MINISTRY OF INVESTMENT AND DOWNSTREAM INDUSTRY/BKPM

ENERGY TRANSITION PARTNERSHIP

UNOPS

REPORT

Supply Chain Integration of Battery Value Chain for Energy Transition in Indonesia

RFP/2023/49848

2025 | **Deliverable 5:** Final Report

Prepared by:

- **Hartree Consultores**
- **Kolibri Orbis**

Hartree®

Kolibri Orbis

AFD Agence Française de Développement

Federal Ministry for Economic Affairs and Climate Action

Department for Energy Security & Net Zero

Environment and Climate Change Canada / Environnement et Changement climatique Canada

Australian Government Department of Climate Change, Energy, the Environment and Water

CIFF Children's Investment Fund Foundation

Sequoia Climate Foundation

UNOPS - Energy Transition Partnership

Final Report

"Supply Chain Integration of Battery Value Chain for Energy Transition in Indonesia" - Project

RFP/2023/49848

November 2025

This report has been issued and amended as follows:

Issue	Revision	Description	Date	Signed

Project executed by:

Hartree Consultores and Kolibri

Disclaimer

Information provided in this document is provided "as is", without warranty of any kind, either express or implied, including, without limitation, warranties of merchantability, fitness for a particular purpose and non-infringement. UNOPS specifically does not make any warranties or representations as to the accuracy or completeness of any such information. Under no circumstances shall UNOPS be liable for any loss, damage, liability or expense incurred or suffered that is claimed to have resulted from the use of the information contained herein, including, without limitation, any fault, error, omission, interruption or delay with respect thereto. Under no circumstances, including but not limited to negligence, shall UNOPS or its affiliates be liable for any direct, indirect, incidental, special or consequential damages, even if UNOPS has been advised of the possibility of such damages. This document may also contain advice, opinions, and statements from and of various information providers. UNOPS does not represent or endorse the accuracy or reliability of any advice, opinion, statement or other information provided by any information provider. Reliance upon any such advice, opinion, statement, or other information shall also be at the reader's own risk. Neither UNOPS nor its affiliates, nor any of their respective agents, employees, information providers or content providers, shall be liable to any reader or anyone else for any inaccuracy, error, omission, interruption, deletion, defect, alteration of or use of any content herein, or for its timeliness or completeness

Contents

Acronyms

ADB	Asian Development Bank
AEML	Electric Mobility Ecosystem Association
APNI	*Asosiasi Penambang Nikel Indonesia* Nickel Miners' Association
ARED	Accelerated Renewable Energy Development
ASEAN	Association of Southeast Asian Nations
ASEAN	Association of Southeast Asian Nations
ATRBPN	Ministry of Agrarian Affairs and Spatial Planning/National Land Agency
BAPPENAS	Ministry of National Development Planning
BESS	Battery Energy Storage Systems
BKPM	Kementerian Investasi dan Hilirisasi (Badan Koordinasi Penanaman Modal)
CAM	Cathode Active Materials
CAPEX	Capital Expenditure
CMEA	Coordinating Ministry of Economic Affairs *Kementerian Koordinator Bidang Perekonomian*
Cr6+	Chromium ion
EOL	End-of-life
EPR	Extended Producer Responsibility
EV	Electric Vehicle
FDI	Foreign Direct Investment
FGD	Focus Group Discussion
FPIC	Free, Prior, and Informed Consent
Gaikindo	*Gabungan Industri Kendaraan Bermotor Indonesia* Association of Indonesian Automotive Industries
GEDSI	Gender Equality, Disability, and Social Inclusion
GHG	Greenhouse Gases
HPAL	High-Pressure Acid Leach
IBC	Indonesia Battery Corporation
ICEV	Internal Combustion Engine Vehicle
IEA	International Energy Agency
IFC	International Finance Corporation
IMIP	Indonesia Morowali Industrial Park
IP	Indigenous People
IWIP	Indonesia Weda Bay Industrial Park
JETP	Just Energy Transition Partnership
KEN	*Kebijakan Energi Nasional* National Energy Policy
KIIC	Karawang International Industrial City
KIMK	Kawasan Industri Mitra Karawang
km	kilometer
KNIC	Karawang New Industrial City
LCE	Lithium Carbonate Equivalent
LFP	Lithium Iron Phosphate Batteries

MEMR	Ministry of Energy and Mineral Resources *Kementerian Energi dan Sumber Daya Mineral*
MHP	Mixe Hydroxyprecipitate
MIND ID	Mining Industry Indonesia
mm	milimeter
MMAF	Ministry of Marine Affairs and Fisheries
MoE	Ministry of Environment *Kementerian Lingkungan Hidup dan Kehutanan*
MoF	Ministry of Finance *Kementerian Keuangan*
MoF	Ministry of Forestry *Kementerian Kehutanan*
MoI	Ministry of Industry *Kementerian Perindustrian*
MoInv	Ministry of Investment *Kementerian Investasi dan Hilirisasi/ Badan Koordinasi Penanaman Modal (BKPM)*
MoLHR	Ministry of Law and Human Rights *Kementerian Hukum dan Hak Asasi Manusia*
MoM	Ministry of Manpower *Kementerian Ketenagakerjaan*
MoT	Ministry of Transport *Kementerian Perhubungan*
MoWECP	Ministry of Women's Empowerment and Child Protection
MW	Mega Watt
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
Ni	Nickel
NMC	Nickel Manganese Cobalt Batteries
OHS	Occupational Health and Safety
PLN	Perusahaan Listrik Negara
PPE	Personal Protective Equipment
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional* National Medium-Term Development Plan
RPJPN	*Rencana Pembangunan Jangka Panjang Nasional*+ National Long-Term Development Plan
RUEN	*Rencana Umum Energi Nasional* National Energy General Plan
RUKN	*Rencana Umum Ketenagalistrikan Nasional* National Electricity Master Plan
RUPTL	*Rencana Usaha Penyediaan Tenaga Listrik* National Electricity Supply Business Plan
SPKLU	*Stasiun Pengisian Kendaraan Listrik Umum*

	Public Electric Vehicle Charging Stations
TOE	Tonne of Oil Equivalent
TSS	Total Suspended Solid
TWh	Terawatt Hours
UKL-UPL	Upaya Pengelolaan Lingkungan dan Upaya Pemantauan Lingkungan
UN	United Nations
UNDRIP	UN Declaration on the Rights of Indigenous Peoples
UNOPS	United Nations Office for Project Services
WTP	Wastewater Treatment Plant

List of Tables

List of Figures

Executive summary

Indonesia's energy transition hinges on developing an integrated and sustainable battery supply chain to accelerate decarbonization and industrial transformation. The Southeast Asia Energy Transition Partnership (ETP), commissioned this project to assess Indonesia's readiness to establish a comprehensive battery ecosystem that supports electric mobility, renewable power integration, and sustainable industrialization. Through the "Supply Chain Integration of Battery Value Chain for Energy Transition in Indonesia" project, the study aimed to help Indonesia expedite its energy transition efforts by integrating the local supply chain for batteries with electric vehicles (EV), battery storage energy systems (BESS) through the development of a supply chain roadmap, policy development, and identification of investment opportunities, along with corresponding investment guidelines.

This report consolidates the findings of four sequential workstreams that examined technical, regulatory, social, and environmental aspects of the national battery value chain. Workstream A provided an overview of the current supply chain structure and assessed critical technologies such as lithium-ion and sodium-ion batteries; Workstreams B and C produced a detailed analysis of Indonesia's supply chain performance, investment needs, and policy landscape; and Workstream D conducted a social and environmental impact assessment to ensure long-term sustainability. Together, these studies offer a comprehensive understanding of the opportunities and challenges that Indonesia faces in building a resilient domestic battery industry.

The report aims to serve as a reference document for policymakers, investors, and development partners to guide strategic action and decision-making. It compiles the latest data on resource availability, production capacities, investment mechanisms, and regulatory gaps, translating them into actionable recommendations. The scope covers every stage of the supply chain—from mining and refining to manufacturing, usage, and recycling—while emphasizing EV and BESS applications. The findings are grounded in extensive stakeholder engagement, field research in strategic regions such as Karawang, Morowali, and Central Halmahera, and a robust analytical framework designed to promote inclusive and evidence-based policymaking.

Indonesia's battery ecosystem depends on a broad network of stakeholders whose collaboration is critical for building a responsible and efficient value chain. The study identified a wide range of actors, including ministries, state-owned enterprises, private companies, financial institutions, civil society organizations, local communities, and foreign investors. These stakeholders were mapped according to their influence and interest, revealing a complex web of relationships shaping policy, investment, and on-the-ground implementation. Core public sector entities like MEMR, MoI, and MoInv, play pivotal roles in policy direction.

A structured engagement strategy was designed to ensure inclusivity, transparency, and mutual benefit across stakeholder groups. Stakeholders were grouped into four categories: key players, keep satisfied, keep informed, and low priority, each with tailored engagement approaches. Activities included focus group discussions, policy dialogues, workshops, and field visits to key regions. These interactions facilitated the exchange of data and perspectives, enabling a better understanding of sectoral interdependencies and local realities. They also helped identify institutional barriers, regional disparities, and opportunities for collaboration between government and industry.

Meaningful stakeholder participation provided essential insights into social, environmental, and governance dimensions of the battery supply chain. Local communities and labor groups highlighted both the economic potential and the social risks of rapid industrialization, including displacement, inequity, and gender concerns. Civil society actors, universities, and NGOs contributed evidence-based analyses on sustainability and human rights, while investors emphasized the need for regulatory stability and transparency. The inclusive approach strengthened the study's findings and ensured that the resulting roadmap reflects Indonesia's diverse priorities and socio-economic context.

Indonesia holds a strategic position in the global battery industry due to its vast mineral reserves and growing commitment to decarbonization. As part of its National Energy Policy, Indonesia targets a 19%-23% renewable energy mix by 2030 and Net Zero Emissions (NZE) by 2060. Batteries play a crucial role in achieving these goals, enabling the electrification of transport and grid integration of renewable energy. With over 20% of global nickel reserves and significant cobalt and manganese resources, Indonesia has the potential to become a central hub for battery production and export in the Asia-Pacific region. However, translating this potential into a coherent and sustainable industrial ecosystem requires significant policy alignment and infrastructure development.

Despite substantial resource availability, Indonesia's battery supply chain remains unevenly developed across its different phases. Upstream mining and refining activities are well established particularly in Sulawesi and North Maluku,. Midstream manufacturing, including cathode and anode production, is in its infancy, with limited domestic capacity and reliance on imported materials such as lithium and graphite. Downstream activities, including EV and BESS deployment, have progressed under government incentives but remain hindered by weak local content enforcement, insufficient charging infrastructure, and limited recycling capacity.

To achieve sustainable integration, Indonesia must address regulatory, technical, and environmental challenges across the supply chain. The report identifies policy inconsistencies, particularly between industrial downstreaming goals and environmental commitments, as key obstacles. For example, mining and refining companies are mostly foreign-owned and rely heavily on coal-based power. Moreover, the absence of a clear circular economy framework hampers end-of-life management, while weak enforcement of environmental and social safeguards risks undermining community trust. By advancing cleaner refining technologies, harmonizing fiscal incentives, and prioritizing domestic manufacturing and recycling, Indonesia can position itself as a leader in sustainable battery value chains.

Indonesia's policy framework has succeeded in attracting investment but struggles with coherence, equity, and environmental alignment. Downstreaming measures such as the nickel export ban and local content mandates have accelerated industrial activity, yet their benefits are unevenly distributed. Most smelters remain foreign-owned, and coal-powered refining continues to generate high emissions. Inconsistencies like simultaneous support for EV imports and domestic EV manufacturing undermine policy effectiveness and create uncertainty for investors. Addressing these contradictions is essential to ensure that Indonesia's industrial growth contributes to long-term sustainability.

The absence of a clearly defined strategic framework for resource security and waste management may pose challenges to the stability of the supply chain. While Indonesia dominates global nickel production, it remains fully dependent on imports for lithium, manganese, and graphite. The absence of stockpiling strategies or diversified sourcing exposes the country to price volatility and geopolitical shocks. Similarly, waste management systems are underdeveloped, and the informal sector's involvement in handling hazardous materials creates safety and environmental risks. Strengthening circular economy mechanisms and creating clear pathways for material recovery are vital to securing supply resilience.

Policy reform must focus on coherence, circularity, and inclusiveness to support a sustainable industrial transition. Key priorities should include harmonizing fiscal incentives across ministries, improving environmental oversight, and integrating gender and human rights perspectives into industrial policy. The government should institutionalize Regulatory Impact Assessments (RIAs) to ensure that new measures align with broader national objectives and international standards. Moreover, encouraging public–private partnerships, especially in recycling and renewable energy integration, will be critical to enhance transparency, attract green financing, and sustain long-term competitiveness.

It is recommended that Indonesia adopts a holistic roadmap that aligns policy, investment, and sustainability objectives to build a competitive battery ecosystem. The proposed roadmap (2026–2040) identifies five key areas for strategic action: policy and regulation, production capacity and end-of-life management, traceability and export readiness, expansion of end-use markets, and financing and bankability. It emphasizes coherence across ministries, the adoption of circular economy principles, and the development of enabling infrastructure for EV and BESS deployment. Establishing a unified governance framework will be central to ensuring consistent implementation and long-term policy stability.

Building domestic capacity while advancing circularity is critical to strengthening supply chain resilience and value creation. The recommendations call for developing lithium and manganese processing capabilities, adopting Extended Producer Responsibility (EPR) systems for battery recycling, and setting clear targets for material recovery. A national battery passport system is proposed to trace components, ensure compliance with ESG standards, and facilitate export readiness. Simultaneously, harmonized local incentives, improved grid readiness, and expanded charging networks are needed to boost domestic demand for EVs and BESS applications.

A robust financing and policy environment will unlock investment and enhance Indonesia's competitiveness in the global market. The report proposes establishing financial mechanisms to de-risk projects, such as public guarantees, special-purpose vehicles, and transparent investment frameworks. Coordination between policymakers, financial institutions, and industry players will be key to mobilizing capital for battery manufacturing, recycling, and infrastructure. Aligning Indonesia's regulatory standards with global frameworks, including the EU Sustainable Batteries Regulation and the Global Battery Alliance, will ensure export access, attract green finance, and bolster investor confidence.

Indonesia stands at a critical juncture where coherent policy, circular innovation, and global collaboration can transform its resource wealth into sustainable growth. The report concludes that Indonesia has made strong progress in establishing the foundations of a domestic battery industry but must now move from fragmented initiatives to integrated execution. Sustained policy coherence across government levels and sectors will determine the success of Indonesia's battery ecosystem. The institutionalization of RIAs, the harmonization of local incentives, and a clear BESS regulatory roadmap will enable a stable and predictable investment climate.

Circular economy integration is key to ensuring environmental and social sustainability across the battery lifecycle. Indonesia's inclusion of batteries in its National Circular Economy Strategy marks an important step, yet implementation remains limited. A comprehensive framework for waste-to-resource transition, certification of recovered materials, and end-of-waste criteria would unlock recycling opportunities and reduce dependence on imports. Embedding product design standards that enable reuse and repair will help extend battery life and minimize environmental impact, positioning Indonesia as a regional model for circular innovation.

Strategic partnerships and sustainable financing are the final pillars to ensure Indonesia's long-term success. Diversifying industrial partnerships, deepening engagement with international frameworks like the Global Battery Alliance, and fostering public–private collaboration will expand access to technology, capital, and global markets. Strengthening grid and logistics infrastructure, accelerating charging station deployment, and incentivizing renewable-powered refining will be essential to operationalize the roadmap. By aligning economic ambition with environmental stewardship and social inclusion, Indonesia can emerge as a leading force in the global energy transition.

1. Introduction

1.1 About the Southeast Asian Energy Transition Partnership (ETP) and this project

The Southeast Asia Energy Transition Partnership (ETP) is a program of the United Nations Office for Project Services (UNOPS) and is a dynamic partnership of government and philanthropic partners, working to facilitate sustainable energy transition in Southeast Asia. ETP is strengthened by its knowledge of the region, unwavering commitment to inclusive growth and ability to mobilize support services that cater to unique project requirements.

ETP's teams synergize the strengths of the public and private sectors and implementing partners, with the project management expertise of UNOPS to coordinate technical and financial resources needed to make a difference.

Through the design and delivery of targeted technical assistance programs, aligned with ongoing initiatives in the region, ETP provides the expertise, coordination, dialogue and knowledge expansion needed to expedite energy transition.

ETP's work is structured around four strategic outcome (SO) areas:

I. Policy alignment with climate commitments,
II. De-risking investments on renewable energy, energy efficiency and fossil fuel phasedown,
III. Sustainable and resilient infrastructure, and
IV. Just transition

1.2 About the project

The overall objective of the "Supply Chain Integration of Battery Value Chain for Energy Transition in Indonesia" project financed by ETP was to help Indonesia expedite its energy transition efforts by integrating the local supply chain for batteries with electric vehicles (EV), Solar Photovoltaic (PV) businesses, and other RE power plants through the development of a supply chain roadmap, policy development, and identification of investment opportunities, along with corresponding investment guidelines.

The methodology and approach provided by the implementing partners in the Inception Report assisted to:

1. Catalyse the development of a *sustainable battery supply chain*[1],
2. Develop an integrated electric vehicle (EV) supply chain and
3. Leverage the abundance of natural resources in the country, particularly nickel.

The study was developed through four workstreams (Figure 1.1). **Workstream A** targeted the analysis of the battery supply chain's current state, identifying key data sources and

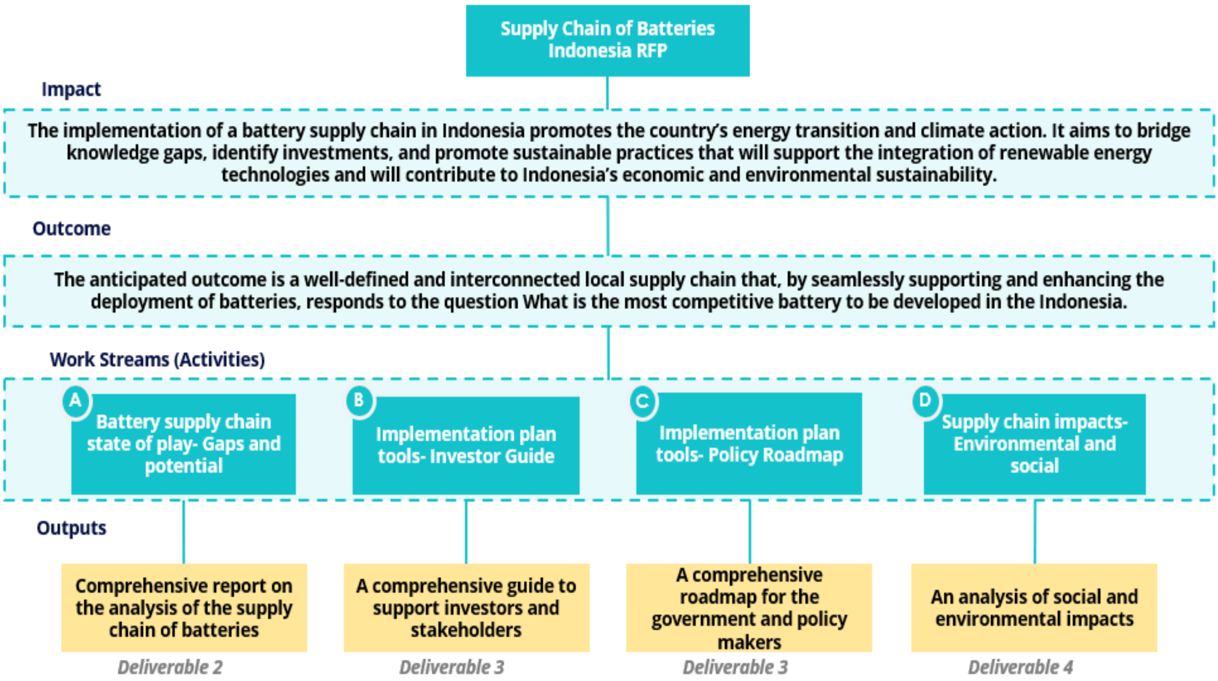
[1] A **sustainable battery supply chain** integrates environmental, social-economic, and financial considerations throughout all stages, from production to end of life. It recognizes potential negative impacts and implements measures to mitigate them, ensuring gender equality, social inclusion, ethical practices, community well-being, and environmental protection from raw material extraction to recycling.

conducting a deep-dive analysis to inform policymakers of gaps and potential areas for development, and had Deliverable 2 as output. Deliverable 2 examined key battery technologies—particularly lithium-ion and sodium-ion—along with their compositions, uses, and emerging trends. The report analyzed the full supply chain, from materials and refining to cathode and anode production, cell manufacturing, and end-of-life management, assessing resource availability, production capacity, and national challenges and opportunities. It also reviewed relevant industries and organizations, presented a geopolitical and economic analysis of critical minerals and EV adoption, and concluded with targeted recommendations to support the strategic development of Indonesia's battery sector.

Deliverable 3 was the result of **Workstream B and Workstream C** which targeted the analysis of Indonesia's current battery supply chain, zooming in on every link of the chain. The report presented a comprehensive guide and roadmap to support potential investors, stakeholders, and the government in accelerating energy transition through batteries for EV, solar PV ecosystem development, and other RE power plants. It explored the integration of supply chains, evaluated current incentive scheme, assessed the compatibility of the policies in place with national targets, and suggested an implementation plan.

Finally, **Workstream D,** which produced Deliverable 4, evaluated the environmental and social factors that are crucial for the sustainable implementation of activities within the battery supply chain. This report presented an analysis of social and environmental impacts related to the supply chain of batteries, and proposed solutions for social and environmental challenges encountered along the supply chain.

Figure 1.1 Study's structure



1.2.1 About this report

The objective of this report is to consolidate the results from all previous Workstreams (Deliverable 1-4), serving as a comprehensive document that records the key findings and takeaways and provides valuable guidance for future developments in the battery supply chain for energy transition. It is structured and designed for ease of access by a wide array of stakeholders to ensure its maximum impact and practicality.

Building upon the output of the earlier deliverables, this report integrates the analytical, technical, and strategic components developed throughout the project. It presents an overarching synthesis of findings from the assessments of Indonesia's battery ecosystem, covering its policy and regulatory landscape, industrial capacities, environmental and social dimensions, and investment opportunities, while translating these insights into actionable recommendations and a roadmap for implementation.

This document represents the final deliverable (Deliverable 5) of the project and consolidates the cumulative knowledge generated through its four workstreams, which examined:

- The current state and potential of Indonesia's battery supply chain;
- Policy and regulatory frameworks guiding its development;
- Investment opportunities and market integration strategies; and
- Environmental and social implications critical to sustainable implementation.

The scope of this report encompasses the entire battery value chain, from mining and refining of critical minerals to component and cell manufacturing, usage in EVs and BESS, and end-of-life management and recycling. By compiling the project's main findings, this report not only provides a snapshot of Indonesia's current readiness to develop a domestic battery supply chain, but it also aims to highlight the recommendations in key action areas to develop the battery supply chain in the short, mid and long term.

The report is intended to serve as a reference and a tool to support decisions for government agencies, policymakers, private investors, development partners, and other stakeholders engaged in Indonesia's energy transition. It aims to inform policy formulation, guide investment planning, and support the creation of an enabling environment for the sustainable growth of the national battery industry. Further details on the information, analysis, findings and conclusions in this report are presented Deliverables 1 – 4 of this study.

1.2.2 Scope and Limitations

The scope of this study covers all stages of the battery supply chain: mining and refining of raw materials, cathode active materials (CAM), cell manufacturing and assembly, end uses i.e., EVs and BESS, and end of life. While the study addresses the battery's role within the EV and BESS production and usage phases, it is important to note that this is not a full assessment of the EV nor BESS supply chain. Accordingly, non-battery EV and BESS components, such as vehicle bodies, containers, motors, and other electronic and nonelectronic components, fall outside the study's scope.

The study specifically focuses on Indonesia's national battery supply chain, with particular emphasis on batteries intended for electric vehicle (EV) applications. This focus aligns with the Government of Indonesia's national priorities, as the country accelerates the development and production of four-wheeled (4W) EVs, establishing both supply and demand side incentives to stimulate investment and market adoption. Among these measures are corporate income tax holidays for EV industry investments, tax import exemption for fully assembled EVs, and preferential loans for EV purchases. This is in line with global trends, since transportation represents more than half of the total end-use sectors for batteries[2]. Consequently, the battery usage phase is limited to EV-related usage and applications and does not cover other batteries or derived enablers, such as stationary storage systems.

The findings and analysis presented in this study are based on information available up to October 2025. Given the rapidly evolving policy landscape for battery supply chains and EVs in Indonesia, some policy and regulatory assumptions may change or become outdated shortly after the completion of this study. Some Deliverables will contain Ministries that no longer exist (like the Ministry of State-Owned Enterprises that got changed into a regulatory agency) or an older version of some planning instruments (like the RUPTL).

1.2.3 Methodologies

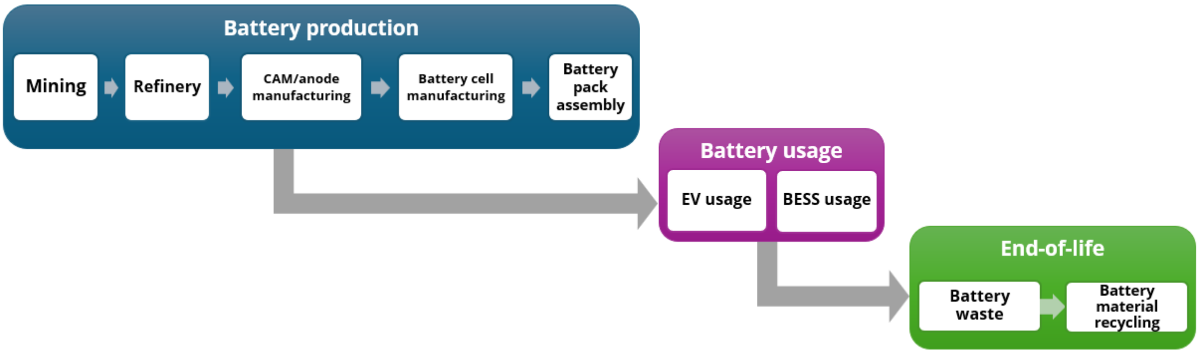
The project used a combined approach of desktop research, stakeholder engagement, and site visits to validate findings to reach its objectives. Gender perspective and social inclusion considerations were also included into the analysis as a cross-cutting approach for project implementation. For the purpose of this project, the supply chain phases were organized into four (4) large groups:

1. **Battery Production:** This phase covers the extraction and processing of raw materials, component manufacturing, and the assembly of battery packs ready for consumer use.
2. **Battery Usage:** This phase focuses on the operational lifespan of batteries during their use by end consumers, which includes applications in electric vehicles (EVs) and battery energy storage systems (BESS).
3. **End-of-Life (EOL):** This phase encompasses the collection, repurposing, and recycling processes aimed at recovering materials and minimizing environmental impacts at the end of the battery's useful life.
4. **Associated Facilities:** In addition to these core phases, the study also considers associated facilities that directly or indirectly support the supply chain, including industrial estates, special ports, and transport and logistics, which provide critical infrastructure and energy inputs to the supply chain.

[2] See Deliverables 2 and 3 from this project to know more about incentives and end-uses for batteries

The diagram in Figure 1.2 shows the detailed steps of each supply chain link. For simplifying purposes, this project did not zoom in on any particular activity, and rather focused on the main steps of the supply chain, providing detailed information whenever possible.

Figure 1.2 Battery supply chain activities



The assessment began with a preliminary supply chain mapping exercise aimed at identifying key global stakeholders in the battery value chain, including their locations, production volumes, and applications. Methodologically, the mapping relied on literature reviews, industry reports and market analysis. The mapping exercise covered major supply chain steps from mining to end of life, detailing each stage with descriptions of key activities, technologies involved, and their relevance and significance for the Indonesian economy and battery demand.

A key aspect of this battery supply chain tracing and mapping was the International Standard Industrial Classification of All Economic Activities[3] (ISIC), which was used for classifying raw material data; and the Harmonized System (HS), specifically, the 6-digit codes to classify each product within the battery supply chain. Using ISIC system and HC codes facilitated the collection of statistics such as the number of companies, employment figures, and geographical distributions relevant to each stage of the battery value chain.

The economic perspective included a demand analysis to estimate the national demand for batteries and a high-level economic analysis of the benefits for Indonesia in developing the battery supply chain. The demand analysis estimated the national demand for batteries in GWh, by constructing scenarios that account for variations in battery chemistry. The targets for EVs and BESS manufacturing were taken directly from Indonesia's regulation and national planning instruments.

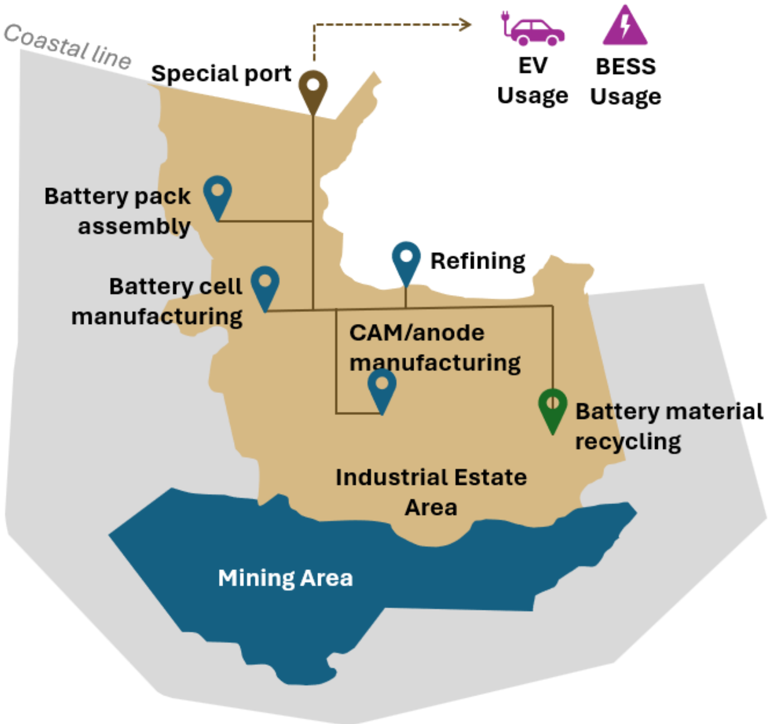
For the regulatory analysis, Indonesia's current governmental policies and initiatives related to energy transition, with a particular focus on their impact on the battery supply chain were mapped. Then, relying on doctrinal legal research, the mapping of the legislative framework governing each stage of the battery supply chain was conducted, with a view of analyzing the application of the rules in the context of batteries. Third, as

[3] UN Statistics Division. ISIC. Available at: https://unstats.un.org/unsd/classifications/Econ/isic

law does not operate in vacuum, the existing national policy and legislative framework within the wider international and transnational framework was examined by relying on law-in-context (law and policy, in particular) and comparative law approaches to understand the international repercussions of measures and learn international best practices in developing a sustainable battery value chain. This analysis considered, inter alia, geopolitical issues, the measures introduced by the EU and the US to support the development of domestic battery supply chains and international collaborations that might impact the supply chain.

A typical interaction between different supply chain phases is illustrated in Figure 1.3. Associated facilities are spatially interconnected with the core activities, forming an integrated system that supports the overall production flow. Mining concessions—typically located outside industrial estates—supply raw ore to refinery plants located in the industrial estate. The industrial estate also hosts the subsequent stages of battery production, such as battery component and cell manufacturing as well as pack assembly. Goods are shipped through land via roads within or outside the industrial estate, or sea transport via special terminals. From these transportation hubs, goods are shipped for battery usage. Battery recycling plants are also planned for development within industrial estates.

Figure 1.3 Typical interaction between core activities and associated facilities



Strategic regions were selected for their roles across the battery supply chain—representing the upstream stage with abundant nickel reserves and active mining and refining operations, and the other representing the downstream stage with industrial estates and transport infrastructure. Below is an elaboration of the chosen regions and the relevant supply chain phases. In addition, Figure 1.4 and Table 1.1 show an overview of each snapshot region in maps.

Figure 1.4 Scope of snapshot regions

Table 1.1 Regions as snapshots of different battery supply chain phases

Battery production | Battery usage | EOL management | Associated facilities

Battery supply chain phase		Region: Karawang*	Region: Morowali*	Region: Central Halmahera
Battery production	Mining			
	Refinery			
	Battery component manufacturing			
	Battery cell manufacturing and assembly			
Battery usage	Battery usage in EVs	Assessed off-site by inherent impact per EV unit		
	Battery usage in BESS	Assessed off-site by inherent impact per BESS unit		
EOL	Battery recycling			
Associated facilities	Industrial estate			
	Special port			
	Transport & logistics			

field visit destinations

Karawang, West Java

Located near Greater Jakarta, Karawang (Figure 1.5) and its surrounding areas have long established themselves as a robust industrial hub. Industrial complexes in this area are relatively rampant compared to the other two regions. Karawang International Industrial City (KIIC), Kawasan Industri Mitra Karawang (KIMK), and Karawang New Industrial City (KNIC) are among the few industrial complexes located in the area. NMC battery producer PT HLI Green Power is a tenant in KNIC.

Being close to the industrial hub in Greater Jakarta, other supply chain industries are also located near Karawang. In Cikarang, automotive companies such as Hyundai Motors Indonesia and Wuling Motors Indonesia (PT SGMW Indonesia) are known to manufacture 4W EV units. Battery cell manufacturing facilities operated by PT International Chemical Industry (Intercallin) and PT Gotion Green Energy Solutions (Gotion) are also located in Jakarta and Bogor, respectively.

Morowali, Central Sulawesi

Morowali is home to various nickel mining concessions (Figure 1.5). Although Sulawesi generally has many mining concessions, Morowali takes precedence as it is also home to two operational HPALs (PT QMB Energy Materials and PT Huayue Nickel Cobalt), anode manufacturer PT BTR New Energy Materials, and the only battery recycling plant in Indonesia (PT Indonesia Puqing Recycling Technology). All companies are situated at the Indonesia Morowali Industrial Park (IMIP), a prominent industrial estate in the region.

As a region, it is experiencing rapid growth in the battery industry. Lithium processing facilities are reportedly under development in Morowali as well[4]. Opportunities and lessons learned at the regional level can give an overview of the upstream battery supply chain.

Central Halmahera, North Maluku

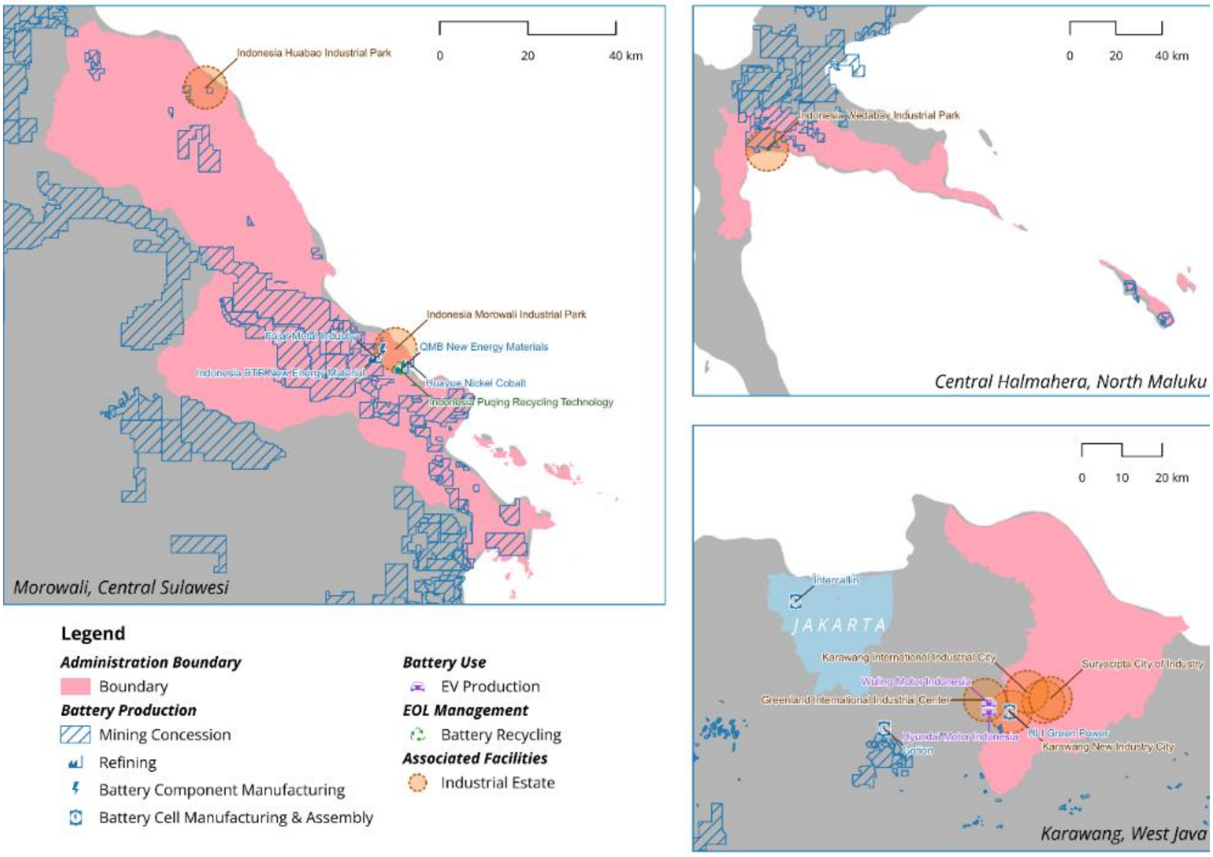
The islands of North Maluku (Figure 1.5) have recently become a hotspot for nickel mining and refinery. Out of the many regencies, Central Halmahera is chosen as it is located in the Indonesia Weda Bay Industrial Park (IWIP).

The presence of IWIP signifies potential future developments. Tenants in IWIP include nickel mining company PT Weda Bay Nickel and nickel refining companies PT Yashi Indonesia Investment, and PT Youshan Nickel Indonesia[5], although nickel refining is reportedly not yet operational. Battery manufacturing facilities have also begun development on the estate although not yet in an operational state[6].

---

[4] RI Lagi Bangun Pabrik Lithium, Ini Dia Pemiliknya (CNBC Indonesia 2023)
[5] Indonesia Weda Bay Industrial Park. (2025). Official website. Link
[6] Menperin apresiasi IWIP bakal ekspor prekursor nikel untuk baterai EV (Antara 2024)

Figure 1.5 Maps of snapshot regions: Morowali, Central Halmahera, and Karawang



Source: Own elaboration, with map sources from ESDM One Map[7] and Google Earth (2025)

Data collection was conducted through desktop research, beneficiary engagement, stakeholder focus group discussions (FGD), and field verification. See Table 1.2 for a detailed overview for each data collection approach.

Table 1.2 Data collection methods

Approach	Description	Timeline
Desktop research	Comprehensive desktop research was conducted to determine current industry practices, identify supply chain issues, perform impact analysis, and develop mitigation strategies. Desktop research encompasses a review of existing literature and publications, publicly available databases, government reports, and conference proceedings.	Continuous
Stakeholder FGD	FGD sessions were conducted good business practices, lessons learned, and grievances. Depending on the stakeholders' availability, FGD can be conducted either before (online or in-person in Jakarta) or during field visits. See Annex A for a detailed overview of these activities.	Jul 10 – Aug 28
Field verification	On-site field verifications by the consultant team were conducted to confirm data collection findings. The proposed destinations are Karawang and Morowali, as both regions can capture the upstream, midstream, and downstream of the battery supply chain. See Annex A for a detailed overview of these activities.	Jul 28 – Sep 3

[7] MEMR. (2025). *ESDM One Map*. [Link]

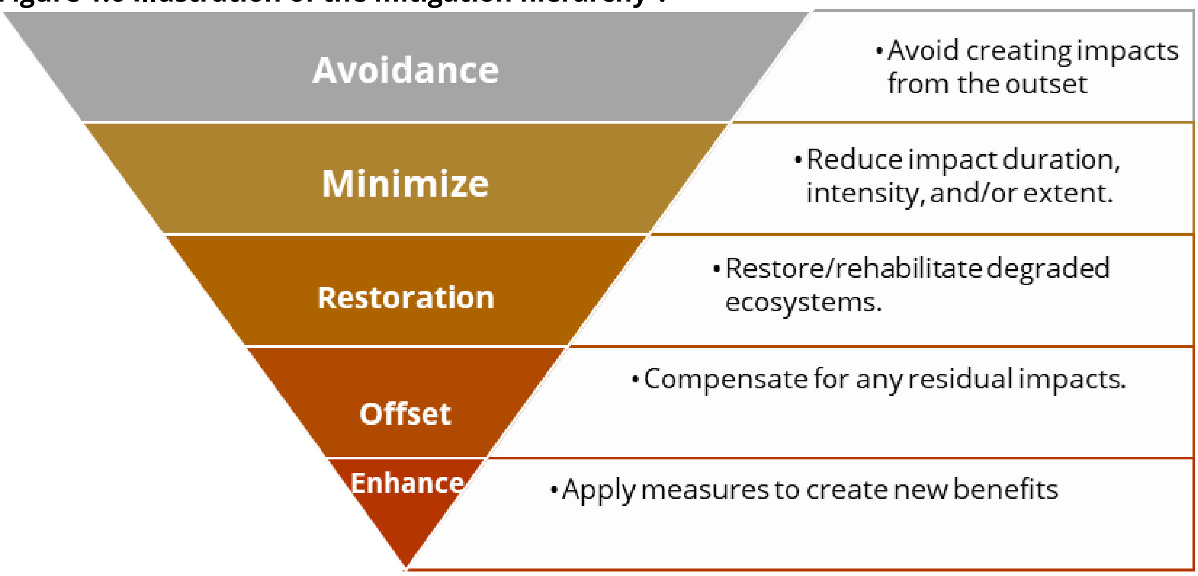
For the Environmental and Social Impact Analysis, the following matrix (Table 1.3) was used to classify impacts:

Table 1.3 Rating significance of impacts

		Likelihood of occurrence				
		Very unlikely to occur (1)	**Not expected to occur (2)**	**Likely – could occur (3)**	**Known to occur – almost certain (4)**	**Common occurrence (5)**
Impact	**Severe (5)**	Moderate	Substantial	High	High	High
Impact	**Major (4)**	Low	Moderate	Substantial	Substantial	High
Impact	**Medium (3)**	Low	Moderate	Moderate	Moderate	Substantial
Impact	**Minor (2)**	Low	Low	Moderate	Moderate	Moderate
Impact	**Negligible (1)**	Low	Low	Low	Low	Low

Based on the impact assessment results, mitigation strategies were determined based on residual impacts. The mitigation strategies will be determined using the mitigation hierarchy approach, as shown in Figure 1.6.

Figure 1.6 Illustration of the mitigation hierarchy[8].



The scope of the ESIA encompassed a high-level overview of the battery supply chain in Indonesia, addressing activities as indicated in Figure 1.7.

[8] Cares Suárez, Rocío Andrea and Franco, Aldina and Bond, Alan, Investigating the Implementation of the Mitigation Hierarchy Approach in Environmental Impact Assessment in Relation to Biodiversity Impacts.

Figure 1.7 General overview of ESIA process

2. Stakeholder engagement strategy

This section gives an overview of the identified stakeholders in the battery supply chain as well as relevant engagement strategies fitting to their respective roles. A list of conducted stakeholder engagement events is also enlisted here.

2.1 Stakeholder identification and mapping

The battery supply chain has a list of stakeholders with their respective roles, influences, and interests. The stakeholders are categorized into several groups: the public sector, industry players, ecosystem players, financial institutions, local communities, civil society, and foreign entities.

2.1.1 Public Sector

Many government institutions are vital in setting the stage for Indonesia's battery supply chain. The key policymakers identified are the Ministry of Energy and Mineral Resources (MEMR), the Ministry of Industry (MoI), and the Ministry of Investment (MoInv). These ministries regulate upstream and downstream industries in the battery supply chain, set industry targets for the EV industry, and attract foreign investment to drive further industrialization. While key policymakers set the context of the battery supply chain in Indonesia, other government institutions complement or act under their direct mandate, further setting the stage. Table 2.1 shows a list of relevant policymakers in the supply chain.

Table 2.1 List of stakeholders from the public sector

Stakeholder	Function in the supply chain
Ministry of Energy and Minerals Resources (MEMR)	MEMR is the ministry accountable for accelerating Indonesia's energy transitions. In the context of the battery supply chain, MEMR governs the mining industry, regulating the overall industry practice (e.g. production capacity, safety procedures, etc). The battery supply chain also falls within the boundary of MEMR's governance of the energy sector, where energy transition can benefit from battery technologies.
Ministry of Industry (MoI)	The MoI strengthens national industrial growth, supports and regulates key industry members in the battery supply chain. It is accountable for issuing permits for industrial compounds and manufacturers, among other things. In response to Indonesia's interest in developing the supply chain further, the MoI has issued a developmental road map, specifically for BEV production.
Ministry of Investment (MoInv)	The Ministry is essential in attracting international and national investors to develop the batteries' supply chain and promote the country as an attractive investment destination, stimulating economic growth.
Ministry of National Development Planning (BAPPENAS)	BAPPENAS is the Ministry that oversees national development in all sectors, including energy. Although not directly influencing the battery supply chain, its development could impact the national development plan, which is within BAPPENAS' jurisdiction.
Ministry of Environment (MoE)	MoE plays a crucial role in overseeing environmental protection laws, guidelines and promoting the sustainable management of Indonesia's natural resources, which may be affected by battery-related activities. MoE is fully accountable for issuing environmental-related permits and enforcing environmental sanctions. In relation to Indonesia achieving net-zero targets,

Stakeholder	Function in the supply chain
	it is in MoE's highest interest that the battery supply chain complies with relevant laws and regulations.
Ministry of Forestry (MoF)	MoF holds the authority over all forest areas in the country. MoF delineates and categorizes forest areas based on their status and usage and, in doing so, is able to issue forestry permits for industrial use. MoF is also able to enforce forest moratoriums. The extraction industry often goes over to forest boundaries, requiring them to engage with the MoF for their business.
Ministry of Transportation (MoT)	MoT is the ministry accountable for transportation in the country. As the battery supply chain will impact transportation in the near future, MoT may have to adjust policies, especially regarding EVs or electric public transportation.
Ministry of Finance (MoF)	MoF plays an important role in building financing mechanisms to accelerate the development of the battery industry. Financing mechanisms issued by the MoF include incentives and tax exemptions. A mature national battery industry that can be capitalized may also be in the MoF's best interest.
DANANTARA Investment Management Agency	The recently created sovereign wealth fund absorbed some of the faculties of the now extinct Ministry of State-Owned Enterprises, and due to its investment and asset-management capacities, it holds significant influence over the battery supply chain by directing capital to certain markets and technologies. It holds managerial, financial and corporate power over key SOEs in Indonesia, such as MIND ID, PLN, and Pertamina.
State-Owned Enterprises Regulatory Agency (BP BUMN)	The agency oversees all SOEs whose business activities are aligned with the country's objectives and goals. Almost all companies that play a significant role in the battery supply chain are SOEs. Previously a Ministry, the Agency will have supervision power over the SOEs, but now holds less influence and power over them.
Ministry of Manpower (MoM)	The MoM oversees policies and regulations regarding manpower, such as occupational health,safety and the acquisition of local workers. National manpower standards apply to high-risk industries in the battery supply chain. Good human resource practices are key to companies seeking investment. The MoM could enforce sanctions on companies that do not comply with standards, e.g., reported accidents.
Ministry of Marine Affairs and Fisheries (MMAF)	MMAF plays a role in ensuring sustainable management of coastal and marine areas through permitting and environmental standards for coastal zones, protection of marine ecosystems, and oversight of industrial activity impacts
Ministry of Agrarian Affairs and Spatial Planning	ATRBPN functions as the gatekeeper of land tenure and spatial compliance. It ensures that the land use for the entire process of supply chain phase is legally sound, geographically clear, and, most importantly, socially.
Ministry of Women Empowerment and Child Protection	Monitoring the social landscape to prevent and address child labor, sexual exploitation, and gender-based violence often associated with large-scale industrial projects and rapid migration.
Ministry of Trade (MoT)	MoT is responsible for regulating the export and import of minerals and derivative products, as well as securing international market access for domestic industries. Its role includes implementing domestic value–addition policies, setting tariffs, and establishing international trade agreements.

Stakeholder	Function in the supply chain
Coordinating Ministry of Economic Affairs (CMEA)	The CMEA is important in determining and accelerating nationally strategic projects (PSN), which can benefit the battery supply chain. The presence of a domestic battery supply chain can influence the national economic roadmap.
National Energy Council (DEN)	The National Energy Council (DEN) issues the National Energy Policy (KEN) and guides the National General Energy Plan (RUEN), overseeing national energy–mix targets, including renewable energy growth.
Regional Governments	Regional governments are essential in the battery supply chain. Regions receive the immediate impact from businesses, such as an increase in regional economic revenue. Likewise, they are among the first to face public grievances when negative business impact emerges. In some instances, governors can issue business-related permits and enforce sanctions.

2.1.2 Industry Players

Industry players in the battery industry are mainly the main operators of the battery supply chain. In the context of Indonesia, industry players are categorized based on their source of investment: state-owned or the private sector. In addition, industrial associations also exist as representatives of professionals and industries, which serve as a platform to advocate sector-specific issues. Table 2.2 shows a list of industry players relevant for the battery supply chain.

Table 2.2 List of stakeholders from the industry player group

Stakeholder	Function in the supply chain
State-owned Enterprises	
Mining Industry Indonesia (MIND ID)	Indonesia's mining industry holding company, which is comprised of PT Aneka Tambang Tbk, PT Bukit Asam, PT Freeport Indonesia, PT Indonesia Asahan Aluminium (Persero), and PT Timah Tbk., plays a significant role in the battery supply chain. Its subsidiaries, particularly Antam, are large players in the mineral industry.
Indonesia Battery Corporation (IBC)	IBC is a SOE focusing on battery development in Indonesia. It is a consortium of four SOEs: Antam, PT Indonesia Asahan Aluminium (Persero), Pertamina, and PLN[9]. IBC's position as a SOE is strategic in the battery sector as it works under the government's direct mandate and contributes to initiating other operating industries.
Perusahaan Listrik Negara (PLN)	PLN is the single electricity company in Indonesia. The company has absolute authority over the transmission, distribution, and supply of energy. PLN's RUPTL (Electricity Supply Business Plan) is a direct mandate of MEMR's RUKN (National Electricity Plan). As a power company, PLN is also part of the IBC and the consortium owns many BEV charging stations in the country.
Aneka Tambang Tbk (Antam)	Antam as Indonesia's largest nickel producer is a key player in developing the national battery supply chain. As a state-owned enterprise, it receives strong government support to accelerate upstream development, making the success of Indonesia's battery ecosystem closely aligned with Antam's strategic interests.

[9] *Inilah 10 Perusahaan Tambang Nikel Terbesar di Indonesia, Apa Saja? – Media Nikel Indonesia, 2023*

Stakeholder	Function in the supply chain
Private Sector	
Domestic Companies	Private companies largely drive the mining industry in Indonesia. Private sector players include PT Vale Indonesia Tbk (subsidiary of Vale Base Metal), PT Ceria Indotama Nugraha, and PT Merdeka Battery Materials Tbk[10].
Industrial Estate Owners	Some supply chain activities may be conducted within industrial estates[11]. Companies within industrial estates are enforced with a different set of rules, regulations and permits and are given access to privileges, e.g., the ability to use industrial facilities for their business activities, such as ports and logistics, waste management, clean water provision, etc. Notable industrial estates associated with the battery supply chain are Indonesia Morowali Industrial Park (IMIP) and Indonesia Weda Bay Industrial Park (IWIP).
Other	
Industrial Associations	Industrial associations provide important and concentrated silos for certain professions and industries. Professional and industry representatives use organizations such as these to advocate for concerns on business practices, market conditions, regulations, and other issues. In the context of the battery supply chain, Indonesia has APNI (Indonesian Association of Nickel Miners), AEML (Electric Mobility Ecosystem Association), FINI (The Indonesian Nickel Industry Forum), and Gaikindo (Association of Indonesian Automotive Industries).

2.1.3 Ecosystem Players

Ecosystem players are essential in stimulating public EV adoption. Per the BEV development roadmap (MoI Regulation 28/2023), public transport operators and EV-exclusive zones initiate the development of EV ecosystems. The emergence of EV fleets in public transport, recharging stations, and battery swapping/recycling facilities are important EV ecosystem components. Table 2.3 shows a list of ecosystem players relevant to the battery supply chain.

Table 2.3 List of stakeholders from the ecosystem player group

Stakeholder	Function in the supply chain
Public Transport Operators	Several public transport operators have included EVs in their fleet. This includes mass transportation (i.e., Transjakarta) and taxi operators (i.e., Blue Bird, Grab). This is part of the MOI EV development roadmap, which aims to create domestic market demand, push EV industrialization, and develop a battery ecosystem.
Battery Charging Station (SPKLU) Operators	Battery charging stations, or SPKLU (*Stasiun Pengisian Kendaraan Listrik Umum*), are generally provided by PLN in strategic business partnerships with external parties such as Electrum and Volta[12]. SPKLU units are reportedly increasing in response to the growing EV market.

[10] *Penyediaan SPKLU Hasil Kerja Sama PLN dan Mitra Swasta Terus Meningkat – Kontan.co.id, 2024*
[11] *IWIP Kebut Pengembangan Kawasan Industri untuk Komponen Baterai Kendaraan Listrik – Kontan.co.id, 2022*
[12] *Indonesia's Electric Vehicle Outlook (AC Ventures, 2023)*

2.1.4 Financial Institutions

The role of financial institutions in the battery supply chain is to provide financing mechanisms to stimulate EV adoption. This group is comprised of sovereign wealth funds (e.g., Indonesia Investment Authority), lenders (e.g., multilateral development banks), and insurance companies. Sovereign wealth funds and lenders provide investments or loans to industry and ecosystem players, whereas banks and insurance companies provide EV financing mechanisms for retail consumers to promote EV purchases. Table 2.4 shows a list of relevant financial institutions in the battery supply chain.

Table 2.4 List of stakeholders from the financial institution group

Stakeholder	Function in the supply chain
Sovereign Wealth Fund	Strategic investment institutions in Indonesia, including INA and Danantara, play a pivotal role in strengthening the national economy and accelerating industrial transformation. INA focuses on deploying sovereign wealth funds to support the development of energy-transition infrastructure and other strategic investments. Danantara acts as a strategic investment manager that drives the growth of high value-added industries, particularly in future-focused sectors such as batteries and electric vehicles.
Multilateral Development Banks (MDBs)	MDBs provide financing mechanisms to the battery supply chain to promote sustainable development and energy transition. Relevant MDBs include the World Bank (WB), Asian Development Bank (ADB), and European Investment Bank. MDBs not only provide loans for EV-related projects but also guide national policies and actions related to EV deployment. Examples include the ADB-funded "Electric Transportation and Charging Infrastructure Project" in Indonesia and WB's "Climate-Smart Mining for Energy Transition"[13].
Banks	Banks are reported to be open to investing or lending funds to any stage of the battery supply chain. Many are interested in providing loans for the EV industry[14], but some are also reportedly interested in the mining industry[15]. For retail consumers, banks also offer financing for EV purchases[12].
Grant Organizations	Grant organizations provide grant funding to accelerate the energy transition by supporting renewable energy deployment, energy efficiency initiatives, and resilient energy infrastructure.
Insurance Companies	Insurance companies, particularly related to automotive insurance, offer EV financing mechanisms for retail purchases to stimulate EV adoption[12].

2.1.5 Local Communities

Local communities are important stakeholders in the battery supply chain, as they experience the direct impacts from industry activities. These stakeholders often represent vulnerable groups whose livelihoods, social well-being, and environment may be affected throughout the supply chain —upstream, midstream, and downstream. Table 2.5 shows a list of relevant local stakeholders that are crucial to the supply chain.

---

[13] *World Bank. (2019). New World Bank Fund to Support Climate-Smart Mining for Energy Transition. Press Release.*

[14] *Perbankan Semakin Gencar Salurkan Kredit Kendaraan Listrik – Kontan.co.id, 2023*

[15] *Pertumbuhan Kredit Investasi Pertambangan Cetak Rekor – Bisnis.com, 2022*

Table 2.5 List of stakeholders from the local community

Stakeholder	Function in the supply chain
Workers and Contractors	Local people working as mining workers highly depend on mining activities, as these companies become their main source of income. In some cases, these workers have been displaced from their previous livelihoods due to the presence of new industries.
Displaced Farmers and Fishermen	Landowners and farmers are heavily impacted by industrial activities, especially during the land acquisition process. During the acquisition, landowners are usually given compensation by the company, but in the process, they also have to shift their livelihoods.
Indigenous People (IP)	IPs have the right to FPIC. Free, Prior, and Informed Consent (FPIC) is a specific right granted to Indigenous Peoples recognized by the UN, which aligns with their universal right to self-determination. FPIC enables Indigenous Peoples to provide or withhold consent at any point regarding projects that impact their territories. In practice, IPs often lack legal backing in negotiations with private companies, such as a lack of ownership papers legalized by a government agency.
Local Businesses	Industrial activities have a significant impact on local businesses, as they stimulate economic activity at the regional/local levels. Businesses such as hotels, restaurants, and construction benefit from the supply chain.
Village Heads	The village heads represent the villages' aspirations and concerns regarding the industry. The villagers believe the village heads have slightly better leverage than ordinary villagers in advocating their grievances. Although local communities must be identified as stakeholders by the legal framework, they do not have leverage over the business. Villages are usually recipients instead of actors.

2.1.6 Civil Society

Civil society organizations are important stakeholders in the battery supply chain, as they serve as a channel for advocacy and influence within the sector. While the supply chain does not directly impact this group, they hold a special role as independent silos for unheard voices. This group comprises journalists, universities, research institutions, and non-governmental organizations.

In addition to being affected parties, these actors are directly connected to on-the-ground dynamics and play a strategic role in promoting responsible and sustainable industry practices. They contribute by monitoring potential risks, advocating for community rights, raising public awareness on social and environmental issues, and providing evidence-based input to inform policy formulation and decision-making processes. Their meaningful engagement is therefore essential to ensuring that battery supply chain development delivers inclusive, equitable, and sustainable benefits for local communities. Table 2.6 shows the list of stakeholders from civil society.

Table 2.6 List of stakeholders from civil society

Stakeholder	Function in the supply chain
Universities	Universities could aid in research and development, as well as identify gaps and problems in the battery supply chain. Regional/local universities may have a heightened interest in the supply chain, as they may seek partnerships with relevant companies.
Independent Think Tanks	Just like universities, think tanks also provide insight into research and development, as well as scientific oversight, in the battery supply chain.
Journalists	Journalists could advocate for local communities' aspirations and concerns regarding the development of the battery industry. Today's "viral" practice of citizen journalism could highly influence policymakers and businesses' decision-making.
Non-governmental Organizations (NGOs)	NGOs are essential stakeholders in any industry. They hold the pivotal role of representing local and marginalized communities that need platforms to communicate their aspirations and needs. In addition, they also have a heightened interest in these communities through developing programs to accommodate them.

2.1.7 Foreign Entities

Foreign entities are also present in the supply chain. Foreign investors and foreign workers represent these (Table 2.7). Foreign investors are major stakeholders in foreign direct investment (FDI), particularly in the battery supply chain. In addition, foreign workers are also reported. Despite the reported friction with them, foreign workers are important agents of knowledge and technology transfer.

Table 2.7 List of stakeholders from foreign entities

Stakeholder	Function in the supply chain
Foreign Investors	Foreign investors play a critical role in Indonesia's battery supply chain by providing the capital, technology, and market access. By partnering with domestic companies and supporting infrastructure, foreign investors help Indonesia move up the value chain, attract global markets, and strengthen its position in the global energy transition.
Foreign Workers	Foreign workers are important stakeholders in Indonesia's battery supply chain as they bring specialized technical expertise, operational experience, and knowledge transfer essential for advancing the country's battery supply chain. Their presence supports local workforce development through skills training and capacity building. That said, job competition with the local workforce remains a significant issue[16].

[16] *The Chinese migrant workers powering the deadly EV nickel boom - Rest of the World, 2025*

2.2 Engagement strategy

The identified stakeholders in the battery supply chain are categorized based on four categories addressed in the Stakeholder Matrix[17] (Figure 2.1). These categories are sorted based on the level of influence and interest of all stakeholders, as such:

- **Key players (high influence, high interest):** Their role in the battery supply chain is crucial, as they can drive its development and changes through policies and legal frameworks, investment decisions, and negotiations. Their high interest also represents how their work is tied to the success of the battery industry, either through achieving national goals, good governance, or increased revenue. This group comprises government institutions and industry players.
- **Keep satisfied (high influence, low interest):** This group generally has enough influence to move the needle, such as mobilizing funds for investments. However, their interest in the battery supply chain is strictly beneficial, and their institutional wellbeing is not tied to the battery industry. This group is represented by financial institutions and foreign investors.
- **Keep informed (low influence, high interest):** This group is comprised of stakeholders whose lives and wellbeing are heavily influenced by the battery supply chain. That said, this group has very low leverage on the development and milestones of the battery sector. This group comprises local communities and foreign workers. Battery charging stations are also added to this group, as their presence is tied closely to the longevity of the battery industry.
- **Low priority (low influence, low interest):** This group is comprised of stakeholders with little to no leverage nor interest on the battery sector. That said, this group still holds a crucial role in monitoring and reporting to the public on the development of the battery supply chain—serving as "watchdogs". While minimal effort is needed, monitoring their stance and stay on top of any potential changes in their influence or interest. This group comprises universities, think tanks, NGOs, and journalists.

Table 2.8 shows an overview of the stakeholders:

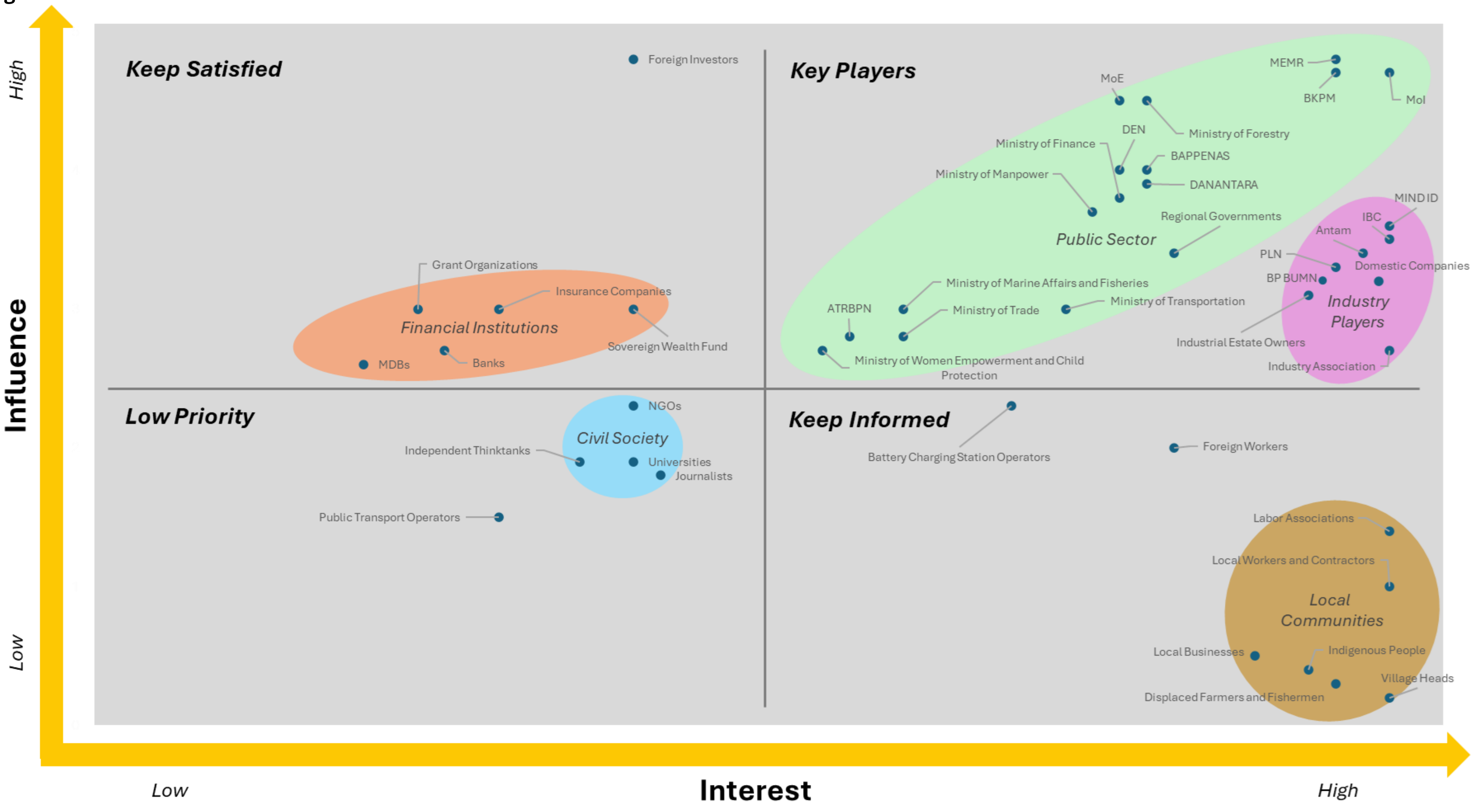
Table 2.8 Stakeholder group categories and engagement strategies

Category	Influence	Interest	Relevant Stakeholders	Engagement Strategies
Key Players	**High**	**High**	• Public Sector • Industry Players	• Must be actively engaged and co-create decisions. • Can be conducted through focus group discussions or developing a task force with representatives of different institutions.
Keep Satisfied	**High**	**Low**	• Financial Institutions	• Involve in significant milestones, such as policy development and

[17] Office of Government Commerce. (2006). "Stakeholder Management Plan". (Link)

Category	Influence	Interest	Relevant Stakeholders	Engagement Strategies
			• Foreign Investors	announcements related to the investments. • Ensure developed frameworks do not create friction with stakeholders and create clear benefits with low burden to promote involvement, e.g., incentives, tax mechanisms.
Keep Informed	**Low**	**High**	• Local Communities • Foreign Workers • Battery Charging Station Operators	• Allow a room for transparent and frequent dialogue. • Involve stakeholders in significant milestones through consultation and co-creation of decisions to ensure shared benefits are optimum, e.g., job opportunities. • For battery charging station operators, involve them in co-creating decisions to enhance infrastructure development and battery/EV adoption.
Low Priority	**Low**	**Low**	• Civil Society • Public Transport Operators	• Monitor the relevant stakeholders on potential changes, findings, and criticism. • Involve stakeholders in significant milestones through consultation, particularly related to research and studies of the battery supply chain to gain expert insight. • For public transport operators, involve them in joint initiatives to optimize battery/EV adoption, such as introducing an electric-powered fleet.

Figure 2.1 Stakeholder Matrix



2.3 Stakeholder engagement conducted activities

Table 2.9 presents all engagement activities conducted throughout the development of the study, i.e., presentation events and focus discussion groups.

Table 2.9 List of stakeholder engagement activities

Activity	Stakeholder	Description	Time
Presentation Event 1: Inception Report	1. Ministry of Investment and Downstream Industry/BKPM	• Inception report: present the project's framework, including objectives, methodology, local context, and planned engagement activities,	Aug 30, 2024
Presentation Event 2: A comprehensive report on the analysis of the supply chain of batteries	1. Ministry of Investment and Downstream Industry/BKPM 2. Ministry of Trade 3. Ministry of Energy and Mineral Resources (MEMR) 4. Ministry of Industry 5. PT CBL Indonesia Investment	• Provide a global overview of battery supply chains and share project progress, followed by stakeholder insights on strategic priorities and supply chain integration in Indonesia's battery sector.	Dec 12, 2024
Presentation Event 3	1. Ministry of Investment and Downstream Industry/BKPM 2. Ministry of Energy and Mineral Resources (MEMR) 3. Ministry of Industry 4. IBC 5. MIND ID 6. PT HLI Green Power 7. APNI 8. Indonesia Mining Institute (IMI) 9. ID Battery (NBRI) ID Battery (NBRI)	• Deepen understanding and gather insights from stakeholders to inform the development of a more comprehensive and needs-based study	Feb 26, 2025
Focus Group Discussion (FGD) with National Policymakers	1. Ministry of Investment and Downstream Industry/BKPM 2. Ministry of Energy and Mineral Resources (MEMR) 3. Coordinating Ministry for Economic Affairs 4. Ministry of Environment 5. Ministry of Transportation 6. BAPPENAS (National Development Planning Agency)	• Understand policy impacts and compliance issues across the battery supply chain. • Collect insights on good practices and inter-ministerial coordination. • Identify strategic issues and priorities to inform the field visits.	Jul 10, 2025

Activity		Stakeholder	Description	Time
Field Observation in Karawang	Collective discussion with PEMDA Karawang	1. Regional Development Planning Agency of Karawang 2. Environmental Agency of Karawang 3. Investment and Integrated One-Stop Service Agency of Karawang	• Understand regional policies and support for the development of the battery sector in Karawang. • Identify supply chain challenges on the ground, such as infrastructure, labor, and environmental issues. • Obtain examples of good local practices in attracting investment and supporting the battery industry.	Jul 18, 2025
	Discussion with representative of disability groups in Karawang	Indonesian Association of Persons with Disabilities (PPDI)	• To gain insight into the perspectives and aspiration of disability groups and fostering a more inclusive industry	Jul 28, 2025
	Collective discussion with representative of women and children's groups in Karawang	1. Department of Women's Empowerment and Child Protection of Karawang Regency (DP3A) 2. Child Protection Commission (KPAI) of Karawang	• Perspectives and efforts addressing social issues, particularly those affecting women and children. • Interview documentation that will serve as inputs for the ESIA (Environmental and Social Impact Assessment) study of the battery supply chain.	Jul 30, 2025
	In-depth interview with Workers' Community	Confederation of Indonesian Labor Unions (KSPI) of Karwawang	• Perspectives and efforts addressing social issues, particularly labor-related issues. • Interview documentation that will serve as inputs for the ESIA (Environmental and Social Impact Assessment) study of the battery supply chain.	Aug 4, 2025
	Field Visit	PT Hyundai Energy Indonesia	• Observation of company operational activities and the surrounding built environment. • Interviews with industry stakeholders regarding standard practices and best practices, environmental and social issues, and their mitigation measures	Sep 3, 2025
		PT Gotion Green Energy Materials	• Observation of company operational activities and the surrounding built environment. • Interviews with industry stakeholders regarding standard practices and best practices, environmental and social issues, and their mitigation measures	Sep 3, 2025
Field Observation in Morowali	Collective discussion with PEMDA Morowali	1. Energy and Mineral Resources Agency of Central Sulawesi 2. Environmental Agency of Morowali 3. Transportation Agency of Morowali 4. Health Agency of Morowali 5. Regional Development Planning Agency of Morowali	• Perspectives and efforts addressing general environmental and social issues related to the battery supply chain; and industrial and infrastructure development, land use, and regional planning. • Interview documentation that will serve as input for the ESIA (Environmental and Social Impact Assessment) study of the battery supply chain.	Aug 13, 2025
	Collective discussion with representative of	Village, Women's Empowerment and Child Protection Agency of Morowali Regency (DPMDP3A)	• Perspectives and efforts addressing social issues, particularly those affecting women and children.	Aug 19, 2025

Activity		Stakeholder	Description	Time
	women and children's groups in Morowali		• Interview documentation that will serve as inputs for the ESIA (Environmental and Social Impact Assessment) study of the battery supply chain.	
	In-depth interview with Workers' Community	Mining and Energy Workers' Union (SPIBE) of Morowali	• Perspectives and efforts addressing social issues, particularly labor-related issues. • Interview documentation that will serve as inputs for the ESIA (Environmental and Social Impact Assessment) study of the battery supply chain.	Aug 11, 2025
	In-depth Interview with Indigenous Community in Morowal	Tito Bungku Indigenous Customary Institution	• Capture Indigenous community perspectives on the social and environmental impacts of industrial development in Morowali. • Highlight their efforts to protect land rights, resources, and cultural practices, and identify key risks such as reduced access to natural resources and cultural sustainability threats.	Aug 28, 2025
	Field Visit	PT Sulawesi Cahaya Mineral	• Observation of company operational activities and the surrounding built environment. • Interviews with industry stakeholders regarding standard practices and best practices, environmental and social issues, and their mitigation measures	Aug 28, 2025
		PT ESG New Materials	• Observation of the company's operational activities and the surrounding built environment. • Interviews with industry stakeholders on standard and best practices, environmental and social issues, and corresponding mitigation measures	Aug 28, 2025
Discussions/Consultations with Financial Institutions		PT Sarana Multi Infrastruktur	• Understand ESG frameworks applied in battery supply chain-related investments. • Identify financing barriers and investor expectations for ESG compliance	Aug 5, 2025
		ESG Group Bank Mandiri		Aug 11, 2025
Presentation Event 4		1. Ministry of Energy and Mineral Resources (MEMR) 2. Ministry of Industry 3. Ministry of Investment and Downstream Industry/BKPM 4. Ministry of Finance 5. Ministry of Trade 6. Ministry of Environment 7. Ministry of Forestry 8. Ministry of Marine Affairs and Fisherie 9. Ministry of Agrarian Affairs and Spatial Planning/National Land Agency	• Present Deliverable 3 - Comprehensive Guide & Roadmap for Energy Transition Acceleration and Deliverable 4 - Social & Environmental Impact Analysis to stakeholders. • Engage stakeholders through discussion and feedback sessions to gather valuable inputs, validate key findings, and ensure the study outputs are aligned with national priorities and stakeholder expectations	Oct 28, 2025

Activity	Stakeholder	Description	Time
	10. Ministry of Women Empowerment and Child Protection 11. Indonesian Nickel Mining Association (APNI) 12. Electric Mobility Ecosystem Association (AEML) 13. National Battery Research Institute (NBRI) 14. PT HLI Green Power 15. PT Gotion Green Energy Solutions 16. PT Hyundai Energy Indonesia 17. PT Industri Baterai Indonesia (Indonesia Battery Corporation) 18. PT Mineral Industri Indonesia (MIND ID) 19. PT Perusahaan Listrik Negara (Persero)		

3. Indonesia's Battery Ecosystem in the Energy Transition

Indonesia is advancing efforts to achieve a renewable energy mix target of 19%-23% by 2030 and to reduce greenhouse gas (GHG) emissions intensity, as outlined in its national development planning documents, including the National Energy Policy (KEN)[18,19]. To support this transition, the development of a strong and sustainable battery supply chain is crucial—especially as batteries play a central role in energy storage systems and electric vehicles (EVs). With the global demand for EVs and battery technologies on the rise, Indonesia has a strategic opportunity to position itself as a key player in the global market—provided that strategic ambition translates into coherent implementation.

To meet its Net Zero Emissions (NZE) target by 2060, the Government of Indonesia has committed to a comprehensive decarbonisation strategy across multiple sectors. This involves ambitious targets and initiatives focused on reducing GHG emissions, particularly in the energy and transportation sectors—two of the country's highest-emitting sectors.

Indonesia has set ambitious national energy transition goals aimed at reducing reliance on fossil fuels and fostering a cleaner, more sustainable energy ecosystem. The government continues to advance policy reforms and developments to support this transition. Recently, Indonesia enacted the Long-Term National Development Plan (RPJPN) 2025–2045[20], which outlines a commitment to reducing greenhouse gas (GHG) emissions intensity. The latest revision of the KEN updates the RE shares targets and lowers them; the initial target of 23% by 2025 and 31% by 2030[21] has been revised to:

- 19–23% by 2030 (368 million TOE to 454 million TOE)
- 36–40% by 2040 (468 million TOE to 596 million TOE)
- 53–55% by 2050 (595 million TOE to 712 million TOE)
- 70–72% by 2060 (665 million TOE to 775 million TOE)[22]

The government has been pushing for the electrification of the transportation sector as a decarbonisation strategy as it represents 26% of Indonesia's total GHG emissions[23]. The production of electric vehicles (EVs) is continuously encouraged by the government. The Ministry of Energy and Mineral Resources (MEMR) set a target of 943,764 EV units by 2030 in the 2025 decree 24.K/TL/01/MEM.L/2025, which establishes the plan for the development of public EV charging infrastructure (SPKLU in Indonesian)[24]. Although there

---

[18] *Government of Indonesia*. (2025). Peraturan Pemerintah Nomor 40 Tahun 2025 Tentang Kebijakan Energi Nasional

[19] *Republic of Indonesia*, *Presidential Regulation Number 12 of 2025 on the National Medium-Term Development Plan (RPJMN) 2025-2029, p.104.* Link

[20] *Government of Indonesia*. (2024). Undang-Undang Republik Indonesia Nomor 59 Tahun 2024

[21] *Government of Indonesia*. (2014). Peraturan Pemerintah Nomor 79 Tahun 2014 Tentang Kebijakan Energi Nasional

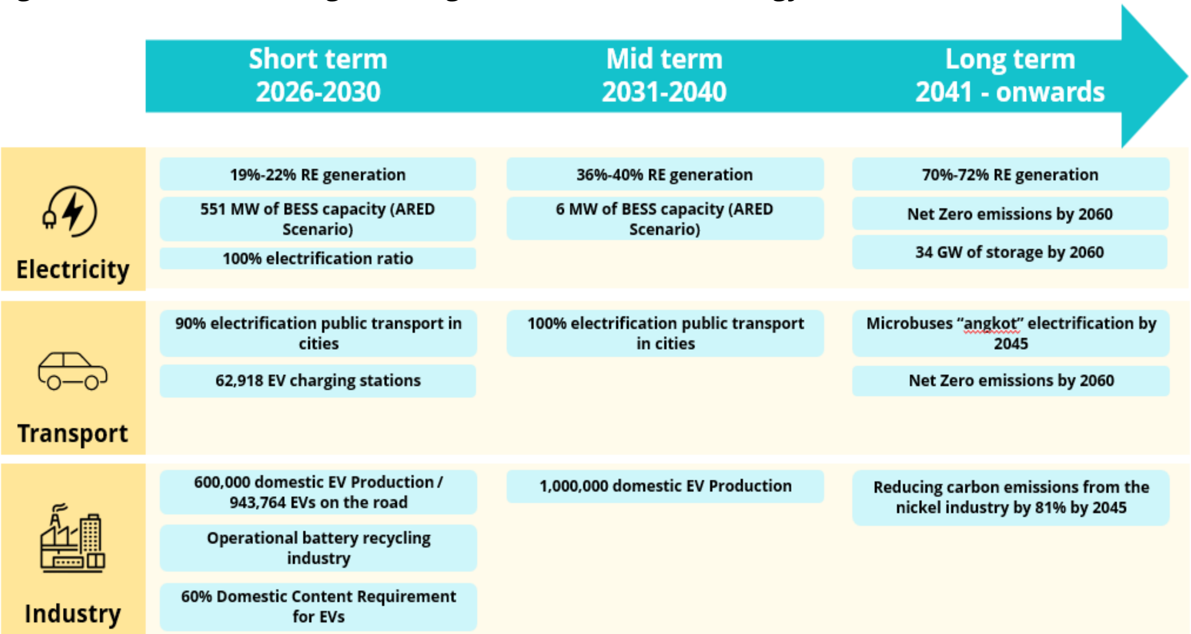
[22] *Government of Indonesia. (2025).* Peraturan Pemerintah Nomor 40 Tahun 2025 Tentang Kebijakan Energi Nasional

[23] *Ministry of Environment of the Republic of Indonesia. (2024).* Laporan Inventarisasi Gas Rumah Kaca (GRK) dan Monitoring, Pelaporan, Verifikasi (MPV) Tahun 2024. Link

[24] Outreach on the Minister of Energy and Mineral Resources Decree No. 24.K/TL.01/MEM.L/2025 concerning the Charging Station Development Plan for 2025–2030. Link

is no clarity on the segregation of 4W and 2W units, this report will use 4W as Indonesia is targeting the ramp-up of 4W EV production. This step is part of the electric vehicle penetration strategy, supported by various regulatory frameworks to achieve these targets, demonstrating a strong commitment to cross-sectoral reform.[25]. Recently, the Government of Indonesia (GoI) issued regulatory reforms to strengthen local content requirements (TKDN)[26]. These initiatives highlight the government's ongoing prioritization of the energy transition agenda, in which for both sectors, developing a robust domestic supply chain is essential—not only to reduce dependence on global markets but also to support Indonesia's long-term economic aspirations. Figure 3.1 shows national energy transition targets in the short, mid and long term.

Figure 3.1 Indonesia's targets and goals related to the energy transition



Deliverable 2 of this study explored how fast and efficient Indonesia has been in reaching these targets. The results show that there is a gap between the targets and what has actually been achieved. Batteries will play a critical role to bridge this gap. As the top three contributor to energy sector emissions, the decarbonization of the transport sector is crucial for the country to reduce its GHG emissions.

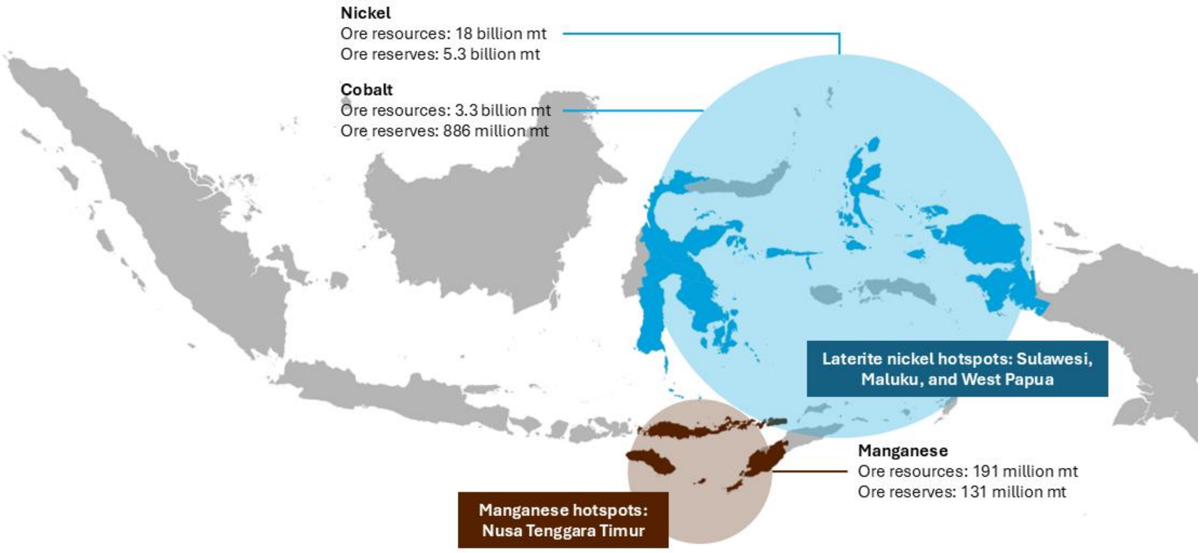
Indonesia has a significant advantage when it comes to battery manufacturing, since the country already has most of the necessary raw materials, as nickel is vital for cathode manufacturing. The country is home to one of the largest laterite nickel deposits in the

[25] Ministry of Energy and Mineral Resources of the Republic of Indonesia Regulation Number 24.K/TL.01/MEM.L/2025.. Link

[26] Presidential Regulation Number 46 of 2025 mandates the use of domestic products with a minimum TKDN value of 25 percent, If there are domestic products with a combined value of TKDN and company benefit weighting of at least 40 percent, then those products must be prioritized. Link

world[27]. It holds about 20% of global nickel reserves[28]. Per MEMR[29] data, Indonesia has 18 bn mt and 5.3 bn mt of nickel resources and reserves, respectively. Nickel hotspots are reported in Sulawesi, North Maluku, and Papua. Through laterite limonite nickel, Indonesia can extract cobalt. The country has 3.3 bn mt and 886 million mt of cobalt resources and reserves[29], accounting for 7.2% of global cobalt reserves[30]. As for manganese, Indonesia holds 3.8% of global reserves[31]. Recent MEMR[29] data shows that there are 191 million mt of resources and 131 million mt of reserves. Manganese is reportedly most abundant in Nusa Tenggara Timur (NTT)[31]. Figure 3.2 shows an overview of the distribution of these minerals in Indonesia.

Figure 3.2 Laterite nickel and manganese hotspots in Indonesia



Source: MEMR, 2024[32]

However, despite of having resources available, Indonesia's mining sector faces a combination of significant challenges and promising opportunities when aiming for sustainable and responsible practices as the domestic battery supply chain is developed.

3.1 The role of batteries in Indonesia's Energy Transition

Globally, the demand for batteries and critical minerals has been steadily rising, driven primarily by EV sales. The transportation sector is one of the largest contributors to global carbon emissions, accounting for 8 Gt of CO_2 emissions in 2021[33]. Switching from internal combustion engine vehicles (ICEV) to EVs can potentially reduce emissions by up to 100 g

[27] Marsh, Erin & Anderson, Eric & Gray, Floyd. (2013). Nickel-Cobalt Laterites—A Deposit Model.
[28] Purwanto, N. P. (2024). Government Policy to Maximize Nickel Potential in Indonesia. Info Singkat A Brief Study of Actual and Strategic Issues Vol. XVI No. 20/II/Pusaka/October/2024
[29] MEMR Decree No. 132.K/GL.01/MEM.G/2024 on National Minerals and Coal Resources and Reserves Balance in 2023
[30] Government of Canada. (2023). Cobalt facts.
[31] MEMR. (2021). Peluang Investasi Mangan di Indonesia
[32] Indonesia Nickel Miners Association. (2024). Unveiling Indonesia's Nickel Potency in Orchestrating Global Battery Manufacturing Excellence. International Battery Summit 2024.
[33] Transport – IEA (2023)

of CO_2 per km[34]. The IEA reported a substantial increase in EV battery volumes, from about 100 GWh in 2015 to approximately 2,300 GWh in 2023[35], alongside a 35% year-on-year increase in EV sales in 2023 compared to 2022[36]. As both EV and RE markets continue to increase, ensuring sustainable growth requires diversifying battery manufacturing and securing critical mineral supplies such as lithium, cobalt, nickel, manganese, and graphite. This approach aims to prevent bottlenecks and price hikes, while maintaining a sustainable battery production supply chain, i.e. from the critical minerals mining to the batteries end of life management.

Battery technologies also play a crucial role in energy storage for a wide range of applications. In the context of EVs and Battery Energy Storage systems (BESS), various battery technologies are employed to meet diverse performance, efficiency, and sustainability requirements. Each technology has unique advantages and challenges, influencing their application and supply chain development in the search for more efficient and sustainable energy solutions.

For BESS, battery technologies that provide scalability and long-duration energy storage are preferred, and sodium-ion batteries are known for their high energy capacity and thermal stability, also being explored. According to McKinsey's Stockholm office, sodium-ion is one technology to watch because this type of battery has the potential to be less costly and less prone to thermal runaway, moreover sodium-ion batteries environmental impact is lower than lithium-ion batteries[37].

3.2 Battery Production Capacity, Policy Landscape, Gasps and Associated Risks

In general, Indonesia's battery supply chain is aimed at EV production. The main focus of Indonesia's battery supply chain is nickel-based lithium-ion batteries, particularly NMC[38]. Nickel Manganese Cobalt (NMC) batteries promote domestic resource absorption, particularly nickel, cobalt, and manganese. Lithium Iron Phosphate (LFP) batteries are also assembled in Indonesia using imported materials to compensate for the country's lack of lithium resources[39,40,41]

According to the Ministry of Investment, the country has the potential to become one of the top five global battery manufacturers by 2040, with a total production capacity of 650

[34] Veza, Ibham & Asy'ari, Muhammad & Idris, Muhammad & Epin, Vorathin & Fattah, I. M. Rizwanul & Spraggon, Martin. (2023). Electric vehicle (EV) and driving towards sustainability: Comparison between EV, HEV, PHEV, and ICE vehicles to achieve net zero emissions by 2050 from EV. Alexandria Engineering Journal. 82. 459-467. 10.1016/j.aej.2023.10.020.

[35] IEA (2024), Batteries and Secure Energy Transitions, IEA, Paris https://www.iea.org/reports/batteries-and-secure-energy-transitions , Licence: CC BY 4.0

[36] IEA (2024) Tends in electric cars; https://www.iea.org/reports/global-ev-outlook-2024/trends-in-electric-cars

[37] Jarbratt, G., Jautelat, S., Linder, M., Sparre, E., Van De Rijt, A., & Wong, Q. H. (2023, August 2). Enabling renewable energy with battery energy storage systems. McKinsey & Company. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/enabling-renewable-energy-with-battery-energy-storage-systems

[38] Per PE2 (December 12th 2024), material presentation by the Directorate of Mineral and Coal Downstreaming MoInv.

[39] Per PE2 (December 12th 2024), based on consultation with representative from MoI.

[40] Based on consultation with a MoI rep in PE2, sodium-based batteries are not seen as an option for Indonesia.

[41] See Deliverables 2 of this project to know more about lithium-processing facilities

GWh per year, accounting for 10% of the global battery demand. However, the rate of nickel production in the last two years[42] was not well absorbed by domestic battery manufacturing.

Indonesia's policy priority is to establish a fully integrated battery ecosystem encompassing all stages from key mineral processing to EV manufacturing, within the nation's borders. This section will focus on a comprehensive mapping of the national battery production capacity and the policy landscape to identify the existing incentive mechanisms to support EV ecosystem development.

3.2.1 Mining and refining

Indonesia has a robust mining and refining sector, particularly for nickel. The country has an established nickel mining industry with an annual production of 175,617,183 mt. Some of the largest nickel mining concessions are located in Sulawesi, North Maluku, and West Papua[43]. However, the same cannot be said about manganese. Apart from seeing no production in 2023, manganese extraction has not been stable since the introduction of the raw ore export ban. The last recorded production was 4,912 mt in 2020. There seemed to be efforts to stimulate foreign investment into the manganese sector, particularly in relation to the battery sector, as shown in a document released by MEMR in 2021 on Manganese Investment Opportunities[31] yet no development has been reported since.

Similarly, the nickel refining industry in Indonesia is already quite established, particularly in pyrometallurgy. With the addition of the battery industry, Indonesia has started to process other nickel products through hydrometallurgy process. Cobalt products, such as cobalt sulfate ($CoSO_4$) are also produced through nickel refining. To date, refined products that are reportedly used to supply the battery supply chain are mixed hydroprecipitate (MHP), nickel sulfate ($NiSO_4$), and cobalt sulfate ($CoSO_4$). Nickel matte, processed via pyrometallurgy, is used as feed to produce $NiSO_4$.

Per this study, Indonesia has 49 pyrometallurgy and five hydrometallurgy smelters in operation. Annual production of processed products is as follows: 670,857 mt of mixed hydro precipitate (MHP), 71,400 mt of nickel matte[44], 719,114 mt of $NiSO_4$, and 31,800 mt of $CoSO_4$ (see Table 3.1). The table below lists operational HPAL smelters in Indonesia as per the report.

---

[42] [Ekspor Nikel Indonesia Kian Tinggi pada 2023, Tembus Rekor Baru (databox Katadata 2024)]

[43] Indonesia Nickel Miners Association. (2024). Unveiling Indonesia's Nickel Potency in Orchestrating Global Battery Manufacturing Excellence. International Battery Summit 2024.

[44] [MEMR. (2024). Kinerja Subsektor Minerba Tahun 2023: PNBP dan Produksi Batubara Meroket, Atur Tegas Reklamasi dan Smelter. Press Release.]

Table 3.1 Consolidated production capacity and investment value of operational HPAL smelters

Company	Product	Production Capacity (mt/year)	Major Shareholder and Country of Origin	Investment Value (US$)
PT Halmahera Persada Lygend	MHP	365,000	Trimegah Bangun Persada (45.1%) – Indonesia[45]	1.26 billion
	$NiSO_4$	246,750		
	$CoSO_4$	31,800		
PT Huayue Nickel Cobalt	MHP	163,000	Zhejiang Huayou Cobalt Co., Ltd. (57%) - China[46]	1.28 billion
PT QMB New Energy Materials	MHP	142,857	GEM Co., Ltd. (63%) - China[47]	998.57 million
	$NiSO_4$	136,364		
	$CoSO_4$	19,512		
PT Fajar Metal Industry	$NiSO_4$	168,000	Excelsior International Investment Pte. Ltd. (99.9%) - Singapore[48]	1.26 billion
PT Teluk Metal Industry	$NiSO_4$	168,000	Tsingshan Holding Group Co.,Ltd. (99.9%) - China	1.26 billion

Source: Rosa-Luxemburg-Stiftung, 2023[49] and multiple sources (shown as footnotes)

Some refining products are exported. In 2023, nickel matte exports hit an all-time high (about 7-fold from 2021 exports) at 1.26 million tonnes in 2023[50]. ICT[51] also reported exports in $NiSO_4$ (66,400 mt in 2023) where China dominates the export destination (100% of total exports). However, some products may not have yet met production targets, such as MHP and $CoSO_4$. ICT reported higher imports than exports in 2023 (2,414 mt for MHP and 82 mt for $CoSO_4$, both mainly from China). Despite nickel being the more mature industry in the country, there is an imbalance in the availability of key components, which hinders the overall supply chain and drives further exports if it persists.

The country's resource availability and mining and refining capacity has been paired with policy instruments to develop the battery supply chain ecosystem within its borders. Such fiscal and non-fiscal instruments rely on downstreaming policies.[52] The main tool in this regard is undoubtedly the nickel export ban. Table 3.2 illustrates the Indonesian national legislative instruments currently in force that seek to support the development of the battery ecosystem with regards to the mining and refining stages.

[45] HPL Corporate Website. https://hpalnickel.com/
[46] Zhejiang Huayou Cobalt Co., Ltd.. (2023). 2023 Semi-Annual Report of Zhejiang Huayou Cobalt Co., Ltd.
[47] PT. QMB NEW ENERGY MATERIALS. (2023). Due Diligence Management System ANNUAL REPORT
[48] Nickel Industries. (2023). Notice of Extraordinary General Meeting.
[49] Rosa-Luxemburg-Stiftung. (2023). Fast and Furious for Future: The dark side of electric battery vehicle components and their impacts in Indonesia. Publication. Southeast Asia - Socio-ecological Transformation - COP26 - Green New Deal.
[50] Ekspor Nikel Indonesia Kian Tinggi pada 2023, Tembus Rekor Baru (databox Katadata 2024)
[51] International Trade Centre. Trade Map. https://www.trademap.org/
[52] 'Downstreaming policies' in the context of this study refer to measures aimed at promoting the processing of raw minerals within the country where they are mined, rather than exporting them in their raw form to be processed elsewhere.

Table 3.2 Overview of fiscal and non-fiscal incentives for mining and refining in Indonesia

	Incentive	Description
Fiscal	**Increase of mining royalties** (Law of the Republic of Indonesia No 3 of 2020 on the Amendment to Law Number 4 of 2009 in Mineral and Coal Mining)	Address the dynamics of global mining market by increased mining royalties. The government has announced higher rates for multiple national key commodities, including nickel, with a view to increasing state revenue and supporting the development of local industry.
	Tax holidays (Ministry of Finance Regulation No. 150/PMK.010/2018)	Up to 20 years of tax holidays for significant investments in nickel processing facilities
	Direct subsidies (Presidential Regulation No. 55/2019)	Financial subsidies to support the development of nickel smelters and refining plants
	Infrastructure grants (Ministry of Public Works and Housing Regulation No. 10/2020)	Grants for infrastructure projects supporting the nickel industry
	Import duty exemptions (Ministry of Finance Regulation No. 176/PMK.011/2009)	Exemptions from import duties on machinery, equipment, and raw materials for nickel refining
	R&D Grants (Ministry of Research and Technology Regulation No. 12/2020)	Funding for research and development initiatives in the nickel sector
Non-Fiscal	**More streamlined and efficient oversight of mineral mining activities** (Ministry of Energy and Mineral Resources Regulation No. 10/2023)	Extending the Work-Plan and Budget-Plan duration to three years, ensuring mining companies can plan and execute long-term strategies more effectively; setting out immediate sanctions for non-compliance; introduction of an online application for Work-Plan and Budget-Plan to simplify and streamline processes; mandating comprehensive reporting, ensuring that all mining activities are closely monitored.
	Regulating domestic nickel ore prices (Ministry of Energy and Mineral Resources Regulation No. 11/2020)	Mandates the use of Indonesia's monthly mineral ore benchmark prices as a price floor for transactions. The regulation aims to ensure that nickel sales comply with market prices and seeks to balance the interest of both miners and refiners by setting the price below international prices to increase the economies of scale for smelters.
	Regulation on coal power supply and prices to nickel producers (Ministry of Energy and Mineral Resources Regulation No. 139/2021)	Outlines the Domestic Market Obligation for coal and sets the price cap for coal suppliers to power plants, including those serving nickel producers.
	Nickel export ban (Regulation of the Minister of Trade No. 96/2019)	Outlines the export provisions for processed and purified nickel products, reinforcing the ban on the export of unprocessed nickel ore
	Empowering local shareholders (Government Regulation 24 of 2024)	Streamline bureaucracy, enhance mining practices, and support the national downstream program within the industry by empowering shareholders. Key requirements include removal of the requirement to submit annual mining and budget plans, extension of mining licenses and granting mining rights to religious organizations.

Yet, despite of the implemented policies described above, there are gaps that should be addressed to ensure coherence between some of these incentives to mitigate the potential risk of undermining key national policy goals. For example, the nickel processing relying on energy-intensive technology currently powered by coal-fired power plants hinder the country's green energy transition progress, whereas Chinese companies that currently dominate the nickel refining segment in Indonesia benefit from subsidized electricity prices.[53]

While policy instruments introduced were designed to promote national interest and downstream industrial development, their implementation has, in practice, largely benefited companies with established operational capacity and investment readiness - many of which are foreign owned. This outcome highlights a potential misalignment between the intended national objectives and the actual distribution of benefits, particularly in the processing sector. It underscores the need to revisit the policy framework to ensure it more effectively supports domestic value creation and aligns with broader national development goals. Indonesia's heavy reliance on China for the supply and processing of minerals exposes the industry to price volatility and supply chain disruptions, highlighting the need for investment diversification and international partnerships to enhance supply chain resilience.

Although the National Energy Policy (KEN) 2025 considers coal stockpiling[54] as part of the efforts to achieve an efficient market and ensure a continuous supply for domestic demand, Indonesia has not adopted specific laws or regulations concerning the stockpiling of those minerals for which the country is reliant in imports, namely lithium, graphite and manganese. the KEN mostly focuses on fuel stockpiling and reserves, and establishes BESS as "temporary stockpiles" of electricity, classifying them under Operational Reserves.

Strategic stockpiling, particularly during periods of low prices, is a policy tool used to strengthen national supply security and ensure access to critical minerals during supply chain disruptions. While such stockpiles can help stabilize prices by mitigating market volatility, large-scale stockpiling may also distort market dynamics. Additionally, the costs associated with storage, security, and management can be significant. Technological advancements further introduce the risk that some minerals may lose their strategic importance over time, potentially rendering stockpiles obsolete and resulting in wasted resources.

3.2.2 Battery Assembly and Manufacturing

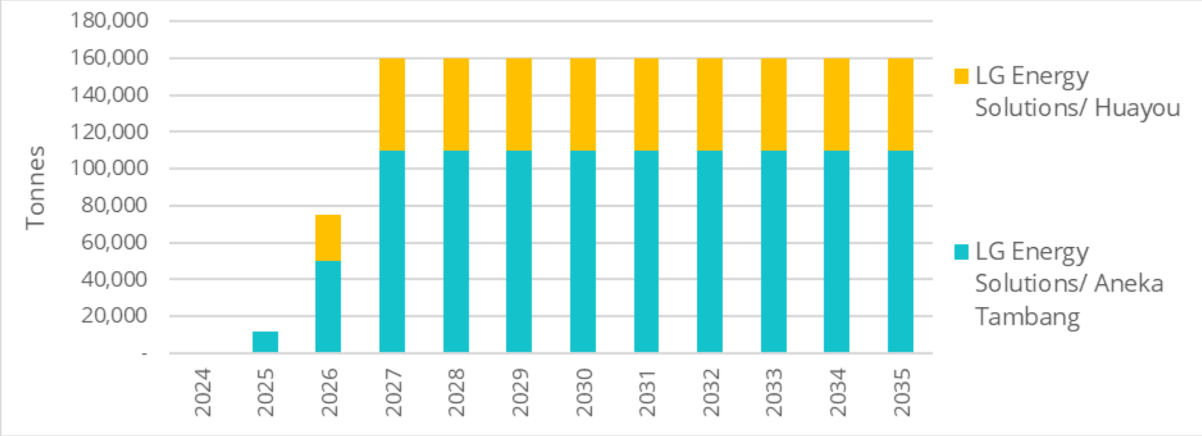
The Indonesian cathode space has an enormous potential, with very limited installed cathode capacity. This is a significant concern since the sector procuring battery materials is cathode space. However, two interesting projects in Indonesia will add a combined capacity of close to 160,000 tons of cathode during the next ten years, the largest one being LG Energy Solutions/Aneka Tambang (Figure 3.3).

---

[53] A Syarif, The Diplomat (2025) 'The Nickel-based Industrial Paradox: Indonesian Resources, Chinese Profits' Link

[54] INDONESIA: Government Regulation No. 79/2014 of 2014 Concerning the National Energy Policy. https://policy.asiapacificenergy.org/node/3016

Figure 3.3 LG Energy Solution announced NMC cathode production in Indonesia



Indonesia's first cathode production facility was recently inaugurated in October 2024-- PT LBM Energi Baru Indonesia. This company produces LFP cathodes, which is key to the LFP supply chain. It is a partnership between INA and Changzhou Liyuan New Energy Technology Co., Ltd. The first phase, which is already operational, has a capacity of 30,000 mt[55]. The second phase is targeted at 90,000 mt by 2025[56].

In contrast, the NMC supply chain has not yet been linked to CAM production. This was accentuated after LG Energy Solutions cancelled its cathode manufacturing project, which was supposed to produce 160,000 mt NMC cathodes for the following decade (see Figure 3.3).

On the other hand, the anode manufacturing sector gave an important step last year as the anode producer PT Indonesia BTR New Energy, located in Central Java, was inaugurated in August 2024. The production facility has a capacity of 50,000 mt of natural graphite anode and 30,000 mt of artificial graphite anode[57,58]. Anodes are reportedly made from imported graphite from Africa[59,60]. Products not absorbed by the domestic market are targeted for export[61]. As the facility is still recent, trade records have not captured this information.

Regarding LIB cell manufacturing, the only NMC battery producer operating at this point is PT HLI Green Power, a joint venture between Hyundai Motor Company, LG Energy Solution, and IBC, which has a capacity of 10 GWh NMC (nickel-manganese-cobalt) battery cells[62,63]. The first phase began commercial production in April 2024, and the second phase is currently under development, with a production target of 20 GWh by 2025[62,64].

---

[55] Production capacity number. Limited information on actual production numbers.
[56] PT LBM Energi Baru Indonesia Resmi Beroperasi di KEK Kendal (Pajak.com 2024)
[57] Pabrik Anoda PT Indonesia BTR New Energy Beroperasi, Nilai Investasi Rp 7,8 T (kumparanBISNIS 2024)
[58] Production capacity number. Limited information on actual production numbers.
[59] Jokowi: Ada Bahan Baku di Pabrik Anoda Baterai Lithium Kendal yang Diimpor (Bisnis.com 2024)
[60] This data is not yet reflected in the latest ICT data (dated 2023) as the production plant is still very recent.
[61] MoF. (2024). Hadiri Undangan PT Indonesia BTR New Energy Material, Pabrik Bahan Anoda Baterai Litium Kapasitas 80.000 Ton per Tahun. News. Direktorat Jenderal Bea dan Cukai. Kementerian Keuangan.
[62] Jokowi Resmikan PT HLI Green Power Karawang, Pabrik Baterai EV Terbesar di Asia Tenggara (Tempo 2024)
[63] Race to produce high-nickel batteries accelerates (The Korea Economic Daily 2021)
[64] Production capacity number. Limited information on actual production numbers.

On the other hand, in the LFP pathway, current battery producers are PT Gotion Green Energy Solutions Indonesia and PT International Chemical Industry (Intercallin)[65,66]. The reported production capacity is at least 100 MWh[67]. The battery parts are reportedly imported from China[68]. However, PT LBM Energi Baru Indonesia's recent inauguration may minimize imports by bringing the supply chain closer to home.

Building on this upstream capacity, the next critical step in Indonesia's battery value chain is the integration of cell manufacturing with pack assembly. Battery cells are typically packed in the same company where battery cells are produced. To date, Indonesia has a production capacity of 138,000 units of Lithium Iron Phosphate (LFP) battery packs (90,000 units from Intercallin[66] and 48,000 units from Gotion[69]) and 50,000[70] units of Nickel Manganese Cobalt (NMC) battery packs[71]. The current NMC battery packing capacity is roughly less than 50% of the LFP battery packing capacity. If Indonesia wants to encourage the utilization of domestic resources, NMC battery cell manufacturing and packing need to outcompete LFP's.

In the context of evolving geopolitics, one of the most pressing global trends within the area of batteries relates to the security of supply and increasing the resilience of the battery supply chain. Many jurisdictions are actively introducing measures that seek to reduce the reliance on external suppliers by increasing domestic manufacturing. Similarly, Indonesia has taken several strategic steps to support the manufacturing segment, as shown in Table 3.3.

Table 3.3 Fiscal incentives to support manufacturing capacities in Indonesia

	Incentive	Description
Fiscal	**Import duty** Amendments to Minister of Finance Regulation Number 26/PMK.010/2022	Manufacturers who pledge to set up domestic factories by 2026 will benefit from a 0% import duty on fully assembled and partially assembled EVs
	Tax exemptions Ministry of Finance Regulation No. 10/2024	Tax incentives for local content production of EVs
	Grants for infrastructure Ministry of Public Works and Housing Regulation No. 10/2020	Grants for infrastructure projects supporting the EV industry
	Investment incentive Ministry of Investment Regulation No. 6/2023	Incentives for companies investing in domestic EV manufacturing facilities
	Tax exemptions Ministry of Industry Regulation 29/2023	Incentives for local electric battery vehicle manufacturers, including reduced import duties on raw materials and tax exemptions
	EV sector grants Ministry of Research and Technology regulation No. 12/2020	Funding for research and development initiatives in the EV sector

[65] NETA Resmi Jalin Kerjasama dengan PT Gotion Green Energy Solutions Indonesia (Beritaplus.id 2024)
[66] ABC Tegaskan Jadi Produsen Cell Baterai Kendaraan Listrik Pertama (Kompas.com 2022)
[67] Miliki Kapasitas Produksi Baterai 90.000 Pack, ABC Perluas Pasar ke Energi Terbarukan (Tribunbisnis 2024)
[68] Pabrik Perakitan Baterai Gotion di Bogor, Fokus LFP (Kompas.com 2024)
[69] Kapasitas Produksi Pabrik Baterai Gotion Tembus 48.000 Unit Per Tahun (Kompas.com 2024)
[70] Fakta-fakta Pabrik Sel Baterai Mobil Listrik yang Baru Diresmikan di Indonesia (kumparanOTO 2024)
[71] Production capacity number. Limited information on actual production numbers.

The local content policies in Indonesia are designed to progressively increase over time, with targets set for different time periods. This allows the industry to adapt and scale up local production capacities. The high local content requirements for batteries highlight the strategic importance of developing domestic capabilities in this area. This specificity ensures that different parts of the value chain are developed simultaneously, promoting comprehensive growth of the local industry. Yet, concerns regarding policy gaps in this incentive have been raised due to the lack of detailed provisions for stakeholder engagement and transparency in the implementation of local content policies, particularly when it comes to compliance with ESG standards. Regulations set by the US and the EU can pose investment challenges, as demonstrated by the withdrawal of German company BASF[72] and French company Eramet[73] from the Sonic Bay nickel and cobalt refinery project due to changing market conditions, and ESG-related concerns[74].

In addition to these implementation challenges, certain policy inconsistencies may further undermine the intended outcomes of Indonesia's local content framework. The policy favouring importers of fully assembled EVs may have distortive effects on the markets, discouraging investment in local manufacturing. Furthermore, the requirement for a periodic review of local content policies in the legislation is vague, limiting the government's ability to monitor effectiveness and adjust targets in line with industry developments.

3.2.3 End-use Applications

- **Electric Vehicles (EVs)**

According to the production numbers between January and November 2024 from Gaikindo[75], Indonesia has produced 24,655 4W BEV units and 65,026 4W HEV units. Top three companies who contributed most to BEV production are Wuling (55%), Chery (21%), and Hyundai (15%), whereas Toyota (66%) and Suzuki (32%) dominated HEV production. In addition, Indonesia also produces electric buses (4W EV >10 persons). The production capacity is small compared to other EV types at 1,980 units[76]. Reported producers are Mobil Anak Bangsa, INKA, VKTR, and SAG[77].

---

[72] June 24, 2024. BASF decides against investment in nickel-cobalt refining complex in Indonesia. https://www.basf.com/global/en/media/news-releases/2024/06/p-24-224

[73] June 24, 2024. Eramet and BASF decide against joint investment in a nickel-cobalt refining complex in Indonesia. https://www.eramet.com/en/news/eramet-and-basf-decide-against-joint-investment-in-a-nickel-cobalt-refining-complex-in-indonesia/

[74] July 5, 2024. Environmental and indigenous rights concerns lead BASF and Eramet to withdraw from Indonesian nickel project. https://www.miningsee.eu/environmental-and-indigenous-rights-concerns-lead-basf-and-eramet-to-withdraw-from-indonesian-nickel-project/

[75] Produksi Domestik Kendaraan BEV, PHEV, dan Hybrid, Januari – November 2024 (Gaikindo 2024)

[76] Investasi Perakitan Kendaraan Listrik RI Tembus Rp 4,49 T, Ini Rinciannya (detikFinance 2024)

[77] Empat Produsen Bus Listrik Ini Bakal Dapat Insentif dari Pemerintah, Salah Satunya Milik Moeldoko (Tribunnews 2023)

MoI addressed, as part of the engagement activities of this study, that Indonesia's annual production target is 600,000 by 2030[78]. With the current rate, Indonesia is capable of fulfilling 4.1% (without HEVs) or 14.9% (with HEVs) of this target.

As of 2023, Indonesia was a net exporter of 2W and 4W EVs. ICT[79] reports that 2023 exports quantified 2.9% and 0.6% of global exports for 2W and 4W EVs, respectively. Most of these exports went to the Philippines (31% of exports for both 2W and 4W EVs). By contrast, Indonesia was a net importer of electric buses from China (95.6% of imports). Although Indonesia's current annual production is less than 10% of the 2030 target, Indonesia has demonstrated its capacity as a regional EV player.

Indonesia has adopted a wide range of policy instruments to incentivize the domestic usage of EVs. The fiscal and non-fiscal incentives implemented so far in Indonesia al presented in Table 3.4.

Table 3.4 Fiscal and non-fiscal incentives for the uptake of EVs and BESS concerning end use

	Incentive	Description
Fiscal	**Purchase subsidy**	Cash subsidies allocated for the purchase of BEV
	VAT Reduction for EVs	Tax rates based on engine capacity, efficiency and emissions; tax rate for BEVs 0%, for PHEV 5% and FCEVs 0%
	Tax reduction Ministry of Finance Regulation No. 38/2023	The VAT for EV buyers has been reduced from 11 % to 1 % for 2024. The VAT reduction involves a 10% cut for cars and buses with at least 40% local content, and a 5% reduction for those with less than 40% but a minimum of 20% local content.
	Tax exemption Ministry of Home Affairs Regulation No. 6/2023	Sets the policy on motor vehicle tax and duty on the transfer of motor vehicle ownership for EVs. The Regulation imposes a 0% motor vehicle tax and a transfer of motor vehicle ownership tax for EVs.
	Loans Bank of Indonesia Regulation No. 22/31/PBI/2020	A 0% downpayment program for battery electric vehicle. The program allows financial institutions to offer motor vehicle loans for EVs with no downpayment, making it easier for consumer to purchase EVs.

[78] Per PE2 (December 12th 2024), as mentioned by the Director of the Planning of Natural Resources MoInv.
[79] International Trade Centre. Trade Map. https://www.trademap.org/

	Incentive	Description
Non-Fiscal	**Guidance to transition to electrified vehicles** Regulation of the Ministry for Energy and Mineral Resources No. 3/2023 concerning General Guidelines for Government Assistance in the Conversion program of Fuel Motorbikes to Battery-Based Electric Motorcycles	Provides guidelines for government assistance in the conversion of fuel-powered motorbikes to battery-based electric motorcycles. Discounts and subsidies for the purchase of the components required for electric conversion.

As EV sales increase, governments need to phase out purchase subsidies or find alternative methods to provide financial support in a sustainable and budget-friendly government manner.[80] For example, implementing differentiated taxes based on vehicle energy efficiency and emissions penalizes poorly performing vehicles and rewards those that meet established standards. Such policies align with broader environmental goals, rather than focusing solely on promoting specific technologies. Furthermore, local and regional measures that support EVs, such as free or discounted parking, complimentary charging, access to priority traffic lanes, and reduced charges for using transport infrastructure can effectively complement national regulatory and fiscal policies.[81] There are certain gaps and/or challenges in the Indonesian legislative framework incentivizing EV end-use that can be identified. These relate mainly to "modernizing" the incentive framework as the market continues to mature:

- Current financial incentives are 'general' in nature; they do not differentiate, for example, based on the income levels of consumers nor do they differentiate in subsidies based on the type of battery chemistry.
- Continued fossil fuel subsidies undermine efforts to promote EVs, raising concerns over policy coherence
- Limited local government initiatives
- Limited support for charging station infrastructure development
- Geographic and economic disparities
- Parallel investments to grid readiness

- **Battery Energy Storage Systems (BESS)**

In the power sector, accelerating the deployment of renewable energy (RE) is a critical pillar of the transition. Indonesia's National Energy Policy (*Kebijakan Energi Nasional* KEN) mentions the energy sector has a major contribution towards meeting the country's national commitment to achieve GHG emission reduction targets, net zero emissions by 2060, and the economic growth target to become a developed country by 2045. The KEN

[80] IEA, *Global EV Outlook* (IEA 2021), pp. 44-45.
[81] IEA, *Global EV Outlook 2018* (IEA 2018), p. 98.

defines the share targets of new and renewable generation in the power mix as presented in Table 3.5.

Table 3.5 RE share targets in national primary energy mix

Year	Target of RE share in national primary energy mix
2030	19%-23%
2040	36%-40%
2050	53%-55%
2060	70%-72%

Source: KEBIJAKAN ENERGI NASIONAL[18]

Although the KEN does not establish a quantitative target for BESS, it does mention storage infrastructure as a national-scale mandate, positioning it as a key aspect for the power grid, providing support for reliability and crisis management.

For wind and solar energy, KEN establishes the following targets as percentages of the country's primary energy mix (Table 3.6):

Table 3.6 Solar PV and Wind share targets in national primary energy mix

Year	Share of Solar PV	Share of Wind
2030	1.3%-1.6%	0.3%-0.5%
2040	13.1%-16%	0.9%-1.1%
2050	23.3%-25.3%	1%-1.2%
2060	29.8%-32%	1.2%-1.3%

Source: KEBIJAKAN ENERGI NASIONAL[18]

In parallel, the National Electricity Master Plan (*Rencana Umum Ketenagalistrikan Nasional* RUKN) 2024-2060 projects a total installed capacity in Indonesia of 443 GW by 2060, of which 41.5% is expected to come from VRE. It also mentions this VRE capacity must be paired with 34 GW of storage[82]. However, it does not detail whether this storage must come from batteries or if it will come from various technologies.

Although these targets are ambitious, current progress remains limited: as 2024, installed solar PV capacity stood at only 911.5 MW[83] and contributed just 0.9% of electricity generation in 2024[84]. Solar module production also remains stagnant at 2.3 GW/year[85] [86]. These gaps signal a need to address structural barriers, including policy uncertainty, limited market demand, and a lack of investment incentives, while also strengthening domestic supply chains to support sustainable scale-up[87].

---

[82] RENCANA UMUM KETENAGALISTRIKAN NASIONAL
[83] Ministry of Energy and Mineral Resources of the Republic of Indonesia. (2025). Laporan Kinerja Kementerian ESDM Tahun 2024. Link
[84] Ministry of Energy and Mineral Resources of the Republic of Indonesia. (2025). National Electricity General Plan (RUKN) 2025–2060. Ministerial Decree No. 85.K/TL.01/MEM.L/2025. Link
[85] Institute for Essential Services Reform (IESR), *Indonesia Solar Energy Outlook 2025* (IESR, 2025). Link
[86] George Heynes, "Indonesia Surpasses 700MW Installed Solar PV Capacity, but Progress Is 'Inadequate'," *PV Tech*, October 21, 2024, Link
[87] IESR, Indonesia Solar Energy Outlook (ISEO) 2025, Link

There are four main instruments that Indonesia has set related to RE targets and Battery Energy Storage Systems (BESS). These are listed in Table 3.7.

Table 3.7 Regulation instruments related to RE and BESS

Instruments	Objective
Government Regulation No. 25/2021 on the Management of the Energy and Minerals Resources Sector; Decree of the Minister of Energy and Mineral Resources, 188.K/HK.02/MEM.1/2021	Acknowledges the role of stationary battery energy storage as an integral part of the electricity system.
The Minister of Finance Regulation No. 103 of 2023 on the provision of fiscal support through a funding and financing scheme in the framework of accelerating energy transition in the electricity sector	This measure seeks to support the implementation of the Presidential Regulation 112/2022 to progressively phase-out coal-fired power plants by mobilizing via various measures public and private funding to support energy system decarbonization.
RUKN (Ministerial Decree No. 85.K/TL.01/MEM.L/2025)	Outlines national electricity policy, current supply conditions, demand and supply projections through 2060, and long-term electricity system development plans aligned with revised KEN targets.
RUPTL (Ministerial Decree No. 188.K/TL.03/MEM.L/2025)	Serves as PLN's electricity development plan for 2025–2034. It outlines power generation, transmission, and distribution projects, integrating long lead-time investments and supporting the energy transition agenda, including renewable energy and grid reliability targets. The RUPTL 2025–2034 sets targets for BESS, with the following information under two scenarios: - RE Base Scenario = 2,463 MW (2.5 GW) - ARED Scenario = 6,013 MW (6.0 GW)

In terms of BESS applications to support the integration of variable RE sources in the grid, in particular, there are no legislative measures adopted that would specifically regulate storage. As the legislative void in acknowledging stationary battery energy storage as a new technology has hindered the possibilities to integrate such a new technology to the energy system in many jurisdictions, the first important legislative measure has been acknowledging its role in the energy system. Therefore, despite it might seem a small measure, the impact of the Government Regulation 25/2021 is significant in providing the possibility of BESS to participate in the market by simply acknowledging its existence and role in the energy system. However, from the supporting policy measures point of view perhaps the most interesting development in this regard is the funding framework provided under the Minister of Finance Regulation 103/2023 as tenders organised under this platform are increasingly including BESS.[88] This type of funding can be very effective if applied appropriately in a non-liberalised market, such as that of Indonesia. In comparison to a liberalised market, where investment decisions in BESS systems are made in response to complicated market price signals, a vertically integrated electricity company like PLN could benefit from a simpler hierarchical decision-making process. A well-designed funding process will allow the company to more efficiently implement measures to promote BESS system integration. Conversely, the absence of market signals may hinder the selection of the most economically and technologically viable alternative.

The possibility to extend the lessons learned from international experiences in integrating BESS into the energy system are limited, given that the forerunner jurisdictions' energy markets are to a great extent liberalized. In a context like Indonesia where electricity markets are not liberalised and the state plays a central role in generation, transmission and distribution, supporting the deployment and integration of BESS requires a tailored set of policy instruments that align with the existing regulatory and institutional framework.

Utility-scale BESS is lagging behind EVs as end-use for batteries. Although Indonesia has ambitious RE goals in place, the deployment of RE power plants has not been fast enough. It has been estimated that if Indonesia were to set a 100% RE target by 2045 it would require 42 MW of energy storage alongside every 100 MW of wind and solar capacity[89]. Additionally, the lack of a strong market signal for BESS means there are no incentives for actors to push forward. As mentioned previously, liberalised markets tend to establish capacity obligations for RE power plants to incentivize storage or allow batteries to receive capacity payments in power markets. With PLN as the sole provider of electricity in the country, it becomes the most relevant stakeholder to work with to scale BESS systems in Indonesia. Currently, all BESS projects in Indonesia have been managed independently and, on a case-by-case basis.

3.2.4 End-of-life Management and Recycling

Per this study, the only battery recycling company in Indonesia is PT Indonesia Puqing Recycling Technology, located in Morowali. It can process up to 18,144 mt/year of used lithium batteries[90]. The facility has a production capacity of 24,000 mt of crude Ni-$CoSO_4$, 510 mt of crude Li_2CO_3, and 1,840 mt of crude MnOH yet no actual production was reported in 2022[91]. Indonesia's nascent battery industry is not yet able to provide sufficient materials for battery recycling. Black mass imported from China is reported to be the current feedstock for the recycling plant[92].

The battery end-of-life management has become increasingly important due to the rapid adoption of EVs, and the environmental concerns associated with battery disposal. The

[88] ICGL, *Renewable Energy Laws and Regulations in Indonesia 2025* (September 19, 2024); <https://iclg.com/practice-areas/renewable-energy-laws-and-regulations/indonesia>

[89] https://www.sciencedirect.com/science/article/pii/S0973082624001352

[90] Wajah Industri Nikel Kini (Betahita 2022)

[91] PT Indonesia Puqing Recycling Technology. (2022). Profil Badan Usaha.

[92] Per PE2 (December 12th 2024), as informed by a representative from PT CBL Indonesia Investment.

main strategies to address the concerns associated with the growing number of EV batteries reaching the end of their life include regulatory measures such as Extended Producer Responsibility and incentives for reuse and recycling. The regulatory framework concerning the end-of-life stage of the battery supply chain in Indonesia is considerably underdeveloped compared to other segments. The central legislative tools currently in force include the following, as illustrated in Table 3.8.

Table 3.8 Fiscal and non-fiscal incentives on battery end-of-life management in Indonesia

	Incentive	Description
Non-Fiscal	**Import of used batteries** Regulation of the Ministry of Commerce No. 100/2020	Aims to support the development of domestic electric vehicle industry by allow the import of used lithium batteries as raw materials
	Battery waste handling Presidential Regulation 55/2019	Article 32 mandates battery waste handling must be carried out through recycling and/or management
	Recycling infrastructure Presidential Regulation 73/2023	Amend and enhance the provisions of the Presidential Regulation No. 55/2019 supporting the development of recycling infrastructure and facilities for battery end-of-life management
	Waste management Government Regulation on Environmental Protection and Management No. 22 of 2021	Established a legal framework for managing B3 waste, including used lithium-ion batteries. Requires environmental permits for any entity involved in the collection, transport, storage, treatment, or disposal of B3 waste; mandates the use of a national tracking system for B3 waste movement, imposes administrative sanctions for non-compliance
	Waste management Ministry of Environment and Forestry Regulation No. 6/2021	Provides the procedures and requirements for toxic and hazardous waste management
	Waste management Ministry of Environment and Forestry Regulation No. 9/2024	Stipulates the need for individuals and business owners to properly manage hazardous waste

With the massive increase of batteries required to achieve the decarbonization targets set in many jurisdictions, the end-of-life treatment of batteries has raised concerns over the environmental sustainability of this technology. Although Indonesia includes batteries in its Circular Economy Roadmap and National Action Plan[93], it does not currently have any legislative measures in place that would support the integration of a circular economy approach to the battery value chain.

Advancing a circular battery economy framework can significantly reduce the risks linked to battery production by creating an economic system that generates value by capturing

[93] PETA JALAN & RENCANA AKSI NASIONAL EKONOMI SIRKULAR INDONESIA 2025–2045 https://www.un-pageindonesia.org/assets/uploads/b6ac7-circular-economy-indonesia-2025-2045-roadmap-and-national-action-plan.pdf

and reusing limited raw materials and energy resources, through slowing, narrowing and closing their loops. By focusing on repurposing and recycling EV batteries, the dependence on raw materials can be reduced, and the adverse social impacts associated with the extraction of the raw materials can be mitigated. Additionally, this approach minimizes the risk of supply chain disruptions caused by shifting trade alliances and geopolitical tensions. The possibility to reuse EV battery packs in stationary energy storage applications extends the lifetime of the battery packs with remaining capacity left but also delay recycling.

The Indonesian legislative framework as it currently stands focuses on hazardous waste management. The regulatory framework concerning hazardous waste (B3 waste) that is currently in place focuses primarily on safe handling and disposal. But it lacks specific guidelines for waste management, such as reuse or recycling, and circular economy principles like waste-to-resource and resource efficiency are not yet fully embedded in B3 licensing procedures. In Indonesia, the transition of a material from being classified as B3 waste to being recognized as a resource – a key enabler of circular economy – is not clearly defined or streamlined on the current framework. The current framework does not provide a clear pathway for reclassifying B3 waste as a secondary raw material or recyclable source, even after safe treatment or repurposing. Indonesia also lacks a certification or verification procedure to confirm that a material has been safely recovered and can be recovered and reintroduced into the market. Even if a battery is repurposed (for example for energy storage applications) it may still legally be treated as B3 waste, requiring full compliance with hazardous waste regulations. For example, a recycler using innovative recycling methods may produce high-purity outputs but cannot market these outputs as secondary raw materials. Instead, they are still subject to hazardous waste transport and storage rules, discouraging circularity.

3.3 Environmental and Social Impact Assessment

The impact assessment is determined by assessing the significance of the identified impacts in the Leopold Matrix (Annex 1. Leopold Matrix). Using desktop research, which is then verified during stakeholder consultations (i.e., FGDs, interviews) and field investigations, the impacts are further rated by assessing the risk and likelihood (Table 1.3). The assigned risk and likelihood for each impact determine the significance of impact. Table 3.9 Summary of environmental and social impact assessment

Activity	Environmental Impacts	Social Impacts
Battery Production		
As the most mature and developed stage, environmental and social impacts related to battery production are the most identifiable. The country already has an established industry, particularly for the mining and refining phase, whose impacts are already widely reported. This also means that these stages have the most robust legal framework. That said, more impact assessment studies may be required for specific processes or materials, starting with the battery material, cell manufacturing, and battery pack assembly. These studies could provide a foundation for future assessments should battery production capacity scale up in the future.		

Mining
Refining
CAM/anode manufacturing
Battery cell manufacturing
	• Mining is the stage of the supply chain that generates the most adverse impacts in almost all environmental aspects. This extends to both the construction and operation phases. The sensitive receptors in question include landscape, soil, water, biodiversity, waste generation, and carbon emissions.
	  ○ Due to its nature, mining activities will heavily alter the landscape, soil, and biodiversity through the land clearing and ore extraction process. Deforestation also contributes significantly to carbon emissions.
	  ○ Mining operations also contribute to wastewater generation. Mining wastewater typically contains total suspended solids (TSS) and oxidized heavy metals, such as Cr^{6+}, which contribute to acid mine drainage that can impact surface and groundwater.
	  ○ Although the post-operation can remedy the impacts to a certain extent, it may never be able to restore the damage fully.
	• The refining stage will have a high impact on the following sensitive receptors: air, water, biodiversity, energy, and carbon emissions.
	  ○ There may be substantial impacts on the landscape and soil, particularly due to tailing and slag management. In the refining process, tailings and slag are produced as waste from hydrometallurgy and pyrometallurgy, respectively.
	  ○ The high impacts from smelters are not only due to the nature of the refining process, but also due to the inclusion of a captive power plant. Ore refining is a highly energy-intensive process and, in Indonesia, it relies predominantly on coal power, which contributes to NO, SO_2, and PM2.5 emissions that disrupt air quality.
		• Similar to the environmental assessment, mining is the most socially disruptive stage. This is shown through the largest number of high-risk outcomes across communities, workers, and vulnerable groups.
		  ○ During the construction and operation phases, community health impacts are significant, as agricultural livelihoods decline when land is converted into mining sites.
		  ○ Community lifestyle impacts are moderate. They are driven by the shift from farming and fishing activities to industrial jobs, alongside the increased presence of police and military forces near mining areas.
		  ○ Human rights risks are substantial. There are genuine concerns over displacement, land grabbing, inadequate compensation, and forced sales.
		  ○ Indigenous Peoples (IPs) and cultural heritage face high risks, as IPs lose access to land, cultural sites, and livelihoods. Free, Prior, and Informed Consent (FPIC) is rarely implemented. Women are disproportionately affected, as land titles are often held by men, excluding women from land rights, decision-making, and equitable income opportunities.
		• Refining activities pose serious risks to both workers and surrounding communities, with health impacts and occupational health and safety (OHS) concerns being particularly severe.
		  ○ Community health risks are high due to air and water pollution.
		  ○ Livelihood risks range from moderate to high, linked to environmental degradation and reduced land productivity. The use of waste storage

Activity	Environmental Impacts	Social Impacts
Battery pack assembly	○ Application of captive power plants in refining also causes a substantial impact on carbon emissions. Common industry practices in Indonesian nickel smelting are reported to produce about 65 tCO2/Ni, which falls within the higher end of industry standards. • The manufacturing of battery components, cells, and pack assembly is either combined into one production facility or separated into three different stages in different entities. ○ The manufacturing of CAM/anode and battery cell components raises concerns about the potential air and soil contamination. These pollutants originate from dust containing heavy metals from battery materials (i.e., nickel, cobalt, lithium, graphite; depending on the product). This understudied impact warrants further analysis, as it may be amplified in the future due to the country's push for increased battery manufacturing. ○ In addition, all three manufacturing phases may cause a substantial impact on waste generation through the increase of hazardous waste. There have been reports of increased post-production waste in industrial areas that is not properly managed. Without proper intervention, this can lead to further waste accumulation.	facilities also carries moderate risks due to potential leaks that could contaminate water resources and impact community livelihoods. ○ Workers face high OHS risks, including respiratory problems from dust and emissions. Labor compliance issues are moderate, with reports of poor working conditions, long hours, low pay, and a lack of adequate safety measures. ○ Human rights violations remain a substantial risk, as reflected in reports submitted to Indonesia's National Commission on Human Rights. • Battery manufacturing presents low to moderate risks for both communities and workers. While generally manageable, these risks can escalate if operational procedures are not followed or if incidental events occur. ○ Community health risks are generally low in battery manufacturing, particularly in facilities within industrial estates where geographic isolation reduces direct disturbance. However, international experiences (e.g., community opposition to the construction of lithium-ion plants in Hungary) highlight the potential for public concern regarding air pollution and waste management. ○ Worker risks are moderate, primarily due to exposure to hazardous chemicals and inadequate use of personal protective equipment (PPE).
Battery Usage		
At the time of the study, battery usage in Indonesia is aimed at EV and BESS applications. For EV usage, this analysis highlights the impact on reducing carbon emissions as well as safety risks from unauthorized battery handling and removal. As for BESS, the impact assessment is more complex due to its integration into the national electricity mix. The assessment of BESS usage is more high-leveled and seen as an integration of the overall electricity scenario compared to of BESS alone.		
EVs BESS	• Meeting national EV production targets would only have a low impact on carbon emission reduction. One of the primary targets of the battery supply chain is to scale up domestic EV production as a means to meet decarbonization goals. ○ EV deployment is projected to increase to 10% and 2% for 2W and 4W, respectively. The current EV adoption rate is still less than 1% for either 4W or 2W,. Meanwhile, the annual production target is 13,000,000 2W and 2,000,000 4W EV units by 2030 based on information from BKPM. Targets in regulation remain at 600,000 by 2030 and 1,000,000 by 2040 for 4W. ○ These numbers can only reduce 3-5% of carbon emissions from the transportation sector. This calculation was done by comparing the target numbers against national statistics using life-cycle GHG data	• The adoption of EVs has generally low risks to community health and lifestyle. ○ That said, risks could escalate if EV production ramps up yet battery collection and recycling infrastructure remains inadequate. Ineffective recycling and collection systems may lead to illegal battery removal, creating hazards for EV owners (e.g., explosions, fires, or malfunctions), as well as risks of water pollution with potential impacts on community health. • BESS can support Indonesia in integrating more renewable energy, expanding energy access, and creating new employment opportunities. • However, their deployment is also associated with risks comparable to those faced by other industrial facilities. Since BESS projects are more

<table>
<tr><th>Activity</th><th>Environmental Impacts</th><th>Social Impacts</th></tr>
<tr><td></td><td>Assessing the impact of BESS applications is more complex, as they are integrated into the national electricity mix. Using the 2025-2034 RUPTL as the basis for assessment, BESS will likely be applied in new infrastructures rather than replacing existing ones.
Incorporating more renewable energy technologies, including BESS, can cause moderate carbon emission reduction. The scenarios presented in the RUPTL projected carbon emission reductions of about 29-30%[105]</td><td>likely to be developed within industrial estates, these risks should be assessed and managed within the context of such estates.</td></tr>
<tr><td colspan="3">Battery End-of-Life (EOL)</td></tr>
<tr><td colspan="3">The end-of-life (EOL) stage is still in its infancy in Indonesia. This leads to under-capacity of battery waste collection and recycling systems. However, the identification of environmental and social impacts is conducted with respect to conditions that occur in other countries. These findings can serve as references to Indonesia’s battery end-of-life development.</td></tr>
<tr><td>Battery waste
Battery material recycling</td><td>There is insufficient data on the projected battery waste post-EV and BESS usage. It is reported that the Coordinating Ministry of Economic Affairs (CMEA) is preparing a dedicated study on battery waste to address this.
Inadequate battery collection may cause a moderate impact on hazardous waste generation. A similar case is reflected in China, where used EVs are abandoned and lead to illegal battery removals.
The current arrangement suggests that battery waste collection is insufficient even for post-production waste. Currently, battery waste from the production process is collected by the informal sector, which lacks regulation and standards. This allows an opportunity for policymakers to strengthen the current collection scheme and minimize waste generation.
Much like battery production, the battery material recycling process mirrors many of its impacts. This includes impacts on air, soil, water, and waste generation. However, available studies specifically on battery recycling are limited.
The battery material recovery process will produce air pollutants containing heavy metals, which can further cause soil and groundwater pollution. That said, this finding warrants further investigation, specifically in the context of battery recycling plants.
The dismantling process may also contribute to increased solid waste from battery packaging. This is linked to the findings regarding battery waste in general.</td><td>Risks are generally low to moderate but depend heavily on effective management practices.
Community lifestyle and health: Largely low risk; however, improper recycling or disposal practices can significantly escalate impacts.
Recycling facilities: Pose limited but notable safety risks, particularly from accidental chemical spills, handling of flammable or reactive reagents, and the transportation of hazardous materials.
Battery collection: Inadequate collection systems increase exposure of communities to toxic components, mainly when illegal or informal removals occur. This raises serious health and safety concerns in areas without formal collection infrastructure.
Defective batteries: A critical risk arises from the high volume of defective batteries generated during the start-up phase of new factories. Improper storage and processing of these defective units can endanger both workers and the surrounding communities.</td></tr>
<tr><td colspan="3">Associated Facilities</td></tr>
<tr><td colspan="3">Associated facilities linked to the battery supply chain are expected to increase in capacity, which warrants the need for their own environmental and social impact assessment. The assessment itself highlights several notable findings, such as the issue with processing waste management, which is within the full accountability of the industrial estate; human rights issues related to land displacement and social concerns from industrial development; as well as perceived impacts from the development of special ports.</td></tr>
</table>

Activity	Environmental Impacts	Social Impacts
Industrial estate Special port Transport & logistics	• Industrial estates allow impacts to be contained within their premises, minimizing impact on the surrounding environment. That said, it does not mean the impacts are less significant. High and substantial impacts are still potential within industrial estate borders, with some having a higher likelihood of spilling over into the environment. ◦ The only time industrial estates produce impacts on their own is during the construction period. The construction phase allows high and substantial impacts on the landscape, soil, water, biodiversity, waste generation, and carbon emissions. This is from the land preparation and construction activities for preparing the industrial lots and infrastructure[94]. ◦ During the operation phase, impacts from the industrial estates are ruled mainly by their tenants. This is due to the nature of its business. Industrial estates serve as "operational hubs" where different types of industries operate in isolation from the surrounding community. Thus, impacts at this stage are driven mainly by what the tenants do and how the estate manages them. ◦ Air pollutants and waste generation are full responsibility of the tenants. Air pollutants are usually emitted from industrial factories, including smelters. Waste from production processes also falls within the responsibility of the industrial tenants. ◦ The industrial estate typically manages effluent water discharge, as it provides wastewater treatment plants (WTP) for tenant usage. The industrial estate must ensure that all tenants adhere to industrial standards, as their environmental licensing is tied to the industrial estate's. The estate also has full authority to suspend tenant activities. ◦ In addition, the industrial estate also holds full accountability to the management of processing waste i.e., nickel slag. Industrial estates such as IMIP are reported to manage their own waste storage facilities by collecting and processing waste from their tenants. Thus, any accidents related to this shall be the industrial estate's responsibility. • Special ports serve as an important infrastructure for mines, smelters, or industrial parks. ◦ The development of special ports seems to lack a planning and policy framework. In Java, as reflected in Karawang, many special ports are built within industrial zones, which promotes the integration of industrial zones. However, in Sulawesi—as reflected in Morowali—special ports are often scattered due to poor road infrastructure.	• Impacts related to industrial estates are generally less severe than mining or refining, but emerging risks in industrial zones warrant close attention. ◦ Since the pre-construction phase, high-risk impacts to IPs have been reported due to lack of FPIC. Land has been taken or deforested without consent, with partial or inadequate compensation. They have faced loss of livelihoods, displacement, and restricted access to cultural and ancestral burial lands. Indigenous groups without government-recognized land certificates are especially vulnerable to dispossession. ◦ Impact on human rights as there are reports document intimidation, threats, and criminalization of residents opposing projects. Compensation processes are often partial, delayed, or contested, with some leaders striking deals without broader community consent. ◦ Once the construction and operation phases kick in, rapid immigration ensues. Thus has doubled local populations, generating social tensions between newcomers, local residents, and companies. ◦ Workers face substantial labor and OHS risks. This comes in the form of corruption in job placement (payments demanded for employment), wage disparities between Indonesian and migrant workers, retaliation against union activities, and limits on overtime. In addition, there are also reports of low wages, poor implementation of PPE, long working hours, passport withholding, and hazardous conditions. The Human Rights & Business Observatory reports high rate of accidents between 2015-2024 (114 incidents, 101 deaths, 240 injuries reported 2015–2024). • Impacts to vulnerable communities have also been linked to industrialization. ◦ Women report denial of menstrual leave and assignment of night shifts during pregnancy, despite national protections. Gender-sensitive measures are largely absent. ◦ Community Livelihoods and Lifestyle: Communities have lost access to agricultural lands, fishing grounds, and IPs have lost access to ancestral burial sites. In addition, Immigration pressures have generated tensions with residents. ◦ Community health is compromised by pollution from industrial estate tenants, linked to respiratory and skin illnesses. ◦ That said, opportunities and improvement of the quality of life are offered to the people. These are demonstrated through scholarships, healthcare, clean water, and support for small and medium-sized

Activity	Environmental Impacts	Social Impacts
	◦ Unsustainable development of special ports can cause a substantial impact on marine ecosystems. This comes from activities such as dredging during construction and overall terminal operations. • Other transport and logistics infrastructure such as roads remain key to enabling an integrated supply chain. ◦ There seems to be an uneven distribution of proper roadworks between Java and the rest of Indonesia. This is evident in how other parts of Indonesia, especially the east, rely more on goods hauling via sea compared to roads.	enterprises. Although the benefits are unevenly distributed and limited in scope. ◦ Port development has disrupted ecosystems long managed by residents, displacing around 1,105 fishing households. Other impacts include: the displacement of youths shifted into low-income activities (i.e., construction, vending, parking, scavenging), and women, previously central to coastal resource management as shellfish gatherers, were excluded from project planning and decision-making. • Transport and Logistics: Moderate to high risks emerge from heavy traffic linked to industrial estates. Large trucks and heavy equipment increase accident risks, particularly in mixed-traffic areas (pedestrians, motorcycles). ◦ Workers face additional risks from heavy machinery and chemical exposure, worsened by inadequate safety measures and communication.

Table 3.9 Summary of environmental and social impact assessment

Activity	Environmental Impacts	Social Impacts
Battery Production		
As the most mature and developed stage, environmental and social impacts related to battery production are the most identifiable. The country already has an established industry, particularly for the mining and refining phase, whose impacts are already widely reported. This also means that these stages have the most robust legal framework. That said, more impact assessment studies may be required for specific processes or materials, starting with the battery material, cell manufacturing, and battery pack assembly. These studies could provide a foundation for future assessments should battery production capacity scale up in the future.		
Mining **Refining** **CAM/anode manufacturing** **Battery cell manufacturing**	• **Mining is the stage of the supply chain that generates the most adverse impacts in almost all environmental aspects**. This extends to both the construction and operation phases. The sensitive receptors in question include landscape, soil, water, biodiversity, waste generation, and carbon emissions. ○ Due to its nature, mining activities will heavily alter the landscape, soil, and biodiversity through the land clearing and ore extraction process. Deforestation also contributes significantly to carbon emissions. ○ Mining operations also contribute to wastewater generation. Mining wastewater typically contains total suspended solids (TSS) and oxidized heavy metals, such as Cr^{6+}, which contribute to acid mine drainage[94] that can impact surface and groundwater. ○ Although the post-operation can remedy the impacts to a certain extent, it may never be able to restore the damage fully. • **The refining stage will have a high impact on the following sensitive receptors: air, water, biodiversity, energy, and carbon emissions.** ○ There may be substantial impacts on the landscape and soil, particularly due to tailing and slag management. In the refining process, tailings and slag are produced as waste from hydrometallurgy and pyrometallurgy, respectively. ○ The high impacts from smelters are not only due to the nature of the refining process, but also due to the inclusion of a captive power plant. Ore refining is a highly energy-intensive process[95] and, in Indonesia, it relies predominantly on coal power, which contributes to NO, SO_2, and $PM_{2.5}$ emissions that disrupt air quality[96].	• **Similar to the environmental assessment, mining is the most socially disruptive stage.** This is shown through the largest number of high-risk outcomes across communities, workers, and vulnerable groups. ○ **During the construction and operation phases, community health impacts are significant, as agricultural livelihoods decline when land is converted into mining sites.** ○ **Community lifestyle impacts are moderate.** They are driven by the shift from farming and fishing activities to industrial jobs, alongside the increased presence of police and military forces near mining areas. ○ **Human rights risks are substantial.** There are genuine concerns over displacement, land grabbing, inadequate compensation, and forced sales. ○ **Indigenous Peoples (IPs) and cultural heritage face high risks, as IPs lose access to land, cultural sites, and livelihoods.** Free, Prior, and Informed Consent (FPIC) is rarely implemented. Women are disproportionately affected, as land titles are often held by men, excluding women from land rights, decision-making, and equitable income opportunities. • **Refining activities pose serious risks to both workers and surrounding communities, with health impacts and occupational health and safety (OHS) concerns being particularly severe.** ○ Community health risks are high due to air and water pollution. ○ Livelihood risks range from moderate to high, linked to environmental degradation and reduced land productivity. The use of waste storage facilities also carries moderate risks due to potential leaks that could contaminate water resources and impact community livelihoods.

[94] AEER. (2023). "Dilema Halmahera di Tengah Industri Nikel". Link
[95] Nickel Institute. (2024). "Nickel life cycle data". Link
[96] CREA & CELIOS. (2024). "Debunking the Value-added Myth in Nickel Downstream Industry". Link

Activity	Environmental Impacts	Social Impacts
Battery pack assembly	○ Application of captive power plants in refining also causes a substantial impact on carbon emissions. Common industry practices in Indonesian nickel smelting are reported to produce about 65 tCO_2/Ni[97], which falls within the higher end of industry standards[98]. • **The manufacturing of battery components, cells, and pack assembly is either combined into one production facility or separated into three different stages in different entities.** ○ The manufacturing of CAM/anode and battery cell components raises concerns about the potential air and soil contamination. These pollutants originate from dust containing heavy metals from battery materials (i.e., nickel, cobalt, lithium, graphite; depending on the product)[99]. This understudied impact warrants further analysis, as it may be amplified in the future due to the country's push for increased battery manufacturing. ○ In addition, all three manufacturing phases may cause a substantial impact on waste generation through the increase of hazardous waste. There have been reports of increased post-production waste in industrial areas that is not properly managed. Without proper intervention, this can lead to further waste accumulation.	○ Workers face high OHS risks, including respiratory problems from dust and emissions. Labor compliance issues are moderate, with reports of poor working conditions, long hours, low pay, and a lack of adequate safety measures. ○ Human rights violations remain a substantial risk, as reflected in reports submitted to Indonesia's National Commission on Human Rights. • **Battery manufacturing presents low to moderate risks for both communities and workers.** While generally manageable, these risks can escalate if operational procedures are not followed or if incidental events occur. ○ Community health risks are generally low in battery manufacturing, particularly in facilities within industrial estates where geographic isolation reduces direct disturbance. However, international experiences (e.g., community opposition to the construction of lithium-ion plants in Hungary) highlight the potential for public concern regarding air pollution and waste management[100]. ○ Worker risks are moderate, primarily due to exposure to hazardous chemicals and inadequate use of personal protective equipment (PPE).
Battery Usage		
At the time of the study, battery usage in Indonesia is aimed at EV and BESS applications. For EV usage, this analysis highlights the impact on reducing carbon emissions as well as safety risks from unauthorized battery handling and removal. As for BESS, the impact assessment is more complex due to its integration into the national electricity mix. The assessment of BESS usage is more high-leveled and seen as an integration of the overall electricity scenario compared to of BESS alone.		
EVs	• **Meeting national EV production targets would only have a low impact on carbon emission reduction.** One of the primary targets of the battery supply chain is to scale up domestic EV production as a means to meet decarbonization goals.	• **The adoption of EVs has generally low risks to community health and lifestyle.** ○ That said, risks could escalate if EV production ramps up yet battery collection and recycling infrastructure remains inadequate. Ineffective recycling and collection systems may lead to illegal battery removal,

[97] IEEFA. (2024). "Indonesia's Nickel Companies: The Need for Renewable Energy Amid Increasing Production". Link

[98] IFC. (2023). "Net Zero Roadmap to 2050 for Copper and Nickel Mining Value Chains ". Link

[99] Degen, F. *et al.*. (2025). "Direct emissions to air, water and soil from a battery gigafactory". *Communications Earth & Environment*, **6**(408). Link

[100] Business and Human Rights (2024). Hungary: Locals oppose construction of Chinese lithium-ion battery plant over air pollution & fear of becoming 'battery wasteland. Available at: https://www.business-humanrights.org/en/latest-news/hungary-locals-protest-against-construction-of-chinese-lithium-ion-battery-plant-over-air-pollution-fear-of-battery-wasteland/

<table>
<tr><th>Activity</th><th>Environmental Impacts</th><th>Social Impacts</th></tr>
<tr><td>BESS</td><td>◦ EV deployment is projected to increase to 10% and 2% for 2W and 4W, respectively. The current EV adoption rate is still less than 1% for either 4W or 2W[101,102]. Meanwhile, the annual production target is 13,000,000 2W and 2,000,000 4W EV units by 2030 based on information from BKPM. Targets in regulation[103] remain at 600,000 by 2030 and 1,000,000 by 2040 for 4W.
◦ These numbers can only reduce 3-5% of carbon emissions from the transportation sector. This calculation was done by comparing the target numbers against national statistics using life-cycle GHG data[104]
• Assessing the impact of BESS applications is more complex, as they are integrated into the national electricity mix. Using the 2025-2034 RUPTL[105] as the basis for assessment, BESS will likely be applied in new infrastructures rather than replacing existing ones.
◦ Incorporating more renewable energy technologies, including BESS, can cause moderate carbon emission reduction. The scenarios presented in the RUPTL projected carbon emission reductions of about 29-30%[105]</td><td>creating hazards for EV owners (e.g., explosions, fires, or malfunctions), as well as risks of water pollution with potential impacts on community health.
• BESS can support Indonesia in integrating more renewable energy, expanding energy access, and creating new employment opportunities.
• However, their deployment is also associated with risks comparable to those faced by other industrial facilities. Since BESS projects are more likely to be developed within industrial estates, these risks should be assessed and managed within the context of such estates.</td></tr>
<tr><td colspan="3">Battery End-of-Life (EOL)</td></tr>
<tr><td colspan="3">The end-of-life (EOL) stage is still in its infancy in Indonesia. This leads to under-capacity of battery waste collection and recycling systems. However, the identification of environmental and social impacts is conducted with respect to conditions that occur in other countries. These findings can serve as references to Indonesia's battery end-of-life development.</td></tr>
<tr><td>Battery waste</td><td>• There is insufficient data on the projected battery waste post-EV and BESS usage. It is reported that the Coordinating Ministry of Economic Affairs (CMEA) is preparing a dedicated study on battery waste to address this.
◦ Inadequate battery collection may cause a moderate impact on hazardous waste generation. A similar case is reflected in China, where used EVs are abandoned and lead to illegal battery removals[106].</td><td>• Risks are generally low to moderate but depend heavily on effective management practices.
◦ Community lifestyle and health: Largely low risk; however, improper recycling or disposal practices can significantly escalate impacts.
◦ Recycling facilities: Pose limited but notable safety risks, particularly from accidental chemical spills, handling of flammable or reactive reagents, and the transportation of hazardous materials.</td></tr>
</table>

[101] BPS. (2023). "Jumlah Kendaraan Bermotor Menurut Provinsi dan Jenis Kendaraan (unit), 2023". Link
[102] Ministry of Transportation. (2022). "Data Penerbitan Sertifikat Registrasi Uji Tipe (SRUT)". *Sistem Pernghubung Layanan Transportasi*. Link
[103] Peraturan Menteri Perindustrian Nomor 28 Tahun 2023 (Permenperin No 28 Tahun 2023) | catatanhukum.id
[104] Mera, Z. *et al*. (2023). "Comparison of the Life-Cycle Greenhouse Gas Emissions of Combustion Engine and Electric Passeneger Cars and Two-Wheelers in Indonesia". *The International Council on Clean Transportation*. Link
[105] PLN. (2025). "Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) 2025-2034". Link
[106] Bloomberg. (2023). "China's Abandoned, Obsolete Electric Cars Are Piling Up in Cities". Link

Activity	Environmental Impacts	Social Impacts
Battery material recycling	○ The current arrangement suggests that battery waste collection is insufficient even for post-production waste. Currently, battery waste from the production process is collected by the informal sector, which lacks regulation and standards. This allows an opportunity for policymakers to strengthen the current collection scheme and minimize waste generation. • **Much like battery production, the battery material recycling process mirrors many of its impacts.** This includes impacts on air, soil, water, and waste generation. However, available studies specifically on battery recycling are limited. ○ The battery material recovery process will produce air pollutants containing heavy metals, which can further cause soil and groundwater pollution[107]. That said, this finding warrants further investigation, specifically in the context of battery recycling plants. ○ The dismantling process may also contribute to increased solid waste from battery packaging. This is linked to the findings regarding battery waste in general.	○ **Battery collection:** Inadequate collection systems increase exposure of communities to toxic components, mainly when illegal or informal removals occur. This raises serious health and safety concerns in areas without formal collection infrastructure. ○ **Defective batteries:** A critical risk arises from the high volume of defective batteries generated during the start-up phase of new factories. Improper storage and processing of these defective units can endanger both workers and the surrounding communities.
Associated Facilities		
Associated facilities linked to the battery supply chain are expected to increase in capacity, which warrants the need for their own environmental and social impact assessment. The assessment itself highlights several notable findings, such as the issue with processing waste management, which is within the full accountability of the industrial estate; human rights issues related to land displacement and social concerns from industrial development; as well as perceived impacts from the development of special ports.		
Industrial estate **Special port**	• **Industrial estates allow impacts to be contained within their premises, minimizing impact on the surrounding environment.** That said, it does not mean the impacts are less significant. High and substantial impacts are still potential within industrial estate borders, with some having a higher likelihood of spilling over into the environment. ○ The only time industrial estates produce impacts on their own is during the construction period. The construction phase allows high and substantial impacts on the landscape, soil, water, biodiversity, waste generation, and carbon emissions. This is from the land preparation and construction activities for preparing the industrial lots and infrastructure[94].	• **Impacts related to industrial estates are generally less severe than mining or refining, but emerging risks in industrial zones warrant close attention.** ○ Since the pre-construction phase, high-risk impacts to IPs have been reported due to lack of FPIC. Land has been taken or deforested without consent, with partial or inadequate compensation. They have faced loss of livelihoods, displacement, and restricted access to cultural and ancestral burial lands. Indigenous groups without government-recognized land certificates are especially vulnerable to dispossession. ○ Impact on human rights as there are reports document intimidation, threats, and criminalization of residents opposing projects.

[107] Xiaodong. *Et al*. (2024). "Environmental Impact Analysis of Waste Lithium-Ion Battery Cathode Recycling". *Journal of Ecological Engineering* 2024, **25**(7), 352-358. Link

Activity	Environmental Impacts	Social Impacts
Transport & logistics	◦ During the operation phase, impacts from the industrial estates are ruled mainly by their tenants. This is due to the nature of its business. Industrial estates serve as "operational hubs" where different types of industries operate in isolation from the surrounding community. Thus, impacts at this stage are driven mainly by what the tenants do and how the estate manages them. ◦ Air pollutants and waste generation are full responsibility of the tenants. Air pollutants are usually emitted from industrial factories, including smelters. Waste from production processes also falls within the responsibility of the industrial tenants. ◦ The industrial estate typically manages effluent water discharge, as it provides wastewater treatment plants (WTP) for tenant usage. The industrial estate must ensure that all tenants adhere to industrial standards, as their environmental licensing is tied to the industrial estate's. The estate also has full authority to suspend tenant activities. ◦ In addition, the industrial estate also holds full accountability to the management of processing waste i.e., nickel slag. Industrial estates such as IMIP are reported to manage their own waste storage facilities by collecting and processing waste from their tenants. Thus, any accidents related to this shall be the industrial estate's responsibility. • **Special ports serve as an important infrastructure for mines, smelters, or industrial parks.** ◦ The development of special ports seems to lack a planning and policy framework. In Java, as reflected in Karawang, many special ports are built within industrial zones, which promotes the integration of industrial zones. However, in Sulawesi—as reflected in Morowali—special ports are often scattered due to poor road infrastructure. ◦ Unsustainable development of special ports can cause a substantial impact on marine ecosystems. This comes from activities such as dredging during construction and overall terminal operations[108].	Compensation processes are often partial, delayed, or contested, with some leaders striking deals without broader community consent. ◦ Once the construction and operation phases kick in, rapid immigration ensues. Thus has doubled local populations, generating social tensions between newcomers, local residents, and companies. ◦ Workers face substantial labor and OHS risks. This comes in the form of corruption in job placement (payments demanded for employment), wage disparities between Indonesian and migrant workers, retaliation against union activities, and limits on overtime. In addition, there are also reports of low wages, poor implementation of PPE, long working hours, passport withholding, and hazardous conditions. The Human Rights & Business Observatory reports high rate of accidents between 2015-2024 (114 incidents, 101 deaths, 240 injuries reported 2015–2024)[109]. • **Impacts to vulnerable communities have also been linked to industrialization.** ◦ Women report denial of menstrual leave and assignment of night shifts during pregnancy, despite national protections. Gender-sensitive measures are largely absent. ◦ Community Livelihoods and Lifestyle: Communities have lost access to agricultural lands, fishing grounds, and IPs have lost access to ancestral burial sites. In addition, Immigration pressures have generated tensions with residents. ◦ Community health is compromised by pollution from industrial estate tenants, linked to respiratory and skin illnesses. ◦ That said, opportunities and improvement of the quality of life are offered to the people. These are demonstrated through scholarships, healthcare, clean water, and support for small and medium-sized enterprises. Although the benefits are unevenly distributed and limited in scope.

[108] UNESCAP. (1992). "Assessment of the Environmental Impact of Port Development". Link

[109] Business & Human Rights Resource Centre (2024). Indonesia: Workers allege 'production first, safety later' culture at IMIP nickel complex leads to unsafe conditions & rising accidents. Available at: Indonesia: Workers allege 'production first, safety later' culture at IMIP nickel complex leads to unsafe conditions & rising accidents - Business & Human Rights Resource Centre
Reported worker deaths and injuries in Indonesia: https://www.business-humanrights.org/duments/40741/Reported-Worker-Deaths-and-Injuries-in-Indonesia-updated-11_4_1.xlsx

Activity	Environmental Impacts	Social Impacts

	• **Other transport and logistics infrastructure such as roads remain key to enabling an integrated supply chain.**
	    ○ There seems to be an uneven distribution of proper roadworks between Java and the rest of Indonesia. This is evident in how other parts of Indonesia, especially the east, rely more on goods hauling via sea compared to roads.
		○ Port development has disrupted ecosystems long managed by residents, displacing around 1,105 fishing households. Other impacts include: the displacement of youths shifted into low-income activities (i.e., construction, vending, parking, scavenging), and women, previously central to coastal resource management as shellfish gatherers, were excluded from project planning and decision-making.
		• **Transport and Logistics: Moderate to high risks emerge from heavy traffic linked to industrial estates.** Large trucks and heavy equipment increase accident risks, particularly in mixed-traffic areas (pedestrians, motorcycles).
		    ○ Workers face additional risks from heavy machinery and chemical exposure, worsened by inadequate safety measures and communication.

Table 3.10. Environmental and social mitigation strategies

Activity	Environmental & Social Mitigation Strategies	Governing Institutions	Mitigation Hierarchy
General	**Human Rights in Business Conduct:** Strengthen awareness and enforcement of the UNGPs[110] through nationwide campaigns, stricter due diligence, and mediation with affected communities. Third-party audits and IFC Performance Standards can improve objectivity and regulatory alignment[111]	• BKPM • MoM • MoLHR • Regional	Minimize
	Improve enforcement of OHS and labor standards, including safe chemical use, reduced overtime, PPE use, workplace hygiene, and health education. Ensure women's rights in the workplace through maternity protections and gender-sensitive policies. Policymakers can push for the improvement of OHS standards and labor rights using policy instruments that companies must adhere to.	• MoM • MEMR • MoWECP	Enhance
	Mandate disclosure of environmental data (air, water quality) and establish independent monitoring units in companies to build community trust and strengthen governance, particularly in the mining sector. This can be done through mandating public disclosure of air and water quality data from industrial facilities to ensure transparency and build community trust, and establishing independent monitoring units within companies to oversee compliance with environmental protection and human rights standards.	• MoE • MEMR • Regional governments	Enhance
	Improve land acquisition by strengthening the One Map Policy (OMP) and ATR/BPN mechanism. Ensure recognition of Indigenous/customary lands and enforce FPIC to safeguard communities and prevent bribery, with pro-community regulations	• BKPM • MEMR • ATRBPN	Enhance
Battery Production	**Spatial Planning & Biodiversity Protection:** Mining concessions must follow spatial and conservation regulations. Biodiversity studies should be conducted early to identify and avoid critical habitats. Alignment with international frameworks is needed to strengthen conservation efforts.	• BKPM • MoE • MoF • ATRBPN	Avoid
	Emphasis should be placed on mine water and wastewater management. The current national framework has taken this into account. **continuous monitoring by the government and relevant stakeholders is encouraged to minimize the impacts on water bodies** both from wastewater discharge and freshwater utilization.	• BKPM • MoE • Regional governments	Minimize
	Air Quality & Energy Source: Refining activities should prioritize air quality management, with better modelling of pollutant dispersion. Policymakers should promote renewable energy to reduce reliance on coal-based captive power plants.	• MoE • Regional governments • MEMR	Minimize
	Pollution Studies & Licensing: More studies are needed on pollutants (air, soil, groundwater) linked to battery compounds such as nickel and manganese. Environmental licensing can enforce these obligations for manufacturers.	• MoE • Regional governments	Minimize
	Post-production waste, which is classified as hazardous, must be appropriately managed under appropriate regulations	• MoE • Regional governments	Minimize
	Recognition of Indigenous Peoples' rights in mining remains weak as Indonesia has not ratified ILO Convention 169 nor fully implemented UNDRIP. Ratification and integration into national regulations are key to strengthen their participation	• MoLHR	Minimize

[110] UN. Guiding Principles on Business and Human Rights: Implementing the United Nations "Protect, Respect and Remedy" Framework. Available at: Guiding Principles on Business and Human Rights: Implementing the United Nations "Protect, Respect and Remedy" Framework | OHCHR

[111] IFC's Performance Standards on Environmental and Social Sustainability. Available at: https://www.ifc.org/en/insights-reports/2012/ifc-performance-standards

Activity	Environmental & Social Mitigation Strategies	Governing Institutions	Mitigation Hierarchy
Battery Usage	**The shift from ICEVs to EVs may risk job losses, raising concerns among workers' unions.** Though current EV targets are still limited, Indonesia should anticipate future impacts by conducting feasibility studies on reskilling and social protection and mobilizing international support for a just transition.	• MoI • MoT • MoM	Minimize
	As BESS deployment expands with renewable energy, potential job displacement in the energy sector must be addressed early. Proactive mitigation helps policymakers and companies prepare corrective measures for a fair transition	• BKPM • PLN • MEMR • MoM	Enhance
Battery End-of-Life	**Battery Waste:** While EV adoption is still at an early stage, policymakers should begin preparing authorized collection systems. Early establishment of such systems will strengthen recycling capacity and reduce potential waste.	• MoE • MoI	Enhance
	National recycling capacity remains low, leading some companies to export rejected battery products, which is costly and risky. Scaling up domestic recycling facilities and centralized collection systems will improve efficiency.	• BKPM • MoE • MoI	Enhance
	As recycling expands, dismantling used batteries may generate solid and hazardous waste. **Proper recycling methods should be promoted and incentivized through policy to minimize risks**	• MoE • Regional governments	Minimize
	Given the early stage of EV adoption, battery waste remains limited, but preparation is crucial. The government is conducting studies and positioning urban mining within the national circular economy agenda. **Establishing an authorized collection system will enhance recycling capacity and reduce risks from unauthorized handling.**	• MoE • MoI	Enhance
Associated Facilities	Wastewater must be strictly monitored, as noncompliance has been reported despite estates' accountability. **Processing waste (e.g., slag) requires safer handling to avoid risks from dumping or landfill collapse. Stronger permit mechanisms are needed.**	• MoE • Regional governments	Minimize
	Further management is needed for the management of wastewater. The current national framework has taken this into account. In fact, industrial estates take full accountability for the wastewater of their tenants. The fact remains that wastewater leaving industrial estates has reportedly shown noncompliant levels.	• MoE • Regional governments	Minimize
	Logistics and special ports should comply with spatial and conservation regulations. International frameworks (e.g., mangroves, migratory species) provide additional context beyond national boundaries and should be adopted.	• BKPM • MoF • MoE • MMAF • MoT • ATRBPN	Minimize
	Adoption of green shipping principles, including Green Shipping Corridors[112], should be promoted to reduce ecological and social disruption. Policymakers should also integrate the Ten Guiding Principles for Sustainable Freight Transport into transport and freight policies	• MoT	Minimize
	Transport and logistics should adhere to the Ten Guiding Principles for Sustainable Freight Transport in Asia and the Pacific. Key social aspects include expanding rural access for equitable benefits, promoting women's participation, and strengthening governance and capacity. Policymakers should integrate these principles into national freight and transport policies.	• MoT	Enhance
	Some of the social aspects highlighted are increased rural access to make logistics more efficient and promote even benefit sharing, promote women's participation in freight transport, and strengthen governance and capacity[113]. **Policymakers can push the inclusion of these principles in policies related to transport and freight.**	• MoT	Minimize

[112] UNESCAP. (2023). "A Study on the Implementation Strategy of the Green Shipping Corridor in Asia and the Pacific". (Link)
[113] UNESCAP. "Ten Guiding Principles for Sustainable Freight Transport in Asia and the Pacific". (Link)

4. Key Challenges and Policy Priorities for Indonesia's Battery Supply Chain

4.1 Policy Instruments

Several policy measures adopted in Indonesia target specifically mining and refining. However, their coherence –both with each other and with national priorities–has been questioned, due to concerns over potential risks of undermining key policy goals. For example, the nickel processing relying on energy-intensive technology currently powered by coal-fired power plants hinder the country's green energy transition progress, whereas foreign companies that currently dominate the nickel refining segment in Indonesia benefit from subsidized electricity prices.

Situations like this underscore the need to revisit the policy framework to ensure it more effectively supports domestic value creation and aligns with broader national development goals. Indonesia's heavy reliance on China for the supply and processing of minerals exposes the industry to price volatility and supply chain disruptions, highlighting the need for investment diversification and international partnerships to enhance supply chain resilience.

One of the main policy instruments for the manufacturing segments are the local content mandates for batteries and EVs. During the Presentation Event 3 (PE3), part of the stakeholder engagement activities described in section 2.3 of this report, the question was raised regarding whether to implement similar rules for BESS. However, the question to ask is if this policy instrument is yielding the desired results. Research showed only two EV models comply with the local content requirements in Indonesia. Content mandates were delayed (from 2025 to 2027) and, additionally, locally manufactured EVs now compete with the influx of imported EVs, which skyrocketed since the tax exemption for fully assembled EVs was introduced. Proponents of local content policies consider these measures support development goals by boosting local production and employment, as well as facilitating technology transfers between domestic and foreign companies. In addition, local content policies involving engagement with local communities have led to securing a social license to operate, particularly in the mining industry.[114] Opponents, on the other hand, consider local content policies to undermine industrial competitiveness over the long-run and for the economy as a whole.[115] While local content requirements are detailed and aim to stimulate domestic industry, their effectiveness remains debated at the global level. Internationally, such measures are often viewed as contentious, raising concerns about their compatibility with trade rules and their actual impact on fostering sustainable local industrial growth (Figure 4.1).

---

[114] M Weiss, 'The role of local content policies in manufacturing and mining in low- and middle-income countries' (United Nations Industrial Development Organisation, Inclusive and Sustainable Industrial Development Working Paper Series WP 19/2016, p. 6.

[115] S Tsani, C Chitou, I Overland, 'Local content policies: Knowledge stock and future directions for research and policy making in view of the sustainability agenda' 162 *Environmental Science and Policy* (2024), 103919.

Figure 4.1 Pros and cons of local content policies, a summary for the local content provisions [116]

+ **Economic growth**: By promoting the use of local materials and labor, local content requirements can situmulate domestic industries and create jobs

+ **Skill development**: Encouraging local content can lead to the development of skills and expertise within the country

+ **Reduced dependency**: local content requirements can reduce reliance on imported goods and services, fostering self-sufficiency

+ **Increase investment**: Local content requirements can attract foreign investment by rensuring that a portion of the investment benefits the local economy

+**Enhanced industrial base**: Local content requirements facilitate building a stronger industrial base, supporting long-erm economic stability

+ **Environmental benefits**: Depending on their design, local content policies can pursue environmental obejctives and create green jobs.

- **Higher costs**: Local content measures can sometimes lead to higher production costs if local material or labor are more expensive thatn imported alternatives

- **Limited competition**: local conten requirements can limit competition, potentially leading to inefficiencies and lower quality products

- **Trade conflict**: Local content requirements can conflict with international trade agreements, leading to disputes and potential sactions

- **Implementation challenges**: Ensuring compliance with local content regulations can be complex and burdensome for companies

- **Short-term disruptions**: in the short-term, industries may face disruptions as they adjust to new sourcing requirements

Considering the negative effects associated with local content policies, measures involving them must be carefully designed, and based on robust industrial mapping and data. While local content requirements have the possibility to violate multilateral World Trade Organization (WTO) agreements, economic partnerships and regional trade agreements, their non-compliance often goes unpunished due to several factors. There have been signs of flexible interpretation of the rules that can lead to varied enforcement outcomes.[117] Nevertheless, any measure to be adopted should be 'risk-monitored' in preparation for possible future litigation.

Additionally, the local content requirement for BESS may not be the most suitable instrument to implement as of today. There is no target anchored to any other planning instrument or mandate, so there is no market for them. As of today, efforts would be better placed in creating rules and a sound revenue stream for BESS, in cooperation with MEMR and PLN.

---

[116] Own elaboration based on M Weiss, 'The role of local content policies in manufacturing and mining in low- and middle-income countries' (United Nations Industrial Development Organisation, Inclusive and Sustainable Industrial Development Working Paper Series WP 19/2016); Lise Johnson, *Space for Local Content Policies and Strategies: A crucial time to revisit an old debate* (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH 2016), p. 7.
[117] M Weiss, 'The role of local content policies in manufacturing and mining in low- and middle-income countries' (United Nations Industrial Development Organisation, Inclusive and Sustainable Industrial Development Working Paper Series WP 19/2016), pp. 10-11.

Regarding financing Mining projects are currently encountering substantial challenges in securing project financing, primarily due to the scale of initial capital investment required. In many cases, the estimated capital expenditure needed to develop these projects exceeds the current market valuation of the companies undertaking them. For example, certain projects require an investment of approximately USD 500 million, while the corresponding market value may be less than USD 100 million—rendering equity financing unfeasible.

In addition, the ongoing low-price environment for key commodities has further constrained access to traditional project financing. Indonesia could take further advantage of its position as the leading Nickel producer by pushing these types of schemes that tie supply i.e., mining and refining, with demand (EV and battery manufacturing).

4.2 Incentives

The Indonesian incentives to support the development of the battery supply chain ecosystem within the borders of the country rely heavily on the so-called downstreaming policies. 'Downstreaming policies' in the context of this project refer to measures aimed at promoting the processing of raw minerals within the country where they are mined, rather than exporting them in their raw form to be processed elsewhere. The main tool in this regard is undoubtedly the nickel export ban, which was implemented since 2014 and renewed in 2020. As described in Deliverable 3, and according to S&P Global, nickel prices rose in 2022 after Indonesia renewed its export ban. While the volume of exports has decreased, its value is higher. In 2019, it exported 32 million metric tons of nickel ore and 1 million of ferronickel, earning $3 billion. By 2022, it exported 5.8 million metric tons of ferronickel, generating $13.6 billion USD. The export ban, along with tax and investment incentives, drew significant foreign investment, mainly from China and South Korea. Nickel smelters in operation rose from 2 in 2016 to over 60 by 2023[118]. This incentive, along with measures to develop Indonesia's battery and EV industries, is expected to attract further foreign direct investment. However, most smelters are foreign owned.

Incentives are also concentrated in the end-use segment of the supply chain, with a heavy focus on EVs. The first subsidies to support the EV uptake focused in particular on purchase studies and vehicle purchase and registration tax rebates that were designed to reduce the price gap between the EVs and conventional combustion engine vehicles.[119] Taxation measures, most specifically vehicle registration tax exemption/reduction as well as vehicle purchase subsidies and/or exemption on vehicle purchase taxes, have proven to be key in increasing EV sales.

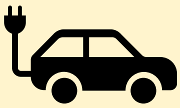
[118] CSIS (2024) Diversifying Investment in Indonesia's Mining Sector. Link

[119] https://www.iea.org/reports/global-ev-outlook-2021/policies-to-promote-electric-vehicle-deployment

Globally, and similar to Indonesia, governments have provided various fiscal incentives to reduce the upfront costs of EVs and make them more attractive to customers. At the same time, developing a robust charging infrastructure is crucial for the widespread adoption of EVs. However, as markets mature, policy incentives should also be revised to ensure they align with current policy priorities and the state of the market. The initial legislative measures aimed at promoting the adoption of EVs usually focus on the development of charging infrastructure. This approach addresses the 'chicken-and-egg' dilemma: to encourage customers to purchase EVs, it is essential to ensure the availability of charging facilities. However, the absence of a substantial user base can deter companies from investing in the necessary infrastructure. Indonesia has adopted a wide range of policy instruments to incentivize consumers and mandate the establishment of charging stations.

Figure 4.2 Odd-even licence plate scheme

How can urban access schemes support the adoption of EVs?



Urban access schemes, which provide priority access, or access free of charge for EVs in highly populated urban areas: the adoption of the Jakarta Governor Regulation No. 88 of 2019 provides the legal basis for the adoption of the Odd-Even rule that is implemented on several major roads in Jakarta during peak hours. The rule applies on weekdays only. According to the rule, vehicles are allowed to enter restricted areas based on the last digit of their license plate: odd-numbered plates on odd dates and even-numbered plates on even dates. Given that the rule is primarily a traffic management rule adopted to address congestion and air pollution, EVs due to their zero-emissions are allowed to travel freely in the rule areas regardless of their license plate number.

Furthermore, Indonesia has established national battery standards for EVs through its Standard Nasional Indonesia (SNI) framework, coordinated by the National Standardization Agency. These standards are designed to ensure safety, performance, and interoperability of EV battery systems.

While these incentives are a step in the right direction and have successfully increased the uptake of EVs in Indonesia, charging stations remain heavily concentrated in urban areas. The rapid rise in EV imports following the incentive highlights accelerated domestic market growth. Gaikindo data shows BEV sales increased 151.4% year-on-year in 2024. Data shows production has fluctuated, however, with no clear upward trend indicating increased foreign or local investment. As of early 2024, only two EV models in Indonesia—Hyundai IONIQ 5 and Wuling Air EV—meet the 40% local content threshold required for full government incentives. No other models have reported compliance. Still, the first six months of 2024, EV sales grew 104% year-on-year, reaching 11,940 units. From January to April 2025, sales surged to 24,020 units—12% of total wholesale car sales and a 27% increase from 6,465 units sold in the same period in 2024. While EV uptake is still far from the GoI's targets, the results are promising.

At the global level, the integration of stationary battery energy storage applications into the electricity grid has faced several challenges that have hindered their development. It should be noted that the primary examples from energy storage integration stem from jurisdictions with liberalised markets and therefore their applicability to the specific Indonesian context is very limited.

In terms of battery energy storage applications to support the integration of variable renewable energy sources in the grid, in particular, there are no legislative measures adopted that would specifically regulate storage in Indonesia. As the legislative void in acknowledging stationary battery energy storage as a new technology has hindered the possibilities to integrate such a new technology to the energy system in many jurisdictions, the first important legislative measure has been acknowledging its role in the energy system. Therefore, despite it might seem a small measure, the impact of the Government Regulation 25/2021 is significant in providing the possibility of BESS to participate in the market by simply acknowledging its existence and role in the energy system. However, from the supporting policy measures point of view perhaps the most interesting development in this regard is the funding framework provided under the Minister of Finance Regulation 103/2023 as tenders organised under this platform are increasingly including BESS.[120] This type of funding can be very effective if applied appropriately in a non-liberalised market, such as that of Indonesia. In comparison to a liberalised market, where investment decisions in BESS systems are made in response to complicated market price signals, a vertically integrated electricity company like PLN could benefit from a simpler hierarchical decision-making process. A well-designed funding process will allow the company to more efficiently implement measures to promote BESS system integration. Conversely, the absence of market signals may hinder the selection of the most economically and technologically viable alternative.

4.3 Security of Supply

With no local Lithium reserves, Indonesia depends completely on imports, exposing the country to market price volatility, political shifts in trade agreements (as seen during the first months of 2025 with the trade war between the US and several countries), and trade routes disruptions. While stockpiling provides certain benefits, it is nevertheless only a buffer mechanism to facilitate the initial survival of a supply chain disruption. Mainstream Lithium-ion battery (LIB) technologies depend on a limited set of critical materials, many of which have few viable substitutes. These materials are often classified as high-risk due to global supply chain vulnerabilities, stemming from resource shortages or concentrated processing in a single country.

Although Government Regulation No. 79/2014 (GR 79/2014) on National Energy Policy KEN considers coal stockpiling[121] as part of the efforts to achieve an efficient market and ensure a continuous supply for domestic demand. This measure is framed under the broader objective of developing and strengthening of the energy infrastructure and

---

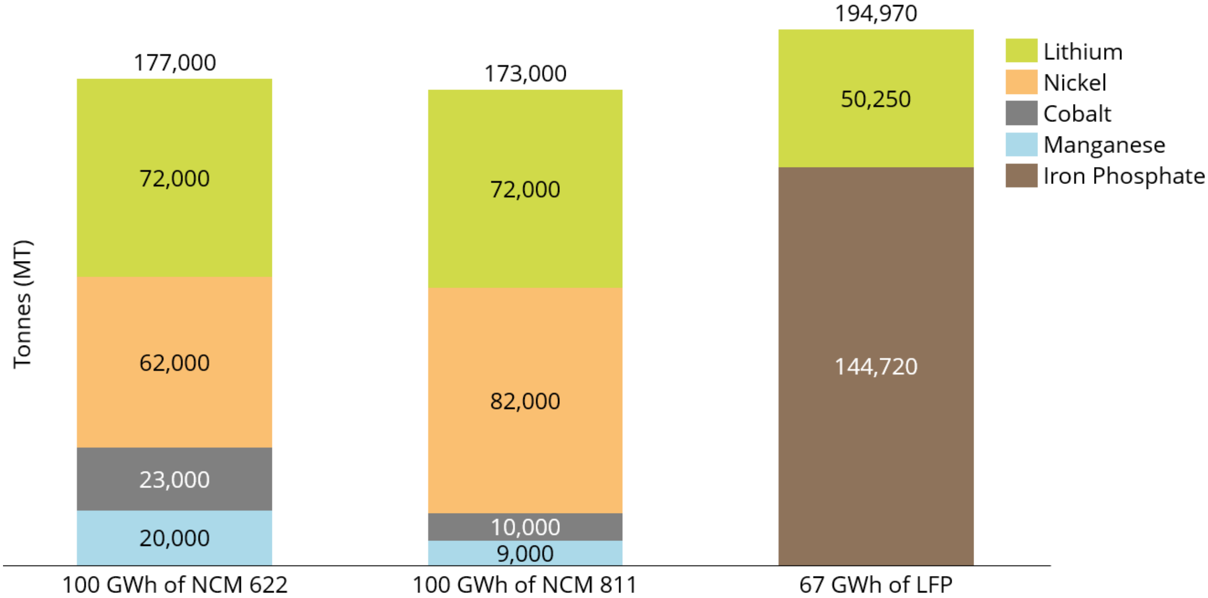
[120] ICGL, *Renewable Energy Laws and Regulations in Indonesia 2025* (September 19, 2024); <https://iclg.com/practice-areas/renewable-energy-laws-and-regulations/indonesia>

[121] INDONESIA: Government Regulation No. 79/2014 of 2014 Concerning the National Energy Policy. https://policy.asiapacificenergy.org/node/3016

access. Indonesia has not adopted specific laws or regulations concerning the stockpiling of those minerals for which the country is reliant in imports, namely lithium, graphite and manganese. Strategic stockpiling, particularly during periods of low prices, is a policy tool used to strengthen national supply security and ensure access to critical minerals during supply chain disruptions. While such stockpiles can help stabilize prices by mitigating market volatility, large-scale stockpiling may also distort market dynamics. Additionally, the costs associated with storage, security, and management can be significant. Technological advancements further introduce the risk that some minerals may lose their strategic importance over time, potentially rendering stockpiles obsolete and resulting in wasted resources.

To achieve a consistent and comprehensive battery material strategy, all battery materials involved were studied under a 2030 demand scenario. Therefore, quantities for battery materials {Li using Lithium Carbonate Equivalent (LCE) figures, Ni, Co, Mn, $FePO_4$} were tested under three scenarios: i) NCM 622 capacity, ii) NCM 811 capacity and finally iii) LFP cell capacity. The results of these scenarios, showing whether Indonesia is capable of sourcing the necessary minerals for each battery technology or not, are presented in Figure 4.3 which shows the required capacities by battery type.

Figure 4.3 Battery material feedstock for Indonesia 2030 by battery type - EVs



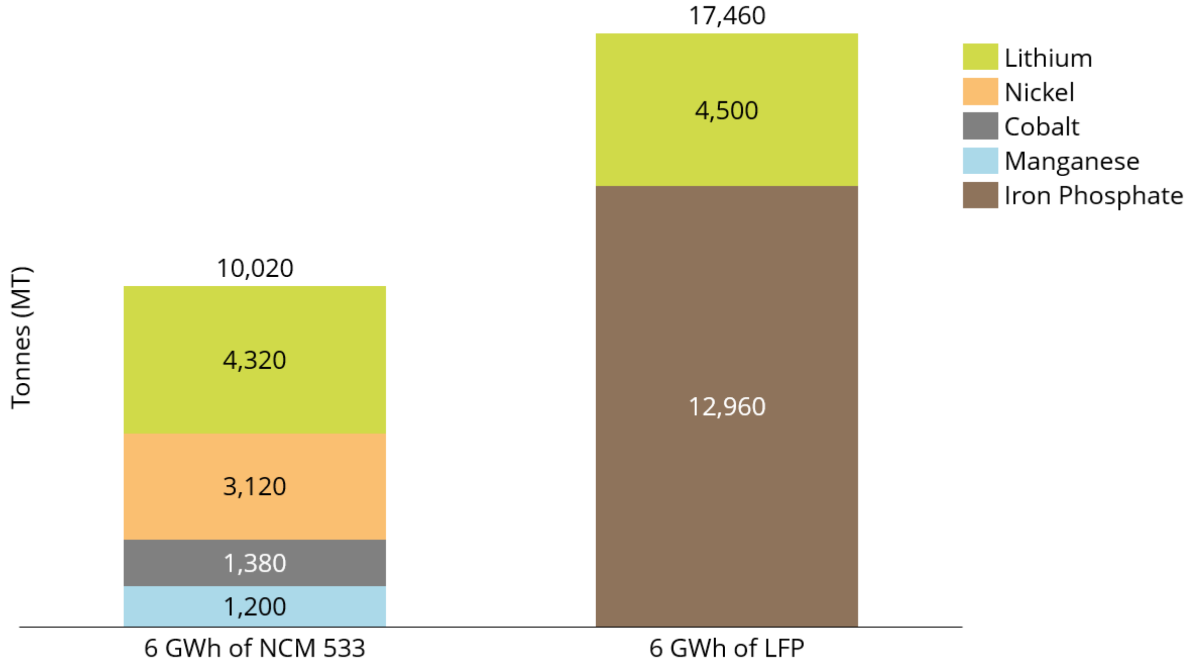
Source: Energy densities from SC Insights[114] and Cao et.al.[115]; capacity is defined to produce 1,000,000 EVs

The analysis showed that there are only two battery materials where Indonesia is self-sufficient: Nickel (largely), and Cobalt (barely). Being the first producer of Nickel and Nickel derivatives gives Indonesia a huge advantage in the sense that its own domestic consumption will be well covered under any government strategy in terms of EV penetration. The case of Cobalt is also positive, where enough feedstock is available to cover its domestic demand: today Indonesia produces more than 25,000 MT-Co, which is higher than the 2030 demand using full-NCM 622 capacity, as shown in Figure 4.3. Lithium, Manganese and Iron Phosphate, on the other hand, tell a different story, with Lithium being the most critical.

For Lithium, an amount of 72 kMT-LCE is needed before the end of the decade, in case of designing the battery strategy based in NCM (Figure 4.3). The latter is equivalent to three mid-size lithium projects, or more than ten (10) reliable supply contracts of 5,000 MT-LCE, which at current market conditions is not trivial to secure. It is worth mentioning that lithium cannot be avoided for electric vehicles, since both NCM and LFP technologies rely on lithium chemicals (carbonate and hydroxide). Additionally, since it's a specialty chemical it needs to be delivered with consistency in quality and volumes.

To calculate the amount of raw materials Indonesia would need to cover its BESS needs, the 6 GW target of the ARED scenario is used as reference. Chemistries NCM533 and LFP are a good option for storage since space is not a limitation. Stationary uses allow for lower battery densities. The following figure shows the tonnes of raw material needed by chemistry, assuming 1 GW of storage = 1 GWh.

Figure 4.4 Battery material feedstock for Indonesia 2034 by battery type - BESS



Source: Energy densities from SC Insights[114] and Cao et.al.[115]; capacity is defined to 6 GWh of BESS

The amount of raw material Indonesia would need to satisfy its 6 GWh of demand by 2034 is far less than the tonnes needed for the EV demand. However, Indonesia would still need to secure materials for this, tying the contracts to BESS. Usually, this is complex due to the sheer size of the EV contracts, leaving only a small fraction of materials for BESS.

4.4 Waste management and recycling

With the massive increase of batteries required to meet decarbonization targets set in many jurisdictions, the end-of-life treatment of batteries has raised concerns over the environmental sustainability of this technology. Lithium-ion batteries are considered hazardous waste under many jurisdictions' legislative frameworks. Spent EV batteries pose several challenges when they become waste; if not properly disposed of EV batteries can leak toxic substances into the environment, contaminating soil and water. Improper handling and disposal of spent EV batteries can lead to fires, as these batteries can still hold a charge and are prone to short-circuiting.[122]

Regarding the end-of life stage of the battery supply chain, three main challenges where identified in the Indonesian legislative framework:

- **Lack of circular economy integration:** Indonesia currently lacks legislative measures supporting the integration of a circular economy approach in the battery value chain.
- **Regulatory barriers:** The existing waste management framework does not facilitate the establishment of a circular battery economy. In addition, the classification of batteries as waste under current legislation complicates the procurement of materials for the recycling sector.
- **Limited incentives and support:** There are no clear incentives or governmental support mechanisms to encourage the adoption of circular economy practices in the battery industry.

The Indonesian legislative framework as it currently stands focuses on hazardous waste management. Indonesia does not have a legislative framework in place that would specifically support the integration of a circular economy approach to batteries. The national legislation setting out the EV promotion strategy, namely Presidential Regulation No. 55/2019 and the amending Regulation No. 73/2023, recognizes the importance of battery recycling and end-of-life treatment. However, to date, no sector-specific implementing legislation to realize the objectives established in the presidential regulations has been adopted. Regulation No. 100/2020 recognizes the need to provide recycling feedstock to kick-start the end-of-life treatment segment and allows the import of used lithium batteries as raw materials. Used batteries, including those from battery EVs, are classified as hazardous and toxic waste (B3) under Indonesian law. As such, their storage, transportation, processing, and reuse are subject to strict regulation—though these provisions are not tailored specifically to EV batteries.

Article 32 of Presidential Regulation No. 55/2019 (as amended) mandates that EV battery waste must be managed through recycling and/or other approved waste management methods, with this responsibility falling to licensed entities. However, in the absence of a dedicated regulatory framework for EV battery waste, current practices continue to rely on general B3 waste management regulations. Regulation No. 22/2021 introduced a risk-based licensing system and technical approvals for B3 waste management, integrating battery waste into the environmental approval process—a prerequisite for any business handling used batteries. Regulation of the Minister of Environment and Forestry No. P56/2015 provides technical guidelines for the collection, storage, transport, and treatment of B3 waste, including used batteries. It sets operational standards for companies managing battery waste to ensure safe and compliant practices. These rules

[122] See e.g. A Jannesar Niri, G A poelzer, S E Zhang, J Rosenkranz, M Pettersson and Y Ghorbani, 'Sustainability challenges throughout the electric vehicle battery value chain' 191 *Renewable and Sustainable Energy Reviews* (2024), 114176.

aim to streamline business licensing while strengthening environmental oversight, but they remain non-specific to the unique characteristics and challenges of EV battery waste.

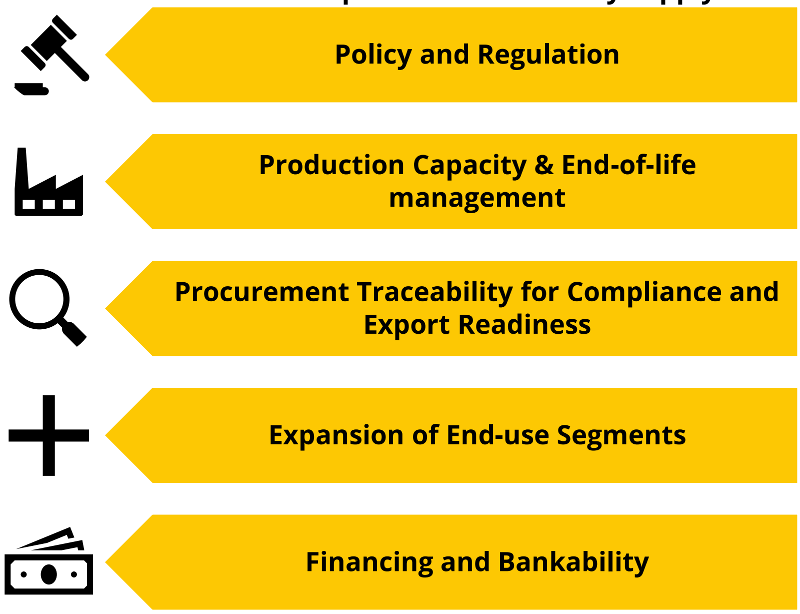
In addition to these regulatory challenges, Indonesia's waste management services face practical constraints. Many are already overwhelmed by high waste volumes and limited personnel capacity. Furthermore, the informal sector plays an active role in handling battery waste due to its economic value. For example, the Environmental Agency of Karawang has observed strong public interest in collecting and managing used batteries, viewing it as a profitable opportunity within the expanding battery industry. However, numerous third-party transporters and handlers fail to comply with established environmental and safety procedures, posing additional risks to effective waste management.

5. Strategic Recommendations and Roadmap to Developing a Sustainable Battery Supply Chain in Indonesia

One of the core aspects of this project was the development of an implementation roadmap for stakeholders (the government in particular) with key actions and a timeframe that would derive in the development of a sustainable battery supply chain in Indonesia. While the country has laid foundational policy frameworks and made significant strides in downstream mineral processing, the realization of an integrated, scalable, and sustainable battery value chain remains a work in progress. The project identifies key constraints that need urgent attention: a lack of lithium resources, underdeveloped domestic infrastructure for EVs and battery recycling, limited financial instruments tailored to clean energy investments, and policy fragmentation that weakens the effectiveness of existing incentives. Another significant gap lies in the end-of-life management of batteries. The absent of robust regulatory framework for battery recycling, use and second-life applications is an opportunity that hasn't been seized to reduce the country dependence on raw material imports and to mitigate environmental risks. Indonesia has included batteries in its national circular economy strategy but specific legislation to incentivize battery recycling is still missing. Without clear policies and infrastructure, batteries reaching the end of their life will pose environmental hazards and squander valuable materials that could be recovered. The adoption of global practices such as the Battery Passport system, currently mandated by the European Union, offers a pathway for Indonesia to align with international standards. Implementing such a framework would enhance traceability, boost export readiness, and promote environmental compliance across the battery life cycle.

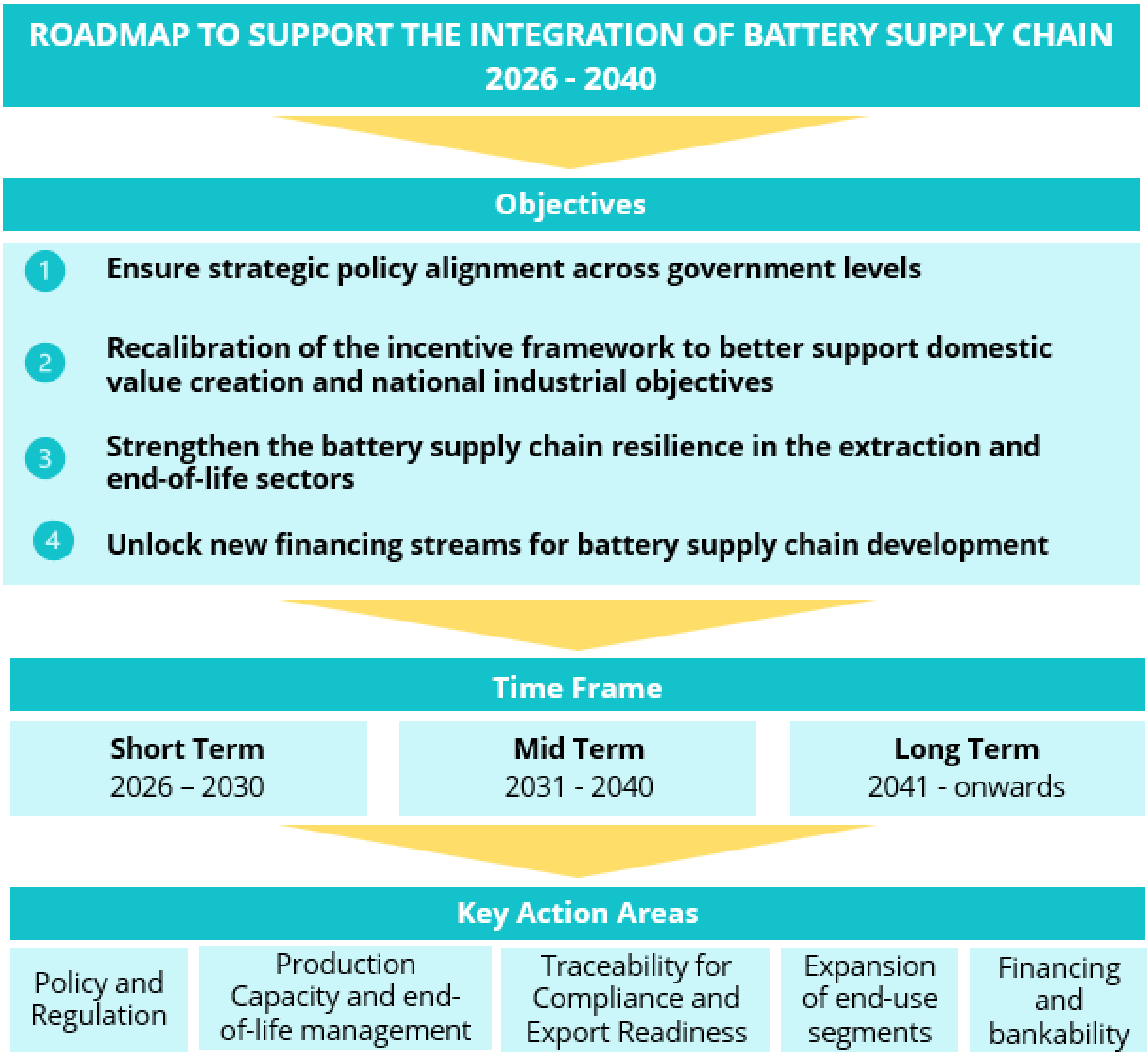
The project identified five strategic areas to address these constraints (Figure 5.1):

Figure 5.1 Key action areas for the development of the battery supply chain in Indonesia



Based on the identified key challenges, a comprehensive was formulated to outline the necessary actions required to address these issues. This roadmap covers the period from 2026 to 2040-onwards and focuses on the development of Indonesia's battery supply chain (Figure 5.2).

Figure 5.2 Roadmap to support the integration of battery supply chain (2026 - 2040)



The roadmap was developed to recommend specific activities to address the challenges described in Chapter 4 (Table 5.1). It details a series of strategic actions, each accompanied by designated stakeholder roles, structured according to the RACI (Responsible, Accountable, Consulted, and Informed) framework (Table 5.2).

The RACI matrix is a strategic tool used in project management to map out and distinguish the specific roles and duties of people or groups involved in a project or organizational workflow. The matrix lays out who is involved in each major task and defines their role, helping to streamline communication and ensure responsibilities are clearly distributed. A single task may involve several of these roles, ensuring all necessary parties are engaged appropriately. The acronym RACI identifies four distinct roles:

- **Responsible (R):** This role is assigned to those who carry out the actual work. They are the primary doers, tasked with completing assignments or activities.
- **Accountable (A):** This is the person who owns the final result. They ensure the task is completed correctly and have the ultimate authority to approve deliverables.
- **Consulted (C):** These are individuals whose opinions and expertise are sought before making decisions. They contribute valuable feedback and knowledge but are not responsible for execution.
- **Informed (I):** These stakeholders are kept in the loop regarding progress and outcomes. They don't contribute directly but need regular updates.

A more detailed description of the activities and they challenges they address are presented in the Deliverable 3 of this study.

Table 5.1. Key challenges and recommended actions to address them

Challenge	Action	Key Area
Ensuring that the national legislative framework is thoroughly reviewed and aligned with current national priorities and objectives: to ensure long-term success, further work is needed to improve coherence across sectors. End-use and end-of-life segments are strongly intertwined with other sectors like waste management, transport, and power. Therefore, battery incentives, targets and regulations must align with the instruments from these sectors.	1. Policy review and impact assessment of current measures to ensure alignment with national priorities	Policy and Regulation
The policy favouring importers of fully assembled EVs may have distortive effects on the markets: The policy has increased EV market share and investment but favours fully assembled imports, potentially disadvantaging local producers. Manufacturers -including potential entrants- may focus on assembling imported components rather than investing in domestic production capabilities	2. Implement Regulatory Impact Assessments	
As of early 2024, only two electric vehicle (EV) models in Indonesia meet the required local content (40%) threshold to qualify for full government incentives: Hyundai IONIQ 5Wuling Air EV. No other models have been reported to comply with the new threshold	3. Evaluate and revise incentive mechanisms as the market develops	
Limited local government initiatives: Only some areas have adopted them to support EV uptake, such as Jakarta and Bali	4. Strengthen and harmonize local and regional incentive mechanisms with national policy goals	
There is no long-term strategy for BESS: RUPTL 2025 has progressive targets for BESS until 2034. However, there is no target clearly anchored to the Net Zero by 2060 target, or to the RE generation targets.	5. Create a robust regulatory framework concerning battery energy storage	
As of today, Indonesia has no viable lithium reserves, which translates into an import dependency: mainstream LIB technologies depend on a limited set of critical materials, many of which have few viable substitutes. Lithium cannot be avoided for EVs, since both NCM and LFP technologies rely on lithium chemicals	6. Secure battery material feedstock	Production Capacity and End-of-life management
There are no stockpiling strategies for critical minerals for batteries: although Government Regulation No. 79/2014 (GR 79/2014) on National Energy Policy considers stockpiling for coal, Indonesia has not adopted specific laws or regulations concerning the stockpiling of those minerals for which the country is reliant in imports, namely lithium, graphite and manganese.	7. Implement strategic stockpiling measures	
There are no recycling initiatives or targets, no circular economy instruments applied, weak end-of-life management for batteries: Currently, Indonesia does not have specific legislation in place that would be solely focused on the end-of-life management of batteries. The country has one battery recycling facility located in Morowali, which imports black mass from China due to lack of sufficient materials for battery recycling. In addition, Indonesia Battery Corporation plans to develop a nickel-based EV battery recycling plant by 2031.	8. Establish targets and policy instruments for material recovery and reuse in battery production	
The lack of detailed provisions for stakeholder engagement and transparency in the implementation of local content policies has caused issues, particularly when it comes to compliance with ESG standards: Regulations set by other countries can pose investment and export challenges, as demonstrated by the withdrawal of BASF and Eramet from the Sonic Bay nickel and cobalt refinery project due to ESG-related concerns.	9. Design and implement a battery passport to keep track of EV components	Traceability for Compliance and Export Readiness

	Challenge	Action	Key Area
	While there are electrification targets for other transportation sectors like public transport, there is no comprehensive regulatory framework for how to reach the 90% electrification of urban mass public transport by 2030. Other sectors like long-haul or last mile services have no incentives or targets.	10. Establish targets for other transport sectors	Expansion of End-use segments
	Limited support for charging station infrastructure development: the lack of battery and EV infrastructure leads to range anxiety by prospective consumers and hinders domestic EV adoption. Current efforts are centred around urban centers	11. Provide more targeted and wider support for charging infrastructure development	
	The lack of detailed provisions for stakeholder engagement and transparency in the implementation of local content policies has caused issues, particularly when it comes to compliance with ESG standards: Regulations set by other countries can pose investment and export challenges, as demonstrated by the withdrawal of BASF and Eramet from the Sonic Bay nickel and cobalt refinery project due to ESG-related concerns.	12. Ensure compliance with global standards to guarantee batteries can be exported worldwide	Financing and Bankability
	Indonesia needs enough domestic demand across all the segments of the supply chain, not only for end-use. This means creating demand for refined products, LIB cells, etc. Otherwise, the country can end up like Europe or the US, with incentives but no real market.	13. Establish a Supply Chain Tracking Platform for Indonesia's Battery Industry	
	Project finance is facing significant challenges due to low commodity prices: Large capital requirements for mining and refining projects hinder their development. Strong off takers are needed in the contracts, like governments or automakers.	14. Implement financial schemes for derisking investments	

Table 5.2 Action Plan and role of stakeholders

R: Responsible, A: Accountable, C: Consulted, I: Informed.

Recommended actions	Timeframe			Stakeholder Role											
	Short-term 2026-2030	Mid-term 2030-2040	Long-term 2041-onwards	MoInv	MEMR	MoE	MoI	MoT	MoF	MoSOE	Regional agencies	PLN	Battery Manufacturers	EV Manufacturers	Financial institutions
1. Policy review of current measures to ensure alignment with national priorities	✓			R/A	A	C	A	R	C	I	I	-	-	-	-
2. Implement Regulatory Impact Assessments (RIA)	✓			R	R	R	R	R	R	R	C	-	-	-	-
3. Evaluate and revise incentive mechanisms as the market develops	✓			R/A	R	C	C	C	R	C	C	C	C	C	-
4. Strengthen and harmonize local and regional incentive mechanisms with national policy goals	✓			A	C	C	C	C	C	C	R	C	I	I	-
5. Create a robust regulatory framework concerning battery energy storage		✓		C	R/A	C/R	C	-	I	I	I	R	I	I	-
6. Secure battery material feedstock		✓		C	R/A	C	A	-	I	C	I	-	I	I	I
7. Implement strategic stockpiling measures		✓		R	A	C	C	-	C	C	I	-	I	I	C
8. Establish targets and policy instruments for material recovery and reuse in battery production		✓		C	R	R/A	R	-	-	I	I	-	I	I	-
9. Design and implement a battery passport to keep track of EV components		✓		C	A	R	R	C	-	I	I	I	I	I	-
10. Establish targets for electrification of other transport sectors in regulatory instruments		✓		I	A	C	R	A	-	I	-	R	I	I	-
11. Provide more targeted and wider support for charging infrastructure development		✓		C	R	C	R	R/A	C	I	-	R/I	I	I	-
12. Ensure compliance with global standards to guarantee batteries can be exported worldwide	✓		✓	R/A	I	R	R/A	-	C	I	-	-	R	R	I
13. Establish a Supply Chain Tracking Platform for Indonesia's Battery Industry		✓		A	C	C	C	-	C	C	C	-	I	I	C
14. Implement financial schemes for derisking investments		✓		R	C	-	C/I	-	R/A	I	-	-	C	C	I

5.1 Recommendations on Policy and Regulation

Although Indonesia has developed a robust set of regulations to incentivise the development of a domestic battery supply chain, key policy and regulatory challenges remain. Sectoral alignment of policy instruments crucial for long-term success. Regulatory frameworks should incorporate Regulatory Impact Assessment to enhance policy effectiveness and adaptability. Strengthening regional policy coordination will be key for fostering a robust and sustainable battery and EV ecosystem. Since most of the targets the GoI has set are for 2030, most of the actions are aligned with this timeframe. The roadmap proposes the following actions:

1. Policy review of current measures to ensure alignment with national priorities:

With the first set of incentives and targets in place reaching their end in 2030, it is important to evaluate all instruments to identify which ones have yielded the best results and evaluate their continuity. This is particularly important for supporting the EV domestic production targets of 1,000,000 by 2040, as well as the local content requirements for EVs. In that sense, while the economic benefits of the downstreaming policies have been undisputed, a more nuanced approach is now being called for the second-generation policies that would be built on better metrics to evaluate the policies beyond revenues.[123]

> **1.2 Check for any possible cross-subsidies or opposing/conflicting incentives, especially in EV imports Vs. domestic production**: The regulatory framework analysis of this study has highlighted how some incentives can have opposing established targets and can be causing opposite effects than the ones they were implemented for (Deliverable 3) such as the apparent conflicting incentives for EV imports vs. locally manufactured EVs. The first incentive supports the decarbonization of transport, but the second one supports the establishment of local demand for the battery supply chain in Indonesia. Phase out or correction of these subsidies is key to ensure the battery sector keeps growing at an appropriate rate to reach the goals set.

2. Implement Regulatory Impact Assessments (RIA): Given Indonesia's decentralized governance structure, the introduction of new regulations often involves multiple levels of authority and oversight. To enhance the effectiveness, coherence, and policy alignment of regulatory initiatives, the Indonesian government should implement a standardized Regulatory Impact Assessment (RIA) framework. RIAs—widely used internationally—serve as a critical tool for evaluating the potential economic, social, and environmental impacts of proposed regulations prior to their enactment. Indonesia should institutionalize mandatory RIAs for all proposed regulations at both the national and sub-national levels, depending on the regulatory domain.

Furthermore, the use of regulatory sandboxes—a mechanism increasingly employed worldwide to pilot regulatory approaches for emerging technologies—should be

[123] M Salomon, F Simanjuntak, A Shafaie and P Heller, 'Indonesia's Energy Transition Ambitions: Nickel Downstreaming and Beyond' (January 30, 2025, *Natural Resource Governance Institute*); <https://resourcegovernance.org/articles/indonesia-energy-transition-ambitions-nickel-downstreaming-and-beyond>

encouraged. These sandboxes facilitate controlled, real-world testing environments and foster structured collaboration between government institutions and industry stakeholders. They offer a valuable opportunity to identify potential challenges and unintended consequences, thereby informing more effective and inclusive policymaking prior to the formal adoption of new regulations.

In addition, ex-post evaluations could be implemented to assess the effectiveness and real-world impact of regulations after their implementation. This would require the development and application of context-specific metrics and performance indicators that reflect Indonesia's economic, social, and environmental priorities. Systematic incorporation of such evaluations will enable policymakers to identify regulatory gaps, inefficiencies, or unintended consequences, and make evidence-based adjustments to maintain regulatory relevance and effectiveness over time.

3. Evaluate and revise incentive mechanisms as the market develops: As Indonesia's EV market matures, fiscal incentives should be periodically revised to reflect market development, social equity, and industrial policy objectives. Existing measures like import tax exemptions for fully manufactured EVs would benefit from evaluation to ensure continued relevance and effectiveness.

In the upstream segment, incentives should be differentiated by vehicle type and technology to align with national priorities and global market trends. For instance, higher subsidies could be directed toward EVs using nickel-based batteries, consistent with Indonesia's resource base and export ambitions, while supporting domestic value creation and competitiveness in international supply chains. Establishing a timeline to phase out ICE vehicle sales would further secure long-term battery demand and contribute to national emission reduction goals. On the downstream side, consumer incentives could be redesigned to be means-tested, ensuring subsidies are targeted toward lower-income buyers and enhancing policy equity.

4. Strengthen and harmonize local and regional incentive mechanisms with national policy goals: Given the key role cities play in deploying electric vehicles and electrifying public transport, any strategies that are implemented at the local level need to be aligned with the national targets of 100% electrification of public transport by 2040, and of installing 62,918 charging stations by 2030. To support a coherent and integrated approach to the development of Indonesia's battery supply chain and broader EV ecosystem, it is essential to assess and revise existing incentive mechanisms to ensure alignment across local, regional, and national levels. Incentive schemes should be strategically coordinated to avoid policy fragmentation and enhance the overall effectiveness of government support.

Successful regional initiatives—such as Jakarta and Bali's ENTREV project (2023–2027)[124] should serve as models for replication in other provinces to incentivize EV uptake. Non fiscal incentives such as urban access schemes for EVs in Low Emissions Zones, or

[124] 31-07-2023. ENTREV. Enhancing Readiness for the Transition to Electric Vehicles in Indonesia https://gatrik.esdm.go.id/assets/uploads/download_index/files/6c672-bahan-entrev.pdf

exemptions from rules aimed at addressing congestion and air pollution in cities could be replicated across the country.

Well-aligned local and regional incentive strategies will not only promote sustainable mobility but also generate cross-sectoral benefits, including advancements in energy, transport, and urban infrastructure.

5. Create a robust regulatory framework concerning battery energy storage: Although the RUPTL 2025 has BESS targets for the period of 2025 to 2034, there are no long-term targets beyond that year. RUPTL 2025 does mention the target of reaching Net Zero Emissions in the Energy sector by 2060, and aligns its ARED scenario with it. Despite the establishment of the 6 GW target of BESS by 2034 under the ARED scenario, there is no overarching strategy for its implementation: all BESS projects are pushed individually and remain under PLN's responsibility for their execution. Furthermore, because BESS investments demand substantial upfront capital (as stated by RUPTL 2025 as well), their success relies on a well-defined revenue framework. One option could be to set standards that BESS projects could follow (similar to the PPA clarification update made by MEMR recently[125]) on the long term to secure revenues, making the projects attractive for an investor, or mandating a certain amount of storage capacity for all new VRE power plants that come online.

A tailored set of policy instruments could facilitate target setting, and at the same time, increase visibility and investment attractiveness (due to regulatory and market certainty) for BESS projects to support the long-term target of 70%-72% of RE. The study proposes three main recommendations to address this:

5.1 Mandates targeting BESS increase: Given that Indonesia's power sector is still vertically integrated, the government should introduce realistic yet ambitious mandates requiring PLN to integrate a certain percentage of storage capacity in connection with new renewable energy projects or in the context of grid upgrades, clearly linking BESS requirements with VRE growth

5.2 Define BESS role in grid operations: While the national power legislation acknowledging energy storage is already a starting point, the next step would include defining in a more concrete and detailed manner the BESS role in different grid operations, potentially followed by increasing regulatory mandates. For example, defining the role of BESS to participate to ancillary services. Reducing regulatory uncertainties could streamline procurement processes, derisking investments for BESS projects.

5.3 Create a national BESS roadmap: Indonesia does not currently have a roadmap that solely focuses on BESS. A roadmap document that outlines targets and shows different use cases e.g. grid support services, would guide future investment needs and coordinated action in BESS integration.

[125] Database Peraturan. Guidelines for Power Purchase Agreements from Power Plants Utilizing Renewable Energy Sources. https://peraturan.bpk.go.id/Details/317619/permen-esdm-no-5-tahun-2025

5.2 Recommendations of Production Capacity and End-of-life management

Even though it is not mature enough to be fully independent, the Indonesian Lithium-ion Battery (LIB) supply chain is on the right track to become self-sufficient in the mid-term. The unquestionable success to develop a national Nickel industry, becoming the largest producer of Nickel battery-grade chemicals, is proof that their economy can develop refining projects and build a suitable battery material environment for local production of EVs and reach the 2040 production target of 1,000,000 units. To complete and integrate the Indonesian LIB supply chain, the roadmap proposes the following key actions:

1. Secure battery material feedstock: While the refining of several battery materials have been developed in the country, Lithium, Manganese (to some extent), and Iron Phosphate remain underdeveloped. Among these, Lithium presents the greatest challenge, given its high capital expenditure (CAPEX) requirements and the remote locations of viable feedstock sources (only one deposit was found in Central Java[126] that is still in the early stages of assessment and has not been quantified). To address this, Indonesia should explore alternative lithium sourcing strategies, including recycling of scrap or end-of-life batteries, which offers a viable secondary supply of Lithium and Iron Phosphate.

Given the absence of domestic Lithium reserves, developing a comprehensive strategy for lithium feedstock is crucial. This includes:

- Securing lithium contracts with international suppliers.
- Assessing the feasibility of stockpiling to mitigate supply chain risks.
- Advancing battery recycling infrastructure to reduce reliance on primary extraction

A well-structured strategy will ensure long-term resource security, strengthen Indonesia's position in the global battery market, and support the sustainable growth of its LIB industry.

2. Implement strategic stockpiling measures: Strategic stockpiling helps ensuring a reliable supply of key minerals during supply chain disruptions. Despite the controversies in relation to strategic stockpiling (such as market price and supply dynamics distortion) measures to regulate it have recently been trending and implemented in some countries like the US's acquisition and retention of stocks of certain strategic minerals required especially for national defense[127], or the EU's recently adopted Critical Raw Materials Act[128].

While stockpiling provides certain benefits, it is nevertheless only a buffer mechanism to facilitate the initial survival of a supply chain disruption. Therefore, measures that have a wider positive impact on the EV battery ecosystem development should be prioritized,

[126] Indonesian REE, Lithium and Graphite Potency. Center for Mineral, Coal and Geothermal Resources. geologi.esdm.go.id/storage/publikasi/tQtg2X7Gd9JbfqO9Wnp7jFrT6rAuvWxyALhOojBo.pdf
[127] Defense Production Act, 50 U.S.C. § 4533.
[128] Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013. (EU) 2018/1724 and (EU) 2019/1021, OJ L 2024/1252, 3.5.2024 ('EU Critical Raw Materials Act').

such as measures that seek to diversify investments in key minerals processing or bi-/multilateral agreements on minerals. Furthermore, ASEAN countries have been increasingly focusing on cooperation regarding key minerals. Joint strategic stockpiling could be examined as a part of broader efforts to enhance regional resilience and ensure a stable supply of key minerals.

3. Establish targets and policy instruments for material recovery and reuse in battery production: To foster the development of a circular economy and a sustainable battery supply chain, Indonesia should revise its existing waste management legislation to formally recognize battery waste as a strategic resource. This recognition is essential for stimulating the emergence of a robust market for secondary raw materials and aligning waste policy with industrial and environmental objectives. Additionally, this would guarantee there is domestic supply for the recycling plants of the country, thus supporting the goal of having an operational recycling battery industry, as mandated by the Ministry of Industry Regulation 8/2023.

A key step in this process involves the introduction of clear regulatory targets and policy instruments that support material recovery and reuse. These measures should include mandatory recovery rates, minimum recycled content requirements for new batteries, and standards for safe and efficient recycling processes. Establishing such requirements will not only improve resource efficiency but also reduce reliance on raw materials, mitigate environmental impacts, and stimulate domestic recycling industries. To remove current barriers to recycling and reuse Indonesia should also introduce targeted regulatory incentives and facilitate investment in recycling infrastructure. Policy instruments may include:

- Implementing reuse obligations, ensuring sustained demand for recycled materials.
- Extended Producer Responsibility (EPR), requiring manufacturers to actively participate in battery recycling systems.
- Product design standards, ensuring batteries are designed for easier material recovery and recycling.
- Developing incentives for closed-loop recycling that encourage investment in sustainable extraction alternatives.
- Implementing industry-wide material recovery benchmarks, ensuring compliance with global best practices. This will help ensure baseline durability for batteries, encouraging improvements in durability without compromising competition of the availability of specialized battery types and chemistries.[129]

3.1 Define material recovery and recycling targets: Indonesia should set clear targets for material recovery and recycling, particularly for non-domestic materials like lithium and graphite, based on waste availability, technical feasibility, and industry readiness. A strong regulatory framework and supporting infrastructure are needed to develop a circular battery ecosystem. Gradually increasing targets

[129] European Commission, Joint Research Centre, Szczuka, C., Sletbjerg, P. and Bruchhausen, M., Performance and Durability Requirements in the Batteries Regulation - Part 1: General assessment and data basis, Publications Office of the European Union, Luxembourg, 2024, https://data.europa.eu/doi/10.2760/289331, JRC136381.

would lower investment risk, attract capital, and ensure balanced growth of supply and demand in the recycling sector.

3.2 Extended Producer Responsibility (EPR) to cover battery producers: Indonesia's current EPR framework focuses on packaging materials, with no specific provisions for batteries under Law No. 18/2008. The recently published National Circular Economy Strategy (2024) recognizes extending the EPR obligations to batteries as a priority area of action, and provides a step-by-step implementation schedule.

In expanding the current EPR legislation to cover batteries, the following key design principles should be followed:

- **Scope and coverage:** Clearly define battery types subject to EPR to align with national recycling targets and evolving international standards.
- **Responsible party:** Assign clear responsibility to avoid overlaps and ensure effective enforcement.
- **Reporting and transparency:** Require regular reporting on collection, recycling, and disposal to enhance accountability.
- **Public awareness:** Support implementation with consumer information and communication campaigns.
- **Government roles:** Specify oversight, monitoring, and infrastructure support at national and local levels.

Under EPR, producers bear physical, financial, and informational responsibilities[130], encompassing waste collection, processing costs, and disclosure of product and waste management data. Compliance should be reinforced through incentive and penalty mechanisms. Finally, to prevent regulatory misalignment that hinders trade in secondary raw materials, Indonesia should engage actively in international standardization initiatives.

5.3 Recommendations on Traceability for Compliance and Export Readiness

Although Indonesia has not set formal battery export targets, the Indonesia Battery Corporation (IBC) aims to reach 140 GWh of production capacity by 2030, with 50 GWh destined for export. To ensure market access, Indonesia must demonstrate compliance with international standards, starting with robust material traceability systems across the supply chain.

1. Design and implement a battery passport to trace battery components:
Currently, three national mechanisms—EITI, SIMBARA, and the Green Industrial Standard—address aspects of transparency but remain limited in scope. EITI and SIMBARA focus on financial and resource monitoring, while the Green Industrial Standard

[130] J Yang, Q Jiang and J Zhang, 'Bridging the regulatory gap: A policy review of extended producer responsibility for power battery recycling in China' 86 *Energy for Sustainable Development* (2025), 101697.

applies mainly to manufacturing and packaging. None provide full traceability across the battery value chain.

The Battery Passport, developed by the Global Battery Alliance and formalized under the EU Sustainable Batteries Regulation, acts as a digital twin of each battery, containing detailed data on materials, production, and sustainability performance accessible via a QR code. Similar frameworks are under consideration in the US, China, and Japan.

Given the EU's role as a major battery market, Indonesia should align its traceability systems with EU standards and explore integrating a battery passport into its national regulatory framework. Doing so will enhance export readiness, attract investment, and strengthen Indonesia's participation in global sustainable battery supply chains.

5.4 Recommendations on Expansion of end-use segments

Establishing clear targets for key battery end-use sectors, i.e. EVs and BESS, is essential to foster market confidence, guide infrastructure investment, and accelerate Indonesia's energy transition. These efforts must be complemented by expanding EV charging networks beyond urban areas and investing in grid readiness to support large-scale electrification and storage integration.

1. Establish targets for electrification of other transport sectors in regulatory instruments: Beyond existing EV goals, Indonesia should extend electrification targets to public transport, logistics, and heavy-duty vehicles to stimulate domestic battery demand and strengthen the supply chain. The Ministry of Transport's goal to electrify 90% of urban mass transport by 2030 should be formalized through policy instruments with dedicated budgets and implementation frameworks.

Similarly, establishing clear targets for BESS deployment is critical to integrate renewable energy (RE) into the grid. Given the high capital intensity and limited private participation in the power market, a structured approach to BESS rollout—coordinated with RE expansion and regional grid needs—will improve system reliability and attract investment.

2. Provide more targeted and wider support for charging infrastructure development: The Decree of the Ministry of Energy and Mineral Resources No. 24.K/TL.01/MEM.L/2025 provides a roadmap for national charging infrastructure, aiming for 62,918 charging stations by 2030. While the regulation promotes nationwide distribution, implementation remains concentrated in urban areas, limiting accessibility and reinforcing range anxiety. Further measures should prioritize remote and low-density regions through incentives, local government cooperation, and community participation in planning to ensure equitable infrastructure development.

> **2.1 Parallel investments to grid readiness:** Expanding fast and ultra-fast charging networks will require significant grid upgrades, particularly in rural and underdeveloped areas. Without parallel investment in grid capacity, especially at connection points in strategic locations such as hospitals, transport hubs, and industrial zones, charging reliability and speed will be compromised.

Strengthening the grid is also essential to accommodate BESS and renewables integration.

5.5 Recommendations on Financing and Bankability

Project success depends on operational, social, and financial feasibility. While the first two are addressed through previous roadmap actions, financial feasibility requires transparent risk–return profiles to attract investment. Projects perceived as high-risk often struggle to secure financing, underscoring the need for mechanisms that enhance project bankability across Indonesia's battery value chain.

1. Ensure compliance with global standards to guarantee batteries can be exported worldwide: To enable global battery exports and attract sustainable financing, Indonesia must align with international environmental, social, and governance (ESG) standards. Strengthening engagement with the Minerals Security Partnership (MSP) can support access to green finance and foreign investment while promoting transparency and traceability. Alignment with evolving regulations, like the EU Sustainable Batteries Regulation, should be maintained continuously to secure long-term competitiveness and investor confidence.

2. Establish a supply chain tracking platform for Indonesia's battery industry, identifying trade flows and capacity constraints: To attract capital for mining, refining, and manufacturing projects, the government should introduce financial instruments such as special-purpose vehicles (SPVs), price floor and ceiling contracts, and equipment financing schemes supported by public guarantees. International models (e.g., Germany's KfW, the UK's UKEF[131]) show how debt-backed financing can cover up to 80% of equipment costs, lowering upfront investment barriers. Additional mechanisms such as prepayment agreements and targeted tax incentives similar to Argentina's large-scale investment program (RIGI) could further enhance liquidity and investor confidence. Active dialogue between policymakers, financiers, and industry stakeholders will be key to ensuring regulatory stability and synchronized development across the supply chain.

[131] See Deliverable 3 for further detail

6. Conclusions and Future Steps

Indonesia stands at a pivotal moment in its energy and industrial transformation. The rapid evolution of the global battery and EV markets presents both opportunities and challenges for the country to leverage its abundant mineral resources and strengthen its industrial base. This chapter consolidates the key conclusions and strategic directions arising from the preceding analysis, emphasizing the institutional, regulatory, and financial enablers necessary to realize Indonesia's ambition of becoming a competitive and sustainable player in the global battery value chain. The findings highlight three overarching dimensions for future action: establishing coherent and adaptive policy and regulatory frameworks, strengthening strategic and international partnerships, and mobilizing investment and financing mechanisms to support long-term industrial growth. To face current and future regional competition, Indonesia must continue innovating and strengthening international collaboration to build a resilient battery ecosystem that supports the national energy transition.

6.1 Policies and Regulation

Strengthening an integrated battery supply chain through coherent, adaptive, and well-aligned policy frameworks

To effectively implement an integrated and sustainable battery supply chain, the Government of Indonesia must rely on a coherent and adaptive policy governance framework that aligns institutions, sectors, and levels of government. While the current regulatory foundation provides a strong basis, long-term success will depend on the government's ability to continuously refine policies, reduce fragmentation, and strategically coordinate incentives and targets.

In conclusion, the development of Indonesia's battery and EV sectors will ultimately hinge on the institutionalization of a whole-of-government approach, grounded in periodic policy reviews, cross-sectoral coordination, and adaptive regulatory instruments. This governance model should be structured around three core pillars:

1. **Integrated Policy Evaluation and Adjustment**: Introduce a national mechanism for regulatory impact assessments (RIA) and ex-post evaluations will ensure that new and existing policies remain effective and responsive to technological, market, and geopolitical changes. These tools will help detect conflicting incentives—such as those between EV imports and domestic production—and allow timely corrections to sustain industrial growth and investment.
2. **Strategic Alignment Across Government Levels**: Establish a formal coordination platform or task force that aligns national, regional, and local policy targets, particularly in local content requirements, EV production targets, and fiscal incentive schemes will prevent fragmentation and ensure that all actors are working toward unified national objectives, supported by clearly defined responsibilities and harmonized metrics. Implementers must be present in the regions, not only at the national government level. For example, it can involve the Environmental Agency in each city.
3. **Forward-Looking Institutional Design**: Create dedicated institutions or strengthen existing ones to oversee the implementation, enforcement, and monitoring of local

content policies and BESS development. This includes defining the role of BESS in Indonesia's energy system and formulating a dedicated BESS roadmap to guide investment and integration into the grid.

By embedding these governance principles into its policy framework, Indonesia will be better positioned to advance inclusive industrialization, global competitiveness, and energy system resilience, while maximizing national value creation from its natural resource endowment.

Strengthening Workforce Training and Enforcement of Occupational Safety Compliance

A comprehensive mapping of factory-level skill requirements is essential to ensure that vocational training centers (BLK/PLK) and formal education programs deliver industry-relevant curricula tailored to the specific needs of the battery and smelter sectors. This workforce development effort must be complemented by more vigorous enforcement of occupational health and safety (OHS) compliance, as smelter-related industries continue to face notable gaps in safety implementation. The mandatory establishment of Occupational Safety and Health Committees (P2K3), involving representatives from top management to shop-floor workers, should be treated as a core governance mechanism to ensure effective OHS implementation, strengthen accountability, and reduce workplace risks. The Ministry of Manpower recently launched a policy requiring companies to establish an OSH Development Committee (P2K3). This committee must involve various elements, from top management to workers, to ensure effective OSH implementation. In OSH implementation, the smelter-related industry often presents compliance gaps that must be addressed immediately.

Enhancing Women's Role in Energy Transition Analysis

Strengthening women's understanding of the energy transition and the benefits of electric vehicles (EVs) is essential to ensure the inclusive and sustainable transformation of the energy sector. Social and environmental impact analysis should be deepened through a gender-based approach, particularly in the development of relatively new renewable energy technologies, to prevent the unintended exclusion of women's perspectives and needs. Gender impact assessments should therefore be institutionalized as an integral component of energy transition studies and policymaking, ensuring that benefits, risks, and economic opportunities are distributed equitably and that women are empowered within the clean energy ecosystem. Additionally, the sector of circular economy and battery recycling (especially in the initial sorting and processing stages) holds significant potential to create job opportunities and economic involvement for women.

Enhancing circular economy systems for end-of-life battery management in Indonesia

Battery waste management is an emerging policy area that requires a clear regulatory framework, given the technical challenges associated with handling and shipping black mass. Black mass derived from NCM and LFP batteries has different chemical characteristics. It cannot be processed under a single recycling stream, making a strict classification system essential from the early stages of waste handling. Without proper classification, process inefficiencies and material quality degradation are likely to increase. In addition, the geographic concentration of battery use in Java, combined with limited recycling facilities and their locations, presents significant logistical challenges and high transportation costs. A structured waste management framework, including standardized process flows, transport regulations, and strategic siting of recycling facilities, is therefore necessary to establish an efficient and sustainable battery recycling system. Although Indonesia's Circular Economy Roadmap and National Action Plan[132] include batteries as a priority area, the country currently lacks specific legislation to operationalize a circular economy approach across the battery value chain. Advancing such a framework is essential to mitigate the environmental and social risks associated with battery production, while fostering an economic system that maximizes resource efficiency through the slowing, narrowing, and closing of material loops.

Worries persist over battery waste management, specifically inter-provincial shipping regulations and the challenge of recycling black mass. Given that black mass from NMC and LFP batteries cannot be recycled together, the readiness of the national recycling process flow must be immediately reviewed.

A circular battery economy can significantly reduce dependency on raw material extraction, lessen the social and environmental impacts of mining, and strengthen supply chain resilience amid global market volatility. Repurposing EV batteries for stationary energy storage can further extend product lifetimes and delay recycling, enhancing value retention across the chain.

In conclusion, the development of a comprehensive circular economy framework for battery end-of-life management in Indonesia should rest on five interlinked pillars:

(i) **Build from the already established National Strategy for Circular Economy:** Indonesia's 2024 National Circular Economy Strategy in 2024[133] provides the foundation for integrating circularity into the battery sector. It should be periodically updated and aligned with Government Regulation No. 22/2021 on Environmental Protection and Management—particularly regarding licensing, hazardous waste (B3) tracking, and environmental permits.

(ii) **Integrate circular economy principles into B3 (hazardous) waste regulatory framework**: Amend the legal framework to explicitly support reuse, recycling, and resource recovery alongside safe disposal; introduce a 'waste-to-resource' hierarchy in B3 licensing procedures, prioritizing recovery over destruction.

(iii) **Develop detailed technical guidelines for battery waste management**: Detailed, chemistry-specific guidance is needed to standardize handling, treatment, and recovery processes, including defining thresholds at which treated materials are no

---

[132] PETA JALAN & RENCANA AKSI NASIONAL EKONOMI SIRKULAR INDONESIA 2025–2045 https://www.un-pageindonesia.org/assets/uploads/b6ac7-circular-economy-indonesia-2025-2045-roadmap-and-national-action-plan.pdf

[133] Kementerian PPN/Bappenas, *Peta Jalan & Rencana Aksi National Economi Sirkular Indonesia 2025-2045* (August 8, 2024); <https://www.un-pageindonesia.org/assets/uploads/b6ac7-circular-economy-indonesia-2025-2045-roadmap-and-national-action-plan.pdf>

longer hazardous. A certification system for recovered materials would enable their legal re-entry into the market, supporting end-of-waste implementation.

(iv) **Establish regulatory sandboxes for innovations aligned with circular economy principles**: Controlled environments for testing emerging recycling and recovery technologies would facilitate innovation while enabling regulators to adapt rules based on empirical evidence. Collaboration among startups, research institutions, and authorities would accelerate the safe scaling of new solutions.

(v) **Embed product design standards that support reuse, repair, remanufacturing and recycling of spent batteries:** Battery design regulations should ensure longevity, safety, easy disassembly, and recyclability. Mandating minimum durability and performance standards would promote efficient material use and reduce waste across the product lifecycle.

Additionally, the establishment of a battery passport framework would enable the Government to implement a standardized system for data disclosure across the battery value chain, including raw material traceability, processing methods, lifecycle emissions, and local content compliance. By institutionalizing this framework, the battery passport can serve not only as a transparency tool but also as a regulatory instrument to link fiscal and non-fiscal incentives to verified performance indicators, such as local content levels (TKDN), carbon intensity, and circularity metrics. In practical terms, eligibility for tax incentives, subsidies, or market access privileges could be conditioned on passport-based verification, thereby strengthening policy enforcement, improving data governance, and accelerating the development of a competitive and sustainable domestic battery industry.

6.2 Strategic Partnerships

Strengthening strategic partnerships to diversify and secure the battery supply chain

Indonesia's abundant nickel and cobalt reserves provide a strong foundation for its battery industry. However, its continued dependence on external sources and processing for key inputs—such as lithium, manganese, and graphite—creates a structural vulnerability in the national battery value chain. The heavy concentration of global processing capacity, particularly in China, exposes Indonesia to risks of supply disruption, price volatility, and limited access to downstream technologies.

The analysis concludes that long-term supply chain resilience and competitiveness will depend on Indonesia's ability to diversify input sources, deepen industrial partnerships, and strengthen participation in global cooperation frameworks. Two complementary dimensions underpin this approach: (i) attracting investment and fostering industrial collaboration, and (ii) leveraging international platforms and public-sector partnerships to enhance financing, technology access, and regulatory alignment.

(i) Attract Investment and Deepen Industrial Collaboration

Engagement with leading actors across the battery supply chain, particularly in CAM, cell manufacturing, and recycling, will be essential to close technological and material gaps. Successful partnerships are likely to be driven by joint ventures that combine foreign expertise with domestic ownership, supported by well-calibrated fiscal incentives and regulatory clarity. Balanced public–private partnerships can stimulate investment in mining, refining, and battery production while maintaining market efficiency. In parallel, cooperation frameworks that facilitate technology transfer including automation, AI integration, and sustainable manufacturing practices will be key to advancing domestic industrial capabilities.

(ii) Leverage international platforms and strategic public-sector agreements
Indonesia's active engagement in international initiatives is central to securing long-term supply stability and knowledge exchange. Frameworks such as the Just Energy Transition Partnership (JETP), Global Battery Alliance (GBA), Asian Development Bank (ADB), and EU Clean Trade and Investment Partnerships (CTIPs) provide access to blended finance, best practices, and harmonized ESG standards. Bilateral and multilateral models like the U.S.–Japan cooperation on battery technology and the Australia–South Korea partnership in lithium and EV development illustrate successful pathways for integrating technology, investment, and policy coordination.

By embedding strategic partnerships into its industrial and trade policy framework, Indonesia can strengthen supply chain security, enhance technological capacity, and consolidate its position as a competitive and sustainable leader in the global battery sector.

6.3 Investment and financing

Despite the government's strong policy commitment, financial and investment-related barriers continue to constrain the growth of Indonesia's battery and EV industries. Although various fiscal incentives—such as tax holidays, import duty exemptions, and subsidies—have been introduced, clean energy investment still lags far behind fossil fuel spending. Investor confidence remains affected by regulatory uncertainty, limited project bankability, and weak coordination between national and regional authorities.

As global clean energy investment patterns evolve, Indonesia must create an environment that offers long-term policy stability, clear regulatory frameworks, and openness to international partnerships. A vertically integrated battery supply chain—linking upstream mineral extraction with domestic manufacturing—would reduce production costs, enhance competitiveness, and support the country's broader industrialization goals.

Accelerate infrastructure development and grid readiness

Infrastructure expansion has not matched Indonesia's ambitions. As of late 2024, only 1,902 public EV charging stations were operational—well below the 62,918 targeted for 2030. Concentration in Java and Bali underscores the need to extend infrastructure to underserved regions, ensuring equitable access and national market expansion.

At the same time, Battery Energy Storage Systems (BESS) remain underprioritized despite their central role in renewable energy integration. Although policy recognition is growing, implementation remains fragmented. Integrating BESS planning into national grid development and securing dedicated financing mechanisms will be essential to support broader electrification efforts.

Deepen industrial capabilities across the battery value chain

Indonesia's industrial landscape is rapidly evolving, driven by state-led initiatives and foreign partnerships. Investments in nickel refining, cathode production, and battery cell manufacturing—including HPAL facilities, PT LMB Energi Baru's LFP cathode plant, and PT HLO Green Power's cell production project—illustrate strong progress in technological diversification.

However, processing for cobalt, manganese, and graphite remains limited, and domestic recycling capacity is still nascent. To close these gaps, Indonesia must strengthen coordination among MEMR, MoI, MoEnv, and IBC, and foster collaboration between industry, research institutions, and regulators to accelerate technology transfer, innovation, and sustainable growth.

NCM vs LFP: Strengthening fiscal policy intervention to maintain the competitiveness of NCM

The EV manufacturing industry has expanded in Indonesia, with 87 four-wheeled vehicle models, including buses, qualifying for incentives, covering over 40% of the market. The electric motor vehicle population has reached 300,000 units, representing 10% of new motor vehicle sales. However, most of them use LFP batteries, with only one product utilizing nickel-based batteries. NCM (Nickel Manganese Cobalt) battery materials are less cost-competitive than LFP (Lithium Iron Phosphate) technology, creating an urgent need for additional policy support to maintain the competitiveness of NCM products that use domestic raw materials. Targeted incentives, such as royalty reductions and tax relief, particularly for HPAL-based smelters with high production costs, are essential to narrow the cost gap between NCM and LFP while reinforcing domestic downstream processing. At the same time, the expiration of BEV import incentives for Completely Built-Up (CBU) units on 31 December 2025, followed by the implementation of a 60% local content requirement (TKDN) in 2027, is expected to accelerate the establishment of local manufacturing facilities. Coordination among ministries is underway to prioritize incentives for nickel battery producers to align with national targets.

Optimize incentives while ensuring fiscal sustainability

Indonesia's investment incentive framework has successfully attracted both domestic and foreign investors through tax holidays, duty exemptions, and soft loan schemes. The 11% VAT reduction for EVs with at least 40% local content, rising to 60% by 2027[134], incentivizes local manufacturing and supply chain integration.

Nonetheless, these policies entail significant fiscal trade-offs with potential VAT revenue losses of USD 8.21 billion (2027–2030)[134]. Sustaining long-term competitiveness will require balancing fiscal incentives with industrial development, ensuring that domestic capabilities expand without compromising public revenues or market efficiency.

Indonesia has made significant progress in laying the institutional and industrial foundations of its battery ecosystem. However, achieving full competitiveness and sustainability will require deepening cross-sectoral coordination, fostering innovation,

[134] See Deliverable 2 for further detail

and ensuring that policy design, investment, and implementation evolve in tandem. The integration of adaptive governance, robust international collaboration, and a balanced financing strategy will be essential to overcome current structural bottlenecks.

Looking ahead, Indonesia's long-term success will depend on its ability to translate strategic intent into operational delivery bridging regulatory ambition with practical implementation across regions and industries. By institutionalizing evidence-based policymaking, embedding circular economy principles, and aligning fiscal incentives with sustainability goals, Indonesia can not only strengthen its domestic value creation but also position itself as a regional hub for clean technology and energy transition leadership.

Annex 1. Leopold Matrix

Notes:

C = Construction, **O** = Operation, **Pre-C** = Pre-construction, **Post-O** = Post-operation, **U** = Usage, (+) = Positive impact, (-) = Negative impact

Cat-egory	Sensitive Receptors	Impact	Battery Production												Battery Usage		Battery End-of-life			Associated Facilities and Activities					
			Mining				Refining		CAM/anode manufacturing		Battery cell manufacturing		Battery pack assembly		EV	BESS	Battery waste	Battery recycling		Industrial estate			Special port		Transport & logistics
			Pre-C	C	O	Post-O	C	O	C	O	C	O	C	O	U	U	U	C	O	Pre-C	C	O	C	O	C&O
Environmental	Landscape	Land conversion	(-)	(-)	(-)	(+)															(-)		(-)		
		Landscape and morphology		(-)	(-)	(+)		(-)													(-)		(-)		
	Soil	Soil quality		(-)	(-)	(+)		(-)		(-)		(-)							(-)		(-)		(-)		
		Soil erosion and landslide		(-)	(-)	(+)		(-)													(-)		(-)		
	Air	Air quality	(-)	(-)	(-)		(-)	(-)	(-)	(-)	(-)	(-)	(-)					(-)	(-)		(-)	(-)	(-)		(-)
		Noise	(-)	(-)	(-)		(-)	(-)	(-)	(-)	(-)	(-)	(-)					(-)	(-)		(-)		(-)		(-)
	Water	Surface water		(-)	(-)	(+)		(-)		(-)		(-)		(-)					(-)		(-)	(-)			
		Groundwater		(-)	(-)	(+)				(-)		(-)							(-)		(-)		(-)		
		Marine water																				(-)	(-)	(-)	(-)
	Biodiversity	Terrestrial biodiversity		(-)	(-)	(+)															(-)		(-)		

Cat-egory	Sensitive Receptors	Impact	Battery Production												Battery Usage		Battery End-of-life			Associated Facilities and Activities					
			Mining				Refining		CAM/anode manufacturing		Battery cell manufacturing		Battery pack assembly		EV	BESS	Battery waste	Battery recycling		Industrial estate			Special port		Transport & logistics
			Pre-C	C	O	Post-O	C	O	C	O	C	O	C	O	U	U	U	C	O	Pre-C	C	O	C	O	C&O
		Aquatic biodiversity		(-)	(-)	(+)		(-)	(-)												(-)	(-)			
		Marine biodiversity						(-)														(-)	(-)	(-)	(-)
		Ecosystem services		(-)	(-)	(+)		(-)	(-)												(-)	(-)	(-)	(-)	(-)
	Waste generation	Solid waste		(-)	(-)	(+)			(-)										(-)				(-)		
		Wastewater		(-)	(-)			(-)	(-)	(-)		(-)							(-)		(-)	(-)	(-)		
		Hazardous waste			(-)			(-)		(-)		(-)		(-)			(-)		(-)			(-)			
	Energy	Energy consumption						(-)		(-)		(-)		(-)					(-)					(-)	
	Carbon emissions	CO/CO2 (metric tonnes)		(-)	(-)			(-)		(-)		(-)		(-)	(+)	(+)			(-)		(-)			(-)	(-)
Social	Surrounding community	Community health		(-)	(-)		(-)	(-)		(-)	(-)		(-)		(-)		(-)					(-)			(-)
		Community lifestyle	(-)	(-)	(-)			(-)		(-)					(-)				(-)		(-)	(-)			(-)
		Livelihood	(+)	(+)	(+)			(+)												(+)	(+)	(+)	(+)		
		Human rights	(-)		(-)		(-)													(-)		(-)			

Cat-egory	Sensitive Receptors	Impact	Battery Production														Battery Usage		Battery End-of-life			Associated Facilities and Activities					
			Mining				Refining		CAM/anode manufacturing		Battery cell manufacturing		Battery pack assembly		EV	BESS	Battery waste	Battery recycling		Industrial estate			Special port		Transport & logistics
			Pre-C	C	O	Post-O	C	O	C	O	C	O	C	O	U	U	U	C	O	Pre-C	C	O	C	O	C&O
	Workers	Labor compliance				(-)		(-)														(-)			
		OHS			(-)			(-)				(-)		(-)					(-)			(-)	(-)		
	Vulnerable people	GEDSI	(-)		(-)																	(-)	(-)		
		IP and cultural heritage	(-)																	(-)					

southeast-asia-energy-transition-partnership

The Southeast Asia Energy Transition Partnership is a programme of the United Nations Office for Project Services.

14th Floor, 208, Wireless Road, Bangkok, Thailand

etp@unops.org

Federal Ministry for Economic Affairs and Climate Action

Department for Energy Security & Net Zero

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Australian Government
Department of Climate Change, Energy, the Environment and Water

CHILDREN'S INVESTMENT FUND FOUNDATION

SEQUOIA CLIMATE FOUNDATION