand is based on IEA's Net-Zero Energy policy, which assumes that global EV sales will increase from 6.6 million in 2021 to 60 million by 2030. Source: IEA, *Energy Technology Perspectives 2023*, January 2023, at page 153.

13 See e.g., Angela Moscaritolo, "EV Batteries 101: Degradation, Lifespan, Warranties, and More," PC Mag, June 29, 2022.

14 See, e.g., David Stringer, Yvonne Yue Li, and Gabrielle Coppola, "Tesla's Lithium Lead at Risk as Rivals Make Supply Deals," Bloomberg, November 29, 2022.

15 See, e.g., Terah U. De Jong, Titus Sauerwein, and Ludivine Wouters, "Mining and the Green Energy Transition: Review of International Development Challenges and Opportunities," USAID, November 2021.

16 SAFE Roundtable Discussion, "Sources, Standards, and Trade: An Outlook for Raw Materials for the EV Supply Chain," April 19, 2022.

17 See e.g., Muhammad Rushdi, et al., "Fast and Furious for Future: The Dark Side of Electric Vehicle Battery Components and Their Social and Ecological Impacts in Indonesia," Dialogue Program Climate Justice Manila/Philippines, 2022.

18 See, e.g., Tracy Shimmield, "An Alternative: Deep-Sea Tailings Placement," Australian Mining, May 30, 2013.

19 SAFE calculations based on data from U.S. Geological Survey.

20 U.S. Department of Defense, Office of Industrial Policy, "Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States," September 2018.

21 Cindy Hurst, "China's Rare Earth Elements Industry: What Can the West Learn?" Institute for the Analysis of Global Security, 2010.

This aerial picture taken on February 11, 2023, shows a mangrove area amid contaminated seawater in Pomalaa in southeast Sulawesi, Indonesia. The dig site is part of a huge rush by domestic and foreign enterprises to mine critical minerals used in electric vehicle batteries.

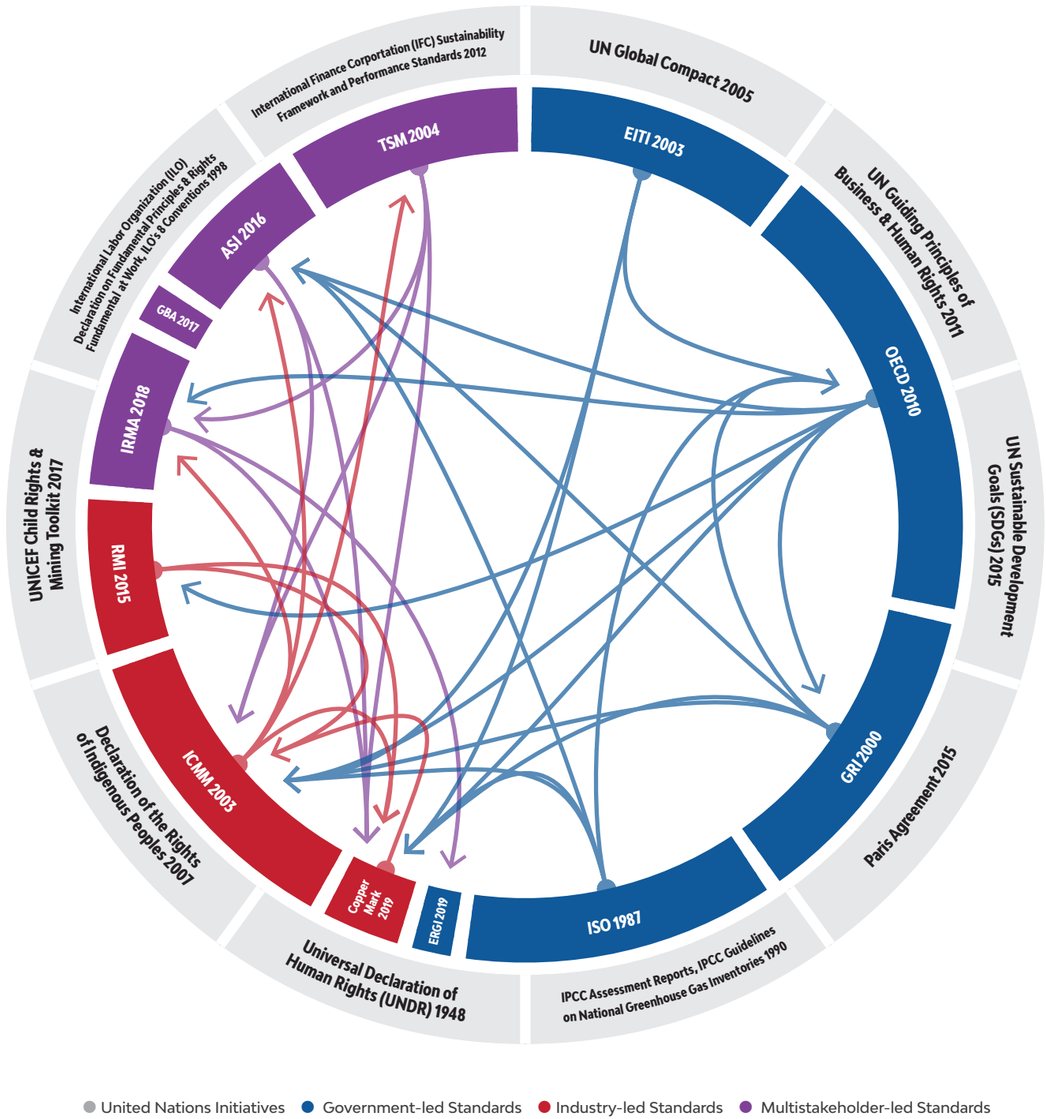
Rather than prioritizing short-term costs and undercutting the competition to find the cheapest and most convenient product, countries should prioritize long-term resiliency and support high standards for environmentally and socially produced goods. This approach, coupled with radical transparency afforded by new technologies, will raise the bar for all, accurately reflect the costs associated with mining, and benefit responsible actors within the United States and around the world by removing the unfair cost advantages that opaque supply chains previously afforded bad actors.

A global effort led by top producing and consuming countries is necessary because the raw materials needed to meet EV targets cannot be met from U.S. and allied production alone. If attempted unilaterally, these higher standards will have little to no effect on industry behavior and supply chains will remain dangerously concentrated. This is because non-participating entities will continue to purchase minerals that cost the least, providing no incentive for irresponsible miners to increase their standards and continuing to make the premium for responsibly produced goods uneconomic. Furthermore, the current lack of transparency enforcement mechanisms means consumers are unable to determine why a particular product is priced higher than another. This leads many consumers to favor the cheaper product, which was likely produced with irresponsible mining practices to reduce costs, perpetuating the global race to the bottom.

Alternatively, if implemented among allies, particularly those with large, tech-driven economies, responsible sourcing standards can change global behavior. For instance, if the United States, Japan, and the EU—three of the world's largest economies and the largest auto markets outside of China—agreed to only source minerals produced with high standards, the rest of the world would have to follow suit.[22] Consequently, the premium for responsibly produced minerals would dissipate over time, as all mineral producers would be incentivized to raise their standards to sell their products into American, Japanese, and European markets. This, combined with robust transparency and traceability frameworks to ensure adherence and limit manipulation, will help level the global playing field, removing the CCP's unfair advantage and enabling the diversification of critical mineral supply chains that is desperately needed.

22 SAFE analysis based on data from the World Bank and European Automobile Manufacturers' Association.

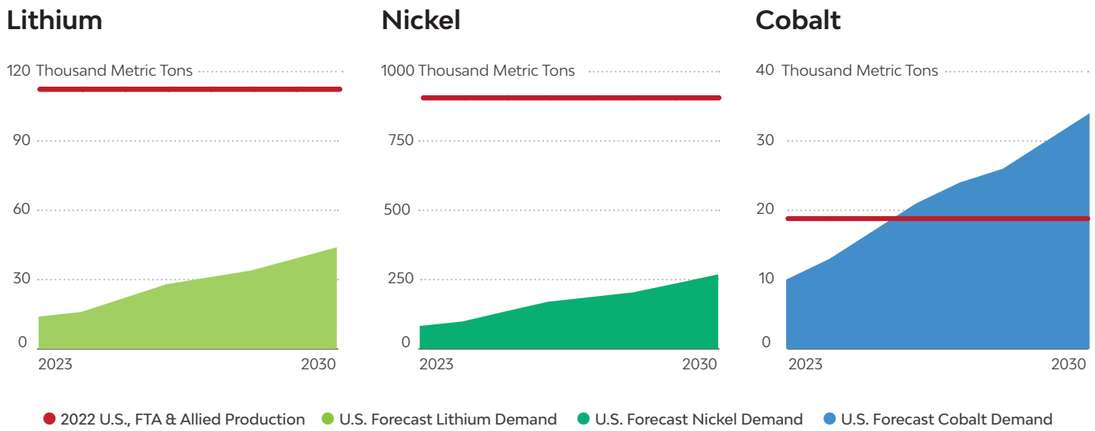
Figure 2 The Interrelationship Between Voluntary Large-Scale Mining Standards



Note: While many mining standards exist, they often cite one another and reference existing United Nations (UN) principles, declarations, and agreements. This leads to a surprising amount of agreement among disparate standards. The connecting lines in the figure show which standards are referenced by other standards. For example, the OECD Due Diligence Guidance is referenced in the ASI, IRMA, RMI, ICMM, Copper Mark, and GRI standards.

Source: SAFE analysis based on a comparison of voluntary large-scale mining standards.

Figure 3 FTA and Allied Production and U.S. Forecast Demand



Note: Based on 2022 mine production levels, U.S., FTA and allied supply of lithium and nickel will be greater than projected U.S. demand for electric vehicle applications through 2030. However, U.S. automakers do not only sell to U.S. markets. Therefore, more reserves will need to be developed.

Source: SAFE analysis based on data from USGS, S&P Global, Benchmark Minerals, and WoodMac.

Achieving this goal will require a mutual understanding of what responsible mining looks like and an enforceable commitment to executing and proving adherence to those standards. This entails adherence to basic principles that are seen throughout most voluntary mining standards: earlier and more frequent community and tribal engagement, including the meaningful participation of those groups in the planning and development processes; baseline water measurements and disclosure of water quality and usage; and, detailed mine closure plans made in consultation with affected communities combined with financial assurance for reclamation costs. Most important, however, will be shifting the focus from ad hoc voluntary standards to enforceable statutory requirements implemented among governments.

Trade agreements, and the enforceable dispute settlement mechanisms established within them, will be a useful tool to expand responsible mining practices. While trade agreements have historically been implemented economy-wide, there is a growing movement to have them be more sector specific. Narrowing the scope of trade agreements could allow for increased international cooperation while potentially avoiding decades-long negotiations that have plagued the formation of such agreements in the past. Precedent already exists within the World Trade Organization (WTO) for commodity-specific agreements. If the United States Trade Representative (USTR) were to implement EV-specific trade agreements among allies and other likeminded nations, it could provide a legally binding, enforceable, and sanctionable way to achieve our shared goals and protect our collective values and interests. The United States-Mexico-Canada Agreement (USMCA) renegotiated during the Trump Administration already includes chapters on environmental and labor protections to ensure a fair exchange of goods. Similar arrangements can be negotiated with the EU and Japan and apply to FTA countries like Korea, Australia, and Chile.

Blockchain and other traceability platforms could be used to track mineral materials all the way from extraction through to vehicle assembly and onto recycling. Projects are already underway that show the origin and production journey of critical minerals that end up in EV batteries, including their environmental and labor production characteristics like emissions profiles and exposure to forced labor.[23]

Moreover, authority currently granted to some U.S. federal agencies can be expanded to ensure that various mineral-intensive products imported into the United States comply with its standards, or agreed upon standards within a trade agreement. Currently, the U.S. Department of Agriculture (USDA) is authorized to conduct international site visits to ensure food products imported into the United States comply with our safety regulations. Congress should authorize the Bureau of Land Management (BLM), in concert with the Mine Safety and Health Administration (MSHA), Environmental Protection Agency (EPA), and other relevant federal agencies, as needed, to perform similar site visits at mines to ensure compliance with U.S. responsible mining standards. This could even be leveraged among countries with which the United States does not share a trade agreement.

Ultimately, transparent knowledge of where mineral materials come from and at what human and environmental cost, all the way down to the consumer level, will help accurately reflect the costs associated with responsible production. Adding a digital identifier with relevant information on the mineral production processes to the Monroney label, the window sticker on vehicles sold within the United States, can help achieve this. Clearly displayed sourcing information on the window sticker of EVs for sale will empower consumers to make informed purchasing decisions based on more than just the price tag. Consumers would be able to discern where the minerals and materials in their desired vehicle come from so that they reflect their values.

While fully implementing some of these policy provisions may take time, there is ample opportunity for the United States, its allies, and countries with which it has trade agreements to start increasing capacity and developing new supply chains that uphold adherence to high standards. Many of these countries already possess large reserves of critical minerals and implement high environmental and labor standards codified within their own laws. For example, working with close allies like Canada and Australia, mineral-rich countries with which the United States has deep military ties, is an immediate way America can insulate itself from overly concentrated critical mineral supply chains.

However, in the long run, the United States and allies will need to work with all countries to meet the need for critical raw materials to feed their tech-driven economies.

Finally, streamlining America's notoriously cumbersome permitting process can make an immediate impact in moving domestic mineral projects forward at the speed of relevance.

The EV market and the transition to a minerals-based economy are still in their relative infancy. There is still an opportunity, however fleeting, to shape the future of this market and its geopolitical, environmental, and economic impacts. Further delay—whether caused by bureaucratic inertia, partisan gridlock, or other financial and parochial interests—will only hamstring the overdue energy and transportation transition and ultimately cause our nation to fall further behind those with hostile strategic interests.

23 See, e.g., Trafigura, "Trafigura and Circulor to Provide Carbon Emissions Tracking and Traceability Via Blockchain to Nickel and Cobalt Supply Chains," Press Release, October 7, 2021.

The Race for the Electric Future

The global transition to a minerals-based economy is underway, fueled by the digitization of the economy and the proliferation of mineral-intensive advanced energy technologies. The drivers of this transition and the ideal endpoint are subject to debate. However, one thing is clear: the world's appetite for minerals is surging and will only continue to grow. Who will supply the minerals and minerals-based technologies that will define the 21st-century economy? Electric vehicles and their supply chains provide a useful case study to identify the benefits and threats of this transition.

Over the last decade, global EV sales have risen sharply, driven in large part by improvements in performance, reductions in cost, and availability of models. From 2018 to 2021, the number of EVs on the road more than tripled, surging from approximately five million in 2018 to more than 16 million in 2021.[24] Automakers worldwide, hoping to capitalize on the emerging EV market, plan to spend approximately $860 billion on the development and production of EVs and EV batteries through 2030.[25]

Governments around the world, also hoping to benefit from the transition to EVs, have released trillions of dollars in federal funding in an attempt to lure investments and generate jobs locally. These recent pledges have contributed to bullish predictions that EVs will reach 20 percent of all vehicles sold by 2030—leading to about 200 million EVs on the road by that time.[26]

Capturing a larger share of the emerging EV market has become a matter of national concern for the United States, whose automotive sector directly and indirectly accounts for roughly five percent of its GDP, contributes more than one trillion dollars to its economy, and comprises the backbone of its manufacturing sector.[27] EVs also represent the most viable pathway to reducing U.S. dependence on oil and reaching true energy security. Recognizing the urgency to act while the industry is still in its infancy, U.S. automakers and government officials have announced ambitious electrification plans and rolled out generous incentive packages to help position themselves favorably for the coming decades.

As EVs gain market share, automakers—and countries—will increasingly compete on lithium-ion battery technology, which requires different supply chains and different skillsets to produce than internal combustion engine (ICE) vehicles.

24 IEA *Global EV Outlook 2022*, May 2022, at page 4; and SAFE analysis using IEA data.

25 Noah Gabriel, "$210 Billion of Announced Investments in Electric Vehicles Manufacturing Headed for the U.S." Atlas EV Hub, January 12, 2023.

26 IEA *Global EV Outlook 2022*, May 2022, at page 5.

27 The Alliance for Automotive Innovation, "Driving the U.S. Economy," Webpage.

EVs for Economic and National Security

Oil is a global commodity traded on an international market that is subject to geopolitical disruption and market manipulation. True and lasting energy security can only be achieved by diversifying the fuels used for transportation, and electric vehicles provide a viable pathway to reduce the transportation sector's use of oil. The U.S. electrical grid's electricity is generated from a rich and diverse portfolio of largely domestic fuels, including natural gas, coal, nuclear, and renewable energy resources like wind, hydropower, and solar.[28] These domestic fuels are priced in regional markets generally isolated from foreign influence, resulting in relatively low and stable electricity prices.

Geopolitically, the ongoing war in Ukraine is just the latest in a long series of conflicts that have affected global oil markets and wreaked havoc on the U.S. economy. Within the first weeks of the invasion, the United States announced a ban on the imports of Russian oil.[29] Revenues from oil and natural gas sales accounted for more than 40 percent of Russia's federal budget.[30] Continuing to purchase Russian oil would have meant funding the war in Ukraine. Following this announcement, the already surging oil prices skyrocketed, and the U.S. benchmark price surpassed $120 a barrel for the first time since 2008.[31]

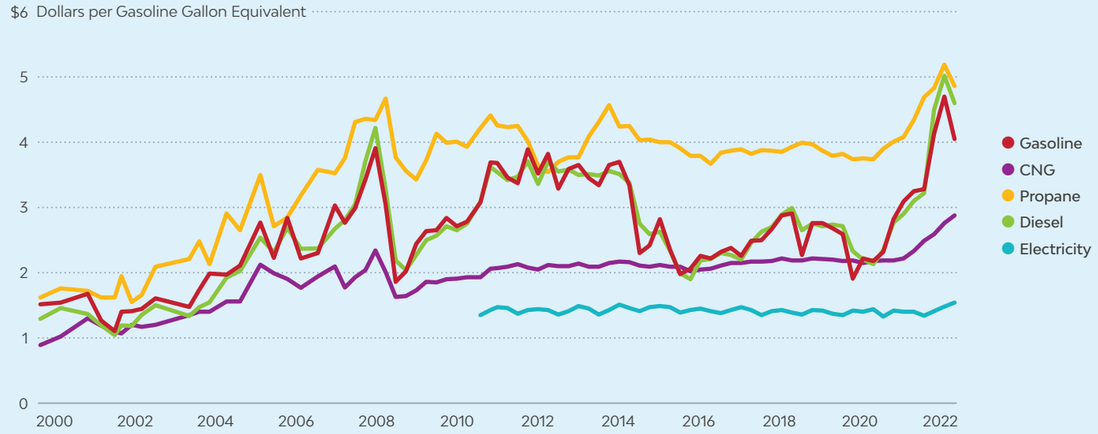
In addition to geopolitical conflicts, the biggest driver of oil price volatility has been OPEC—more specifically, Saudi Arabia. In the last decade, the kingdom has demonstrated its willingness to use its dominance in oil markets for its own political purposes. For example, in 2014, the Saudis flooded the global market with additional crude oil to harm U.S. producers.[32] Their actions crashed the price of oil from $110 per barrel in June 2014 to just $26 per barrel by February 2016, resulting in more than 200 U.S. energy sector bankruptcies.[33] More recently, Saudi Arabia failed to respond to the turmoil following Russia's invasion of Ukraine. The kingdom decided to support Russian President Vladimir Putin and stick to its OPEC+ agreement to limit oil production despite a visit by President Biden to the kingdom to directly appeal to the royal family to keep oil flowing.[34]

America, the world's largest oil consumer, has been searching for "energy independence" since the 1973 Arab Oil Embargo.[35] For decades, oil price volatility stressed the economy on both the high and low ends: consumers and businesses struggled when prices were too high, and domestic producers struggled when prices were too low, often leading to job losses. In recent years, as the United States became the largest oil producer and a net exporter of petroleum, a narrative developed that it has achieved "energy dominance."[36] The notion that we have meaningfully strengthened our economic and national security by achieving energy independence, however, has been a mirage. As we rediscovered over the past year, domestic production does not provide refuge from global events that impact the oil market, or from the effect of oil prices on our economy.

Regardless of the volume of oil we import, the U.S. transportation sector remains dependent on oil—a highly volatile commodity priced by a global market. Oil powers 90 percent of our nation's cars, trucks, planes, and ships.[37] Given transportation's strategic economic importance in advanced economies, especially one as mobile as the United States, the highly volatile global oil market continues to pose a threat not just for the transportation sector, but the U.S. economy as a whole.[38]

Geopolitical events and non-market actors will continue to threaten American economic competitiveness and national security so long as our transportation sector and economy run on oil.

Figure 4 Average Retail Fuel Prices, 2000-2022



Note: Electricity is cheaper than other alternative fuels and less volatile in terms of price.

Source: Clean Cities Alternative Fuel Price Reports.

People rally in St. Paul, Minnesota to support the Ukrainian people and Ukraine's sovereignty and to stop the war that Russia is waging against them.

28 U.S. Energy Information Administration (EIA), "Electricity Explained: Electricity Generation, Capacity, and Sales in the United States," last updated June 15, 2022.

29 The White House, "Fact Sheet: United States Bans Imports of Russian Oil, Liquified Natural Gas, and Coal," Press Release, March 8, 2022.

30 Josh Boak, "Biden's Russia Sanctions May Let Moscow Profit From Oil, Gas," Associated Press, February 27, 2022.

31 Shariq Khan, "Oil Surges as U.S. Bans Russian Crude, Britain to Phase Out Purchases," Reuters, March 8, 2022.

32 Cyrus Sanati, "Saudi Arabia Hangs Tough on Oil in Fight for its Future," Fortune, December 4, 2015.

33 Samantha Gross, "Is the United States the New Saudi Arabia?," Brookings Institute, January 26, 2018; EIA, "Petroleum and Other Liquids: Spot Prices;" and Gregg Gelzinis, Michael Madowitz and Divya Vijay, "The Fed's Oil and Gas Bailout Is a Mistake," Center for American Progress, July 31, 2020, at page 5.

34 See e.g., "OPEC+ Agrees Deep Oil Production Cuts, Biden Calls It Shortsighted," Reuters, October 5, 2022; and Aamer Madhani et. al., "Biden's Saudi Visit Aims to Balance Rights, Oil, Security," AP News, July 15, 2022.

35 EIA, Short-Term Energy Outlook, Table 4a, February 8, 2022.

36 EIA, "Oil and Petroleum Products Explained: Oil Imports and Exports," and New York Times, "Full Transcript: Trump's 2020 State of the Union Address," February 5, 2020.

37 SAFE analysis based on data from EIA.

38 SAFE, "Overcoming America's Energy Security Mirage," April 2022, at page 3.

China's Battery Dominance

For decades, the CCP has sought to move China up the manufacturing value chain by consolidating control over the rare earth and critical mineral supply chains needed for advanced technologies, including EVs. As early as 1992, Chinese Premier Deng Xiaoping extolled China's relative advantage in critical minerals, explaining, "There is oil in the Middle East; there is rare earth in China."[39] As a result, all roads for critical minerals today lead through the People's Republic—from mining and minerals processing to component production, manufacturing, and recycling. However, this dominance is not absolute. Today, other countries—accelerated by surging demand for EVs, climate pledges, and the war in Ukraine—are beginning to reexamine critical mineral supply chains and undertake sweeping policies to promote their own EV industries. Over the next decade, developing these new diverse streams will be essential to ensuring American competitiveness and national security.

The main determinant of an EV's performance is its battery. At its core, a battery is something that stores chemical energy and converts it into electric energy. The basic unit of a battery is the cell, consisting of a negatively charged anode, a positively charged cathode, and an electrolyte—or a medium through which ions are exchanged.[40] Energy is generated when electrons flow from the anode to the cathode. Battery cells can be assembled into larger battery modules, and battery modules can further be constructed into battery packs. For example, the BMW all-electric i3 contains a total of 96 battery cells that are combined into eight battery modules that form one battery pack.[41] How automakers arrange batteries within their vehicles greatly influences vehicle performance, capacity, and lifespan, giving different EV manufacturers a competitive edge.[42]

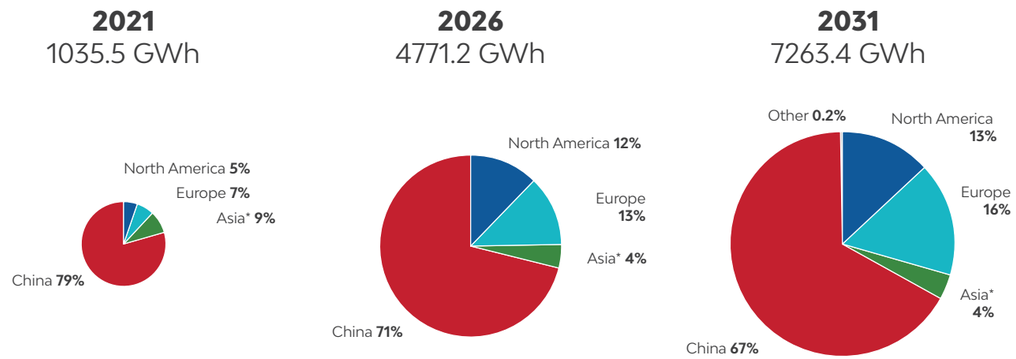
While incumbent U.S. automakers were pioneers in gasoline-powered ICE technology, they are laggards in EV battery technology. By comparison, Chinese companies, which for years had built smaller batteries to power consumer electronics, were able to leverage their institutional knowledge to master producing larger batteries to power EVs. Today, Chinese battery giants Contemporary Amperex Technology Co., Ltd (CATL) and Build Your Dreams Co., Ltd (BYD) are the first and second-largest EV battery makers in the world, respectively, with nearly 50 percent of total market share.[43] By 2032, China is expected to maintain its market dominance with more than 4,800 gigawatt hours (GWh) of annual battery production capacity—approximately 67 percent of all forecasted battery cell manufacturing capability.[44]

A latecomer to the automotive sector, the CCP long struggled to compete with established carmakers that had been manufacturing and refining internal combustion engines for decades. Alternatively, EVs encompassed a new kind of technology that required fewer moving parts, removing many of the advantages held by American, German, and Japanese legacy automakers. This provided an opportunity for Chinese companies to compete on a more advantageous playing field and leapfrog foreign competitors focused on ICE vehicles.

In 2006, China began implementing policies to incentivize private companies to produce EVs.[45] China's Ministry of Science and Technology (MOST) and the National Development and Reform Commission (NDRC) launched preliminary programs to fund EV research and development. The first such program, Project 863, or the National High Technology Research and Development Program, provided funding for more than a dozen high-tech industries, including $174 million for EVs, which was the first substantial allocation of funds toward EV development.[46]

Following its significant investments to develop its EV technology, China soon turned to policies that could stimulate demand. It began testing EV subsidies for consumers in five major cities as early as 2009.[47] In addition to these subsidies, EV buyers also received benefits such as faster and cheaper license plate registration, free or preferential parking, and exemption from driving restrictions.[48]

Figure 5 Battery Capacity by Region, 2021-2031, estimates as of September 2022



Note: Despite announced investments in U.S. and EU battery manufacturing capacity, China is poised to maintain its market dominance throughout the decade.

Source: Benchmark Mineral Intelligence

Employees assemble lithium-ion batteries at a factory on November 14, 2020 in Huaibei, Anhui Province of China.

39 Cindy Hurst, "China's Rare Earth Elements Industry: What Can the West Learn?" Institute for the Analysis of Global Security, 2010.

40 University of Washington, "Components of Cells and Batteries," Webpage accessed June 28, 2022.

41 Samsung SDI, "The Composition of EV Batteries: Cells? Modules? Packs? Let's Understand Properly!," Webpage accessed June 28, 2022.

42 M.F.R. Zwicker, et al., "Automotive Battery Pack Manufacturing – A Review of Battery to Tab Joining," Journal of Advanced Joining Processes, Volume 1, March 2020.

43 See, e.g., Chris Randall, "One Third of the World's EV Batteries Comes From CATL," electrive.com, August 8, 2022; Heejin Kim, "BYD Keeps No.2 Rank in Global Electric Vehicle Battery Market," Bloomberg, October 5, 2022.

44 Benchmark Mineral Intelligence analysis presented at *Battery Gigafactories USA 2022 Conference*, June 23-24, 2022.

45 Shiqi Ou et al., "A Study of China's Explosive Growth in the Plug-in Electric Vehicle Market," Oak Ridge National Laboratory, January 2017.

46 U.S. Chamber of Commerce, "Made in China 2025: Global Ambitions Built on Local Protections," 2017; and IEA, "Hybrid and Electric Vehicles: The Electric Drive Captures the Imagination," March 2012.

47 Christopher Marquis et. al, "China's Quest to Adopt Electric Vehicles," Stanford Social Innovation Review, Spring 2013.

48 David Sandalow, *Guide to Chinese Climate Policy 2019*, Columbia Center on Global Energy Policy, September 2019, at pages 95-97.

Figure 6 Global Percentage Share of EV Battery Production, 2022

STAGE 1
MINING

	China	U.S.	FTA	Major Allies*	Other
Nickel	3%	1%	9%	18%	69%
Cobalt	1%	<1%	7%	4%	88%
Graphite	65%	–	3%	8%	25%
Lithium	15%	1%	77%	7%	1%
Manganese	5%	–	18%	2%	76%
Rare Earths	70%	14%	6%	2%	8%

STAGE 2
CHEMICAL PROCESSING

	China	U.S.	FTA	Major Allies*	Other
Nickel	72%	1%	7%	14%	5%
Cobalt	75%	–	6%	15%	4%
Graphite	100%	–	–	–	–
Lithium	58%	2%	32%	6%	1%
Manganese	93%	–	–	1%	6%
Rare Earths	94%	–	–	1%	5%

STAGE 3
BATTERY COMPONENT PRODUCTION

	China	U.S.	FTA	Major Allies*	Other
Cathode Production	74%	<1%	16%	9%	–
Anode Production	92%	–	4%	4%	–

STAGE 4
BATTERY CELL PRODUCTION

	China	U.S.	FTA	Major Allies*	Other
Lithium-Ion Battery Cell Manufacturing	76%	6%	8%	8%	2%

Note: "Major Allies" consists of NATO allies, countries designated or treated as major non-NATO allies (MNNAs), and EU member states. If a major ally also has an FTA with the United States, it is listed under FTA countries (Australia, Bahrain, Morocco, and South Korea). Production data for Russia and North Korea are listed under "Other." In 2022, Russia produced seven percent of global nickel supply and around five percent of global cobalt supply. Neither Russia nor North Korea produces EV batteries or associated components.

Source: U.S. Geological Survey and Benchmark Mineral Intelligence.

Beijing also continued to refine policies to support EV component manufacturing and provided low interest loans to potential EV makers.[49] These efforts have been successful in making China the world's largest market for EVs: half of all EVs sold in the last decade have been sold in China, and EVs now account for 16 percent of all vehicles on the road in China, compared to just one percent of vehicles on the road in the United States.[50]

Strong and growing domestic demand combined with Beijing's whole-of-nation industrial policy has allowed Chinese companies to corner the global supply chain not just for battery manufacturing, but also for the midstream component production, minerals processing, and the mining required to create batteries.[51] For example, China produces approximately 74 percent of the world's cathodes and 92 percent of the world's anodes.[52] It also processes anywhere from 60 to 100 percent of all the minerals needed for batteries and electric motors, and it has been strategically investing in mineral deposits all around the world.[53] This manufacturing and raw material prowess has assured China's ascendence in battery production, helped to establish the region's technological leadership, and increased the concentration of battery production facilities, improving their efficiency and cost competitiveness. All of this has made China a formidable player in the race to electrify.

49 Ibid.

50 SAFE analysis based on data from IEA's Global EV Outlook 2022.

51 SAFE, *Commanding Heights of Global Transportation*, September 2020, at pages 27 to 46.

52 Data from Benchmark Mineral Intelligence.

53 SAFE analysis based on data from Benchmark Mineral Intelligence; and Jon Yeomans and Fred Harter, "Who owns the Earth? The Scramble for Minerals Turns Critical," The Times, May 1, 2022.

U.S. and Allied Efforts to Diversify Supply

Despite the CCP's current dominance of critical mineral and battery supply chains, their supremacy is not inevitable. Much of their competitive advantage is due to strategic policy decisions and opaque supply chains that have allowed them to extract and process minerals at a lower cost often at the expense of the environment and workers, as opposed to natural geologic advantage.

Sensing an opportunity, many countries, including the United States, are beginning to examine policies and implement sweeping legislation to incentivize upstream production and downstream demand to fuel investments in domestic mining, processing, manufacturing, and recycling in an attempt to insulate themselves from dependency on Beijing. However, these efforts are likely to fall short without coordinated action among the United States, its allies, and partners.

Unilateral actions taken by countries like Canada, Australia, and those within the EU are attempting to build up their own mineral, battery, and EV supply chains. For example, the Canadian government recently announced a $3 billion investment to support the country's first Critical Minerals Strategy.[54] Their strategy provides upstream incentives and downstream subsidies, including a 30 percent Critical Mineral Exploration Tax Credit; $1.2 billion for new critical mineral projects with a focus on mineral processing, materials manufacturing, and recycling applications; and, more than $60 million to create publicly available datasets to support mineral exploration and development.[55] Canada is also planning to spend an additional $1.3 billion over five years to extend their Zero-Emission Vehicles program, which provides up to $4,000 in purchasing credits for consumers.[56]

The Australian government has similarly announced its own critical minerals strategy, which commits close to $32.5 million to establish the Australian Critical Minerals Research and Development Hub to support research and collaboration and another $32 million in funding for a three-year grant program for early and mid-stage critical mineral projects.[57] This funding is in addition to a previous $32 million the Australian government awarded to six key mining projects to feed critical technologies like batteries and defense industries.[58]

Meanwhile, the EU is considering legislation targeting battery supply chains and the circular economy, and its European Commission (EC) has announced a new Critical Raw Materials Act to bolster domestic supply of critical raw materials.[59] The EU is also gaining market share in battery manufacturing: it is currently the fastest growing battery market outside of China, and by 2030 it is projected to have almost 790 GWh of annual battery capacity—enough to make almost 15 million EVs per year.[60]

The United States has similarly implemented unilateral actions to shore up its critical mineral supply chains—some with global consequences. Until recently, competing foreign incentives, trade rules, labor costs, and geographic availability of raw materials had created conditions that favored offshoring sectors within the mineral and battery supply chain, rather than keeping them localized within the United States. However, in less than two years—and under presidents from two different political parties—the U.S. government has unleashed a series of incentives at the executive and legislative levels to spur the establishment of a U.S.-based critical mineral and battery supply chain to meet growing consumer demand and automaker commitments for critical minerals and EVs.

In 2020, President Trump invoked the Defense Production Act (DPA), a Cold War-era defense law that allows the president broad authority to spur domestic industry in the interest of national defense, to build domestic processing capacity for rare earths.[61] MP Materials, one of the awardees and the company that operates the United States' only REE mine, received a

54 Note: U.S. dollar values calculated based on the monthly rate in April 2022, $1=C$1.2628, from the Bank of Canada. Source: Government of Canada. Source: Prime Minister of Canada Justin Trudeau, "Helping More Canadians Drive Electric Vehicles," Government of Canada, April 11, 2022.

55 Note: U.S. dollar values calculated based on the monthly rate in April 2022, $1=C$1.2628, from the Bank of Canada. Source: Government of Canada, *Canadian Critical Minerals Strategy*, 2022, at pages 19 and 22.

56 Note: U.S. dollar values calculated based on the monthly rate in April 2022, $1=C$1.2628, from the Bank of Canada. Source: Prime Minister of Canada Justin Trudeau, "Helping More Canadians Drive Electric Vehicles," Government of Canada, April 11, 2022.

57 Note: U.S. dollar amounts are calculated based on the monthly exchange rate in October 2022, AU$1= $0.6420, from the Reserve Bank of Australia. Source: Katina Curtis, "Federal Budget boosts for critical minerals and support the Pacific revealed," The West Australian, October 20, 2022.

58 Note: U.S. dollar amounts are calculated based on the monthly exchange rate in October 2022, AU$1= $0.6502, from the Reserve Bank of Australia. Source: Australian Government, "Critical Minerals Projects Receive $50 Million," September 23, 2022; and Reserve Bank of Australia, "Exchange Rates – Monthly – January 2010 to Latest Complete Month of Current Year."

59 Commissioner Theirry Breton, "Critical Raw Materials Act: Securing the New Gas and Oil at the Heart of Our Economy," European Commission, September 14, 2022.

60 Green Car Congress, "Benchmark Minerals: Europe's EV Gigafactory Capacity Pipeline to Grow 6-fold to 789.2 GWh to 2030," March 12, 2022.

61 The Trump White House, "Executive Order on Addressing the Threat to the Domestic Supply Chain from Reliance on Critical Minerals from Foreign Adversaries," National Archives, September 30, 2020.

President of the United States Joe Biden signs the Bipartisan Infrastructure Investment and Jobs Act into law at the White House in Washington, DC on November 15, 2021.

total of $44.6 million from two separate Department of Defense (DOD) grants awarded under both Republican and Democratic administrations.[62]

More recently, Congress passed the Infrastructure Investment and Jobs Act (IIJA)—better known as the Bipartisan Infrastructure Law (BIL)—the Inflation Reduction Act (IRA), and the CHIPS and Science Act (CHIPS Act) to jumpstart investments in domestic manufacturing for clean energy and EVs. The Biden Administration also similarly invoked the DPA to spur investments in domestic feasibility studies for critical mineral mining.[63] Of particular note have been new competitive grant programs within the BIL that provide more than $6 billion in grants for battery material processing, manufacturing, and recycling. In October 2022, the Department of Energy (DOE) announced the first round of grant recipients, which are expected to produce enough battery-grade lithium and graphite to supply millions of EVs per year.[64]

Despite the history-making nature of the BIL, the IRA is proving to be much more significant. While the DPA, BIL, and CHIPS Act provide multiple "carrots" for producers to establish critical mineral and battery supply chains within the United States, the IRA provides the first "stick." Within the IRA, language renewing the clean vehicle tax credit—a consumer subsidy that provides up to $7,500 per qualifying vehicle, including EVs—contains sourcing provisions for the minerals and battery components contained within EV battery packs. Beginning in 2023, at least 40 percent of the value of the minerals contained in an EV battery, and at least 50 percent of the value for battery components, must come from a country the United States has a free trade agreement with or North America, respectively. Furthermore, beginning soon thereafter, no minerals or battery components can come from China or any other country deemed a "foreign entity of concern." Because this "stick" will send important signals for private sector investment into U.S. and allied supply chains, the U.S. government is exploring avenues to expand the definition of a free trade agreement beyond just the 20 countries with which it has a formal Free Trade Agreement (FTA). Instead, the U.S. government is determining whether the provisions could extend to close allies like Japan with which we have other types of trade agreements.

In addition to clean vehicle tax credits, the bill also provides substantial production tax credits (PTCs) until 2033 to incentivize the localization of critical minerals processing and battery component manufacturing within the United States. Within the confines of the law, processed and refined critical minerals and "electrode active materials"—namely, materials that could be used in battery cathodes and anodes as well as solvents, additives, and electrolytes—are eligible for a 10 percent production tax credit on all costs incurred to produce those materials. Moreover, battery manufactures would receive $35 per kilowatt-hour of battery cells produced and $10 per kilowatt-hour of battery modules produced.

The global implications of the sourcing provisions and the PTCs within the IRA cannot be overstated. Within weeks of the passage of the act, major automakers had begun to rethink their supply chains in order to reap the benefits of the law. Tesla has already announced that it will prioritize its Texas battery plant over producing more batteries in Germany, and automakers like General Motors (GM) are seeking offtake agreements with mines in FTA countries to ensure a compliant supply stream to qualify for the lucrative incentives contained in the IRA.[65] In response, many countries, including close allies like Canada and the EU, are beginning to reexamine their own incentives for domestic battery production to prevent off-shoring of their battery sectors to the United States. For example, the EC recently announced a Green Deal Industrial Plan, which will attempt to ease the EU's ability to provide financial support to European-based battery production.[66]

While unilateral actions are important, the United States and its allies face identical challenges in overcoming dangerous supply chain concentration for critical minerals and batteries. These obstacles are better solved through multilateral cooperation. No one country has the ability to act unilaterally to secure enough material.

Only by acting together can the United States and other countries counter anti-competitive market practices like dumping and opaque supply chains that could derail each country's efforts to establish diverse sources for critical minerals and materials.

Existing multilateral frameworks could be better leveraged to achieve more robust supply chains. For instance, although the United States, EU, and Japan have been meeting trilaterally to share information and coordinate policies on critical minerals since 2011 when China cut off supplies of REEs to Japan, the meetings have yet to lead to the level of supply chain diversification necessary to insulate themselves from overreliance on China.[67] The group has recently grown to include Canada and Australia, which could potentially spur more conversations around expanded mineral production, helping them to overcome the obstacle of obtaining much needed raw material. For instance, the group could leverage work conducted among the United States, Canada, and Australia since 2019 through the Critical Mineral Mapping Initiative (CMMI) to develop a global database of mineral resources to find new deposits to exploit and to direct investment in allied jurisdictions. Furthermore, while the United States and Canada signed a Joint Action Plan on critical minerals in 2020 that seeks to attract investment into integrated critical mineral supply chains, it has yet to lead to more robust investments. Moreover, the United States lacks such an agreement with any other country.[68]

In 2022, the U.S. Department of State established another multilateral initiative on critical mineral supply chains—the Minerals Security Partnership (MSP)—which also seeks to improve resiliency and sustainability within critical mineral supply chains.

While the MSP convenes high-income countries to spur investment in what it sees as responsible mining projects, the initiative could be better leveraged by also garnering measurable, time-bound commitments from participating countries to only source materials for their tech-driven economies with minerals that adhere to certain environmental and labor standards. It could also jointly work to establish transparency mechanisms to ensure a global race to the top and diversify critical mineral supply chains. Finally, MSP could shift its focus beyond simply obtaining raw materials to establishing a coordinating mechanism among partner and key non-partner countries to help determine a roadmap for regional specialization to increase supply chain diversification.

Most recently, at the UN Biodiversity Conference in December 2022, the United States, Australia, Canada, France, Germany, Japan, and the United Kingdom launched the Sustainable Critical Minerals Alliance to drive the global uptake of environmentally sustainable and socially inclusive mining, processing, and recycling practices into supply chains.[69] In the future, the Alliance plans to develop mining practices following a number of basic principles, including supporting local and Indigenous communities. While this is an excellent first step at reaching global consensus on responsible mineral supply chains, there is much more work that needs to be done to ensure proper enforcement of such agreements. Only by acting together can the United States and other countries counter anti-competitive market practices like dumping and opaque supply chains that could derail each country's efforts to establish diverse sources for critical minerals and materials.

62 MP Materials, "MP Materials Awarded Department of Defense Heavy Rare Earth Processing Contract," Press Release, February 22, 2022.

63 Heidi M. Peters, et.al, "2022 Invocation of the Defense Production Act for Large-Capacity Batteries: In Brief," Congressional Research Service, May 27, 2022.

64 Department of Energy, "Biden-Harris Administration Awards $2.8 Billion to Supercharge U.S. Manufacturing of Batteries for Electric Vehicles and Electric Grid," Press Release, October 19, 2022.

65 See, e.g., Nathan Eddy, "Tesla Prioritizes Texas Battery Plant Over German Production," Automotive News Europe, September 19, 2022; and David Shepardson, "GM to Take Equity Stake in Australian Mining Company," Reuters, October 11, 2022.

66 European Commission, "Green Deal Industrial Plan: Putting Europe's Net-Zero Industry in the Lead," Press Release, February 1, 2023.

67 Japan's Ministry of Economy, Trade, and Industry, "13th Conference on Critical Materials and Minerals Held," June 23, 2022.

68 Natural Resources Canada, "Canada and U.S. Finalize Joint Action Plan on Critical Minerals Collaboration," January 9, 2020.

69 Government of Canada, "Countries Commit to the Sustainable Development and Sourcing of Critical Minerals," Natural Resources Canada, News Release, December 12, 2022.

Minerals Fuel the Future

The world is just coming to terms with the looming mineral intensity of new energy technologies and the sheer volume of minerals required for the energy transition, including EVs. According to the International Energy Agency, critical and strategic mineral demand for clean energy technologies will increase by a factor of 13 for lithium, eight for graphite, seven for nickel, and six for cobalt by 2040.[70] Benchmark Mineral Intelligence estimates that more than 300 new mines will need to come online to meet this demand. The world will also need more than 120 million metric tons of aluminum and copper to support electricity networks.[71] One of the main factors driving increased mineral demand is EVs, which require approximately six times the mineral inputs to build compared to traditional ICE vehicles.[72]

EVs require a number of different minerals and metals to function. Aluminum and iron are used in the body and chassis, copper is used for electrical wiring, and elements such as silicon, germanium, and gallium, among others, are used in semiconductors found throughout the car. Current EV batteries primarily use lithium, nickel, manganese, and cobalt-based (NMC) cathodes and graphite-based anodes. Permanent magnets found within EV motors are fortified with REEs like neodymium, praseodymium, and dysprosium.

Some of these elements, such as aluminum, iron, and copper, are mined in large quantities and used across other sectors. Other elements, however, have historically been mined in much smaller quantities as by-products or co-products, including lithium, cobalt, and REEs. The push to electrify is driving the need for these lesser-mined elements to skyrocket, causing subsequent fears that society will not be able to obtain enough of them to meet ambitious decarbonization and EV targets.[73] Of particular concern are the minerals needed for EV batteries and the REEs for EV motors.

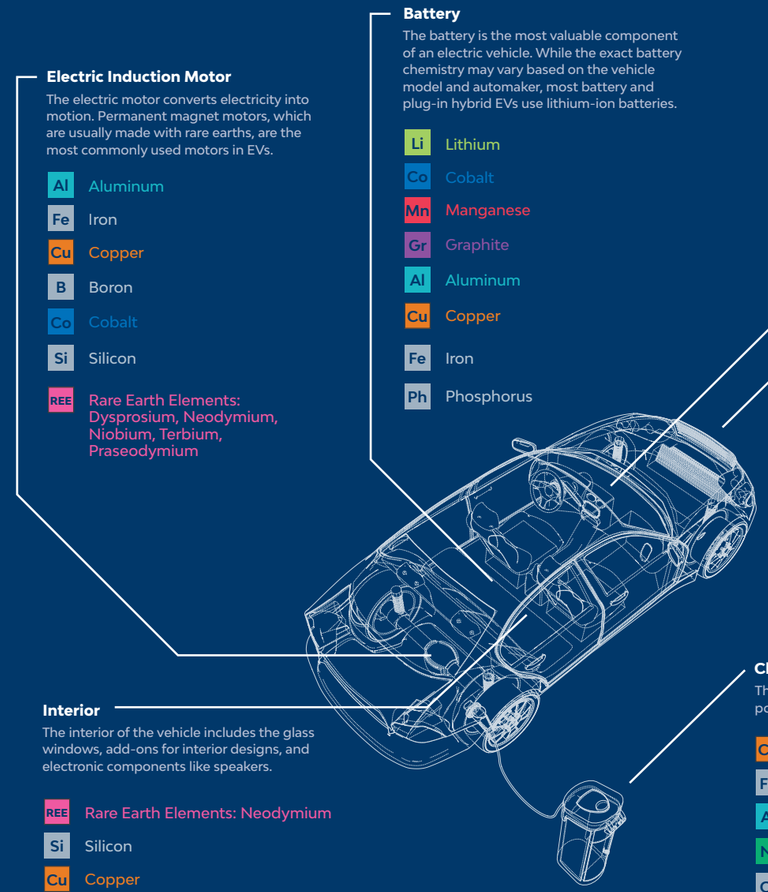
70 IEA, "Growth in Demand for Selected Minerals from Clean Energy Technologies by Scenario, 2040 relative to 2020," Data Chart, last updated October 26, 2022.

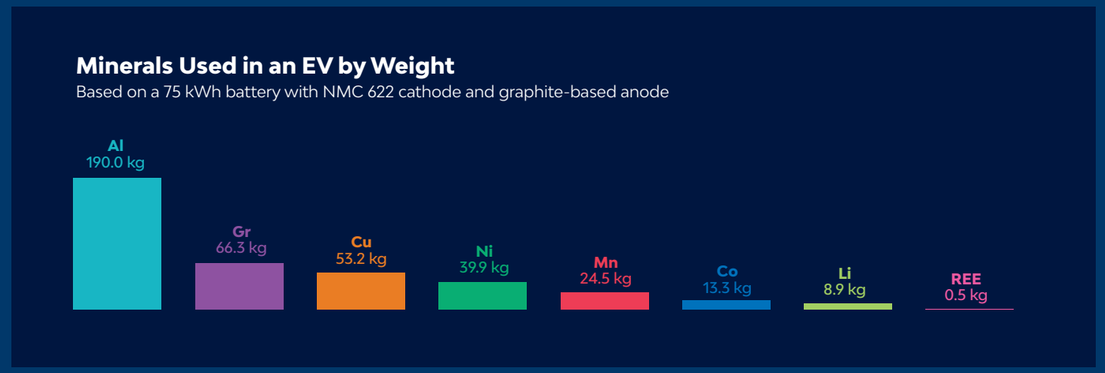
71 IEA, *The Role of Critical Minerals in Clean Energy Transitions*, revised March 2022, at page 190.

72 Ibid., at page 5.

73 Amena Saiyid, "US EV Consumer Demand Not Matched by Production Capacity as Registrations Rise: S&P Global Mobility," IHS Markit, May 20, 2022.

Figure 7 Minerals in an Electric Vehicle





Note: EV component definitions are created by SAFE based on information from Battery University, Institute for Electrical and Electronics Engineers, Toyota, DOE Alternative Fuels Data Center, IDTechEX, Meticulous Research, Law Insider, and News Reports. EV diagram source: International Energy Agency, Visual Capitalist, Battery University, Institute for Electrical and Electronics Engineers, IDTechEx, Meticulous Research, DOE Alternative Fuels Data Center, Toyota, Law Insider, New Reports.

Column chart source: SAFE analysis based on data from International Energy Agency and Visual Capitalist.

Prevailing Battery Chemistries

Today, prevailing technologies dictate the necessary chemistries and subsequent mineral inputs of EV batteries and motors. While technology is rapidly evolving—partly in response to consumer demand for longer ranges and shorter charge times, and partly in response to environmental and social concerns of specific mineral inputs—lithium-ion batteries are projected to remain the dominant battery chemistry for the coming decade.[74]

In addition to NMC cathode chemistries, there are also nickel, cobalt, and aluminum-based (NCA) cathodes and lithium, iron, and phosphate-based (LFP) cathodes. The different chemistries affect the performance characteristics of the battery, including the energy density, power density, cycle life, safety, and cost.[75] NMC and NCA batteries typically have higher energy densities than LFP batteries, meaning they can travel farther on a single charge. NMC and NCA batteries are more dominant in countries like the United States, while LFP chemistries are more widely used in China. However, LFP batteries have recently been gaining popularity for their affordability, recent improvements in design and range, and lack of supply chain concerns: namely, they do not contain cobalt or nickel, which are associated with some of the worst human rights concerns (cobalt) and environmental damage (nickel) during the mining phase, as well as supply shortages and higher costs. Iron and phosphate in LFP batteries are widely available, reducing supply chain concerns and lowering prices.

Cobalt, in particular, has been singled out as a troubling element in EV battery chemistries today. When used within a cathode, cobalt enhances structural integrity, making the battery safer and less likely to catch fire.[76] However, more than 70 percent of the world's cobalt comes from the Democratic Republic of the Congo (DRC), where child labor and other human rights abuses have been widely documented.[77] To prevent any allegations of child labor within their supply chains, makers of batteries and EVs are attempting to reduce the amount of cobalt used within NMC and NCA cathodes, or remove the problem altogether by switching to LFP batteries. For example, prevailing NMC chemistries are increasingly moving toward higher nickel and lower cobalt concentrations. Originally, NMC batteries contained a ratio of six units of nickel for every two units of manganese and cobalt, commonly referred to as NMC 6-2-2. To reduce the amount of cobalt, battery makers are beginning to create NMC 8-1-1 batteries, which use eight units of nickel for every unit of manganese and cobalt.[78]

Other types of lithium-ion batteries are beginning to make headway and could soon gain greater market share. Lithium-sulfur batteries, which have a sulfur cathode, could provide higher energy densities than traditional lithium-ion batteries. For instance, newcomer Lyten, an advanced materials company that has developed a lithium-sulfur battery, recently broke ground on a new pilot facility and is testing its batteries for use on satellites. Additionally, solid-state batteries, which use a solid electrolyte, similarly show promise, but will require more research to overcome range and lifecycle challenges. The evolution of battery chemistries will influence which minerals—and, subsequently, which countries—will be necessary for the energy transition. The United States and others should keep supply chain constraints in mind when considering investments in future battery technologies.

74 Department of Energy, "National Blueprint for Lithium Batteries: 2021-2030," June 2021.

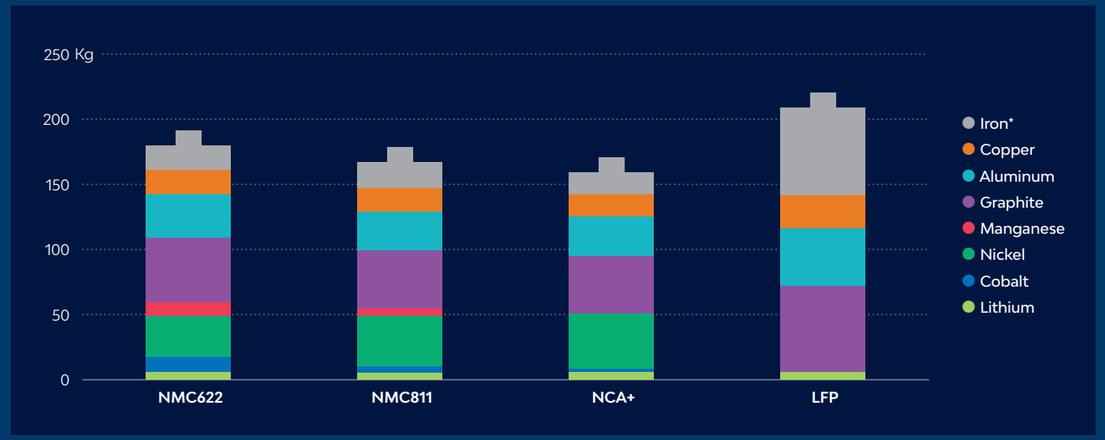
75 Lithium-ion Car Battery Recycling Advisory Group, 2022.

76 Ahmad Mayyas, Darlene Steward and Margaret Mann, "The Case for Recycling: Overview and challenges in the Material Supply Chain for Automotive Li-ion Batteries," National Renewable Energy Laboratory, Elsevier, December 13, 2018, at page 2.

77 U.S. Geological Survey, Mineral Commodity Summaries 2022, January 31, 2022, at page 53; and IEA, *The Role of Critical Minerals in Clean Energy Transitions*, revised March 2022, at page 151.

78 See e.g., Beth Murdock, Kathryn Toghill, and Nuria Tapia-Ruiz, "A PersPective on the Sustainability of Cathode Materials Used in Lithium-Ion Batteries," Advanced Energy Materials, Volume 11, Issue 39, 2021, at pages 3 and 10.

Figure 8 Mineral Requirements for Prevailing Battery Chemistries, 60kWh Battery



Note: While some lithium-ion battery chemistries do not contain nickel and cobalt, it will be more difficult to diversify away from lithium and to reduce the amount of strategic metals used in EV batteries overall. *Includes steel.

Source: Transport and Environment

The United States has long been concerned with ensuring undisrupted access to sufficient quantities of certain minerals used in industrial production. The minerals of greatest concern have been labeled "critical." The list of critical minerals is ever-evolving due to changing technology and shifts in criteria that determine a mineral's eligibility. The Strategic and Critical Minerals Stockpiling Act of 1979, for example, defined critical minerals as "materials that (A) would be needed to supply the military, industrial and essential civilian needs of the United States during a national emergency, and (B) are not found or produced in the United States in sufficient quantities to meet such need."[79] The Energy Security Act of 2020 expanded the scope beyond times of national emergency, characterizing critical minerals as "non-fuel minerals or mineral materials essential to the economic or national security of the United States and which have a supply chain vulnerable to disruption."[80]

The newest critical minerals list released by the U.S. Department of the Interior (DOI) in 2022 further expands the criteria to include countries' willingness to give the United States the minerals it needs.[81]

Today, 50 minerals are deemed critical by the U.S. federal government.[82] These range from everyday commodities like aluminum, which is used in almost every sector of the U.S. economy, to more obscure elements like terbium, which is used in magnets, fiber optics, and lasers. Given the mineral intensity of EVs and their growing economic importance, it is not surprising that many of the minerals needed to produce EV batteries and motors are also included in the list of 50 critical minerals. However, while it is an important tool, the critical minerals list as currently constructed fails to address the criticality of commodities until their import reliance is already a problem. A critical minerals forecasting tool, or a "threatened" list for minerals that are integral to key industries, but not yet at the point of no return for import reliance, could help the United States ensure a steady, uninterrupted supply of key elements.

Aside from import reliance, supply chains for EV minerals are fraught with challenges that must be addressed in order to support a rapid transition to transportation electrification. In addition to significant influence from Beijing, there are growing concerns related to the impact of mining—especially at the scale required to support the ongoing shift to EVs. Mitigating these risks include working with communities to acquire the social license to operate and with allies to mitigate the risk of future supply chain disruptions. Addressing all of these concerns will be necessary to ensure critical mineral supply chains evolve in ways that can uphold the vibrant U.S. automotive industry and protect democratic values.

79 50 USC § 98h-3.

80 U.S. Geological Survey, "U.S. Geological Survey Releases 2022 List of Critical Minerals," Press Release, February 22, 2022.

81 Ibid.

82 Ibid.

Aerial view of turquoise colored pools at Silver Peak Lithium Mine, Nevada, California, USA.

Building An Allied Supply Chain

Diversifying critical mineral supply chains is the only way to ensure dependable, resilient, and secure supplies of the materials and components needed for the electric future; and setting enforceable, trackable, global standards among allies and likeminded nations for responsible mining is the only way to counteract non-market actors and level the global playing field to diversify critical mineral supply chains.

In the near term, the United States can work with like-minded countries to develop new deposits that adhere to high environmental and labor standards in their own backyards. Yet, over the longer term, the United States will have to work with international partners to raise standards globally to insulate themselves from non-market competitors and to establish a global race to the top that benefits all communities.

Mineral reserves—which are defined as known, economically viable geologic deposits—occur all over the world. While there is currently excessive concentration where critical minerals are mined, some of that concentration, and many more reserves, exist in friendly countries.

The likelihood that the United States will be able to solve its critical mineral supply chain challenges on its own is low. The United States does not produce a substantial amount of EV battery minerals domestically. It has only one active lithium mine, the Silver Peak mine in Nevada, and only one active nickel mine, the Eagle mine in Michigan, which is expected to close in 2025.[83] And although the United States recently opened a brand-new cobalt and copper mine, the Jervois mine in Idaho, it will produce about one-tenth of the cobalt that a mine in the DRC produces.[84]

As of 2022, American reserves of lithium and REEs accounted for four percent and two percent of global reserves, respectively. The United States has less than one percent of global nickel and cobalt reserves, with no reserves reported for natural graphite and manganese.[85] While the United States is one of the top global producers of REEs, accounting for more than 14 percent of global supply, it mines less than one percent of other battery-related minerals where data are reported.[86] The short-term outlook for the United States' capacity for minerals processing is similarly low, with the United States accounting for only two percent of lithium processing and one percent of nickel processing.

Additional U.S. deposits are under consideration for lithium, nickel, and other critical minerals to expand domestic production of key battery materials. For example, the Thacker Pass lithium mine in Nevada is estimated to produce 66,000 tons per year of battery-grade lithium, eclipsing current U.S. production levels at the Silver Peak mine, which has an output capacity of 5,000 tons of lithium per year.[87] Albemarle, however, is investing up to $50 million to double Silver Peak's production capacity.[88] Furthermore, Standard Lithium's South-West Arkansas Project, in an earlier development stage, is estimated to have the resource base to produce 30,000 tons of lithium per year.[89]

More nickel projects are also in the pipeline. The Tamarack Mine, a high-grade nickel deposit in Minnesota, was recently awarded one of the DOE's battery material processing grants to refine nickel ore

83 Katie Brigham, "How a Global Nickel Shortage Could Disrupt the Electric Vehicle Industry," CNBC, March 19, 2022.

84 Claire Bushey and Aime Williams, "US Opens New Cobalt Mine as EV Battery Needs Grow," Financial Times, October 7, 2022.

85 SAFE analysis based on data from U.S. Geological Survey.

86 Ibid.

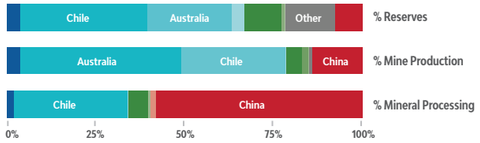
87 Ivan Penn and Eric Lipton, "The Lithium Gold Rush: Inside the Race to Power Electric Vehicles," The New York Times, May 6, 2021.

88 Ibid.

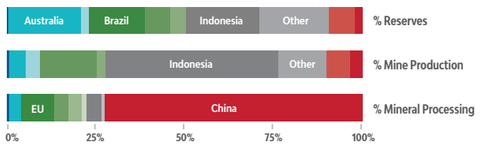
89 Standard Lithium, "Standard Lithium Announces Positive Preliminary Economic Assessment and Update of Inferred Mineral Resource at South-West Arkansas Lithium Project," Press Release, October 12, 2021.

Figure 9 Map of Key Mineral Reserves, Mine Production, and Processing, 2022

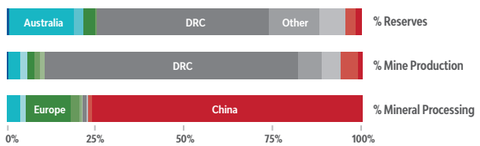
Li
Lithium



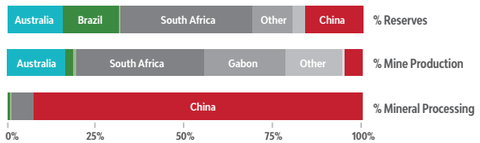
Ni
Nickel



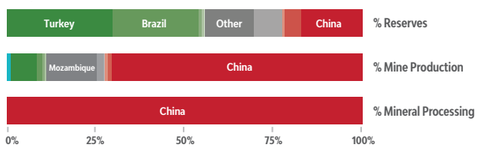
Co
Cobalt



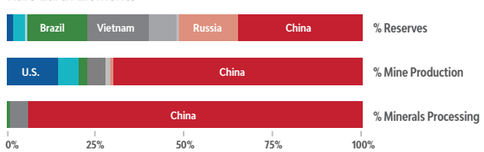
Mn
Manganese



C
Graphite (Natural)



REE
Rare Earth Elements



Country Designations

Unites States | Free Trade Agreement Countries | Major Allies | Other | Foreign Entities of Concern

In 2022, **Canada** accounted for 4% of global nickel and close to 2% of global cobalt production. The country is also looking to develop its rare earths reserves and expand its processing capacity.

The **United States** is the second largest rare earths producer after China. U.S. lithium reserves are the fifth largest in the world, but production is not reflective of U.S. reserves.

Clarion-Clipperton Zone
Clarion-Clipperton Zone has great potential for seabed mining of manganese, nickel, cobalt, and rare earths. The area is governed by the International Seabed Authority, which aims to finalize its deep-sea mining regulations by July 2023. Scientists are also trying to better understand the environmental impacts of mining in the Zone.

Chile is home to more than a third of lithium reserves—the largest in the world. It is also the second largest lithium producer, accounting for 30% of the global supply in 2022.

In 2022, **Argentina** was responsible for 5% of global lithium production. The country, home to the third largest lithium reserves, has been attracting substantial amounts of investment to expand its production capacity.

Brazil has the second largest graphite reserves, the third largest nickel and rare earths reserves, and the fourth largest manganese reserves. While it is the fourth largest graphite producer, the country's mine production for the other minerals is not reflective of its reserves. Note that some of Brazil's critical mineral reserves may be in the Amazon rainforest.

Europe is the second largest processor and refiner of cobalt and nickel, accounting for 12% and 9% of global production in 2022, respectively. It also has a smaller share of manganese and rare earths processing. New Caledonia, France's territory in the southwest Pacific Ocean, is the fourth largest nickel miner.

Turkey's graphite reserves, more than a quarter of global reserves, are the largest in the world. However, the country's share of graphite mine production is less than 1%.

In 2022, **Russia** produced 7% of the global nickel supply, making it the world's third largest nickel producer. However, the country is not a reliable supplier.

China holds considerable influence over every phase of the EV supply chain. In 2022, it mined around 15% and 65% of the lithium and graphite supply, respectively. China's nickel and cobalt production is significantly smaller, at 3% and 1% of global supply respectively, due to its limited reserves. Nevertheless, the country is a mineral processing powerhouse.

In 2022, 4% of nickel processing and refining took place in **South Korea**, a country known for its EV battery makers.

Japan was responsible for 4% of nickel processing or refining in 2022. The country also has smaller processing capacities for cobalt and is home to EV battery maker Panasonic.

While it only has 5% of global nickel reserves, the **Philippines** is the second-largest nickel producer, mining 10% of the global nickel supply in 2022.

The second largest rare earths reserves, close to 18% of the global total, are located in **Vietnam**. The country's 1% rare earths production share in 2022 is not reflective of its reserves.

The largest nickel producer, **Indonesia** was responsible for close to half of the global supply in 2022. The country is looking to use its position as a large supplier to drive investments in domestic nickel processing to produce battery-grade materials.

The second largest producer of refined or processed rare earth metals, **Malaysia** produced approximately 5% of global supply in 2022.

South Africa and Gabon are the two largest manganese producers. They produced about 60% of the global supply in 2022.

The **Democratic Republic of Congo** (DRC) is the largest cobalt producer, responsible for approximately 70% of cobalt production in 2022. China owns 8 of the 14 active cobalt mines, controlling nearly half of the country's output.

Mozambique and **Madagascar** are the largest natural graphite producers after China. Mozambique accounted for 13% of the global supply in 2022.

Australia is the only country that mines all four cathode minerals. It is the largest lithium producer, accounting for close to half of global production. In 2022, Australia mined for 16% of the global manganese supply and 5% global nickel supply. It is also the third largest producer of rare earths.

*Europe includes EU27 and Norway. Note: U.S. lithium mine production was revised based on news reports. Major allies consist of NATO countries, countries designated or treated as major non-NATO allies (MNNAs), and EU member states. If any of these major allies also have an FTA agreement with the US, they are listed under FTA countries (Australia, Bahrain, Morocco, and South Korea).

Source: U.S. Geological Survey and Benchmark Minerals Intelligence.

into battery-grade material in North Dakota.[90] Talon, the company that owns the deposit, has already secured an offtake agreement with Tesla for its nickel once its mining and processing operations are up and running.

While promising, these projects still have to contend with the United States' mercurial permitting process and potential litigation.

There are many reasons why it can take up to ten years or longer to open a new mine in the United States.[91] First, there are multiple federal, state, and local agencies involved in the permitting process each tasked with a different regulatory compliance mechanism, which leads to long wait times, a lack of cohesive interagency coordination, and an overall convoluted process. These procedural inefficiencies have led to very long timelines for regulatory agencies to reach final decisions on proposed projects. Furthermore, the lack of a codified community engagement requirement has meant that even after permits are issued, projects typically must still contend with lengthy litigation from non-governmental organizations, tribes, and local communities.

Attempts to address these issues have been made in the past. For example, to provide accountability, transparency, and predictability in the permitting process, Congress passed the Fixing America's Surface Transportation Act (FAST Act) in 2015. Title 41 of the FAST Act (FAST-41) created an interagency Permitting Council and a centralized online dashboard to catalog and track projects, including large mines, to facilitate coordinated, multiagency reviews of complex high-priority projects.[92] If a project is selected by the Permitting Council for FAST-41 coverage, the permitting dashboard is made available to the coordinating agencies and the public to ensure accountability. According to the Permitting Council, projects covered by FAST-41 reduced their environmental impact statement (EIS) timelines by 45 percent from 4.5 years to 2.5 years while still complying with all regulations.[93]

Congress has recently taken steps to come to a consensus on permitting reform, although none have successfully been signed into law. Bills across party lines have been introduced that offer a variety of solutions—from creating a lead agency to coordinate permitting across the entire government, to requiring the completion of an early community impact report.[94] These efforts, combined with the expansion of FAST-41 coverage to all federally regulated critical mineral mining projects, would effectively decrease the lengthy timelines inhibiting the United States' ability to responsibly obtain the minerals and materials to compete in the race to electrify.

In light of the United States' small reserves and the challenges facing the development of new mines domestically, the United States can work with allied countries and, per IRA regulation, countries with which it shares a free trade agreement, to gain access to the critical minerals it needs in the near term. Many of these countries are already top producers of EV battery minerals.[95] For instance, Chile and Australia produced three quarters of the global lithium supply in 2022, and Australia is one of the top five global producers for every single battery mineral except for graphite. Canada is a top five global producer of cobalt, ranks sixth in global nickel production, and is one of the top ten global producers of graphite. For example, Canadian company Nouveau Monde Graphite expects to produce approximately 500,000 tons of graphite annually at its new facility in Québec.[96] Expanding the list to include major U.S. allies, including those within the North Atlantic Treaty Organization (NATO) and Major Non-NATO Allies (MNNA) as defined by the U.S. Department of State, the list of viable production partners increases dramatically, especially for nickel.[97]

90 Department of Energy, "Bipartisan Infrastructure Law Battery Materials Processing and Battery Manufacturing & Recycling Funding Opportunity Announcement Selections Factsheets," October 19, 2022.

91 National Mining Association, "U.S. Minerals Mining Fact Sheet," June 4, 2021, at page 1.

92 Federal Improvement Steering Council, "The Federal Improvement Steering Council (Permitting Council)," September 2022.

93 Federal Improvement Steering Council Office of the Executive Director, "FPISC Annual Report to Congress 2020," permits.performance.gov, 2021.

94 Environmental Justice for All Act, S.872, 117th Congress, 2022; and Environmental Justice for All Act, H.R. 2021, 117th Congress, 2022; and Securing America's Mineral Supply Chains Act of 2022, H.R. 8981, 117th Congress, 2022; and START Act, S. 4815, 117th Congress, 2022; and Senate Committee on Energy and Natural Resources, "Manchin Statement on Permitting Reform Vote," December 15,, 2022.

95 Note: The U.S. Trade Representative maintains a list of countries with which the United States shares an FTA. The United States currently has FTAs with 20 countries: Australia, Bahrain, Canada, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Korea, Mexico, Morocco, Nicaragua, Oman, Panama, Peru, Singapore, Canada, and Mexico.

96 Nouveau Monde Graphite, "NMG Issues Positive Results of its Preliminary Economic Assessment for the Uatnan Mining Project – One of the World's Largest Graphite Projects in Development with Indicative NPV in Excess of C$2 Billion," Press Release, January 10, 2023.

97 Note: For the purposes of this report, "major U.S. allies" include NATO and Major Non-NATO allies, as well as the EU's 27 member countries.

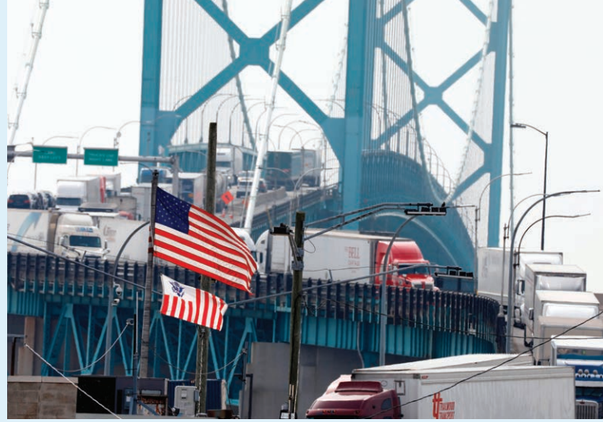
Building A North American Battery Ecosystem

The North American automotive market and its related supply chains are deeply integrated. Since the 1965 Automotive Product Agreement (better known as the Canada-US Auto Pact), Canada and the United States have promoted inter-country specialization to aid in large-scale production and bring down vehicle costs for both countries.[98] Consequently, the Great Lakes auto manufacturing cluster, which consists of Michigan, Indiana, Illinois, Ohio, and Ontario, has become the largest North American producer of vehicles and the third-largest producer globally.[99] Automotive parts in this cluster cross the U.S.-Canada border up to six times before reaching final assembly.[100]

The pact has since been replaced by the North American Free Trade Agreement (NAFTA) and the newly renegotiated United States-Mexico-Canada Agreement (USMCA), allowing the greater integration of Mexico.

It makes sense that as the automotive industry undergoes the transformation to EVs—and begins building new supply chains for EV-specific automotive parts—that we continue to recognize the value of integrated North American supply chains among the United States, Canada, and Mexico.

An integrated North American battery supply chain can leverage comparative advantages of each of the countries. For example, energy-intensive industries benefit greatly from ample supplies of clean and cheap hydropower, which are not as readily available in the United States and Mexico. In Bécancour, QC, plans for battery material processing and recycling facilities are already underway with Brazil's Vale SA and German-based BASF. U.S.-based General Motors has announced that it will partner with South Korea-based POSCO to build a new facility to produce cathode active material (CAM) in the region.[101] The CAM processed in Quebec will be sent to the Ultium gigafactories in the United States.[102] Ultium is a joint venture between GM and LG Energy Solutions to manufacture batteries that will power GM's EVs. GM and Ford are also building vehicle assembly plants in Ontario.[103] The province is the only place in North America to boast vehicle assembly plants for five major OEMs—Fiat Chrysler, Ford, GM, Honda and Toyota.[104]



Vehicles cross at the U.S. customs booth at the Ambassador Bridge that connects Windsor, Canada, to Detroit, Michigan, on March 18, 2020 in Detroit, Michigan.

Furthermore, U.S. import reliance on highly concentrated supply chains for key elements like nickel, cobalt and graphite is less worrying when considering the entire North American supply chain. According to data from the U.S. Geological Survey and Benchmark Mineral Intelligence, Canada ranks third in terms of cobalt processing, fifth in terms of cobalt production, and seventh in terms of overall cobalt reserves.[105] It is also the sixth largest nickel producer, and the primary source of U.S. nickel imports.[106] Both Canada and Mexico contain substantial amounts of graphite, for which the United States has none.[107]

Increased North American integration as the global automotive market transitions to EVs will reduce the cost of production for EVs and continue to strengthen U.S. and allied resiliency to supply disruptions for vital minerals, materials, and components critical for EVs.

98 David Crane, "Canada-US Auto Pact," The Canadian Encyclopedia, February 6, 2006.

99 Government of Canada, "Canada: Integral to the Success of the U.S. Automotive Industry," September 2021.

100 Ibid.

101 General Motors, "GM Expands Its North America-Focused EV Supply Chain with POSCO Chemical in Canada," Press Release, March 7, 2022.

102 General Motors, "GM Expands Its North America-Focused EV Supply Chain with POSCO Chemical in Canada," Press Release, March 7, 2022; and Ultium Cells, "Our Locations," Webpage.

103 See e.g, Reuters, "Canadata to Invest C$518 Million in Two GM Plants in Ontario," April 4, 2022, and Invest Ontario, "Initiative Positions Ontario, Canada's Auto Industry for Long-Term Sustainability and Growth," Press Release, October 8, 2020.

104 Invest Ontario, "Initiative Positions Ontario, Canada's Auto Industry for Long-Term Sustainability and Growth," Press Release, October 8, 2020.

105 SAFE analysis based on data from U.S. Geological Survey and Benchmark Mineral Intelligence.

106 SAFE analysis based on data from U.S. Geological Survey; and U.S. Geological Survey, *Mineral Commodity Summaries 2023*, January 31, 2023, at page 21.

107 U.S. Geological Survey, *Mineral Commodity Summaries 2023*, January 31, 2023, at page 83..

Working with major U.S. allies and countries with which the United States has a free trade agreement to diversify mineral supply chains could satisfy much of the Unites States' projected EV demand for lithium and nickel through 2030.

SAFE analysis shows that 2022 U.S., FTA, and allied production levels are well above the amount of lithium and nickel projected to be used in EVs in the United States through 2030. Yet, while allied and FTA supply could satisfy much of U.S. demand, U.S. automakers compete in a global market whose projected needs are much higher than American demand alone, so additional resources will need to be brought online well before 2030.

In the case of cobalt, it is clear that much of U.S. demand will come from resource-rich countries with which the United States does not have a trade or defense agreement if new allied deposits do not come online.

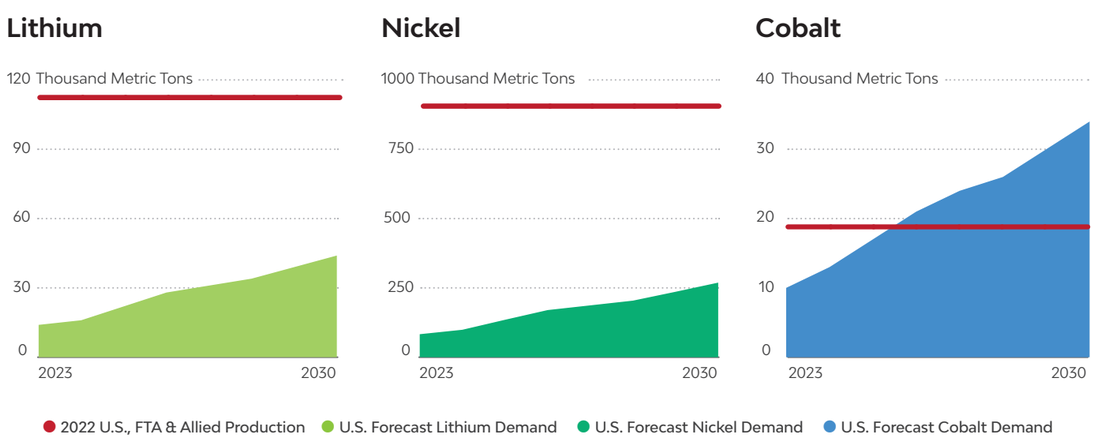
Another potential avenue to secure the necessary mineral resources could be in the middle of the Pacific Ocean more than 4,000 meters below the water's surface. Polymetallic nodules, which are potato-sized accretions resting unattached to the seafloor, contain vast quantities of nickel, cobalt, manganese, REEs, and copper and are a currently undeveloped resource that could provide enough raw material to fuel millions of EVs.[108] Nauru Ocean Resources Limited, the subsidiary of a Canadian company, The Metals Company (TMC), is currently launching pilot programs in an attempt to lift the nodules from the seafloor and process them at a test plant in India with plans for a future, larger processing plant in North America.[109] While TMC's prospects of collecting the nodules were improved when its host nation, the Pacific Island Nation of Nauru, triggered a two-year rule that requires the International Seabed Authority (ISA), a multilateral organization established by the UN Convention on the Law of the Sea, to finalize and adopt regulations for seabed mining by July 2023, many groups remain opposed to the project's development due to environmental concerns.[110]

108 See, e.g., James Conca, "Is Mining the Ocean Bottom Better For Metals Really Better Than Mining On Land?" Forbes, February 24, 2021.

109 The Metals Company, "The Metals Company Enters into Business Collaboration MoU Epsilon Carbon to Complete a Pre-Feasibility Study for the World's First Commercial Polymetallic Nodule Processing Plant in India," Press Release, March 17, 2022.

110 Institute for Advanced Sustainability Studies, "Two-Year Countdown for Deep Seabed Mining," Phys.org, August 26, 2022.

Figure 10 FTA and Allied Production and U.S. Forecast Demand



Note: Based on 2022 mine production levels, U.S., FTA, and allied supply of lithium and nickel will be greater than projected U.S. demand for electric vehicle applications through 2030. However, U.S. automakers do not only sell to U.S. markets. Therefore, more reserves will need to be developed.

Source: SAFE analysis based on data from USGS, S&P Global, Benchmark Minerals Intelligence, and WoodMac.

Although FTA partners and allied countries rank highly in mineral production, non-allied countries with which the United States does not have trade agreements will still play an essential role in developing critical mineral supply chains. This latter group of countries makes up the largest producers of nickel, cobalt, manganese, graphite, and REEs—by a large margin.

China, for example, is the top graphite producer in the world, controlling more than 65 percent of global production. The next largest graphite producer, Mozambique, controls around 13 percent. This scenario of extreme mineral production concentration plays out across almost all the EV minerals. For cobalt, manganese, nickel, and REEs, the top global producers control 70 percent (DRC), 36 percent (South Africa), 49 percent (Indonesia), and 70 percent (China) of production, respectively.[111]

Furthermore, the current country-level production numbers do not convey a valuable metric: the nationality of the companies mining the material. China's success is partially due to the strategic guidance of its Ministry of Industry and Information Technology (MIIT), which began implementing a strategic plan in 2016 to deploy state-owned enterprises and other private firms to secure mineral resources in other countries. This provided an opening for China to use state-backed funding to form relationships with companies or governments that needed capital.[112] Consequently, Chinese companies have obtained the rights to key hard rock mineral deposits of EV minerals within top producing countries, effectively securing upstream supplies for its downstream manufacturing ambitions.

Today, as a result of that planning, Chinese-owned interests have stakes in many of the world's lithium deposits, despite only having eight percent of global lithium reserves.[113] Chinese firms also control 15 of the 19 cobalt-producing mines in the DRC.[114] Considering that more than two-thirds of the world's cobalt comes from DRC, Beijing has a significant influence over the majority of the cobalt supply, despite having negligible resources of their own—only one percent of global reserves.[115]

111 U.S. Geological Survey, *Mineral Commodity Summaries 2022*, January 31, 2022, at pages 53, 101, 107, 115, and 135.

112 FP Analytics, "Mining the Future: How China is Set to Dominate the Next Industrial Revolution," Foreign Policy, May 1, 2019, at page 5.

113 Allison Prang, "Tianqi Lithium to Buy Minority Stake in Miner SQM for $4.07 Billion," The Wall Street Journal, May 7, 2018.

114 Eric Lipton, Dionne Searcey, and Michael Forsythe, "Race to the Future: What to Know About the Frantic Quest for Cobalt," The New York Times, updated December 7, 2021.

115 Ibid.

Given the scale of the problem, taking unilateral action to source minerals and materials from friendly nations will not be enough to satisfy the growing demand from a burgeoning U.S. EV industry. The United States will need to spearhead a global effort to not only secure access to all the necessary minerals in the long term, but to also build an allied supply chain that is competitive at the global level. A commitment to mining with high standards to level the global playing field will be an important lever to ensure that the U.S. achieves this second goal.

The Current Race to the Bottom

Today, it is incredibly difficult to diversify critical mineral supply chains because it is incredibly difficult to compete on cost. The mining and processing required to obtain and refine these minerals come with many environmental, community, and labor-related challenges. Mining in some instances pollutes air and drinking water, reduces biodiversity, and alters natural landscapes. These environmentally disruptive projects can at times be significantly labor intensive, leading to meaningful human rights concerns. Mining projects require vast amounts of capital to develop and often involve long lead times between when an asset is discovered, when it is extracted, and when it generates a return on investment. Minerals processing can be incredibly energy intensive and result in large amounts of wastewater and chemical tailings that can be dangerous to communities if not properly managed. To decrease operating and labor costs, many mining and processing projects have been offshored to lower regulatory environments where governance is weak, the cost of meeting environmental and labor standards is low, and the ability of corrupt governments to overrule community dissent is high. This uneven playing field, where producers compete on cost alone and visibility into how things are sourced is low, has created a global race to the bottom for critical minerals that not only disadvantages communities, the environment, and responsible producers, but also threatens American national security.

A comparison of nickel mining in Indonesia and Australia shows how weak enforcement of environmental standards can provide an advantage to one country over another despite having similar—or in some cases superior—critical mineral reserves. Indonesia and Australia are tied for the most nickel reserves in the world: each has 21 million metric tons of nickel.[116]

116 U.S. Geological Survey, *Mineral Commodity Summaries 2023*, January 31, 2023, at page 123.

Indonesia's reserves are predominantly made up of laterite ores, which are lower grade and not well suited for battery making. Nickel from laterites is typically converted into lower purity (Class 2) products used in steel making and other industrial applications.[117] Conversely, Australia's nickel reserves include a mix of laterite and sulfide deposits.[118] Sulfide deposits are higher grade and more suitable for producing battery-grade (Class 1) nickel.[119] Despite this, Australia has not been able to develop its resources as successfully as Indonesia.[120]

While global nickel production more than doubled between 2000 and 2022, Indonesia's nickel output increased by a factor of 16. It now produces close to half of the global nickel supply.[121] Indonesia's success is partially attributable to the fact that laterites are cheaper and easier to develop. Since the primary driver of nickel demand in the past two decades has been steelmaking—not batteries—there has been little reason to mine higher grade deposits.[122]

Still, this alone cannot explain the concentration of nickel production in Indonesia. Indonesia's mining industry is plagued with environmental problems. Its environmental impact assessments during the mine permitting stage are often seen as a formality rather than a meaningful requirement.[123] Once a mine is up and running, there is little to no oversight of its operations.[124] Various organizations and news agencies have documented how mishandled waste from mines seeps into drinking supplies and pollutes lakes and coastal waters.[125] In 2020, Jakarta passed legislation that weakens public participation in project development, limiting citizens' ability to be involved in the public participation process.[126] Lax environmental standards have no doubt advantaged Indonesia's reserves over Australia's and played a role in Indonesia's rise to become the world's leading nickel producer.

Despite batteries now being a major driver of future nickel demand, and despite Australia and other nickel sulfide-rich countries like Canada or Finland being better suited for battery-grade nickel production, projections indicate that Indonesia will continue to account for about 50 percent of the global nickel production growth through 2025.[127]

As a part of its aspirations to become the main supplier of battery-grade nickel, Indonesia has banned the export of nickel ore in an attempt to attract more downstream investment, and it has been attracting international investment—largely Chinese—to build multiple processing facilities to create refined nickel products and batteries. Converting Indonesia's nickel reserves into battery-grade material, however, is a complex process.[128] For example, many of the nickel refining facilities under development will use an environmentally intensive process called high-pressure acid leaching (HPAL), which requires proper management and disposal of its acidic tailings.[129] Furthermore, many existing HPAL plants use electricity generation from coal-fired power plants, which emit up to three times more greenhouse gases than processing nickel from from sulfide deposits.[130]

Since 2021, Chinese companies have invested or committed to invest around $30 billion in the Indonesian nickel sector.[131] The most prominent firm, Tsingshan, owns the second-largest nickel mine in the country, built the Weda Bay and Morowali industrial parks to smelt nickel and produce other nickel-based products—including battery components—and is currently leading the development of another HPAL

117 IEA, *The Role of Critical Minerals in Clean Energy Transitions*, May 2021, at page 144.

118 Geoscience Australia, *Australian Resource Reviews: Nickel 2020*, April 2021, at page 6.

119 IEA, *The Role of Critical Minerals in Clean Energy Transitions*, May 2021, at page 144.

120 Geoscience Australia, *Australian Resource Reviews: Nickel 2020*, April 2021, at page 6.

121 SAFE analysis based on data from U.S. Geological Survey.

122 Leah Chen and Scott Yarham, "Electric Vehicle and the Nickel Supply Conundrum, Opportunities and Challenges Ahead," S&P Global, December 31, 2021.

123 See e.g., Erwida Maulia, "Dirty Metals for Clean Cars: Indonesian Nickel Could be Key to EV Battery Industry: Rich Nickel Reserves Attract Chinese Investment but Environmental Hurdles Remain," Nikkei Asia, October 19, 2022.

124 Ibid.

125 See e.g., Earthworks, "Indonesia," Webpage; Stephanie Tangkilisan and Muhammad Fasili, "From Dreams to Dust," Yale Environment 360, August 22, 2022; and Ian Morse, "Mining Turned Indonesian Seas Red. The Drive for Green Cars Could Gerald a New Toxic Tide," Washington Post, November 20, 2019.

126 See e.g., Stephanie Tangkilisan and Muhammad Fasili, "From Dreams to Dust," Yale Environment 360, August 22, 2022.

127 Leah Chen and Scott Yarham, "Electric Vehicle and the Nickel Supply Conundrum, Opportunities and Challenges Ahead," S&P Global, December 31, 2021; and IEA, *The Role of Critical Minerals in Clean Energy Transitions*, May 2021, at page 145.

128 See e.g., IEA, *The Role of Critical Minerals in Clean Energy Transitions*, May 2021, at page 146; and Henrique Ribeiro, Jacqueline Holman, and Lucy Tang, "Rising EV-Grade Nickel Demand Fuels Interest in Risky HPAL Process," S&P Global Commidty Insights, March 3, 2021.

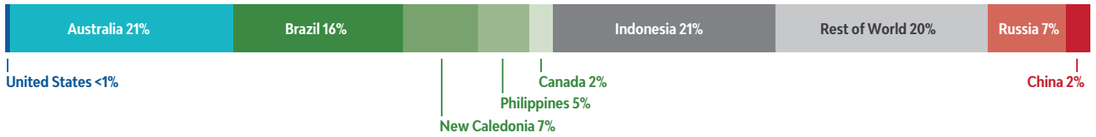
129 IEA, *The Role of Critical Minerals in Clean Energy Transitions*, May 2021, at page 146.

130 Henrique Ribeiro, Jacqueline Holman, and Lucy Tang, "Rising EV-Grade Nickel Demand Fuels Interest in Risky HPAL Process," S&P Global Commidty Insights, March 3, 2021.

131 Ibid.

Figure 11 Nickel Reserves and Mine Production, 2022

Ni Global Reserves



Ni Global Production

Note: Indonesia and Australia's share of global nickel production in 20022 were not representative of their reserves.

Source: SAFE analysis using data from the U.S. Geological Survey.

project.[132] Another Chinese firm, Ningbo Lygend, co-commissioned the first HPAL project in May 2021, and yet another, Huayou Cobalt, has signed agreements with Vale, the owner of Indonesia's largest nickel mine, to build two HPAL plants.[133] CATL, China's premier battery manufacturer, has also entered into a joint investment for nickel mining.[134]

Other examples of lower environmental and human rights standards benefiting production in one country over another can be seen for multiple critical mineral commodities. For example, the cost to adhere to higher environmental standards in the United States is one of the reasons why it conceded its dominance in the REE market to China in the late 1990s.

From the 1960s to the 1980s, the United States was largely self-sufficient in REE production.[135] Yet, by 1999, the United States was importing 90 percent of its REEs from China due in part to lower-cost Chinese materials.[136] China was able to produce REEs at a much lower cost than the United States partially due to their more relaxed environmental standards.[137] Their primary REE mine, Bayan Obo, produced approximately ten million tons of radioactive wastewater every year, most of which was discharged untreated directly into the Yellow River, which 150 million people relied on as their source of drinking water.[138] The experiences of villagers living near REE mines in China have been well documented, with the radioactive material leaking into the soil and water sources, killing crops, cattle, and people.[139]

In addition to environmental concerns within the critical mineral supply chains, human rights abuses have also been clearly documented in countries like the DRC, where there are currently more than 200,000 artisanal miners digging for cobalt, including 35,000 children—some as young as six-years-old.[140] Miners in this region often face hazardous working conditions, armed violence, and informal contracts

132 Mining Technology, "Five Largest Nickel Mines in Indonesia in 2021," June 3, 2022; IEA, *The Role of Critical Minerals in Clean Energy Transitions*, May 2021, at page 145; Indonesia Weda Bay Industrial Park, "Homepage," Webpage; HSBC, "Tsingshan's Indonesia Morowali Industrial Park: Build, and They Will Come," 2019; and Rodrigo Castillo, Lily Blumenthal, and Caitlin Purdy, "Indonesia's Electric Vehicle Batteries Dream Has a Dirty Nickel Problem," Brookings, September 21, 2022.

133 Isabelle Huber, "Indonesia's Nickel Industrial Strategy," Center for Strategic and International Studies, December 8, 2021; Reuters, "Nickel Miner Vale Indonesia Signs HPAL Deal with China's Huayou," September 13, 2022; and Mining Technology, "Five Largest Nickel Mines in Indonesia in 2021," June 3, 2022.

134 Rodrigo Castillo, Lily Blumenthal, and Caitlin Purdy, "Indonesia's Electric Vehicle Batteries Dream Has a Dirty Nickel Problem," Brookings, September 21, 2022.

135 U.S. Government Accountability Office, "Rare Earth Materials in the Defense Supply Chain," April 14, 2010.

136 Susan Juetten, "Rare Earth mining at Mountain Pass," Sierra Club California/Nevada Desert Committee, March 2011.

137 Cindy Hurst, "China's Rare Earth Elements Industry: What Can the West Learn?" Institute for the Analysis of Global Security, 2010.

138 Ibid.

139 Jonathan Kaiman, "Rare Earth Mining in China: The Bleak Social and Environmental Costs," The Guardian, March 20, 2014.

140 Yoann Le Petit, *Cobalt from Congo: How to Source it Better*, Transport & Environment, April 2019; and Annie Kelly, "Apple and Google Named in US Lawsuit Over Congolese Child Cobalt Mining Deaths," The Guardian, December 16, 2019.

for work, which can lead to unfair remuneration for labor. A lawsuit on behalf of 14 children and parents of Congolese child laborers who were killed or maimed in the mines has been filed against some of the major tech companies that source cobalt from the region, including Tesla and Apple.[141]

These abhorrent abuses have been allowed to perpetuate in part from lack of visibility and ignorance from governments and businesses—whether real or claimed—as to where and how critical minerals are being produced. This opacity has provided cover to irresponsible companies, corrupt governments, and human rights abusers, leading to calls for supply chain visibility and robust tracking and tracing mechanisms.

Until recently, policymakers in the United States and elsewhere had never addressed concerns about the environmental, human rights, and labor concerns related to mining and processing minerals abroad. It had been seen as a reputational risk that businesses and consumers would manage and negotiate. This narrow thinking left key U.S. and allied industries dangerously vulnerable to supply chain disruption and political coercion from actors that do not share their strategic interests or values.

Yet, even with increased calls for transparency and recent technological developments like the Internet of Things (IoT) and blockchain, which can physically track an item from one place to another, it remains difficult to pinpoint minerals once they are transformed into a refined material, and it is equally difficult to reliably attach value-related attributes, such as labor conditions, to those tracking mechanisms without on-the-ground validation. These shortcomings are further amplified by a suite of logistical issues, such as a lack of digitized records, barriers to moving data across borders, and are partially due to a lack of incentives for the industry to adopt existing technological solutions.

Around ten start-up companies currently exist that use blockchain and other tracking and traceability mechanisms to trace minerals from the mine all the way to the market. While some are only at the pilot project level, others have been implemented at full scale for companies' supply chains. For example, Circulor, a London-based tracking and traceability company, has partnered with mining companies like BHP to track copper throughout their supply chain. Circulor is also working with major automakers to track minerals in their supply chain, providing greater visibility into upstream processes needed for battery packs.[142]

These advances in transparency and traceability technology can only reach their full potential if policies exist to support their use. Furthermore, the layering of standards onto these frameworks will be necessary to level the global playing field for mineral production and create more diverse supply chains.[143] While working to overcome these challenges will be vital for leveling the cost landscape for responsible miners in a host of more diverse countries, it will only help to overcome one part of the problem. While it is surely in the United States' and its allies' best interest to bring more deposits online in their own countries, mining alone cannot solve dangerous supply chain concentration. This is because you cannot simply take a rock and put it into a battery. Most material that is mined today will unavoidably end up in China for processing and refining into useable materials. Without properly addressing minerals processing while the minerals-based economy is still in its infancy, the United States and its allies will continue to be vulnerable to manipulation by the CCP.

Most material that is mined today will unavoidably end up in China for processing and refining into useable materials.

141 See, e.g., Annie Kelly, "Apple and Google Named in US Lawsuit Over Congolese Child Cobalt Mining Deaths," The Guardian, December 16, 2019.

142 Joann Muller, "'Battery Passports' Could Help Electric Cars Qualify for Tax Credits," Axios, September 2, 2022; and Cindy Huynh, "BMW Partners With Circulor to Bring Blockchain to Ethical Sourcing," Coinsquare, March 6, 2018.

143 Note: Several issues related to tracking and traceability platforms will need to be addressed as these solutions are deployed at a greater scale. More work has to be done to determine best practices for the industry and to standardize the way data is used to track and report specific environmental or labor attributes of critical minerals on digital identifiers. Furthermore, the data security laws in certain countries may make it challenging for traceability platforms to move information across borders as critical material makes its way along the supply chain. Finally, true transparency will require the validation of the reported and tracked information. The platforms currently track information collected during annual audits. For greater accuracy, the system will need to move from periodic audits to continuous monitoring of production. Periodic audits can then be used to validate data and ensure that information is reported correctly.

Minerals Processing—The True Chokepoint

China's control of critical minerals processing, or the steps required to turn mined material into useable compounds and goods, is staggering. MP Materials, for example, has mined enough neodymium and praseodymium, two rare earth elements used interchangeably in neodymium-iron-boron magnets, in its California mine to meet the demand for 11 million electric vehicles per year.[144] These mined rare earths, however, have to be sent to China for processing.[145] A similar story is true for battery minerals. Currently, 60 to 100 percent of all battery minerals are processed in China.[146]

Extracting enough critical and strategic metals and minerals to meet soaring demand continues to be a significant supply issue. However, not addressing the processing challenge will continue to give the CCP an incredible advantage as to where and how the end material is used.

144 SAFE and Roland Berger analysis.

145 Ibid.

146 Jon Yeomans and Fred Harter, "Who Owns the Earth? The Scramble for Minerals Turns Critical," The Times, May 1, 2022.

China's dominance in minerals processing has also given it an edge in spent material recycling, as these two processes are incredibly similar, with the same physical and chemical reactions needed to extract an element from a rock as from a spent battery. Thus, in addition to its dominance in raw material processing, China is on track to have the most battery recycling capacity in the world, further cementing its ability to capture and keep critical minerals within its borders. Beijing currently has rules in place that require manufacturers to work with recycling companies to improve recycling processes, and in 2021 they had more than triple the recycling capacity relative to the United States.[147] Just as most critical minerals mined in the United States are sent to China for processing, most of the black mass—an intermediate battery recycling product—produced in the United States is also shipped to China for further refining.[148]

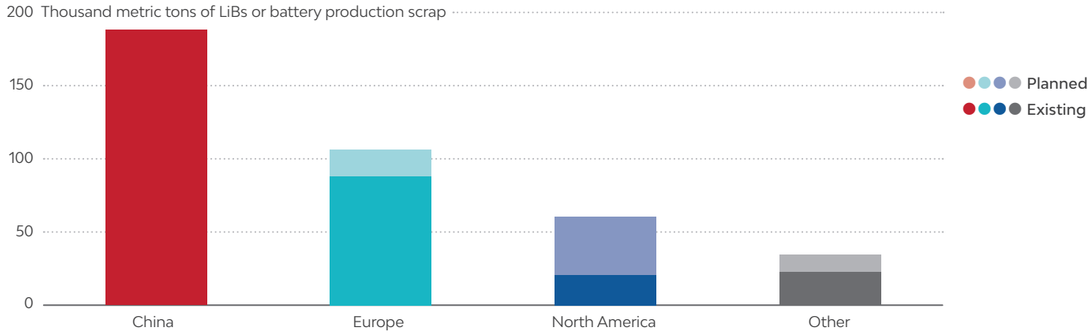
The United States and its allies, comparatively, have much lower control over these vital midstream and downstream links in the mineral supply chain. While the EU has the second largest processing capacity for cobalt (12 percent), synthetic graphite (ten percent), and

147 Maria Virginia Olano, "Chart: China is Trouncing the US on Battery Recycling," Canary Media, June 17, 2022.

148 SAFE analysis based on conversations with recycling industry experts.

This photo taken on Dec. 8, 2022 shows the graphitization process of anode materials for lithium-ion batteries at a workshop of a company in Hegang City, northeast China's Heilongjiang Province.

Figure 12 Annual Recycling Capacity by Region, 2021



Note: China's recycling capacity for end-of-life lithium-ion batteries and battery production scrap is indicative of its dominance in material processing. ("Other" includes existing or planned recycling capacity in South Korea, Japan and Australia.)

Source: American Chemical Society

nickel (nine percent), it has no capacity for lithium or natural graphite. The United States can process small amounts of synthetic graphite (five percent), lithium (two percent), and nickel (one percent), but no other important EV minerals.[149] There is one bright spot for minerals processing: Chile, an FTA country, controls more than 30 percent of global lithium processing.[150]

For recycling, although the EU is negotiating new regulations to improve their recycling capacity, the United States is far from implementing (or even considering) any such measures. Also, the looming energy crisis in the EU due to Russia's ongoing war in Ukraine and Russian President Vladimir Putin's weaponization of natural gas could mean that EU mineral processing capacity—which is very energy intensive—could soon be diminished if the transition away from Russian oil and gas is not well managed.

The United States has recognized its comparative disadvantage in critical minerals processing and has begun to take steps to address this critical supply chain chokepoint. Under DPA Title III funding, DOD has awarded MP materials $9.6 million to develop processing capabilities for light rare earths, including neodymium-praseodymium (NdPr), and $35 million to process heavy rare earths that are not only used in permanent magnets in electric motors, but also have critical defense applications.[151] The company's rare earths separation and processing facility in Mountain Pass for light rare earth elements and heavy rare earth concentrates began its commissioning in 2022. MP materials expects to produce enough NdPr for six to ten million EV motors.[152] The company is also in the process of building a magnetics facility to produce neodymium-iron-boron magnets, and continues to develop its separation project for heavy rare earths.[153]

There are also processing facilities under development for battery minerals. DOE recently released almost $3 billion in funding to 20 different projects to build up battery material processing capacity in the United States. It estimates that funding will support production capacity to supply enough battery-grade lithium production for two million EVs, enough battery-grade graphite for about a million EVs, and enough battery-grade nickel for 400 thousand EVs.[154] Due to these projects and many others, North America is poised to process 54 percent of its forecasted 2030 lithium demand, 26 percent of its forecasted 2030 graphite demand, 21 percent of its forecasted 2030 cobalt demand, and five percent of forecasted 2030 nickel demand.[155]

Building new processing capacity in North America is not a simple task. Companies looking to establish mineral processing and refining facilities are entering a market in which China is not only the main processor of mined material, but also the largest buyer of the final processed mineral goods—an end-to-end capacity that the CCP has been working to build up since the 1990s.[156] Thus, any new entrants must contend with preferred Chinese suppliers to sell into Chinese midstream markets until other markets are more developed.

REEs provide a stark example of how this supply chain domination has made it difficult to build and sustain production capacity at these vital midstream steps. In the mid-2000s, export quotas and subsidies were used to keep mined rare earths in the country and encourage the domestic production of oxides, metals, and alloys.[157] Joint venture requirements were also established for processing and smelting projects to restrict foreign direct investment.[158] At the same time, the Chinese government was working to build up its permanent magnet industry—one of the main end-products for REE alloys. Chinese companies acquired U.S. permanent magnet makers and their intellectual property. The last-standing U.S. permanent magnet maker, Magnequench—a subsidiary of GM—was sold to a consortium of two Chinese companies in 1995, and by 2006, all U.S. operations for Magnequench were shut down and moved to China.[159]

As China cornered not only the mining and processing of REEs but also the majority of the downstream market for those critical minerals—including 90 percent of REE metal conversion and 92 percent of magnet manufacturing capacity—maintaining remaining U.S. mining and processing capacity became a challenge.[160] Molycorp, the previous owner of Mountain Pass, had attempted to process the rare earths elements mined at Mountain Pass, but went bankrupt in 2015. The company was unable to bring its rare earths separation technology to market while also competing with China's near monopoly, where Chinese producers could flood the market with low-priced rare earth oxides.[161]

Newcomers to mineral processing must also contend with Chinese competitors whose businesses are likely heavily subsidized. The Chinese government has been providing direct and indirect subsidies to domestic producers of batteries, battery components, and battery materials since the early 2000s. While the exact amount of government support is difficult to quantify, there have been multiple news reports and studies on subsidies received by Chinese companies along the supply chain.

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The CATL example shows the scale at which Chinese companies, even when they seem privately owned, continue to benefit from state support. By 2020, the company had already become the world's leading lithium-ion battery manufacturer.[162] However, the government subsidies received that year were still equivalent to one-fifth of the company's net income.[163] Companies looking to process critical and strategic materials are also receiving these subsidies. For instance, a major Chinese lithium producer, Ganfeng Lithium, has reported that it received $238 million in subsidies in 2018 and $79 million in subsidies in 2019.[164]

While all countries are known to provide some sort of government support to their domestic industries, an Organization for Economic Cooperation and Development (OECD) study that analyzed the subsidies received by the top 17 aluminum producers between 2013 and 2017 draws a stark comparison between the level of Chinese state support and government support in other countries. The report attributes close to $8 billion of the $12.7 billion in total global non-financial support (i.e., energy subsidies,

149 Jon Yeomans and Fred Harter, "Who Owns the Earth? The Scramble for Minerals Turns Critical," The Times, May 1, 2022.

150 Data from Benchmark Mineral Intelligence.

151 MP Materials, "MP Materials Awarded Department of defense Heavy Rare Earth Processing Contract," Press Release, February 22, 2022.

152 MarketScreener, "Transcript: MP Materials Corp. Presents at 9th Annual Morgan Stanley Auto 2.0 Conference, Jan-05-2023 01:45 PM," January 5, 2023.

153 MP Materials, "MP Materials Reports Third Quarter 2022 Results and Begins Stage II Commissioning," Press Release, November 3, 2022.

154 U.S. Department of Energy, "Biden-Harris Administration Awards $2.8 Billion to Supercharge U.S. Manufacturing of Batteries for Electric Vehicles and Electric Grid," Press Release, October 19, 2022.

155 Benchmark Minerals, "Can North America Build a Battery Supply Chain?," November 17, 2022.

156 Pui-Kwan Tse, *China's Rare Earth Industry*, U.S. Geological Survey, 2011, at page 2.

157 China Power, "Does China Pose a Threat to Global Rare Earth Supply Chains?," Center for Strategic and International Studies, Webpage.

158 Pui-Kwan Tse, *China's Rare Earth Industry*, U.S. Geological Survey, 2011, at page 2.

159 David Greising, "China's Investment Wave: Good or Bad?," Chicago Tribune, July 10, 2005; and U.S. Magnet Association, "U.S. Magnets History," Webpage.

160 U.S. Department of Energy, *Rare Earth Permanent Magnets: Supply Chain Deep Dive Assessment*, February 24, 2022, at page 25.

161 See e.g., John Xie, "California Mine Becomes Key Part of Push to Review US Rare Earths Processing," Voa News, December 31, 2020; and Jeffrey A. Green, "The Collapse of American Rare Earth Mining—and Lessons Learned," Defense News, November 12, 2019.

162 Henry Sanderson, "China's Electric Vehicle Battery King," Time, September 29, 2022.

163 Keith Bradsher and Michael Forsythe, "Why a Chinese Company Dominates Electric Car Batteries," New York Times, December 22, 2021.

164 Global Trade Alert, "China: Government Subsidy Changed for Listed Company GANFENGLITHIUM in Year 2019," Webpage.

MP Materials' rare earths mining and processing facility stands in Mountain Pass, California.

other input subsidies, preferential tax treatment, concessions, etc.) given to major aluminum producers by the Chinese government.[165] This number does not include additional support Chinese companies receive in the form of concessional loans.

China is also largely the sole producer of equipment and machinery used in processing facilities, giving it an advantage in expertise and allowing it to exert its control over others' ability to build up processing capacity.

When the Saskatchewan Research Council (SRC) tried to purchase Chinese tanks for use in its upcoming Saskatoon REE processing facility, the message was clear: the Chinese companies were dragging their feet and did not want to take part in building a rare earths processing facility in Canada. The companies either asked for an unrealistically high price for their equipment or refused to give guarantees that the units they built would function properly. SRC wound up having to design and build its own rare earths separator—making 150 units for the price a Chinese company asked for a single unit.[166] While developing its own technology and equipment, SRC also designed its facility to re-treat and re-use waste water and chemicals. In China, waste water and chemicals are usually discharged into the environment.

Unlike in the mining sector, where higher standards can lead to higher production costs, cleaner processing solutions more often result in lower cost products. Thus, in order to become competitive in a market that is dominated by China on both ends, many up-and-coming processing companies in North America are looking to develop newer, cleaner, faster and more efficient ways to process minerals using technology and equipment developed outside of China. Efficiency provides an alternative way for a processing facility that does not receive input subsidies to reduce its operational costs. For example, Urbix's novel graphite processing technology is significantly more energy and cost-efficient compared to the standard graphite refining methods and operates in only a light industrial zone.[167]

SRC and Urbix are examples of how innovative research and development can help likeminded countries and the United States reduce dependence on the CCP while also developing cheaper, more efficient, and cleaner processes that revolutionize what has traditionally been a relatively dirty industry—providing an alternative destination for raw materials.

165 Organisation for Economic Co-operation and Development (OECD), *Measuring Distortions in International Markets: The Aluminum Value Chain*, January 8, 2019, at page 15.

166 Bryn Levy, "Saskatchewan Research Council Eyes Future As West, China Drift Apart," Saskatoon StarPhoenix, November 4, 2022.

167 Green Car Congress, "US-Based Graphite Processor Urbix Expands to UK," March 31, 2022.

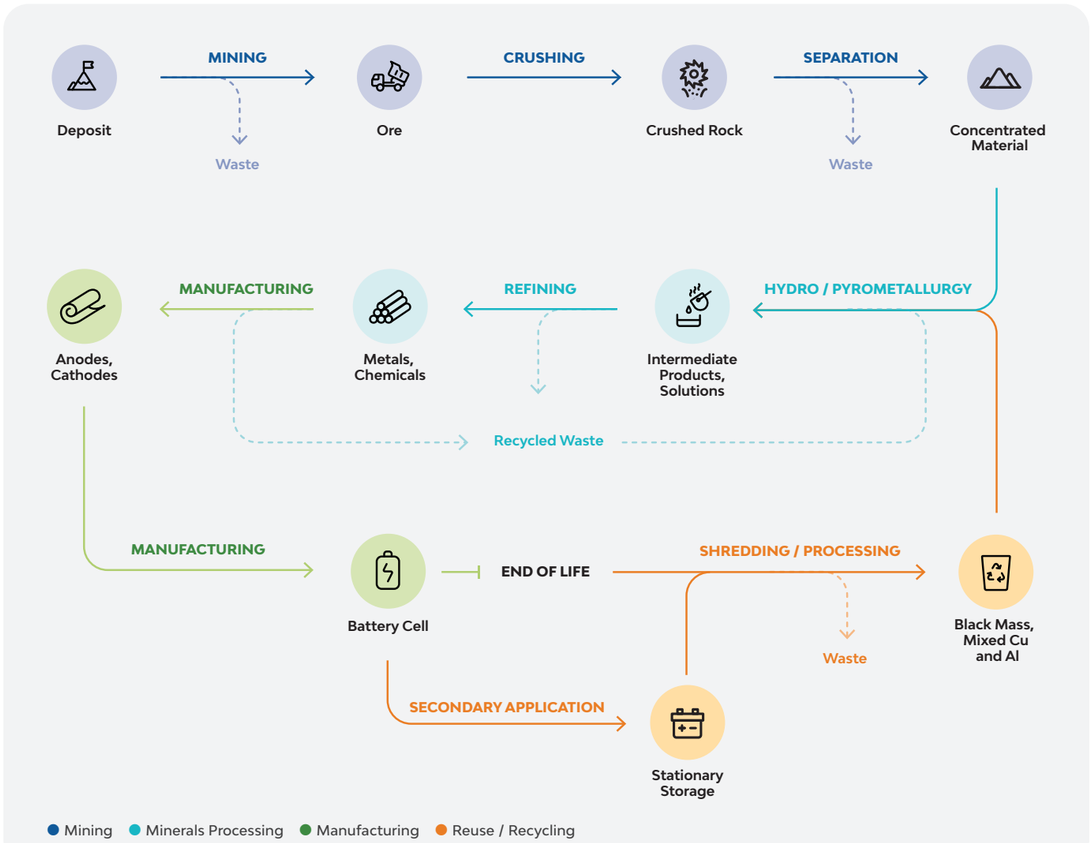
The Role of a Circular Economy

As the transition to a minerals-based economy accelerates, the concept of energy security will shift. An economy run on fossil fuels requires a constant and continuous flow of material that combusts one time to generate energy. Unlike oil, gas, coal, and nuclear energy, critical minerals-based batteries are reusable. As such, the ability to commoditize and recycle materials and technologies will be an essential pillar of energy security in the 21st century.

A clear roadblock in the U.S. economy is its ability to "make-use-recycle" more critical minerals that are already in circulation.[168] Critical minerals are already used in a number of important defense, medical, and transportation technologies, yet the United States lacks a comprehensive recycling apparatus to collect, transport, and reprocess batteries, components, and equipment. Rather, these vital commodities sit inside junk drawers, landfills, or are exported. This inhibits the United States' ability to extend the lifespan of materials and maintain a secure supply of concentrates, oxides, alloys, components, cells, and the batteries themselves. The circular economy model would relieve extractive

168 Adina Renee Adler, "Recycling Critical Minerals is an Underappreciated National Security Tool," The Hill, May 19, 2022.

Figure 13 Lifecycle of Critical Minerals Used in Electric Vehicle Batteries



Notes: Critical minerals undergo multiple transformations before making their way into an electric vehicle (EV) battery or motor. The raw material must be mined, crushed, and separated before it is converted into intermediate products and metals through minerals processing and refining techniques. These intermediate products are further transformed into manufactured goods like battery cathodes before finally reaching their end of life either as a recycled good or in a secondary application. Each of the steps in the lifecycle of a critical mineral can occur in different places.

Source: SAFE analysis, based on conversations with with mining experts.

and landfilling pressures on the environment while also creating domestic jobs, reducing dependence on foreign adversaries, and aligning policy and regulation with key defense allies that strengthen supply chains.

An EV battery's lifespan is limited. The continuous cycle of charging and discharging eventually degrades the battery, and once its capacity falls to around 70 to 80 percent of its original capacity, the battery is no longer qualified for automotive use.[169] It takes an estimated ten years or longer for an EV battery to be retired.[170] An estimated 500,000 EVs are expected to be scrapped by 2025, and this number will only grow as EVs increase their market share. According to the European Commission, the number of lithium-ion batteries ready to be recycled will increase by seven-fold between 2020 and 2040.[171]

It remains an open question as to what will happen to these vehicles' batteries. Some analysts believe that batteries will see a second life as stationary storage devices for electrical grids, while others think batteries will largely end up in landfills.[172] When not able to refurbish or repurpose a battery, recycling provides a pathway to not only solve the waste issue associated with scrapped vehicles, but also to maximize smaller domestic reserves of key mineral commodities, reduce reliance on current geographically concentrated supply chains, and mitigate some of the environmental and human rights issues associated with mining.

Given the surging demand for EV minerals, recycling on its own will not be the universal remedy. However, bolstering a domestic recycling industry is an important step toward establishing a secure and sustainable material supply chain that can continue to provide feedstock for key industries. The potential for recycling to offset the need for virgin materials is not insignificant. The World Bank projects that by 2050, if recycling rates increase significantly, battery recycling could decrease the need for newly mined material by up to 23 percent for nickel, 15 percent for cobalt, and 26 percent for lithium.[173]

169 Mohammed H. S. M. Haram, "Feasibility of Utilising Second Life EV Batteries: Applications, Lifespan, Economics, Environmental Impact, Assessment, and Challenges," Alexandria Engineering Journal, Volume 60, Issue 5, October 2021, at page 4519.

170 Camille Carhluet and Wesley Van Barlingen, "How Long Do Electric Batteries Last?," EVBox, last updated June 16, 2022; National Grid, "What Happens to Old Electric Car Batteries?," Webpage, July 15, 2022; and Cory Gunther, "How Long Do EV Batteries Last?," Review Geek, April 19, 2022.'

171 European Commission, "Questions and Answers on Sustainable Batteries Regulation," December 10, 2020.

172 See e.g., Ian Morse, "A Dead Battery Dilemma," Science, May 20, 2021.

173 Kirsten Hund et. al., *Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition*, World Bank, 2020, at page 82..

Bolstering a domestic recycling industry is an important step toward establishing a secure and sustainable material supply chain that can continue to provide feedstock for key industries.

Recycling begins with discharging and dismantling the end-of-life batteries, followed by shredding and sorting the materials to separate out the copper, aluminum, steel casings, and plastic fluff. The resultant product after sorting and shredding is referred to as black mass, a lumped or flaked black material comprised of high concentrations of EV minerals and other impurities. Further refining by chemical processes is required to recover specific battery-grade minerals from black mass.

There are seven operational facilities and eight planned facilities for lithium-ion battery recycling in North America, compared to more than 10,000 in China.[174] U.S. EV battery recycling faces many challenges, including logistical barriers, high costs, and permitting for waste transportation. Collecting and transporting batteries make up about half of the cost of recycling an EV battery in the United States.[175] Infrastructure and facilities permitted to collect, sort, and disassemble large format EV batteries are still nascent in the country.

The United States lags Asian countries in battery manufacturing, which is key to purchasing scrap to feed the recycling industry—North American recycling plants mainly recycle manufacturing scrap and recalled EV batteries, as large volumes of EV batteries have not yet reached their end-of-life.[176] Furthermore, North American recyclers do not currently produce battery-grade precursor materials for cathodes and anodes, although many are considering building the proper infrastructure to do so at a commercial scale.[177] Hence, any recycled material produced must be exported for further conversion into battery precursors and electrode active materials.

174 California Environmental Protection Agency (CalEPA), *Lithium-ion Battery Recycling Advisory Group Final Report*, March 16, 2022, at page 21; and Carrie Hampel, "Battery Reuse & Recycling Expand to Scale in China," Electrive.com, January 29, 2022.

175 Ibid., at page 14.

176 Ibid., at page 20.

Despite these challenges, automakers are partnering with U.S. and Canadian recycling companies to reuse their manufacturing scrap to provide sustainable sources of materials needed for EV batteries. For example, GM and LG Energy Solution recently announced a partnership with Li-Cycle, a recycling company located in Canada and the United States, to recycle up to 100 percent of their material scrap from battery cell manufacturing.[178] This new partnership will recover cobalt, nickel, lithium, graphite, copper, manganese, and aluminum from used batteries for new manufacturing. Additionally, automakers are considering end-of-life applications and recycling while designing new EVs to fully capitalize on the full lifecycle of a vehicle. For example, Rivian Automotive, a U.S.-based EV manufacturer, ensures that all end-of-life EV batteries in their cars are designed to be recycled.[179]

More incentives are needed to support recycling industries while the EV market is still nascent. Virgin material is often cheaper and more widely available than recycled content.[180] Some experts estimate it will take at least ten years for the cost of recycling EV batteries to reach parity with manufacturing EV batteries from raw materials. Yet, once in place, using recycled materials could ultimately reduce the total cost of manufacturing a lithium-ion battery pack by 20 percent.[181]

To overcome these hurdles and lay the necessary groundwork to be ready for the influx of batteries, countries are beginning to implement policies to incentivize recycling production. China and the EU, for example, have explored regulations to support battery circularity. In 2020, the European Commission introduced the EU Battery Regulation, which requires battery makers to use recycled materials in new battery manufacturing and implement a battery labeling system to help recyclers process batteries, increase data information sharing, and support supply chain due diligence.[182] In 2017, China implemented a national-level lithium-ion battery recycling system and a battery traceability platform to better track batteries throughout their lifecycle.[183] China also implemented a program to encourage automakers to design with the full EV battery lifecycle in mind.[184]

Incentives for recyclers to take their products all the way from black mass to usable compounds and goods will be essential to ensure recycling contributes to our national security. In a preliminary document floated by the U.S. Internal Revenue Service regarding IRA implementation, it signaled that to qualify for the recycling portion of the tax credits the recycled material must go beyond simply black mass.[185]

A few options exist for this within an allied supply chain: Sudbury Integrated Nickel Operations, owned by Glencore in northern Ontario, is currently the primary purchaser of black mass in North America. Newer recycling companies, such as Li-Cycle, are planning to process their black mass into battery precursor materials in the United States. Additionally, Nevada-based Redwood Materials is currently developing a system to create cathode active materials and copper foils from their recycled products.[186]

Developing recycling and processing hubs and supporting the entire mid-stream from cathode and anode manufacturing to direct recycling in North America will lower costs for consumers and create a secure EV battery ecosystem.

177 SAFE Recycling Roundtable, 2022.

178 Batteries News, "Ultium Cells, GM & LG Energy Solution JV, and Li-Cycle Collaborate to Expand Battery Recycling," May 12, 2021.

179 SAFE Recycling Roundtable, 2022.

180 See e.g., Mark Burton and Thomas Biesheuvel, "The Next Big Battery Material Squeeze is Old Batteries," Bloomberg, September 1, 2022; Julian Spector, "EV Battery Recycling is Costly. These 5 Startups Could Change That," Canary Media, and Ule Chrobak, "What Will It Take to Recycle Millions of Worn-Out EV Batteries?," American Battery Technology Company, September 21, 2022.

181 Ahmad Mayyas, Darlene Steward and Margaret Mann, "The Case for Recycling: Overview and challenges in the Material Supply Chain for Automotive Li-ion Batteries," National Renewable Energy Laboratory, Elsevier, December 13, 2018, at page 19.

182 European Commission, *A Proposal for a Regulation of the European Parliament and the Council Concerning Batteries and Waste Batteries, Repealing Directive 2006/66//EC and Amending Regulation (EU) No 2019/1020*, December 10, 2020.

183 Ibid., at pages 69 and 85.

184 CalEPA, *Lithium-ion Battery Recycling Advisory Group Final Report*, March 16, 2022, at page 23.

185 U.S. Internal Revenue Service, "Anticipated Direction of Forthcoming Proposed Guidance on Critical Mineral and Battery Component Value Calculations for the New Clean vehicle Credit," 2022.

186 CalEPA, *Lithium-ion Battery Recycling Advisory Group Final Report*, March 16, 2022, at page 20.

The Minnesota Boundary Waters Canoe Area (BWCA) is a large wilderness area in northeastern Minnesota that is also rich in critical mineral deposits.

Supporting a Global Race to the Top

While working with allies and robust recycling will be essential to obtaining the minerals and materials to meet global EV targets, more will be needed. The time to create new supply chains is now, while the EV battery market is still nascent. If responsible mining, better recycling, and dangerous dependencies within critical mineral and battery supply chains are not addressed, it could threaten to slow—or completely halt—EV adoption, leaving the world reliant on oil and the American auto sector stuck in time. It is in the United States' best interest to support a rapid transition, while energetically pushing to address the challenges laid out within the EV supply chain.

Implemented unilaterally, responsible mining practices have little to no effect on diversifying critical mineral supply chains. Non-participating entities, able to produce minerals more cheaply by degrading the environment or exploiting workers, are able to continue flooding the market with lower cost minerals, making the premium for the responsibly produced goods uneconomic. Furthermore, the current lack of transparency mechanisms means that consumers will be unable to determine why a particular mineral is priced higher than another, likely leading them to favor the cheaper mineral to reduce costs and perpetuating the global race to the bottom.

Implemented among allies with large, tech-driven economies, responsible mining standards can move markets and change global behavior. For instance, if the United States, Japan, and the EU—three of the world's largest economies—agreed to only source minerals mined with high standards, the rest of the world would have to follow suit. Consequently, the premium for responsibly produced minerals would dissipate, as all mineral producers would be incentivized to raise their standards to sell their products into the American, Japanese, and European markets. This, combined with robust transparency frameworks to ensure adherence and limit manipulation, will help level the global playing field and enable the diversification of critical mineral supply chains that is desperately needed.

Linking Transparency and Voluntary Standards

Standards are fundamental instruments of the free market, signaling the collective preferences of different stakeholder groups—from governments and businesses to investors and consumers. First used to ensure countries could efficiently conduct commerce with one another, standards have evolved into a mechanism to improve business and operational conduct globally. Governments participate in standards setting to inform and foster consensus on policy positions, and businesses participate in standards setting to demonstrate best practices and attract consumers. Standards are often developed and financed by multistakeholder-led groups made up of governments and non-governmental organizations (NGOs) with expertise or a stake in a particular issue. While most standards remain voluntary, some include a certification process or public disclosure requirement to ensure and verify adherence.

While different groups have used standards for decades to coordinate business practices and optimize trade, mining standards are a relatively recent phenomenon spurred by the globalization of supply chains and the push toward cleaner energy technologies. Most mining standards were created in the last 20 years, with a flurry of more recent standards released in the late 2010s. However, while many mining

standards are relatively new, their basic principles are often based on more established international norms.

For instance, most mining standards reference multiple United Nations (UN) declarations, treaties, and initiatives, which have evolved to align with and adhere to international laws and norms set by the UN's various governing bodies. These include, but are not limited to, the Universal Declaration of Human Rights (1948), the Declaration of the Rights of Indigenous Peoples (2007), and the UN Guiding Principles of Business and Human Rights (2011), which serve as the global guidance for respecting human rights; the International Labor Organization (ILO), which has compiled more than 100 conventions ranging from maternity protection and social security to hours of work and working conditions; and the 2015 Paris Agreement and initiatives like the UN Sustainability Development Goals (SDGs) and UN Global Compact, which serve as reference points for governments, civil society, and the private sector to design climate regulations and set emission reduction targets.[187]

To be truly effective, standards and transparency must go hand-in-hand. Standards without transparency lack legitimacy; and transparency without standards lacks consequence. Furthermore, both standards and transparency lack meaningful outcomes without actionable enforcement mechanisms.

Standards without transparency lack legitimacy; transparency without standards lacks consequence.

Some of the first attempts to address the issue of standards in critical mineral supply chains were actually exercises in transparency. The Extractive Industries Transparency Initiative (EITI), a voluntary financial disclosure mechanism widely cited within modern mining standards, was established in 2003 to reduce corruption and bribery within the extractives sector.[188] Developed in response to global outrage following the release of a 1999 report detailing the opaque management of oil contracts and revenues in Angola, the EITI standard began as a framework and database to promote and facilitate revenue transparency for governments and companies.[189] According to the OECD, the extractives industry accounts for the largest percentage of foreign bribery cases of any sector, including the bribery of public officials to secure a business transaction.[190] In the majority of cases, corporate management or the Chief Executive Officer were aware of and endorsed the bribery.[191] EITI implementing countries agree to publish the revenues they receive from natural resource extraction, and extractives companies within their jurisdictions are required to publish what they pay.[192] As EITI has matured, it has evolved to encompass beneficial ownership, contract transparency, commodity trading, and gender and environmental impacts.[193]

EITI is recognized as the international standard for open and accountable management of oil, gas, and mineral resources. Today, more than 50 governments are EITI implementing countries. EITI's reporting requirements have been included in legislation in the United States, EU, Nigeria, Liberia, and the World Bank's International Finance Corporation's (IFC) standards for extractives projects.[194] In 2014, the United States was accepted into EITI and formed the USEITI multistakeholder group (MSG) to oversee national implementation.[195] In response, the DOI launched the U.S. Natural Resources Revenue Database.[196] As part of its launch, and for the first time, the United States disclosed calendar year revenues paid to and collected by the Office of Natural Resources Revenue (ONRR) by company, revenue type, and commodity.[197] In 2017, the United States withdrew as an EITI implementing country but remains a financial supporter of the initiative.[198]

Another example of transparency requirements designed to affect critical mineral supply chains is the

187 SAFE analysis based on a review of international laws and norms set by UN governing bodies.

188 Extractive Industries Transparency Initiative (EITI), "Our History," Webpage; and EITI, "Our Mission," Webpage.

189 EITI, "Our History," Webpage.

190 OECD, "Foreign Bribery Report," December 2, 2014, at page 8.

191 Ibid., at page 22.

192 Publish What You Pay, "The EITI," Webpage.

193 EITI, "Our History," Webpage.

194 EITI, "Our History," Webpage; and EITI, "Countries," Webpage.

195 U.S. Department of State, "Extractive Industries Transparency Initiative (EITI)," Archived Webpage; and 79 FR 49534.

196 U.S. Department of Interior, "Interior Department Launched Data Portal Detailing the U.S. Extractive Industries Transparency Initiative's First Annual Report," Press Release, last edited September 9, 2021.

197 Ibid.

198 Julia Simon, "U.S. Withdraws From Extractive Industries Anti-Corruption Effort." Reuters, November 2, 2017; and EITI, "EITI Chair Statement on United States withdrawal from the EITI," November 2, 2017.

Artisanal miners carry sacks of ore at the Shabara artisanal mine near Kolwezi, Democratic Republic of Congo, on October 12, 2022.

2010 Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act). During the DRC's second civil war from 1998 to 2003, armed rebel groups occupied and controlled mining operations and trade routes for precious metals, including tin, tungsten, tantalum, and gold—commonly referred to as the 3TG minerals—to finance their operations. These groups continued to profit from 3TG minerals after the second civil war formally ended.[199] Section 1502 within the Dodd-Frank Act added new provisions to the Securities and Exchange Act of 1934, instructing the Securities and Exchange Commission (SEC) to create an annual reporting requirement for "conflict minerals" originating from the DRC and surrounding countries.[200] In 2012, the SEC issued their final ruling classifying the 3TG minerals as conflict minerals and requiring companies to disclose certain information on products that contained these minerals.[201] However, after heavy lobbying from the electronics industry, the reporting requirements lack enforcement mechanisms: in 2017, the SEC's Division of Corporation Finance issued a no-action relief statement saying that the SEC would not enforce actions against companies that do not comply with the disclosure requirements.[202]

While the Dodd-Frank Act lacks regulatory enforcement mechanisms, it paved the way for future initiatives to focus on the sourcing of minerals. Dodd-Frank catalyzed the creation of OECD's 2010 Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, as well as the 2015 Responsible Minerals Initiative's (RMI) Responsible Minerals Assurance Process (RMAP) and Conflict Minerals Reporting Template (CMRT), and the Global Reporting Initiative (GRI)—all internationally recognized standards. The Due Diligence Guidance has been adopted by mining giants like BHP. Furthermore, Dodd-Frank has also inspired the EU's Regulation 2017/821, which requires all EU importers of 3TG to conduct supply chain due diligence.[203]

Although the Due Diligence Guidance acknowledges serious human rights abuses within mineral supply chains, its narrow focus on conflict financing ignores other serious societal and environmental impacts of industrial mining. For instance, artisanal mining is framed as an exclusive channel for funding armed groups rather than as a critical source of livelihood for millions of people. As a result, many companies aim to eradicate minerals produced by artisanal miners from their supply chains, rather than recognizing the potential benefits of strengthening and integrating the sector into the formal economy and industrial operations. This can further stigmatize local populations and exacerbates grievances in which governments allow foreign companies to exploit and pollute the environment with impunity.[204]

199 Nik Stoop, Marijke Verpoorten, and Peter van der Windt, "More Legislation, More Violence? The Impact of Dodd-Frank in the DRC," PLOS ONE, August 9, 2018, at page 4.

200 Pub. L 111-203 § 1502.

201 77 FR 56273.

202 U.S. Securities and Exchange Commission, "Updated Statement on the Effect of the Court of Appeals Decision on the Conflict Minerals Rule," Public Statement, April 7, 2017.

203 OECD, "An International Standard: OECD Due Diligence Guidance for Responsible Mineral Supply Chains," Responsible Business Conduct, Webpage.

204 International Crisis Group, "Mineral Concessions: Avoiding Conflict in DR Congo's Mining Heartland," June 30, 2020, at page 23.

Finally, government procurement practices can also provide a mechanism to implement transparency. For example, Section 857 of the 2023 National Defense Authorization Act (NDAA) requires contractors selling magnets to the DOD to disclose the location where the rare earths in the magnets were mined and processed.[205] Section 857 also stipulates that if a contractor has no visibility into its supply chain, it must to establish methods to do so prior to selling permanent magnets to the U.S. government.

Examining Voluntary Mining Standards[206]

There have been many attempts to define high standards for responsible mining at the international, governmental, non-governmental, and industry levels. At their best, these standards serve as ways to streamline best practices across multiple operating jurisdictions and meaningfully push for better community and tribal participation, improved labor conditions, and better environmental outcomes. At their worst, mining standards are largely voluntary, rubber-stamping exercises that lack clearly defined reporting, validation, or enforcement mechanisms. Additionally, new mining standards are created frequently, leading to confusion over which standard is ultimately the best, and different mining companies sign onto different mining standards. For example, BHP, the largest mining company in the world, follows International Council on Mining and Metals' (ICMM) Mining Principles and Performance Expectations, while Lithium Americas has opted to sign on to the Initiative for Responsible Mining Assurance (IRMA), a multistakeholder-led standard first developed in 2017. This panoply of standards contributes to the erosion of public trust in mining standards overall and a negative perception of responsible mining practices.

Today, governments and businesses, unaccustomed to dealing with global mining standards, are having to thoughtfully respond to community and consumer concerns regarding the mining industry's real or perceived lack of meaningful community and tribal engagement, reports of child and forced labor, and the history of contaminated waterways, tailings disasters, and un-reclaimed mining lands that dominate global headlines. In an attempt to save face and convince consumers they are dedicated to environmental, social, and governance (ESG) principles, private companies from automakers to tech start-ups are feverishly joining groups and signing onto standards to prove their commitment to green principles. However, this rush to join could ultimately have the opposite of its intended effect—turning standards adherence into a check-the-box exercise and watering down all standards in the process.

Wading through mining standards can be exceedingly difficult. Mining standards vary depending upon their organizational framework, operating region, and even sometimes by commodity. Government-led standards are often more high-level than industry or multistakeholder-led standards and usually do not require validation. This is most likely due to their need to gain consensus among countries that have diverse values and encourage broader participation and uptake among those countries.

Some standards were developed for specific regions, such as OECD's Due Diligence Guidance, which was specifically designed to address conflict-affected and high-risk areas in the Great Lakes Region of Africa. While other standards can be applied around the world, such as the Mining Association of Canada's Toward Sustainable Mining (TSM) standard, which was originally developed to provide cohesion across the many provincial jurisdictions in Canada, but has so far been adopted by mining associations in Argentina, Australia, Botswana, Brazil, Columbia, Finland, Norway, Spain, and the Philippines.[207] There are also issue-specific standards, such as the International Cyanide Management Code and the Global Industry Standard on Tailings Management.

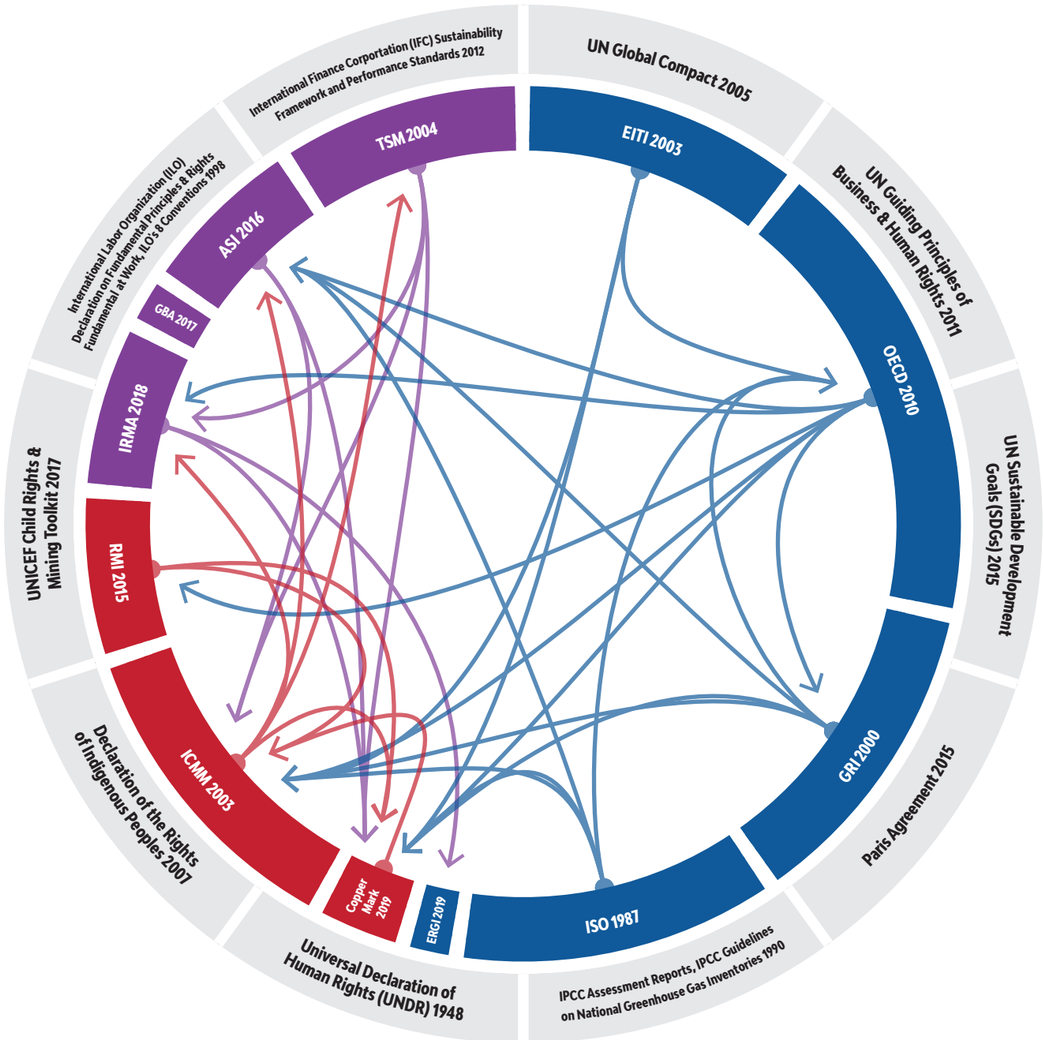
Some standards aim to make all other standards obsolete, whereas others aim to be specific and complementary. For instance, IRMA is pushing to become the primary standard across all operating regions, while Copper Mark, a commodity-specific standard established in 2019, was developed in coordination with the Responsible Minerals Initiative (RMI) and references every other standard examined in this report. In fact, all of the standards examined in this report reference other standards: TSM's tailings protocol is one of the most widely cited standards on how to deal with mine waste, the Global Reporting Initiative (GRI) is one of the most widely cited for how to track

205 Marcia Madsen, Luke Levasseur, Cameron Edlefsen, and Evan Williams, "US NDAA for Fiscal Year 2023: Important Changes to Procurement Laws and Policy," Mayer Brown, December 30, 2022.

206 Note: There is also a growing interest in establishing best practices and data standards for supply chain traceability. For the purposes of this paper, we will not examine these efforts, and instead focus on responsible mining standards.

207 The Mining Association of Canada, "Towards Sustainable Mining," Webpage.

Figure 14 The Interrelationship Between Voluntary Large-Scale Mining Standards



Note: While numerous mining standards exist, many of them cite one another, and all of them refer back to existing principles, declarations, and agreements developed by the United Nations (UN)— identified on this figure by the gray arcs. This leads to a surprising amount of congruity among disparate standards despite varying levels of specificity. The connecting lines show which standards reference and are referenced by other existing standards.

Source: SAFE analysis based on a comparison of voluntary large-scale mining standards.

and publicly report mining information, and OECD is cited often for its due diligence guidance.

Most industry and multistakeholder standards are applied at the site level and provide a ramped timeline for compliance. Most standards use the same assurance firms to conduct their third-party auditing to ensure on-the-ground compliance.[208]

In an attempt to shed some light on differences and similarities between mining standards, this report examined a subset of prevailing large-scale, voluntary standards from government, industry, and multistakeholder-led initiatives across the hardrock mining sector. While the role of artisanal and small-scale mining is critical to this sector, this report does not examine those standards. Instead, this report compares best practices across large-scale mining standards on three key areas of concern affecting the social acceptance of mining today, which could potentially hinder the transition to an electric future. These include:

1. **Community and tribal engagement**
2. **Child and forced labor**
3. **Environment, including water quality, waste, and reclamation**[209]

To support the transition to EVs and create a global race to the top with high standards, any new investments in mining projects to support the electric future will need to meaningfully address these concerns.

Of the ten standards analyzed, all of them have minimum requirements for community engagement and child labor, all have minimum environmental requirements, and nine have forced labor provisions. However, only five provide reporting templates or metrics by which to measure those standards by, and only six require some level of assurance and third-party audit to verify adherence to their stated principles.

Additionally, the level to which each standard lays out recommendations for each of the three key areas of concern varies widely from high-level statements that broadly commit to a goal to incredibly specific criteria that spell out the exact level and manner in which a standard must be executed. Between these endpoints, there exists a continuum of subjective and objective requirements that use varying language, making them difficult to compare.

Despite these challenges, this report attempts to classify the reviewed standards into four key groups based on their level of specificity:

- **Guiding Principle**: Espouses a high-level commitment to an overarching issue or set of issues. Does not require third-party validation or auditing.
- **Reporting Mechanism**: Outlines mechanisms to disclose actions taken regarding a particular issue or set of issues. Does not require third-party validation or auditing.
- **Verification Protocol-Level 2:** Requires the establishment of mechanisms to address a particular issue or set of issues. Requires third-party validation or auditing.
- **Verification Protocol-Level 1:** Requires adherence to specific criteria to address a particular issue or set of issues. Requires third-party validation or auditing.

For two out of the three issues of concern—community and tribal engagement and environment—supplementary specificity points were added to standards based on their inclusion of additional criteria that went above and beyond the general existence of a stated standard. For example, when classifying standards based on their environmental practices, extra specificity points were added to standards that included references to reclamation and closure plans developed with community input, financial assurance for the closure of the mine being required before a mine is approved, and a requirement to monitor the site beyond the life of the mine, among other measures. These criteria represent a non-definitive list of measures valued by stakeholders. A full list of the specificity criteria can be found in Appendix D.

The rankings and added specificity points seek to demonstrate that although many standards exist, and while some may be more specific than others, they often agree on basic principles that are enforceable and trackable with traceability frameworks.

For example, while both the OECD and IRMA have sections addressing environmental concerns, OECD's environmental chapter is more high-level, while IRMA's is quite prescriptive. OECD's environmental chapter primarily stipulates that a company, "Establish and maintain a system of environmental management

208 See e.g. SCS Global Services, Responsible Minerals Initiative, Webpage; and RCS Global Group, Audit and Mapping, Webpage.

209 Note: Our analysis focuses on the local environmental impacts of mining and does not examine greenhouse gas emissions associated with mining activities. While reducing GHG emissions associated with mining activities will be important to minimize the carbon footprint of clean energy technologies, for the scope of this paper, we aimed to address the main environmental concerns raised during a mine's permitting process.

Figure 15 Comparing Voluntary, Large-Scale Mining Standards

Community Engagement

Guiding Principle	**GBA**	**ERGI**		**IGF**	
Reporting Mechanism			**GRI**		
Verification Protocol - L2		**OECD**			**TSM**
Verification Protocol - L1			**Copper Mark**	**ICMM**	**ASI, IRMA**

Low ← Specificity → High

Tribal Engagement

Guiding Principle	**IGF, ERGI, OECD**				
Reporting Mechanism	**GRI**			**Copper Mark**	
Verification Protocol - L2					**ICMM**
Verification Protocol - L1					**TSM, ASI, IRMA**

Low ← Specificity → High

Water Quality

Guiding Principle	**ERGI, GBA**	**IGF, OECD**			
Reporting Mechanism			**GRI**		
Verification Protocol - L2	**ICMM**		**Copper Mark**	**TSM**	
Verification Protocol - L1				**ASI, IRMA**	

Low ← Specificity → High

Waste & Reclamation

Guiding Principle	**GBA**	**OECD, ERGI**		**IGF**	
Reporting Mechanism			**GRI**		
Verification Protocol - L2				**Copper Mark**	
Verification Protocol - L1			**TSM, ASI**		**IRMA**

Low ← Specificity → High

Child Labor

Guiding Principle	**IGF, ERGI, GBA**
Reporting Mechanism	**GRI**
Verification Protocol - L2	**TSM, Copper Mark**
Verification Protocol - L1	**OECD, ICMM, ASI, IRMA**

Forced Labor

Guiding Principle	**ERGI, GBA**
Reporting Mechanism	**GRI**
Verification Protocol - L2	**ICMM, TSM, Copper Mark**
Verification Protocol - L1	**OECD, ASI, IRMA**

Note: No specificity points were added to the Child and Forced Labor areas of concern. Tables comparing ten large-scale voluntary mining standards: Aluminum Stewardship Initiative (ASI); Copper Mark; Energy Resources Governance Initiative (ERGI); Global Battery Alliance (GBA); Global Reporting Initiative (GRI); Intergovernmental Forum on Mining, Minerals, Metals, and Sustainable Development (IGF); International Council on Mining and Metals (ICMM); Initiative for Responsible Mining Assurance (IRMA); Organization for Economic Cooperation and Development (OECD) Due Diligence Guidance; and Towards Sustainable Mining (TSM). The tables qualitatively compare the standards on key issue areas based on their assigned group (e.g., Guiding Principle, Reporting Mechanism, Verification Protocol-Level 2, and Verification Protocol-Level 1) and level of specificity according to points awarded by SAFE analysis. For a full list of standards and awarded specificity points, please see Appendix D.

Source: SAFE analysis based on a comparison of voluntary, large-scale mining standards.

appropriate to the enterprise..."[210] IRMA, on the other hand, sets precise requirements for waste management, water management, air quality, noise and vibration, greenhouse gas emissions, biodiversity, and cyanide and mercury management.[211] IRMA also stipulates specific requirements for acceptable levels of water contamination. Although, it is worth noting that many of these more specific requirements are taken from existing, codified environmental regulation from the United States, Canada, and Australia, among other countries. For example, the IRMA Drinking Water and Human Health Water Quality Criteria cites Australian regulations for 18 different metalloid and non-metal chemical water levels, Canadian regulations for 17 different levels, and American regulations for 14 different levels.[212]

While child and forced labor provisions are widely accepted and relatively straightforward among all the standards examined, community and tribal engagement standards are more nuanced. Unlike child and forced labor provisions, and even environmental standards, which are more or less objective, community and tribal engagement standards are inherently—and intentionally—subjective so as to be tailored to the needs of specific communities. Therefore, almost all the standards contain high-level language calling for meaningful community engagement, stakeholder mapping, and established grievance mechanisms, yet some also stipulate adding educational programs or community investment. Standards that go above and beyond, including TSM, IRMA, ASI, and IGF provide additional criteria, including requiring consultation with affected communities as a requirement for permitting at every stage of the mine's life, committing resources to community development and supporting local livelihoods, publishing transparent and publicly available reports on mining standards, and aiming to obtain Free, Prior, and Informed Consent (FPIC) prior to operating, among other things. While some of the more detailed language varies, the spirit of these standards across this criterion is fairly universal.

In general, all of the standards point toward earlier and more frequent community and tribal engagement with meaningful participation, including seeking and incorporating community input on the development of plans, and transparent and accessible grievance mechanisms. They also generally agree on baseline water monitoring and transparent disclosure of water quality and usage, along with detailed waste disposal plans and financial assurance for reclamation at the mine's end of life. Many also call for continued monitoring beyond the life of the mine and community involvement in determining how the land is reclaimed. An additional criterion that is gaining momentum in the public discourse is equity stake or other forms of financial participation for communities in mining projects. For example, in 2020 the Québec government signed a $4.6 billion agreement with the First Nations Cree community through 2050 to harmonize government and First Nation's interactions and decisions in new infrastructure and natural resource projects.[213]

We see these unifying standards as basic principles that should be required for any mineral materials imported into the United States. The United States should further work with like-minded and allied countries to implement enforceable regulations in their own supply chains so that bad actors cannot continue to flood the market with lower cost, lower standard materials.

The Long-Term Goal: Creating Global Principles to Level the Playing Field

A comparison of these voluntary mining standards shows that they mostly adhere to a common set of basic principles. However, because these mining standards are voluntary, bad actors can disregard them without consequence—whether by opting not to join them, or by obscuring their bad practices with opaque supply chains and little to no enforcement. As a result, voluntary mining standards and certification schemes fall short of achieving their goals.

Regulatory support is needed to address the challenges associated with implementing standards frameworks, and increased participation in them is needed to ensure a level playing field. Working with allies and like-minded countries, the United States should push for universal acceptance of standards based on these basic principles and use transparency mechanisms to confirm adherence.

The United States already has an established practice of promoting the implementation of multinational environmental and labor standards. One effective mechanism it has used in the past—and which has been brought to the fore with the IRA—is trade agreements.

210 OECD, *Due Diligence Guidance for Multinational Enterprises*, 2011, page 42.

211 Initiative for Responsible Mining Assurance (IRMA), "Standard," Webpage.

212 IRMA, *IRMA Standard for Responsible Mining IRMA-STD-001*, June 2018, at page 141.

213 Government of Québec, "The Québec Government and the Cree Nation will collaborate to carry out an ambitious infrastructure plan in the Eeyou Istchee James Bay Territory," Press Release, February 17, 2020.

Nickel sulfate from SungEel HiTech Co., a company that specializes in recycling lithium-ion batteries in Gunsan, South Korea. SungEel collects old and defective cells from automakers and some of the country's biggest battery makers, including LG Energy Solution, and has the capacity to extract about 4,400 metric tons of nickel and cobalt annually.

Since the North American Free Trade Agreement (NAFTA) came into force in 1994, all U.S. trade agreements, as well as side agreements for environmental cooperation, have promoted collaboration and capacity building to ensure proper enforcement of environmental laws within each participating country.[214] In the last two decades, actions have been taken to ramp up these commitments beyond simple promotion, and today all U.S. trade agreements include legally binding, enforceable, and sanctionable environmental provisions.[215]

According to the USTR, the FTAs with Panama, Peru, South Korea, and Columbia were the first to include sweeping provisions outlined on May 10, 2007 to ensure that the countries involved were held to the same level of accountability for meeting environmental commitments as it was to meet other commitments, including market access and intellectual property protection.[216] This meant that FTA partner countries had to effectively enforce their environmental laws and comply with all obligations in the environment chapter of those agreements or face a dispute settlement process that could result in the suspension of trade benefits. Furthermore, no country could lower its environmental standards to attract trade or investment.[217]

The May 10th agreement also required each FTA country to ensure the implementation of five internationally recognized labor principles, including "the elimination of all forms of forced and compulsory labor," "the effective abolition of child labor, and a prohibition on the worst forms of child labor," and other provisions.[218]

Environmental and labor provisions were further strengthened in NAFTA's successor agreement, the United States-Mexico-Canada Agreement (USMCA), which was renegotiated and came into force during the Trump Administration. The new USMCA environmental and labor chapters require each party to perform environmental impact assessments similar to the kinds used by the U.S. Environmental Protection Agency (EPA) and establish new dispute mechanisms to settle environmental and labor-related conflicts.[219] These provisions will no doubt be a precedent for future trade agreements.

It is important to note that countries that are signatories to trade agreements have the sovereignty to determine their own laws and establish their own rules and regulations. The U.S. Congress, however, can set basic requirements for all signatories to satisfy when it assigns Trade Promotion Authority (TPA) to the administration.[220] For instance, the 2015 TPA required that all signatories to U.S. trade agreements incorporate labor standards established by the ILO and effectively implement seven "multilateral environmental agreements" to which they are a

214 Richard Lattanzio and Ian Fergusson, "Environmental Provisions in Free Trade Agreements (FTAs)," Congressional Research Service, December 6, 2016, at pages 1-2.

215 U.S. Trade Representative, "Bipartisan Trade Deal," May 2007, at pages 2 and 3.

216 Office of the United States Trade Representative, "Schwab Statement on Completion of Text for Bipartisan Trade Agreement," Archived Press Release, June 25, 2007.

217 U.S. Trade Representative, "Bipartisan Trade Deal," May 2007, at pages 2 and 3.

218 Ibid.

219 Congressional Research Service, "USMCA: Legal Enforcement of the Labor and Environment Provisions," May 14, 2021.

220 U.S. Trade Representative, "Bipartisan Trade Deal," May 2007, at page 2.

party.[221] The common agreements include The Montreal Protocol on Substances that Deplete the Ozone Layer, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat.[222] Such requirements have received pushback from U.S. trading partners. Environmental and labor obligations in trade agreements impose a new level of oversight and sanction power that exert significant influence by holding countries accountable for their implementation of non-binding multilateral agreements.

Signing a trade agreement is only the first step—the most impactful outcomes for the environment and workers are often achieved once a trade agreement with various enforceability mechanisms has come into force. The committees and commissions on the environment established by trade agreements, as well as many dispute settlement mechanisms, serve as platforms to further raise and harmonize standards among trade partners—and potentially the world.

The committees and commissions on the environment established by trade agreements, as well as many dispute settlement mechanisms, serve as platforms to further raise and harmonize standards among trade partners—and potentially the world.

A NAFTA dispute on the disposal of spent lead-acid batteries (SLABs) provides a good example of the power of dispute mechanisms harmonizing environmental standards. In 2009, the U.S. EPA updated the National Ambient Air Quality Standard for lead, while the standards framework in Mexico remained unchanged.[223] Recycling SLABs in the United States became more expensive, and industry players started to export SLABs to Mexico for cheaper recycling.[224] The relocation of a significant portion of SLAB recycling activity from the United States to Mexico, however, was associated with declining community health in Mexico, especially among infants.[225]

Following reports on changes in trade flows and the health hazards experienced in Mexico, the Commission for Environmental Cooperation (CEC), established under NAFTA, published a report in April 2013 on the impact of SLAB trade in North America and the current regulatory environment for SLABs in the United States, Canada, and Mexico.[226] It acknowledged the difference between U.S. and Mexican standards, identified a number of gaps in Mexico's legal and regulatory framework, and listed several recommendations to improve the situation. In response, Mexico enacted new regulations for its SLAB recycling facilities.[227] The CEC then published its 2016 technical guidelines, which were eventually adopted by the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal.[228] The CEC set up by NAFTA was not only effective in improving regulations in Mexico, but it also played a significant role in enhancing global standards and guidelines.

Beyond raising standards abroad, trade agreements are also effective in helping trade partners build the governance capacity required to set and enforce higher standards. By 2015, trade agreements and capacity-building activities as a part of those agreements, resulted in more than 700 new environmental laws and regulations in partner countries.[229] Moreover, capacity-building efforts do not have to be restricted to regulatory enforcement. They can also help achieve other environmental objectives. The U.S.-Chile FTA, for example, identified eight environmental cooperation projects, including a project to help remediate mining pollution in Chile.[230] As a part of the project, EPA shared cost-effective methods to reduce pollution in contaminated mine sites, and provided training on environmental risk assessment and enforcement measures at mining sites.[231]

While trade agreements have historically encompassed entire economies, new thinking hopes to establish more limited, sector-specific or commodity-based agreements in an attempt to increase trade while avoiding the decades-long negotiations that often scuttle good faith attempts at agreements.

Precedent for commodity-specific agreements already exists within the World Trade Organization (WTO), the intergovernmental organization that regulates and facilitates international trade.[232] Though commodity-specific agreements have typically been used to raise and stabilize the prices of goods in the agricultural sector like coffee and cocoa, there have also been international agreements on tin and tropical timber geared toward sustainability. In particular, the tropical timber agreement could be used as a model for future mineral-specific commodity agreements. First implemented in 1982, the International Tropical Timber Agreement is a multilateral agreement that promotes sustainable management and conservation of tropical forests, as well as the expansion and diversification of international trade.[233] The USTR could work on multilateral agreements between U.S. allies and like-minded countries that focus on responsible mining, increased transparency, and trade diversification.

If the United States were to enter into EV or battery sector-specific trade agreements with the EU, Japan, and other likeminded countries that include baseline environmental and labor standards—and update its agreements with countries like South Korea, Australia, and Chile to include them—, it would provide an enforceable mechanism by which to implement a global race to the top for critical mineral supply chains. These smaller, sector-wide trade agreements could potentially take less time to implement than an economy-wide trade agreement while still adhering to the general trade agreement structure. These agreements would, in effect, create a new Critical Minerals Alliance, helping to coordinate a global response to halt dumping and undercutting environmental and worker protections. An alliance like this could also expand upon the newly announced Sustainable Critical Minerals Alliance created at the UN Biodiversity Conference in 2022. Only through a new Critical Minerals Alliance or by expanding the existing Alliance, bound by fair practices, high standards, and transparency, will American businesses be able to fairly compete and its military be able to maintain access to materials it needs to keep citizens safe.

Unfortunately, there is little appetite for new trade agreements currently in Washington. This was made clear from President Trump's withdrawal from the Trans-Pacific Partnership (TPP) and from President Biden's prioritization of cooperative efforts like the America Partnership for Economic Prosperity (APEP) and the Indo-Pacific Economic Framework for Prosperity (IPEF). These cooperation frameworks, however, lack an enforceability mechanism, making them sub-optimal tools for raising global standards and increasing U.S. competitiveness.

Another mechanism for increasing transparency within the critical mineral supply chain could be providing additional authority to U.S. agencies to identify and determine which countries—or, if necessary, which mine sites—meet equivalent environmental and labor standards. This new authority could be implemented on its own or in concert with any newly negotiated trade agreements to help increase its trade partners' capacity to set and implement regulations based on the basic principles identified in multiple voluntary mining standards. It could sit within one lead agency, such as the U.S. Bureau of Land Management (BLM), or operate as an interagency working group with EPA, USGS, MSHA, and other relevant agencies.

The United States currently uses the U.S. Department of Agriculture's (USDA) Food Safety and Inspection Service (FSIS) equivalence process to assure that food products imported into the United States are safely prepared and properly labeled under the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).[234] For countries to apply for this equivalence through the USDA, they must undergo onsite verification audits. FSIS has been tasked with monitoring the production of imported agricultural food because it pertains to the health and safety of Americans, and U.S. law requires

221 19 U.S. Code § 4201

222 19 U.S. Code § 4210.

223 Lauri Scherer, "Tighter US Lead Pollution Standards Shifted Industry to Mexico," The NBER Digest, November 2021.

224 Ibid.

225 See e.g., Elisabeth Rosenthal, "Lead From Old U.S. Batteries Sent to Mexico Raises Risks," The New York Times, December 8, 2011.

226 Commission for Environmental Cooperation, *Environmentally Sound Management of Spent Lead-acid Batteries in North America: Technical Guideline*, January 2016, at page 2.

227 Ibid.

228 Basel Convention, *Revised Draft Factsheets on Specific Waste Streams*, Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal Thirteenth Meeting, February 16, 2017, at pages 28 and 29.

229 U.S. Trade Representative and U.S. Department of State, *Standing up for the Environment*, May 2015, at page 13.

230 U.S. Department of State, "United States – Chile FTA Environmental Chapter," Webpage.

231 U.S. Environmental Protection Agency, "EPA Collaboration with Chile," Webpage.

232 Group on Environmental Measures and International Trade, "General Agreement on Tariffs and Trade," World Trade Organization, September 7, 1993 at article 20(h).

233 International Tropical Timber Organization, "About ITTO," Webpage.

234 Food Safety and Inspection Service, "Import Guidance," U.S. Department of Agriculture, Webpage; and Food Safety and Inspection Service, "Equivalence," U.S. Department of Agriculture, Webpage.

importers of agricultural goods to satisfy U.S. or comparable standards.[235]

While critical minerals are different in that their importation does not directly impact the immediate health and safety of Americans, the national security imperative to build an allied supply chain and the need for a level playing field for our industries to be globally competitive are clear. It calls for innovative solutions to address a challenge that has not been addressed before, and U.S. agencies can be utilized in an impactful way.

As in the example of mining pollution remediation, BLM can also help build capacity to implement higher standards by training foreign counterparts on best practices for mine inspection. BLM can also be an active participant in bilateral or multilateral talks regarding a health and safety violation-related trade dispute. The U.S. government can also utilize BLM outside of trade agreements. U.S. agencies often cooperate with their foreign counterparts to support capacity building. Such cooperation can take many forms. Beyond training foreign authorities, BLM and other U.S. agencies can work with their foreign counterparts to identify shared regulatory objectives, participate in each other's rulemaking process, and work toward regulatory harmonization whenever possible.[236] The U.S. government can prioritize cooperation with MSP partners, or with countries with which we have trade and investment framework agreements to accomplish these goals.

Finally, a country or an independent mine could apply for a voluntary BLM equivalence and be audited, regardless of the country in which it is located—just like FSIS. A voluntary equivalence framework, however, would require a strong incentive for participation.

These data should be reported on a newly updated Monroney label, the vehicle window sticker within the United States. This updated label, coupled with a unique digital identifier, would allow consumers purchasing EVs to know exactly where and under what environmental and labor conditions the minerals, materials, and battery and motor components within their desired EV were produced, allowing them to make informed purchasing decisions. If vehicles are not required to meet a baseline standard, adding transparent, easily accessible information to consumers about relevant environmental and labor characteristics associated with mined material in their vehicle would still allow them to make decisions based on their respective values.

EU member states are already piloting battery passport projects with the same intent. The German government's Battery Pass project aims to establish the technical standards for the development of a European Battery Passport required by the EU Battery Directive and forthcoming EU Battery Regulation.[237] The creation of a battery passport will enforce circular and transparent battery supply chains and will allow for key battery mineral attributes like recycled content, child and forced labor, and embedded emissions to be tracked throughout the lifecycle of each individual battery manufactured in the EU.

It is noted that the timeline to implement these policy provisions would be long, and the need to secure its critical mineral and battery supply chains is immediate. Therefore, in the short term, while these international mechanisms are being created and other countries are bringing their operations in line with these determined goals, the United States should work with allies like Canada and Australia, which already have robust, high-standard environmental, labor, community, and human rights regulations, and with which the United States already has trade agreements, to mine in their own backyards and obtain the minerals they need for their economies and mutual security.

235 Agricultural Marketing Service, "Section 8e & Imports," U.S. Department of Agriculture, Webpage.

236 Administrative Congress of the United States, "Federal Agency Cooperation with Foreign Government Regulators," June 13, 1991, at page 2.

237 Battery Pass, "Advancing the implementation of the battery passport in Europe and beyond," Webpage.

An Immediate Solution: Supporting Domestic and Allied Production

While U.S. domestic and allied production will not be able to satisfy the world's demands for critical minerals in the long term, in the short term, working within these countries to source the materials society needs with high standards will help begin the global race to the top.

Canada and Australia boast major mineral resource potential, enforce vigorous mining regulations, and are close major allies with the United States. The three countries share multiple defense agreements, including NATO with Canada, the Quad and AUKUS with Australia, and the Five Eyes multilateral intelligence initiative with both. Moreover, Canada and Australia are both considered "domestic" resources under the National Technology and Industrial Base Integration (NTIB) program, which governs trade related to U.S. national defense. NTIB countries are granted unique access to the United States in terms of innovation, technology, and interoperability.[238] This makes it extremely easy for the United States to work with these two countries quickly, and in the case of mining, easily secure the mineral resources necessary for the transition to an electric future.

Responsible mining practices are primarily upheld and regulated at the provincial and state levels in Canada and Australia and at the federal level in America.

In the United States, more than 640 million acres of land—approximately 27 percent of the United States— belongs to the federal government.[239] This land is managed by four major federal agencies, including the Bureau of Land Management (BLM) the National Park Service within the Department of the Interior, the Fish and Wildlife Service, and the Forest Service within USDA. The rest consists of about 8.8 million acres managed by the Department of Defense.[240] If a proposed mine falls on federal or Tribal trust lands, mining operations must comply with the National Environmental Protection Act (NEPA) and complete an environmental assessment (EA) or an environmental impact assessment (EIA) prior to receiving a permit to mine. This process is generally carried out by multiple government agencies with state government compliance, although if state regulations are more rigorous than federal regulations, the state laws supersede federal laws.

While not perfect, U.S., Canadian, and Australian codified regulatory processes compare favorably with the most rigorous voluntary mining standards with respect to community and tribal engagement, child and forced labor, and environmental standards.

In line with prevailing mining standards, all three countries require public notification of proposed mining projects, and Canada and many Australian states further require community engagement and comment periods before applying for a permit to mine.[241] In the United States, this is done during the public scoping period of NEPA.[242] Additionally, growing attention on the mining sector in light of the energy transition and the war in Ukraine is forcing these countries, and many others, to rethink their community engagement and permitting strategies, resulting in a flurry of new and updated legislation and policies to reflect more modern thinking.

238 Heidi M. Peters, "Defense Primer: The National Technology and Industrial Base," Congressional Research Service, February 23, 2021.

239 Micah, "Fed Lands in America: How much do they own?" checklands.com, March 2, 2021.

240 Ibid.

241 The Mining Association of Canada, personal communication, 2022; and See e.g., Aylin Cunsolo and Baker McKenzie, "Mining in Australia: Overview," Thompson Reuters, 2022.

242 United States Bureau of Land Management, *H-1790-1-National Environmental Policy Act Handbook*, January 2008, at page 76.

The Nouveau Monde Graphite Matawinie Mine in Saint-Michel-des-Saints, Quebec, Canada, on Thursday, Oct. 6, 2022. The company recently entered into an agreement with the village of Michel-des-Saints but is still facing some pushback from local indigenous groups.

Successful Community Engagement In Québec

Québec is one of the most mineral-rich provinces in all of Canada, with well-documented reserves of critical minerals like graphite, niobium, and lithium.[243] Unlike some prominent mining regions, Québec has shown a unique aptitude for meaningfully engaging with local and indigenous communities throughout the exploration and mining processes, helping its projects gain relatively wide acceptance. The province currently is home to 22 active mines, three retired mines, and 33 mining projects.[244]

One key to this success has been their Bureau d'audiences publiques sur l'environnement, or BAPE. The BAPE is an independent and neutral government organization that allows citizens to learn about and publicly express their views on proposed infrastructure and energy projects in an easily accessible online format.[245] The BAPE process allows the public to frame the scope of an environmental review. After posting the project details to a public website, the BAPE holds informational sessions with community members and reports their findings to the Québec government. Once the BAPE reviews are complete, public hearings on their grievances are held before the final permit is issued. As of 2022, more than eight public hearings have been held addressing mining projects.[246]

In addition to the BAPE process, recent changes to the Québec Mining Act require mandatory public consultation for all metal mines prior to mine development and establish monitoring committees for all mines.[247] These monitoring committees establish their own grievance mechanisms unique to each mine and align Québec with the recommendations of the prevailing international mining standards. Québec's sustainability laws also allow the government to refuse a project because of indigenous opposition: a major step in attempting to reach the goals of FPIC.

A leader in community engagement and transparency, the Québec permitting process ensures that there is public engagement throughout the operating life of a mine and that all relevant environmental and social impacts are made available to the public.

243 Natural Resources Canada, "Minerals and the Economy," Government of Canada, Webpage; and Government of Quebec, "Minerals for the Future," Webpage.

244 Henry Lazenby, "GMS: Proactive Quebec Government Makes for a Top-Tier Mining Investment Destination," The Northern Miner, October 7, 2022.

245 Government of Québec, "The Bureau D'Audiences Publiques sur L'Environment," Webpage.

246 Québec Mining Act, c M-13.1, a. 101.0.3.

247 Ibid.

Canada and Australia's robust, front-end public engagement has paid off: opening a new mine in their countries typically takes two to three years, whereas opening a new mine in the United States takes an average of ten.[248] At least some of this time difference can be attributed to inadequate public engagement in the United States which leads to ensuing litigation. A study by the U.S. National Academy of Science, Engineering, and Medicine that convened hardrock mining stakeholders concluded that the environmental review and permitting process would likely be expedited and more effective in the United States if all stakeholders were given the ability to participate in the earliest scoping and pre-environmental permitting process of a proposed mining project.[249]

All three countries similarly have regulations in place to involve indigenous communities in the mining process, although the level of engagement differs per country, and all are rethinking ways to better include indigenous communities. In Canada, agencies must draft a Consultation Report, which includes advice on the adequacy of indigenous consultation during the environmental review process.[250] In Australia, the Native Title Act of 1993 governs native parties' ability to negotiate agreements with mining companies who wish to conduct exploration or mine on indigenous lands. In the United States, engagement with tribal governments occurs during the public scoping period of the NEPA process, although multiple treaties and federal laws have limited tribes' authority to regulate and authorize mining on tribal lands.[251] Tribal nations in the United States have publicly requested that consultation and participation either during the initial phase of planning or the pre-licensing phase of a mining project be implemented at the federal level.[252]

Canadian provinces and the United States are working to improve indigenous community involvement in the permitting process. In 2019, British Columbia passed the Declaration on the Rights of Indigenous Peoples Act, which requires their provincial government to ensure its laws are consistent with the United Nations Declaration on the Rights of Indigenous Peoples.[253] This is a major step toward achieving FPIC with local indigenous communities and is underscored by the province's Environmental Assessment Act of 2019.[254]

In 2021, the United States issued a memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships, which directs all federal agencies to engage in regular, meaningful, and robust consultation with tribal officials to develop policies with tribal implications.[255]

As more and more mining is required to meet society's rising mineral demands, more and more communities will be affected by mining. Therefore, it is critical that the United States and other countries seeking to develop mineral wealth meaningfully include affected communities and indigenous populations early and often throughout the exploration, permitting, mining, and closure processes.

While the push to enhance community engagement practices in these three countries is relatively new, environmental protections and regulations are not. Bedrock environmental legislation in the United States, including the NEPA, the Clean Water Act (CWA), the Clean Air Act, the Federal Land Policy Management Act (FLPMA), and the Resource Conservation and Recovery Act, among others, were largely passed more than 50 years ago. Passage of FLPMA spurred the BLM to publish a slew of surface management regulations in 1980 to protect public lands from unnecessary or undue degradation while ensuring that the mined lands are reclaimed.[256] Since the original rule-making and the creation of Title 43 CFR Part 3800 Subpart 3809 titled "Surface Management" regulations in 2001 and updated in 2022, fewer environmental problems have been reported for new mining operations in the United States.[257]

Water quality and waste are heavily regulated within the United States, Canada, and Australia. Mines generate large volumes of waste, including waste rock, tailings, and spent ore.[258] All stages of the hardrock mining and processing industry generate

248 National Mining Association, "U.S. Minerals Mining Fact Sheet," June 4, 2021, at page 1.

249 National Research Council, *Hardrock Mining on Federal Lands*, National Academies of Sciences, Engineering, and Medicine 1999.

250 Government of Canada, "Impact Assessment Process Overview," Webpage.

251 U.S. Government Accountability Office, *Hardrock Mining Management, Selected Countries, U.S. States, and Tribes Have Different Governance Structures but Primarily Use Leasing*, June 2021.

252 United States Departments of Interior, Army, and Justice, "Improving Tribal Consultation and Tribal Involvement in Federal Infrastructure Decisions," 2017.

253 See e.g., Innes, et al., "A Comparative Review of Canadian Mining Laws and Responsible Mining Standards," 2020.

254 Ibid.

255 The White House, "Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships," January 26, 2021.

256 65 FR 69997.

257 Ibid.

258 United States Environmental Protection Agency, National Pollutant Discharge Elimination System, Webpage, 2022.

hazardous materials.[259] Safe disposal of this waste is recognized as one, if not the largest, challenge facing the mining industry worldwide.[260] All three countries have strict regulations surrounding mine waste management and mine closures. All countries require permits and approval of tailings facilities known as impoundment structures for tailings disposal. Mining companies in the United States must receive EPA authorization for all discharges from mining operations through the EPA's National Pollutant Discharge Elimination System program prior to mining.[261] The Australian government's leading practices guidebook on hazardous materials management lists mine waste rock, tailings, and wastewater as hazardous substances requiring extra regulatory care when storing and transporting.[262] In Western Australia, for example, mining companies are required to submit extensive mine waste and tailings disposal plans, including detailed testing about the probability of acid mine drainage from waste rock and tailings.[263]

Prior to the implementation of the BLM's surface management regulations in 2001, many mining companies in the United States did not properly plan or evaluate the costs of closing and reclaiming mined lands. As a result, many mining operations were abandoned in the 1990s, and the burden of mine site clean-up and reclamation fell on local governments and surrounding communities. When properly managed for their pollution risks, these abandoned mine sites can be a valuable source of critical minerals. Metals like lithium that were not economic to mine decades ago or for which the technology to efficiently process them was not yet invented, were treated as waste and ended up in tailings or waste rock piles. Today, these minerals are in high demand, and there is a business case to re-mine old tailings and waste rock, while simultaneously supporting the reclamation of abandoned mine lands. In the United States alone, there are over 500,000 abandoned hardrock mines, more than 40 of which are listed on the EPA's National Priorities List for cleanup.[264] Not all of these sites are economically viable re-mining targets, but thousands could be.

U.S. Strategic Metals has cleaned up a former Missouri lead mine in the National Priorities List. It now uses abandoned mine waste as a feedstock for its critical minerals processing operations.[265] Larger mining companies are also looking into re-mining abandoned sites. For example, in 2021, Rio Tinto made an investment in the re-mining and restoration start-up, Regeneration, to target legacy sites.[266] Similar opportunities exist for active mines with decades-old mine tailings. Rio Tinto is also looking to mine battery-grade lithium from its former boron mine in California.[267] In addition, Canadian provincial governments are assessing tailings facilities for critical minerals. The Québec government's Critical Minerals Plan promotes the recovery of minerals from mine waste and tailings.[268]

As with recycling, re-mining at legacy and active sites will not by itself fulfill global demand for critical minerals. However, re-mining is a potentially important part of the solution, especially given its ability to help address the legacy of abandoned and orphaned mines.

It is important to note that if a mining company in the United States wants to develop the deposits on an abandoned mine site or reclaim the land, they can be liable for any damages under U.S. regulations.[269] Therefore, changes to these regulations will need to be put in place to make it easier for more companies to re-process the deposits left at old mine sites and to clean up the abandoned sites.

To ensure cleaning up abandoned mines does not continue to pose a problem as more mines are needed, all three countries require mining companies to develop reclamation plans prior to permitting new mines, this is in line with prevailing voluntary mining standards. In the United States, a mining company must submit a reclamation plan which is reviewed prior to the commencement of the major environmental assessment processes dictated by NEPA.[270] In Ontario, closure plans must be made available to the public, and they are allowed to comment on them.[271] The Mine Rehabilitation Guidebook published by the Australian government suggests that mining companies develop their rehabilitation or reclamation plans with community engagement and rehabilitate areas while the mine is in operation.[272] In Western Australia, reclamation plans must result in the return of rehabilitated areas to self-sustaining and functional ecosystems comprised of local species, and rehabilitation plans are required to be audited and confirmed by external companies.[273] Additionally in Western Australia, stakeholder consultation, including local communities, is required while the mining company is preparing the reclamation plan.[274]

Yet, simply having a closure plan is not enough. Mining companies today must also provide regulators with financial evidence guaranteeing they will be able to afford to reclaim the land. When effective regulations and enforcement mechanisms are not in place, mining companies have sometimes declared bankruptcy prior to properly closing their mines, proving that self-bonding practices do not always work to hold companies accountable. Many voluntary standards, for example, will not certify a mine if a company provides assurances via self-bonding or corporate guarantees.[275] However, TSM, the United States, Canada, and Australia allow for corporate sureties and self-bonding as adequate forms of reclamation assurance.

Although there is room for improvement, the United States, Canada, and Australia generally contain robust regulatory environments that adhere to prevailing voluntary mining standards. Additionally, all three countries are continuing to review and strengthen responsible mining practices. The Biden Administration has convened an interagency working group (IWG) to examine responsible mining practices within the United States and suggest reforms for regulation and permitting.[276] The IWG is currently collecting input on its suggestions and prioritizing suggestions for stronger environmental, safety, tribal consultation, and community engagement standards.

Working together in the short term to obtain the minerals and materials needed for a robust minerals-based economy and effectively compete with our strategic adversaries will be critical to ensuring the United States and the rest of the world can meet looming electrification goals without inadvertently worsening critical dependencies. We must also strive to improve our domestic mining practices, laws, and regulations, ensuring that we put our best foot forward in the global race to electrify.

259 MiningWatch Canada, *Submarine Tailings Disposal Toolkit*, June 13, 2002; and Government of Australia, "Hazardous Materials Management: Leading Practice Sustainable Development Program for the Mining Industry," September 2016.

260 MiningWatch Canada, *Submarine Tailings Disposal Toolkit*, June 13, 2002.

261 U.S. Environmental Protection Agency, National Pollutant Discharge Elimination System, Webpage, 2022.

262 Government of Australia, "Hazardous Materials Management: Leading Practice Sustainable Development Program for the Mining Industry," September 2016.

263 Government of Western Australia Environmental Protection Authority, "West Musgrave Copper and Nickel Project," OZ Minerals Musgrave Operations Pty Ltd, 2022.

264 Earthworks, Abandoned Mine Legacy, Webpage, 2022; U.S. Department of the Interior, Bureau of Land Management, *The Cooperative Conservation Based Strategic Plan for the Abandoned Mine Lands Program*, March 2006; and U.S. Environmental Protection Agency, "Abandoned Mine Lands: Superfund," April 2005.

265 PR Newswire, "U.S. Strategic Metals Announces Wholly Domestic Production of Critical Minerals for Electric Vehicle Batteries," Business Insider, September 15, 2022.

266 Rio Tinto and Resolve, "Rio Tinto invests in start-up to support habitat restoration," Press Release, November 9, 2021.

267 Rio Tinto, "Rio Tinto Achieves Battery Grade Lithium Production at Boron Plant," Press Release, April 7, 2021.

268 Government of Québec, "2020-2025 Québec Plan for the Valorization of Critical and Strategic Minerals," 2020, available at: https://cdn-contenu.quebec.ca/cdn-contenu/adm/min/energie-ressources-naturelles/publications-adm/plan-strategique/PL_valorisation_mineraux_critiques_strategiques.pdf.

269 National Research Council, *Hardrock Mining on Federal Lands*, National Academies of Sciences, Engineering, and Medicine 1999.

270 United States Bureau of Land Management, "H-1790-1-National Environmental Policy Act Handbook," January 2008.

271 See e.g., Innes et al., "Raising the Stakes: A Comparative Review of Canadian Mining Laws and Responsible Mining Standards," January 2020.

272 Government of Australia, "Mine Rehabilitation: Leading Practice Sustainable Development Program for the Mining Industry," September 2016.

273 Environmental Protection Agency, Government of Western Australia, "Guidance for the Assessment of Environmental Factors: Rehabilitation of Terrestrial Ecosystems," June 2006.

274 Ibid.

275 Initiative for Responsible Mining Assurance, *IRMA Standard for Responsible Mining IRMA-STD-001*, June 2018.

276 United States White House, "Fact Sheet: Securing a Made in America Supply Chain for Critical Minerals," February 22, 2022.

Policy Recommendations

Although the United States faces an uphill battle to overcome the multi-decade head start enjoyed by the Chinese Communist Party (CCP) in the race to build up critical mineral, battery, and advanced technology sectors and their subsequent supply chains, America has awoken to the challenge and can leverage its ingenuity, alliances, natural resource wealth, and robust environmental and labor standards to claim the commanding position in the minerals-based economy.

To create secure, sustainable critical mineral and battery supply chains to feed its innovation-driven economy and to support its advanced weapons systems and defense capabilities, the United States can focus on three key issue areas:

- **Strengthening domestic policy in mining, mineral processing, re-mining, and recycling**. Over many decades, the United States has been lulled into complacency and become dangerously dependent upon strategic competitors to obtain the critical minerals and materials upon which its economy and national security rely. Americans have lost touch with what it takes to build things, and some American politicians have subsequently prioritized blocking projects rather than facilitating and encouraging the development of responsible ones. While U.S. reserves alone cannot solve all our problems, the United States must return to its industrial roots through strategic policies that incentivize responsible domestic mining, processing, and manufacturing within realistic timelines to support its important automotive, energy, and defense sectors. It must also reestablish trust with local communities to regain the social license to operate.
- **Leveraging existing partnerships to build an allied supply chain**. The United States already participates in multiple fora, research programs, and defense agreements with allies and like-minded countries. While many are focused on critical minerals and materials, all could be leveraged in better ways to share information, adhere to common standards, and support domestic and allied projects alike.
- **Creating new multinational sourcing agreements and increasing transparency to counter anticompetitive market behavior**. Anticompetitive market behavior will continue to threaten American access to critical minerals, materials, and batteries without a coordinated global response to deter bad actors from flooding the market with lower cost goods, ostensibly achieved by undercutting environmental and worker protections. Only through a new Critical Minerals Alliance bound by fair practices, high standards, and transparency will American businesses be able to fairly compete and citizens remain safe.

ISSUE #1

Strengthening Domestic Policy in Mining, Mineral Processing, and Recycling

The United States is more than 50 percent import reliant for almost every electric vehicle (EV) mineral, including nickel, cobalt, manganese, graphite, and rare earth elements. It is more than 25 percent import reliant for lithium.[277] The United States only has one active lithium mine—the Silver Peak mine in Nevada—and only one nickel mine—the Eagle mine in Michigan, which is slated to close in 2025. In addition to being woefully reliant on other nations for raw materials, the United States is even more reliant on one country, China, to actually turn those mineral commodities into even more critical chemical compounds and metal alloys, which are ultimately incorporated into final products like batteries, wind turbines, and smart bombs. Furthermore, the United States lags behind the rest of the world in its capacity to recycle critical minerals, which, unlike fossil fuel-based energy sources of the past, are infinitely re-useable.

PROPOSAL

Bring permitting and mining legislation into the 21st century to achieve the social license to operate and increase production.

Historical mining practices and the subsequent offshoring of production have led to the erosion of public trust in the mining sector. Communities continue to wonder whether the standards laid out within the U.S. regulatory framework are sufficiently updated from historical practices to keep them and the environment safe. To address this concern, an unbiased study conducted by third-party experts of the full range of health, safety, environmental, and land usage issues associated with mining could demonstrate to stakeholder communities that the federal government is committed to promoting only responsible mining. Furthermore, added transparency and accountability throughout the permitting process will help to accelerate timelines without reducing environmental requirements.

1. **Direct and fund the National Academies of Sciences to conduct a comprehensive study that builds upon work by the Department of the Interior's Interagency Working Group on Responsible Mining to examine the existing regulatory frameworks and impacts of mining in the United States to ensure that the regulatory regime addresses health, safety, environmental, and land usage issues associated with mining and to recommend legislation or other measures necessary to address any shortcomings.**

2. **Update the permitting process to enhance visibility and predictability and ensure cohesive coordination between the federal government, state governments, and tribal governments without bypassing existing environmental regulations.**

    a. Expand the scope of the FAST-41 permitting process to include all federally regulated mining, processing, and refining projects for critical minerals. Additionally, reduce the threshold of project eligibility for energy projects from $200 million to $50 million.

    b. Direct the Permitting Council to work with the United States Office of Management and Budget on a policy requiring all agencies to comply with tribal trust obligations, treaties, and consultation requirements prior to the approval of an infrastructure project affecting tribal interests.

3. **Require early and ongoing community engagement throughout the environmental permitting process and lifecycle of the mine.**

    a. Require that all stakeholders be notified and participate in the earliest mineral exploration phase of mining and the pre-scoping phase of the National Environmental Policy Act (NEPA) requirements. .

        i. Require any federal agency participating in the NEPA process to complete a Community Impact Report assessing the potential impacts of the proposed project on the local community.

    b. Require all coordinating federal agencies that participate in any part of NEPA to develop a clear and accessible grievance process for local communities throughout the lifecycle of the mine.

4. **Ensure new mines are never abandoned and that current abandoned mines can be reclaimed while avoiding undue liability issues so that waste rock and tailings piles can be re-processed where feasible and assessed for future economic value.**

    a. Strengthen federal and state mining regulations to require mining companies to provide financial assurance other than self-bonding or corporate guarantees in their reclamation plans to ensure that if the mining company must abandon their operation that the reclamation costs do not fall on state or local communities. Additionally, ensure all reclamation plans include financial assurances for long-term treatment of the surface and groundwater post-mine closure.

    b. Pass Good Samaritan legislation that limits past liability placed on third parties wanting to clean up abandoned mine sites or re-process abandoned mine waste and tailings to help meet demand for critical minerals.

    c. Include incentives to support restoration, such as supporting efforts to pilot re-mining and restoration at designated sites, particularly where Good Samaritans couple re-mining with restoration efforts.

277 U.S. Geological Survey, "Mineral Commodity Summaries 2022," January 31, 2022.

PROPOSAL

Update the U.S. Department of the Interior's Critical Minerals List to include a "threatened" designation.

While the current U.S. Critical Minerals List accurately captures many of the obstacles facing steady and secure access to mineral commodities, it does not list them as "critical" until there is already a high risk of supply chain disruption. To improve mineral forecasting and our ability to react to looming mineral shortages, DOI should create a new "threatened" list for critical minerals that captures vulnerabilities to important commodities before it is too late.

1. **Update the U.S. Department of the Interior's Critical Minerals List to provide an aspect of minerals forecasting, including a "threatened" list of minerals critical for key industries but that do not yet pose the same level of dangerous import reliance as the existing definition for critical minerals.**

PROPOSAL

Increase visibility into the U.S. government's critical mineral supply chain and procurement practices.

Key military applications rely on lithium-ion batteries built using critical minerals. While the National Defense Authorization Act (NDAA) for Fiscal Year 2023 requires the Department of Defense (DOD) to implement a supply chain tracking system for the permanent magnets it procures, it does not have a requirement for the lithium-ion batteries it procures. Congress should expand this requirement to cover lithium-ion batteries to better illuminate and assess supply chain vulnerabilities.

1. **Expand supply chain tracking requirements for DOD procurement under NDAA to cover lithium-ion batteries and 'covered' battery minerals. The list of covered minerals should, at a minimum, include lithium, nickel, cobalt, manganese, graphite, aluminum, and copper.**

PROPOSAL

Work with like-minded and allied countries with similarly high environmental and labor standards to develop new mines and diversify supply.

1. **Support increased funding for Defense Production Act (DPA) Title III Program funding to bolster American, Canadian, and Australian feasibility studies, mining projects, and processing facilities. Ensure that funding for characterizing mine waste by Good Samaritans is included.**
2. **Strengthen American, Canadian, and Australian bilateral and multilateral action plans and frameworks to support a minerals supply chain based on high standards.**
    a. Direct the U.S. Commercial Service, the Export-Import Bank, and the Development Finance Corporation to work with their Canadian and Australian counterparts to promote business relationships and the development of an allied supply chain.
    b. Establish a U.S.-Australia Joint Action Plan on Critical Minerals similar to the U.S.-Canada plan to spur investment in Australian mining, re-mining, processing, refining, and recycling projects that highlight bilateral partnerships.
    c. Expand the Critical Minerals Mapping Initiative, which allows for collaboration and data sharing between the geoscience organizations of Australia, Canada, and the United States (Geoscience Australia, Geological Survey of Canada, and the U.S. Geological Survey), to include knowledge sharing on minerals processing techniques.[278]

PROPOSAL

Develop new public-private partnerships for critical mineral processing to overcome financial barriers and increase the uptake of innovative methods into the commercial sector.

Minerals processing is currently the most pressing chokepoint in critical mineral and battery supply chain. China controls 60 to 100 percent of all minerals processing, depending on the commodity, whereas the United States has less than two percent.[279]

Building up new critical minerals processing capacity is incredibly capital intensive. It can take hundreds of millions to billions of dollars to build a new facility. The traditional paradigm of mining companies funding processing facilities is compromised in the United States and among allied nations, where reserves for critical mineral resources are relatively small, and the appetite for developing new mining projects is even smaller. Therefore, a new paradigm for funding minerals processing facilities must be adopted in which downstream industries reliant upon steady access to critical mineral-based chemical compounds and metal alloys invest in infrastructure and capacity to obtain them.

Furthermore, to help make U.S. and allied processing facilities more attractive than traditional, entrenched, Chinese-owned facilities, American and allied processing must be cheaper, cleaner, and faster than traditional processing practices.

1. **Launch a public-private partnership to establish U.S. critical mineral processing and refining capacity.**
    a. Direct the Department of Energy's (DOE) Office of Fossil Energy to establish a cost-sharing initiative with automakers, battery makers, and other downstream industries to build critical minerals processing and refining facilities for lithium-ion battery materials, including nickel and cobalt sulfate, lithium hydroxide, and lithium and manganese carbonate.
2. **Launch a public-private partnership to develop cleaner, faster, and more economic ways to process and refine critical minerals.**

278 United States Geological Survey, Critical Minerals Mapping Initiative (CMMI), Webpage, August 4, 2021.

279 Benchmark Mineral Intelligence, "Infographic: China's Lithium-Ion Battery Supply Chain Dominance," October 3, 2022.

a. Direct the Secretary of Energy through the Critical Materials Institute at Ames National Lab and Argonne National Lab to establish a research consortium and cost-sharing initiative in partnership with mining and minerals processing and refining sectors to fund research, development, and demonstration projects and facilities that advance and scale cutting-edge technology and new approaches to process and refine critical minerals from raw and spent material and existing mine waste that is cleaner, faster, and more economically competitive.

PROPOSAL

Address key value-added sectors that were not adequately addressed by Inflation Reduction Act (IRA), DOE, or DOD action thus far, including rare earth element (REE) metal, alloy, and magnet production.

Rare earth elements are essential components in permanent magnets used in motors for EVs and wind turbines and in other critical defense applications. While the Bipartisan Infrastructure Law (BIL) and the IRA substantially address issues to shore up America's ability to manufacture batteries, more must be done to address America's capacity to produce REE metals, alloys, and magnets.

1. **Congress should re-introduce production tax credits for magnet manufacturing as outlined in H.R. 5033, The Rare Earth Magnet Manufacturing Production Tax Credit Act of 2021.**

2. **The Department of Commerce should implement its recommendations pursuant to its Section 232 investigations into the imports of NdFeB magnets, including supporting the production of NdFeB magnets through DOD and other programs.**

ISSUE #2

Leveraging Existing Partnerships to Build an Allied Supply Chain

Existing multilateral frameworks could be better leveraged to achieve more robust critical mineral and battery supply chains. For instance, although the United States, EU, and Japan have been meeting trilaterally to share information and coordinate policies on critical minerals since 2011 when China cut off supplies of REEs to Japan, the meetings have yet to lead to the level of supply chain diversification necessary to insulate themselves and others from overreliance on China.[280] The group has recently grown to include Canada and Australia, which could potentially spur more conversation around expanded mineral production, helping them to overcome the obstacle of obtaining much needed raw material, while leveraging EU and Japanese processing capacity.

PROPOSAL

Move beyond information sharing to develop multinational funding mechanisms for strategic international deposits.

We have reached an inflection point in the transition to an electric future, where we no longer need to ask *why* it is important to electrify our energy and transportation sectors and instead need to ask to *how* to electrify as quickly and responsibly as possible. Doing this will require more than information sharing and collaboration. It will require significant resources and policy alignment among the United States, its allies, and like-minded countries to fully implement. The United States and its allies can invest in international projects through the Minerals Security Partnership (MSP), but the partnership's capabilities are limited. We will need complementary initiatives that map domestic and international deposits of strategic national importance, expand available funding for international projects, and develop policies that facilitate the production and trade of responsibly produced minerals and materials.

1. **Direct the U.S. Trade Representative (USTR) to negotiate a multinational agreement with MSP partners that outlines common standards and guidelines for critical and strategic minerals and materials production to which all parties would conform.**

2. **Establish a task force to identify domestic and international deposits of strategic national importance.**

   a. Direct the Department of the Interior, in coordination with the Department of Energy, Department of Commerce, and Department of State, to establish an impartial task force to identify significant, economically viable critical mineral deposits of strategic national importance necessary for our national security and economic prosperity located domestically and within allied and strategic partner countries.

280 Japan's Ministry of Economy, Trade, and Industry, "13th Conference on Critical Materials and Minerals Held," June 23, 2022.

3. **Develop a multinational Critical Mineral Deposit Prospectus, similar to Australia's Critical Minerals Prospectus, which highlights shovel-ready critical mineral deposits that could satisfy allied demand for minerals.**

    a. The countries could leverage work done by the American, Canadian, and Australian geological surveys through the existing Critical Mineral Mapping Initiative (CMMI) to develop a global database of significant, responsible deposits to mine. Indicate that the CMMI should extend its mapping analysis to include the analysis of legacy mine waste.

4. **Establish a U.S. funding pipeline for international deposits of strategic national importance.**

    a. **High-income countries:** Direct the Export-Import Bank to work with allies and strategic partners to finance critical mineral projects of strategic national importance that adhere to high environmental and labor standards.

    b. **Low-income countries**: Direct the U.S. International Development and Finance Corporation to finance critical mineral projects of strategic national importance that adhere to high environmental and labor standards.

5. **Create and generously fund a demonstration and pilot grant program under DOE to allow industry, technology companies, auditors, and national labs to support the development of mapping and traceability tools used to trace minerals and their associated characteristics along the EV supply chain.**

    a. Use findings from pilot projects to inform government guidance on data sharing and data security to ensure the protection of proprietary data.

    b. DOE should make funding under this pilot program available to MSP projects to ensure that secure and responsible supply chains being developed through MSP efforts are created as models of transparency.

PROPOSAL

Develop new critical mineral frameworks with more countries

The United States only has one official critical minerals collaboration framework with Canada. The U.S.-Canada Critical Minerals Joint Action Plan is intended to help foster information sharing, ease trade barriers, and coordinate standards and action across the two countries. The United States should enter into similar formal agreements with more countries to help build up an allied supply chain.

1. **Direct the U.S. Department of State to develop Critical Mineral Roadmaps with countries like Australia, Chile, Argentina, Brazil, Vietnam, and African Nations.**

2. **Direct the MSP to expand beyond just identifying and funding critical mineral deposits to developing a Critical Mineral and Battery Supply Chain Roadmap with member countries to identify nations most likely to contribute to the supply chain and leverage their comparative advantages and areas of specialization.**

ISSUE #3:

Creating New Multinational Sourcing Agreements and Increasing Transparency to Counter Anticompetitive Market Behavior

Opening new deposits and building new processing capacity can only go so far in protecting the United States and its allies from anticompetitive market practices that perpetuate a global race to the bottom for critical minerals. To be truly secure, we must form a new global alliance of techno-democracies to extract enforceable commitments that require each country to import only responsibly mined mineral materials.

This will slow down trade in cheaper, dirtier products and expand trade for responsibly produced goods. The determination of whether or not a good is responsibly produced will entail adherence to basic principles that are seen throughout most voluntary, large-scale mining standards: earlier and more frequent community and tribal engagement, including the meaningful participation of those groups in the planning and development processes; baseline water measurements and disclosure of water quality and usage; and, detailed mine closure plans made in consultation with affected communities combined with financial assurance for reclamation costs.

While the long-term goal is to shift from voluntary mining standards to enforceable mining standards among allies and like-minded countries, we appreciate the difficulty and time required to establish those frameworks. Therefore, we recommend a two-pronged approach to achieve our goal: First, establishing sector-specific trade agreements and leveraging existing transparency and capacity building frameworks to lay the groundwork for agreed upon mining standards. Second, in the short-term, we recommend collecting metrics and arming consumers with information on how the batteries and motors within EVs were produced based on metrics aligned with the basic principles described above.

PROPOSAL

Enhance supply chain transparency and develop assurance mechanisms to improve the enforceability of standards

1. **Renew the Trade Promotion Authority and direct the USTR to negotiate and sign sector-specific trade agreements or commodity agreements with allied countries and key players in the minerals mining and processing space.**

    a. Require all signatories to incorporate basic environmental, forced labor, and child labor standards specific to mining into their domestic laws and regulations.

    b. Request that trade agreements include provisions that promote cooperation and capacity building for implementation and enforcement of rules and regulations related to the mining and processing of critical and strategic minerals.

2. **Deploy the Bureau of Land Management (BLM) in concert with the Mine Safety and Health Administration (MSHA), the Environmental Protection Agency (EPA), and other relevant federal agencies to promote cooperation between and adherence to allied mining standards.**

a. Support capacity building by offering training programs to regulators from minerals-rich countries that will be a part of a secure, sustainable, allied supply chain.

b. Explore opportunities to harmonize regulations with key trading partners.

c. Offer independent auditing to foreign mines if the mine operator volunteers to attain equivalence.

3. **The United States should rejoin the Extractive Industries Transparency Initiative (EITI) to show leadership in creating a new minerals-based economy rooted in transparency.**

   a. Direct the Secretary of the Interior to be the senior individual responsible for EITI implementation to help promote supply chain transparency and rebuild the social license to operate domestically and around the world.

PROPOSAL

Boost demand for responsibly produced products by sharing material information with consumers

Strong market demand will be necessary to accelerate efforts to promote supply chain transparency and incentivize companies to build responsible mining and processing operations. The Monroney label, or vehicle window sticker, was established in 1958 to provide customers with accurate, easily understandable, and relevant information to guide their vehicle purchasing decisions. Subsequent updates to the label have been made following changes in the auto industry, such as the rollout of new technologies and the availability of new industry-wide data. The latest version of the window sticker, however, fails to capture adequate information about critical mineral and strategic metal supply chains.

Congressional action is required to ensure that such information is on a label affixed to every new vehicle sold in the United States so that consumers have important information about the environmental and labor attributes of the covered minerals and strategic metals in new light-duty vehicles. The President should also direct that purchases of new vehicles by the federal government set an example of responsible procurement and demonstrate the ability to develop responsible supply chains.

1. **Direct the executive branch to promote supply chain transparency by requiring environmental and labor data reporting to be included on the Monroney label via a unique digital identifier affixed to every new vehicle sold in the United States.**

   a. Until agreed upon standards can be produced, the government should develop metrics to measure a range of attributes associated with the covered materials and their supply chains.

   b. Metrics shall be established for the cobalt, lithium, manganese, graphite, and nickel that are used in electric vehicle batteries, and the rare earth elements that are incorporated into motors, of any vehicle with a battery with the capacity to store at least 7 kWh of electricity.

   c. The EPA shall develop environmental metrics for the supply chains for covered minerals and strategic metals. The metrics should address, at a minimum, water quality, use, and management; waste generation and management; land-use impacts; and reclamation.

   d. The Department of Labor shall develop labor metrics for the supply chains for covered minerals and strategic metals. The metrics should address, at a minimum, the risk of forced or child labor.

   e. This process will capture multiple metrics, but must also be reduced to a single score for each category for the purpose of being incorporated into a label affixed to each new light-duty vehicle sold in the United States.

   f. EPA and the Department of Labor shall make use of existing domestic and international metrics to the extent possible.

2. **Direct that federal purchases of vehicles meet minimum required standards for environmental and labor attributes that auto manufacturers are required to track and report.**

APPENDIX A

Glossary of Abbreviations

ASI – Aluminum Stewardship Initiative

BIL – Bipartisan Infrastructure Law

CCP – Chinese Communist Party

CMMI – Critical Minerals Mapping Initiative between the American, Canadian, and Australian geological surveys

DOD – U.S. Department of Defense

DOE – U.S. Department of Energy

DOI - U.S. Department of the Interior

DPA – Defense Production Act

DRC – Democratic Republic of Congo

EC – European Commission

EPA – U.S. Environmental Protection Agency

EU – European Union

EV – Electric Vehicle

FAST-41 - Fixing America's Surface Transportation Act Title 41

FTA – Free Trade Agreement

GDP – Gross Domestic Product

GM – General Motors Company

GRI – Global Reporting Initiative

GWh – Gigawatt Hours

HEV – Hybrid Electric Vehicle

HPAL – High Pressure Acid Leaching

ICE – Internal Combustion Engine

IIJA – Infrastructure Investment and Jobs Act

IRMA – Initiative for Responsible Mining Assurance

IRA – Inflation Reduction Act

IWG – Interagency Working Group

LFP – Lithium-Iron-Phosphorous cathodes

mbd – Million Barrels Per Day

MNNA – Major Non-NATO Allies

MSHA – Mine Safety and Health Administration

MSP – U.S. State Department's Mineral Security Partnership

NAFTA – North American Free Trade Agreement

NATO – North Atlantic Treaty Organization

NCA – Nickel-Cobalt-Aluminum cathodes

NEPA – National Environmental Policy Act

NMC – Nickel-Manganese-Cobalt cathodes

NTIB – National Technology and Industrial Base

OECD – Organization for Economic Co-operation and Development

OPEC – Organization of the Petroleum Exporting Countries

OPEC+ – Organization of Petroleum Exporting Countries, including Azerbaijan, Bahrain, Brunei, Kazakhstan, Malaysia, Mexico, Oman, Russia, South Sudan and Sudan.

PRC – People's Republic of China (China)

PTC – Production Tax Credit

REE – Rare Earth Element

SLAB – Spent Lead Acid Battery

TSM – Toward Sustainable Mining

U.S. – United States

USGS – U.S. Geological Survey

USMCA – United States-Mexico-Canada Agreement

USTR – United States Trade Representative

ZEV – Zero-Emission Vehicle

APPENDIX B

Country Designations

FTA Countries	Major Allies			Foreign Entities of Concern
	NATO Allies*	Major Non-NATO Allies (MNNA)	EU Single Market Members	
Australia	Albania	Afghanistan	Austria	China
Bahrain	Belgium	Argentina	Belgium	Iran
Canada	Bulgaria	Australia	Bulgaria	North Korea
Chile	Canada	Bahrain	Croatia	Russia
Colombia	Croatia	Brazil	Cyprus	
Costa Rica	Czech Republic	Colombia	Czech Republic	
Dominican Republic	Denmark	Egypt	Denmark	
El Salvador	Estonia	Israel	Estonia	
Guatemala	France	Japan	Finland	
Honduras	Germany	Jordan	France	
Israel	Greece	Kuwait	Germany	
Jordan	Hungary	Morocco	Greece	
Korea	Iceland	New Zealand	Hungary	
Mexico	Italy	Pakistan	Ireland	
Morocco	Latvia	Philippines	Italy	
Nicaraua	Lithuania	Qatar	Latvia	
Oman	Luxembourg	South Korea	Lithuania	
Panama	Montenegro	Thailand	Luxembourg	
Peru	Netherlands	Tunisia	Malta	
Singapore	North Macedonia	Taiwan***	Netherlands	
	Norway		Poland	
	Poland		Portugal	
	Portugal		Romania	
	Romania		Slovakia	
	Slovakia		Slovenia	
	Slovenia		Spain	
	Spain		Sweden	
	Turkey			
	United Kingdom			
	United States			
	New Caledonia**			

*NATO countries yet to ratify Sweden and Finland's accession.

**New Caledonia (listed under NATO allies because it is a French territory).

***Taiwan is not formally designated as an MNNA, but is treated as such per Pub. L. 107-228.

APPENDIX C

Standards Comparison

		GOVERNMENT-LED			INDUSTRY-LED		
		IGF	**OECD**	**ERGI**	**GRI**	**ICMM**	**MAC**
First Published		2002	2010	2019	2000	2003	2004
Adherents		75+ Countries	38+ Countries	5 Countries	500+ Companies	26 Companies	54+ Companies
3rd-Party Assurance / Validation Required		**No**	**Yes**	**No**	**No**	**Yes**	**Yes**
Labor Practices	**Child Labor**	**Guiding Principle** E.g., Strengthen, monitor, and enforce laws on child labor.	**Verification Protocol - Level 1** E.g., Neither tolerate, profit from, contribute to, assist, or facilitate the worst forms of child labor or forced labor.	**Guiding Principle** E.g., References UN Sustainable Development Goals, the IFC's Environmental and Social Performance Standards, and IRMA	**Reporting Mechanism** E.g., Report how the organization manages child labor and steps it is taking to abolish it.	**Verification Protocol - Level 1** E.g., Do not employ child labor and do not assign hazardous work to those under 18.	**Verification Protocol - Level 2** E.g., Have processes in place to ensure through verification that no child under the age of 18 engages in hazardous work.
	Forced Labor	**Not Specified**	**Verification Protocol - Level 1** E.g., Neither tolerate, profit from, contribute to, assist, or facilitate the worst forms of child labor or forced labor.	**Guiding Principle** E.g., References UN Sustainable Development Goals, the IFC's Environmental and Social Performance Standards, and IRMA	**Reporting Mechanism** E.g., Report how the organization manages forced or compulsory labor; Report operations and suppliers at significant risk for forced labor; Report measures taken to eliminate all forms of forced labor;	**Verification Protocol - Level 2** E.g., Avoid forced labor; equitably remunerate employees and assign working hours within legally required limits.	**Verification Protocol - Level 2** E.g., Have processes in place to ensure forced labor, including bonded, indentured, or involuntary labor is not used.
Community and Tribal Engagement Practices	**Community Engagement**	**Guiding Principle - CTE +4** E.g., Encourage processes for community views, interests, and concerns to be heard, understood, and taken into account; Support local businesses and workers; Make consultation with affected communities a requirement for permitting and at every stage of mining cycle.	**Guiding Principle - CTE +1** E.g., Stakeholder engagement should be interactive with meetings and consultation proceedings that includes two-way communication. **Verification Protocol - Level 2** E.g., Establish company-level grievance mechanism for CAHRAs	**Guiding Principle - CTE +1** E.g., Companies should engage with communities at three levels of frequency: annual, periodic, and continous; Royalties are a common and effective way to help communities; Monitor social impact.	**Reporting Mechanism - CTE +3** E.g., Report how local communities are managed and signficant actual and potential negative impacts of operations; Report the percentage of operations with engagement, impact assesment, and/or development programs, including mapping, development, consultation, and grievance processes.	**Verification Protocol - Level 1, CTE +4** E.g., Conduct stakeholder engagement and provide access to an appropriate grievance mechanism; Enable local procurement and contracting opportunities.	**Verification Protocol - Level 2, CTE +5** E.g., Have formal mechanisms for idenfitying communities and facilitating engagment that are co-developed with communities of interest; mechanisms are regularly reviewed and upated; Mechanisms exist to escalate complaints if not dealt with properly.
	Indigenous Community and Tribal Engagement	**Guiding Principle** E.g., Ensure domestic policies are, at minimum, consistent with international law and norms; References UN Declaration on the Rights of Indigenous Peoples among other standards.	**Guiding Principle** E.g., Respect the human rights of individuals belonging to specific groups or populations; Rights should be the subject of periodic review; References UN Declaration on the Rights of Indigenous Peoples.	**Guiding Principle** E.g., Meaningful engagement between industry and indigenous communities is key to building effective relationships.	**Reporting Mechanism** E.g., Report how the rights of indigenous peoples are managed, the total number of identified incidents involving indigenous peoples and the status of the incidents; References the UN Declaration on the Rights of Indigenous Peoples.	**Verification Protocol - Level 2, CTE +4** E.g., Respect the rights, interests, culture, and natural-resource-based livelihoods of indigenous Peoples; Work to obtain FPIC.	**Verification Protocol - Level 1, CTE +5** E.g., Aim to obtain FPIC before proceeding with new projects or expansions of projects; Mutally agree upon objectives for collaboration; Seek to understand and provide opportunities for on-site cultural education, awareness, and training; Provide evidence of outcomes.
Environmental Practices to Protect Water and Land	**Water Quality**	**Guiding Principle - EP +1** E.g., Have and strictly monitor environmental management standards for surface and groundwater, including quality and quantity of effluent streams from mine works and leaching from waste dumps and tailings; Minimize likelihood of impacts beyond the mine site.	**Guiding Principle - EP +1** E.g., Establish and maintain an environmental management system to collect, evaluate, and monitor environmental, health, and safety information; Establish targets for improvement and mitigation plans; Engage with affected communities and provide verifiable information on measurements and progress.	**Guiding Principle** E.g., Manage and preserve quality of groundwater; Have surface water discharge policies and standards.	**Reporting Mechanism - EP +3** E.g., Report how water and effluents are managed, including how water is used, consumed, and discharged; how water impacts are addressed with community stakeholders; minimum standards for effluent discharge and how they were determined; and total water withdrawal and discharge by source, including breakdown of freshwater.	**Verification Protocol, Level 2** E.g., Implement water stewardship practices that provide strong and transparent governance; Collaborate with stakeholders at the catchment level.	**Verification Protocol, Level 2, EP +3** E.g., Develop a systematic approach, including water balances, monitoring of surface and groundwater that is routinely updated; Engages with communities within the watershed and participates in watershed-scale planning and governance; Results of independent verification of water performance are publicly available.
	Waste and Reclamation	**Guiding Principle - WR +3** E.g., Design waste and tailings storage facilities so that geotechnical and environmental impacts are appropriately assessed and reassessed thoughout the entire life of the mine and after mine closure; Commission independent expert reviews before and during operation; Progressively rehabilitate the land.	**Guiding Principle** E.g., Develop provisions and explore ways to improve GHG emissions reductions; Promote awareness among consumers of GHG emissions for using products.	**Guiding Principle - WR +1** E.g., Have standards for waste treatment, storage, structural integrity, mine closure and structure rehabilitation with continuous environmental monitoring.	**Reporting Mechanism - WR +2** E.g., Disclose all activities that could lead to waste generation and efforts to manage and prevent waste and promote circularity; Specific disclosures of waste generated, diverted, and disposed of, including weight, composition, and how it was ultimately handled. Disclose size and location of all habitat areas protected or restored, whether restoration approved by independent external professionals, and status of the restoration; Disclose list of affected species.	**Verification Protocol - Level 2, WR +1** E.g., Plan and design for closure in consultation with relevant authorities and stakeholders, make a financial provision to enable agreed closure and post-closure commitments realized.	**Verification Protocol - Level 1, WR +3** E.g., Tailings management plans must include a tailings transportation and placement plan, a water management plan, and a closure plan including long-term maintenance of the facility, all to the technical specifications of TSM; Developed with community input and accounts for local natural hazards.

APPENDIX C

Standards Comparison (continued)

MULTISTAKEHOLDER-LED			
ASI	**GBA**	**IRMA**	**Copper Mark**
2016	2017	2018	2019
262 Members	120+ Members	68 Members	30+ Mine Sites
Yes	**No**	**Yes**	**Yes**
Verification Protocol - Level 1 E.g., Entity shall ensure that all workers are over the age of 15 years.	**Guiding Principle** E.g., Support eliminating child and forced labor.	**Verification Protocol - Level 1** E.g., Document the ages of all workers; Children under 18 shall not be hired to do hazardous work.	**Verification Protocol - Level 2** E.g., Have a management system in place that ensures against the employment of child labor.
Verification Protocol - Level 1 E.g., Neither engage in nor support forced labor directly nor through contracted employment or recrutiment program; Do not require migrant workers to lodge deposits or security payments; Do not hold workers in debt bondage or restrict the freedom of movement; publicly disclose Modern Slavery Statement detailing actions to end modern slavery.	**Guiding Principle** E.g., Support eliminating child and forced labor.	**Verification Protocol - Level 1** E.g., Do not employ forced labor or participate in human trafficking; Monitor suppliers and develop procedures to remedy or shift suppliers over time if forced labor is determined to exist.	**Verification Protocol - Level 2** E.g., Have a management system in place that assures no use of forced labor or human trafficking.
Veritfication Protocol - Level 1, CTE +5 E.g., Implement a plan to identify, prevent, monitor, mitigate, and account for impacts in consultation and with the participation of affected populations; Commit resources to community development; Review the plan frquently; Support local livelihoods.	**Guiding Principle** E.g., Support strenghtening communities, high value job creation, local value creation, and economic diversification.	**Verification Protocol - Level 1, CTE +5** E.g., Identify stakeholders and collaborate with them to develop engagement plan and grievance mechanism; Allow stakeholder oversight; Encourage local procurement; Make all information related to IRMA available upon request; Must obtain broad community support.	**Verification Protocol - Level 1, CTE +3** E.g., Conduct stakeholder mapping that is regularly updated, establish a grievance mechanism.
Verification Protocol - Level 1, CTE +5 E.g., Ensure policies consistent with UN Declaration on Rights of Indigenous Peoples; New projects or major changes to existing projects may require FPIC; Provide funding to enable indigenous peoples to select an independent expert to review impact assessments; Publicly disclose policies and processes.	**Not Specified**	**Verification Protocol - Level 1, CTE +5** E.g., Have a publicly available policy that includes UN Declaration on the Rights of Indigenous Peoples; FPIC required for new mines; Provide funding to address capacity issues.	**Verification Protocol - Level 2, CTE +3** E.g., Implement a specific Indigenous Peoples' engagement/development plan; Have FPIC and good working conditions.
Verification Protocol - Level 1, EP +4 E.g., Establish proactive communitcation mechanisms and management plans for water use; Empower local communities to participate in water monitoring program, quantify and publicly disclose discharges to water from its activities within its area of influence; Consider physical, chemical, biological stressurs of sites direct and outsourced water effluents.	**Guiding Principle** E.g., Foster the protection of public health and the environment, and minimize and remediate the impact from pollution.	**Verification Protocol - Level 1, EP +4** E.g., In consultation with stakeholders, identify water users and rights holders, current and potential water uses at local and regional level; Gather baseline or background data on water quality and quantity to determine seasonal and temporal variabilty in physical, chemical and biological conditions of surface waters; Develop models, monitor and mitigate impacts; publish the data.	**Verification Protocol - Level 1, EP +3** E.g., Conduct water-use impact assessment in collaboration with stakeholders; Assess risks in basins, catchments, and watersheds in the entity's area of influence; Identify baseline data and seaonal and temporal variabilitiy in water quantity and physical, chemical, and biological conditions;
Verification Protocol - Level 1, WR +3 E.g., Develop a mine rehabilitation plan in consultation with and participation from affected populations and organizations and designed by a qualified specialist; publicly disclose and share the mine rehabilitation and closure plans; progressively rehabilitate the land as soon as practicable.	**Guiding Principle** E.g., Foster the protection of public health and the environment, and minimize and remediate the impact from pollution.	**Verification Protocol - Level 1, WR +5** E.g., Stakeholders receive at least 60 days to comment on the reclamation plan; Review of mine waste management facilities from siting to design must be informed by independent reviews throughout the mine lifecycle; Financial surety for mine closure must be in place before ground disturbance begins; Requires post-closure monitoring for a minimum of 25 years for water contamination data.	**Verification Protocol - Level 2, WR +3** E.g., Design, operate, and monitor tailings with adverse affects to human health and environment; Engage a competent, objective third party to conduct an independent review, including design through to maintenance. Workers, affected communities, and regulators should be invovled early in mine closure discussions; financial provisions for clsoure must be set aside before or during active operations;

APPENDIX D

Standards Specificity Points Table

		GOVERNMENT-LED			INDUSTRY-LED			MULTISTAKEHOLDER-LED			
		IGF	OECD	ERGI	GRI	ICMM	TSM	ASI	GBA	IRMA	Copper Mark
Communitiy and Tribal Engagement	**CTE +1:** Community and Tribal engagement mechanisms are co-developed by communities and are routinely assessed and updated.	✓	✓	✓	✓	✓	✓	✓		✓	✓
	CTE +1: Community and Tribal groups have access to clear grievance mechanisms.	✓			✓	✓	✓	✓		✓	✓
	CTE +1: Community and Tribal engagement plans include specific benefits for local communities, including investments in workers, local sourcing requirements, and cultural education and enrichment, as applicable.	✓				✓	✓	✓		✓	
	CTE +1: Publishes transparent disclosure reports.				✓		✓	✓		✓	
	CTE +1: Publishes transparent disclosure reports.	✓				✓	✓	✓		✓	✓
Environmental Practices	**EP +1:** Environmental management plans are developed with community input and routinely assessed and updated.						✓	✓		✓	✓
	EP +1: Includes baseilne measurements and/or impacts beyond the mine site.	✓			✓		✓	✓		✓	✓
	EP +1: Provide comprehensive guidance on different effluent streams, including storm water runoff, leach pad and mine works drainage, and impacts on surface and groundwater.				✓			✓		✓	
	EP +1: Publishes transparent disclosure reports.		✓		✓		✓	✓		✓	
Waste and Reclamation	**WR +1:** Reclamation and closure plans are developed with community input and routinely assessed and updated.					✓	✓	✓		✓	✓
	WR +1: Independent auditing and validation of closure plans.	✓			✓		✓			✓	✓
	WR +1: Financial assurance required before mining is approved.							✓		✓	
	WR +1: Requires or references monitoring past the life of the mine.	✓		✓			✓			✓	
	WR +1: Publishes Transparent Disclosure.				✓			✓		✓	✓

SAFE

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The Ambassador Alfred Hoffman, Jr.
Center for Critical Minerals Strategy

The Ambassador Alfred Hoffman, Jr. Center for Critical Minerals Strategy aims to secure all aspects of the critical minerals supply chain to help empower the United States to lead in the connected, autonomous, shared, and electric vehicles future with a focus on the entire minerals life cycle upon which these sectors rely.

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