

GLOBAL STATE OF *Sustainable* ELECTRIC VEHICLE BATTERIES

Key Recent Accomplishments and Priority Actions for 2023

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Issue Brief



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OVERVIEW

2022 was a pivotal year of both opportunity and continued risk for the sustainability of the global electric vehicle (EV) battery supply chain. Countries in key markets are elevating their transportation electrification ambitions while also taking steps towards centering environmental protection and human rights in the supply chain. Yet more work is needed to ensure that parties are held to consistently high standards worldwide. Throughout 2022, UC Berkeley's Center for Law, Energy & the Environment (CLEE), along with ClimateWorks, has conducted outreach to a variety of organizations active in EV battery supply chain sustainability efforts—including human rights and transportation electrification advocates—about recent successes and ongoing challenges. This brief summarizes central themes from 2022 and previews future actions that can advance a just and sustainable battery supply chain.

As the electric vehicle industry expands to meet the need for decarbonized transportation, there is a pressing need for a more sustainable supply chain, from mining reforms to increased material recycling and reuse. This issue brief identifies key battery supply chain developments from 2022 and forecasts priority actions for 2023.

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SUMMARY OF 2022 PIVOTAL DEVELOPMENTS

Key developments in 2022 centered around inadequate mining safeguards, changing economic conditions, and policy developments in the U.S. and Europe with global ramifications.

Increased mining will require more stringent safeguards

As the global push towards electrification accelerates, more mining is required to supply an increasing demand for batteries and their component materials. The International Energy Agency (IEA) projects that demand for lithium, graphite, cobalt, and nickel will increase substantially for battery storage and EV use by 2040 (over 40 times in the IEA Sustainable Development Scenario for lithium and 20-25 times for the other minerals).¹ The World Bank estimates that demand for these materials will increase by nearly 500 percent by 2050 to meet demands for low-carbon energy technologies.² However, the exact increase in demand for materials will depend in part on progress in minerals recycling and recovery, as well as demand reductions from improved land use and increased transit and mobility options, such as electric buses or e-bikes.³

Even if mineral recycling and reuse increases substantially, meeting this growing demand will require additional mining activity,⁴ which could generate negative impacts for communities and the surrounding environment, depending on the stringency of laws and regulations and their enforcement. Additionally, some analysts and advocates noted ongoing concerns about corruption and governance issues in the context of increased mining activity, and advocates generally urged more consistency in mining standards that uplift human rights and environmental protection. They also called for greater adherence to the practice of Free, Prior, and Informed Consent of indigenous communities,⁵ which enables communities to participate fully in consultation and decision-making processes and ensures self-determination.⁶

In addition to mandatory laws and regulations, governments and companies throughout the battery supply chain could consider adopting voluntary mechanisms to set more stringent standards and apply practices consistently, perhaps by using a widely accepted standard like the Initiative for Responsible Mining Assurance (IRMA).⁷ The European Union's recent battery law, which references IRMA, represents a potential example of supply chain sustainability policy for other nations to follow.⁸

Mining law reform is another pathway for reducing harmful impacts for communities and the natural environment. For example, a number of advocacy organizations participated in conversations about reforming the U.S. Mining Law of 1872, which is over 150 years old and remains the primary U.S. federal law governing prospecting and mining. They instead supported the Clean Energy Minerals Reform Act to advance mining reforms.⁹ Although the Act ultimately did not succeed in Congress, it elevated long overdue conversations about the impacts of existing mining law and opportunities for improvement. Meanwhile, the Interagency Working Group (IWG) on Mining Law Reform continued to work on reforming hardrock mining laws, regulations, and permitting policies under a set of "Fundamental Principles for Domestic Mining Reform."¹⁰

Circular economy practices can reduce the demand for new mining by providing battery manufacturers a greater source of inputs from recycled or reused materials, and policy makers could incentivize or require manufacturers to source these materials. Policy makers could further reduce demand for minerals by promoting sustainable mobility, transit options, and land use that reduces the need for traveling long distances.¹¹ Policy makers also will need to increase investment in processing facilities and programs, including incentives that encourage recycling and reuse (or discontinuation of subsidies for new extraction), as many countries lack adequate capacity to process materials. Some advocates noted that policy makers could target

different supply chain points (e.g., mining, processing) according to what works best in a particular context or location.

Changing economic conditions disrupted prices and the supply chain

The war in Ukraine, ongoing COVID-19 pandemic impacts, and supply chain constraints led to high costs and material shortages in 2022.¹² The war in Ukraine drove up nickel prices and raised costs for EV battery manufacturers, and some advocates noted that the war negatively impacted efforts to secure better nickel practices.¹³ Organizations will continue to monitor geopolitical, economic, and supply chain factors to determine the long-term effects on the battery supply chain.

Countries are also searching for opportunities to retain more of the supply chain within their own borders. For example, Zambia and the Democratic Republic of Congo (DRC) signed a joint cooperation agreement to bolster battery manufacturing within their countries, which have abundant mineral resources for EV batteries.¹⁴ In August 2022, the Inflation Reduction Act (IRA) was signed into law in the United States and included EV provisions that incentivize supply chain activities within North America and set a framework for retaining as many jobs and economic benefits as possible within the region.

Mineral-producing countries are positioning themselves strategically in the rapidly changing EV battery supply chain. Indonesia has banned exports of commodities like nickel to incentivize development of downstream industries like EV battery component manufacturing within the country.¹⁵ Indonesia is also seeking opportunities to produce the higher-quality nickel required for EV batteries.¹⁶

Yet unless reforms occur in many of these countries, the enhanced supply chain can exacerbate existing environmental harms. For example, in 2022, Tesla announced plans to purchase \$5 billion of Indonesian nickel supply for battery manufacturing,¹⁷ despite environmental and carbon intensity concerns arising from Indonesia's mining processes (although in early 2023 Indonesia announced plans to power more smelters with energy sources other than coal).¹⁸ In response, a group of international environmental organizations signed a letter to the company expressing concern about environmental damage and harm to vulnerable groups and indigenous communities stemming from the Indonesian nickel industry.¹⁹

New policy in the U.S. and E.U. gathered global attention

The IRA, signed by President Biden in August 2022, represents the largest clean energy and climate investment ever made by the U.S. government.²⁰ The law expands manufacturing and production tax credits to cover activities throughout the EV battery supply chain, including critical minerals mining and production, processing, refining, and recycling. It also introduces domestic content requirements for EV batteries by requiring that certain amounts of material are extracted or processed in the U.S. or a country with which the U.S. has a free trade agreement, or are recycled in North America.^{21,22} While the U.S. is seeking to secure economic benefits, other countries have expressed concern about the potential disruptions that these requirements will create for the global EV and EV battery supply chains.

Moving more of the EV supply chain to the U.S. underscores the need for domestic mining reform. As previously noted, existing U.S. mineral law dates back to 1872, so some groups have expressed concern that an increase in mining activity in the U.S. as a result of IRA provisions will increase negative environmental and social impacts, including on indigenous communities. Similarly, the IRA's production tax credit for mining and its battery mineral sourcing requirements place greater emphasis on U.S. domestic mining, while also bolstering a domestic circular economy. Some advocates have noted that this combination could exacerbate negative impacts without more stringent and targeted U.S. mining and material processing reforms and efforts to reduce new mineral extraction by promoting reuse.

The 2021 Bipartisan Infrastructure Law also made headlines in 2022 as U.S. federal agencies announced details about programs that implement funds across several EV battery supply chain activities. For example, the U.S. Department of Energy (DOE) awarded funding to 10 projects that advance battery recycling and reuse.²³ DOE also received \$2.8 billion to allocate to companies that “build and expand commercial-scale facilities in 12 states to extract and process lithium, graphite and other battery materials, manufacture components, and demonstrate new approaches, including manufacturing components from recycled materials.”²⁴

The European Union is advancing its EV battery law towards final implementation after reaching a provisional agreement in December 2022.²⁵ The new regulation focuses on battery sustainability throughout the full lifecycle of the battery, including through recycling and content requirements, demonstration of responsible sourcing, and consideration of a battery's carbon footprint.²⁶ The law establishes varying rates of material recovery for cobalt, lead, nickel, copper, and lithium, and increases the stringency of the requirement over time. Additionally, the law introduces information-sharing requirements for companies, such as on the source of materials within the battery, as well as battery labeling requirements. The circular economy focus of the E.U. regulation sets an example for other countries and blends the priorities of industry and advocacy groups.

While these policies are centered in the U.S. and the E.U., the protectionist trend of major markets keeping more economic activity within their own borders is expected to have far-reaching impacts on countries throughout the supply chain. For example, countries like Indonesia that host EV battery manufacturing but do not share a trade agreement with the U.S. are at a disadvantage in terms of accessing the U.S. market.

2023 DECISION POINTS

Looking ahead to the remainder of 2023 and beyond, CLEE has identified a number of key decision points where organizations' collective efforts could potentially influence outcomes. Examples include:

- The E.U. battery policy is expected to go into effect in summer 2023. Companies will have a 24-month implementation period before they are expected to meet full compliance. Key decision points in the coming year will center on how the law is implemented and how companies prepare for new actions required by the law. In March 2023, the E.U. proposed two new laws to improve its clean technology supply chain—the Net-Zero Industry Act and the Critical Raw Minerals Act. The Net-Zero Industry Act seeks to create conditions for investment in clean technology manufacturing and

production by reviewing permitting requirements, encouraging innovation and job training, establishing objectives that enhance certainty for investors, and focusing on demand-side mechanisms, among other measures.²⁷ The Critical Raw Minerals Act aims to secure the supply of materials necessary for clean technologies and EV batteries, among many other end uses, by reducing Europe’s reliance on imports, boosting the European supply chain for minerals and their processing, “improv[ing] the E.U. capacity to monitor and mitigate current and future risks of disruptions to the supply of critical raw minerals,” and “ensur[ing] the free movement of critical raw materials on the single market while ensuring a high level of environmental protection by improving their circularity and sustainability.”²⁸ Conversations throughout the coming months will shape how these proposed regulations evolve.

- In the U.S., IRA implementation efforts continue to take shape as federal agencies issue new programs, funding announcements, and loan and grant opportunities. For example, DOE announced a conditional commitment to loan \$375 million to Li-Cycle, a lithium-ion battery recycling and recovery company, to support its contributions to a more circular battery supply chain.²⁹ Actions like this one will shape how the market for materials recycling and reuse—as well as the broader EV battery manufacturing market—evolves. However, groups remain concerned about some IRA funds supporting companies that are unwilling to commit to due diligence, standard setting, or compliance checks. The federal government is expected to release additional guidance on tax credit eligibility soon, and the guidance may make certain European battery components eligible for the tax credit.
- 2023 will be a crucial year for global conversation on mining and processing practices as more countries expand resource extraction efforts, implement fast-track measures to expedite permitting procedures, and position themselves for participation in the growing global battery market. Actions taken by countries, advocacy groups, and corporate entities this year could influence supply chain sustainability, environmental impacts, human rights, and governance and corruption outcomes for years to come.³⁰

In addition to these examples, reformers in major mineral-producing countries will continue the work of advancing sustainability in all aspects of the supply chain. Building on the momentum of the past year, progress in 2023 will ultimately be determined by these and other leaders within countries, companies, and advocacy organizations, among other stakeholders, who seek to advance the most effective policies to ensure the sustainability of the EV battery supply chain.

ENDNOTES

All URLs last accessed March 28, 2023

- 1 International Energy Agency, *The Role of Critical Minerals in Clean Energy Transitions*, (2021), available at <https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary>.
- 2 World Bank, *Minerals for Climate Action – The Mineral Intensity of the Clean Energy Transition*, (August 2022), available at <https://pubdocs.worldbank.org/en/961711588875536384/Minerals-for-Climate-Action-The-Mineral-Intensity-of-the-Clean-Energy-Transition.pdf>.
- 3 Thea Riofrancos et al., *Achieving Zero Emissions with More Mobility and Less Mining*, (January 2023), available at <https://www.climateandcommunity.org/more-mobility-less-mining#:~:text=This%20report%20finds%20that%20the,batteries%2C%20and%20maximizing%20lithium%20recycling>.
- 4 See Elsa Dominish, Sven Teske and Nick Florin, *Responsible Minerals Sourcing for Renewable Energy*, Institute for Sustainable Futures, (2019), available at https://earthworks.org/wp-content/uploads/2019/04/Responsible-minerals-sourcing-for-renewable-energy-MCEC_UTS_Earthworks-Report.pdf, stating “[r]ecycling can significantly reduce primary demand, especially for batteries, however it cannot meet all demand,” thus, new mining is likely to meet demand in the short term until recycled metals are more widely available.
- 5 See Food and Agriculture Organization of the United Nations, *Free Prior and Informed Consent: An Indigenous Peoples’ Right and a Good Practice for Local Communities*, (2016), available at <https://www.fao.org/3/i6190e/i6190e.pdf>.
- 6 The United Nations Declaration on the Rights of Indigenous Peoples establishes a right to free, prior, and informed consent for actions that impact resources and lands. For more information, see the full text of the UN Declaration [here](#).
- 7 Initiative for Responsible Mining Assurance (webpage), available at <https://responsiblemining.net/>.
- 8 For full text of the E.U. battery law, see <https://data.consilium.europa.eu/doc/document/ST-5469-2023-INIT/en/pdf>
- 9 H.R. 7580 – 117th Congress (2021-2022): Clean Energy Minerals Reform Act of 2022, H.R. 7580, 117th Cong. (2022), available at <https://www.congress.gov/bill/117th-congress/house-bill/7580>.
- 10 U.S. Department of the Interior, “Interior Department Launches Interagency Working Group on Mining Reform,” (February 22, 2022), available at <https://www.doi.gov/pressreleases/interior-department-launches-interagency-working-group-mining-reform>; U.S. Department of the Interior, “Biden-Harris Administration Fundamental Principles for Domestic Mining Reform,” (February 22, 2022), available at <https://www.doi.gov/sites/doi.gov/files/biden-harris-administration-fundamental-principles-for-domestic-mining-reform.pdf>.
- 11 Thea Riofrancos et al., *Achieving Zero Emissions with More Mobility and Less Mining*, supra.
- 12 See, e.g., World Bank, “Russian Invasion of Ukraine Impedes Post-Pandemic Economic Recovery in Emerging Europe and Central Asia,” (October 4, 2022), available at <https://www.worldbank.org/en/news/press-release/2022/10/04/russian-invasion-of-ukraine-impedes-post-pandemic-economic-recovery-in-emerging-europe-and-central-asia>; Alfred Kammer et al., “How War in Ukraine is Reverberating Across the World’s Regions,” International Monetary Fund Blog, (March 15, 2022), available at <https://www.imf.org/en/Blogs/Articles/2022/03/15/blog-how-war-in-ukraine-is-reverberating-across-worlds-regions-031522>; KPMG, “Six Key Trends Impacting Global Supply Chains in 2022,” (March 2022), available at <https://kpmg.com/sg/en/home/insights/2022/03/six-key-trends-impacting-global-supply-chains-in-2022.html>.
- 13 Maddie Stone, “European Electric Car Makers Have a Russian Nickel Problem,” Grist, (April 22, 2022), available at <https://grist.org/international/european-electric-car-makers-have-a-russian-nickel-problem/>; Jack Farchy et al., “The 18 Minutes of Trading Chaos That Broke the Nickel Market,” Bloomberg, (March 13, 2022),

- available at <https://www.bloomberg.com/news/articles/2022-03-14/inside-nickel-s-short-squeeze-how-price-surges-halted-lme-trading>.
- 14 United Nations Economic Commission for Africa, “Trade ties: Zambia and DRC Sign Cooperation Agreement to Manufacture Electric Batteries, Create Jobs,” (May 2022), available at <https://www.un.org/africarenewal/magazine/may-2022/trade-ties-zambia-and-drc-sign-cooperation-agreement-manufacture-electric>.
 - 15 Indonesia Ministry of Investment, “Indonesia Economic Development Through Downstream Industries,” (2022), available at <https://www5.bkpm.go.id/en/publication/detail/news/indonesia-economic-development-through-downstream-industries>.
 - 16 Rodrigo Castillo et al., “Indonesia’s Electric Vehicle Batteries Dream Has a Dirty Nickel Problem,” Brookings, (September 21, 2019), available at <https://www.brookings.edu/blog/up-front/2022/09/21/indonesias-electric-vehicle-batteries-dream-has-a-dirty-nickel-problem/>.
 - 17 “Indonesia Says Tesla Strikes \$5 Billion Deal to Buy Nickel Products,” Reuters, (August 7, 2022), available at <https://www.reuters.com/business/autos-transportation/indonesia-says-tesla-strikes-5-blm-deal-buy-nickel-products-media-2022-08-08/>.
 - 18 “Indonesia Details Plans to Limit Development of Nickel Smelters – Report,” Reuters, (January 13, 2023), available at <https://www.reuters.com/markets/commodities/indonesia-details-plans-limit-development-nickel-smelters-report-2023-01-13/>.
 - 19 For full text of the letter sent to Tesla, see: https://foe.org/wp-content/uploads/2022/07/2022.07.25_Letter-to-Tesla-re-nickel-mining_WALHI.pdf
 - 20 U.S. Department of Energy – Loan Programs Office, “Inflation Reduction Act of 2022” (webpage), available at [https://www.energy.gov/lpo/inflation-reduction-act-2022#:~:text=The%20Inflation%20Reduction%20Act%20\(IRA,putting%20the%20United%20States%20on](https://www.energy.gov/lpo/inflation-reduction-act-2022#:~:text=The%20Inflation%20Reduction%20Act%20(IRA,putting%20the%20United%20States%20on).
 - 21 The battery component requirement (percentage of battery components that are manufactured or assembled in North America) scales from 50% before January 1, 2024 to 100% after December 31, 2028.
 - 22 Inflation Reduction Act, P.L. 117-169 (2022). Section 13401.
 - 23 U.S. Department of Energy, “Bipartisan Infrastructure Law (BIL) Electric Drive Vehicle Battery Recycling and Second Life Applications – FOA # DE-FOA-0002680,” (November 2022), available at <https://www.energy.gov/sites/default/files/2022-11/BIL%2040208%20Electric%20Drive%20Vehicle%20Battery%20Recycling%20and%20Second%20Use%20Selections%20Table.pdf>; U.S. Department of Energy – Vehicle Technologies Office, “Bipartisan Infrastructure Law: Battery Recycling and Second Life Applications Selections,” (November 16, 2022), available at <https://www.energy.gov/eere/vehicles/articles/bipartisan-infrastructure-law-battery-recycling-and-second-life-applications>.
 - 24 U.S. Department of Energy, “Biden-Harris Administration Awards \$2.8 Billion to Supercharge U.S. Manufacturing of Batteries for Electric Vehicles and Electric Grid,” (October 19, 2022), available at <https://www.energy.gov/articles/biden-harris-administration-awards-28-billion-supercharge-us-manufacturing-batteries>.
 - 25 European Commission, “Green Deal: EU Agrees New Law More Sustainable and Circular Batteries to Support EU’S Energy Transition and Competitive Industry,” (December 9, 2022), available at https://ec.europa.eu/commission/presscorner/detail/en/IP_22_7588.
 - 26 Council of the European Union, “Proposal for a Regulation of the European Parliament and of the Council Concerning Batteries and Waste Batteries, Repealing Directive 2006/66/EC and Amending Regulation (EU) No 2019/1020,” (2023), available at <https://data.consilium.europa.eu/doc/document/ST-5469-2023-INIT/en/pdf>.
 - 27 European Commission, “Proposal for a Regulation of the European Parliament and of the Council on Establishing a Framework of Measures for Strengthening Europe’s Net-Zero Technology Products Manufacturing Ecosystem (Net-Zero Industry Act)”, (2023), available at https://single-market-economy.ec.europa.eu/system/files/2023-03/COM_2023_161_1_EN_ACT_part1_v9.pdf.

- 28 European Commission, “Proposal for a Regulation of the European Parliament and of the Council, Establishing a Framework for Ensuring a Secure and Sustainable Supply of Critical Raw Materials and Amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724, and (EU) 2019/1020,” (2023), p.2 , available at https://single-market-economy.ec.europa.eu/system/files/2023-03/COM_2023_160_1_EN_ACT_part1_v7.pdf.
- 29 “Li-Cycle Receives Conditional Commitment for \$375 Million Loan from the U.S. Department of energy ATVM Program,” BusinessWire, (February 27, 2023), available at <https://www.businesswire.com/news/home/20230227005220/en/Li-Cycle-Receives-Conditional-Commitment-for-375-Million-Loan-from-the-U.S.-Department-of-Energy-ATVM-Program>.
- 30 For recommendations on corruption reform, see Natural Resource Governance Institute – Expert Group on Preventing Corruption in Transition Minerals, “Preventing Corruption in Energy Transition Mineral Supply Chains,” available at https://resourcegovernance.org/sites/default/files/documents/preventing_corruption_in_energy_transition_mineral_supply_chains.pdf.

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