Sector supply-chain guidance – batteries

European Bank
for Reconstruction and Development

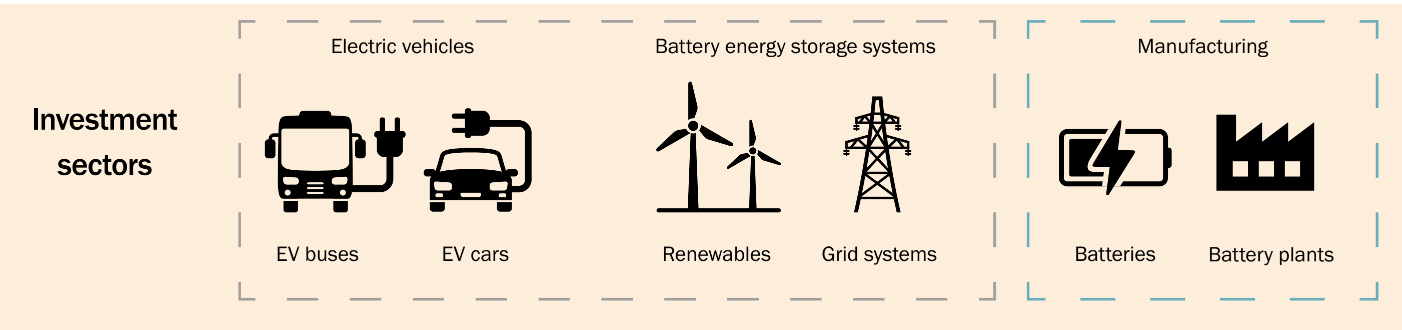
1. Introduction

This note focuses on actions that a project sponsor or the developer of a project involving electric vehicles (EVs) or battery energy storage systems (BESSs) can take to manage social and environmental risks associated with the battery supply chain. The project sponsor may be an EBRD client to which the Bank is providing direct finance or a sub-borrower of one of the EBRD's financial intermediaries (FIs). It may also be an investee company of a fund in which the EBRD is investing.

Battery composition and supply chains may differ between batteries for EVs and BESSs. Among other things, these differences are the result of variations in performance requirements, technological advances and market trends. Consequently, investments with a substantial battery component must consider risks associated with their specific battery supply chain. This guidance outlines general risk characteristics found in some of the most prominent battery supply chains and illustrates some of the most common challenges faced by the battery industry. There are multiple parties involved in the battery manufacturing supply chain. This guidance focuses on practical actions a project sponsor can take to improve visibility and management of social and environmental risks in the primary phases of the battery manufacturing supply chain.

Note that investments in other sectors may also involve the battery supply chain. The steps outlined in this guidance also apply to other projects where batteries are a material component. For example, investments in renewable energy generation, including solar or wind parks, also rely on batteries to store the energy produced.

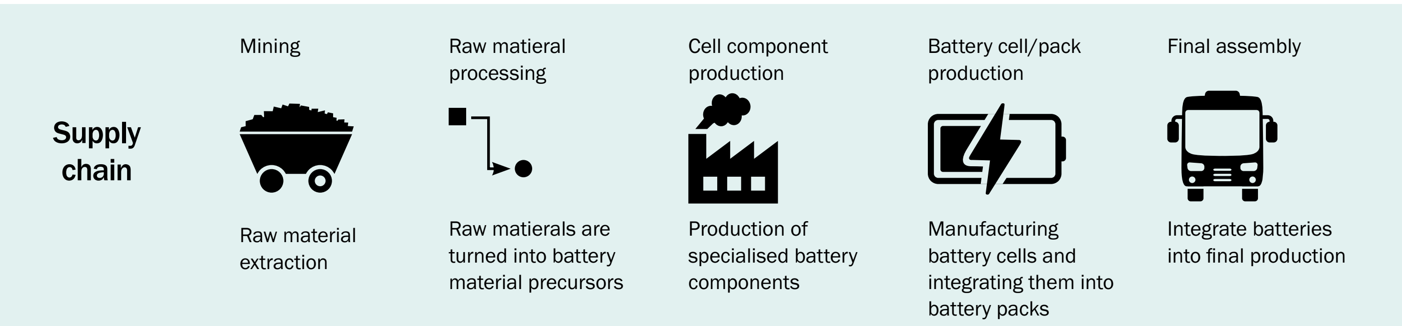
Figure 1. Investment sectors that may involve a battery supply chain



1.1. Overview of the battery manufacturing supply chain

The battery manufacturing supply chain includes raw material extraction, raw material processing and battery component manufacturing.

Figure 2. An overview of the supply chain for battery manufacturing



This note focuses on lithium-ion batteries, which currently dominate the EV market. While potential alternatives to lithium-ion batteries are under development (most notably sodium-ion and lithium-sulphur batteries), none have yet been widely adopted.[1] Of the six main types of lithium-ion battery, three are commonly used in electric vehicles. Key features of these three types are set out in Table 1.

[1] See IEA (2023).

Table 1. Key features of the three main types of lithium-ion battery commonly used in EVs

	Lithium nickel manganese cobalt oxide (NMC)	Lithium iron phosphate (LFP)	Nickel cobalt aluminium oxide (NCA)
Material composition – cathode	Lithium nickel manganese cobalt	Lithium iron phosphate	Lithium nickel cobalt
Material composition – anode	Graphite	Graphite	Graphite
Approximate EV market share[2]	60%	30%	8%
Key use cases	Typically used in long-range EVs	Larger vehicles (buses, lorries, forklifts); vehicles that are depleted and charged on a daily basis (golf carts and other recreational vehicles)	Typically used in high-performance EVs

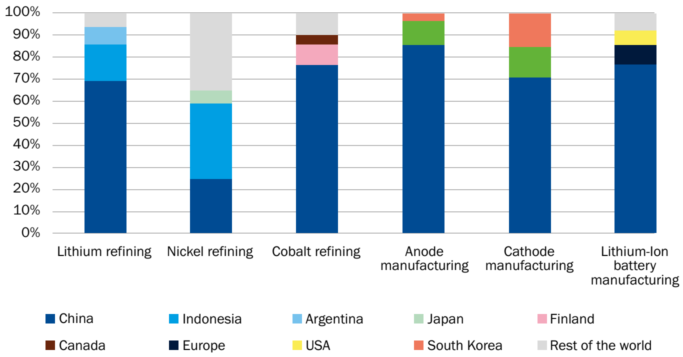
2. Supply-chain mapping and traceability

2.1. Production and supply-chain context

As discussed in the introduction, supply chains associated with distinct types of battery can vary considerably. Consequently, the associated risks will differ too. The risks discussed below cover some of the most prominent battery supply chains. Understanding the risks associated with a project's specific supply chain can only be accomplished with a targeted risk analysis of that particular supply chain.

Battery cell production is also primarily concentrated in China (more than 75 per cent). Europe, the United States of America, Japan and South Korea also have some manufacturing capacity.

Figure 3. Production capacity across the battery supply chain



Sources: European Commission Raw Materials Information System, Statista and IEA.

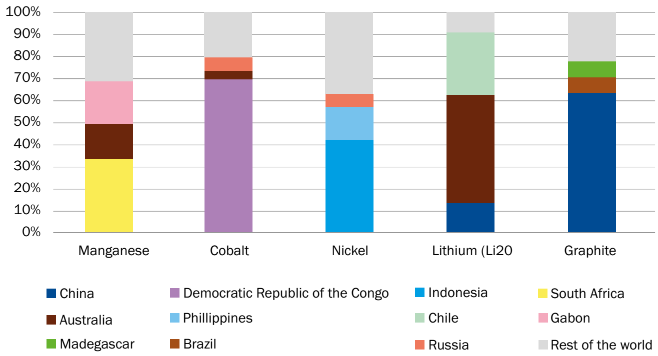
EV battery manufacturing is not only concentrated geographically, but also in terms of the companies involved. In the mining, cell component and battery cell manufacturing elements of the supply chain, the three largest companies have a combined market share of more than 25 per cent (based on 2021 data).[3]

Cell component production mostly takes place in China, with some manufacturing in Japan and South Korea.

Raw material processing is dominated by China, which processes more than 50 per cent of all lithium, cobalt and graphite globally. Europe's role in the material processing stage of the supply chain is generally minor, with the exception of cobalt processing, where about 10 per cent occurs in Finland. Indonesia also accounts for a significant share of the material processing stage of the nickel supply chain.

Mining for the key raw materials is heavily centralised in a relatively small number of countries. Around 70 per cent of the world's cobalt comes from the Democratic Republic of the Congo and, despite government efforts to formalise the sector, it is estimated that between one-sixth and one-third stems from artisanal and small-scale mining (ASM).[4]

Figure 4. Production of key raw materials by country



Source: Federal Ministry of Finance of Austria.

[2] Ibid. [3] See IEA (2022). [4] See Posner and Baumann-Pauly (2023).

2.2. Traceability

The supply chains for EVs and BESSs are complex and variable, depending on the battery technology used and the underlying chemical composition. Generally, traceability in battery supply chains is limited and only possible after the assembly of the battery cell. [5]

One significant regulatory requirement is EU Regulation 2023/1542,[6] which will require "economic operators that place batteries on the market or put them into service" to "establish and operate a system of controls and transparency regarding the supply chain, including a chain of custody or traceability system, identifying upstream actors in the supply chain" by 18 August 2025.

The most prominent initiative to achieve traceability of the whole battery supply chain is the Global Battery Alliance's "Battery Passport".[7] The alliance, which is supported by more than 150 actors, including mining companies, car manufacturers and United Nations organisations, aims to develop a comprehensive reporting framework to establish a digital identification for batteries. The objective is to establish a transparent platform for collecting and exchanging data among stakeholders on battery supply chains.

Within the EV sector, several pilot programmes are in operation that use blockchain technology to support traceability and risk identification, particularly for minerals known to be high risk. For example, ReSource uses blockchain technology to allow users to track cobalt from mines to EV facilities, including assurance on the volume of traceable material and information on sustainability.[8]

Special focus: Cobalt
The overlap between large-scale mining (LSM) and artisanal/small-scale mining (ASM) is a key challenge for cobalt traceability. According to the Organisation for Economic Co-operation and Development (OECD),[9] there is extensive interaction between large- and small-scale/artisanal mines, and a significant number of large-scale mines source material from small-scale operators in order to meet technical and commercial requirements. At the same time, ASM often takes place within LSM concessions. The lack of legal recognition and a clear regulatory framework for ASM has resulted in upstream operators inaccurately declaring the origin of minerals on chain-of-custody documentation. Bribery and corruption are also key issues, resulting in the fraudulent misrepresentation of the origin of materials. There are several initiatives focused on improving traceability for cobalt. For example, the Responsible Minerals Assurance Process (RMAP)/Cobalt Refiner Due Diligence Standard is the flagship programme of the Responsible Minerals Initiative (RMI).[10] RMAP helps companies make informed choices about responsibly sourced minerals in their supply chains. The methodology focuses on a "pinch point" (a point with relatively few actors) in the supply chain. It uses an independent third-party assessment of smelter/refiner management systems and sourcing practices to validate conformity with RMAP standards.

Traceability of mined minerals is still a significant challenge. Chain-of-custody standards have been developed for individual raw materials by certification organisations such as the Initiative for Responsible Mining Assurance (IRMA). However, due to the low market share of certified materials, the reach of these traceability schemes remains low. As non-certified materials are mostly blended throughout the supply chain, in many cases, it is not possible to determine the origins of raw materials included in any product.

Key resources on traceability
• IRMA, Draft chain of custody draft standard • Global Battery Alliance Battery Passport • OECD (2019) Interconnected supply chains: a comprehensive look at due diligence challenges and opportunities sourcing cobalt and copper from the Democratic Republic of the Congo • RMI Responsible Minerals Assurance Process (RMAP)/Cobalt Refiner Due Diligence Standard • The Battery Passport Content Guidance • EU Battery Regulation 2023/1542

2.3. Overview of potential actions to improve mapping and traceability

Table 2. Potential actions to improve mapping and traceability

Examples of foundational actions	Examples of intermediate actions	Examples of leading practice
Clarifying the type of battery used and identifying the key raw materials in the supply chain Using publicly available sources to establish primary geographies in the raw mineral supply chains	Leveraging a third party (such as an industry group) to gather supplier information Developing approaches in order to increase the visibility of raw materials, for example, by sourcing through a smaller number of suppliers	Participating in a credible traceability initiative, such as the "Battery Passport"

[5] See Riexinger et al. (2022). [6] See European Union (2023). [7] See Global Battery Alliance (2023). [8] See ReSource (n.d.). [9] See OECD (2019).

[10] See RMI (n.d.). [11] See IRMA (n.d.a).

3. Supply-chain risk identification

3.1. Child labour

Child labour is not reported to be a significant risk in the **manufacturing of battery components.**

Due to the nature of mining activities, child labour in the extraction of key raw materials used in battery supply chains is likely to constitute the worst form of child labour.[12] Child labour is usually not present in formalised, large-scale mining operations, but rather small-scale, informal and, often, illegal mine sites. In the Democratic Republic of the Congo, child labour is endemic in the artisanal and small-scale mining of cobalt.[13] Much of the work is hazardous, involving dangerous, labour-intensive practices, such as digging underground, crushing rocks, washing minerals and carrying heavy loads of ore, waste or water. In mining regions, child labour is also associated with the provision of indirect services to workers, including the sale of food and drink and sex work.[14]

3.2. Forced labour

Where other key raw materials used in battery supply chains are concerned, there are some reported forced labour risks in relation to extraction and mining. In the Democratic Republic of the Congo and Zambia, cases of forced labour have occurred on ASM sites linked to cobalt production.[15] Poorly defined working conditions and hazardous working conditions create general risks that forced labour may occur.[16]

Sources on child labour and forced labour

Child labour:

- ETI Sweden (2023): Human Rights Risks Behind Electric Buses in Swedish Public Transportation
- US Department of Labor (2022): Child labor – Democratic Republic of the Congo

Forced labour:

- US Department of Labor (2022d): Solar supply chains
- UN OHCHR (2022): Assessment of human rights concerns in the Xinjiang Uyghur Autonomous Region, People's Republic of China

3.3. Deforestation

Mining is the fourth-largest driver of deforestation worldwide.[17] Among the primary battery minerals, manganese, cobalt and nickel pose deforestation risks.[18] Deforestation stems not just from mining operations themselves, but also from indirect effects, such as the construction of infrastructure needed to set up mining operations.[19]

[12] See ILO (1999). [13] See US Department of Labor (2022a). [14] See US Department of Labor (2022b). [15] See US Department of Labor (2022a; 2022c). [16] See OECD (2019). [17] See Chatham House (2020). [18] See WWF, WU Vienna and Satelligence (2023). [19] See World Bank (2019). [20] See ETI Sweden (2023). [21] See Allianz (n.d.).

Sources on deforestation in raw material extraction and processing

- The Metals Company (2023): Nickel and Cobalt Mining Impact on Terrestrial Carbon Sinks in Sulawesi, Indonesia and Katanga, DRC
- World Bank (2013): Deforestation Trends in the Congo Basin
- GIZ (2022): Nickel for the energy transition – a developmental perspective
- Business and Human Rights Resource Centre (2023): Powering electric vehicles – human rights and environmental abuses in Southeast Asia's nickel supply chains

3.4. Risk of harm

Manufacturing of battery components poses similar safety risks to other export manufacturing jobs,[20] including insufficient breaks, chemical hazards and exposure to toxic materials. In addition, workers in battery factories have raised concerns about facing both physical and mental health risks due to inadequate personal protection equipment (PPE).

Workers who assemble or integrate batteries into electric vehicles are also exposed to a range of potential health and safety risks from the high voltage and toxicity of components.[21] Risks include fatal electric shocks, explosions or fires and the release of explosive gases and harmful substances from damaged batteries.

All extractive industries carry inherent risks to physical safety and health. Typical mining- and refining-related risks include exposure to hazardous substances and dust, leading to respiratory diseases, damaged eyesight and skin diseases with potentially lifelong effects. Risks to life and limb are generally more pronounced the more informal the mining operation. Severe injury to and the death of miners are common particularly in highly informal mining sectors, such as cobalt and nickel, as well as the small-scale mining of lithium in Africa. Specific risks exist for key raw materials:

Sources of harm in raw material extraction and processing

Cobalt:

- NYU Stern Center for Business and Human Rights and Geneva Center for Business and Human Rights (2023): Cobalt Mining in the Democratic Republic of the Congo: Addressing Root Causes of Human Rights Abuses
- BGR (2019): Mapping of the Artisanal Copper-Cobalt mining sector

Nickel:

- GIZ (2022): Nickel for the energy transition – a developmental perspective.
- Forests & Finance (2022): The Impact Of Mining On The Brazilian Amazon

Manganese:

- SOMO, Action Aid and MACUA/WAMUA (2021): Manganese matters: A metal of consequence for women and communities in South Africa affected by mining and the global energy transition
- BHRRC (2021): Georgian Manganese

3.5. Overview of potential risk identification actions

Table 3. Actions to identify potential risk

Examples of foundational actions	Examples of intermediate actions	Examples of leading practice
Identifying and verifying supply-chain risks using self-assessment questionnaires for suppliers. Overlaying information on the location of production with environmental and/or social risk information that has a geographical component. Where the location of production is not known, this is based on key locations associated with raw materials.	Performing risk analysis for most relevant raw materials to verify country of origin. While traceability to mine site is usually hard to accomplish, for most raw materials, risks are very similar at a country level. Where cobalt is concerned, identifying actual or likely refiners/smelters and whether the smelters/refiners are sourcing from informal (ASM) mines.	Source specifically from mines certified by a credible certification organisation (such as IRMA) and use audit results as grounds for a risk analysis.

4. Risk mitigation

Effective risk mitigation approaches will depend on the structure of the deal and the position of the client/investee and financier in relation to the risk within the supply chain.

4.1. Battery manufacturing and battery integration

Multi-stakeholder platforms exist to facilitate dialogue between industry actors, civil society, governments and academia on responsible sourcing. The leading initiative is the Global Battery Alliance (GBA), with its Battery Passport programme. In addition to tracing the battery supply chain from end to end, the programme sets out child labour and human rights criteria for uniform reporting on these issues. While the programme is currently in development, three proof-of-concept pilots have been completed. A GBA-connected initiative is the Battery Pass, which aims to set EU Battery Regulation implementation guidelines.[25]

4.2. Raw materials

The raw materials stage is likely to include participation in industry certification schemes and multi-stakeholder initiatives. A greater focus can be placed on contractual mitigation for those elements of the supply chain that are closer to the project sponsors' own operations.

4.2.1. Certification schemes

Certification systems have been established for many raw materials. These vary in governance, ambition, scope and reach.

- Initiative for Responsible Mining Assurance's (IRMA) standard: IRMA is widely recognised as the industry leader in responsible mining certification because of its multi-stakeholder governance, extensive sustainability requirements, transparency and broad scope, encompassing all mined materials.[26] Mines can be certified to four achievement levels (with an increasing level of performance): IRMA Transparency, IRMA 50, IRMA 75 and IRMA 100.[27]
- Joint Due Diligence Standard: The Copper Mark is an industry-led initiative providing assurance on human rights and environmental issues in the copper supply chain. The Joint Due Diligence Standard also encompasses nickel.[28]
- Responsible Minerals Initiative ESG Standard for Mineral Supply Chains: The standard is applicable to all mined materials and covers mineral processors, smelters and refiners, including those integrated with mine sites.
- CERA 4in1 Performance Standard (under development): The standard system encompasses all minerals and combines four standards that together cover the entire supply chain from mining to finished product.
- The Better Mining Programme (pilot) is a not-for-profit initiative established by RCS Global and the Better Sourcing Program to certify artisanal mined cobalt from the Democratic Republic of the Congo as responsibly produced. It also allows for traceability throughout the supply chain.

Key resources on raw material certification systems
• BGR (2022): Sustainability Standard Systems for Mineral Resources • Lead the Charge (2024): An Assessment of Third-Party Assurance and Accreditation Schemes in the Minerals, Steel and Aluminum Sectors

[22] See Global Battery Alliance (2022a). [23] See Global Battery Alliance (2022b). [24] See Global Battery Alliance (2023). [25] See European Union (2023). [26] See BGR (2022), Lead the Charge (2024) and US Department of State (2022). [27] See IRMA (n.d.b). [28] See Copper Mark (2022).

4.2.2. Multi-stakeholder initiatives

At the raw-material level, multi-stakeholder initiatives aim to bring together brands, supply-chain actors, civil society and public actors. They can facilitate dialogue between downstream expectations and upstream pushbacks, as well as between local communities and large corporate entities. Ideally, multi-stakeholder initiatives will lead to requirements/standards at the mining and processing level, as well as greater willingness to adopt those requirements/standards by upstream companies. The most widely recognised initiatives are:

- IRMA: Due to its multi-stakeholder governance, IRMA serves as a dialogue platform for brands and mining companies, large civil society organisations and representatives of local communities, as well as labour unions. Members have certain obligations, for example, starting at least one IRMA audit in the year after joining the association. Recognised as one of the most ambitious standards in mineral resources, members can profit from internal learning on best practices.
- RMI: Originally working only on conflict minerals, the RMI has extended its scope to various other raw materials. It has a multi-stakeholder governance structure and offers members a variety of tools, such as standards, training, smelter databases and reporting templates.
- Credible mineral-specific multi-stakeholder initiatives: Multi-stakeholder initiatives for specific raw materials, such as the Responsible Lithium Partnership, can serve as a valuable platform for discussion on human rights in their specific supply chains.

4.3 Overview of potential risk mitigation actions

Specific risk mitigation actions should be based on the results of the mapping and risk identification exercise. Based on the overall risk profile for batteries, the key focus area is likely to be labour issues linked to raw-material extraction.

Table 4. Actions to mitigate potential risk

	Examples of foundational actions	Examples of intermediate actions	Examples of leading practice
Child labour and forced labour – raw material extraction	Joining an industry-led initiative on responsible business conduct Starting to source certified materials	Joining a multi-stakeholder initiative on responsible business conduct Sourcing materials that are certified through an organisation with credible multi-stakeholder governance Setting specific targets on the amount of certified materials to be sourced by a specific date In relation to cobalt – using best efforts to identify the refiners/smelters in the supply chain and having documentation and/or systems in place to demonstrate that the refiners/smelters they are sourcing are conducting appropriate due diligence	Within the initiative, setting specific targets In a certification organisation, working towards more ambitious criteria for the standard
Risk of harm – component manufacturing	Relevant provisions, also relating to the supply of PPE and training, are included in supplier contracts		

Key resources on mitigation actions

- OECD (2017): Practical actions for companies to identify and address the worst forms of child labour in mineral supply chains:
- OECD (2013): OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas:
- Re-sourcing (2021): Renewable Energy Sector: Roadmap for Responsible Sourcing of Raw Materials until 2050

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