

CHINA'S EV BATTERY DOMINANCE: THE NEED FOR US- SOUTH KOREA COOPERATION

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Introduction

Global demand for electric vehicles (EVs) is rising sharply owing to advancing technology, declining manufacturing costs, and policies to encourage or force EV adoption in the United States (federal tax credits, state regulations phasing out internal combustion engine [ICE] vehicles), the European Union (rules to phase out ICE vehicles), and China (tax incentives, manufacturing subsidies, and dedicated government procurement initiatives).¹ Demand for EVs has in turn stimulated demand for EV batteries.

Most EV batteries are lithium-ion batteries that store grid electricity and use it to power the vehicle.² Batteries can amount to up to one-third of an electric vehicle's cost.³ Nearly a third (30%) of an EV battery's value resides in its cathode, which has significant impact on EV battery manufacturing, inputs, and pricing.⁴ As prices for other EV battery pack components have fallen, cathode materials have made up a rapidly increasing share of value in lithium-ion batteries; the share of cathode materials

in battery pack prices soared from under 5% in 2016 to over 20% in 2021.⁵

China's large internal market and significant government investment and subsidies have propelled the country's EV and battery manufacturers into a dominant role in global markets. This situation not only establishes supply chain dependencies in the United States and allied countries, but also allows China to build economies of scale and to secure technological leadership. More problematic, it provides China's companies (and potentially China's government) with important leverage in dealing with both their suppliers and their customers.

The United States and its allies have common interests in competing with China but are also competing with one another, something that complicates efforts at cooperation. Nevertheless, cooperation among America and its allies will be necessary to contend with China's powerful role in EV and battery markets. South Korea can be an especially important US partner.

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Key Minerals in Electric Vehicle Batteries

Lithium, nickel, and cobalt are critical inputs in the cathodes of nickel manganese cobalt (NMC) batteries, which have thus far dominated in EVs, though less expensive lithium iron phosphate (LFP) batteries are gaining market share.⁶ In fact, between 2020 and 2022, LFP batteries increased from just 6% to 30% of the market.⁷ LFP batteries' reliance on relatively abundant iron and phosphorous, rather than nickel and cobalt, helps to reduce their cost. Like most natural resources, lithium, nickel, and cobalt—and the infrastructure to extract and process them—are unevenly distributed around the world, providing market leverage to the states and firms able to influence their production and export. This paper concentrates on these three minerals due to their current role in international EV markets.

Lithium

Lithium, a soft metal, has many uses in manufacturing, but its use in lithium-ion EV batteries is stimulating global demand; global lithium production grew by 21% between 2021 and 2022,⁸ and forecasts suggest fivefold growth by 2030.⁹

Figures 1 and 2 present lithium reserves and production in 2023. Some countries with higher reserves have lower production, which reflects varied access to mineral deposits, existing mining infrastructure, and investment, among other factors. With only one operating mine, the United

States withholds lithium production figures to avoid disclosing company proprietary data.

Note that the US Geological Survey defines reserves as “that part of the reserve base that could be economically extracted or produced at the time of determination.” The broader term “resource” refers to deposits from which commodity extraction is “currently or potentially feasible.”¹⁰ Bolivia is notable in holding an estimated 23 million metric tons (mmt) of lithium resources.¹¹

Figure 1. Lithium reserves

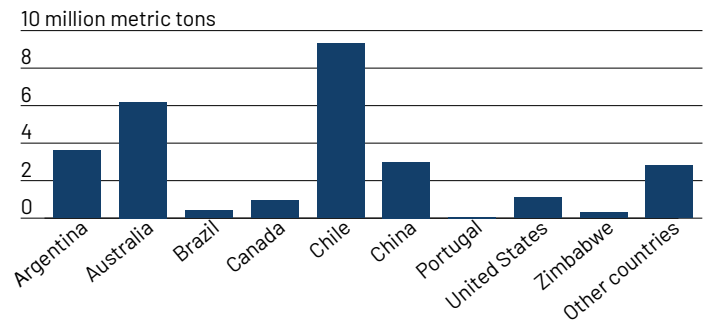
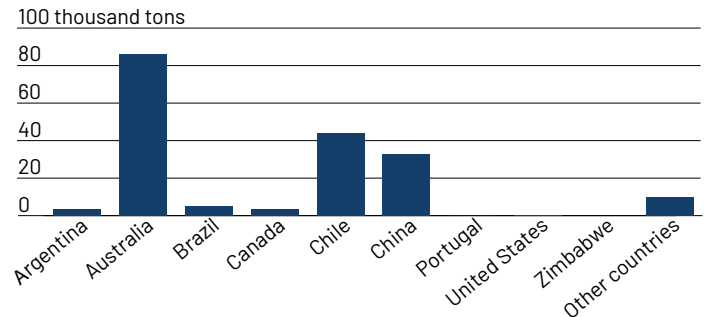


Figure 2. Lithium production



Source: US Geological Survey

Nevada’s Silver Peak lithium mine produces approximately 5,000 metric tons (mt) of lithium carbonate equivalent annually, or somewhat less than 1,000 mt of lithium, though the company has plans to double this.¹² The Thacker Pass mine, also in Nevada, is set to reopen with plans to produce 80,000 mt/year of lithium carbonate equivalent, or about 15,000 mt/year of lithium,¹³ and it has won a \$2.26 billion loan from the US Department of Energy to support this.¹⁴ A steep decline in lithium prices due to slowing EV demand may reduce EV battery prices and is complicating efforts to develop domestic supply chains.¹⁵

Nickel

Nickel is similarly important as a component in many lithium-ion battery cathodes, though not in LFP batteries. Nickel makes up 80% of nickel cobalt aluminum (NCA) batteries and 33% of NMC batteries, though its share in some newer NMC batteries approaches that in NCA units.¹⁶ Nickel increases energy density and therefore energy storage capacity, meaning that a more energy-dense battery could release energy at the same rate over a longer period than a less energy-dense alternative. Figures 3 and 4 show nickel reserves and production in 2023; Indonesia holds the world’s largest reserves.

As demand for EVs and batteries intensifies, international companies have competed vigorously to invest in Indonesia’s mining sector to secure access to the metal. Importantly, most mining in Indonesia yields class 2 nickel, which can be used in stainless

steel, but not in batteries, which require higher-quality class 1 nickel.¹⁷

Figure 3. Nickel reserves

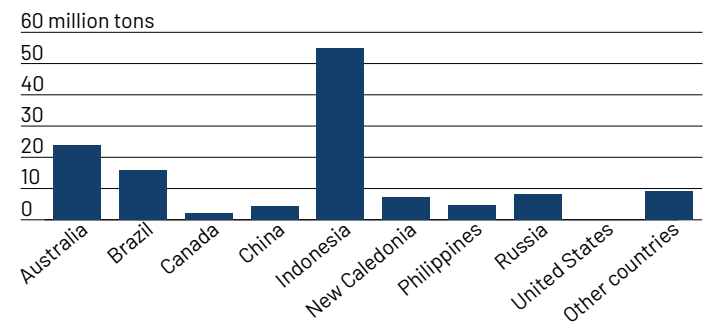
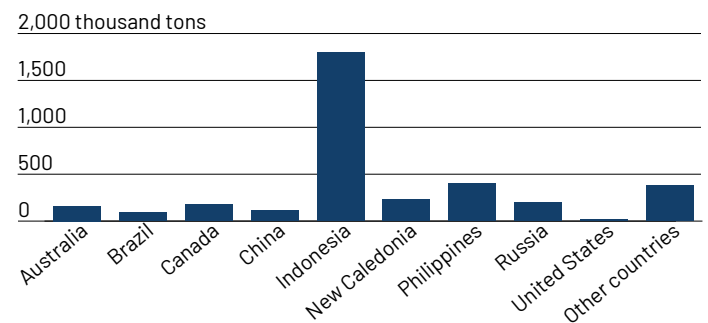


Figure 4. Nickel production



Source: US Geological Survey

The United States has 340,000 mt in nickel reserves at three projects and produces 17,000 mt/year, all at the Eagle Mine in Michigan.¹⁸

Cobalt

This blue metal helps to stabilize the chemical structure of other battery metals, to increase the rate at which a battery can produce power, and to reduce fire risk.¹⁹ The Democratic Republic of the Congo (DRC) has the largest

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China’s EV Battery Supply Chain Dominance

China has seen unprecedented growth in its automotive market and became the world’s largest car producer in 2009²² and its largest market in 2010.²³ China’s early adoption of and investments in electric vehicles have made the country the world’s largest EV market as well.²⁴ In 2022, China sold 4.4 million electric vehicles, over 3 million more than the rest of the world combined.²⁵ Of EVs sold to Chinese households, 8 out of 10 were produced by domestic automakers.²⁶ According to the China Association of Automobile Manufacturers, Chinese consumers purchased 6.26 million battery electric vehicles in 2023.²⁷

The Chinese government’s dual circulation strategy, an effort to make China’s economy as self-reliant as possible in both supply chains and technology, relies heavily on domestic demand as the primary driver for growth.²⁸ However, China’s massive internal market, and its economies of scale, in turn facilitate highly competitive international exports. In particular, they have provided considerable advantages to China’s EV and battery exporters, as well as to Chinese firms in other sectors. In 2022, six Chinese battery companies supplied 60% of the global market for EV, plug-in hybrid, and hybrid batteries; led by CATL, in first place, all were among the world’s top-10 battery manufacturers.²⁹ China likewise dominated manufacturing capacity for cathodes (70%) and anodes (85%).³⁰ As a result, Chinese firms not only

cobalt reserves of any country, approximately 6 mmt, more than half the world’s total cobalt reserves of 11 mmt.²⁰

Figure 5. Cobalt reserves

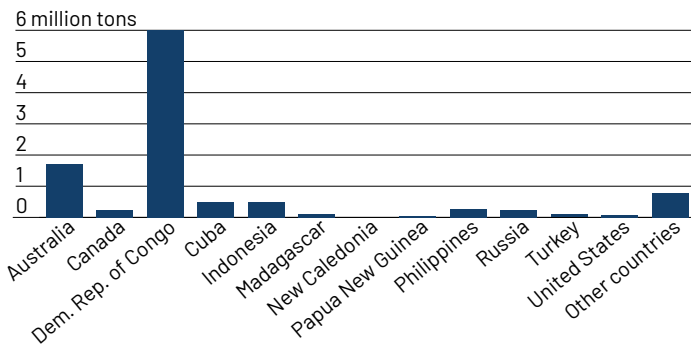
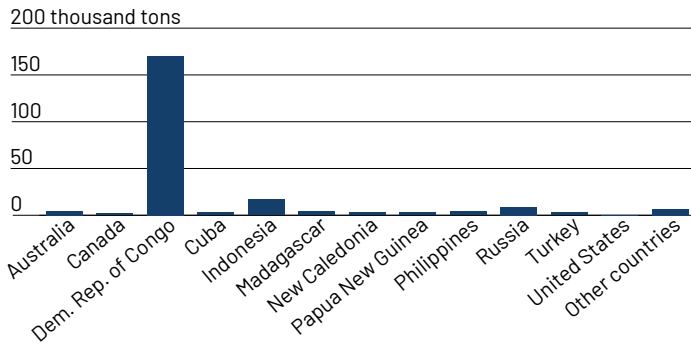


Figure 6. Cobalt production



Source: US Geological Survey

The United States has 69,000 tons in cobalt reserves and produces 500 tons/year, with additional projects in development.²¹ Figures 5 and 6 present cobalt reserves and annual production.

have market advantages, but also have considerable technological advantages.³¹

While limited to licensing LFP battery technology, the partnership between China's Contemporary Amperex Technology Co., Limited (CATL) and Ford establishes a deeper connection between China's battery making and America's EV manufacturing at a time when US officials are working to "de-risk" the US-China trade relationship.³² While Ford will fully own the battery plant using CATL's technology, the company will still have to source its battery materials in international markets, meaning that the company may depend on CATL or other Chinese-owned, Chinese-controlled, or Chinese-influenced companies for both battery materials and manufacturing technologies.

Members of Congress continue to inquire about Chinese firms' participation.³³ Analogous to the information and communications technology sector, Chinese firms have drawn special attention because the state and state-owned enterprises have a major role in China's economy. The Chinese state's share in the total market capitalization of the country's 100 largest listed companies reached 61% in the first half of 2023.³⁴ Battery manufacturer CALB—China's third largest battery firm, after CATL and BYD—originated under Aviation Industry Corp. of China (AVIC), which still owns 11.7% of the company after a spin-off.³⁵ A 2021 executive order prohibits Americans from investing in AVIC and many subsidiaries, which the Biden administration classified as components of China's military-industrial complex.³⁶ Large state

enterprises lead the Chinese mining sector³⁷ and tend to lead Belt and Road Initiative mining projects.³⁸

China's Search for Battery Mineral Resources

Chinese companies are pursuing battery mineral resources across the Global South, including in Africa (lithium and cobalt), Latin America (lithium), and Southeast Asia (nickel).

If China's current efforts to secure lithium supplies succeed, the country's firms could gain access to one-third of the world's estimated 2025 lithium mining capacity.³⁹ Chinese companies already dominate lithium refining and battery manufacturing, holding two-thirds of the former⁴⁰ and three-quarters of the latter⁴¹ through domestic refining capacity development and strategic foreign acquisitions since 2012.

Chinese firms have invested at least \$4.5 billion since 2022 in lithium mines in Mali, Namibia, and Zimbabwe.⁴² China is simultaneously expanding its investment in developing lithium projects in Bolivia, which recently declared confirmed lithium reserves of 23 million metric tons.⁴³ Chinese firms Citic Guoan and CATL—along with Russia's Uranium One, a subsidiary of the state nuclear monopoly Rosatom, which also has responsibility for other high-tech energy systems—have signed multi-billion-dollar deals to develop lithium mines in Bolivia.⁴⁴

China has led in investments in Indonesia's nickel industry, putting a total of over \$14 billion into its top-two nickel producing islands in the 2012–2022

period; Australia, Canada, South Korea, and the United States invested \$1.5 billion combined, or about a tenth of China's commitment.⁴⁵ Chinese firms are developing new technologies to produce more class 1 nickel in Indonesia as well.⁴⁶ Indeed, China's nickel-processing technology is now the world's best, creating further challenges to rival firms—especially as nickel prices fall on softening EV demand.⁴⁷

China's massive investment in Indonesia's nickel mining and processing was the outcome of a decade-long Indonesian effort to pressure foreign firms into helping the nation move up the mining value chain and thus generate more export revenue, taxes, and jobs in Indonesia.⁴⁸ This effort yielded significant growth in foreign investment in Indonesia's mineral sector starting in 2009, when a new mining law took effect.⁴⁹ Chinese investment soared in 2013–2016, overtaking all other foreign investment in Indonesia's mining sector.⁵⁰ Then, in the two years between 2020 and 2022, the value of the country's nickel exports grew from \$3 billion to \$30 billion.⁵¹ Chinese firms won a dominant role in the nickel industry, which they used as leverage in seeking to pay below-market prices for nickel, in turn triggering a tightening of the country's mineral export rules and a variety of disputes in the World Trade Organization and elsewhere.⁵²

Africa holds 47% of the world's cobalt as well as other critical minerals that are necessary for electric vehicle batteries, such as manganese (85% of global reserves).⁵³ Chinese companies either fully or partly own almost all the DRC's operating cobalt mines⁵⁴ and are directly operating mines such as the Balubi

and Muliashi copper and cobalt deposits in Zambia.⁵⁵ Chinese firms are also investing in Indonesia's cobalt production.⁵⁶ Importantly, cobalt's scarcity and higher cost have not been the only factors encouraging some Western automakers to adopt LFP battery technology; reports of child labor in the DRC's cobalt mining have generated political controversy and may also be a factor in the turn to LFP technology by some firms.⁵⁷

China's EV Battery Dominance: A Source of Political and Economic Leverage?

Chinese companies, and by extension the Chinese Communist Party, have an increasingly dominant presence in the global battery mineral sector. This presence extends beyond a leading market position to include growing political and economic ties with governments across the Global South. Chinese resource investments can be extremely important for these governments; in Bolivia, for example, net annual inflows of foreign investment have typically ranged between approximately \$500 million and \$1 billion for most of the last decade.⁵⁸ China's billion-dollar mining projects could comprise a substantial share of this, even spread across several years.

China could exercise political and economic influence through various means:

- Political pressure on countries importing processed minerals, battery components, or batteries to accommodate Chinese preferences

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- Political pressure on countries producing battery minerals to discourage competing projects or to pursue other policies helpful to China
- Economic pressure on rival mineral producers and processors to drive them out of business
- Economic influence over industry standards and technology decisions
- Economic pressure on rival mineral producers and processors that limits their investment in innovation

Many believe that China restricted delivery of rare earth metals to exert pressure on Japan during a 2010 dispute following a Chinese fishing vessel's collisions with two Japanese Coast Guard patrol boats.⁵⁹ This incident has driven long-standing subsequent concern surrounding China's potential use of supply chain dependencies for political leverage. More recently, in August 2023, China's Commerce Ministry announced export restrictions of germanium and gallium in an apparent bid to discourage US microchip export controls.⁶⁰ China has already exercised economic leverage in other sectors where it has a dominant role, such as the solar photovoltaic sector.⁶¹

US–South Korea Trade

China's battery mineral dominance poses a serious challenge to the United States and to US allies with significant EV and battery manufacturing industries. One such country is South Korea, home to three of the world's top-10 battery makers⁶² and one of the top-10 EV manufacturers.⁶³

The United States and its allies have considerable common interests in contending with China's dominant role in EV battery mineral markets. Yet even as they compete with China, US and allied EV and battery firms are competing with one another. This complicates efforts to develop cooperative policies; indeed, competition rather than cooperation has often defined US–South Korea trade relations—and the automobile sector has been among the more contentious aspects in US–South Korea trade.

Korea-US (KORUS) Free Trade Agreement

The KORUS Free Trade Agreement (FTA) originated within a George W. Bush administration attempt to expand and accelerate free trade talks in the early 2000s. A trade agreement with South Korea was an early goal and, after long and complex talks, President Bush signed the KORUS FTA in June 2007.

Nevertheless, the US Congress debated the treaty for four years before its eventual ratification in October 2011. Indeed, the KORUS FTA was the most challenging among its generation of trade agreements due to heavy criticism from the automotive industry and the modifications

necessary to win eventual support from Ford, Chrysler, and the United Autoworkers union, as well as labor-focused members of Congress.⁶⁴ The trade balance was a major problem; in 2005, American auto companies sold only 5,795 automobiles to South Korea, while South Korean firms sold 730,863 vehicles in America.⁶⁵ Heavy pressure from US carmakers and unions led to greater opening of South Korea's market and slower reductions in US tariffs on imported South Korean cars.⁶⁶

Post-KORUS Trade Tensions and the Inflation Reduction Act

During the US 2016 presidential election, the KORUS FTA and other trade deals, including the North American Free Trade Agreement (NAFTA) and the proposed Trans-Pacific Partnership, became increasingly politicized. After his election, President Donald Trump referred to the KORUS FTA as “job-killing”⁶⁷ and threatened to end it,⁶⁸ then ultimately secured additional reductions in tariff and nontariff trade barriers for US cars exported to South Korea. The new talks further extended US tariffs on South Korean pickup trucks (for another 20 years), limited South Korea's exports of steel (an important input in auto manufacturing), and raised a South Korean import quota that US exporters had not been meeting.⁶⁹

The 2022 Inflation Reduction Act (IRA) also had important consequences for US–South Korea automobile trade through the IRA's EV tax credit. The refundable EV tax credit provided \$3,750 to consumers for vehicles meeting a critical mineral requirement and another \$3,750 for vehicles satisfying a battery component requirement.

The critical mineral requirement stipulates that a yearly, escalating percentage of the value of the critical minerals in an EV “must be extracted or processed” in the US or by a US FTA partner, which would include South Korea.⁷⁰ The battery component requirement similarly requires that a yearly, escalating percentage of the value of an EV's battery components be “manufactured or assembled in North America,” but this requirement lacks the FTA carve-out.⁷¹ The IRA's EV tax credit rules sparked considerable concern in South Korea, prompting one former senior official to compare the IRA to “being stabbed in the back.”⁷²

In time, however, the Treasury Department used creative interpretations of the law—and particularly a loophole for leased vehicles—to address South Korean car manufacturers' frustration with the battery component requirement.⁷³ By April 2023—six months after the IRA's passage—South Korea's trade and industry ministry stated that a proposed guideline “substantially relieves” the concerns of the country's battery companies.⁷⁴ South Korea's EV and battery makers also partly accommodated to the law's battery component requirement by investing heavily in new factories in the United States.

US and South Korean EV and battery firms face an additional challenge, however, in the IRA EV tax credit's Foreign Entity of Concern Requirement, which blocks vehicles that include battery components from “businesses significantly influenced by” governments in China, Iran, North Korea, or Russia.⁷⁵ Indeed, about one-third of EV models that qualified for the credit at the end of 2023 were no longer eligible in late January 2024, after this rule went into effect.⁷⁶

US Battery Supply Chain Policy

The United States has devoted increasing attention to ensuring access to energy-related minerals.

President Trump signed an executive order focused on developing a critical minerals strategy in December 2017.⁷⁷ About 18 months later, in 2019, the Trump administration announced the Energy Resource Governance Initiative (ERGI), a new partnership to help resource-rich countries find and develop mineral resources, including lithium and cobalt for EV batteries.⁷⁸ In addition to the United States, the group's initial members included Argentina, Australia, Botswana, Brazil, the DRC, Namibia, Peru, the Philippines, and Zambia.⁷⁹ The following year, in 2020, President Trump issued an executive order directing US government agencies to assess and report on critical mineral dependencies, to identify legal and budgetary authorities that could support efforts to reduce these dependencies, and to present plans and policy options. The executive order also sought to encourage domestic production of critical minerals.⁸⁰

President Biden issued a similar but broader executive order on supply chains—across many industries—in February 2021, shortly after taking office,⁸¹ and announced new investments one year later.⁸² In April 2022, Biden invoked Defense Production Act authorities allowing the Department of Defense new powers to increase mining and processing of battery minerals in the United States.⁸³ The State Department launched the Minerals Security Partnership (MSP) in 2022; where the ERGI had focused on mineral-producing countries, the

MSP focused on working with US allies to develop supply chains.⁸⁴ The MSP's first members were Australia, Canada, Finland, France, Germany, Japan, South Korea, Sweden, and the United Kingdom, in addition to the US and the European Commission.⁸⁵

The United States and South Korea could benefit from further efforts at “friendshoring” to secure their EV and battery supply chains. President Biden and South Korean president Yoon Suk Yeol declared their intent to foster “public and private cooperation” in this area and others at their April 2023 summit meeting.⁸⁶ More remains to be done. One option is to advance regional supply chain cooperation in the Indo-Pacific, either within the Indo-Pacific Economic Framework or through multilateral groups involving the United States, Japan (another key ally and manufacturer in the region), South Korea, and leading resource-rich countries, such as Australia and Indonesia. Securing investment and financing for new projects is a critical objective; collaborative research to rival China's battery technologies—and to reduce critical mineral needs—is similarly important.

Geopolitical risk is a serious threat to the EV battery industry. Even setting aside China's possible intent, overconcentration of supply chains creates undue vulnerability to disruption. Because US reserves and production are limited, America can succeed in a battery minerals strategy only through cooperation. Notwithstanding enduring competitive tensions in the automotive sector, South Korea can and should be an important partner.

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Endnotes

- 1 Z. Yang, "How Did China Come to Dominate the World of Electric Cars?," MIT Technology Review, March 2, 2023, <https://www.technologyreview.com/2023/02/21/1068880/how-did-china-dominate-electric-cars-policy/>. In China's case, demand grew from 1.3 million to 6.8 million vehicles in only two years.
- 2 Some manufacturers are experimenting with alternative battery chemistries, such as sodium-ion batteries. See Yayoi Sekine, "Electric Vehicle Battery Makers Test a Future without Lithium," Bloomberg, March 21, 2023, https://www.bloomberg.com/news/articles/2023-03-21/electric-vehicle-batteries-of-the-future-may-be-lithium-less?in_source=embedded-checkout-banner.
- 3 Adrian König et al., "An Overview of Parameter and Cost for Battery Electric Vehicles," *World Electric Vehicle Journal* 12, no. 1 (2021): 21, <https://doi.org/10.3390/wevj12010021> <https://www.mdpi.com/2032-6653/12/1/21>.
- 4 "EV Battery Makers Race to Develop Cheaper Cell Materials, Skirting China," Reuters, November 15, 2022, <https://www.reuters.com/business/autos-transportation/ev-battery-makers-race-develop-cheaper-cell-materials-skirting-china-2022-11-15/>.
- 5 International Energy Agency (IEA), "Average Pack Price of Lithium-Ion Batteries and Share of Cathode Material Cost, 2011–2021," May 13, 2022, <https://www.iea.org/data-and-statistics/charts/average-pack-price-of-lithium-ion-batteries-and-share-of-cathode-material-cost-2011-2021>.
- 6 Paul Lienert, "For EV Batteries, Lithium Iron Phosphate Narrows the Gap with Nickel, Cobalt," Reuters, June 23, 2023, <https://www.reuters.com/business/autos-transportation/ev-batteries-lithium-iron-phosphate-narrows-gap-with-nickel-cobalt-2023-06-22/>.
- 7 "LFP Batteries Transforming EV Market Dynamics Globally," EVMarketsReports, August 2023, <https://evmarketsreports.com/lfp-batteries-transforming-ev-market-dynamics-globally/>.
- 8 US Geological Survey, Mineral Commodity Summaries 2023 (Reston, VA: US Geological Survey, 2023), p. 108, <https://doi.org/10.3133/mcs2023>.
- 9 Li-Bridge, "Building a Robust and Resilient U.S. Lithium Battery Supply Chain," February 2023, p. 4, <https://energystorage.lbl.gov/wp-content/uploads/sites/21/2023/02/Li-Bridge-Industry-Report.pdf>.
- 10 US Geological Survey, Mineral Commodity Summaries 2024 (Reston, VA: US Geological Survey), pp. 207–08, <https://pubs.usgs.gov/periodicals/mcs2024/mcs2024.pdf>.
- 11 *Ibid.*, p. 111.
- 12 Jim Romsaas, "Silver Peak Mine the Only Source of Lithium in U.S.," Mesabi Tribune, February 26, 2023, https://www.mesabtribune.com/mine/silver-peak-mine-the-only-source-of-lithium-in-u-s/article_dbffa8c4-a95a-11ed-82c1-1b0b7db2f567.html. One metric ton of lithium requires about 5.3 metric tons of lithium carbonate equivalent. See Paul Martin, "How Much Lithium Is in a Li-Ion Vehicle Battery?," November 29, 2017, <https://www.linkedin.com/pulse/how-much-lithium-li-ion-vehicle-battery-paul-martin/>.
- 13 "Lithium Americas Starts Construction at Thacker Pass in Nevada," Reuters, March 2, 2023, <https://www.reuters.com/legal/litigation/lithium-americas-starts-construction-thacker-pass-nevada-2023-03-02/>.
- 14 Jeniffer Solis, "Lithium Americas to Get Massive Federal Loan to Develop Thacker Pass Mine," Nevada Current, March 15, 2024, <https://nevadacurrent.com/2024/03/15/lithium-americas-to-get-massive-federal-loan-to-develop-thacker-pass-mine/>.
- 15 Hannah Northey, "Biden's EV Agenda Hits Mining World's Boom-and-Bust Cycle," E&E News, January 31, 2024, <https://www.eenews.net/articles/bidens-ev-agenda-hits-the-mining-worlds-boom-and-bust-cycle/>.
- 16 Nickel Institute, "Nickel in Batteries," <https://nickelinstitute.org/en/about-nickel-and-its-applications/nickel-in-batteries/>.
- 17 John McBeth, "Indonesia's Mineral Export Bans Face Hot Global Fire," Asia Times, July 5, 2023, <https://asiatimes.com/2023/07/indonesias-mineral-export-bans-face-hot-global-fire/>.

- 18 US Geological Survey, Mineral Commodity Summaries 2024, p. 124.
- 19 Kevin Clemens, "Understanding the Role of Cobalt in Batteries," DesignNews, February 16, 2023, <https://www.designnews.com/electronics/understanding-role-cobalt-batteries>.
- 20 US Geological Survey, Mineral Commodity Summaries 2024, p. 63.
- 21 Ibid.
- 22 OICA, "2009 Production Statistics," <https://www.oica.net/category/production-statistics/2009-statistics/>.
- 23 IEA, "Global Car Sales by Key Markets, 2005–2020," May 18, 2020, <https://www.iea.org/data-and-statistics/charts/global-car-sales-by-key-markets-2005-2020>.
- 24 Joel Jaeger, "These Countries Are Adopting Electric Vehicles the Fastest," World Resources Institute, September 14, 2023, <https://www.wri.org/insights/countries-adopting-electric-vehicles-fastest#:~:text=In%202022%2C%2022%25%20of%20passenger,easier%20all%20over%20the%20world>.
- 25 Ibid.
- 26 Keith Bradsher, "China Is Flooding the World with Cars," New York Times, September 6, 2023, <https://www.nytimes.com/2023/09/06/business/china-car-exports.html>.
- 27 China Association of Automobile Manufacturers, "Sales of New Energy Vehicles in December 2023," January 12, 2024, <http://en.caam.org.cn/Index/show/catid/66/id/2039.html>.
- 28 Alicia Garcia Herrero, "What Is Behind China's Dual Circulation Strategy," China Leadership Monitor 69 (Fall 2021), posted September 1, 2021, <https://www.prclleader.org/post/what-is-behind-china-s-dual-circulation-strategy>.
- 29 Yang Jian, "6 Chinese Companies Rank among World's Top 10 Battery Suppliers for EVs, Plug-in Hybrids, Hybrids in 2022," Automotive News, February 9, 2023, <https://www.autonews.com/china/which-chinese-companies-rank-among-worlds-top-battery-suppliers>.
- 30 IEA, "Global Supply Chains of EV Batteries," July 2022, p. 2, <https://iea.blob.core.windows.net/assets/961cfc6c-6a8c-42bb-a3ef-57f3657b7aca/GlobalSupplyChainsofEVBatteries.pdf>.
- 31 Shunsuke Tabeta, "CATL, BYD, Others Unite in China for Solid-State Battery Breakthrough," Nikkei Asia, February 12, 2024, <https://asia.nikkei.com/Business/Technology/CATL-BYD-others-unite-in-China-for-solid-state-battery-breakthrough>.
- 32 Seaton Huang, "Ford-CATL Partnership Illustrates the Challenge of Decoupling EV Supply Chains," Council on Foreign Relations, March 7, 2023, <https://www.cfr.org/blog/ford-catl-partnership-illustrates-challenge-decoupling-ev-supply-chains>.
- 33 David Shepardson, "Lawmakers Want US to Probe Four Chinese Firms Involved in Ford Battery Plant—Letter," Reuters, January 29, 2024, <https://www.reuters.com/business/autos-transportation/lawmakers-want-us-probe-four-chinese-firms-involved-ford-battery-plant-letter-2024-01-29/>.
- 34 Tianlei Huang and Nicolas Veron, "China's State vs. Private Company Tracker: Which Sector Dominates?," Peterson Institute for International Economics, July 27, 2023, <https://www.piie.com/research/piie-charts/chinas-state-vs-private-company-tracker-which-sector-dominates#:~:text=The%20share%20of%20China's%20state,the%20first%20half%20of%202023>. About four-fifths of these state enterprises are majority-owned by the state, while the remainder have mixed ownership with a state role under 50% and above 10% (the threshold below which the authors consider firms to be private).
- 35 C. K. Tan, "State-Backed Battery Maker Gives Competitive Jolt to China's CATL," Nikkei Asia, May 25, 2022, <https://asia.nikkei.com/Spotlight/Electric-cars-in-China/State-backed-battery-maker-gives-competitive-jolt-to-China-s-CATL>.
- 36 The White House, "Executive Order on Addressing the Threat from Securities Investments That Finance Certain Companies of the People's Republic of China," June 3, 2021, <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/06/03/>

[executive-order-on-addressing-the-threat-from-securities-investments-that-finance-certain-companies-of-the-peoples-republic-of-china/](#).

- 37 See Ian Hissey, "Investing in Chinese State-Owned Enterprises," FactSet, December 17, 2019, <https://insight.factset.com/investing-in-chinese-state-owned-enterprises>; and Sheila Olson, "9 Biggest Mining Companies in China," Investopedia, December 7, 2023, <https://www.investopedia.com/insight/chinese-mining-companies/>.
- 38 S&P Global Market Intelligence, "Chinese Foreign Mining Investment—China's Private Sector Eyes Low-Cost Regions," March 12, 2021, <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/chinese-foreign-mining-investment-8212-china-s-private-sector-eyes-low-cost-regions-63066809>.
- 39 Sha Hua, "China's Risky Strategy to Control One-Third of the World's Lithium Supply," Wall Street Journal, May 24, 2023, <https://www.wsj.com/articles/china-spends-billions-on-risky-bets-to-lock-down-worlds-lithium-39e174e8>.
- 40 P. Pattison and F. Firdaus, "Battery Arms Race: How China Has Monopolised the Electric Vehicle Industry," The Guardian, November 25, 2021, <https://www.theguardian.com/global-development/2021/nov/25/battery-arms-race-how-china-has-monopolised-the-electric-vehicle-industry>.
- 41 T. Moerenhaut, L. Y. Lee, and J. Glynn, "Critical Mineral Supply Constraints and Their Impact on Energy System Models," Center on Global Energy Policy at Columbia University-SIPA, June 12, 2023, https://www.energypolicy.columbia.edu/wp-content/uploads/2023/06/CriticalMineralsSupply-Commentary_CGEP_052323-2.pdf.
- 42 Ibid.
- 43 "Bolivia Boosts Lithium Resources Estimate, Cementing Spot as Global Leader," Associated Press, July 20, 2023, <https://apnews.com/article/bolivia-lithium-resources-15e170b6f2f42079b750d262da9c258a>.
- 44 Ibid. Uranium One is a subsidiary of Russia's state nuclear monopoly Rosatom; its operations have largely avoided Western sanctions following Russia's invasion of Ukraine due to ongoing reliance on Russia for nuclear fuel and enrichment services. See Alexandra Prokopenko, "Rosatom: A Difficult Target," Russia's Global Energy Role—Working Paper No. 1, Energy Innovation Reform Project, May 8, 2023, <https://innovationreform.org/eirp-russia-energy-series-rosatom-a-difficult-target/>.
- 45 Yudith Ho and Eko Listiyorini, "Chinese Companies Are Flocking to Indonesia for Its Nickel," Bloomberg, December 15, 2022, <https://www.bloomberg.com/news/articles/2022-12-15/chinese-companies-are-flocking-to-indonesia-for-its-nickel>.
- 46 Ibid.
- 47 Harry Dempsey, A. Anantha Lakshmi, and Mercedes Ruehl, "Indonesia's Flood of Nickel Sparks 'Darwinian' Battle for Survival among Miners," Financial Times, January 29, 2024, <https://www.ft.com/content/dd9434b4-04e5-474d-85ff-7149f89efd19>.
- 48 Angela Tritto, "How Indonesia Used Chinese Industrial Investments to Turn Nickel into the New Gold," Carnegie Endowment for International Peace, April 11, 2023, <https://carnegieendowment.org/2023/04/11/how-indonesia-used-chinese-industrial-investments-to-turn-nickel-into-new-gold-pub-89500>.
- 49 Ibid.
- 50 Ibid.
- 51 Ho and Listiyorini, "Chinese Companies Are Flocking to Indonesia." This was likely due in part to Indonesia's success in adding value to its exports and in part to nickel prices, which nearly doubled in 2020–2021 (during the COVID-19 pandemic). See Trading Economics, "Nickel," <https://tradingeconomics.com/commodity/nickel>.
- 52 Tritto, "How Indonesia Used Chinese Industrial Investments."
- 53 Ben Lefebvre and James Bikales, "State Department Launches Africa Push to Secure Critical Minerals Supply," Politico Pro, September 25, 2023, <https://subscriber.politicopro.com/article/2023/09/state-department-launches-africa-push-to-secure-critical-minerals-supply-00117652>.

- 54 Edward A. Burrier and Thomas P. Sheehy, "Challenging China's Grip on Critical Minerals Can Be a Boon for Africa's Future," United States Institute of Peace, June 7, 2023, <https://www.usip.org/publications/2023/06/challenging-chinas-grip-critical-minerals-can-be-boon-africas-future>.
- 55 PorterGeo, "Luanshya (Roan Antelope), Baluba, Muliashi," <https://portergeo.com.au/database/mineinfo.asp?mineid=mn351>.
- 56 Karl Decena, "Indonesia Emerging as Major Cobalt Supplier amid Lingering ESG Concerns," S&P Global Market Intelligence, July 31, 2023, <https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/indonesia-emerging-as-major-cobalt-supplier-amid-lingering-esg-concerns-76472560>.
- 57 "Tesla Chooses LFP Batteries for Some Model 3 and Model Y Cars Made in China," CNN, June 1, 2022, <https://www.cnn.com/2022/06/01/cars/tesla-lfp-battery/index.html>.
- 58 World Bank, "Foreign Direct Investment, Net Inflows (BoP, current US\$)-Bolivia," <https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?locations=BO>.
- 59 P. Mercer, "Australia Challenges China in Mining for Essential Elements," BBC News, October 17, 2022, <https://www.bbc.com/news/business-62760354>.
- 60 "China to Restrict Exports of Chipmaking Materials as US Mulls New Curbs," Reuters, July 3, 2023, <https://www.reuters.com/markets/commodities/china-restrict-exports-chipmaking-materials-us-mulls-new-curbs-2023-07-04/>.
- 61 Regarding how China's manufacturing decisions damaged South Korea's solar industry, see Jae Ho Yun and Chinho Park, "South Korea's Solar Power Industry: Status and Prospects," Energy Innovation Reform Project, October 2023, <https://innovationreform.org/wp-content/uploads/2023/11/EIRP-South-Koreas-solar-power-industry.pdf>. On how China's solar market dominance thwarted innovation, see David Hart, "The Impact of China's Production Surge on Innovation in the Global Solar Photovoltaics Industry," Information Technology and Innovation Foundation, October 5, 2020, <https://itif.org/publications/2020/10/05/impact-chinas-production-surge-innovation-global-solar-photovoltaics/>.
- 62 Yang Jian, "6 Chinese Companies Rank among World's Top 10 Battery Suppliers."
- 63 Tom Swallow, "Top Ten: Electric Vehicle Companies," Energy Digital, September 27, 2023, <https://energydigital.com/top10/top-10-electric-vehicle-companies>.
- 64 Congressional Research Service, "Free Trade Agreements: Impact on U.S. Trade and Implications for U.S. Trade Policy," RL31356, February 26, 2014, <https://www.everycrsreport.com/reports/RL31356.html>.
- 65 Kelly Olsen, "U.S., South Korea Reach Free Trade Deal," Washington Post, April 2, 2007, https://www.washingtonpost.com/wp-dyn/content/article/2007/04/02/AR2007040200273_pf.html.
- 66 "U.S., South Korea Sign Sweeping Free-Trade Agreement," Taipei Times, December 5, 2010, <https://www.taipeitimes.com/News/front/archives/2010/12/05/2003490144>.
- 67 Drew Harwell, "Trump's Trade Talk Is Scaring One of America's 'Greatest Friends,'" Washington Post, August 12, 2016, <https://www.washingtonpost.com/news/business/wp/2016/08/12/trumps-trade-talk-is-scaring-one-of-americas-greatest-friends/>.
- 68 "Trump: We May Terminate U.S.-South Korea Trade Agreement," Washington Post, April 27, 2017, https://www.washingtonpost.com/politics/trump-we-may-terminate-us-south-korea-trade-agreement/2017/04/27/75ad1218-2bad-11e7-a616-d7c8a68c1a66_story.html.
- 69 Josh Zumbrun, Bob Davis, and Kwanwoo Jun, "U.S. Wins 'Modest' Trade Concessions from South Korea," Wall Street Journal, March 26, 2018, <https://www.wsj.com/articles/trade-deal-eases-way-for-u-s-south-korea-to-collaborate-on-north-1522058350>.
- 70 United States Department of the Treasury, "Treasury Releases Proposed Guidance on New Clean Vehicle Credit to Lower Costs for Consumers, Build U.S. Industrial Base, Strengthen Supply Chains," March 31, 2023, <https://home.treasury.gov/news/press-releases/jy1379>.

- 71 Ibid.
- 72 Jeong-Ho Lee and Heejin Kim, "South Korea Sees 'Betrayal' in Biden's Electric Vehicle Push," Bloomberg, September 1, 2022, <https://www.bloomberg.com/news/articles/2022-09-02/south-korea-sees-betrayal-in-biden-s-electric-vehicle-push?sref=ATN0rNv3/>.
- 73 Chad P. Brown, "How the United States Solved South Korea's Problems with Electric Vehicle Subsidies under the Inflation Reduction Act," Working Paper 23-6, Peterson Institute for International Economics, July 2023, <https://www.piie.com/sites/default/files/2023-07/wp23-6.pdf>.
- 74 Kim Na-young, "S. Korea Welcomes New Guidance on EV Tax Credits under U.S. Inflation Reduction Act," Yonhap News Agency, April 1, 2023, <https://en.yna.co.kr/view/AEN20230401001400315>.
- 75 Nicholas E. Buffie, "Foreign Entity of Concern Requirements in the Section 30D Clean Vehicle Credit," Congressional Research Service, IN12322, February 28, 2024, <https://crsreports.congress.gov/product/pdf/IN/IN12322>.
- 76 Ibid.
- 77 Executive Office of the President, "A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals," Executive Order 13817 of December 20, 2017, Federal Register, December 26, 2017, <https://www.federalregister.gov/documents/2017/12/26/2017-27899/a-federal-strategy-to-ensure-secure-and-reliable-supplies-of-critical-minerals>.
- 78 "Nine Countries Join U.S. Strategic Minerals Initiative," Reuters, September 26, 2019, <https://www.reuters.com/article/idUSL2N26G229/>.
- 79 Ibid.
- 80 The White House, "Executive Order on Addressing the Threat to the Domestic Supply Chain from Reliance on Critical Minerals from Foreign Adversaries," September 30, 2020, <https://trumpwhitehouse.archives.gov/presidential-actions/executive-order-addressing-threat-domestic-supply-chain-reliance-critical-minerals-foreign-adversaries/>.
- 81 The White House, "Executive Order on America's Supply Chains," February 24, 2021, <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/02/24/executive-order-on-americas-supply-chains/>.
- 82 The White House, "Fact Sheet: Securing a Made in America Supply Chain for Critical Minerals," February 22, 2022, <https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/22/fact-sheet-securing-a-made-in-america-supply-chain-for-critical-minerals/>.
- 83 US Department of Defense, "Defense Production Act Title III Presidential Determination for Critical Materials in Large-Capacity Batteries," April 5, 2022, <https://www.defense.gov/News/Releases/Release/Article/2989973/defense-production-act-title-iii-presidential-determination-for-critical-materi/>.
- 84 US Department of State, "Minerals Security Partnership," <https://www.state.gov/minerals-security-partnership/#Establishing>.
- 85 Ibid.
- 86 The White House, "Leaders' Joint Statement in Commemoration of the 70th Anniversary of the Alliance between the United States of America and the Republic of Korea," April 26, 2023, <https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/26/leaders-joint-statement-in-commemoration-of-the-70th-anniversary-of-the-alliance-between-the-united-states-of-america-and-the-republic-of-korea/>.