

Recharge Responsibly

The Environmental and Social Footprint
of Mining Cobalt, Lithium, and Nickel for
Electric Vehicle Batteries

MARCH 2021



EARTHWORKS



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ABOUT EARTHWORKS

Earthworks is a nonprofit organization dedicated to protecting communities and the environment from the adverse impacts of mineral and energy development while promoting sustainable solutions. We work with communities and grassroots groups to reform government policies, improve corporate practices, influence investment decisions, and encourage responsible materials sourcing and consumption. We expose the health, environmental, economic, social, and cultural impacts of mining and energy extraction through work informed by sound science.

COVER PHOTOS AND DESIGN

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About This Report

This report is designed to inform downstream battery metal users of key environmental, social, and governance issues associated with the extraction and processing of the three battery metals of principal concern for the development of electric vehicles and low-carbon energy infrastructure—lithium, cobalt and nickel—and to offer guidance on responsible minerals sourcing practices. This report reflects and summarizes some of the key concerns of communities impacted by current and proposed mineral extraction in hotspots around the world: Argentina, Chile and the United States for lithium; Papua New Guinea, Indonesia and Russia for nickel; and the Democratic Republic of Congo for cobalt.



Clean Energy, Not Dirty Mining

The transition to a fully renewable energy system is necessary to keep global temperature rise below 1.5 degrees C and avert the most disastrous impacts of climate change. We are making steady progress: global annual investment in new renewable energy infrastructure is already double that of fossil fuels and nuclear and campaigns to transition away from fossil fuels are steadily changing the political landscape. But the lifecycle of these low-carbon technologies begins with mining for minerals, which generates toxic waste, violates human rights, pollutes freshwater, and threatens ocean health through the risky practices of submarine tailings disposal and deep sea mining. Metals mining is one of the world's dirtiest industries, responsible for 10 percent of global climate change impacts, according to the UN Environment Programme. In the United States, metals mining is the leading industrial polluter of air, land, and water.

It is critical that the clean energy economy not repeat the mistakes of the dirty fossil fuel economy that it is seeking to replace. The pivot from internal combustion engines towards electric vehicles provides an unprecedented opportunity to develop a shared commitment to responsible mineral sourcing. We can accelerate the renewable energy transition *and* drive improvements in the social and environmental performance of the mining industry by reducing overall demand for new minerals, increasing mineral recycling and reuse, and ensuring that mining only takes place if it meets high environmental, human rights and social standards.

Any company that fails to get ahead of this issue and demand responsibly-sourced minerals risks tarnishing its brand. This risk is particularly acute for electric vehicle and battery manufacturers, who stand to lose the reputational benefit tied to their climate-friendly products if the supply chain for those products are rooted in other sustainability issues. Consumers and investors increasingly demand products made with respect for the environment and high ethical standards, especially those early adopters making a step away from fossil fuels to purchase an electric vehicle. Companies powering the renewable energy transition have an opportunity to further strengthen their reputations by demanding the minerals used in their products are sourced responsibly.

The pivot from internal combustion engines towards electric vehicles provides an unprecedented opportunity, but the lifecycle of these low-carbon technologies begins with mining for minerals.

Electric vehicle charging station. Photo: Noel / Adobe Stock.

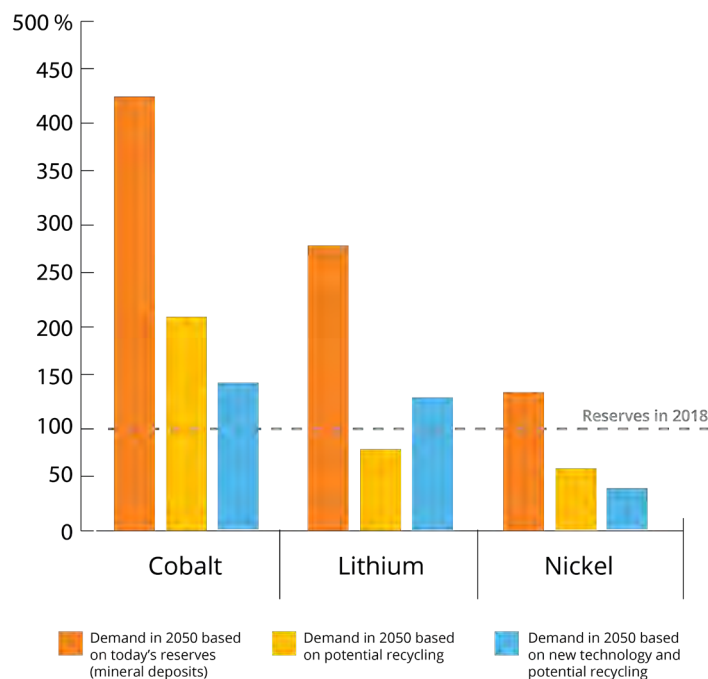


Battery Minerals for Clean Energy

This report pays special attention to battery minerals as a result of research commissioned by Earthworks from the Institute for Sustainable Futures at the University of Technology Sydney. This research indicates that of the minerals required for low-carbon energy infrastructure, lithium, cobalt, and nickel (used in a variety of lithium-ion battery chemistries for electric vehicles) are of principal concern.

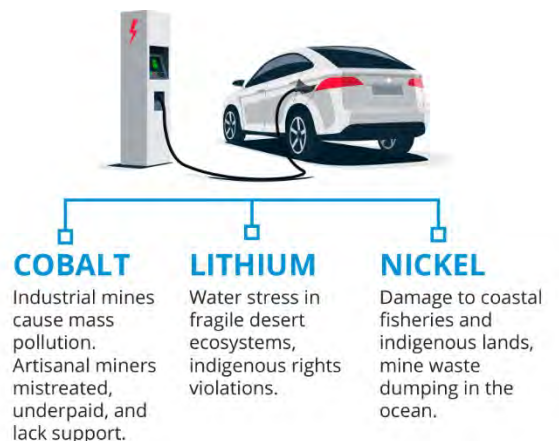
In a 100 percent renewable energy future, demand could reach 136 percent of the documented nickel deposits that are currently economically feasible to extract, 280 percent for lithium, and 426 percent for cobalt (see figure below). The skyrocketing demand for these minerals is driving the expansion of mining in geographic “hotspots” throughout the world, with disproportionately negative impacts in the Global South. Given the steep projected demand curve for these metals, intervention at an early stage in their development is necessary. The transition to EVs offers new opportunities for responsible sourcing through greater supply chain transparency, adherence to strict sourcing standards (notably the right of communities to say no to mining), and greater material circularity (see A Note on Recycling at the end of this document).

MINERAL DEMAND SCENARIOS FOR BATTERY MINERALS IN 2050. Percentage relative to reserves (mineral deposits). Assuming 100% renewable energy scenario.



Note: “new technology” accounts for material substitution and battery chemistry developments, which is why lithium figures increase substantially in that scenario, contrary to nickel and cobalt. Source: UTS-ISE.

KEY ISSUES ASSOCIATED WITH THREE BATTERY METALS WHICH MUST BE ADDRESSED



In Focus: Lithium

While there are several lithium extraction methods, two processes make up nearly all of current production: hardrock mining and evaporitic extraction from the brines below salt flats. Hardrock lithium mining in Western Australia is the largest source of production today, but the vast majority of the world's lithium deposits are found underneath the salt flats of Chile, Bolivia, and Argentina. Current operations, and a massive wave of exploratory work, are a source of disputes throughout this region. In the United States, particularly Nevada, several lithium projects at various stages of development are also the source of controversy and community concerns.

1 Chile

Two companies, SQM and Albemarle, are responsible for all of Chile's lithium production, and their operations in the Atacama salt flat have expanded significantly over the past four decades.

As global demand for lithium has increased, concerns about its environmental impacts have grown in Chile. The Atacama is the ancestral territory and home of the Indigenous Lickanantay people, who have been at the center of social conflicts over water and brine use for lithium production.

The Council of Atacaman People (CPA) — the Indigenous governance body of 18 Lickanantay communities — pursued legal action against SQM and has recently called for the revocation of their environmental license. The CPA has also signalled SQM's failing to adequately consult communities, in effect disregarding their right to free prior and informed consent. In addition to legal actions, local communities have also peacefully protested against lithium mining in the region.

In 2015, a wide — reaching political corruption scandal by SQM made international headlines, and disputes over the distribution of royalties and taxes from lithium mining have resulted in social tensions.

The brine below the surface of the salt flat is an ancient fossil water — considered a sacred and inextricable part of the territory — which sustains the life of microorganisms whose role in the broader ecosystem is still not fully understood.



Two companies are responsible for all of Chile's lithium production, and their operations in the Atacama salt flat have expanded significantly over the past four decades.

The Lickanantay communities have lived with, and suffered the consequences of, copper and lithium mining for decades. According to a government-commissioned study, the Atacama's water table is losing an estimated 1,750-1,950 liters per second more than it receives, due in significant part to the extraction of brine from SQM and Albemarle's lithium operations.¹ In recognition of these impacts, which have not yet been fully assessed, Sergio Cubillos, former President of the CPA, characterized the Atacama as "sick", but added that more studies are needed to determine just how advanced the sickness is.

More recently, in other salt flats (such as Coipasa and Maricunga) in northern Chile, a growing number of companies are investing in lithium exploration and early-stage projects. These projects are creating new sources of disputes between companies and Indigenous communities.

¹Estudio de modelos hidrogeológicos conceptuales integrados, para los salares de Atacama, Maricunga y Pedernales, Informe Final, Modelo Hidrogeológico Consolidado Cuenca Salar de Atacama, (Comité de Minería No Metálica CORFO), 30 de agosto 2018, p. 352.

A roadblock by local communities and residents of San Pedro de Atacama in protest of Corfo's agreement with SQM (February, 2018).
Photo: Ramón Morales Balcázar, Observatorio Plurinacional de Salares Andinos



2 Argentina

In Argentina, commercial lithium extraction began in 1997. Today, there are two active operations, and dozens more in various stages of exploration, development and construction in the north western provinces of Jujuy, Salta, and Catamarca.

There are four lithium mining concessions in the Salinas Grandes and Laguna de Guayatayoc basin, none of them operational. Salinas Grandes is the largest salt flat in Argentina and the third largest in the world. It is a popular tourism destination, and considered one of the country's "seven natural wonders." It is part of the Indigenous Kolla and Atacama peoples' ancestral territory, where they have built their livelihoods around the region's arid climate, harvesting salt, herding animals, and growing crops. Exercising their right to self-determination, 33 Kolla and Atacama Indigenous communities have organized against lithium exploration and extraction.

For more than a decade, the Kolla and Atacama communities have studied the potential impacts of lithium extraction, denounced the lack of adequate consultation, and taken peaceful direct actions to protest the presence of exploration companies on their land. Today, many of these communities have taken a strong stance against lithium exploration or extraction, after seeing how companies operated elsewhere in Argentina and Chile, the impacts they generated, and experiencing first-hand the lack of respect for their autonomy by lithium mining and exploration companies.

These communities have also developed a protocol on free, prior and informed consent called Kachi Yupi or "tracks in the salt" in Quechua. In 2019, they filed an environmental protection action "to prevent the serious and irreversible damage of lithium and borate mining" in the Salinas Grandes and Laguna de Guayatayoc basin.

Below: Salinas Grandes in Argentina. Photo: Andrmoe / Adobe Stock.

Below right: Creative action carried out by the Mesa de los Pueblos Originarios de la Cuenca de la Laguna Guayatayoc y Salinas Grandes to help bring greater visibility to their process of resistance. The text on the balloon reads: "Life and water are worth more than lithium – No to contamination – Salinas Grandes, Jujuy, Argentina. Photo: Clemente Flores.

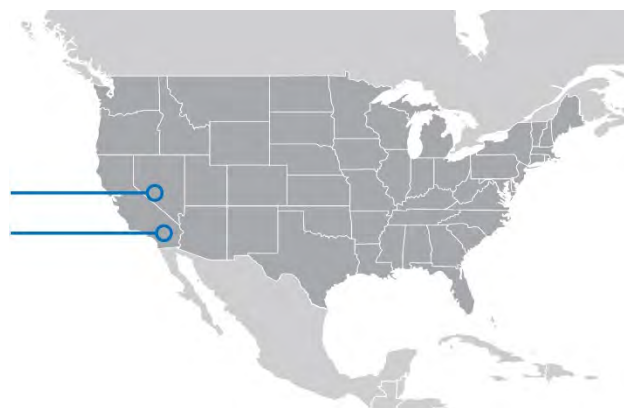


3 United States

In the United States, there is only one operating lithium mine— the Silver Peak operation by Albemarle in Nevada. However, there are many projects at early and exploratory stages throughout the deserts of Nevada and California. Two lithium mining projects in particular, in Nevada, have garnered criticism from communities and local NGOs.

The Rhyolite Ridge project is a proposed open-pit hardrock lithium mine by Australian company Ioneer. Several civil society groups, including the Progressive Leadership Alliance of Nevada, Great Basin Resource Watch (GBRW) and the Center for Biological Diversity, are concerned that the mine could drive a rare wildflower species, Tiehm's Buckwheat, to the brink of extinction.

The Thacker Pass project is another proposed open-pit operation by Canadian company Lithium Americas which has faced opposition due to concerns over environmental impacts and a lack of community consultation. Thacker Pass is located within the traditional territory of the Fort McDermitt Paiute Shoshone Tribe. This community continues to act as caretakers of this territory to protect and enhance the landscape including cultural sites which are central to their identity, sovereignty, and resilience as Indigenous Peoples.



Many lithium projects at early and exploratory stages are throughout the deserts of Nevada and California.

In this arid ecosystem, the local ranching and farming community are worried that the levels of water extraction could destroy their livelihoods. According to GBRW, it would “disturb roughly 5,545 acres of land, pump up to 3,250 gallons per minute of groundwater and utilize 2,900 tons of acid per day at the on-site sulfuric acid plant.” GBRW’s analysis also shows that for generations to come “active treatment of water pollution will be needed to avoid groundwater contamination and potentially surface water contamination.” This project is now facing a lawsuit by a local rancher, Edward Bartell, and another lawsuit by a coalition of NGOs, as well as an active protest camp.

In California, several exploration projects have drawn the attention of environmental groups. In the case of the Panamint Valley mine, Friends of the Inyo have raised concerns over the potential contamination and depletion of groundwater sources. Panamint Lake is a place of cultural significance for several Paiute and Shoshone tribal groups and is of high ecological significance as the home to unique desert wetland ecosystems and as a wildlife corridor.

The Salton Sea and surrounding Imperial Valley in which it lies, bears a long legacy of environmental injustice. Dust laced with toxins from agricultural runoff has created a public health crisis in the region, with largely Latinx communities suffering the brunt of this harm.

This artificial inland water body is the site of 11 geothermal facilities. Lithium found in the geothermal brine has attracted a great deal of attention in recent years, leading to the creation of a

Lithium Valley Commission and several proposed direct lithium extraction projects connected to these geothermal facilities.

These proposed projects have been described as a much less environmentally damaging method of lithium extraction. However, Luis Olmedo, Director of the local community-based organization, Comité Cívico del Valle, points out that other issues associated with geothermal production must be addressed first. He highlights the fact that these facilities produce contaminants found in the solutes of the brine, which are dumped into landfills, and emissions from the steam that these plants generate. Additionally, 9 of these 11 facilities are not subject to stricter regulations due to generation capacities below 50MW, the threshold for additional scrutiny by the California Energy Commission.



Geothermal facilities produce contaminants found in the solutes of the brine, which are dumped into landfills, and are in emissions from the steam that these plants generate. Photo: Khaleel / Adobe Stock.

Agriculture along the Salton Sea in California. Photo: Tim Roberts / Adobe Stock.



In Focus: Nickel

Devastating cases of damage to freshwater and marine ecosystems have been documented in Canada, Russia, Australia, Philippines, Indonesia, Papua New Guinea, and New Caledonia due to nickel mining and refining practices.

There are two major types of nickel deposits: sulphide and laterite. Nickel from laterite ores is difficult to concentrate into high-quality nickel products using conventional separation or pyro-metallurgy. As a result, much laterite ore is processed into the low-grade, highly ferrous nickel pig iron, which is often destined for use in the stainless steel industry. However, electric vehicle battery cathodes require a much higher quality nickel product. To produce high-quality nickel products from laterite ores, a process known as High-Pressure Acid Leaching is being increasingly adopted, particularly in Indonesia where several projects are underway or slated for construction. This process is highly toxic, polluting, energy-intensive, and leaves a massive amount of residual material to be disposed of, in some cases through submarine tailings disposal—the dumping of mine waste directly into rivers, lakes, and oceans. Indonesia recently announced to the media, after receiving much pressure, that it would not authorize any future mine waste dumping in the oceans. This commitment is not yet reflected in the country's regulations.

4 Papua New Guinea

The Ramu nickel and cobalt mine in Papua New Guinea, a joint venture between the Metallurgical Corporation of China Ltd and Conic Metals Corp., has generated controversy and deep concerns over its environmental and social impacts. The Ramu Mine began operations in 2012 and is located along the Ramu River near Basamuk Bay, on indigenous Kurumbukari territory. Despite fierce local opposition and a legal battle that suspended operations for 19 months, the mine is currently operating, dumping an estimated 14,000 tonnes of toxic mine waste into Basamuk Bay, part of the Coral Triangle, every day. In late August of 2019, a processing plant spilled around 23 tonnes of toxic waste into the surface waters of Basamuk Bay. The pollution, which is normally piped into the ocean at a depth of 150 meters, turned the water red and left a sludgy residue on the shoreline. Local landowners subsequently filed a new lawsuit in response.

Coastal residents depend on the Bismarck Sea for bathing, food and medicine, and an estimated 30,000 fishermen make their livelihoods in Basamuk Bay. The PNG National Fisheries Authority criticized the project, calling it “unsustainable socially, economically and environmentally.”

The indigenous Kurumbukari people were forcibly displaced from their ancestral homeland to make way for the mine, separating them from their livelihoods, traditional way of life, and spiritual practice. Now, those living along the Ramu River



are raising concerns to their government about polluted water and destroyed fishing grounds from the open-pit mine. In the eight years since the mine went into production, communities have witnessed the transformation of the natural state of the river due to sedimentation, and concerns about health impacts from pollution are on the rise.

“Communities along the Basamuk Bay, the pipeline and Krumbukare (production site) that once were in support of the mine are now frustrated and angry. They are not receiving benefits from the mine as promised and most importantly, they see the destruction by the company. There has been continuous environmental pollution and health related issues are on the rise.” — John Chitoa, Director, Bismarck Ramu Group

Overlooking Bismarck Sea, Papua New Guinea. Photo: Credit Natalie Lowrey.



5 Russia

In the Taymyr Peninsula and Murmansk Oblast in the far north of Russia, Nor Nickel operates a series of nickel sulphide mines and processing plants which release dangerous levels of sulfur dioxide into the atmosphere, which also comes down as acid rain. They have contaminated Indigenous lands and the city of Norilsk, where Nor Nickel has its main operations and is often referred to as one of the most polluted places on Earth.



The company is also responsible for a massive oil spill which occurred on May 29, 2020. The spill released 21,000 tonnes of diesel into the Ambarnaya and Daldykan rivers. It is the largest oil spill to have occurred in Russia since 1994 and is considered to be an ongoing environmental disaster. Independent researchers who visited the site of the spill had the samples they took confiscated from them.

Nor Nickel's operations have been the target of a campaign by the Indigenous rights organization, Aborigin Forum. In a recent letter, the organization calls upon companies to not buy from Nor Nickel until the company "conducts a full and independent assessment of the environmental damage of mining for nickel ... compensates indigenous communities for the damages done to their traditional way of life ... prepares and implement a plan for re-cultivating contaminated lands in the Taymyr Peninsula and Murmansk Oblast [and] revises its policies for engaging with indigenous peoples."

Below: Spilled diesel, in red, on the Ambarnaya River on May 31, 2020. Photo: European Space Agency.
Below right: Gennady Schukin, Dolgan people, Taimyr Peninsula. Photo: <https://indigenous-russia.com>.



In Focus: Cobalt

Around 70 percent of global cobalt production is concentrated in two southern provinces of the Democratic Republic of Congo (DRC): Lualaba and Haut-Katanga. The impacts of industrial and artisanal cobalt mining are perhaps the most well documented of the three metals covered in this report, thanks to the work of organizations such as Afrewatch, Premicongo, SOMO, RAID, Amnesty International, Resource Matters, and others.

5 Democratic Republic of the Congo

Industrial-scale copper-cobalt mines operated by a mix of state-owned and multinational companies account for an estimated 80 percent of Congolese cobalt production. Cases of corruption, tax evasion, and other improprieties by large mining companies have reduced what little economic benefits the sector offers the country and affected communities.

Many mining companies and downstream buyers have responded to these issues by seeking cobalt outside the DRC. By distancing themselves from their legacy of harm, these companies are driving an expansion of cobalt projects around the world, including in the depths of the ocean. Meanwhile, the updated Congolese Mining Code of 2018 has introduced a host of progressive reforms designed to increase the public benefit of mining activity, including increased royalty and tax payments, which have been opposed by multinational mining companies, among them Glencore and Barrick.

Decades of water and air pollution from industrial mining operations are responsible for widespread respiratory illnesses and toxic concentrations of metal in the blood for the many communities living near mine sites. This contamination has also



Below: Opencast industrial copper-cobalt mine in the DRC. Photo: Gwenn Dubourthoumieu.



led to the loss of vegetation and farmland, impeding the growth of agriculture and tourism, sectors that could help diversify the region's economy and reduce its dependence on mining.

Artisanal Cobalt Mining

While only producing an estimated 20 percent of Congolese cobalt, the artisanal cobalt mining sector has attracted the lion's share of international scrutiny—primarily over child labor. Yet unlike industrial-scale mining, artisanal mining sustains hundreds of thousands of workers and their families in a region with few alternatives.

It is important to note that there have been reforms over the last five years that have changed the dynamics around child labor in the sector. Notable among them are the efforts to centralize and formalize the markets where artisanally mined cobalt is sold. These government efforts should be supported by purchasers of cobalt and downstream users.

It is also important to note that there are other challenges facing artisanal miners that have been largely overlooked in coverage of the sector. Among them are the particular challenges faced by women miners and cobalt traders including gender-based violence, additional burdens in work and at home, and stigmatization.

Artisanal miners are developing solutions and calling for the formalization of the sector. Access to ZEAs (artisanal mining concessions), to credit and fair pricing—as well as broader poverty reduction measures and economic diversification—are among some of the solutions proposed by artisanal miners and mining-impacted communities.

Solutions proposed by artisanal miners themselves, Congolese civil society or even government actors are too often left out of the Global North-centered debates—and a growing range of initiatives—on cobalt and artisanal mining in the DRC.

Ruashi copper-cobalt mine showing the proximity of the mine to thousands of Lubumbashi houses. During the explosions necessary to free the ore in the mining pit, the people living closest to the mine are evacuated. After several hours, they are allowed to return to their homes. Image and caption from: Cobalt Blues: Environmental pollution and human rights violations in Katanga's copper and cobalt mines (2016 - ACIDH, Afrewatch, Premicongo and SOMO), page 25. Original source: Google maps photographs, 2 March 2016.



Deep Sea Mining

As terrestrial ore grades continue to decline, some companies and states have looked towards deep sea mining as a source of new deposits and revenue streams. Leading experts have warned that “deep sea mining would potentially cause severe and irreversible damage to our oceans and marine life and further threaten the global climate.” Potential dangers include disruptions of seafloor ecosystems that could release toxic metals and minerals and create plumes of sediment that would affect aquatic life.

The absence of a coherent, effective international policy to safeguard the marine environment, along with scientific uncertainty around impacts, underscores the need for a moratorium on deep sea mining. Yet mining companies and contractors are pushing for deep seabed mining to take place before the impacts are quantified and analyzed. The precautionary principle dictates that all deep sea mining activity must be suspended to avoid irreversible harm. This call for a moratorium is supported by more than 80 organizations who are members of the Deep Sea Conservation Coalition, as well as a growing number of scientists, politicians, the fishing industry and governmental bodies, and auto and tech companies. Among those speaking out against deep sea mining are Sir David Attenborough and Sylvia Earle.

This call for a moratorium is supported by more than 80 organizations, and notable figures including Sylvia Earle and Sir David Attenborough.

Indonesian coral reef. Photo: Parnupong Norasethkamol / Adobe Stock.



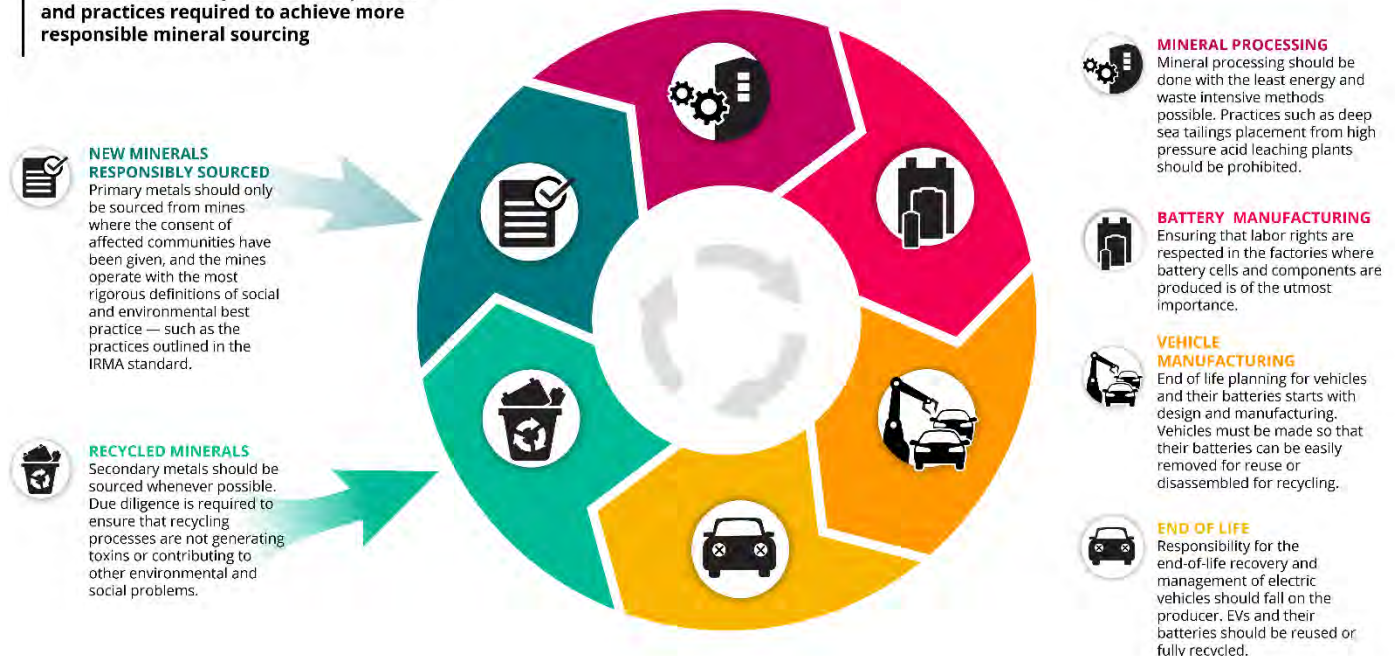
How Far Can We Go with Recycling?

New research carried out by the University of Technology Sydney's Institute for Sustainable Futures, and commissioned by Earthworks, examines the viability of recycling and its potential to reduce primary metal demand over the coming two decades. Results show that it is already technologically possible to recover and recycle upwards of 90 percent of the four battery metals studied (lithium, nickel, cobalt, and copper). The report also calculates a potential offsetting of demand for battery metals by approximately 25 percent to 55 percent (depending on the metal in question) in the year 2040. Such an offset could significantly reduce the demand for new mining.

With proper recycling, battery mineral demand could be offset by approximately 25 – 55 percent.

Earthworks' Making Clean Energy Clean, Just & Equitable initiative aims to ensure that the transition to renewable energy economy is powered by responsibly and equitably sourced minerals that minimizes the need for new extraction and moves the mining industry toward more responsible practices.

Key elements in the life cycle of an electric vehicle, with an emphasis on the policies and practices required to achieve more responsible mineral sourcing



The Opportunity

Pressure is mounting from consumers and investors alike to ensure that mineral sourcing for EV batteries is as responsible as possible.

There is an urgent opportunity to scale up the use of renewable energy sources and low-carbon technologies, including EVs, while scaling back our dependence on dirty mining. Doing so will require a concerted commitment from EV manufacturers to the following principles.

Earthworks is calling on companies in the EV vehicle battery supply chain to commit to the following:

1. Transparency

Manufacturers of batteries and EVs must make every effort to trace the minerals in their products back to the source, and make that information publicly available.

2. Mineral reuse and recycling

Manufacturers of EVs and battery technologies must dramatically scale up their use of recycled minerals and design to maximize end-of-life takeback, recycling and reuse. Policymakers must create incentives for minerals reuse and recycling and requirements for companies to take back their products at the end of their useful lives. Health, safety, and protection for workers and communities must be the top priority at recycling operations.

3. Responsible minerals sourcing

When sourcing from mining operations where communities live with—and are seeking improvements to—existing operations, purchasers must insist that those operations adhere to stringent international environmental and human rights best-practice standards (such as those developed by the multi-stakeholder [Initiative for Responsible Mining Assurance](#)) with independent, third-party assurance of compliance.

- **Community consent:** Under no circumstances should mining take place, or new operations begin, where those projects are contested by affected people. Respect for the decision making and autonomy of affected communities, particularly Indigenous communities, including their right to say no to extraction, must be upheld by actors throughout the supply chain.
- **Protect ecosystems:** No mining should take place in recognized protected areas, including: International Union for Conservation of Nature (IUCN) protected areas designated as protected area management category 1-IV, Ramsar sites, UNESCO biosphere reserves and buffer zones, World Heritage Sites, and areas on a State Party's official Tentative List for World Heritage Site Inscription and areas with protected status under national or state laws. Similarly, no mining in the deep sea should form part of a responsible mineral sourcing strategy.
- **Responsible tailings management:** The [Safety First Guidelines](#) should serve as a baseline for land-based tailings management, and no disposal of tailings in water bodies should be permitted.



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Photo above: Electric vehicle lithium battery pack by Nischaporn / Adobe Stock.
Photo below: Opencast industrial copper-cobalt mine in the DRC by Gwenn Dubourthoumieu.