The Security–Sustainability Nexus: Lithium Onshoring in the Global North

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Abstract

The political economy of lithium, a "critical mineral" for the renewable energy transition, is marked by two striking developments. First, Global North governments that have historically offshored mining are onshoring lithium to enhance "supply chain security." Second, these governments have committed to "sustainably sourcing" lithium. In this article, I theorize both developments in terms of a novel *security–sustainability nexus*: an interlocking set of policies and justifications that promote lithium extraction and emphasize the environmental credentials of Global North mining. The security–sustainability nexus evidences an alignment between state and corporate interests. For public officials, onshoring policies counter China's "dominance" over battery supply chains. For mining and auto firms, onshoring translates into lucrative incentives, supply security, and reputational benefits. However, despite this state–corporate alignment, the tensions within the security–sustainability nexus illuminate the contradictions of green capitalism. I conclude that the geopolitical and socioenvironmental conflicts over the material foundations of the energy transition are reshaping the inequalities linked to extractive sectors.

The energy transition is unleashing a global mining boom for the raw materials required to manufacture green technologies (Ambrose 2021). Lithium exemplifies the extractive frontiers of renewable energy. Lithium-ion batteries are essential for decarbonization, especially electrifying transportation and stabilizing energy grids powered by intermittent wind and solar. The International Energy Agency (2021, 9) forecasts that lithium demand will increase 4,200 percent by 2040. But getting lithium—and other transition minerals—out of the ground entails grave consequences at the sites of extraction, threatening water systems and biodiversity and violating Indigenous rights (Blair et al. 2022).

* Research and writing were generously supported by the Radcliffe Institute, the Carnegie Corporation, and Providence College. Drafts of this article were presented at the University of Chicago's Comparative Politics Workshop, New York University's Climate Change Doctoral Group, Princeton University's Climate Futures Workshop, Ohio State University's "Worlds in Contention" Conference, and Utrecht University's "Tackling Climate Change and Inequality Together" Conference. I am grateful for feedback from Alyssa Battistoni, Daniel Aldana Cohen, Jessica Green, Adam Leeds, Timmons Roberts, Quinn Slobodian, Jake Werner, and two anonymous reviewers.

Global Environmental Politics 23:1, February 2023, https://doi.org/10.1162/glep_a_00668

These consequences are magnified by the pressure to fast-track projects as demand surges.

The mining imperative appears to pose a zero-sum choice between decarbonization and the protection of ecosystems and communities. However, lithium supply is not an objective parameter but a temporally and spatially dynamic relationship between deposits, scientific knowledge, technological innovations, and public policies (Greim et al. 2020). Demand for new lithium mining is likewise contingent on myriad factors that determine the resource intensity of the energy transition. The political economy of extraction matters, and I argue here that political economy is marked by two striking developments. First, Global North governments are promoting domestic lithium projects to enhance "supply chain security." Second, these same governments have committed to "sustainably sourcing" lithium. Both phenomena are unexpected: harmful extraction is generally sited in the Global South, and sustainability rarely factors into interstate competition. Especially striking is the trends' convergence, with policy makers now conflating the *security* and *sustainability* of lithium supplies.

I situate these surprising developments in a broader context: US and European Union (EU) governments are deploying new corporate-friendly industrial policies to "dominate" green technology supply chains, in explicit competition with China. The onshoring imperative is especially marked in the lithium sector. With direct financing, speedy environmental permitting, public investment in R&D, and supply chain coordination, state officials are luring multinational lithium firms to explore and extract in their territories.

These developments are remarkable because mining is among the most environmentally toxic (Luckeneder et al. 2021) and least-value-added nodes of supply chains, with a record of human rights violations and violence (Global Witness 2020)—all of which can spark protest (Scheidel et al. 2020, 5). For these reasons, the Global North has historically offshored mining, reinforcing a pattern of "unequal ecological exchange" dating to colonialism (Dorninger et al. 2021). Over the past century and a half, the United States and EU have increasingly relied on mining imports, with Australia, Brazil, Canada, Chile, the Democratic Republic of Congo, Peru, and Zambia as top exporters (Regueiro and Alonso-Jimenez 2020, 211). In 1900, Europe "accounted for more than 50% of global mineral production"—falling to under 5 percent in 2018 (Regueiro and Alonso-Jimenez 2020, 209–210); the number of mineral commodities for which the United States is more than 25 percent net reliant on imports nearly tripled between 1954 and 2019, from twenty-one to fifty-eight (US Geological Survey [USGS] 2020, 4). Lithium exemplifies import dependency. The vast majority of lithium processed in the United States comes from Chile and Argentina; the EU relies on two import streams: Australia for unrefined lithium concentrate and Chile and Argentina for lithium carbonate.[1] China is the

1. David Merriman, Wood MacKenzie, personal communication, November 22, 2021.

world's single largest importer and refiner of lithium, accounting for 50–60 percent of global consumption over the past half-decade and 80 percent of refining capacity (Bloomberg NEF [BNEF] 2020; Hao et al. 2017; Song et al. 2021).

It is this dependence on distant mining and Chinese processing that US and EU policies hope to transform. Mining, however, entails environmental costs and social conflicts. Why, despite these risks, have Global North policy makers embraced onshoring? I theorize these governments' pivot to lithium onshoring in terms of a novel *security–sustainability nexus*: an interlocking set of policies and justifications that promote lithium extraction and emphasize the environmental credentials of Global North mining. The security–sustainability nexus evidences an alignment between state and corporate interests. For public officials, onshoring policies counter China's "dominance" over battery supply chains. For mining and auto firms, onshoring translates into lucrative incentives, supply security, and reputational benefits.

As I demonstrate, the security–sustainability nexus consolidated through a policy process commencing in 2008, when US and EU policy makers first framed China and other emerging economies as threatening Global North access to "critical minerals." Policy attention to these minerals accelerated when COVID-19 snarled global supply chains and an intensifying climate crisis combined with manufacturing innovations—primarily in China—propelled the energy transition and its technologies. US and EU policy makers now prioritize the territorial control of green technology supply chains and particularly of lithium, a critical mineral for decarbonizing the multi-trillion-dollar global auto industry. Simultaneously, these policy makers embrace "sustainable" lithium on "geoeconomic" (Roberts et al. 2019) grounds: in their estimation, Western firms can outcompete their Chinese counterparts on environmental and ethical credentials.

Furthermore, I show that mining and auto companies endorse the security–sustainability nexus. In a context of declining investment in the mining sector (S&P 2020), and uneven investment in lithium specifically, extractive firms welcome government support. Meanwhile, by expanding and diversifying lithium supply, onshoring addresses EV manufacturers' concerns about a near-term shortage. Both sectors benefit from policy makers' emphasis on sustainability. Under pressure from nongovernmental organization (NGO) campaigns, local activism, media scrutiny, and "Environmental Social Governance" (ESG) investing, mining and auto firms have committed to "sustainable sourcing." Lithium companies compete to sell "green" lithium to car companies, which likewise seek "sustainable" raw materials based on their perceptions of consumer and investor preferences. There are, however, tensions between state and corporate preferences. Government goals of decoupling from China could impose logistical and economic costs, and corporations prefer unenforced sustainability standards to binding regulations. Firms want carrots, not sticks. The security–sustainability nexus illuminates the contradictions of green capitalism.

My conceptualization of the security–sustainability nexus intervenes in a growing body of research on the political economy and geopolitics of the global energy transition (Allan et al. 2021; Blondeel et al. 2021; Newell et al. 2021; Su et al. 2021). As this scholarship reveals, renewable energy systems are crisscrossed by multiple tensions: between fossil fuel interests and emergent green capitalists, between incumbent industrial powers and an ascendant China, and between a greener status quo and a transformative "just transition." These conflicts are particularly fraught at the energy transition's extractive frontiers. Intensified mining for transition metals, such as lithium, cobalt, rare earth elements (REE), and nickel, has caused social and environmental harm (Lèbre et al. 2020), prompting local protest; simultaneously, states see such sectors as strategic for their geopolitical stature (Kalantzakos 2020).

In this vein, social science scholarship on lithium has explored its socio-environmental impacts (Jerez et al. 2021; Liu and Agusdinata 2020), the meanings ascribed to it (Barandiarán 2019; Sanchez-Lopez 2019), the policies governing it (Lunde Seefeldt 2020; Obaya 2021), and its embeddedness within production networks (Bos and Forget 2021; Hao et al. 2017; Obaya et al. 2021; Song et al. 2021). While immensely valuable, this research centers primarily on Latin America and secondarily on China, therefore neglecting dynamics within the Global North—the site of the most surprising changes to the global geography of lithium mining. There, battery supply chains are a laboratory for a green industrial policy that aims for geoeconomic dominance. But scholars have not yet analyzed the US and EU governments' rerouting of the lithium frontier through their territories—nor their fusion of "security" and "sustainability" into a novel policy paradigm. This article identifies this underexplored development and traces the process accounting for it.

In what follows, I outline the lithium sector's political economy and geography; present my methodology and data sources; analyze the consolidation of, and tensions within, the security–sustainability nexus; and reflect on the implications of lithium onshoring for energy transition research.

Geology Is Not Destiny

The majority of the world's lithium is found in closed-basin brines, for example, the Atacama Salt Flat in northern Chile, followed by hard-rock formations, such as the spodumene deposits of Western Australia, and clay and geothermal deposits (USGS 2017, 5). Globally, the USGS (2022) estimates 89 million tons of lithium resources and 22 million tons of lithium reserves (resources that are profitable to exploit).

Despite relative geological abundance, policy makers and downstream manufacturers are concerned about supply. One reason is deposits' variation in quality (Munk et al. 2016). Another is the regulatory frameworks that condition lithium's profitability and the lapse between discovery and production, which can result in supply lagging behind demand. Furthermore, supply is

partly endogenous to prices: from 2018 to 2020, low prices dampened investor interest in lithium (with the key exception of Chinese private and public investment; Helveston and Nahm 2019). Due to these factors, 100,000 tons are in production (0.0045 percent of global reserves), concentrated in Australia, Chile, China, and Argentina (USGS 2022). While over the past six years production levels more than doubled (USGS 2016), market analysts predict that demand will exceed market supply as soon as 2022.[2] Reflecting the risk of shortages and its nonsubstitutable role in the energy transition, the US and EU governments added lithium to "critical mineral" lists (discussed later), as has China (Andersson 2020, 133).

"Criticality" is less a stable condition than an emergent outcome of interacting variables: the discovery of deposits, the development of new extraction methods, government promotion of EVs, evolving battery chemistries, and recycling capacity, among others. This means that policies favoring public transit and improving materials recovery will reduce lithium demand while accelerating decarbonization (Greim et al. 2020). The volume of extraction is not a given but a result of political and economic choices. Key among them is Global North lithium onshoring. Making sense of this policy shift requires understanding states' roles in shaping the global territoriality of extraction.

State agencies grant environmental and social permits, concessions for exploration and exploitation, subsidies for extraction (including energy, water, and transportation infrastructure), and, if the state is the resource owner, contracts with firms and the collection—and distribution—of rents (Bakker and Bridge 2008; Bridge 2014; Perreault 2020). Additionally, by regulating extraction and compensating communities, states mitigate capitalism's tendency to undermine its socionatural conditions (Gudynas 2016; O'Connor 1988, 23–34).

State agencies thus govern where extraction takes place. Geology is not destiny. As Klinger (2018) shows for REE, another "critical mineral," the territoriality of extraction is shaped by two forces in mutual tension: states seek to "externalize" socioenvironmental harm while "capturing the geopolitical benefits" of controlling "strategically vital elements." In combination, these objectives "[drive] production to the frontiers of empire, state, and capital" (Klinger 2018, 11). Capitalism's extractive frontiers are mobile. The lithium sector provides a clear illustration: in a world order marked by China's economic ascent, Global North policy makers prioritize the benefits of territorial control over those of offshoring.

States do not, of course, act in a vacuum. In recent decades, neoliberal policies have challenged the primacy of the state in raw materials sectors and empowered markets and firms to coordinate extraction (Bakker and Bridge 2008, 224–225; Perreault 2020, 231–232). Although the neoliberal turn validates Huber's (2021, 167) contention that profitability determines whether a particular resource is extracted, lithium onshoring cannot be explained by

2. https://twitter.com/sdmoores/status/1457332359485874178, last accessed April 13, 2022.

fiduciary obligation alone. Rather, it constitutes a public–private response to the co-constitutive dynamics of capital accumulation, geopolitical tensions, and socioenvironmental conflict.

Global North onshoring evinces parallels with resource nationalism in the Global South, particularly Latin America. Both paradigms reassert the state's role in extraction (Haslam and Heidrich 2016), a trend evident in the region's lithium sector (Barandiarán 2019, 388; Obaya 2021). Similarly, Global North onshoring uses state power to encourage and legitimate extraction and, in its ambition of supply chain dominance, echoes the developmentalism of resource nationalism. But rather than increasing the state share and equitable redistribution of resource rents, US and EU lithium policies subsidize and de-risk extractive projects to ensure profitability, while boosting their environmental and ethical credentials. Ultimately, Global North lithium onshoring evidences both the necessity and limits of state action in the context of a nascent green capitalism.

Methodology and Data

To identify and explain the understudied phenomenon of Global North lithium onshoring, I analyze data gathered from interviews (more than 100 conducted with corporate personnel, investors, market analysts, regulators, Indigenous and environmental activists, and NGO staff in Chile, the United States, the United Kingdom, the EU, and Australia); media (more than 2,000 news clippings coded); participant observation of four industry conventions; government and corporate documents (legislation, regulations, executive orders, press releases, investor relations communiques, and company websites); and fieldwork in Chile (Santiago and the Atacama Desert), the United States (Nevada), and the EU (Brussels). These sites capture a range of positions in the lithium sector and evidence the effects of onshoring policies. Chile's Atacama Desert contains almost half of global reserves and supplies about a quarter of the world's market (USGS 2022). The United States contains significant reserves (USGS 2022), but its one lithium mine in operation (Silver Peak Mine, Nevada) accounts for just 1 percent of global output (Blackmon 2021); the Trump and Biden administrations have aimed to expand domestic production. As a result, in Nevada alone, forty-seven lithium projects are currently at some level of exploration or development.[3] The EU accounts for a miniscule portion of the world's lithium (Portugal, the continent's top supplier, produces 1.6% of global output). But EU officials have prioritized expanding lithium mining, and projects are under development in Portugal, Spain, and Germany.

Multi-sited fieldwork is crucial to understanding Global North onshoring, which unfolds in the context of the global political economy of lithium of which it forms a constitutive part. For this reason, I treat the locales of this study

3. Nevada lithium projects map, compiled by Center for Biological Diversity, available at: https://www.google.com/maps/d/u/0/viewer?mid=1kq8TRUSMR97kg-XQ22kdQpE4lUT0Rj49&ll=39.063819831243%2C-116.9765662&z=7, last accessed April 13, 2022.

as *sites* of a macro-level *process* rather than *cases* to *compare*. The analytic and methodological challenge is to simultaneously "connect the dots" while keeping in view the overall shape that the dots form—in dynamic relation with one another and with the emergent macrostructure they compose (Mintz 1986, xiv–xx). Site selection is governed by different principles than case selection (Riofrancos 2021). Rather than selecting cases with the goal of maximizing variation on a dependent variable, I assume heterogeneity and interdependence among sites. I choose sites where the macroprocess in question is empirically observable, politically salient, and the subject of conflict—three criteria that provide leverage on the co-constitution of process and sites.

To explain lithium onshoring, I connect data and argument via process tracing attuned to situated actors' evolving understandings of the world around them (Glaeser 2011, 165–250). Here the process encompasses the chronological and multi-sited unfolding of lithium onshoring—evidenced by public policies, and public and private investment—and actors' motivations for those events, accessed via interviews, participant observation, media coverage, and documents.

The Security–Sustainability Nexus

Institutional and Ideological Roots of Critical Minerals Onshoring

In the United States, mineral stockpiling dates to the interwar period: the lead-up to World War II saw the first legislation to catalog and store "strategic and critical minerals" (Black 2018, 68–83; National Research Council 2008, 29–30). This policy shifted in 1951, when the Paley Commission recommended that, aside from minerals needed in a "military emergency," the nation rely on "lower-cost foreign sources for economic purposes" (Congressional Budget Office 1983, 9). Layered on this history is the 1970s "energy crisis." Although the causes of rising oil prices were myriad, the attribution to "dependency" on "foreign oil" became hegemonic (Huber 2013, 97–127). This narrative endured, inflecting President Obama's expansion of fracking under the banner of "energy independence" (Sica and Huber 2017, 338) and President Trump's "energy dominance." These legacies form the ideological groundwork for onshoring lithium. But they do not explain the motivation or timing of the US and EU governments' onshoring decisions. This development is particularly surprising in the EU, where, despite the body's origins in the regulation of and market-making for steel and coal, raw materials have long been a relatively neglected policy area (Šolar et al. 2012, 22).

On both sides of the Atlantic, 2008–2011 marked a turning point for the salience of raw materials and a rebooting of the "critical minerals" frame. The inflection had two causes. First, the global commodity boom (2000–2014) saw skyrocketing prices for raw materials, owing to China's rapid industrialization and that of other emerging economies. US and EU officials worried about access

to and cost of primary commodities—especially those required by new energy technologies (European Commission 2011; National Research Council 2008, ix–x, 57–61, 76–77; Šolar et al. 2012, 22). Geoeconomic anxiety transposed the threat of external dependency from petrostates to China, now seen as a competitor to incumbent powers. In 2008, following the global financial crisis, the EU Commission launched its Raw Materials Initiative and the National Academy of Sciences published *Minerals, Critical Minerals, and the US Economy*, with support from the USGS and the National Mining Association.

Exacerbating fears of mineral dependency were a second set of events centering on REE. Between 2000 and 2010, the Chinese government reformed its governance of REE, of which China provided 97 percent of global supply (Klinger 2018, 4). Responding to environmental and health crises in mining regions and policy makers' desire to upgrade to value-added refining and manufacturing, the central government reined in extraction and imposed export quotas (Klinger 2018, 128–143). Then, in September 2010, the Chinese military disrupted an REE shipment to Japan following a dispute in the contested waters between Taiwan and Okinawa. Although the disruption was relatively minor and unrelated to China's decade-long REE policy shift, the international press framed it as an "embargo," setting off a market panic. In response, Obama administration officials and members of Congress adopted "green nationalism" (Klinger 2018, 143–146), advocating for REE reshoring and recycling on the grounds that domestic sourcing is "environmentally superior" to Chinese imports—despite the fact that the Mountain Pass mine in California, which had previously accounted for more than half the world's REE supply, was shuttered partly for environmental contamination (US Department of Energy 2010, 6; Klinger 2018, 113–114; National Research Council 2008, 22–23, 40–41, 128–136).

These events set the stage for renewed attention to "critical minerals" and their centrality to the energy transition, taking the form of the US Department of Energy (DOE 2010) *US Critical Minerals Strategy* and the European Commission's (2011) first catalog of critical minerals. Although neither considered lithium to be "critical" yet, the DOE noted that "lithium is the only key material that shifts into a higher criticality category from the short to medium term" (DOE 2010, 99).

This observation proved prescient. In 2018 and 2020, the United States and EU added lithium to their critical mineral lists, citing its essential role in the energy transition and the threat of supply disruptions (European Commission 2020, 3; US Department of the Interior 2018). This trajectory intersected with the United States–China trade wars and the COVID-19 pandemic, which reinforced US and EU officials' desires to onshore supply chains. It also intersected with another trajectory, relevant to the private sector's embrace of onshoring. Since the end of the commodity boom, investment in mining has declined (S&P 2020), and two years of low lithium prices (2018–2020) reduced financing for new projects. Lithium firms were receptive to

government support that would attract investment—and downstream EV manufacturers embraced any policy to increase lithium supply as analysts warned of a shortage. Lobbying activity reflects these industry preferences: the Battery Materials and Technology Coalition advocates for "[tax] incentives, grants, loan guarantees and other federal policy supports" (Iaconangelo 2020), and the Zero Emissions Transportation Alliance favors policies to "promote production across the entire supply chain, from raw materials to manufacturing to battery recycling."[4]

From Security to Sustainability

The end of the Trump administration saw a flurry of executive, legislative, and agency activity around critical mineral security. In May 2019, Senator Lisa Murkowski introduced the American Mineral Security Act to "[reduce] the United States' dependence on foreign minerals." As she put it, "our reliance on China and other nations for critical minerals costs us jobs, weakens our economic competitiveness, and leaves us at a geopolitical disadvantage." Several of its provisions were incorporated into the 2020 Omnibus Appropriations Bill and the bipartisan 2021 Infrastructure Investment and Jobs Act (discussed later).[5] In September 2020, Trump issued Executive Order (EO) 13953, "Addressing the Threat to the Domestic Supply Chain from Reliance on Critical Minerals from Foreign Adversaries and Supporting Domestic Mining and Processing Industries."[6] The EO directed agencies to "accelerate the issuance of permits and the completion of projects." The DOE's Argonne Lab expanded its role in the battery supply chain, from awarding grants and prizes to lithium mining companies for R&D to establishing a battery recycling center (Kunz 2019).[7] This is green industrial policy: state and capital collaborating to secure the extractive inputs of renewable energy technologies.

President Biden ramped up these efforts. His administration linked Trump's geoeconomic framing with climate imperatives and ushered in an interagency push to onshore the lithium battery supply chain. Biden signed the "Executive Order on America's Supply Chains," requiring a 100-day review of supply chains for four "critical and essential goods"[8] —two of which were

4. ZETA Policy Platform, available at: https://www.zeta2030.org/policy-platform#manufacturing, last accessed April 13, 2022.
5. For a quote, see https://www.energy.senate.gov/2019/5/murkowski-manchin-colleagues-introduce-bipartisan, last accessed April 13, 2022.
6. See https://www.federalregister.gov/documents/2020/10/05/2020-22064/addressing-the-threat-to-the-domestic-supply-chain-from-reliance-on-critical-minerals-from-foreign, last accessed April 13, 2022.
7. "Albemarle Selected by U.S. Department of Energy for Lithium Research Projects," https://www.prnewswire.com/news-releases/albemarle-selected-by-us-department-of-energy-for-lithium-research-projects-301123271.html, last accessed April 13, 2022.
8. "Executive Order on America's Supply Chains," https://www.whitehouse.gov/briefing-room/presidential-actions/2021/02/24/executive-order-on-americas-supply-chains/, last accessed April 13, 2022.

"high-capacity batteries, including electric-vehicles," and "critical minerals and other identified strategic minerals."[9] The resulting report dedicated nearly half of its 250 pages to these sectors (White House 2021). The document evidenced the decade-long policy process that defined "critical minerals" in geoeconomic terms: "More secure and resilient supply chains are essential for our national security, our economic security, and our technological leadership," and thus "we cannot afford to be agnostic to where [clean energy] technologies are manufactured and where the associated supply chains and inputs originate" (White House 2021, 6–8).

The executive and legislative branches soon began implementing the recommendation to onshore lithium under the banners of security and sustainability. Argonne was again a key institution. Working with the multinational lithium company SQM, it published a life cycle analysis comparing the sustainability of different methods of lithium extraction (Hansard 2021)—buoying the green credentials of a firm under environmentalist and Indigenous pressure for its operations in Chile. The lab also launched a public–private alliance, Li-Bridge ("the first collaboration of its kind in the U.S. battery industry"), to "[accelerate] the development of a robust and secure domestic supply chain for lithium-based batteries" (Burmahl 2021). Simultaneously, the DOE announced $209 million in funding to fill gaps in the domestic lithium battery supply chain.[10] The Infrastructure Investment and Jobs Act allotted $6 billion (of $550 billion) to lithium battery–related investments.[11] The bill funds USGS to map "critical minerals" linked to green technologies;[12] encourages critical minerals onshoring by requiring federal permitting processes be completed "with maximum efficiency and effectiveness";[13] and establishes grants, prizes, and federal programs to incentivize battery recycling and materials recovery as a means to "supply chain resiliency," to "[make] better use of domestic resources; and … [to eliminate] national reliance on minerals and mineral materials that are subject to supply disruptions."[14]

These policies reflect an ideological consensus spanning the political spectrum: onshoring is the route to critical mineral security and sustainability. Francis Fannon, Trump's appointee to assistant secretary of the Bureau of Energy Resources in the State Department, animated this consensus at

9. "FACT SHEET: Securing America's Critical Supply Chains," https://www.whitehouse.gov/briefing-room/statements-releases/2021/02/24/fact-sheet-securing-americas-critical-supply-chains/, last accessed April 13, 2022.
10. "26 Projects and Partnership with Argonne Lab Will Advance the Development of Lithium Batteries and Bridge Existing Gaps in Domestic Battery Supply Chain," https://www.energy.gov/articles/doe-announces-209-million-electric-vehicles-battery-research, last accessed April 13, 2022.
11. H.R.3684, available at: https://www.congress.gov/bill/117th-congress/house-bill/3684/text, last accessed April 13, 2022.
12. Secs. 40201, 40204.
13. Sec. 40206.
14. Secs. 40207, 40208, 40210.

Benchmark Mineral's EV Fest in May 2020.[15] He noted the "serious issues" plaguing extractive sectors linked to the energy transition: human rights abuses, environmental degradation, and political corruption. He worried that these threatened a fledging EV market, potentially "[staining] a whole industry." Fannon saw the United States playing a key role in improving the industry's sustainable credentials via the country's "long earned history of responsible mineral development" and relationships with "responsible" country partners.

During her confirmation hearing, Jennifer Granholm, Biden's appointee for DOE secretary, shared Fannon's sentiment: "If we allow for China to corner the market on lithium or for the Democratic Republic of Congo to be the place where everybody gets cobalt when there may be child labor or human rights violations associated with that supply, then we are missing a massive opportunity for our own security but also for our market" (Dillon and Clark 2021). Once confirmed, she applied this logic to lithium, hosting the "US Department of Energy Roundtable: A National Lithium Battery Blueprint" (pegged to the aforementioned report).[16] As she stated there, "China is the only country with control over every tier of the supply chain for critical materials including lithium and 80% of raw material refining capacity—and here again the US has virtually none. And if we remain reliant on imports, we just simply will not be able to compete in the global market for clean energy technologies." Despite tensions between onshoring and the incentives governing global capital (discussed later), industry participants welcomed Biden's onshoring paradigm. As J. B. Straubel, cofounder of Tesla before starting the battery recycling outfit Redwood Materials, put it, "we have a pretty challenging supply chain problem in front of us and not only is it a national competitiveness issue, it's a national security issue. But this is really an economic issue and an environmental issue as well." For Straubel, recycling secures supply chains, protects the national interest, and improves EV's environmental profile. Mining executives concurred. Glenn Merfield, vice president and CTO of Albemarle (which operates the United States' lone lithium mine, in addition to overseas assets), interwove security and sustainability—without losing focus on the bottom line. He advocated for the United States "fully [utilizing]" its lithium resources in a "cost [competitive]" and "sustainable manner." Along with domestic mining, recycling would keep lithium "within the circular economy in the US."

Whether through onshoring or recycling, reducing "dependency" on other countries—especially particularly worrying foreign powers—has become paramount. As the House of Representatives' Energy Subcommittee and the Environment and Climate Change Subcommittee warned ahead of a joint hearing titled "Securing America's Future: Supply Chain Solutions for a Clean Energy

15. EV Fest, May 2020, https://www.benchmarkminerals.com/events/ev-festival/, last accessed April 13, 2022.
16. "US Department of Energy Roundtable: A National Lithium Battery Blueprint," June 2021, available at: https://www.youtube.com/watch?v=LM8DUnQxQa8, last accessed April 13, 2022.

Economy," "in some cases, the United States is almost entirely dependent on countries, like China, that have developed supply chain strongholds. Developing or relocating parts of these supply chains to the United States could reduce reliance on other countries, including those with deficient human rights protections or environmental standards" (Holzman 2021). This discourse circulates subnationally, among officials tasked with lithium governance. Mark Visher, administrator of Nevada's Division of Minerals, framed lithium sourcing as an ethical choice: "Where do you want them to come from? From a place where it's highly regulated, or from a third world country where nobody's paying attention? And what's more environmentally responsible for the world?" (Dentzer 2021).

Despite the seeming shift away from neoliberal globalization and the pursuit of low-cost inputs, domestic extraction has an economic logic: US and EU policy makers see sustainable and ethical production as "the West's" last hope to resume its manufacturing prowess—the one terrain on which its manufacturers can outperform China. According to interviews at a prominent commodity analytics firm, the "sustainability agenda" justifies a supply chain diversification away from China *and* claims an axis of competition along which the United States and EU can prevail: "there was a period where the EU and US tried to go toe to toe with China economically, and it didn't work. … What can we target? Sustainability."[17]

The security–sustainability paradigm is particularly advanced in the EU. To onshore battery supply chains, and subject them to sustainability standards, the European Commission established the EU Battery Alliance (in 2017) and the EU Raw Materials Alliance (ERMA; in 2020). Both take a multistakeholder approach—albeit with an outsized role for corporations—and channel public funds to private entities. In 2019 and 2021, the Battery Alliance approved its first tranches of member state funding: over $7 billion to build out the battery supply chain, including raw material extraction and processing, and over a billion dollars from the R&D fund Horizon Europe.[18] It announced new roles for the European Investment Bank: "de-[risking] raw materials projects" and, with private funds, closing the "estimated financial gap [in raw materials investment] of 15 billion euros by 2025." ERMA aims to boost the regional supply of "critical minerals," including lithium. In launching ERMA, commissioner Thierry Breton declared the ambitious goal of the EU becoming "self-sufficient in lithium for our batteries" by 2025 (Willuhn 2020). To this end, the EU has directly invested in the pilot stages of lithium mines (via the fund EIT InnoEnergy) in Spain, Germany, Portugal, and the Czech Republic.[19]

17. Interviews, analysts at Roskill, London, February 23, March 4, and March 11, 2021.
18. For the first figure, I combined sums as reported in https://www.greencarcongress.com/2021/02/20210207-eubatin.html and https://www.greencarcongress.com/2019/12/20191210-ec.html, last accessed April 13, 2022. For the second, see https://ec.europa.eu/commission/presscorner/detail/en/speech_21_1142, last accessed April 13, 2022.
19. See https://www.spglobal.com/platts/en/market-insights/latest-news/metals/061820-infinity-lithium-secures-eu-backing-for-spanish-project, last accessed April 13, 2022; https://www

The apotheosis of the security–sustainability nexus is the EU Commission's Sustainable Battery Regulation, pending parliamentary ratification. Aligning with commitments to a circular economy and the Green Deal, the regulation requires batteries be manufactured with increasing levels of recycled content and with carbon footprint labels; eventually, batteries will be subjected to life cycle emissions targets. These environmental goals have a geoeconomic logic. As the regulation states, "this [critical raw materials] is an area where Europe needs to enhance its strategic autonomy and increase its resilience in preparation for potential disruptions in supply due to health or other crises. Enhancing circularity and resource efficiency with increased recycling and recovery of those raw materials, will contribute to reaching that goal" (EU Commission 2020, clause 19). Alongside onshoring, circular economy approaches reduce "environmental and social impacts" and "Union dependency on materials from third countries." It is worth noting, however, that when tensions between security and sustainability emerge, security is prioritized: in the event of supply risks, the Commission can "[amend] the targets for the minimum share of recycled" battery materials (EU Commission 2020, clause 21).

These themes appear in the discourse of top officials. According to Maroš Šefčovič, the Commission's vice president for inter-institutional relations, "this ambitious framework on transparent and ethical sourcing of raw materials, carbon-footprint of batteries, and recycling is an essential element to achieve open strategic autonomy in this critical sector and accelerate our work under the European Battery Alliance."[20] In announcing the EU–Canada Strategic Partnership on Raw Materials, Commission president Ursula von der Leyen stated, "We, as Europeans, want to diversify our inputs away from producers like China because we want more sustainability, we want less environmental damage, and we want transparency on labor conditions" (Aarup 2021). The words *security* and *sustainability* recur throughout the partnership text.[21]

Interviews with EU officials offer additional insight. I spoke to Peter Handley, head of the EU Commission's Raw Materials Unit, in December 2019.[22] One month before the first reported case of COVID-19 in Europe, Handley was already worried about global turbulence and saw onshoring lithium as the solution. He ticked off the causes of onshoring—solar trade wars, volatile lithium markets, and the instability roiling Latin American exporters

.thinkgeoenergy.com/vulcan-secures-agreement-on-help-launching-geothermal-lithium-project/, last accessed April 13, 2022; https://www.innoenergy.com/news-events/the-business-investment-platform-closes-agreement-to-support-savannah-resources/, last accessed April 13, 2022; https://www.mining.com/lithium-projects-key-to-the-race-to-secure-strategic-materials-report/, last accessed April 13, 2022.

20. "Green Deal: Sustainable Batteries for a Circular and Climate Neutral Economy," available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2312, last accessed April 13, 2022.
21. "European Union-Canada Summit—Joint Statement," available at: https://www.consilium.europa.eu/media/50757/20210614-joint-statement-final.pdf, last accessed May 4, 2022.
22. Interview, Peter Handley, Brussels, December 11, 2019.

("Chile or Bolivia, one day it's the most reliable supplier, next day in chaos")—and tempting advantages: investment, jobs, and "sovereignty." The downsides of not acting were stark: "There is a risk that we will lose our whole value chain … with massive economic consequences." Handley expertly wove together security and economy; this was geoeconomics in action. He wove in a third concept: *sustainability*. Europe, he noted, could not compete with Asian-made lithium batteries on cost. But, he asserted, Europe can be "greener than the competition," especially in terms of sourcing materials like lithium. He imagined a future in which Europe self-supplies a quarter of its demand for all battery minerals, extracted and refined under EU standards, and imports the rest under equally strict protocols—all while increasing recycled feedstock. Handley's colleagues concurred. As Joanna Szychowska (head of the EU Commission's Automotive and Mobility Industries Unit) told me, the impetus to onshore supply chains is "as much an economic project as political."[23] Onshoring supply chains enables "control": "the longer the value chain is, and the more distant a specific segment, the less control you have"—especially over the "sustainable sourcing" of raw materials like lithium.

Andreas Klossek, director of EIT's RawMaterial Community, elaborated how sustainable sourcing would give European companies a competitive edge: "We [the EIT] need to promote companies that are behaving sustainably, showcase them, show a success story … if you have a champion in sustainable sourcing and gets a value for this, enjoys a premium on prices for its products, then you will see followers. That's where Europe needs to be at the forefront."[24] He saw sustainable sourcing occurring through a mix of private "entrepreneurship" (reinforced by competition) and EU regulations—though he worried about the possibility that new rules might "hamper" the global competitiveness of European companies. One year after these interviews, the EU Commission promulgated the Sustainable Battery Regulation. Sustainability, once the mantra of nature-loving utopians, is now a vital source of profitability and a strategic bulwark against geoeconomic threats.

Tensions on the Horizon

Corporate representatives have embraced the security–sustainability paradigm. Take the example of Thacker Pass, a claystone project that aims to be the second lithium mine on US soil. The project is owned by Lithium Nevada, a subsidiary of Canada-based Lithium Americas, which is also developing a project in Argentina. In January 2021, the Bureau of Land Management (2021) granted Thacker Pass a "record of decision," approving the company's Environmental Impact Assessment. Echoing the critical minerals consensus, Lithium Americas president and CEO, Jon Evans, told reporters, "Thacker Pass has the potential to

23. Interview, Joanna Szychowska, Brussels, December 10, 2019.
24. Interview, Andreas Klossek, Brussels, December 11, 2019.

provide … lithium chemicals critical for establishing a strong domestic lithium supply chain."[25] Security rhetoric is complemented with sustainability. Alexi Zawadski, president of the company's North American operations, favorably compared Thacker Pass with South American brine deposits—which activists have targeted for their impact on water—noting, "We recycle a lot of our water. We actually generate carbon-free energy from our process, and we'll have an excess that we'll sell to the grid."[26] Perhaps the clearest corporate articulation of the security–sustainability nexus appears in an Atlantic Council report on minerals in transportation electrification, funded by the National Mining Association (Blakemore 2021). A section titled "Supply Chain Security and Sustainability" highlights the US mining sector's role in provisioning reliable and responsible minerals to the EV industry and lauds the Biden administration's focus on the domestic supply chain—especially its commitment to "streamline" permitting and "manage risk" for firms and investors (Blakemore 2021, 14–16).

This public–private alliance, however, is beset by tensions. US and EU officials hope to square the circle, betting customers will pay a premium for green and ethical supply chains. More important, however, are subsidies and de-risking that mitigate the costs of sustainability requirements (most notably in the EU) and of Global North operations. But these corporate-friendly policies do not resolve the contradictions between economic efficiency and environmental sustainability, or between hawkish industrial policy and globe-trotting capital. As I learned in interviews and observation of industry conventions, auto, mining, and recycling managers and executives welcomed government support but warned of the difficulty of decoupling from China.[27] Regulation is another sticking point: these personnel were skeptical about new environmental rules, instead professing that the profit motive and competition would spur adoption of sustainable practices.[28]

Concern about the regulatory dimension of green industrial policy manifests in the corporate response to the EU's Sustainable Battery Regulation. The auto industry, the most powerful sector affected by the regulation, rhetorically embraces its sustainability goals while lobbying to dilute them. In the European Automobile Manufacturers' Association's (representing the sixteen major Europe-based automobile manufacturers) position paper , the first "Key Message" is that "batteries must become sustainable, high-performing and safe"—a direct, albeit unattributed, quote from the EU Commission's press release on the regulation (European Automobile Manufacturers' Association

25. "Lithium Americas' Thacker Pass Closer to Production," available at: https://www.mining.com/lithium-americas-thacker-pass-moves-closer-to-production/, last accessed April 13, 2022.
26. "Nevada's 'Lithium Valley' Could Provide Domestic Supply for Tesla Batteries," available at: https://insideevs.com/news/419466/tesla-nevada-lithium-supply-potential/, last accessed April 13, 2022.
27. Interview, Auto Manufacturer Supply Department manager, September 1, 2021; interview, Redwood Materials representative, September 20, 2021.
28. Ryan Melsert, CEO of American Battery Metals, Lithium Supply and Markets convention, Las Vegas, NV, September 20, 2021.

[ACEA] 2021, 1).[29] But subsequent messages warn of regulatory overreach that "hinder[s] innovation as it would slow down the electrification process, thereby jeopardising the EU climate targets" (ACEA 2021, 1). This framing protects the industry's interests *and* positions the sector as a climate savior. As I was told by Michael Reckordt of the Berlin-based NGO PowerShift, the auto industry is "trying to weaken the regulation," acting in concert to go at the "speed of the slowest."[30] They are particularly worried about "liabilities": while open to standards that create a "level playing field" among competitors, they oppose binding enforcement and legal accountability (they want, in Reckordt's words, "a tiger without teeth—or sharp teeth"), which increase costs. These observations were confirmed in interviews with EU-based auto firms; one procurement manager commented that the materials tracing envisioned by the sustainability regulation is "very ambitious" and "very expensive to carmakers."[31] However, the manager also noted that the industry is not monolithic: some firms already subject their raw materials to "sustainability" standards. These tend to be lead firms that can absorb the cost of implementation because they benefit from economies of scale and leverage over their suppliers, allowing them to externalize the costs of "green capital accumulation" onto upstream companies (Ponte 2020).

These corporate responses reveal the contradictions inhering within the security–sustainability nexus and the heterogeneity of interests, power, and profitability along battery supply chains. Ultimately, the affinities as well as the tensions between state and corporate strategy make clear that powerful decision makers are operating in a state of flux and contingency. The choices they make will shape the trajectory to come—encoding power relations into the extractive materiality of the energy transition.

Conclusions

Under the rubric of the security–sustainability nexus, Global North governments and multinational mining and auto companies are promoting lithium onshoring, thereby transforming the sector's economic and political geography. Policy makers are redrawing the lithium frontier through a novel policy framework combining corporate-friendly industrial policy—subsidies, public investment, regulatory fast-tracking, and supply chain coordination—with an emphasis on sustainable sourcing: statutory incentives for battery recycling and recovery in the United States and the EU's pending Sustainable Battery Regulation. For policy makers and corporate executives, "secure" lithium is "sustainable" lithium, and vice versa. With this two-pronged approach, an elite alliance seeks green industrial prowess in direct competition with China.

29. https://ec.europa.eu/commission/presscorner/detail/en/ip_20_2312, last accessed April 13, 2022.
30. Interview, Michael Reckordt, May 20, 2021.
31. Interview, Auto Manufacturer Supply Department manager, September 1, 2021.

It is too soon to tell whether the competing objectives of national security, environmental sustainability, and corporate profitability will coexist in an equilibrium or whether one will prevail over the others. Key in determining the outcome of this dynamic process is a force thus far neglected in this article: social movements. Global North onshoring has shifted the front lines of lithium extraction. As the sector expands, Indigenous and environmentalist protest erupts in major exporting countries like Chile and Argentina alongside new sites in Spain, Portugal, Serbia, and the United States. These activists act in transnational coordination, via networks such as Yes to Life, No to Mining and Earthwork's Making Clean Energy Clean, Just and Equitable campaign. Their efforts reflect shared realities: from Chile's Atacama Desert to the western United States to northern Portugal, activists decry impacts on water, ecosystems, and livelihoods and call for the enforcement of community consent. To the dismay of governments and firms, movements have complicated onshoring, whether by slowing down the permitting process or by stalling projects altogether.

Conflicts over the material foundations of the energy transition are reshaping the inequalities linked to extractive sectors. For centuries, unequal ecological exchange between Global North and South has structured the geography of extraction—and is evidenced in today's "green sacrifice zones" on the peripheries of the world system (Zografos and Robbins 2020). However, as the literature on environmental justice makes clear, toxic harms also afflict marginalized communities within the Global North (Mohai et al. 2009). The emerging map and sheer volume of planetary extraction will intensify unequal ecological exchange at multiple scales: *within* Global North countries, where policy makers seek to expand domestic extraction; *between* the Global North and South; and in territories that defy easy classification in either supranational category, such as between China's resource hinterlands and its industrial centers or between China and low-income countries. These developments call for an interdisciplinary research agenda on the emerging geographies, geopolitics, and political economy of the energy transition.

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