European Bank
for Reconstruction and Development

Sector supply-chain briefing note – batteries

Environmental and social risk management toolkit for financial intermediaries

June 2026

Introduction

This note focuses on practical actions that a project sponsor or the developer of a project involving electric vehicles (EVs) or battery energy storage systems (BESSs) can take to identify and 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.

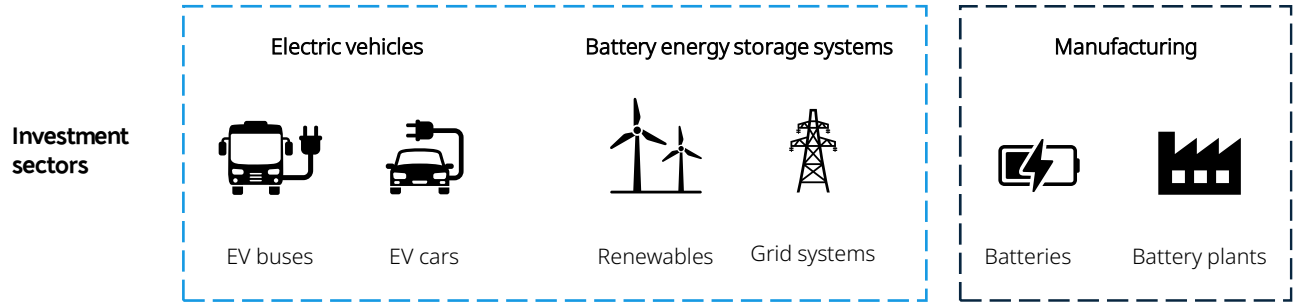
Under the EBRD Environmental and Social Policy (ESP) 2024, significant environmental and social (E&S) risks associated with a project's core supply chains should be identified and managed as part of the project's E&S assessment and throughout project implementation. Core suppliers may include suppliers and sub-suppliers, regardless of tier, that provide goods, equipment or materials essential to the project. Where significant risks are identified, the appropriate level of due diligence and risk management should reflect the severity and likelihood of the risks and impacts, the project sponsor's relationship to them, and the leverage available over relevant suppliers and sub-suppliers.

Battery composition and supply chains may differ significantly between batteries for EVs and BESSs. Among other things, these differences are the result of variations in sourcing patterns, technological advances, market developments and E&S risks associated with certain materials, processing stages and geographies. Consequently, investments with a substantial battery component should assess the specific characteristics and risks of the battery supply chain relevant to the project.

This briefing note outlines general risk characteristics associated with some of the most prominent battery supply chains and illustrates common E&S challenges that may arise across raw-material extraction and processing, component manufacturing and battery production. This guidance focuses on practical actions a project sponsor can take to improve supply-chain visibility, identify significant E&S risks and strengthen the management, monitoring and mitigation of those risks. Where adverse impacts have already occurred, appropriate remediation should also be considered.

Note that investments in other sectors may also involve material exposure to the battery supply chain. The principles and actions outlined in this briefing note may therefore also be relevant to other projects where batteries form an important part of the project or procurement package, including renewable-energy projects incorporating battery storage.

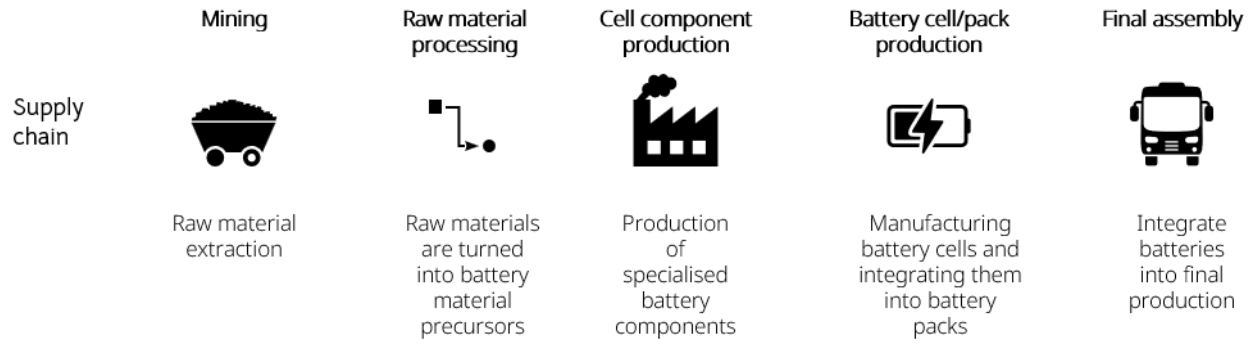
Figure 1. Investment sectors that may involve a battery supply chain



Overview of the battery manufacturing supply chain

The battery manufacturing supply chain includes raw material extraction, raw material processing and refining, production of battery-grade precursor materials and components, battery-cell manufacturing and battery-pack assembly and integration. Depending on the battery technology and procurement model, multiple suppliers and sub-suppliers may be involved across these stages.

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



This note focuses primarily on lithium-ion batteries, which currently dominate both the EV and BESS markets. Other battery technologies, including sodium-ion and lithium-sulphur batteries, are developing rapidly but have not yet achieved comparable levels of commercial deployment. Lithium-ion batteries encompass a range of chemistries with different material compositions, applications and associated supply-chain risks. Among the most widely used chemistries are lithium iron phosphate (LFP) and nickel-based chemistries, including lithium nickel manganese cobalt oxide (NMC) and nickel cobalt aluminium oxide (NCA). Their relative market shares vary significantly by application and geography and continue to change as battery technologies and markets evolve.

LFP batteries have grown particularly rapidly in recent years. In 2025 they accounted for more than half of global EV battery deployment and most stationary battery storage installations. Nickel-based chemistries, including NMC and NCA, remain widely used in EV applications requiring higher energy density and longer range.[1] Key features of selected lithium-ion battery chemistries types are set out in Table 1.

Table 1. Key characteristics of selected lithium-ion battery chemistries

	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
Typical applications	Typically used in long-range EVs	Larger vehicles (buses, lorries, forklifts); vehicles that are depleted and charged daily (golf carts and other recreational vehicles)	Typically used in high-performance EVs
Key supply-chain consideration	Exposure to nickel, cobalt, lithium and graphite supply chains	Exposure primarily to lithium, graphite, phosphate and iron supply chains	Exposure to nickel, cobalt, lithium, aluminium and graphite supply chains

Supply-chain mapping and traceability

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 environmental and social risks will differ too. The risks discussed below cover some of the most prominent battery supply chains and should be treated as indicative. Understanding the risks associated with a project's specific supply chain can only be accomplished with a targeted risk analysis of that supply chain.

1 See IEA (2023).

Battery supply chains remain highly geographically concentrated, particularly at the refining, active-material and battery-cell manufacturing stages.

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.

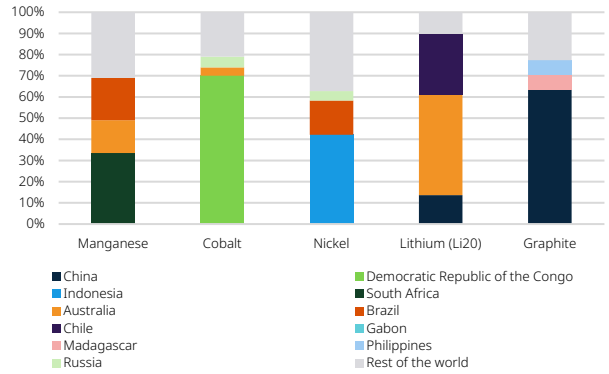
EV battery manufacturing is not only concentrated geographically, but also in terms of the companies involved. In the mining, cell component and battery cell manufacturing elements of the supply chain, the three largest companies have a combined market share of more than 25 per cent (based on 2021 data).[2]

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, except for 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 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).[3]

Figure 3. Production of key raw materials by country



Source: Federal Ministry of Finance of Austria (n.d.).

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.[4]

One significant regulatory requirement is Regulation (EU) 2023/1542 on batteries and waste batteries, as amended by Regulation (EU) 2025/1561.[5] From 18 August 2027, economic operators within the scope of the battery due-diligence requirements must establish and operate systems of controls and transparency regarding relevant battery supply chains, including chain-of-custody or traceability systems identifying upstream actors. The Regulation also requires due-diligence policies to be incorporated into supplier contracts and provides for grievance and remediation mechanisms.

One of the most prominent initiatives to achieve traceability of the whole battery supply chain is the Global Battery Alliance's "Battery Passport".[6] 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 to allow users to track cobalt from mines to EV facilities, including assurance on volumes of traceable material and information on sustainability.[7]

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),[8] 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

2 See IEA (2022).
3 See Posner and Baumann-Pauly (2023).
4 See Riexinger et al. (2022).
5 See EU (2023).
6 See Global Battery Alliance (2023).
7 See ReSource (n.d.).
8 See OECD (2019).

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. The Responsible Minerals Initiative (RMI) provides a range of standards, assessment tools and resources designed to support responsible mineral sourcing and supply-chain due diligence. Historically, the RMI operated a dedicated Cobalt Refiner Supply Chain Due Diligence Standard under the Responsible Minerals Assurance Process (RMAP); however, assessments against that standard ceased from 1 January 2026 as RMI transitioned towards a broader standards suite covering supply-chain due diligence and environmental, social, occupational health and safety and governance risks.[9] RMAP helps companies make informed choices about responsibly sourced minerals in their supply chains. The methodology focuses on a "pinch point" in the supply chain, such as smelters and refiners, where a relatively small number of actors process material from multiple upstream sources. It uses an independent third-party assessment of facility 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 modest. 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

- Battery Pass (2023), *Battery Passport Content Guidance*.
- EU (2023), Battery Regulation 2023/1542.
- Global Battery Alliance (n.d.), Battery Passport.
- IRMA (2024), Chain of Custody Standard for Responsibly Mined Minerals.
- 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 (n.d.), RMI Responsible Minerals Assurance Process (RMAP)/Cobalt Refiner Due Diligence Standard.

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 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"

Supply-chain risk identification

1. Child labour

Available evidence indicates that the most significant risks of child labour in battery supply chains are concentrated in raw-material extraction, particularly informal and artisanal mining, rather than in formal battery-component manufacturing. However, project-specific supply-chain assessment should consider whether the risks of child labour may also arise at other stages or locations.

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.[10] 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

9 See RMI (n.d.).

10 See ILO (1999).

cobalt.[11] 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.[12]

2. Forced labour

Forced-labour risks may arise at different stages of battery supply chains, including raw-material extraction, processing, refining and manufacturing, depending on the sourcing geography and supplier arrangements. Reported cases and risk indicators have been identified in artisanal and small-scale mining and in other upstream stages of selected mineral supply chains. In the Democratic Republic of the Congo and Zambia, cases of forced labour have occurred on ASM sites linked to cobalt production.[13] Poorly defined working conditions and hazardous working conditions create general risks that forced labour may occur.[14]

Supply-chain due diligence should therefore not be limited to the extraction stage, but should consider relevant processing, refining and manufacturing stages where significant risks are identified.

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 (2022a), Child labor – Democratic Republic of the Congo.

Forced labour:

- US Department of Labor (2022d), *Traced to Forced Labor: Solar Supply Chains Dependent on Polysilicon from Xinjiang*.
- UN OHCHR (2022), *Assessment of human rights concerns in the Xinjiang Uyghur Autonomous Region, People's Republic of China*.

3. Deforestation

Mining is the fourth-largest driver of deforestation worldwide.[15] Among the primary battery minerals, manganese, cobalt and nickel pose deforestation risks.[16] 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.[17]

Sources on deforestation in raw material extraction and processing

- Business & Human Rights Resource Centre (2023), *Powering electric vehicles: human rights and environmental abuses in Southeast Asia's nickel supply chains*.
- GIZ (2022), *Nickel for the Energy Transition: A Developmental Perspective*.
- 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: Reconciling Economic Growth and Forest Protection*.

4. Occupational health and safety, including GBVH and other worker harm

Manufacturing of battery components poses similar safety risks to other export manufacturing jobs,[18] 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.[19] 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

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

respiratory diseases, damaged eyesight and skin diseases with potentially lifelong effects. Risks of serious injury and ill health are generally more pronounced in informal or poorly regulated mining operations. Severe injury and fatalities have been documented, particularly in highly informal mining sectors, including artisanal and small-scale mining associated with cobalt and other battery minerals. GBVH can also be a health and safety risk for workers in battery supply chains. Risks may be greater for temporary, migrant or subcontracted workers, workers in isolated locations, or those relying on employer-provided accommodation or transport. Examples include sexual harassment, intimidation or abuse by supervisors or co-workers, and exploitation linked to recruitment or accommodation arrangements. Supplier assessments should therefore consider whether appropriate policies, reporting channels and measures are in place to prevent and respond to such incidents.[20]

Sources of harm in raw material extraction and processing

Cobalt:

- BGR (2019), Mapping of the Artisanal Copper-Cobalt mining sector.
- 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*.

Nickel:

- Forests & Finance (2022), *The Impact of Mining on the Brazilian Amazon*.
- GIZ (2022), *Nickel for the Energy Transition: A Developmental Perspective*.

Manganese:

- ActionAid, SOMO 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*.
- Business & Human Rights Resource Centre (2021), *Georgian Manganese*.

Sources of harm in raw material extraction and processing

- Gender-based violence and mining in the energy transition (IIED, 2026). https://www.iied.org/sites/default/files/uploads/2026/10/Gender-based_violence_and_mining_in_the_energy_transition.pdf

- Understanding gender-based violence in critical mineral mining, IIED (2025). https://www.iied.org/22610iied?utm_source=chatgpt.comOverview

20 See IndustriALL Global Union (2025); IIED (2025); EBRD (2025a; 2025b).

5. 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. • Mapping key suppliers, relevant raw materials and, where possible, the main countries and production stages associated with those materials. • 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. Assessing suppliers' management systems, including policies, procedures, grievance mechanisms, traceability arrangements and monitoring of their own suppliers. • 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.

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.

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,[21] which aims to set EU Battery Regulation implementation guidelines.[22]

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.

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 one of the most comprehensive multi-stakeholder standards for responsible mining because of its multi-stakeholder governance, extensive sustainability requirements, transparency and broad scope, encompassing all mined materials.[23] Mines can be certified to four achievement levels (with an increasing level of performance): IRMA Transparency, IRMA 50, IRMA 75 and IRMA 100.[24]
- Joint Due Diligence Standard: Veramark Assurance, formerly 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.[25]
- 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: the standard system encompasses all minerals and combines

21 See Battery Pass (n.d.).
22 See EU (2023).
23 See BGR (2022), Lead the Charge (2024) and US Department of State (2022).
24 See IRMA (n.d.b.).
25 See Copper Mark (2022).

four standards that together cover the entire supply chain from mining to finished product.

- The Better Mining Programme : 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: A Comparative Overview*.
- Lead the Charge (2024), *An Assessment of Third-Party Assurance and Accreditation Schemes in the Minerals, Steel and Aluminum Sectors*.

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.

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	• Include prohibitions on child labour and forced labour in supplier codes and contracts • Require suppliers to undertake appropriate due diligence and report significant incidents • 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
OHS, GBVH and other worker harm – processing and	• Include requirements on OHS, PPE, training, GBVH prevention and worker grievance mechanisms in supplier contracts	• Review supplier OHS and GBVH policies, incident records, training arrangements and grievance mechanisms	• Conduct or commission higher-risk supplier audits or site assessments

component manufacturing	• Relevant provisions, also relating to the supply of PPE and training, are included in supplier contracts	• Require corrective-action plans where significant gaps are identified	• Monitor corrective actions and require evidence that serious incidents have been addressed and affected workers appropriately supported or remediated

Key resources on mitigation actions

- OECD (2016), *OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas*.
- OECD (2017), *Practical actions for companies to identify and address the worst forms of child labour in mineral supply chains*.
- Re-sourcing (2021), *Renewable Energy Sector: Roadmap for Responsible Sourcing of Raw Materials until 2050*.

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June 2026

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